Species Status Assessment for the Grizzly Bear (*Ursus arctos horribilis*) in the Lower-48 States

Photo Credit: Wayne Kasworm

Prepared by the U.S. Fish and Wildlife Service
Grizzly Bear Recovery Office, Missoula, Montana

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Writers and Contributors:

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Executive Summary

This species status assessment (SSA) documents the results of our comprehensive review of the life history, ecology, threats, and viability for the grizzly bear (*Ursus arctos horribilis*) in the conterminous (lower-48) United States (hereafter, grizzly bear). The grizzly bear is listed as threatened under the Endangered Species Act (Act) in the lower-48 States (40 FR 31734, July 28, 1975), and this listed entity is the subject of this SSA report. As such, unless specified otherwise, we use the term "species" to refer to the listed entity and the term "ecosystem" to refer to the populations of this listed entity. This SSA report is intended to provide the best available biological information to inform the U.S. Fish and Wildlife Service's (Service's) decisions for the grizzly bear under the Act, including a 5-year status review and any additional actions, as needed. The SSA will be updated annually, and this version incorporates the most recent data available as of December 31, 2023.

We used the three-part SSA framework (Service 2016, entire; Smith *et al.* 2018, entire) to guide our biological risk assessment for the grizzly bear in the lower-48 States. An SSA begins with a compilation of the best available biological information on the species, including its taxonomy, life history, and habitat, and its ecological needs at the individual, population, and species levels, based on how environmental factors are understood to act on the species and its habitat (Service 2016, p. 6). Next, an SSA describes the current condition of the species' habitat and demographics, and the probable explanations for past and ongoing changes in abundance and distribution within the species' ecological settings, such as areas representative of the geographic, genetic, or life history variation across the species' range (Service 2016, p. 6). Lastly, an SSA forecasts the species' response to probable future scenarios of environmental conditions and conservation efforts (Service 2016, p. 6). As a result, the SSA characterizes the species' viability, or its ability to sustain populations in the wild over time based on the best scientific understanding of current and future abundance and distribution within the species' ecological settings.

Throughout the assessment, the SSA uses the conservation biology principles of resiliency, redundancy, and representation, collectively known as the "3Rs," as a lens to evaluate the current and future condition of the species (Service 2016, p. 6). Resiliency is the ability for populations to sustain themselves in the face of environmental and demographic stochastic events, or for populations to recover from years with low reproduction or reduced survival, and is associated with population size, growth rate, connectivity, and the quality and quantity of habitats. Redundancy is the ability for a species to withstand catastrophic events, for which adaptation is unlikely, and is associated with the number and distribution of populations. Representation is the ability of a species to adapt to changes in the environment and is associated with its diversity, whether ecological, genetic, behavioral, or morphological.

In the first phase of our SSA analysis, we identified what the grizzly bear in the lower-48 States needs, first in terms of the habitat factors needed by individuals to breed (including all stages of reproduction), feed, shelter, and disperse, then in terms of the demographic factors that populations need to be resilient, and finally, what the grizzly bear in the lower-48 States needs for redundancy and representation (Chapter 4). In the second phase of our analysis, we evaluated the stressors and conservation efforts that influence the needs (Chapter 5), and then we evaluated the current condition of those needs in terms of the 3Rs (Chapter 6). In the third and final phase of our analysis, we projected the future condition of the needs, again in terms of the 3Rs, using future scenarios to capture uncertainty associated with the future to year 2055 to 2070 (Chapter 7). For this assessment, we define viability as the ability of the grizzly bear to sustain populations in natural ecosystems over a biologically meaningful timeframe, in this case, by approximately the middle of the 21st century (2055 to 2070). The 2055 to 2070 timeframe for this assessment is a period that allows us to reasonably project the duration of conservation efforts due to the typical duration of agency land-use plans (e.g., forest plans), potential effects of various stressors, and accounts for approximately two to three generation intervals of grizzly bear. This timeframe is consistent with the time scale for which we have data available for the grizzly bear and for which we can project conservation actions.

Summary of Life History, Taxonomy, Ecology, and Distribution

The grizzly bear is a large, long-lived mammal that occurs in a variety of habitat types in portions of Idaho, Montana, Washington, and Wyoming in the lower-48 States. Grizzly bears hibernate in the winter, typically in dens, feed on a wide variety of foods, weigh up to 363 kilograms (800 pounds), and live more than 25 years in the wild. Grizzly bears are light brown to nearly black and are so named for their "grizzled" coats with silver or golden tips. Grizzly bears are a member of the brown bear species (*U. arctos*) that occurs in North America, Europe, and Asia. The subspecies *U. a. horribilis* is limited to North America (Rausch 1963, p. 43; Servheen 1999, pp. 50–53). Grizzly bears have three life stages: dependent young, subadults, and adults.

Historically, the grizzly bear occurred throughout much of the western half of the contiguous United States, central Mexico, western Canada, and most of Alaska. An estimated 50,000 grizzly bears were distributed in one large contiguous area throughout all or portions of 18 western States (i.e., Washington, Oregon, California, Idaho, Montana, Wyoming, Nevada, Colorado, Utah, New Mexico, Arizona, North Dakota, South Dakota, Minnesota, Nebraska, Kansas, Oklahoma, and Texas). Populations declined in the late 1800s with the arrival of European settlers, government-funded bounty programs, and the conversion of habitats to agricultural uses. Grizzly bears were reduced to less than 2 percent of their former range in the lower-48 States by the time grizzly bear was listed as threatened under the Act in 1975, and the estimated population in the lower-48 States was 700 to 800 individuals. At the time of listing, only five areas in mountainous regions, national parks, and wilderness areas contained populations, including the Northern Continental Divide in northwest Montana; the Greater Yellowstone area in northwest Wyoming, eastern Idaho, and southwest Montana; the Cabinet-Yaak Mountains in northeast Idaho and northwest Montana; the Selkirk Mountains in northwest Idaho and northeast Washington; and the North Cascades range in northcentral Washington. Current populations in the Northern Continental Divide, Cabinet-Yaak, and Selkirk extend into Canada to varying degrees. Although there is currently no known population in the North Cascades, it constitutes a large block of contiguous habitat that also spans the international border. Grizzly bears were known to have existed in the recent past in two additional areas, the Bitterroot Mountains in central Idaho and western Montana, and the San Juan Mountains in Colorado. The Grizzly Bear Recovery Plan refers to these areas as grizzly bear ecosystems (Service 1993, p. 10). In 1993, the Service identified six recovery areas within these ecosystems, and recommended further evaluation of the seventh, the San Juan Mountains, to determine recovery potential (Service 1993, p. 121).

Grizzly bear populations in the lower-48 States have significantly expanded since the time of listing in 1975 and now occupy approximately 6 percent of their historical range in the lower-48 States (Haroldson *et al.* 2021a, p. 164). Currently, grizzly bears primarily exist in four ecosystems: the Northern Continental Divide (NCDE), Greater Yellowstone (GYE), Cabinet-Yaak (CYE), and Selkirk (SE) ecosystems (Figure 1). There are no known populations in the North Cascades and Bitterroot (BE) ecosystems and no known populations outside the populations in the NCDE, GYE, CYE, and SE, although we have documented bears, primarily solitary, outside the estimated occupied range of these populations. Current estimated occupied range does not include low-density peripheral locations and represents a minimum known area of occupancy, not an extent of occurrence. Outside the lower-48 States, approximately 55,000 grizzly bears exist in the largely unsettled areas of Alaska and western Canada (Alaska Department of Fish and Game 2020, entire; COSEWIC 2012, p. vi). In North America, grizzly bears occupy approximately 60 percent of their historical range (Haroldson *et al.* 2021a, p. 164).

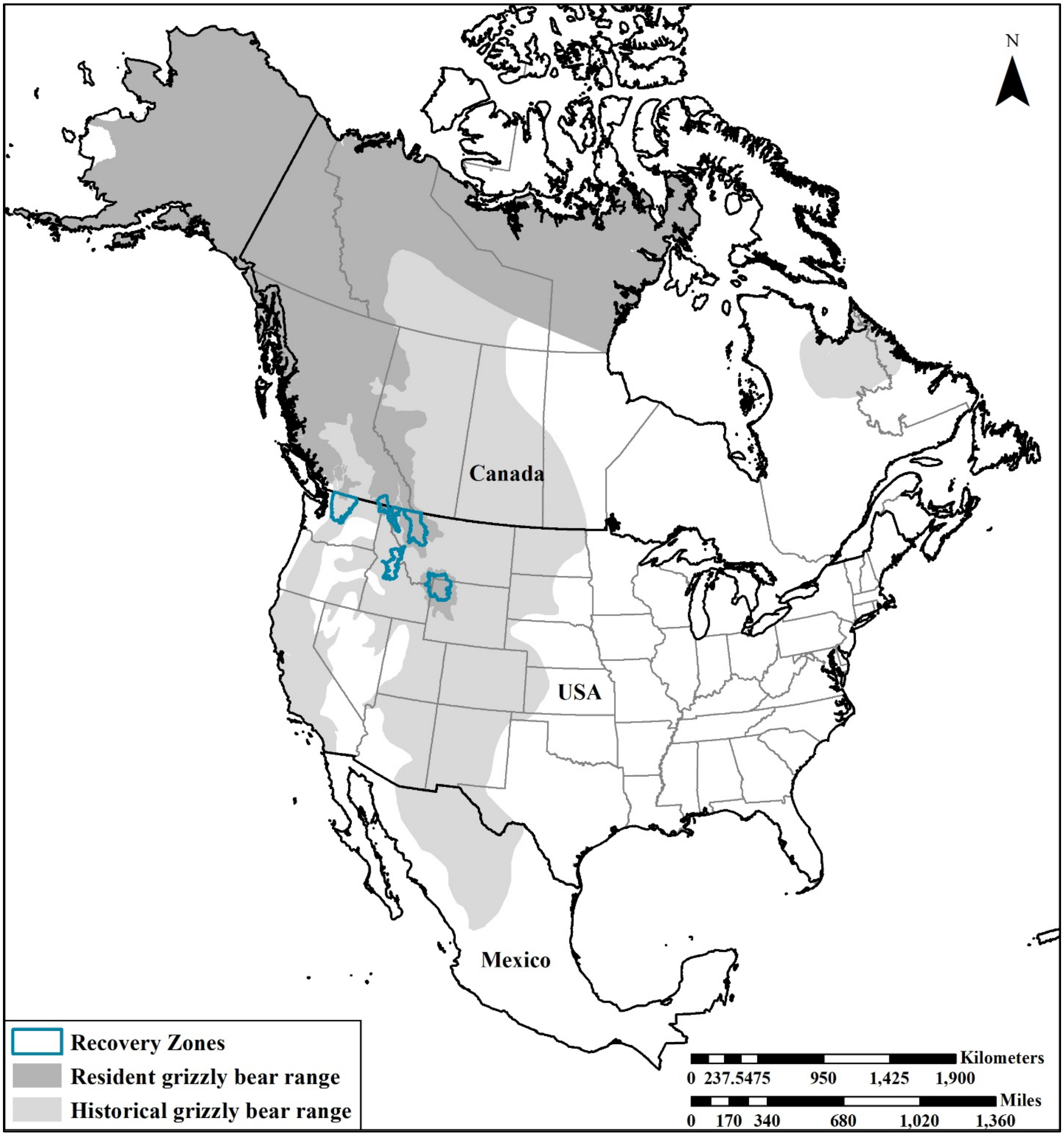


Figure 1. Map of historical (Haroldson et al. 2021a, p. 165) and current (Costello et al. 2023, p. 14; Delllinger et al. 2023, p. 23; Kasworm et al. 2024a, p. 74) estimated occupied grizzly bear range in North America and the six recovery zones for the grizzly bear in the lower-48 States. Currently, grizzly bears primarily exist in four ecosystems: the Greater Yellowstone (GYE), Northern Continental Divide (NCDE), Cabinet-Yaak (CYE), and Selkirk (SE) ecosystems. There are currently no known populations in the North Cascades and Bitterroot (BE) ecosystems and no known populations outside the populations in the GYE, NCDE, CYE, and SE, although we have documented bears, primarily solitary, outside these populations. Ecosystems are generally considered to be the larger area surrounding the recovery zones in which grizzly bears may be anticipated to occur as part of the same population.

Summary of Needs

In general, a grizzly bear's individual habitat requirements and daily movements are driven by the search for food, water, mates, cover, security, or den sites. Grizzly bears in all life stages need habitat security (i.e., habitat that is relatively undisturbed by human influence) to breed, feed, shelter, and disperse; cover to shelter; high-caloric foods to feed and breed; and dens as winter shelter. For the purposes of this conceptual model, breeding includes all stages of reproduction. To be resilient, grizzly bear populations need sufficient abundance for genetic and demographic health, high adult female survival, adequate survival of all other life stages, fecundity and recruitment that translate into stable to increasing population trends, and genetic diversity. Grizzly bears in the lower-48 States need multiple, resilient ecosystems distributed across a broad geographic range in order to achieve redundancy and withstand catastrophic events. Additionally, grizzly bears in the lower-48 States need genetic and ecological diversity to preserve variation and the ability to adapt to changing conditions (Figure 2).

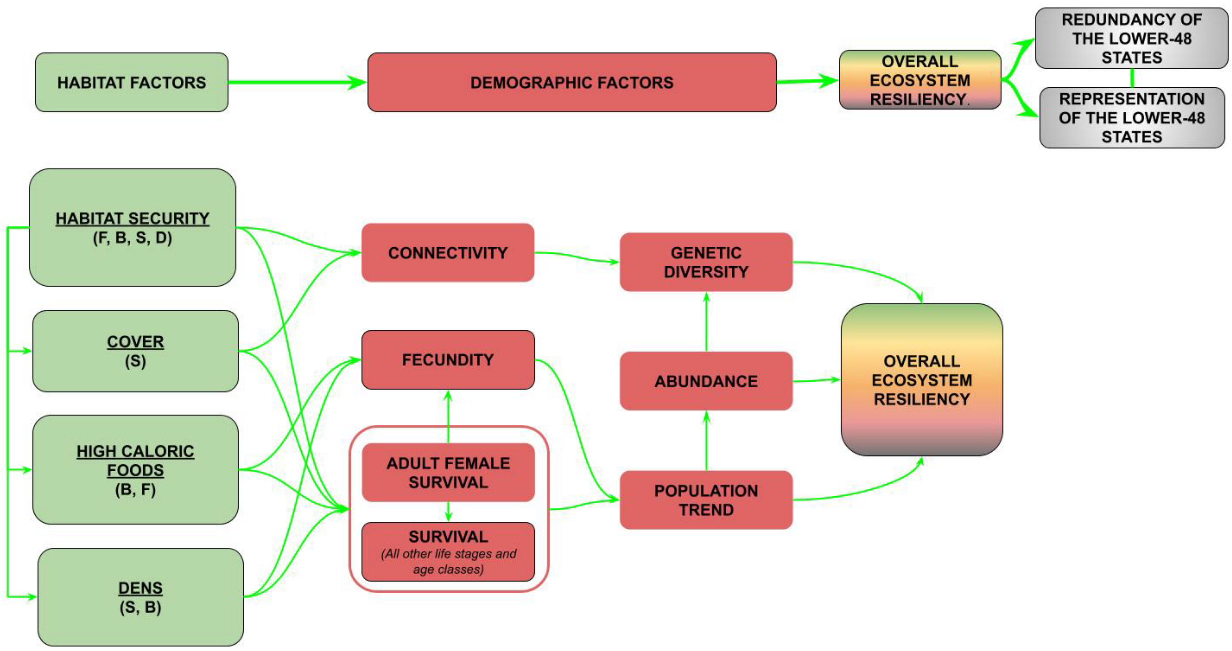


Figure 2. Conceptual model of needs for grizzly bear ecosystem resiliency, in terms of habitat factors (green boxes) needed by individuals to breed (B; includes all stages of reproduction), feed (F), shelter (S), and disperse (D), and demographic factors (red boxes) that ecosystems need to be resilient. Green arrows represent positive relationships between nodes. The core conceptual model for resiliency is provided at the top of the figure for reference.

The primary factors affecting grizzly bears at both the individual and ecosystem levels are excessive human-caused mortality and human activity that reduces the quality and quantity of habitats. Human activities are the primary factor impacting habitat security and the ability of bears to find and access foods, mates, cover, and den sites. Regulating human-caused mortality and displacement through habitat management and conflict prevention are effective approaches, as evidenced by increasing grizzly bear populations in the lower-48 States, specifically the GYE and NCDE, where conflict prevention measures are commonly employed and motorized access standards exist and have been met.

Summary of Cause-and-Effects

We evaluated sources, stressors, and other activities that can positively (conservation actions) or negatively (stressors) affect grizzly bears at the individual, ecosystem, or lower-48 States levels, either currently or into the future (Chapter 5). We also evaluated the potential cumulative effects of stressors that may act together in concert to influence ecosystem resiliency. A stressor is defined as the potential change in demographics, such as an increase in human-caused mortality, or the habitat resources needed by the species, such as a decrease in high-caloric foods that causes a demographic response such as a decrease in abundance. We evaluated the potential effects of three categories of stressors on the grizzly bear: those with habitat-related effects; sources of human-caused mortality; and other stressors. These stressors are interrelated to varying degrees (e.g., habitat stressors around motorized access are related to both habitat and human-caused mortality). Stressors with potential habitat-related effects include: motorized access and its management, developed sites, livestock allotments, mineral and energy development, recreation, vegetation management, habitat fragmentation, development on private lands, and activities that may disturb dens. Sources of human-caused mortality that we evaluated include: management removals, accidental killings (e.g., train and vehicular strikes), mistaken-identity kills, illegal killings, and defense-of-life kills. We also evaluated other stressors including: natural mortality, connectivity and genetic health, changes in food resources, effects of climate change, and stochastic events, such as earthquakes and volcanic eruptions, some of which could be catastrophic. There are a variety of conservation efforts and mechanisms across the six ecosystems that either reduce or ameliorate stressors or improve the condition of habitats or demographics. These conservation efforts or mechanisms include: total mortality limits within the DMA; Federal land protections, such as the Wilderness Act and Inventoried Roadless Areas (IRAs); State and private forestlands with motorized access restrictions; habitat improvements/vegetation management; attractant removal and community sanitation measures, such as food storage orders; conservation easements; information and education (I&E) programs; effective law enforcement; and augmentation or translocation programs.

We developed a conceptual model to illustrate the relationships between the stressors, conservation effects, and their potential influence on ecosystem resiliency (Figure 3). Then, we evaluated the potential effects of the stressors on ecosystem resiliency, considering current and future conservation efforts.

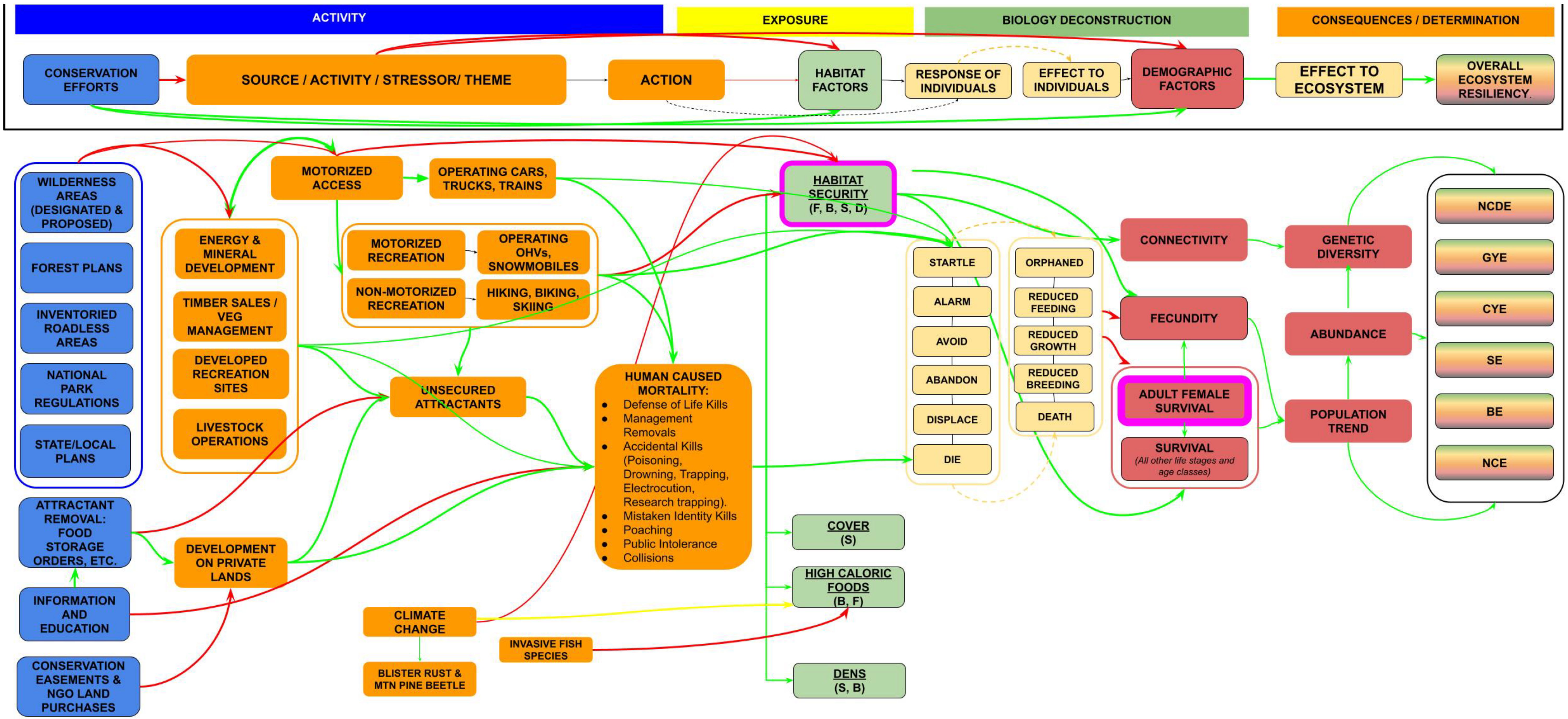


Figure 3. A conceptual model for the primary causes-and-effects (stressors and conservation efforts) that may influence the resiliency of grizzly bear populations within ecosystems in the lower-48 States. The core conceptual model for resiliency at the top of the figure has been expanded to include activity and exposure pathways and is included for reference. We also evaluated potential effects of natural mortality, connectivity and genetic health, stochastic events such as earthquakes and volcanic eruptions, potential future effects associated with legal hunting, which are not displayed in this conceptual model. Green arrows represent positive relationships between nodes, red arrows represent negative relationships between nodes, and yellow arrows represent relationships that can be a combination of positive and negative. There are numerous other relationships that have less significant influences that are not represented with arrows in this figure, such as the contribution of demographic connectivity to abundance and population trend. B = breeding (includes all stages of reproduction); F = feeding; S = sheltering; D = dispersal.

Summary of Current Condition

To evaluate resiliency for each ecosystem, we developed a categorical model, called a condition category table, to calibrate resiliency based on a range of conditions for two habitat factors (natural, high-caloric foods and habitat security) and six demographic factors (adult female survival, abundance as measured by population targets and number of bears, population trend, reproductive female distribution (fecundity), inter-ecosystem connectivity, and genetic diversity). We selected these habitat and demographic factors based on their importance to resiliency and because we had information to evaluate them relatively consistently across all six ecosystems. We systematically evaluated these factors in each ecosystem, and then used the condition category table like a key to evaluate resiliency for each ecosystem. To calculate an overall score for resiliency, we assigned weighted values to the resiliency categories and then calculated a weighted average of the habitat and demographic factor ranking. We weighted the demographic factor for abundance as measured by the estimated number of bears, three times, due to its relative importance to the resiliency of each ecosystem and to balance its weight proportionally to four other demographic factors (Figure 4).

$$\begin{aligned}
&\boldsymbol{Overall\ Resiliency}\\
&= (\boldsymbol{High\ Caloric\ Foods} + \boldsymbol{Habitat\ Security}\\
&+ \boldsymbol{Adult\ Female\ Survival}\\
&+ \boldsymbol{Population\ Target}\ + \mathbf{3}\\
&* (\boldsymbol{Number\ of\ Bears}) + \boldsymbol{Population\ Trend}\\
&+ \boldsymbol{Reproductive\ Female\ Distribution}\\
&+ \boldsymbol{InterEcosystem\ Connectivity}\\
&+ \boldsymbol{Genetic\ Diversity})/\mathbf{11}
\end{aligned}$$

Calculation of Thresholds for Overall Resiliency Condition

Max Score	4	
Intervals	0.8	
	Min	**Max**
High (4)	3.2	4
Moderate (3)	2.4	3.2
Low (2)	1.6	2.4
Very Low (1)	0.8	1.6
Extirpated – X (0)	0.0	0.8

Figure 4. Formula and thresholds used to calculate an overall score for resiliency for each ecosystem based on our evaluation of condition for the two habitat factors and six demographic factors.

Table 1. Condition category table (categorical model) used to evaluate resiliency for the six ecosystems of grizzly bear in the lower-48 States, based on the condition of two habitat factors and six demographic factors.

	Habitat Factors		**Demographic Factors**						
Resiliency Categories	**Natural, High-Caloric Foods**	**Habitat Security**	**Adult Female Survival**	**Abundance: Population Target**	**Abundance: Number of Bears (3x)**	**Population Trend**	**Reproductive Female Distribution**	**Inter-Ecosystem Connectivity**	**Genetic Diversity**
Evaluation Metrics	Body fat data, stable isotope analysis, and/or direct monitoring of food sources	Status of meeting various habitat standards; existence of other protections that ensure habitat security	Estimated survival rates using peer reviewed methodology[1]	Recovery criteria and/or Conservation Strategies indicate population target; the methods we use to estimate the number of bears depends on the ecosystem	The methods we use to estimate the number of bears varies by ecosystem	The method we use to estimate population trend varies by ecosystem and reflects long-term trend.	A BMU is occupied by a reproductive female at least once in a 6-year window	Monitor natural immigration into ecosystems during the most recent generation interval (10 to 15 years) (through radio-collared bears, DNA sampling, marked individuals)	Effective population size, heterozygosity, allelic richness, inbreeding rates
High (4)	Diverse, high-caloric, natural foods are not limiting	Availability of secure habitat is sufficient to meet individual needs	Survival rate is above 0.93	At or above target	More than 800 bears	Lambda stable or increasing (≥ 1)	All BMUs within the recovery zone are occupied	Females have immigrated and bred (demonstrating demographic connectivity)	Sufficient for long-term fitness
Moderate (3)	Diverse, high-caloric, natural foods are somewhat limiting	Availability of secure habitat to meet individual needs is somewhat limiting	Survival rate is between 0.90–0.93	80–99 percent of target	400–799 bears	Lambda is slightly declining (between 0.98 and 1)	70–99% of the BMUs within the recovery zone are occupied	Males have immigrated and bred (demonstrating genetic connectivity)	Sufficient for short-term fitness
Low (2)	Diverse, high-caloric, natural foods are limiting	Availability of secure habitat to meet individual needs is limiting	Survival rate is below 0.90	50–79 percent of target	91–399 bears	Lambda is declining (between 0.95 and 0.98)	50–69% of the BMUs within the recovery zone are occupied	Evidence of an immigrant that has established a home range within the ecosystem but no documented breeding	Sufficient for short-term fitness, but with high levels of inbreeding
Very Low (1)			Female survival rate cannot be accurately estimated as a result of inadequate monitoring, small sample size, or a newly established population.	Less than 50 percent of the target and has evidence of reproduction.	Fewer than 90 bears and a known population	Lambda is precipitously declining (below 0.95). A population may also be considered very low if lambda cannot be accurately estimated as a result of inadequate monitoring, small sample size, or a newly established population.	Less than 50% of the BMUs are occupied	Immigrant is documented within the ecosystem but no evidence of home range establishment or breeding	Insufficient for short-term or long-term fitness or newly established population
Extirpated (0)	Diverse, high-caloric, natural foods are absent	There is no secure habitat	No known population	No known population	No known population	No known population	No BMUs occupied	No connectivity	No known population

[1] Data from radio-collared individuals is currently used to estimate survival rates.

Table 2 summarizes our evaluation of current resiliency for each ecosystem. Currently, the GYE and NCDE have high resiliency due to the generally high and moderate conditions for habitat and demographic factors. The SE has moderate resiliency, and the CYE has low resiliency primarily due to very low numbers of bears, although this factor could improve as bears reproduce and expand in the future (Table 2). Despite the moderate to high condition of habitats, without known populations, the BE and North Cascades are currently functionally extirpated, and therefore have no resiliency (Table 2).

Redundancy describes the number and distribution of ecosystems, such that the greater the number and the wider the distribution of the ecosystems, the better grizzly bears in the lower-48 States can withstand catastrophic events. Grizzly bears in the lower-48 States currently occupy four ecosystems, two with high resiliency, one with moderate resiliency, and one with low resiliency. Two ecosystems are currently functionally extirpated, with no resiliency, so do not contribute to redundancy. The four occupied ecosystems are currently distributed across multiple ecoregions through their distribution from north to south and east to west as illustrated in Figure 5. Ecological diversity between the four occupied ecosystems provides for representation (Figure 5). For example, the GYE, contained in the Middle Rockies ecoregion, is dominated by forested, mountainous habitat, and dry sagebrush to the east and south, and includes hydrothermal features and other unique geologic features. The NCDE includes parts of the Great Plains, Middle Rockies, and Northern Rockies ecoregions, and habitat varies from wet forested lands west of Glacier Park to much drier habitat to the east, including prairie grasslands. The CYE and SE are both contained within the Rocky Mountains, and are characterized by wet, forested mountains. The BE is primarily contained in the Idaho Batholith ecoregion, and contains mountainous regions, canyons, dry, partly wooded mountains, grasslands, high glacial valleys, and hot dry canyons. The North Cascades, part of the North Cascades ecoregion, spans high, rugged mountains, with a high concentration of active glaciers heavily influenced by a maritime climate on the west side and an increasingly arid region on the east side.

Table 2. Current condition for six ecosystems for the grizzly bear in the lower-48 States, evaluated used the condition category table for resiliency. We calculated an overall score for resiliency as the weighted average of all factors, with "number of bears" weighted three times due to its importance to resiliency. High=4, Moderate = 3, Low=2, Very Low=1, and Functionally Extirpated (X) = 0, with score thresholds as Moderate= 2.4–3.19, Low= 1.6–2.39, Very Low=0.8–1.59= Very Low Condition; and less than 0.79 = Functionally Extirpated (X) Condition. An X in number of bears results in an overall condition of X, regardless of the other factors. In general, ecosystems with higher resiliency have greater viability over the next 30 to 45 years, based on their ability to withstand stochastic events, than ecosystems with lower resiliency.

CURRENT CONDITION											
Ecosystem	Habitat Factors		Demographic Factors								RESILIENCY
	Natural, High-Caloric Foods	Habitat Security	Adult Female Survival	Abundance		Population Trend	Reproductive Female Distribution	Inter-Ecosystem Connectivity	Genetic Diversity	
				Population Target	Number of Bears (3x)						
GYE	High	High	High	High	High	High	High	X	Moderate	**High**
NCDE	High	High	Moderate	High	High	High	High	High	High	**High**
CYE	Moderate	Moderate	Moderate	Low	Very Low	High	Moderate	Moderate	Low	**Low**
SE	Moderate	Moderate	Moderate	Moderate	Very Low	High	Moderate	Moderate	Moderate	**Moderate**
BE	Moderate	High	X	X	X	X	X	Very Low	X	**X**
North Cascades	Moderate	Moderate	X	X	X	X	X	X	X	**X**

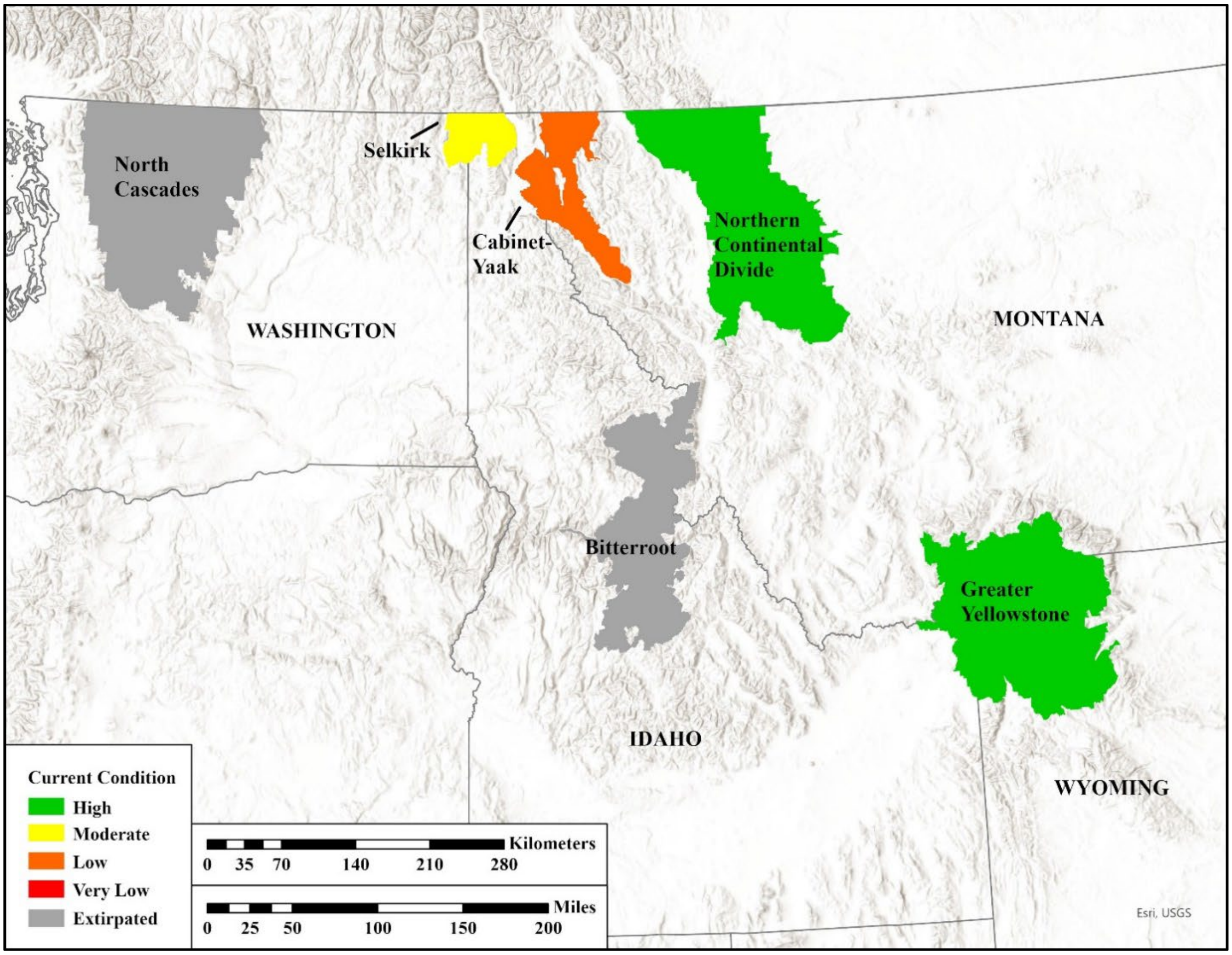


Figure 5. Map of the current condition for the six grizzly bear ecosystems in the lower-48 States, in terms of resiliency, redundancy, and representation. Colors represent the current resiliency for each ecosystem, based on the current condition of two habitat factors and six demographic factors for each ecosystem. Ecosystems with higher levels of resiliency are at less risk from environmental and demographic stochasticity. Currently, the Greater Yellowstone (GYE) and Northern Continental Divide (NCDE) ecosystems have high resiliency, the Selkirk ecosystem (SE) has moderate resiliency, and the Cabinet-Yaak ecosystem (CYE) has low resiliency. The North Cascades and Bitterroot (BE) ecosystems are in an extirpated condition currently, so have no resiliency. Four ecosystems (GYE, NCDE, SE, and CYE) distributed as illustrated on the map contribute to redundancy and these ecosystems feature a diversity of ecological types used by the grizzly bear for representation.

Summary of Future Conditions

We projected a range of plausible future conditions for the grizzly bear in the lower-48 States, 30 to 45 years into the future, a biologically meaningful timeframe that captures approximately two to three grizzly bear generation intervals. A generation interval is defined for grizzly bears as the approximate time that it takes a female to replace herself in the population. For female grizzly bears, average generation intervals range from 10 to 15 years. Given the longevity of grizzly bears with a maximum lifespan of 25 to 37 years observed in the wild, 2 to 3 generation intervals (30 to 45 years) represent a time period during which a complete turnover of the population would have occurred and any positive or adverse changes in the demographics of the population would be detectable. This timeframe also considers the possibility that conservation measures that reduce and regulate potential stressors, such as land management plans, could be revised by applicable land management agencies at least once.

We used future scenario planning to describe plausible futures for the grizzly bear and to capture uncertainty associated with the future. We developed two pessimistic future scenarios, two optimistic future scenarios, and one continuation future scenario. These future scenarios that we used to project the condition for the grizzly bear in the lower-48 States are:

- **Future Scenario 1 – Significantly Decreased Conservation**: Under this scenario, conservation actions decrease significantly, largely through the termination or non-renewal of plans or regulations, and rate of private land development increases dramatically;
- **Future Scenario 2** – **Decreased Conservation**: Under this scenario, conservation actions decrease, but not as significantly as Scenario 1, due to decreased effectiveness and implementation of conservation actions and mechanisms, and rate of private land development increases;
- **Future Scenario 3 – Continuation of Conservation:** Under this scenario, conservation actions continue at their same rate, magnitude, and effectiveness as current condition, and rate of private land development remains the same;
- **Future Scenario 4 – Increased Conservation:** Under this scenario, conservation actions increase or improve, and rate of private land development decreases;
- **Future Scenario 5 – Significantly Increased Conservation:** Under this scenario, conservation actions increase significantly, and rate of private land development decreases dramatically.

Although there may be different probabilities associated with our future scenarios, all five of our scenarios are plausible for the purposes of our SSA analysis. Table 22 summarizes each of the future scenarios in more detail. We then used the same methodology that we used to evaluate current condition to project the resiliency for the six ecosystems 30 to 45 years into the future. We projected the future condition for the two habitat factors and six demographic factors for each of the five future scenarios and then calculated an overall resiliency score for each ecosystem under each scenario using the same weighted average. After evaluating resiliency, we then evaluated redundancy and representation for each future scenario.

With a significant decrease in conservation under Scenario 1, there are subsequent decreases in resiliency across habitat and demographic factors over the next 30 to 45 years (Table 3). Both the GYE and NCDE decrease in overall resiliency from high to moderate, the SE declines from moderate to low, and the CYE declines from low to very low. While the four ecosystems are still distributed similarly to current condition within their respective ecological types, the resiliency of each ecosystem has decreased under this Scenario; given this decrease in resiliency, grizzly bears in the lower-48 States are also less able to withstand catastrophic risk and environmental change (Figure 6). In other words, as resiliency declines with decreased conservation under Scenario 1, redundancy and representation decrease correspondingly.

With a decrease in conservation efforts under Scenario 2, potential decreases in overall resiliency are less severe than under Scenario 1. Under Scenario 2, the NCDE remains in high overall resiliency, the CYE remains in low resiliency, but the GYE drops from high to moderate and the SE drops from moderate to low overall resiliency (Table 3). While the four ecosystems are still distributed similarly to current condition within their respective ecological types, the resiliency of two ecosystems decreases under this Scenario. Given this decrease in resiliency, grizzly bears in the lower-48 States are also slightly less able to withstand catastrophic risk and environmental change (Figure 6). In other words, as resiliency declines with decreased conservation under Scenario 2, redundancy and representation decrease correspondingly.

Under Scenario 3, the continuation scenario, all stressors and conservation efforts continue at the same rate and magnitude 30 to 45 years into the future. Current funding levels and effectiveness and implementation of conservation actions and mechanisms remain the same under this scenario. As a result, redundancy and representation improve slightly from current condition. The GYE and NCDE remain in high resiliency, the SE stays moderate resiliency, but resiliency of the CYE improves from low to moderate and the BE improves from extirpated to very low (Table 3). The North Cascades remains in a functionally extirpated condition, with no resiliency under the continuation scenario (Table 3). Catastrophic risk is spread across five ecosystems (redundancy), compared to four ecosystems in the current condition. Improvements under Scenario 3 ultimately translate into increased ecological diversity at the central extent of the overall range and one additional ecoregion supporting grizzly bear populations (representation) (Figure 6).

With an increase in conservation under Scenario 4, redundancy and representation improve. Both the BE and North Cascades shift from functionally extirpated condition with no resiliency to low resiliency. The GYE and NCDE remain in high resiliency, the SE remains moderate, and the CYE improves from low to moderate resiliency (Table 3). Risk from potential catastrophic events is now spread across six instead of four ecosystems (redundancy) with additional ecological diversity gained at the northwestern and central extents of the overall range (representation) (Figure 6).

Future Scenario 5 is an optimistic scenario under which conservation increases significantly. As a result, resiliency, redundancy, and representation for the grizzly bear improve. Under this scenario, the GYE and NCDE stay in high resiliency, but the CYE and SE improve to high resiliency. The BE and North Cascades shift from functionally extirpated condition with no resiliency to low resiliency under this scenario (Table 3). Four ecosystems have high resiliency under this scenario, and catastrophic risk is spread across six ecosystems (redundancy) with additional ecological diversity gained at the northwestern and central extents of the overall range (representation) (Figure 6).

Table 3. Current and future conditions in terms of overall resiliency for six ecosystems for the grizzly bear in the lower-48 States. NCDE= Northern Continental Divide Ecosystem, GYE= Greater Yellowstone Ecosystem, CYE= Cabinet-Yaak Ecosystem, SE= Selkirk Ecosystem, BE=Bitterroot Ecosystem. Future projections are 30 to 45 years into the future under five plausible future scenarios: Scenario 1= conservation decreases significantly, Scenario 2=conservation decreases, Scenario 3 = conservation stays the same, Scenario 4 = conservation increases, and Scenario 5 =conservation increases significantly.

CURRENT AND FUTURE RESILIENCY						
	Current Condition	***Future Scenario 1*** ↓↓ ***Conservation***	***Future Scenario 2*** ↓ ***Conservation***	***Future Scenario 3*** ***Continuation Conservation***	***Future Scenario 4*** ↑ ***Conservation***	***Future Scenario 5*** ↑↑ ***Conservation***
GYE	High	Moderate	Moderate	High	High	High
NCDE	High	Moderate	High	High	High	High
CYE	Low	V Low	Low	Moderate	Moderate	High
SE	Moderate	Low	Low	Moderate	Moderate	High
BE	X	X	X	V Low	Low	Low
North Cascades	X	X	X	X	Low	Low

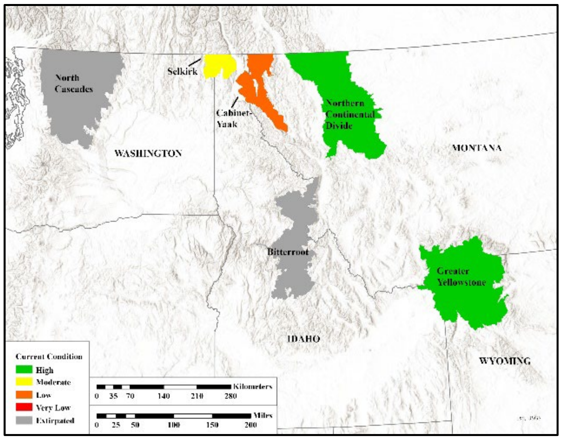
Currently, redundancy for the grizzly bear is described as four ecosystems, the NCDE, GYE, CYE, and SE, as they are distributed from north to south and east to west across the lower-48 States. Catastrophic risk is spread across these four ecosystems and their ecological diversity contributes to representation. Two ecosystems, the BE and North Cascades have no populations, are not resilient, so do not currently contribute to redundancy or representation. In 30 to 45 years, redundancy is maintained across the future scenarios and never falls below the four, currently resilient ecosystems as they are distributed. Although redundancy stays the same from now to the future, if conservation efforts decrease, as under Scenarios 1 and 2, resiliency decreases, and the four ecosystems are at greater risk to stochastic events. If conservation efforts stay the same (Scenario 3), resiliency in the BE improves and redundancy improves as the number and distribution of ecosystems increases from four to five ecosystems. But if conservation efforts increase, as under Scenarios 4 and 5, resiliency in the BE and North Cascades improves, as does redundancy, as the number and distribution of ecosystems increases from four to six ecosystems. This improvement in redundancy reduces risk to the grizzly bear from catastrophic events (Table 4). To summarize redundancy across the future scenarios, catastrophic risk to the grizzly bear decreases if conservation efforts continue at their current rate and effectiveness or if conservation efforts increase. With continued conservation efforts, the BE would improve from functionally extirpated to very low resiliency. With increased conservation, the BE and North Cascades improve from functionally extirpated to low resiliency. Catastrophic risk increases if conservation efforts are reduced, and representation declines due to decreased resiliency of the ecosystems.

Our SSA characterizes the viability for the grizzly bear in the lower-48 States based on expert judgement and the best scientific understanding of its current and future abundance, distribution, and diversity. Based on our assessment of the 3Rs, currently and 30 to 45 years into the future, viability for the grizzly bear in the lower-48 States improves slightly if conservation efforts continue at their current rate and levels of effectiveness. If conservation efforts decline, viability also decreases. If conservation efforts increase, viability improves.

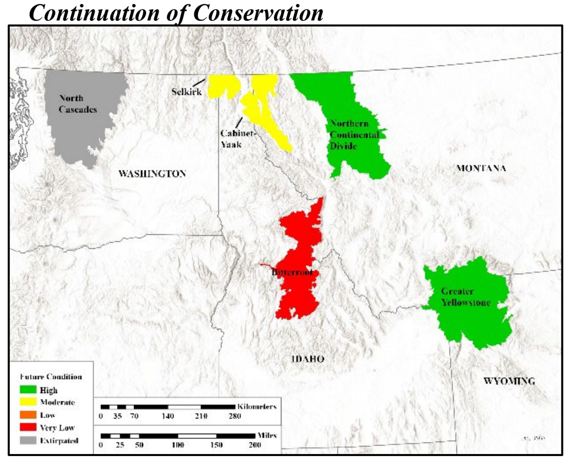
Table 4. Summary of current and future (30 to 45 years) viability, in terms of resiliency, redundancy, and representation, for the grizzly bear in the lower-48 States.

VIABILITY: CURRENT AND FUTURE 3Rs						
	Current Condition	***Future Scenario 1*** ↓↓ ***Conservation***	***Future Scenario 2*** ↓ ***Conservation***	***Future Scenario 3*** ***Continuation Conservation***	***Future Scenario 4*** ↑ ***Conservation***	***Future Scenario 5*** ↑↑ ***Conservation***
Resiliency	2 High 1 Moderate 1 Low 2 Extirpated	2 Moderate 1 Low 1 Very Low 2 Extirpated	1 High 1 Moderate 2 Low 2 Extirpated	2 High 2 Moderate 1 Very Low 1 Extirpated	2 High 2 Moderate 2 Low	4 High 2 Low
Redundancy	4 ecosystems, as distributed	4 ecosystems, as distributed	4 ecosystems, as distributed	5 ecosystems, as distributed	6 ecosystems, as distributed	6 ecosystems, as distributed
Representation	Ecological diversity across 4 ecosystems	Ecological diversity across 4 ecosystems	Ecological diversity across 4 ecosystems	Ecological diversity across 5 ecosystems	Ecological diversity across 6 ecosystems	Ecological diversity across 6 ecosystems

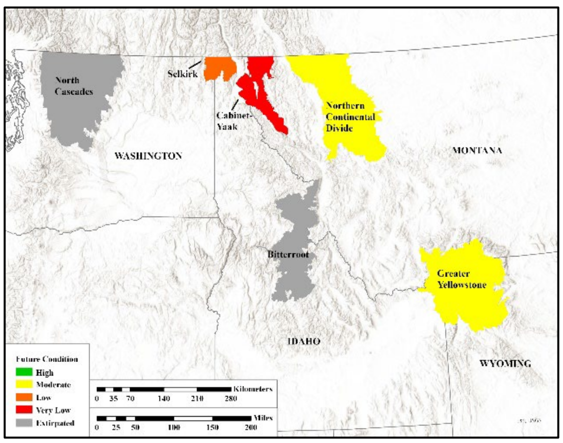
Current Condition



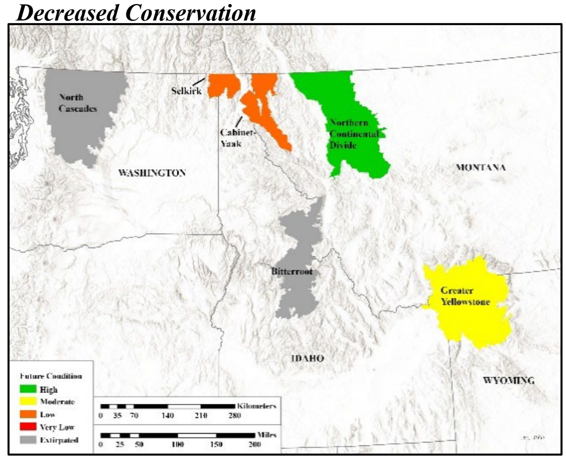
Future Scenario 3
Continuation of Conservation



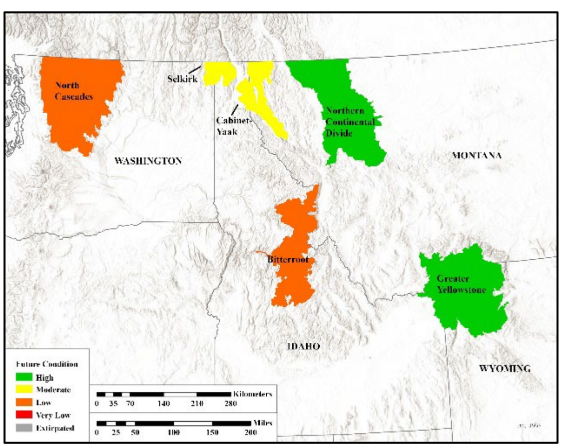
Future Scenario 1
Significantly Decreased Conservation



Future Scenario 2
Decreased Conservation



Future Scenario 4
Increased Conservation



Future Scenario 5
Significantly Increased Conservation

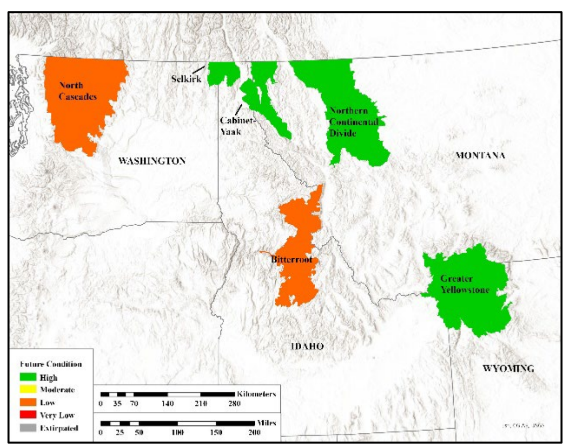


Figure 6. Current and future (30 to 45 years) conditions for resiliency, redundancy, and representation for grizzly bear in the lower-48 States.

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List of Acronyms

ARM	Administrative Rule of Montana
B.C.	British Columbia
BE	Bitterroot Ecosystem
BIR	Blackfeet Indian Reservation
BLM	Bureau of Land Management
BMU	Bear Management Unit
BORZ	Bears Outside Recovery Zone
CS&KT	Confederated Salish and Kootenai Tribes
CYE	Cabinet-Yaak Ecosystem
DCA	Demographic Connectivity Area
DMA	Demographic Monitoring Area
DNRC	Montana Division of Natural Resources Conservation
DPS	Distinct Population Segment
EIS	Environmental Impact Statement
FIR	Flathead Indian Reservation
GNP	Glacier National Park
GTNP	Grand Teton National Park
GYE	Greater Yellowstone Ecosystem
HCP	Habitat Conservation Plan
I&E	Information and Education
IDFG	Idaho Department of Fish and Game
IGBC	Interagency Grizzly Bear Committee
IGBST	Interagency Grizzly Bear Study Team
IPCC	Intergovernmental Panel on Climate Change
IRA	Inventoried Roadless Area
JDR	John D. Rockefeller Memorial Parkway
MFWP	Montana Fish, Wildlife, and Parks
NCDE	Northern Continental Divide Ecosystem
NCNP	North Cascades National Park
NF	National Forest
NGO	Nongovernmental organizations
NPS	National Park Service
NRA	National Recreation Area
OMRD	Open Motorized Route Density
ROD	Record of Decision
SE	Selkirk Ecosystem
Service	U.S. Fish and Wildlife Service
SSA	Species Status Assessment
TMRD	Total Motorized Route Density
TRU	Total reported and unreported
USDA FS	U.S. Department of Agriculture Forest Service
USDOI	U.S. Department of the Interior
USFS	U.S. Forest Service
USGS	U.S. Geological Survey

WDFW	Washington Department of Fish & Wildlife
WGFD	Wyoming Game and Fish Department
WRR	Wind River Reservation
WSA	Wilderness Study Area
YES	Yellowstone Ecosystem Subcommittee
YNP	Yellowstone National Park

Chapter 1: Introduction and Analytical Framework

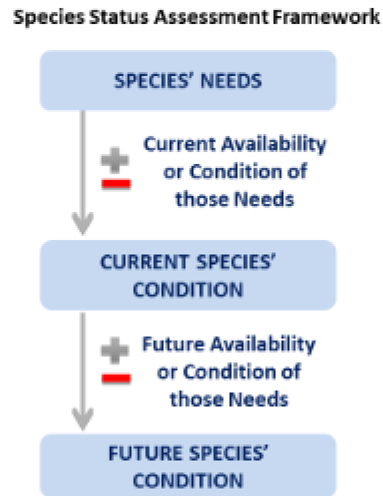

Figure 7. The SSA framework's three basic phases (Service 2016, p. 6).

This species status assessment (SSA) report summarizes the biology, life history, ecology, and stressors (threats) for the grizzly bear (*Ursus arctos horribilis*) in the conterminous (lower-48) United States (hereafter, grizzly bear). This report also summarizes the results of a biological risk assessment for the grizzly bear, using the SSA framework (Service 2016, entire; Smith *et al*. 2018, entire). The grizzly bear is listed as threatened under the Endangered Species Act (Act) in the lower-48 States (40 FR 31734, July 28, 1975), and this listed entity is the subject of this SSA report. The SSA framework is an analytical approach to deliver foundational science to help inform the Service's decisions under the Act (Service 2016, p. 4). This SSA report is intended to provide a clear, in-depth characterization of the species' biology and ecology; the influence of environmental stressors and conservation management actions on the species' viability; its current biological status, also called its "current condition;" and its projected, plausible future biological status, also called its "future condition," under a range of future scenarios. Viability describes the ability of a species to sustain populations in the wild over time (Service 2016, p. 9). This SSA report is not meant to accumulate all information regarding grizzly bears in North America but provides foundational scientific information to help inform recovery planning and the U.S. Fish and Wildlife Service's (Service's) responsibilities under the Act, including a 5-year status review and other actions, as needed. This SSA report can be easily updated as new scientific information becomes available to support all functions of our Endangered Species program. The SSA will be updated annually, and this version incorporates the most recent data available as of the end of 2023.

Importantly, this SSA report is not a decision-making document or a final agency action. Instead, this SSA report synthesizes the best available scientific and commercial information regarding the biological status, or condition, of the grizzly bear. This SSA report is a stand-alone, science-based document produced independently from the Service's application of policy or regulation, and it provides a review of the available information strictly related to the life history, ecology, stressors, and current and future viability of the grizzly bear. Any decisions under the Act, such as a 5-year status review recommendation, will be made by the Service after reviewing this document and all relevant laws, regulations, and policies, and the results of any decisions to change status will be announced in the *Federal Register*, with opportunities for public input, if appropriate.

The SSA framework has three, iterative assessment phases, as summarized below and illustrated above in Figure 7.

- Phase I: Species' Needs – An SSA begins by describing the ecological needs of the species at the individual, population, and species levels based on the effect of environmental factors on the species and its habitat.

- Phase II: Current Species' Condition – Next, an SSA describes the current condition of the species' habitat and demographic needs, and the probable explanations for past and ongoing changes in the abundance of populations and the distribution and diversity of the species.
- Phase III: Future Species' Condition – Lastly, a SSA projects the species' response to probable future scenarios of environmental conditions and conservation efforts.

As a result, the SSA characterizes the species' viability based on the best scientific understanding of its current and future abundance, distribution, and diversity (Service 2016, p. 6).

Throughout this report, we describe the needs and viability of the grizzly bear in terms of the conservation biology principles of resiliency, redundancy, and representation, collectively known as the 3Rs (Shaffer and Stein 2000, pp. 307–310; Wolf *et al.* 2015, entire; Service 2016, pp. 12–13, 21; Smith *et al.* 2018, entire). The 3Rs are defined as follows:

- **Resiliency** is the ability for populations to persist in the face of stochastic events, or for populations to recover from years with low reproduction or reduced survival, and is associated with population size, growth rate, and the quality and quantity of habitats. Resiliency is positively related to abundance (population size) and growth rate and may be influenced by connectivity between populations. Populations need an abundance of individuals within habitat patches of adequate quantity and quality to survive and reproduce in spite of disturbance (Service 2016, p. 12).
- **Redundancy** is the ability for the species to withstand catastrophic events, such as a rare destructive natural event or episode involving many populations for which adaptation is unlikely and is associated with the number and distribution of populations. Redundancy is about spreading risk among multiple populations to minimize potential loss of the species from catastrophic events and is characterized by having multiple, resilient populations distributed within the species' ecological settings and across the species' range. Redundancy can be measured by the number of populations, their spatial extent, and degree of connectivity.
- **Representation** is the ability of a species to adapt to changes in the environment over time and is associated with its diversity, whether ecological, genetic, behavioral, or morphological. It is characterized by the breadth of genetic and environmental diversity within and among populations and measures of representation may include the number of varied occupied niches, genetic diversity, heterozygosity, alleles per locus, or other geographic, genetic, or life history variation of the species.

In general, species risk will decrease, or at least does not increase, with increases in representation, resiliency, and redundancy. In other words, the more redundant and representative the species is, and the more resilient its populations, the more likely the species is to sustain populations over time, even under changing environmental conditions. For the purpose of this assessment, we define viability as the ability of the grizzly bear to sustain populations in natural ecosystems over a biologically meaningful timeframe, in this case, by approximately the middle of the 21st century (2055 to 2070). Viability is not a specific state, but rather a continuous measure of the likelihood that the species will sustain populations over time

(Service 2016, p. 9). Therefore, our assessment of the relationships between demographic and habitat factors and the species resiliency, representation, and redundancy does not result in a conclusion on whether the species is viable, but instead serves as the context to explore potential changes from the species' current condition to its projected future conditions (Service 2016, p. 13).

The 2055 to 2070 timeframe for this assessment is a period that allows us to reasonably project the duration of conservation efforts due to the typical duration of agency land-use plans (e.g., forest plans), potential effects of various stressors, and accounts for approximately two to three generation intervals of grizzly bear. A grizzly bear generation interval is defined as the approximate time that it takes a female to replace herself in the population, and ranges from 10 to 15 years. Given the longevity of grizzly bears of up to 37 years in the wild, 2 to 3 generation intervals (30 to 45 years) represent a time period during which a complete turnover of the population would have occurred and any positive or adverse changes in the demographics of the population would be detectable. The timeframe covered in this assessment also allows time for revisions to land management plans that include conservation measures that might reduce and regulate potential stressors. Finally, this timeframe is consistent with available data and our ability to reasonably project conservation actions.

In this SSA report, we:

- First summarize grizzly bear biology, including its taxonomy, historical and current distribution, its habitat, life history, and life cycle (Chapter 2);
- Then summarize our regulatory history with grizzly bears and ongoing recovery efforts and conservation partnerships (Chapter 3);
- Then describe the ecological needs at the individual, population, and species (lower-48 States) levels in terms of resiliency, redundancy, and representation (Chapter 4);
- Identify known stressors (threats) that negatively influence viability and the conservation actions that positively influence viability (Chapter 5);
- Then describe the current condition, also in terms of the resiliency of ecosystems, and the redundancy and representation for the grizzly bear (Chapter 6); and
- Finally, we project the response of the grizzly bear to probable future scenarios of environmental conditions and conservation efforts (Chapter 7) and summarize a comparison of projected future conditions with current condition (Chapter 8).

The Service's decisions under the Act are based on an assessment of a species' risk of extinction. This SSA report is intended to inform an assessment of extinction risk by describing the grizzly bear's current biological status (Chapter 6) and assessing how this status may change in the future under a range of plausible future scenarios (Chapter 7). We evaluate the current biological status of the grizzly bear by assessing the factors that positively and negatively affect the grizzly bear (Chapter 5) and describe the current condition of the species in terms of the 3Rs (Chapter 6). We then evaluate the future biological status by describing a range of plausible future scenarios representing a range of conditions for the primary factors affecting the species and forecasting the future condition for each scenario in terms of the 3Rs (Chapter 7).

Core Conceptual Model for Viability used for the SSA

For our assessment of viability, we relied on the SSA framework's core conceptual model for resiliency to describe the current and future viability of grizzly bears in the lower-48 States (Service 2016, p. 10; Smith *et al.* 2018, entire) (Figure 8). This conceptual model illustrates the relationship between habitat factors that are important to individuals, demographic factors that are important to populations, the resiliency of these populations, and the redundancy and representation at the species-level. As described in more detail below, we refer to populations of grizzly bear in the lower-48 States as ecosystems. Habitat factors are the resources needed by individual grizzly bears to breed (including all stages of reproduction), feed, shelter, and survive from one life cycle stage to the next and promote successful dispersal of some individuals. Demographic factors include abundance and trends that ecosystems need to be resilient to stochastic events. In general, a species needs a certain number and distribution of resilient populations in order to withstand catastrophes (redundancy) and diversity to adapt to novel, environmental change (representation).

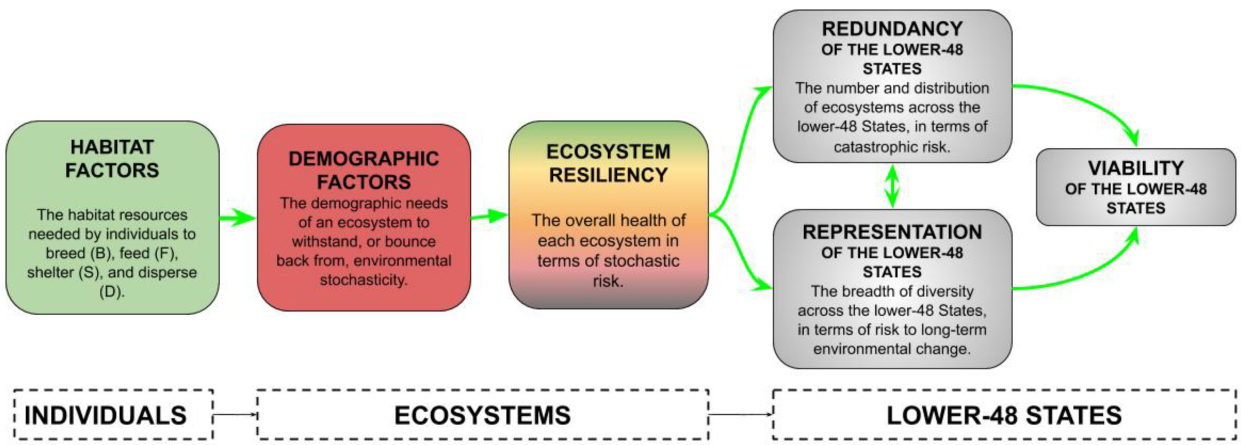

Figure 8. Simple core conceptual model used for our analysis of viability for grizzly bear in the lower-48 States, in terms of the 3Rs of conservation biology: resiliency, redundancy, and representation. Throughout this report, habitat factors are illustrated in green and demographic factors in red. Model based on the core conceptual model for the species status assessment (SSA) framework (Service 2016, p. 10). Throughout our assessment, ecosystems are synonymous with populations and are the scale at which we evaluated the 3Rs.

Ecosystems to Evaluate the 3Rs

In this SSA, we describe the resources, circumstances, and demographics that most influence the resiliency of a population. These may vary if populations are distributed across different ecological settings. It is necessary to define populations in the SSA analysis because species viability corresponds to population resiliency (Service 2016, p. 12).

As described below in *Geographic Boundaries for Recovery Planning* (Chapter 3), Federal, State, and Tribal partners have delineated a variety of geographic boundaries to illustrate areas important to grizzly bear recovery planning and to document where grizzly bear populations occur. For the purposes of our SSA, we refer to populations of the grizzly bear in the lower-48 States as ecosystems. We evaluated resiliency, redundancy, and representation at the scale of these ecosystems. As described in our recovery planning documents, ecosystems are areas with the potential to provide adequate habitat quantity and quality to support the grizzly bear as a viable and self-sustaining species (Service 1993, p. 33). The plan acknowledged that linkage, which we also refer to as connectivity, between ecosystems would be necessary for isolated populations to reach and sustain themselves at recovery levels (Service 1993, pp. 23, 24). Ecosystems are the larger areas surrounding the recovery zones in which grizzly bears may be anticipated to occur as part of the same population. For this assessment, we evaluated the 3Rs at the scale of the six ecosystems identified in the 1993 Recovery Plan (Service 1993, p. 16), as described below (Figure 9):

- The **Greater Yellowstone Ecosystem (GYE)** is located in northwest Wyoming, eastern Idaho, and southwestern Montana and refers to the larger ecological system containing and surrounding Yellowstone National Park (YNP). The GYE includes portions of five National Forests (NFs; the Shoshone, Beaverhead-Deerlodge, Bridger-Teton, Caribou-Targhee, and Custer Gallatin); YNP, Grand Teton National Park (GTNP), and the John D. Rockefeller Memorial Parkway (JDR; administered by GTNP); and Bureau of Land Management (BLM), State, Tribal, and private lands. The GYE is generally defined as those lands surrounding YNP with elevations greater than 1,500 meters (m) (4,900 feet (ft)) (see U.S. Department of Agriculture Forest Service (USDA FS) 2004, p. 46; Schwartz *et al.* 2006c, p. 9). While we consider the terms "Greater Yellowstone Area" and "Greater Yellowstone Ecosystem" to be interchangeable, we use GYE. The GYE is part of the Middle Rockies ecoregion (Woods *et al.* 1999, entire). In the GYE, plant communities vary from grasslands at lower elevations (less than 1,900 m (6,230 ft)) to conifer forests at mid-elevations and subalpine and alpine meadows at higher elevations (greater than 2,400 m (7,870 ft));
- The **Northern Continental Divide Ecosystem (NCDE)** is located in northwest Montana and refers to the larger ecological system containing and surrounding Glacier National Park (GNP) and is the southern portion of a larger Rocky Mountain divide population that spans the U.S.-Canada border. The NCDE also includes portions of four NFs (the Flathead, Helena-Lewis and Clark, Kootenai, and Lolo), State, BLM, Tribal, and private lands. The NCDE is part of the Canadian Rockies, Middle Rockies, Northern Rockies, Northwestern Glaciated Plains, and Northwestern Great Plains ecoregions (Woods *et al.* 1999, entire). Plant communities vary from mixed grass prairie and wheat fields at lower elevations (less than 1,900 m (6,230 ft)) on the eastern foothills to extensive conifer forests at mid-elevation and subalpine and alpine meadows at higher elevations (greater than 2,400 m (7,870 ft)) in the mountainous core;
- The **North Cascades Ecosystem (North Cascades)** constitutes a large block of contiguous habitat that spans the international border but is isolated from grizzly bear populations in other parts of the U.S. and Canada. The U.S. portion of the ecosystem is bounded roughly by the Okanogan Highlands and Columbia Plateau on the east, Snoqualmie Pass to the south, the Puget lowlands to the west, and the Canadian border to the north. The recovery zone encompasses all of North Cascades National Park Complex (NCNP Complex), including North Cascades National Park, Ross Lake National Recreation Area (NRA), and Lake Chelan NRA, portions of two NFs (the Mount Baker-Snoqualmie, and Okanogan-Wenatchee), State, Tribal, and private lands. The North Cascades is part of the North Cascades ecoregion (Woods *et al.* 1999, entire). The ecosystem spans the crest of the Cascade Range from the temperate rainforests of the

west side to the dry ponderosa pine forests and sage-steppe on the east side, and comprises one of the most intact wildlands in the contiguous United States;

- The **Selkirk Ecosystem (SE)** refers to the larger ecological system surrounding the recovery zone in northwest Idaho, northeast Washington, and southeast British Columbia (B.C.). The SE includes portions of two NFs (the Idaho Panhandle and Colville), State, Tribal, and private lands. The SE recovery zone includes part of Canada because the habitat in the U.S. portion was thought to not be of sufficient size to support a minimum population (Service 1993, p. 12) and the biological population (comprised of contiguous occupied habitat) extends into Canada up to B.C. Highways (Hwys.) 3 and 3A (Proctor *et al.* 2005, p. 2410; Proctor *et al.* 2012, p. 14). However, because the grizzly bear in the lower-48 States is the listed entity and the subject of this SSA report, we did not consider grizzly bears in Canada as part of our analysis except when the best available data for the relevant demographic factors, such as population trend and abundance, include the Canadian portion of this ecosystem in their estimation. We acknowledge this assumption in our evaluation of current and future condition. The SE is part of the Rocky Mountain ecoregion (Woods *et al.* 1999, entire). The SE ranges in elevation from 540 m (1,772 ft) to 2,375 m (7,792 ft), and includes vegetation dominated by various forested types;
- The **Cabinet-Yaak Ecosystem (CYE)** refers to the larger ecosystem surrounding the recovery zone in northwest Montana and northeast Idaho. It includes portions of three NFs (the Kootenai, Idaho Panhandle, and Lolo), State, and private lands. The Kootenai River bisects the CYE, with grizzly bear habitat within the Cabinet Mountains to the south and the Yaak River drainage to the north, which has partially isolated the Cabinet portion of this ecosystem from a bear movement and breeding perspective (Proctor *et al.* 2012, p. 14; Kasworm *et al.* 2024a, p. 7). The Yaak portion of this ecosystem extends into Canada to B.C. Hwy. 3 in what is contiguous occupied habitat (Proctor *et al.* 2005, p. 2410; Proctor *et al.* 2012, p. 14; Kasworm *et al.* 2024a, p. 34). The SE is part of the Rocky Mountain ecoregion (Woods *et al.* 1999, entire). Elevations range from 610 m (2,001) to 2,664 m (8740 ft), and vegetation is diverse with climax forest species, open huckleberry shrub fields, and lush riparian meadows throughout the area;
- The **Bitterroot Ecosystem (BE)** refers to the larger ecological system surrounding the recovery zone in central Idaho and western Montana and includes portions of four NFs (the Nez Perce-Clearwater, Bitterroot, Lolo, and Salmon-Challis), State, and private lands (Service 1996, p. 1; 65 FR 69624, November 17, 2000; Service 2000, pp. 1–3). The recovery zone encompasses two of the largest wilderness areas in the lower-48 States and is one of the largest contiguous blocks of public land remaining in the lower-48 States. The BE is part of the Idaho Batholith ecoregion (Woods *et al.* 1999, entire). Elevations range from 457 m (1,500 ft) along the Clearwater River to 3,859 m (12,662 ft) on Borah Peak. Vegetation communities range from dry pine forests in the south to wetter cedar-hemlock forests primarily in the north.

Because the listed entity for the grizzly bear is the entire lower-48 States (40 FR 31734, July 28, 1975; 50 CFR 17.11), we discuss historical range in the lower-48 States in addition to these six ecosystems in *Historical Range and Distribution*, below (Figure 14). Records show that grizzly bears historically existed throughout all or portions of 18 western States (i.e., Washington, Oregon, California, Idaho, Montana, Wyoming, Nevada, Colorado, Utah, New Mexico, Arizona, North Dakota, South Dakota, Minnesota, Nebraska, Kansas, Oklahoma, and Texas) (Servheen

1989, pp. 1–2; Service 1993, p. 9; Servheen 1999, pp. 50–51). The original 1975 listing (40 FR 31734, July 28, 1975) erroneously included areas outside this historical range; we exclude these areas from our analysis.

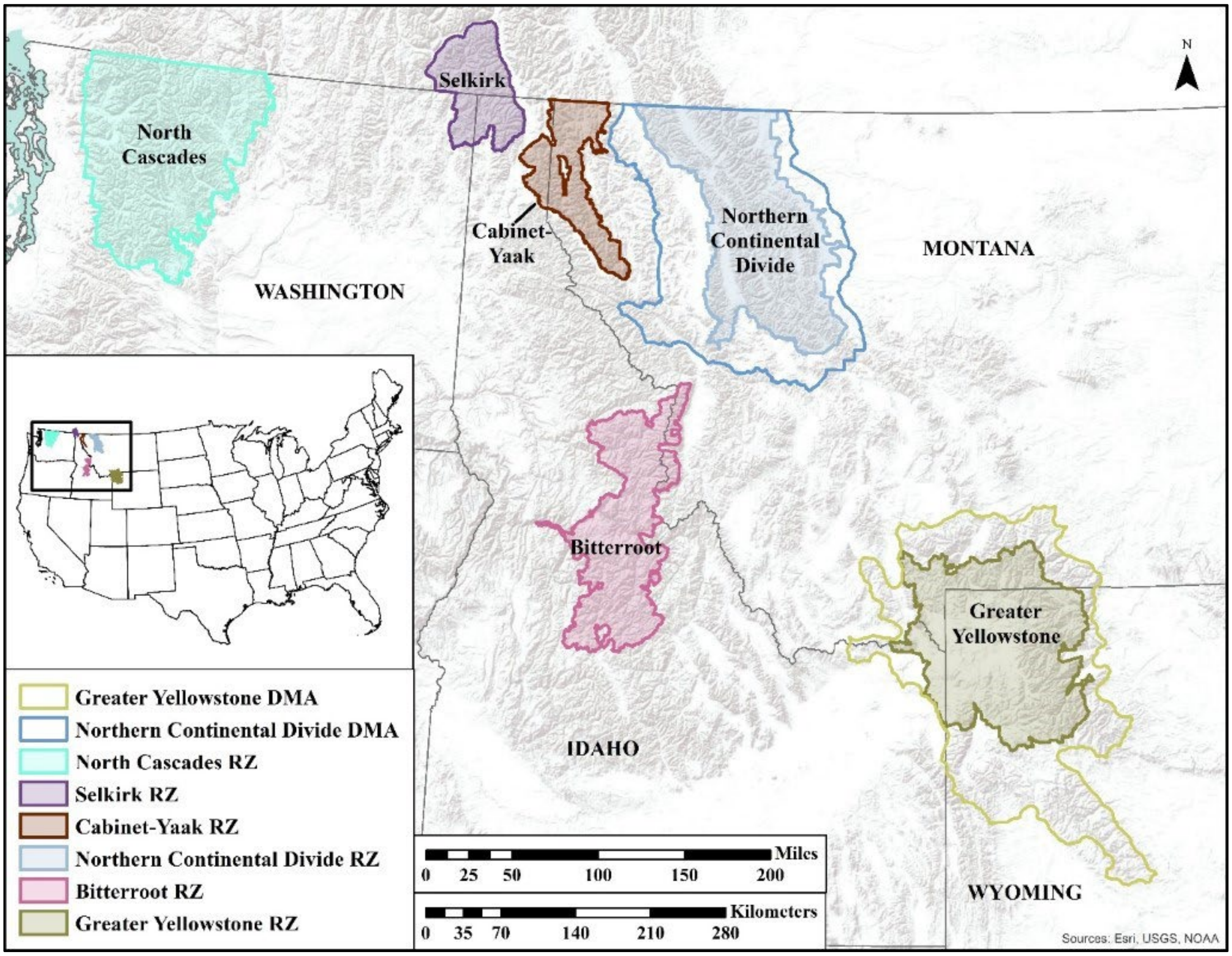

Figure 9. Recovery zones (RZ) and demographic monitoring areas (DMA), where applicable, for the six ecosystems identified in the Recovery Plan, the Northern Continental Divide (NCDE), Greater Yellowstone (GYE), Cabinet-Yaak (CYE), Selkirk (SE), Bitterroot (BE), and North Cascades. DMAs surround and include the recovery zones in the GYE and NCDE. The Service has not defined ecosystem boundaries for any of the ecosystems across the lower-48 States, but for the purposes of our analysis, ecosystems are generally the larger area surrounding the recovery zone in which grizzly bears may be anticipated to occur as part of the same population. For our SSA, we evaluated resiliency at the scale of these ecosystems, which are synonymous with populations for our assessment.

Analytical Framework used for the Species Status Assessment

We followed the three-phase SSA framework for our biological risk assessment of the grizzly bear in the lower-48 States, the listed entity. The SSA-framework begins with an assessment of the species needs at the individual, population, and species level, followed by an assessment of the current condition of those needs, considering positive and negative factors that influence resiliency, and ending with an evaluation of the projected future condition of those same needs (Service 2016, p. 6; Smith *et al.* 2018, entire).

We developed a conceptual model for the SSA (Figure 10) based on the SSA's three-phase framework and the core conceptual model for viability in terms of the 3Rs. This SSA reviews the life history, ecology, historical and current range and distribution, life stages, and life cycle for the grizzly bear (Chapter 2) as well as recovery planning and other conservation efforts (Chapter 3). Based on our review of life history and ecology, we identify habitat factors needed by individuals, the demographic factors needed in the grizzly bear ecosystems, and the redundancy and representation needed by grizzly bears within the lower-48 States (Chapter 4). We then evaluate stressors and conservation actions that affect resiliency, either positively or negatively, by directly influencing demographic factors and indirectly by influencing habitat factors (Chapter 5). We evaluate the current condition for each of these habitat and demographic needs for each of the six ecosystems and summarize current condition for the grizzly bear in terms of the 3Rs (Chapter 6). Finally, we developed future scenarios to capture the range of uncertainty regarding future conservation actions and evaluate the condition for all six ecosystems, under each future scenario, using the same methodology that we used to evaluate current condition (Chapter 7). Finally, we summarize the change in conditions from current to future to summarize risk to the grizzly bear in the lower-48 States in terms of the 3Rs (Chapter 8).

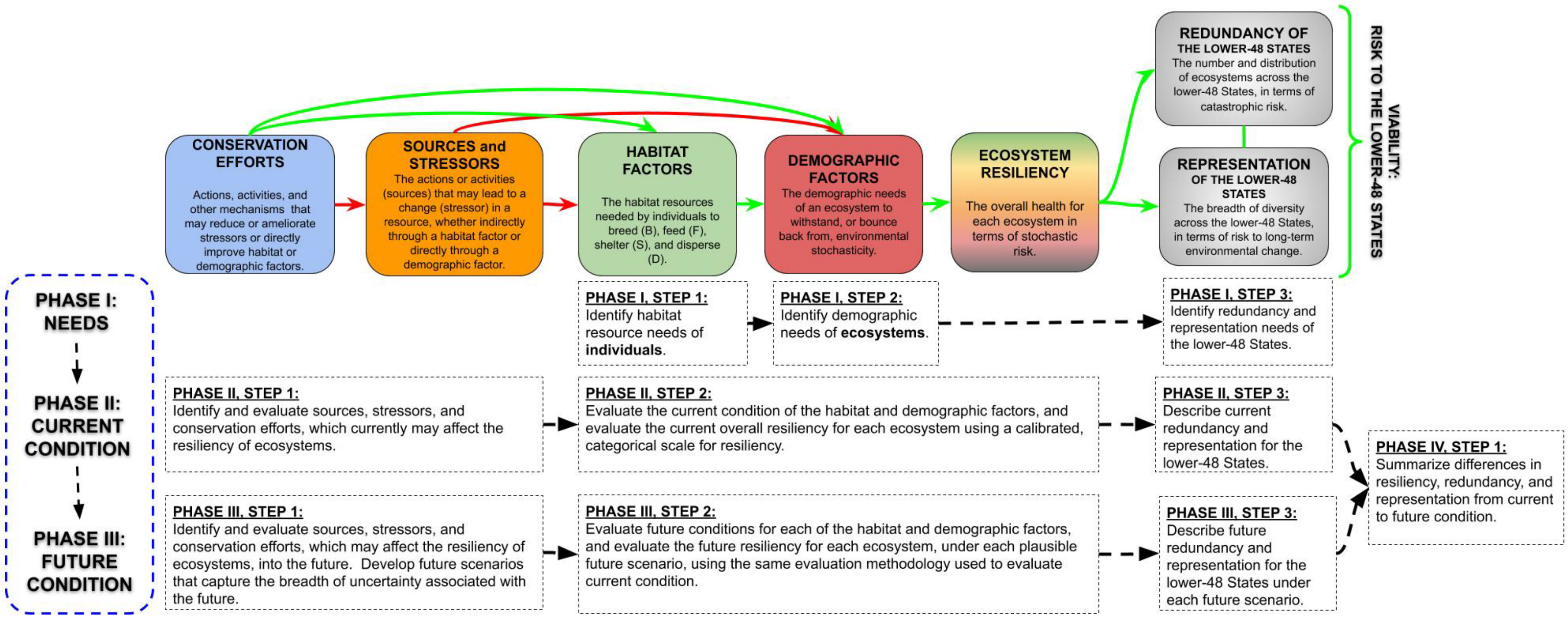

Figure 10. A conceptual model of our analytical framework for the SSA to evaluate current and future condition for the grizzly bear in the lower-48 States. The three-phase SSA framework (species needs, current condition, and future condition) and the core conceptual model for viability guided our analysis (Service 2016, p. 6; Smith et al. 2018, entire). Green arrows represent positive relationships between nodes and red arrows represent negative relationships between nodes. Dashed boxes and arrows represent the steps of our analysis. Throughout our SSA, ecosystems are synonymous with populations.

Chapter 2: Description, Distribution, and Ecology of the Lower-48

In this chapter, we describe the grizzly bear in the lower-48 States, as well as its taxonomy, historical and current distribution, and life history. This information provides scientific background on grizzly bear life history and ecology in advance of our identification of ecological needs in Chapter 4.

Species Description

Grizzly bears are generally larger and heavier than other bears. Adult males average 200 to 300 kilograms (kg) (400 to 600 pounds (lb)) and adult females 110 to 160 kg (250 to 350 lb) in the lower-48 States (Craighead and Mitchell 1982, pp. 517–520; Schwartz *et al.* 2003b, p. 558). Although their coloration can vary widely from light brown to nearly black (LeFranc *et al.* 1987, pp. 17–18), they can be distinguished from black bears (*Ursus americanus*) by longer less curved front claws, humped shoulders, and a facial profile that appears to be concave (Craighead and Mitchell 1982, p. 517). The coat features longer guard hairs over a dense underfur with tips that are usually silver or golden in color – hence the name "grizzly" (Figure 11). Grizzly bears are long-lived mammals, with maximum lifespans of 25 to 37 years observed in the wild (LeFranc *et al.* 1987, pp. 47, 51; Kasworm *et al.* 2024a, p. 29).

Figure 11. Grizzly bears in the lower-48 States are larger and heavier than other bears, with coloration that can vary widely from light brown to nearly black and long guard hairs that give a "grizzled" appearance (Photos by U.S. Fish and Wildlife Service).

Taxonomy

Grizzly bears (*Ursus arctos horribilis*) are a member of the brown bear species (*U. arctos*) that occurs in North America, Europe, and Asia. The subspecies *U. a. horribilis* is limited to North America (Rausch 1963, p. 43; Servheen 1999, pp. 50–53) and is a widely recognized subspecies of brown bear that historically existed throughout much of continental North America, including most of western North America from the Arctic Ocean to central Mexico (Hall 1984, pp. 4–9; Trevino and Jonkel 1986, p. 12). Grizzly bears in the lower-48 States are listed as threatened under the Act and are the subject of this SSA report. Throughout this report we use "grizzly bear" to refer to this listed entity in the lower-48 States.

Life Stages and Life Cycle

Grizzly bears have three life stages: dependent young, subadults, and adults (Figure 12). Dependent young are usually less than two years old and depend on and are associated with their mother, relying on her for food, protection, and survival. There are two primary sub-categories of dependent young: (1) cubs-of-the-year or cubs, defined as cubs born during the most recent denning season and less than one year old; and (2) yearlings. Cubs are born in the den and do not hibernate but nurse after birth in the den and after den emergence. They also increasingly eat foods with their mother once outside the den. Yearlings den with their mother, where they undergo hibernation and do not nurse in the den. Outside of the den, yearlings eat the same foods as their mother, but also occasionally nurse.

Shortly after den emergence, two-year-old offspring generally leave their mother to become subadults. Subadults are typically not sexually mature enough to breed; however, a small percentage of 3-year-old females do breed and produce cubs as 4-year-olds. Some subadults, generally males, may disperse away from their mother and establish their own home range (see *Behavior and Life History* below for further details).

Adult bears are four years old or older and have reached sexual maturity. Some bears may not breed until they are older than five years old, but they can reproduce once they reach the adult stage. Adults generally live into their mid- to late-20s (LeFranc *et al.* 1987, pp. 47, 51; van Manen *et al.* 2014, p. 326), although some wild bears have lived for over 35 years (Kasworm *et al.* 2024a, p. 29). Female reproductive senescence starts around age 25 for those long-lived individuals (Schwartz *et al.* 2003a, p. 114). Dependent young have the greatest mortality (lowest age-specific survival), primarily from natural causes, with relatively low rates of mortality (high probability of survival) for those surviving this bottleneck (van Manen *et al.* 2014, p. 136; Costello *et al.* 2016, pp. 61–68; Keay *et al.* 2018, p. 794).

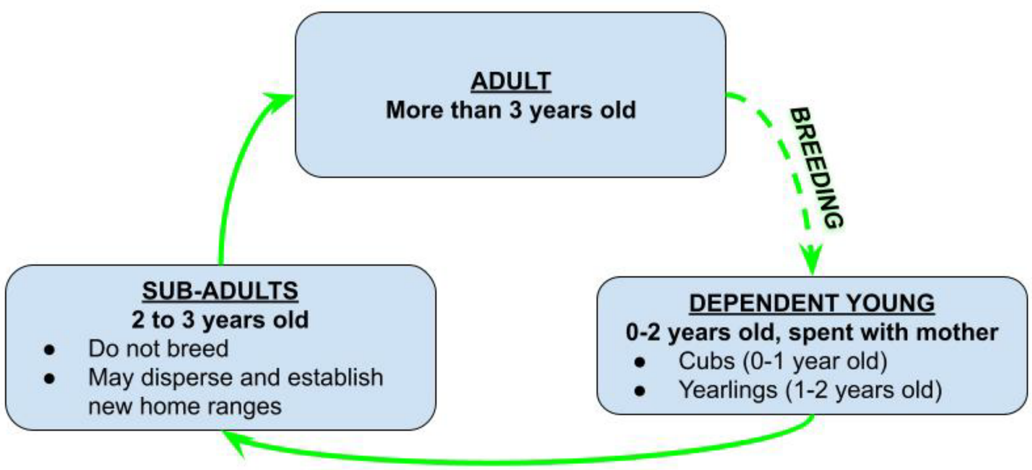

Figure 12. Life cycle diagram for the grizzly bear, with three life stages: dependent young, subadults, and adults. There are two sub-stages of dependent young: cubs and yearlings.

Habitat

Grizzly bears use a variety of habitats (LeFranc *et al.* 1987, p. 120). In general, a grizzly bear's individual habitat needs and daily movements are largely driven by the search for food, water, mates, cover, security, or den sites. The available habitat for bears is also influenced by people and their activities. Human activities are the primary factor impacting habitat security (i.e., habitat that is relatively undisturbed by human influence) and the ability of bears to find and access foods, mates, cover, and den sites. Other factors influencing habitat use and function for grizzly bears include overall habitat productivity (e.g., food distribution, quality, and abundance), the availability of habitat components (e.g., denning areas, cover types), grizzly bear social dynamics, learned behavior and preferences of individual grizzly bears, grizzly bear population density, and random variation. Water is an important habitat requirement; however, we have no information to suggest that water is limiting in the habitat that bears currently occupy, but may have limited distribution in portions of historical range since bears were less common or did not occur in large expanses of the North American deserts and Great Plains ecoregions (Rollins 1935, p. 191; Wade 1947, p. 444; Mattson and Merrill 2002, p. 1128; Haroldson *et al.* 2021a, pp. 163, 165).

The six ecosystems occur in mountainous ecoregions that provide the habitat heterogeneity necessary for adequate food, denning, and cover resources. Grizzly bear habitat management focuses on reduction or mitigation of the risk of human-caused mortality and displacement. An effective habitat management tool for reducing grizzly bear mortality risk on public lands is managing motorized access to ensure bears have secure areas away from humans (Nielsen *et al.* 2006, p. 225; Schwartz *et al.* 2010a, p. 661). Unmanaged motorized access: (1) increases human interaction and grizzly bear mortality risk; (2) increases displacement from important habitat; (3) increases habituation to humans; and (4) decreases habitat where energetic (i.e., food) requirements can be met (Mattson *et al.* 1987, pp. 269–271; McLellan and Shackleton 1988, pp. 458–459; McLellan 1989, pp. 1862–1864; Mace *et al.* 1996, pp. 1402–1403; Schwartz *et al.* 2010a, p. 661). Managing motorized access on public lands helps ameliorate these impacts. Other habitat management tools that minimize displacement and reduce grizzly bear mortality include regulating livestock allotments and developed sites on public lands. Implementation and enforcement of food storage orders on public lands also reduces mortality risk for both humans and grizzly bears. Requiring users and recreationists in occupied grizzly bear habitat to store their food, garbage, and other bear attractants so that they are inaccessible to bears reduces human-grizzly bear encounters and conflicts. In addition, encouraging users and recreationists to carry bear spray and know how to use it helps reduce the potential for injury to people and bears. Information and education (I&E) programs aimed at preventing mistaken identification killings limit grizzly bear mortality risk.

The primary stressors affecting grizzly bears at both the individual and ecosystem levels are excessive human-caused mortality and human activity that reduces the quality and quantity of habitats. Regulating human-caused mortality and displacement through habitat management can effectively minimize these stressors, as evidenced by increasing grizzly bear populations in the lower-48 States where motorized access standards exist and have been met (e.g., GYE and NCDE). Multiple studies have modeled a decrease in adult male survival, adult female survival, and/or bear density as road densities increase with similar road density recommendations (<0.6

km/km^2 (1 mi/ mi^2)) for a sustainable population (Schwartz *et al.* 2010a, p. 661; Boulanger *et al.* 2013, p. 282; Boulanger and Stenhouse 2014, p. 11; Lamb *et al.* 2018, p. 1411; Proctor *et al.* 2019, p. 20). Effective recovery requires ongoing monitoring of the grizzly bear population to understand if it is sufficiently resilient to allow for a conservative level of human-caused mortality without causing population decline. Although motorized access standards have contributed to a positive population trend in the CYE and SE, these standards have not yet been fully implemented (see *Motorized Access in the CYE and SE* below for further information, including anticipated implementation dates). The BE recovery zone is 98 percent wilderness; however, motorized access standards have not been developed for adjacent areas to the north and east, where female occupancy is necessary for natural recolonization of the BE (see *Motorized Access in the BE* and *Connectivity and Genetic Health in the BE* below for further information). The National Forests and National Park Service (NPS) within North Cascade save agreed to a "no net loss" of core areas approach (USDA FS 1997, entire); however, we have not evaluated whether this 1997 "no net loss" approach provides an adequate amount of secure habitat for a healthy grizzly bear population (see *Motorized Access in the North Cascades* below for further information).

Behavior and Life History

Home Range

Adult grizzly bears are normally solitary except when breeding or when females have dependent young (Nowak and Paradiso 1983, p. 971), but they are not territorial and home ranges of adult bears frequently overlap (Schwartz *et al.* 2003b, pp. 565–566). Grizzly bears are known to congregate on ungulate carcasses (Gunther 2012, p. 20; IGBST, unpublished data). Home range size is highly variable and is affected by resource availability, habitat quality, sex, age, and reproductive status (LeFranc *et al.* 1987, p. 31; Blanchard and Knight 1991, pp. 48–51; Mace and Waller 1997b, p. 48). Generally, females with cubs-of-the-year or yearlings have the smallest home range sizes (Aune and Kasworm 1989, p. 53; Blanchard and Knight 1991, pp. 48–49; Mace and Roberts 2011, pp. 26–28).

Table 5 shows the average annual home ranges observed in each ecosystem for adult males and females. Home range size varies within and among the ecosystems in response to population densities and habitat productivity (Mace and Roberts 2011, p. 28; Bjornlie *et al.* 2014b, p. 5) as well as the methodology used to measure range. The large home ranges of grizzly bears, particularly males, enhance maintenance of genetic diversity in the population by enabling males to mate with numerous females (Blanchard and Knight 1991, pp. 46–51; Craighead *et al.* 1998, p. 326).

Young, female grizzly bears usually establish home ranges within or overlapping their mother's (Waser and Jones 1983, p. 361; McLellan and Hovey 2001, pp. 841, 843; Schwartz *et al.* 2003b, p. 566). This pattern of home range establishment can make dispersal of females across landscapes a slow process. Radio-telemetry and genetic data suggest females typically establish home ranges an average of 9.8 to 14.3 km (6.1 to 8.9 mi) away from the center of their mother's home range, whereas males generally disperse farther, averaging 29.9 to 42.0 km (18.6 to 26.0

mi) away from the center of their mother's home range (McLellan and Hovey 2001, p. 842; Proctor *et al.* 2004, p. 1108). Maximum male dispersal distances of 67–176 km (42–109 mi) have been documented in the GYE and NCDE (Blanchard and Knight 1991, pp. 50, 55; McLellan and Hovey 2001, p. 841; Peck *et al.* 2017, p. 2). Studies also indicate that females occasionally disperse long distances up to 80–90 km (50–56 mi), typically on the periphery of expanding populations. Although the frequency of long-distance dispersal by females is much lower than males, it can contribute to range expansion and demographic connectivity between populations (Swenson *et al*. 1998, pp. 822–824; Jerina and Adamič 2008, pp. 1495–1497).

Table 5. Average annual home range sizes for adult male and female grizzly bear in the six ecosystems (NCDE = Northern Continental Divide Ecosystem, GYE = Greater Yellowstone Ecosystem, CYE = Cabinet-Yaak Ecosystem, SE = Selkirk Ecosystem, and BE = Bitterroot Ecosystem).

Ecosystem	Average Adult Female Home Range Size	Average Adult Male Home Range Size	Citation
NCDE	358 km^2 (138 mi^2)	1,364 km^2 (527 mi^2)	MFWP, unpublished data*
GYE	130 km^2 (50 mi^2)	475 km^2 (183 mi^2)	Bjornlie *et al.* 2014b, supplement 3**
CYE	403 km^2 (156 mi^2)	1,895 km^2 (732 mi^2)	Kasworm *et al.* 2024a, p. 48*
SE	252 km^2 (97 mi^2)	729 km^2 (281 mi^2)	Kasworm *et al.* 2024b, p. 33*
BE	NA	NA	NA
North Cascades	NA	NA	NA

* Using 100% minimum convex polygons
** Using 95% minimum convex polygons

Breeding

Grizzly bears have a promiscuous mating system (Hornocker 1962, p. 70; Craighead and Mitchell 1982, p. 522; Schwartz *et al.* 2003b, p. 563). Mating occurs from May through July with a peak in mid-June (Craighead and Mitchell 1982, p. 522; Nowak and Paradiso 1983, p. 971). Although females mate in spring and early summer, their fertilized embryos do not implant into the uterus for further development until late fall. Fat stores obtained by female grizzly bears at the end of fall are positively correlated with earlier birth dates and faster growth rates of their cubs (Robbins *et al.* 2012, p. 543). Additionally, a body fat threshold may exist below which females may not produce cubs, even when bred (Robbins *et al.* 2012, p. 543). Cubs are born in the den in late January or early February and nurse for 3 to 4 months inside the den. Offspring typically remain with the female for about 2.5 years. Age of first reproduction, litter size, and inter-birth interval (the average number of years between litters) may be related to nutritional state and/or density-dependent effects (Stringham 1990, p. 433; McLellan 1994, p. 20; Hilderbrand *et al.* 1999, pp. 135–136; Schwartz *et al.* 2006c, p. 21; van Manen *et al*. 2016, pp. 307–308; Hilderbrand *et al.* 2019, pp. 115–116).

Table 6 lists the average age of first reproduction, litter size, and inter-birth interval for each ecosystem.

Table 6. Average age of first reproduction, litter size, and inter-birth interval for the six ecosystems (NCDE = Northern Continental Divide Ecosystem, GYE = Greater Yellowstone Ecosystem, CYE = Cabinet-Yaak Ecosystem, SE = Selkirk Ecosystem, and BE = Bitterroot Ecosystem).

Ecosystem	Age of First Reproduction	Litter Size	Inter-birth Interval	Citation
NCDE	5.7	2.1	3	Mace and Waller 1997a, p. 108; Costello *et al.* 2016b, pp. 56–57
GYE	5.8	2.34	2.78	Schwartz *et al.* 2006c, pp. 19–20; Gould *et al.* 2024a, p. 10
CYE	6.3	2.16	2.89	Kasworm *et al.* 2024a, p. 39–40
SE	6.3	2.19	3.46	Kasworm *et al.* 2024b, p. 27
BE	NA	NA	NA	NA
North Cascades	NA	NA	NA	NA

Grizzly bears have one of the slowest reproductive rates among terrestrial mammals, resulting primarily from the reproductive factors described above: late age of first reproduction, small average litter size, and the long inter-birth interval (Nowak and Paradiso 1983, p. 971; Schwartz *et al.* 2003b, p. 564). Given the above factors, it may take a female grizzly bear 10 or more years to replace herself in a population (Service 1993, p. 4). The slow reproductive rate should also be understood in the context of having one of the longer life spans of terrestrial mammals (*Ursus arctos* in 90th percentile for longevity) (Healy *et al*. 2014, entire). A population is made up of numerous overlapping generations. It is possible for mothers, daughters, and granddaughters to be reproductively active at the same time. Grizzly bear females typically cease reproducing some time in their mid-to-late 20s (Schwartz *et al.* 2003a, pp. 109–110).

Hibernation and Denning

Grizzly bears hibernate in winter; hibernation is a life history strategy bears use to cope with seasons of low food abundance. In preparation for hibernation, bears increase their food intake dramatically during a process called hyperphagia (Craighead and Mitchell 1982, p. 544). Hyperphagia occurs throughout the 2 to 4 months prior to den entry (i.e., August through November). During hyperphagia, excess food is converted into fat, and grizzly bears may gain as much as 1.65 kg/day (3.64 lb/day) (Craighead and Mitchell 1982, p. 544). Grizzly bears must consume foods rich in protein and carbohydrates in order to build up fat reserves to survive denning and post-denning periods (Rode and Robbins 2000, pp. 1643–1644; McLellan 2011, p. 554; McLellan 2015, p. 760). Fat stores are crucial to the hibernating bear as they provide a source of energy and insulate the bear from cold temperatures and are equally important in providing energy to the bear upon emergence from the den when food is still sparse relative to metabolic requirements (Craighead and Mitchell 1982, p. 544). However, we are unaware of a minimum body fat threshold for survival during the denning period and documentation of natural mortality in independent-age bears is low for non-collared individuals (see *Natural Mortality* for further discussion).

Grizzly bears in the lower-48 States hibernate in dens for four to six months each year, typically entering dens between October and December, with males entering their dens later than females (Mace and Waller 1997a, p. 39; Linnell *et al.* 2000, p. 401; Haroldson *et al.* 2002, p. 29; Kasworm *et al.* 2024a, p. 49; Kasworm *et al*. 2024b, p. 33). Females give birth to cubs in the den in late January to early February. On average, males exit dens from early March to late April (Haroldson *et al.* 2002, p. 29; Kasworm *et al.* 2024a, p. 51; Kasworm *et al*. 2024b, p. 35; IGBST, unpublished data; MFWP, unpublished data). Females typically emerge from their dens from mid-March to mid-May, with females with cubs emerging later from mid-April to late-May (Mace and Waller 1997a, p. 37; Haroldson *et al.* 2002, p. 29; Kasworm *et al.* 2024a, p. 51; Kasworm *et al*. 2024b, pp. 34–35; IGBST, unpublished data; MFWP, unpublished data).

Grizzly bears typically hibernate alone in dens, except for females with young and subadult siblings who occasionally hibernate together. Grizzly bears often dig dens on steep slopes where wind and topography cause an accumulation of deep snow and where the snow is unlikely to melt during warm periods. Most dens are located at higher elevations, above 2,500 m (>8,000 ft) in the GYE and 1,942 m (6,400 ft) in the NCDE (Mace and Waller 1997a, p. 39; Haroldson *et al.* 2002, p. 33) and on slopes ranging from 30 to 60 degrees (Judd *et al.* 1986, p. 115; Mace and Waller 1997a, pp. 39–40). Approximately 66 percent (6,815 km^2 (2,631 mi^2)) of the GYE is potential denning habitat, and it is well distributed, so its availability is not considered a limiting factor for grizzly bears in the GYE (Podruzny *et al.* 2002, p. 22). In the NCDE, approximately 29 percent (6,815 km^2 (2,631 mi^2)) of the recovery zone is potential denning habitat; its availability is not considered a limiting factor for grizzly bears in the NCDE (Costello 2018, *in litt.*). In the CYE, the majority of den sites occurred above 1,600 m (5,248 ft), often on northerly and easterly aspects, though all aspects were used (Kasworm *et al.* 2024a, pp. 53–54). In the SE, dens were located above 1,600 m (5,248 ft), often on easterly aspects, but all aspects were used (Kasworm *et al.* 2024b, pp. 37–38). Given the variety of den site use, den availability does not appear to be a limiting factor for populations at this time in the CYE or SE. The North Cascades contains large areas at high elevations with isolated, steep, snow-packed slopes and many natural caves to serve as potential den sites. Additional areas associated with ridge systems stemming from major volcanic peaks may provide den sites at lower elevations within the North Cascades (Almack *et al.* 1993, p. 23). Davis and Butterfield (1991, p. 26) assessed the northern part of the BE recovery zone and areas to the immediate north and concluded that deep snow and mountainous terrain provides adequate denning habitat.

Denning increases survival during periods of food scarcity and inclement weather (Craighead and Craighead 1972, pp. 33–34). During this period, bears do not eat, drink, urinate, or defecate (Folk *et al.* 1974, pp. 376–377; Nelson 1980, p. 2955). Hibernating grizzly bears exhibit a marked decline in heart and respiration rate, but only a slight drop in body temperature (Nowak and Paradiso 1983, p. 971). Due to their relatively constant body temperature in the den, hibernating grizzly bears may be aroused and have been known to exit or relocate dens when disturbed by seismic or mining activity (Harding and Nagy 1980, p. 278; Reynolds *et al.* 1986, p. 174) or other human activities (Swenson *et al.* 1997, p. 37). Dens are rarely used twice by an individual, although individuals usually use the same general area from year-to-year (Servheen and Klaver 1983, p. 205; Schoen *et al.* 1987, p. 300; Miller 1990, p. 285; Linnell *et al.* 2000, p. 403). Females display stronger area fidelity than males and generally stay in their dens longer, depending on reproductive status (Judd *et al.* 1986, pp. 113–114; Schoen *et al.* 1987, p. 300; Miller 1990, p. 283; Linnell *et al.* 2000, p. 403). Females with cubs usually spend a few weeks close to their den upon emergence, unlike solitary bears that leave the den area shortly after emergence.

Cover

Grizzly bears use a variety of cover types to rest and shelter. Grizzly bears often select bed sites with horizontal and vertical cover, especially at day bed sites (Ordiz *et al*. 2011, p. 63), suggesting that bed site selection is important for concealment from humans. Blanchard (1978, pp. 27–29) documented the relative importance of cover to grizzly bears in a 4-year study in the GYE. Ninety percent of 2,261 aerial radio locations of 46 instrumented grizzly bears were in forest cover too dense to observe the bear. Sahlén *et al*. (2011, p. 156) also found that brown bears in Sweden denned in denser cover when closer to villages. Blanchard (1978, p. 45) recorded the importance of an interspersion of open areas as feeding sites associated with cover: "Only 1 percent of the relocations were in dense forest more than a kilometer from an opening." This is likely because diverse habitat complexes, such as forest interspersed with moist grass-forb meadows, provide both abundant food and cover. Generally, areas with vegetative cover are important to grizzly bears for use as bedding sites (Servheen and Lee 1979, pp. 57, 60; Munro *et al*. 2006, p. 1119). Schallenberger and Jonkel (1980, p. 54) found that grizzly bears preferred forest in over 80 percent of their radio relocations. Beds underneath any type of vegetative cover (not necessarily always forest cover) provide bears shade during the hottest parts of the day and a place to sleep at night.

Nutritional Ecology (Feeding)

The lower-48 States provides highly diverse landscapes containing a wide array of habitat types and bear foods across and within the ecosystems. Plant communities vary from grasslands at lower elevations (less than 1,900 m (6,230 ft)) to shrub fields created by fires, avalanches, or timber harvest, to conifer forests at mid-elevations and subalpine and alpine meadows at higher elevations (greater than 2,400 m (7,870 ft)). Grizzly bears are opportunistic omnivores and display great diet plasticity within and across populations (Edwards *et al.* 2011, pp. 883–886), shifting their diet according to foods that are most nutritious (i.e., high in fat, protein, and/or carbohydrates) and available (Mealey 1980, pp. 284–291; Servheen 1981, pp. 99–102; Kendall 1986, pp. 12–18; Mace and Jonkel 1986, p. 108; Martinka and Kendall 1986, pp. 21–22; LeFranc *et al.* 1987, pp. 111–114; Aune and Kasworm 1989, pp. 63–71; Kasworm and Thier 1993, pp. 38–41; McLellan and Hovey 1995, pp. 706–709; Schwartz *et al.* 2003b, pp. 568–569; Van Daele *et al*. 2012, pp. 25–27; Gunther *et al.* 2014, p. 65). Gunther *et al.* (2014, p. 65) conducted an extensive literature review and documented over 260 species of foods consumed by grizzly bears in the GYE, representing 4 of the 5 kingdoms of life. The ability to use whatever food resources are available is likely one reason brown bears are the most widely distributed bear species in the world, occupying habitats from deserts to alpine mountains and everything in between. This ability to live in a variety of habitats and eat a wide array of foods makes grizzly bears a generalist species. In contrast, specialist species (e.g., mountain lions) eat only a few specific foods or live in only one or two specific habitat types (Krebs 2009, p. 100). Morphological adaptations that support a diverse diet include crushing molars and the greatest intestinal length relative to body length of any carnivore (Mealey 1975, pp. 109–110, 113–114). Grizzly bears also exhibit a high degree of plasticity in body size, dependent on quality of foods and quantity of macronutrients; as an example, protein intake in the form of animal matter is associated with larger body size (Hilderbrand *et al.* 1999, p. 134; McLellan 2011, p. 554; Costello *et al.* 2016a, p. 15; Murray *et al.* 2017, p. 8). The energetic advantage of smaller body size can be significant in areas with limited abundance of quality foods, especially for reproductive females (Rode *et al.* 2001, pp. 69–70; McLellan 2011, p. 555).

Grizzly bear diets are highly variable among individuals, seasons, and years, and between ecosystems (Servheen 1983, pp. 1029–1030; Mattson *et al.* 1991a, pp. 1625–1626; LeFranc *et al.* 1987, pp. 113–114; Felicetti *et al.* 2003, p. 767; Schwartz *et al.* 2003b, pp. 568–569; Felicetti *et al.* 2004, p. 499; Fortin *et al.* 2013, p. 278; Costello *et al.* 2014, p. 2013; Gunther *et al.* 2014, p. 65). They opportunistically seek and consume whatever plant and animal foods are available to them. Grizzly bears will consume almost any food available including living or dead mammals or fish, insects, worms, plants, human-related foods, and garbage (Knight *et al.* 1988, pp. 123–124; Mattson *et al.* 1991a, p. 1620; Mattson *et al.* 1991b, p. 2433; Schwartz *et al.* 2003b, pp. 568–569; Gunther *et al.* 2014, entire). In areas where animal matter is less available, berries, grasses, roots, bulbs, tubers, seeds, and fungi are important in meeting protein and caloric requirements (LeFranc *et al.* 1987, pp. 111–114; Schwartz *et al.* 2003b, pp. 568–569). Grizzly bears often sample new foods so that they have alternative options in years when preferred foods are scarce (Mattson *et al.* 1991a, p. 1625). In the GYE, Blanchard and Knight (1991, p. 61) noted that, "After 10 years of food habits data collection, new feeding strategies continued to appear annually in this population."

Grizzly bears opportunistically prey on livestock, agricultural crops, and other human foods. Cattle and sheep depredation rates are generally higher where bear densities are higher and in later summer months (Wells *et al*. 2018, pp. 5–6). In the GYE and NCDE, depredation is generally higher where livestock is more abundant, such as areas with livestock allotments and privately owned ranchland. Grazing is less common in the CYE and SE, and depredation rates are correspondingly lower. Grizzly bears also opportunistically prey on small livestock, such as chickens, llamas, and goats, which primarily occur on private land in all ecosystems.

Food resources are especially important during the period leading up to hibernation when grizzly bears must consume energetically rich foods to build up fat reserves to survive denning and post-denning periods (Rode and Robbins 2000, pp. 1643–1644; McLellan 2011, p. 554; McLellan 2015, p. 760). As discussed in *Hibernation and Denning* above, fat stores provide a source of energy and insulate the bear from cold temperatures during hibernation (Craighead and Mitchell 1982, p. 544). Also, fat stores obtained by female grizzly bears at the end of fall are positively correlated with earlier birth dates and quicker growth rates of their cubs (Robbins *et al.* 2012, p. 543). Additionally, a body fat threshold may exist below which females may not produce cubs, even when bred; studies have shown that females with less than 20 percent body fat are unlikely to produce cubs (Robbins *et al.* 2012, p. 543). However, we are unaware of a minimum body fat threshold for survival during the denning period.

Historical Range and Distribution

For this SSA report, we considered the historical range of grizzly bears circa 1850. We determined that this timeframe is appropriate for measuring the historical grizzly bear range because it is a period for which published faunal (animals characteristic of a region) records document grizzly bear range, bear occurrence, and local extirpation events (Mattson and Merrill 2002, p. 1125). Additionally, it precedes the major distribution changes in response to excessive human-caused mortality and habitat loss (Servheen 1999, p. 51).

Historical range of the grizzly bear began receding with the arrival of Europeans to North America, with rapid extirpation of populations from most of Mexico and from the central and southwestern United States and California (Craighead and Mitchell 1982, p. 516). Prior to the arrival of Europeans, grizzly bears occurred throughout much of the western half of the contiguous United States, central Mexico, western Canada, and most of Alaska (Figure 13) (Roosevelt 1907, pp. 27–28; Wright 1909, pp. vii, 3, 185–186; Merriam 1922, p. 1; Storer and Tevis 1955, p. 18; Rausch 1963, p. 35; Herrero 1972, pp. 224–227; Schwartz *et al.* 2003b, pp. 557–558; Hall 1984, pp. 4–9; Trevino and Jonkel 1986, p. 12). Historically, an estimated 50,000 grizzly bears were distributed in one large contiguous area throughout all or portions of 18 western States (i.e., Washington, Oregon, California, Idaho, Montana, Wyoming, Nevada, Colorado, Utah, New Mexico, Arizona, North Dakota, South Dakota, Minnesota, Nebraska, Kansas, Oklahoma, and Texas) (Figure 14) (Servheen 1990, pp. 1–2; Servheen 1999, pp. 50– 51; Service 1993, p. 9). Grizzly bears were probably most common in the Rocky Mountains, along the Upper Missouri River, and in California (Storer and Tevis 1955, pp. 15–21; Schneider 1977, pp. 15, 17, 25–36; Mattson and Merrill 2002, pp. 1125, 1127–1128; Haroldson *et al.* 2021a, pp. 163, 165). Historically, grizzly bears were less common or did not occur in large expanses of the North American deserts and Great Plains ecoregions (Rollins 1935, p. 191; Wade 1947, p. 444; Mattson and Merrill 2002, p. 1128; Haroldson *et al.* 2021a, pp. 163, 165).

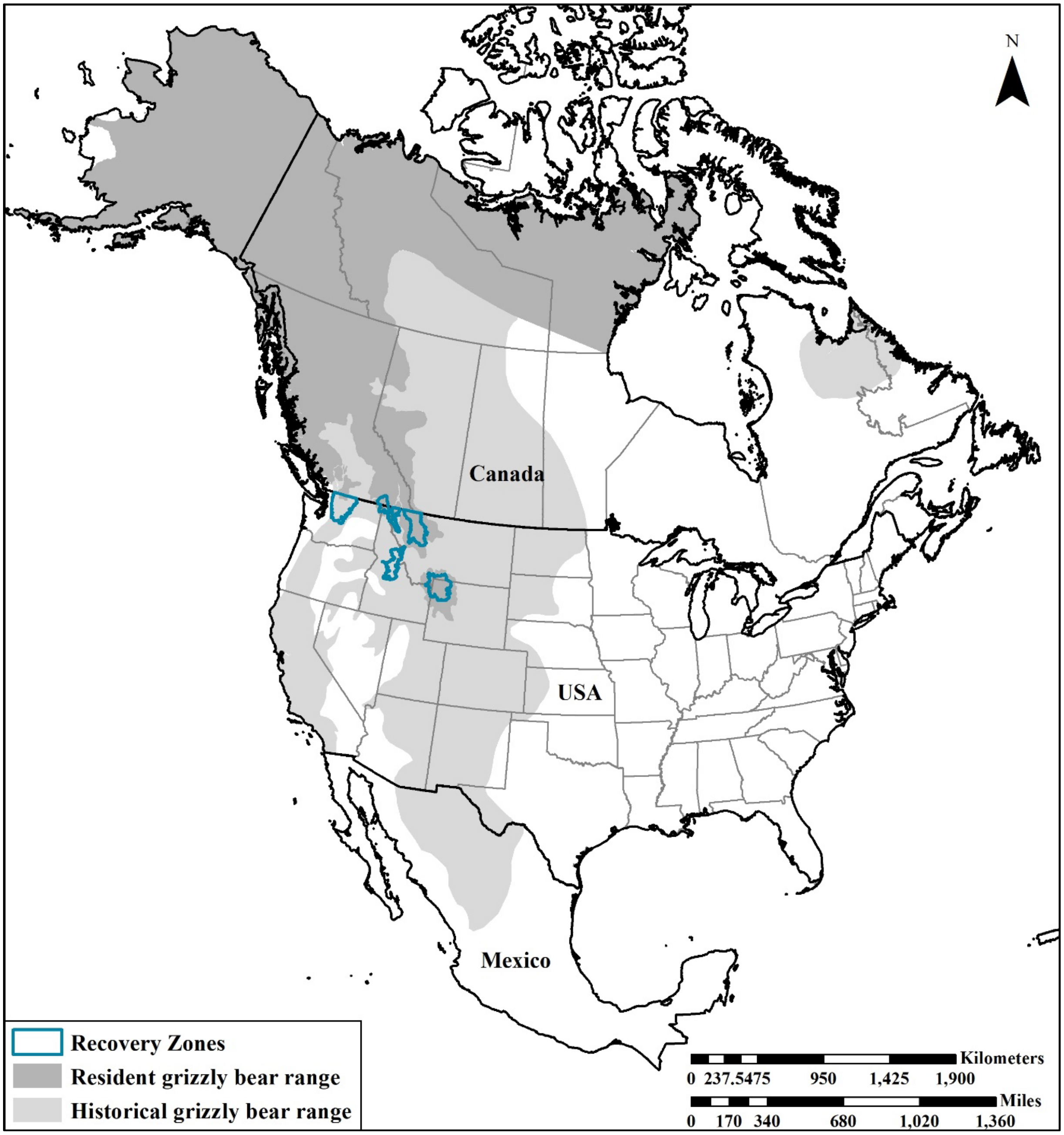

Figure 13. Current estimated occupied range (Costello et al. 2023, p. 14; Delllinger et al. 2023, p. 23; Kasworm et al. 2024a, p. 74) and historical grizzly bear distribution in North America circa 1850 (Haroldson et al. 2021a, p. 165) and recovery zones for the six ecosystems identified in the Recovery Plan: Northern Continental Divide (NCDE), Greater Yellowstone (GYE), Cabinet-Yaak (CYE), Selkirk (SE), Bitterroot (BE), and North Cascades.

With the arrival of Europeans to North America, grizzly bears were seen as a threat to livestock and human safety and, therefore, an impediment to westward expansion and settlement. In the 1800s, in concert with European settlement of the American West and government-funded bounty programs aimed at eradication, grizzly bears were shot, poisoned, and trapped wherever they were found (Roosevelt 1907, pp. 27–28; Wright 1909, p. vii; Storer and Tevis 1955, pp. 26–27; Leopold 1967, p. 30; Koford 1969, p. 95; Craighead and Mitchell 1982, p. 516; Servheen 1999, pp. 50–51). The resulting declines in range and population were dramatic. Grizzly bears were reduced to close to 2 percent of their former range in the lower-48 States by the 1930s, with a corresponding decrease in population, approximately 125 years after first contact with European settlers (Figure 14, below) (Service 1993, p. 9; Servheen 1999, p. 51). Of 37 grizzly bear populations thought to be present in 1922 within the lower-48 States, 31 were extirpated by the time of listing in 1975, and the estimated population in the lower-48 States was 700–800 animals (Figure 14) (Mattson and Merrill 2002, p. 1125).

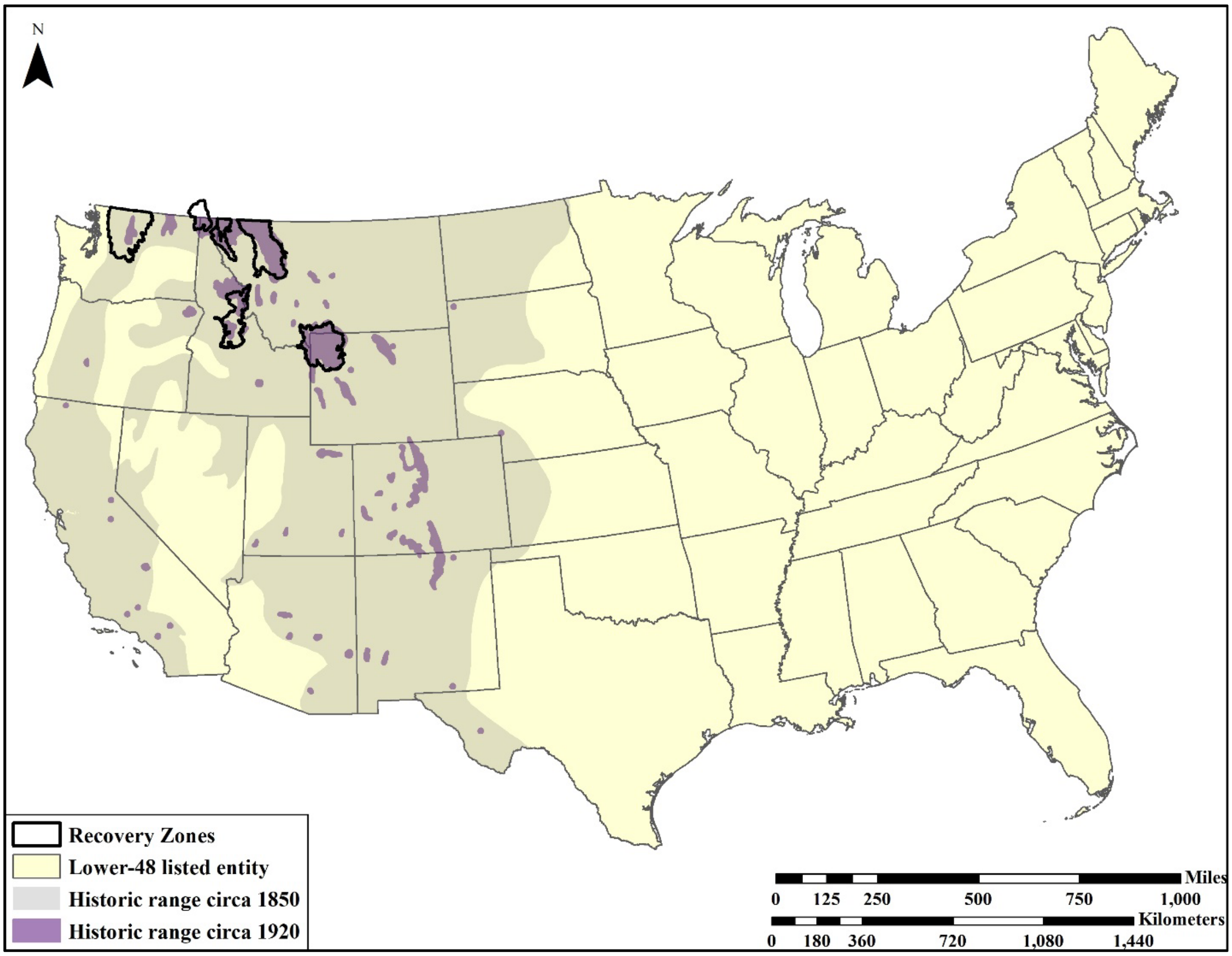

Figure 14. Historical grizzly bear distribution in the lower-48 States circa 1850 (Haroldson et al. 2021a, p. 165) and 1920 (Mattson and Merrill 2002, p. 1125), and recovery zones for the six ecosystems identified in the Recovery Plan: Northern Continental Divide (NCDE), Greater Yellowstone (GYE), Cabinet-Yaak (CYE), Selkirk (SE), Bitterroot (BE), and North Cascades.

Most of the shortgrass prairie on the east side of the Rocky Mountains and other areas within historical range has been converted into agricultural land (Woods *et al.* 1999, entire), and high densities of traditional food sources are no longer available due to land conversion and human occupancy of urban and rural lands. Traditional food sources such as bison (*Bison bison*) and elk (*Cervus canadensis*) have been reduced and replaced with domestic livestock such as cattle, sheep, chickens, goats, pigs, beehives, and agricultural crops, which can become food sources for grizzly bears, leading to conflicts with humans. While food sources such as grasses and berries are abundant in some years in the riparian zones within which the bears travel, these are not reliable every year and can only support a small number of bears. These nutritional constraints of natural foods and the potential for associated human-bear conflicts limit the potential for a self-sustaining population of grizzly bears to develop in the prairies, although we expect some grizzly bears to live in these areas.

In the early 20th century, regulations recognizing bears (black and grizzly) as game animals, protecting females and their offspring, and setting harvest limits (either season or bag limit) were designed to stop future extirpations. In some areas, the protections came too late. By 1975, grizzly bear populations in the lower-48 States had been reduced in number and were restricted largely to the confines of National Parks and Wilderness areas in Washington, Idaho, Montana, and Wyoming (40 FR 31734, July 28, 1975; Service 1982, p. 10; Dood *et al.* 1986, p. 166; Craighead *et al.* 1995, pp. 41–42; Schwartz *et al.* 2003b, pp. 575–579), although significant numbers remained in Alaska and northern Canada. Grizzly bears were relegated to these areas in the lower-48 States primarily because of limited human influences. High grizzly bear mortality in 1970 and 1971, following closure of the open-pit garbage dumps in YNP (Gunther 1994, p. 550; Craighead *et al.* 1995, pp. 34–36), and concern about grizzly bear population status throughout its remaining range, primarily due to habitat destruction and excessive human-caused mortality, prompted the 1975 listing of the grizzly bear as a threatened species in the lower-48 States under the Act (40 FR 31734, July 28, 1975). When the grizzly bear was listed in 1975, the population estimate in the GYE ranged from 136 to 312 individuals (Cowan *et al.* 1974, pp. 32, 36; Craighead *et al.* 1974, p. 16; McCullough 1981, p. 175). Around the time of listing, it was estimated that the entire NCDE population had been reduced to as few as 300 bears (Dood *et al.* 1986; p. 166; Service 1993, p. 12), primarily within GNP and surrounding Wilderness areas. Little was known about populations in the CYE, SE, North Cascades, and BE at the time of listing (Service 1982, pp. 12–13).

In 1993, the Service's Recovery Plan identified six recovery areas (GYE, NCDE, CYE, SE, BE, North Cascades), and recommended further evaluation of other potential areas to determine recovery potential (Service 1993, pp. 11, 15–16, 121). The San Juan Mountains was specifically identified for further evaluation, but no confirmed sightings of grizzly bears have occurred there since a grizzly bear mortality in 1979 (Service 1993, p. 11). It recommended conducting an evaluation of these areas to focus on habitat values, size of area, human use and activities in general, relation to other areas where grizzly bears exist, and historical information (Service 1993, p. 121). The Service conducted this analysis, focusing on secure core habitat in historical range outside of the six ecosystems in 2019–2020 (see *Appendix A* for further discussion).

The most crucial element in grizzly bear recovery is habitat. Areas of suitable habitat must be of adequate size to support a population, diverse such that it provides a wide range of foods, and isolated from development and human activities, where human-bear interactions, which often result in higher bear mortalities, are minimal (Service 1993, p. 21; Craighead and Mitchell 1982, p. 530). In general, road access probably poses the most imminent threat to grizzly bear habitat, and therefore the Recovery Plan recommended that road management be given the highest priority for grizzly bear recovery (Service 1993, pp. 21–22). For this reason, both the GYE and NCDE incorporate threshold levels for motorized access and secure core/habitat (areas with no motorized access) into habitat-based recovery criteria (Service 2007a, 2018, entire). Although we have not yet developed habitat-based recovery criteria for the remaining ecosystems, the BE recovery zone is 98 percent wilderness, to create and protect grizzly bear habitat the CYE and SE have implemented motorized access standards, and the North Cascades has a "no net loss" of core areas agreement (USDA FS 1997, entire; USDA FS 2011a, entire). The Recovery Plan also specified that areas to be considered for grizzly bear recovery must have the potential to sustain themselves as viable grizzly bear populations, either as large populations or through connectivity to other populations (Service 1982, p. 1; Service 1993, pp. 13, 15, 24, 121). Therefore, our evaluation of potentially suitable habitats considered habitat security (roads) and size, human population density, land ownership (Federal, State, and Tribal), historical range, and the potential to maintain a self-sustaining population.

We analyzed habitat security (secure core and secure habitat) for Federal, State, and Tribal lands within mapped historical grizzly bear range circa 1850 (Mattson and Merrill 2002, p. 1125). We report secure core as: the percentage of Federal, State, and Tribal lands within the analysis area with no motorized routes that are more than 500 m (1,650 ft) from an open or gated motorized route and at least 2,500 acres (10.1 km^2 (3.9 mi^2)) in size. We report secure habitat as: the percentage of Federal, State, and Tribal lands within the analysis area with no motorized routes that are more than 500 m (1,650 ft) from an open or gated motorized route and at least 10 acres (0.31 km^2 (0.016 mi^2)) in size. The largest area of secure core/habitat within grizzly bear historical range outside of the six ecosystems (NCDE, GYE, North Cascades, BE, SE, and CYE) is the Sierra Nevada Mountain Range in California (see Figure 1 in *Appendix A* for further details). We further analyzed the Sierra Nevada Range to determine if the area contains enough secure core/habitat to support an isolated grizzly bear population. We also analyzed secure core/habitat in the San Juan Mountains because of the Recovery Plan recommendation to do so (Service 1993, pp. 16, 121). Finally, we considered the potential of these areas to maintain a self-sustaining population by examining potential population size and the future ability of individuals to move between ecosystems (e.g., potential for connectivity), including distance from existing grizzly bear populations and potential barriers to dispersal (Service 1993, pp. 13, 24, 121). Details of this analysis can be found in Juliusson and Fortin-Noreus (2020, entire), *Appendix A* in this SSA report.

Our goal was to compare the amount of secure core/habitat in the Sierra Nevada and San Juan mountains with secure core/habitat in recovery zones, therefore we calculated secure core using the definition used in the NCDE and secure habitat using the definition used in the GYE (see *Appendix B* for secure core/habitat definitions). We could not calculate core areas consistent with methodology used in the CYE, SE, and North Cascades because data for high-use trails was unavailable. The analysis area for the Sierra Nevada Mountains is 52,531 km^2 (20,282 mi^2) in size, of which 76 percent (39,872 km^2 (15,395 mi^2)) is Federal, State, and Tribal lands. Forty-three percent of Federal, State, and Tribal lands is secure core and 47 percent is secure habitat. The San Juan Mountains analysis area is 26,512 km^2 (10,236 mi^2) in size, of which 82 percent (21,636 km^2 (8,354 mi^2)) is Federal, State and Tribal lands. Fifty-two percent of Federal, State, and Tribal lands is secure core and 56 percent is secure habitat. It is important to keep in mind that the specific boundary and size of analysis areas influence the percent core and secure habitat. Our selection of these boundaries was based largely on big areas of Federal lands and political boundaries; however, analysis areas also include some chunks that are primarily private land or checkerboards of private and public land. The process we used is likely somewhat different from that used to designate the original recovery zones, and comparisons between these two analysis areas and recovery zones should be made with caution.

These percentages of secure core and secure habitat in the Sierra Nevada (43 and 47 percent, respectively) and San Juan Mountains (52 and 56 percent, respectively) are significantly lower than that in the GYE and NCDE recovery zones (NCDE Subcommittee 2020, Appendix 4; YES 2024, Appendix E). Secure habitat averages 85.6 percent of the recovery zone in the GYE (YES 2024, Appendix E) and secure core averages 76.4 percent of the recovery zone in the NCDE (NCDE Subcommittee 2020, Appendix 4). In addition, research in the NCDE indicated that 68 percent secure core is the minimum threshold necessary for successfully reproducing adult female grizzly bears (Manley 1993, *in litt*.; Service 1995, p. 6). Our analysis did not calculate route density and secure core/habitat by bear management subunit as in the GYE and NCDE. Doing so would likely highlight smaller areas within the Sierra Nevada and San Juan Mountains that have higher levels of secure core and are more suitable for grizzly bears. However, the total amount of public access to Federal, State, and Tribal lands in the Sierra Nevada and San Juan Mountains is high, and we would expect resultant high human-caused mortality levels and habitat displacement (McLellan and Shackleton 1988, pp. 458–459; McLellan 1989, pp. 1862–1864; Mace et al. 1996, pp. 1402–1403; Schwartz *et al.* 2010a, p. 661).

At 52,531 km^2 and 26,512 km^2 (20,282 mi^2 and 10,236 mi^2), the Sierra Nevada and San Juan Mountains, respectively, are larger in area than either the CYE or SE recovery zones and could be large enough to support a population of grizzly bears (we define a population as two or more reproductive females or one female reproducing during two separate years (as defined in this document)). However, natural recolonization of these areas is unlikely because of the distance from existing grizzly bear populations. The Sierra Nevada and San Juan Mountain ranges are very far (greater than 880 km (550 mi) and 480 km (300 mi), respectively) from current grizzly bear populations. Maximum dispersal distances of 67–176 km (42–109 mi) for males have been documented in the GYE and NCDE (Blanchard and Knight 1991, pp. 50, 55; McLellan and Hovey 2001, p. 841; Peck *et al.* 2017, p. 2), while female grizzly bears rarely disperse long distances (Swenson *et al*. 1998, pp. 822–824; Jerina and Adamič 2008, pp. 1495–1497). Recolonization and recovery of a new area would require continuous occupation by females, and for areas at great distance from existing populations, this is not likely to occur.

Additionally, the areas between the Sierra Nevada and San Juan Mountain ranges and current populations include large blocks of rangeland with open canopy coverage, agriculture and private lands, and are bisected by several major highways and interstates. Increasing human development will increase these barriers in the future. Thus, the likelihood of even one male bear successfully immigrating from existing populations to these areas is minimal, and it is even more unlikely that a population would naturally recolonize and achieve recovery.

A population could be established through reintroduction. However, neither of these areas are large enough to contain sufficient numbers of bears to maintain long-term fitness, and ongoing translocations would likely be needed to ensure long-term genetic health. A total population size of approximately 400 animals is needed for short-term fitness (Miller and Waits 2003, p. 4338) and the population would require one to two effective immigrants from one of the other established grizzly bear populations approximately every 10 years (e.g., a generation interval) to ensure genetic health over the long-term (Mills and Allendorf 1996, pp. 1510, 1516; Newman and Tallmon 2001, pp. 1059–1061; Miller and Waits 2003, p. 4338). Given these factors, at this time we believe the possibility of populations naturally recolonizing these areas is almost impossible; even if a population were reintroduced, there is a very low likelihood of natural connectivity to existing populations needed to maintain long-term fitness and become self-sustaining (Service 1982, p. 1; Service 1993, p. 13, 24).

Although other grizzly bear populations and unoccupied recovery zones included in the lower-48 States, such as the GYE, North Cascades, and BE, are currently isolated, they are within male dispersal distance of existing populations, and connectivity is possible. In addition, with the expanding NCDE population, the BE is expected to be within female dispersal distance in the future. For example, the GYE grizzly bear population remains isolated today, with no evidence of genetic exchange with any other population; however, the distance between current distributions of grizzly bears in the GYE and NCDE has decreased recently and distributions are now close (98 km (61 mi))[2] (Costello *et al.* 2023, p. 14; Dellinger *et al*. 2023, p. 23) with multiple verified sightings in between, and it is likely that natural connectivity will occur in the near future (see *Connectivity and Genetic Health in the GYE* for more information).

The North Cascades does not currently contain a grizzly bear population and the area remains isolated from other existing populations. Natural recolonization by females is unlikely in the near future due to the low numbers of bears in nearby populations and the highly fragmented landscape in between (NPS and Service 2024a, p. 7). However, if a population is established in the North Cascades, there are other populations close enough that could provide occasional male immigrants, thereby ensuring long-term genetic fitness. There are at least three populations within long-distance male dispersal range (67–176 km (42–109 mi)) (Blanchard and Knight 1991, pp. 50, 55; McLellan and Hovey 2001, p. 841; Peck *et al.* 2017, p. 2), from the North Cascades, including the Stein-Nahatlatch, Squamish-Lillooet, Garibaldi-Pitt Grizzly Bear Population Units in Canada. If restoration in the North Cascades occurs in the future, the North Cascades has the potential to become a self-sustaining population that is connected with other existing populations.

The BE is also isolated and does not currently contain a population. However, multiple grizzly bears have been confirmed in areas immediately surrounding the recovery zone over the last 15 years, including a collared bear that dispersed from the CYE into the BE recovery zone in 2019 and three subadults (two males and one female) that dispersed from the NCDE to within miles of the BE recovery zone from 2022 to 2023. These examples indicate that connectivity and natural recolonization is possible.

The SE and CYE are small recovery zones and do not have the potential to contain 400 bears. However, both recovery zones are contiguous with grizzly bear habitat northward into Canada,

[2] In 2023, Fortin-Noreus *et al.* developed a guidance document for estimating occupied range for grizzly bear populations within the lower-48 States. The revised methodology resulted in a more compact and realistic estimate of occupied range for the NCDE than the unrevised methodology (Costello 2023a, *in litt.*). This was primailry due to the revised cell size (3x3 km versus 7x7 km), although there were some differences in occupied cells due to the revised window length (10 versus 15 years) and use of GPS data (all versus 1 per day). Analysis with the larger cell size tended to include more scattered peripheral observations and led to more inflated and smoothed contours.

and a recovered population would be a subset of a much larger population. Bears can and do move between recovery zones and contiguous habitat to the north, thereby enabling demographic connectivity and long-term genetic fitness.

Our initial analysis indicated other areas within grizzly bear historical range that currently contain substantial secure habitat, such as the Uinta and Mogollon Mountains in the southwestern U.S. (Juliusson 2019, *in litt*.). All of these areas are smaller than the Sierra Nevada and San Juan Mountains and have the same limiting factors that more than likely prevent them from supporting a self-sustaining population, including: low amounts of secure core, extremely low potential of connectivity to existing grizzly bear populations due to high human densities, transecting highways and interstates, agriculture, lack of cover, and high densities of motorized routes. Therefore, we did not conduct subsequent analyses on these other areas.

Geographic Boundaries

We refer to several geographic boundaries relevant to the grizzly bear in this SSA report: ecosystems, recovery zones, demographic monitoring areas (DMAs), demographic connectivity areas (DCAs), management zones, bear management units (BMUs), and bears outside recovery zones (BORZ). Figure 9Figure 9, above, illustrates how recovery zones and DMAs relate to each other. Individual ecosystem maps are below (Figures 14–18). Various boundaries were created for management and monitoring purposes. We briefly discuss here for context but see below for full discussion of management and monitoring.

Ecosystems

The Service has not explicitly identified ecosystem boundaries on the landscape for any of the ecosystems across the lower-48 States. However, ecosystems are generally considered to be the larger area surrounding the recovery zones in which grizzly bears may be anticipated to occur as part of the same population. Throughout our assessment, ecosystems are synonymous with populations, and are the extent at which we evaluated the 3Rs.

Recovery Zones

The 1993 Recovery Plan, and subsequent supplements, identified recovery zones at the core of each of the six ecosystems to further recovery efforts (in their entirety: Service 1993, 1996, 1997, 2000) (Figure 9, above). Each recovery zone represents an area large enough and of sufficient habitat quality to support a recovered grizzly bear population (Service 1993, p. 17). The Recovery Plan recognized that grizzly bears would move and reside permanently in areas outside the recovery zones; however, only the area within the recovery zone is managed primarily for grizzly bear habitat (Service 1993, p. 18). The plan acknowledged that connectivity would be necessary for isolated populations to increase and sustain themselves at recovery levels (Service 1993, pp. 23, 24). The recovery zones identified are: (1) the GYE in northwestern Wyoming, eastern Idaho, and southwestern Montana at 23,853 km^2 (9,210 mi^2); (2) the NCDE of north-central Montana at 23,135 km^2 (8,932 mi^2); (3) the North Cascades area of north-central Washington at 25,322 km^2 (9,777 mi^2); (4) the SE area of northern Idaho, northeast Washington, and southeast B.C. at 6,575 km^2 (2,539 mi^2); (5) the CYE area of northwestern Montana and northern Idaho at 6,705 km^2 (2,589 mi^2); and (6) the BE in the Bitterroot Mountains of central Idaho and western Montana at 15,100 km^2 (5,830 mi^2).

Demographic Monitoring Areas (DMAs)

The recovery plan describes a 10-mile buffer around each recovery zone within which demographic recovery criteria are monitored. The GYE and NCDE demographic monitoring areas (DMAs) serve a similar concept, including and surrounding the recovery zone (Figure 9, above). The DMA is the area in which the population is annually surveyed for and estimated for the GYE and within which the mortality limits apply for the GYE and NCDE. For both areas, DMA boundaries took into consideration physical and recognizable features, however several differences exist. For the GYE, the Interagency Grizzly Bear Study Team (IGBST) developed the DMA using suitable habitat (see *Appendix C*) as the basis and added areas that are possible mortality sinks (areas where death rates exceed birth rates) by applying a six km buffer to suitable habitat based on the average annual activity radii for GPS radio-collared females. These generally represented long and narrow areas where human influence could have disproportionate effects (i.e., "edge effect") on the population generally contained within the suitable habitat zone (IGBST 2012, p. 42; Woodroffe and Ginsberg 1998, p. 2126). By including these areas, any extra mortality due to edge effects would be included in the count against the mortality threshold. The GYE DMA includes suitable habitat plus the potential sink areas for a total area of approximately 49,931 km^2 (19,278 mi^2) (Figure 9, above). The GYE DMA contains 100 percent of the recovery zone and 100 percent of suitable habitat, as shown in *Appendix C*. For the NCDE, the recovery zone and Zone 1 (see description below) comprise the DMA, which is 42,549 km^2 (16,440 mi^2). The following were considered in development of the NCDE DMA boundary: avoiding inclusion of adjacent areas that are in a different conservation status; preserving opportunities for connectivity to other grizzly bear populations; inclusion of contiguous or semi-contiguous large blocks of public land where population expansion and habitat that supports connectivity exists; exclusion of areas that are primarily private lands to the east; and recognizing that there is a reasonable limit to the mortality monitoring area and the dispersal capability of grizzly bears. For the other ecosystems, the mortality limits in the Recovery Plan apply within a 10-mile buffer around the recovery zone. DMAs have not been identified for other ecosystems. Where the CYE and SE 10-mile buffers overlap, the Service and Idaho Department Fish and Game (IDFG) have an agreement to use U.S. Hwys. 1 and 95 to delineate mortalities for the two ecosystems.

Demographic Connectivity Areas (DCAs) and Zones 1, 2, and 3 for the NCDE

Zone 1 (the portion of the DMA outside the recovery zone) provides a 19,444 km^2 (7,507 mi^2) buffer around the NCDE recovery zone, where the population objective is continuous occupancy by grizzly bears and habitat protections that are compatible with a stable to increasing grizzly bear population (see Figure 19 for zone boundaries). Zone 1 contains two demographic connectivity areas (DCAs), the Ninemile DCA (2,094 km^2 (808 mi^2)) and the Salish DCA (1,902 km^2 (734 mi^2)). Within the DCAs, specific protections were identified to support female occupancy and eventual demographic connectivity (e.g., female dispersal) to the CYE and to serve as a source population for the BE. A recently released connectivity model by Sells *et al.* (2023, p. 6) confirms that the DCAs encompass areas with the highest predicted female use between the NCDE and the CYE and BE. The objective of Zone 2, at 18,854 km^2 (7,280 mi^2) is to provide the opportunity for grizzly bears to move between the NCDE and adjacent ecosystems (e.g., the GYE). Connectivity pathways predicted by Sells *et al.* (2023, pp. 6–7) also show high predicted use for both females and males in Zone 2. Other areas within the NCDE (eastern Montana) are referred to as Zone 3 (the extent of Zone 3 will be determined in future Service decisions). In contrast to Zones 1 and 2, Zone 3 does not provide habitat for connectivity to other grizzly bear ecosystems. The focus of management in Zone 3 is conflict prevention and a quick response to human-grizzly bear conflicts.

Bear Management Units (BMUs)

Bear management units (BMUs) and subunits are analysis areas used to track habitat security and distribution criteria for females within recovery zones (Christensen and Madel 1982, p. 6; USDA FS 1997, entire; Service 2007c, pp. 20, 41, 44–46; USDA FS 2011a, pp. 4–5, 66; NCDE Subcommittee 2020, pp. 16, 145–146; Service 2018, p. 9). BMUs approximate the lifetime size of a female's home range and were delineated using topographic and hydrologic features. In some cases, BMUs may not reflect current lifetime female home range estimates within each ecosystem because home range sizes change with population densities and in some cases, more ecosystem specific data is available now than at the time they were established. BMUs vary in size from approximately 250 km^2 (96 mi^2) to 1,380 km^2 (532 mi^2). Subunits are analysis areas that approximate the annual home range size of adult females. Where identified, subunits provide the optimal scale for evaluation of seasonal feeding opportunities and landscape patterns of food availability for grizzly bears (Weaver *et al.* 1986, p. 236). In the GYE, 18 different BMUs were designated within the recovery zone and each BMU was further subdivided into subunits, resulting in a total of 40 subunits contained within the 18 BMUs (Figure 23, below). In the NCDE, 23 different BMUs were designated within the recovery zone and each BMU was further subdivided into subunits, resulting in a total of 126 subunits contained within the 23 BMUs (Figure 24, below). In the CYE, 22 BMUs were designated within the recovery zone (Figure 25, below); in the SE, 10 BMUs were designated within the U.S. portion of the recovery zone (Figure 25, below); and lastly in the North Cascades, 42 BMUs were designated in the recovery zone (Figure 26, below). Subunits have not been designated in these 3 ecosystems. BMUs have also been identified for two population units in B.C., with six in the South Selkirk population unit (the Canadian portion of the SE recovery zone) and six in the Yahk population unit adjacent to the CYE (MacHutchon and Proctor 2016, p. 61). In the BE, neither BMUs nor subunits have been designated yet.

Bears Outside Recovery Zones (BORZ)

The 1993 Recovery Plan recognized that grizzly bears could occur outside the recovery zone lines and that the mere presence of bears outside of the boundary was not sufficient reason to change the recovery zones (Service 1993, p. 18). While observation data are limited and these habitats have not been evaluated to determine if they are of significant biological value, on-going and future land management activities in these areas could result in adverse effects (e.g., incidental take) on grizzly bears (USDA FS 2011a, entire). These areas were called Bears Outside Recovery Zones (BORZ) for the CYE and SE. The biologists involved in the 2002–2003 BORZ analysis recognized that the mapping may need to be revisited and updated periodically. Consequently, in 2011, an interagency team of biologists revisited the BORZ for the CYE and SE to refine maps of occupied grizzly bear habitat and developed a process to consistently identify these areas based on the number and type of observations and the use of an objective mapping unit boundary to help define these areas (Allen 2011, entire). Delineation was based on three or more credible sightings within the last 16 years in individual 6th order watershed Hydrologic Unit Codes (HUCs). Sixth order HUCs were selected because of their size (typically 40–162 km^2 (15–63 mi^2)) and their common use as cumulative effects boundaries for watershed, fisheries, and wildlife analyses in environmental documents by the USFS. Adjacent HUCs with enough grizzly bear use to be considered recurring were combined to create contiguous areas of recurring use. The methodology allowed for future expansion in the overall size of the BORZ if adjacent 6th order HUCs experienced repeated visitation by bears. The size and juxtaposition of individual BORZ were not developed to imitate BMUs in the recovery zone. Tolerance of grizzly bear presence in areas of human occupation is an important consideration that may limit population expansion in the future (see *Preventative Measures to Address Public Attitudes towards Grizzly Bears and Reduce Mortality*).

Summary of Methods Used to Measure Population Trends and Annual Estimates

Wildlife managers and population ecologists monitor a number of factors to gauge the status of a population and make scientifically informed decisions. These measures include estimates of population size, population trend, density, and current estimated occupied range. While population size is a well-known and easily understood metric, it only provides information about a population at a single point in time. Wildlife managers often want to know how a population is changing over time and why. For grizzly bears in the lower-48 States, the methods used to estimate population trends and numbers vary by ecosystem due to differing level of available resources, the history of monitoring efforts and types of data collected, and the size of each ecosystem (see *Appendix D* for further details). Current estimated occupied range does not include low-density peripheral locations and represents a minimum known area of occupancy, not an extent of occurrence. As managers and technical experts review new techniques or approaches for potential adoption, they should consider the technique's cost, field sampling logistics, utility to managers, and the ability to investigate trends over time.

In the GYE, the IGBST uses an integrated population model (IPM) to estimate population abundance, trend, and other demographic parameters based on consistent, annual data collections obtained since 1983 (Gould *et al.* 2024a, entire).

In the NCDE, the population trend is estimated using two methods: (1) deterministic projections from vital rates; and (2) individual-based, stochastic population modeling (Costello *et al.* 2016b, p. 69). The population estimate is based on a genetic capture/recapture study conducted in 2004 (Kendall *et al.* 2009, entire) and subsequent estimates of population trend (Costello *et al.* 2016b, p. 16).

In the CYE and SE, population growth rates are estimated using a population projection of bootstrapped vital rates using program Booter 1.0 (Hovey and McLellan 1996, pp. 1411–1412; Mace and Waller 1998, p. 1008; Kasworm *et al.* 2024a, pp. 10–12; Kasworm *et al*. 2024b, pp. 8–9). Minimum population sizes are estimated using two methods: (1) DNA analysis of hair from captured bears, hair corrals, and rub sites, and opportunistic efforts; and (2) calculations based on observed females with cubs as set forth in the 1993 Recovery Plan (Service 1993, pp. 83–84, 101–102; Kasworm *et al.* 2024a, pp. 17–18, 32, 42; Kasworm *et al*. 2024b, pp. 13–14, 20–21).

There are currently no known populations within the North Cascades or BE, so population monitoring is not being conducted at this time. However, we document all verified sightings within or near these ecosystems. Previously, we developed a definition of a "population" for use in determining the feasibility of experimental population status for the Bitterroot Ecosystem (Service 2000, pp. 3-14–3-15). We solicited input from 54 scientists familiar with bear populations. Thirty-seven scientists responded and as a result of this Delphi analysis, the Service adopted a definition. Here, we adopt a similar definition for use in defining a minimal grizzly bear population wherever these conditions are met. "A grizzly bear population is defined by verified evidence (Kasworm *et al.* 2001, p. 8) within the previous six years of at least two different female grizzly bears with young or one female seen with different litters in two different years in an area geographically distinct from other grizzly bear populations."

Current Range, Distribution, and Trends

Outside the lower-48 States, approximately 55,000 grizzly bears currently exist in the largely unsettled areas of Alaska and western Canada (Figure 13) (Alaska Department of Fish and Game 2020, entire; COSEWIC 2012, p. vi); however, populations within the lower-48 States are much more fragmented (McLellan *et al*. 2016, pp. 2–5). While the range of bears in some ecosystems has significantly expanded since 1975, the overall range and distribution of bears in the lower-48 States remain below historical levels at approximately 6 percent of historical range (Haroldson *et al*. 2021a, p. 164).

Within the lower-48 States, grizzly bear populations currently exist primarily within and around four ecosystems (CYE, GYE, NCDE, and SE) that include portions of four States (Idaho, Montana, Washington, and Wyoming). Grizzly bear range has been expanding in these areas, and multiple grizzly bear sightings have been confirmed in potential connectivity areas (Figure 15) (Sells *et al.* 2023, pp. 6–7) between the existing ecosystems and also within the BE; however, there is no known population in the BE or between ecosystems. There is also no known population in the North Cascades.

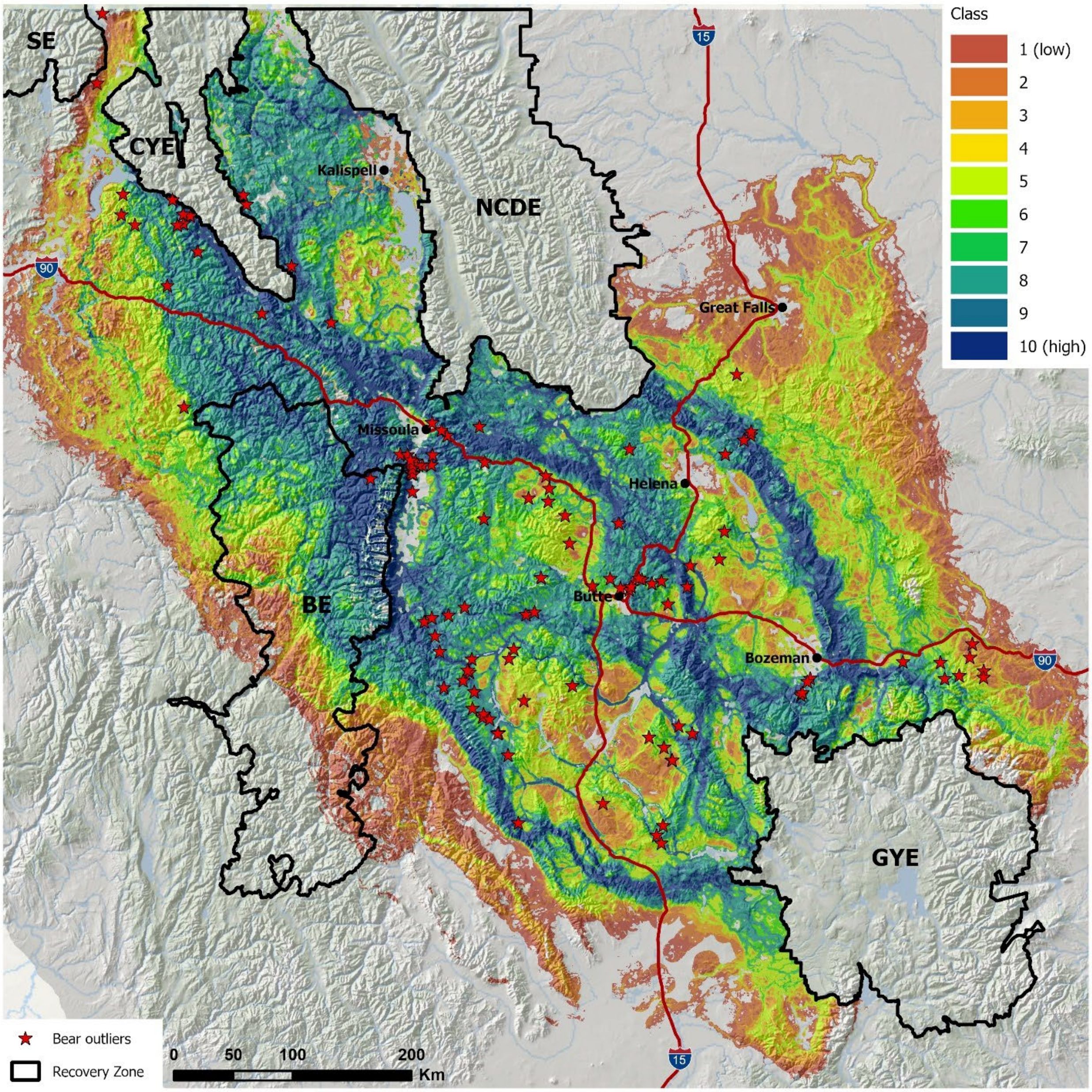

Figure 15. Prediction of female grizzly bear connectivity pathways in western Montana with independent grizzly bear outlier observations from Sells et al. 2023 (p. 6).

Although the focus of this SSA is the listed entity in the lower-48 States, Canadian grizzly bear populations and habitat are contiguous with the four ecosystems along the international border (NCDE, CYE, SE, and North Cascades; Figure 16). Radio-collared individuals have demonstrated the permeability of the international border in three (NCDE, CYE, and SE) of the four ecosystems (Mace and Roberts 2011 p. 31; Kasworm *et al.* 2024a, pp. 81–112; Kasworm *et al.* 2024b, pp. 61–79). Although there is currently no known population in the North Cascades, it constitutes a large block of contiguous habitat that spans the international border. Canadian bear populations are critical to future management of these transboundary populations and can provide genetic and demographic connectivity (Proctor *et al*. 2012, pp. 31–34). However, Proctor *et al.* 2012 (pp. 20–23) detected multiple fracture zones between Canadian populations

(Figure 16), representing areas with little to no migrants across those fractures. Canadian population and management information is provided in *Appendix E*.

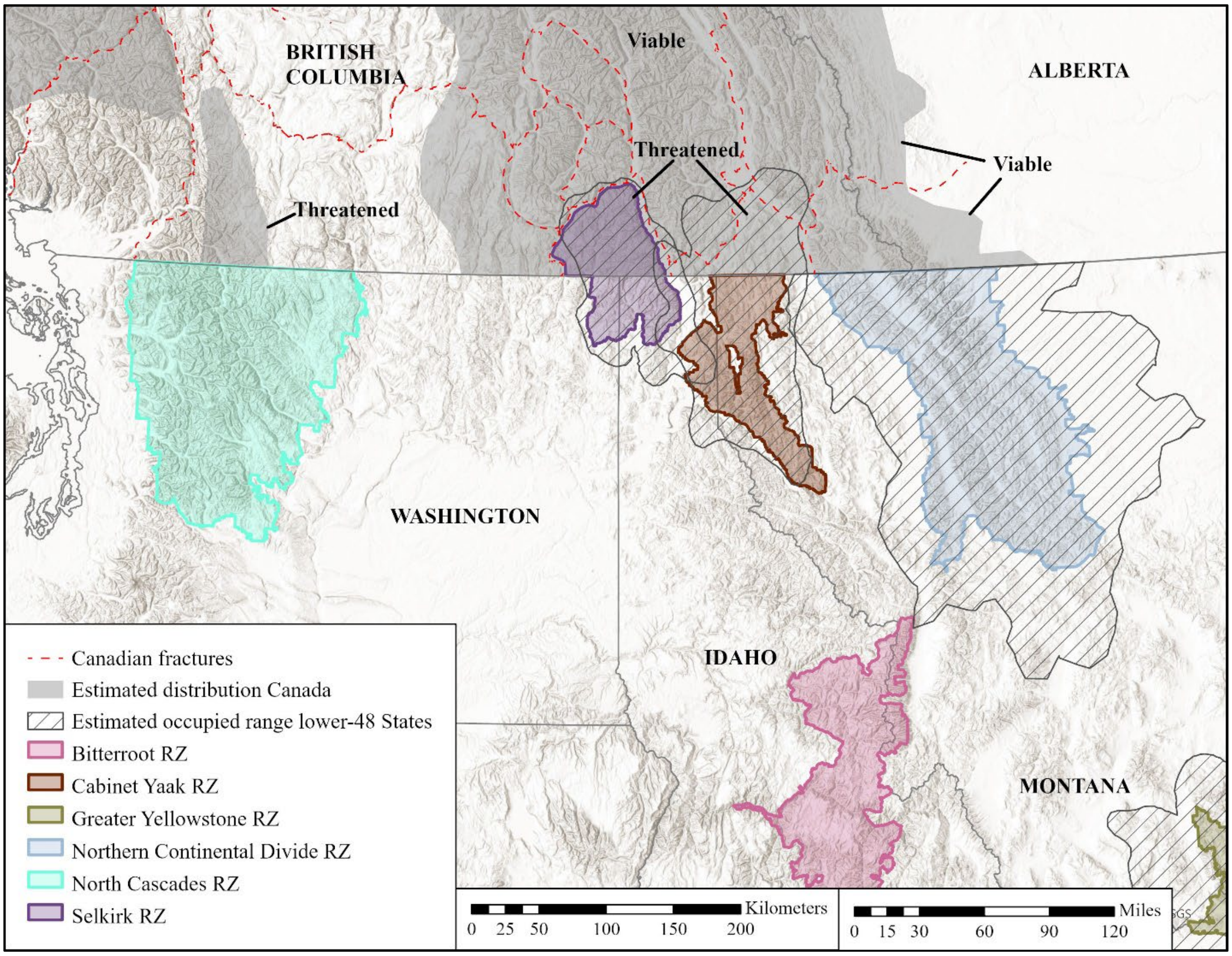

Figure 16. Map of estimated occupied range in trans-boundary populations and potential fracture zones in Canada (Proctor et al. 2012, p. 14; Proctor et al. 2015, p. 2; Costello et al. 2023, p. 14; Dellinger et al. 2023, p. 23; Kasworm et al. 2024a, p. 74).

As of 2023, it is estimated that there are at least 2,314 individuals in the lower-48 States (1,030 in the GYE DMA, 1,163 in the NCDE, about 70 in the CYE, and a minimum of 51 in the U.S. portion of the SE, although some bears have home ranges that crossed the international border) (Figure 17; Table 7) (Costello *et al.* 2024, *in prep.*; Gould *et al.* 2024c, *in prep.*; Kasworm *et al.* 2024a, p. 43; Kasworm *et al*. 2024b, p. 21). In the GYE, this estimate does not capture the entire distribution of grizzly bears. As mentioned above, grizzly bears have been verified in potential connectivity areas (Figure 15) (Sells *et al.* 2023, pp. 6–7) between ecosystems, however, we have limited data to indicate the presence of resident grizzly bears (e.g., established home range) in the lower-48 States outside estimated occupied ranges.

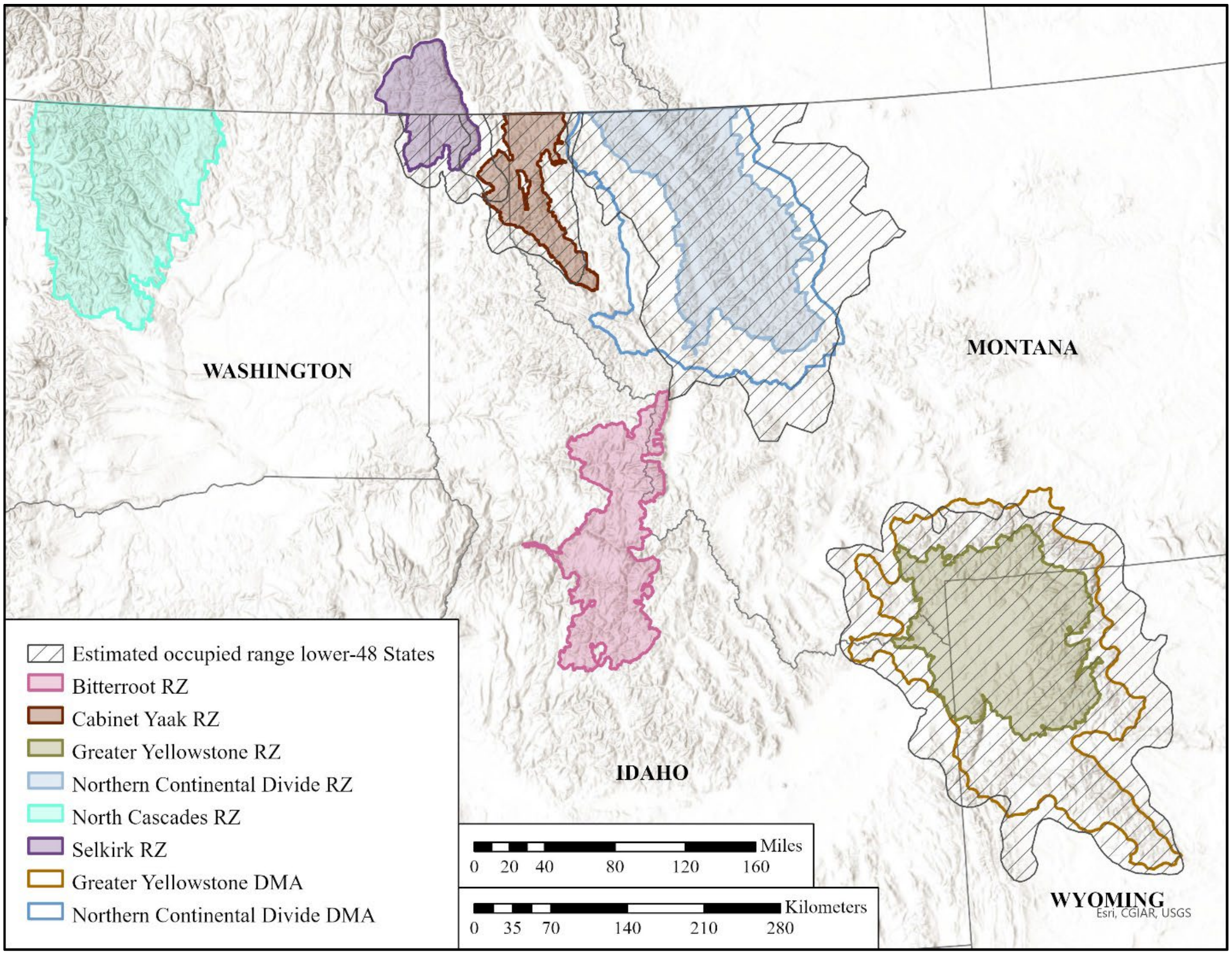

Figure 17. Recovery zones (RZ), demographic monitoring areas (DMA), where applicable, and current estimated occupied range for the six ecosystems identified in the Recovery Plan: the Northern Continental Divide (NCDE), Greater Yellowstone (GYE), Cabinet-Yaak (CYE), Selkirk (SE), Bitterroot (BE) and North Cascades. DMAs surround and include the recovery zones in the GYE and NCDE. Current estimated occupied range does not include low-density peripheral locations and represent a minimum known area of occupancy, not an extent of occurrence. Estimated occupied ranges are current as of 2022 within the lower-48 States (Costello et al. 2023, p. 14; Dellinger et al. 2023, p. 23; Kasworm et al. 2024a, p. 74).

Table 7. Current population estimates, as of 2023, of grizzly bears in the six ecosystems in the lower-48 States (NCDE = Northern Continental Divide Ecosystem, GYE = Greater Yellowstone Ecosystem, CYE = Cabinet-Yaak Ecosystem, SE = Selkirk Ecosystem, and BE = Bitterroot Ecosystem).

Ecosystem	Estimated Number of Bears	Citation
GYE (as measured in the DMA)	1,030	Gould *et al.* 2024c, *in prep.*
NCDE	1,163	Costello *et al.* 2024, *in prep.*
CYE	70	Kasworm *et al.* 2024a, p. 43
SE	Minimum of 51 in U.S. portion, B.C. estimate of 69	Kasworm *et al.* 2024b, p. 21, Proctor *et al.* 2022, p. 2
BE	No known population	
North Cascades	No known population	

Below, we summarize the current distribution and trends for each ecosystem. In Chapter 3, we summarize recovery planning efforts and progress toward recovery goals for each ecosystem. In addition to the six ecosystems identified in the Recovery Plan, linkage zones "between currently separated populations that provide adequate habitat for low densities of individuals to exist and move between two or more larger areas of suitable habitat" were identified as desirable (Service 1993, pp. 24–25).

The Greater Yellowstone Ecosystem (GYE)

The Greater Yellowstone Ecosystem (GYE) is located in northwest Wyoming, eastern Idaho, and southwestern Montana and refers to the larger ecological system containing and surrounding YNP (Figure 18). As of 2023, the GYE grizzly bear population was estimated to be 1,030 individuals inside the DMA (Gould *et al.* 2024c, *in prep.*), more than triple the estimated population size of 136 to 300 at the time of listing in 1975 (Cowan *et al*. 1974, pp. 32, 36; Craighead *et al*. 1974, p. 16; McCullough 1981, p. 175). This estimate does not capture the entire distribution of bears in the GYE. As predicted by Pyare *et al*. (2004, pp. 5–6), grizzly bears have naturally recolonized many areas. Grizzly bears have tripled the extent of their occupied range in the GYE since the early 1980s (Service 1982, p. 11; Dellinger *et al.* 2023, p. 23). Estimated occupied range in the GYE in 2022 was 70,101 km^2 (27,066 mi^2) (Dellinger *et al*. 2023, p. 23). Grizzly bears in the GYE currently occupy about 97 percent of suitable habitat (45,572 km^2 (17,959 mi^2)) and 97 percent of the DMA (48,431 km^2 (18,699 mi^2)) and are expanding beyond the DMA. Thirty percent of the current estimated occupied range occurs beyond the DMA (21,670 km^2 (8,367 mi^2)) (Dellinger *et al*. 2023, p. 23). We do not have an estimate for the number of grizzly bears ecosystem-wide, however bears permanently reside in areas beyond the DMA.

The population trajectory based on IPM estimates for the period 1983 to 2023 indicates robust population growth in the DMA starting in the late 1980s and throughout the 1990s, with growth slowing, but remaining positive, during the 2000s and 2010s (Gould *et al*. 2024a, p. 13). Previous research indicates the slowing of population growth that started in the early 2000s was a function of lower cub and yearling survival and a reduced probability of female bears transitioning to cub production, factors that were associated with higher grizzly bear densities and indicative of a population exhibiting density-dependent effects in the core of its range (van Manen *et al*. 2016, pp. 308–310). As the grizzly bear population in the GYE has increased in numbers they have also expanded their range beyond the recovery zone, into other suitable habitat in the DMA and also outside the DMA.

No population can grow forever because required resources, such as food, are finite. Carrying capacity is the maximum number of individuals a particular environment can support over the long-term without resulting in population declines caused by resource depletion (Vandermeer and Goldberg 2003, p. 261; Krebs 2009, p. 148). Grizzly bear populations naturally maintain themselves around carrying capacity in relatively unexploited populations (Miller *et al*. 2003, p. 148). Many factors affect carrying capacity of animal populations in the wild and carrying capacity itself typically varies over time. Populations usually fluctuate above and below carrying capacity, resulting in relative population stability over time (i.e., lambda value of approximately 1.0 over the long-term) (Colinvaux 1986, pp. 138–139, 142; Krebs 2009, p. 148). For populations at or near carrying capacity, population size may fluctuate just above and below carrying capacity around a long-term mean, sometimes resulting in annual estimates of growth rate (lambda) showing a declining population. However, to obtain a biologically meaningful estimate of average annual population growth rate for a long-lived species like the grizzly bear that reproduces only once every 3 years and typically does not start reproducing until at least 4 years old, we must examine lambda over a longer period of time to see what the average trend is over that specified time. This is not an easy task. For grizzly bears, it takes at least 6 years of monitoring of at least 30 females with radio collars to accurately estimate average annual population growth (Harris *et al.* 2011, p. 29).

Mechanisms that regulate or control population size fall into two broad categories: density-dependent effects and density-independent effects. Generally, factors that limit population growth more strongly as population size increases are density-dependent effects, or intrinsic factors, usually expressed through individual behaviors, physiology, or genetic potential (McLellan 1994, p. 15). Extrinsic factors, such as drought or fire that kill individuals regardless of how many individuals are in a population, are considered density-independent effects (Colinvaux 1986, p. 172). These extrinsic factors may include changes in resources, predators, or human impacts and may cause carrying capacity to vary over time. Population stability (i.e., fluctuation around carrying capacity or a long-term equilibrium) is often influenced by a combination of density-dependent and density-independent effects. Among grizzly bears, manifestations of density-dependent population regulation can include: (1) decreased yearling and cub survival due to increases in intraspecific killing (i.e., bears killing other bears), (2) decreases in home range size, (3) increases in generation time, (4) increases in age of first reproduction, and (5) decreased reproduction (McLellan 1994, entire; Eberhardt 2002, pp. 2851–2852; Kamath *et al.* 2015, p. 5516; McLellan 2015, pp. 13–14; van Manen *et al*. 2016, pp. 307–308). Indicators that density-independent effects are influencing population growth can include:

(1) larger home range sizes (because bears are roaming more widely in search of foods) (McLoughlin *et al.* 2000, pp. 49–51), (2) decreased cub and yearling survival due to starvation, (3) increased age of first reproduction due to limited food resources, and (4) decreased reproduction due to limited food resources.

Despite the challenges involved in determining whether a population is affected more strongly by density-dependent or density-independent effects, the IGBST provided evidence based on several decades of data that supports density-dependent effects were likely a factor in the recent slowing in population growth in the GYE; these findings are consistent with other research suggesting that the GYE grizzly bear population in the core area of its range is exhibiting density-dependent effects (van Manen *et al.* 2016, entire). Schwartz *et al.* (2006c, entire) estimated survivorship of cubs-of-the-year, yearlings, and independent (2 years old or older) bears as well as reproductive performance to estimate population growth. They examined geographic patterns of population growth based on whether bears lived inside YNP, outside the park but inside the recovery zone, or outside the recovery zone entirely. Based on decreased cub and yearling survival inside YNP compared to outside YNP, Schwartz *et al.* (2006c, p. 29) concluded that grizzly bears were approaching carrying capacity inside YNP. Consistent with findings by Schwartz *et al.* (2006c, p. 29), the IGBST (2012, p. 33) documented lower cub and yearling survival than in the previous time period. The slowing of population growth since the early 2000s was primarily a function of this lower survival of dependent young (i.e., cubs and yearlings) and moderate reproductive suppression (IGBST 2012, p. 8). Additionally, survival of cubs-of-the-year and reproduction were lower in areas with higher grizzly bear densities but showed no association with estimates of decline in whitebark pine tree cover, suggesting that density-dependent factors contributed to the change in population growth (van Manen *et al*. 2016, entire). Importantly, annual survival of independent females (the most influential age-sex cohort on population trend) remained the same while independent male survival increased (IGBST 2012, p. 33). In addition, female home range sizes have decreased in areas of greater bear densities, as would be expected if density-dependent regulation is occurring (Bjornlie *et al.* 2014b, p. 4) (see *Food Resources in the GYE*, below, for more detailed information). Collectively, these studies indicate that the growth rate of the GYE grizzly bear DMA population has slowed as bear densities have exhibited density-dependent effects, particularly in the core area of their current range.

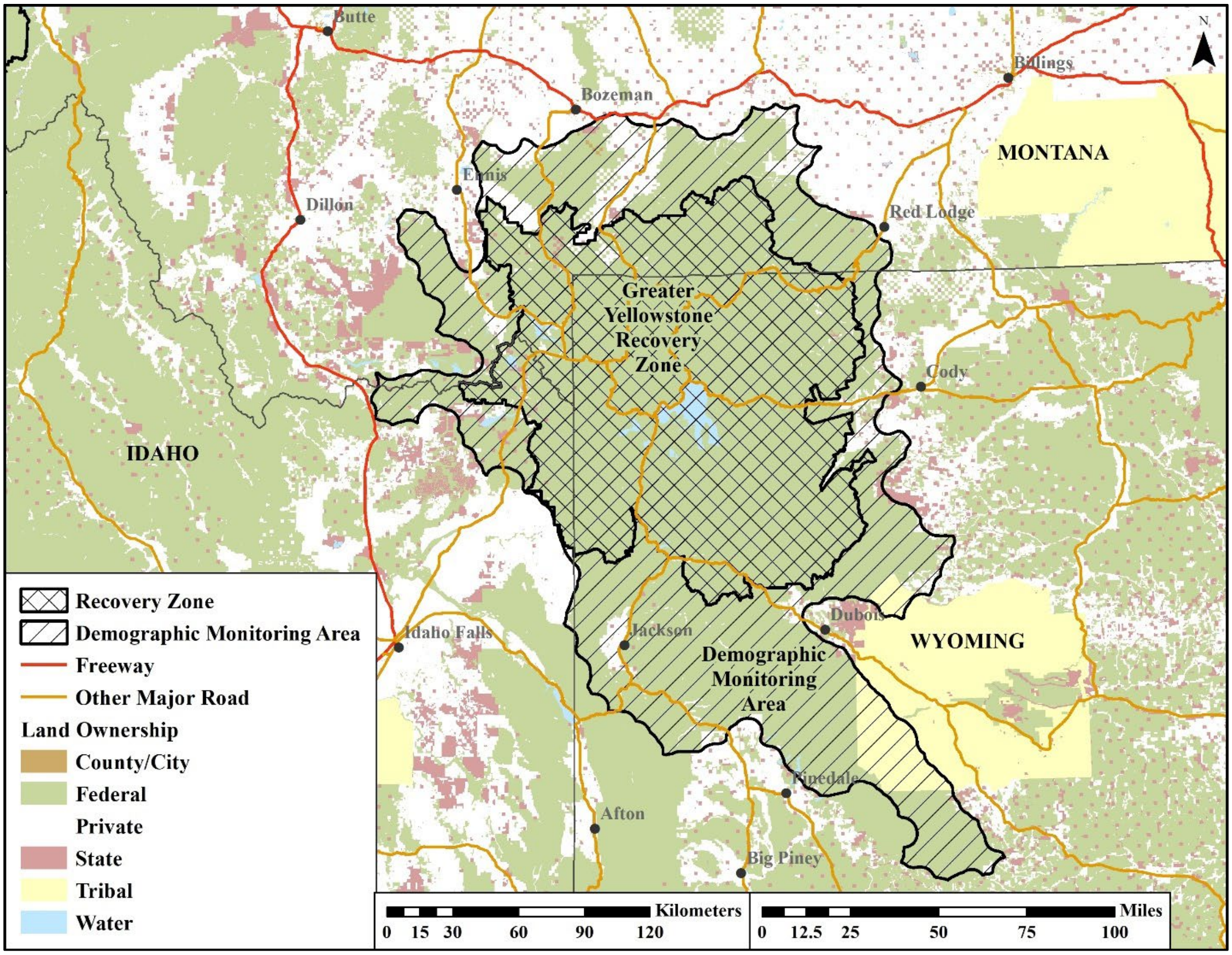

Figure 18. Map of the Greater Yellowstone Ecosystem (GYE). Land ownership and boundaries are shown for the recovery zone and the Demographic Monitoring Area (DMA). The DMA surrounds and includes the recovery zone.

Northern Continental Divide Ecosystem (NCDE)

The Northern Continental Divide Ecosystem (NCDE) is located in northwest Montana and refers to the large ecological system containing and surrounding GNP (Figure 19). Grizzly bears historically occurred throughout the area of the NCDE (Stebler 1972, pp. 297–298), but they were less common in prairie habitats (Rollins 1935, p. 191; Wade 1947, p. 444). Historical grizzly bear presence in these drier, grassland habitats was associated with rivers and streams where grizzly bears used bison carcasses as a major food source (Burroughs 1961, pp. 57–60; Herrero 1972, pp. 224–227; Stebler 1972, pp. 297–298; Mattson and Merrill 2002, pp. 1128–1129).

Since the 1975 listing of grizzly bears as threatened under the Act, the NCDE grizzly bear population has more than tripled in size and range (from 24,800 km^2 (9,600 mi^2) to 55,652 km^2 (21,487 mi^2)) (Dood *et al.* 1986, p. 166; Service 1993, pp. 11–12; Kendall *et al.* 2009, p. 3; Mace *et al.* 2012, p. 124; Costello *et al.* 2016b, p. 2; Costello *et al.* 2023, p. 14; Costello *et al.* 2024, *in prep.*). The NCDE population increased from as few as 300 bears in 1986 to an estimated 765 bears in 2004, based on a genetic capture/recapture population estimate (Dood 1986, p. 166;

Kendall *et al.* 2009, p. 9). The population is contiguous with grizzly bears in Canada (Figure 16). Applying a calculated population growth of 2.3 percent annually since 2004, the 2023 population estimate was estimated at 1,163 individuals throughout the NCDE (Costello *et al.* 2016b, p. 2; Costello *et al.* 2024, *in prep.*). We do not have any data in the NCDE to indicate that the NCDE is exhibiting density-dependent effects in this ecosystem. The expansion and dispersal of grizzly bears outside of the NCDE will likely benefit other ecosystems in the future through natural connectivity (GYE and CYE) and recolonization (BE) (see *Connectivity and Genetic Health* below for further information).

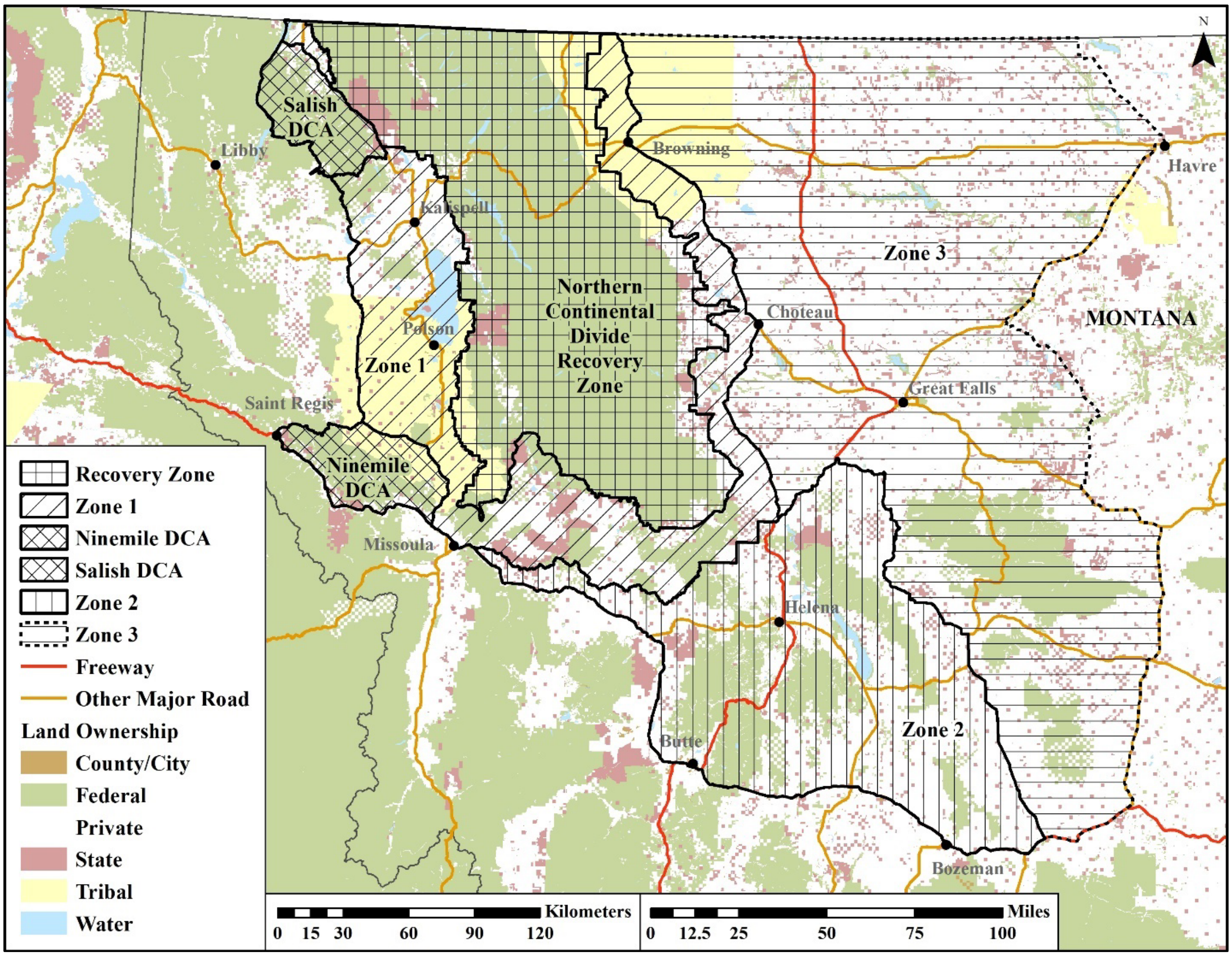

Figure 19. Map of the Northern Continental Divide Ecosystem (NCDE). Land ownership and boundaries are shown for the recovery zone, management Zones 1, 2, and 3, and demographic connectivity areas (DCAs). The demographic monitoring area (DMA) is comprised of the recovery zone and Zone 1. The eastern and southern extent of Zone 3 will be determined in future Service decisions.

Cabinet-Yaak Ecosystem (CYE)

The Cabinet-Yaak Ecosystem (CYE) refers to the larger ecosystem surrounding the recovery zone in northwest Montana and northeast Idaho (Figure 20). Based on known fates of radio-collared individuals and reproductive outputs, it is estimated that the population of grizzly bears in the CYE is currently increasing, with an annual growth rate of 2.7 percent between 1983 and 2023 (Kasworm *et al.* 2024a, p. 41). This is a significant improvement from earlier trend calculations that indicated the population was declining, and now represents 16 years of an improving trend since 2006 (Kasworm *et al.* 2024a, p. 42). The trend calculation utilizes all native (non-augmentation) collared bears from the U.S. and the Yahk population unit in B.C. (Kasworm *et al*. 2024a, p. 41). Additional information on populations and management in B.C. is provided in *Appendix E*. A population estimate derived from mark and recapture efforts estimated the U.S. population in 2012 at 48–50 individuals (Kendall *et al*. 2016, p. 80). Applying the calculated rate of increase (2.7 percent) to the midpoint of this estimate (49) results in a gain of 18 bears from 2012 through 2023, resulting in 67 bears. The augmentation program added an additional eight bears since 2012 but four of those have either left the target area or are known dead. Based on this information, a population estimate of about 70 bears would seem reasonable (Kasworm *et al.* 2024a, p. 43). The Kootenai River bisects the CYE approximately in half, with the Cabinet Mountains to the south and the Yaak River drainage to the north and may have limited movement between the two (Kasworm *et al.* 2024a, pp. 76–80). While no movement was detected prior to 2010, three males have been detected on both sides of the Kootenai River in the last decade (Kasworm *et al.* 2024a, pp.76–80). No gene flow associated with reproduction by these males has yet to be detected in the Cabinet Mountains. Due to the short distance between these two populations, full connectivity remains a management goal and evidence to date suggests progress towards that goal.

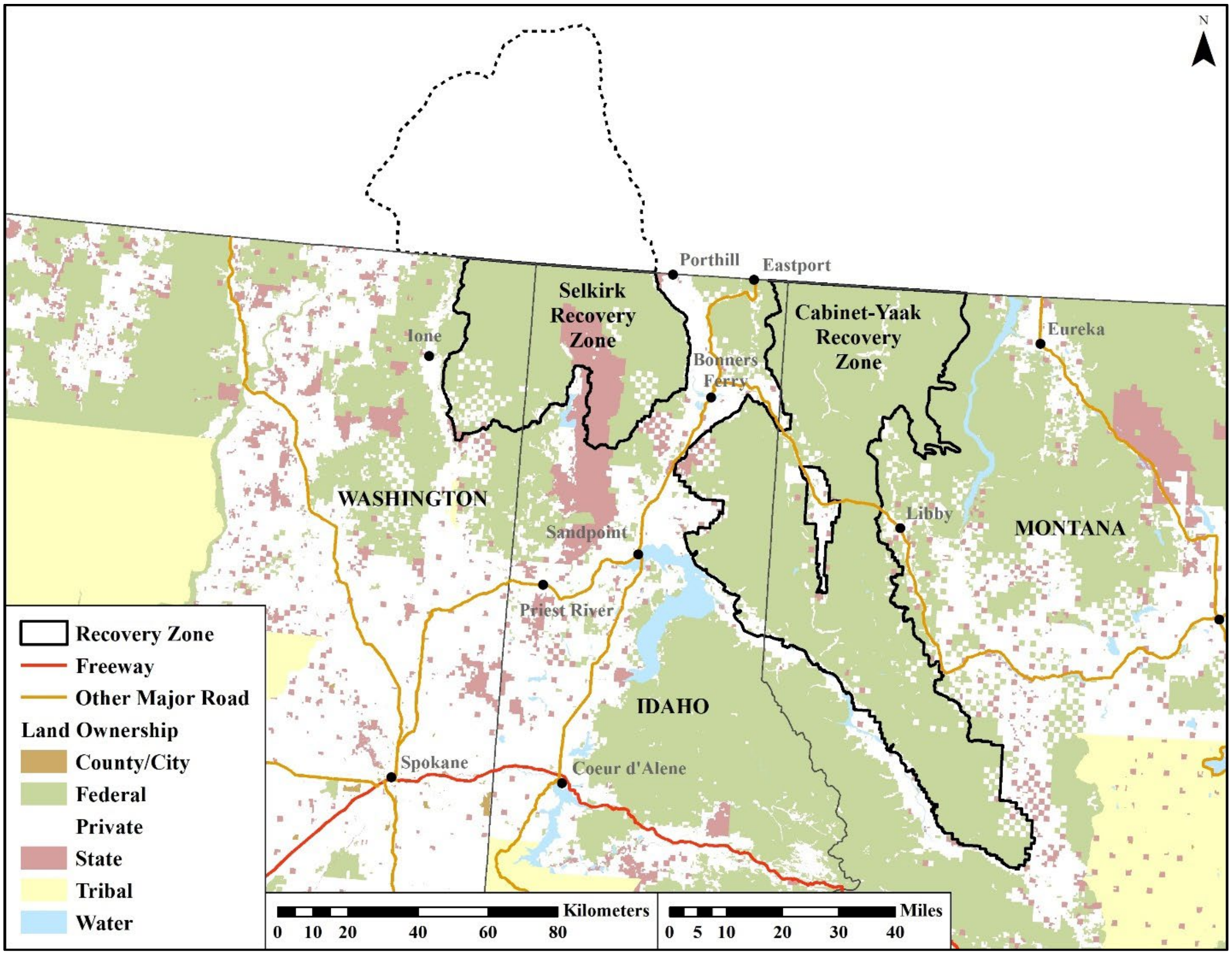

Figure 20. Map of the Cabinet-Yaak (CYE) and Selkirk (SE) Ecosystems. Land ownership and recovery zone boundaries are shown for the CYE and SE. Based on the 1993 Recovery Plan, the SE recovery zone extends into Canada, therefore, some of the demographic information (i.e., female survival and population trend) we have is based on the entire recovery zone (so includes bears in Canada).

Selkirk Ecosystem (SE)

The Selkirk Ecosystem (SE**)** refers to the larger ecological system surrounding the recovery zone in northwest Idaho, northeast Washington, and southeast B.C. (Figure 20, above). DNA analysis of hair from captured bears, corrals, rub sites, opportunistic collection efforts, and collared bears identified a minimum of 51 grizzly bears (24 males, 17 females, 10 unknown) within the U.S. portion of the SE in 2022 (Kasworm *et al*. 2024b, p. 21). Some of these individuals likely have home ranges that overlap with Canada. There were an estimated 69 bears in the Canadian portion of the population as of 2021 (Proctor *et al.* 2022, p. 2). The U.S. and B.C. population estimates for the SE are not completely exclusive because numerous bears overlap in their home ranges, therefore adding estimates together would cause some double counting. An estimate of 83 bears for the international population was made in 2010 (Proctor *et al.* 2012, p. 31). A new effort to estimate the population is ongoing on the B.C. side of the SE and should be integrated with U.S. data and complete in 2025. Based on known fates of radio-collared individuals and reproductive outputs, it is estimated that the population of grizzly bears in the SE, including Canada, is currently increasing, with an annual growth rate of 2.5 percent between 1983 and

2023 (Kasworm *et al*. 2024b, p. 28). The trend calculation utilizes all collared bears in the U.S. and B.C. Additional information on populations and management in B.C. is provided in *Appendix E*.

Bitterroot Ecosystem (BE)

The Bitterroot Ecosystem (BE) refers to the larger ecological system surrounding the recovery zone in central Idaho and western Montana (Figure 21). At the time of listing, there were no known grizzly bears in the BE. It was believed that no grizzly bears occurred in the BE until a young male grizzly bear was killed just to the north of the BE recovery zone in 2007. To assess the presence of grizzly bears in the northern Bitterroot Mountains portion of the BE in the area in which the grizzly bear was killed in 2007, a systematic survey for grizzly bears was conducted between Hwy. 12 and I-90 during 2008 and 2009 using DNA hair corrals and cameras (Servheen and Shoemaker 2010, entire). No photos of or hair samples from grizzly bears were obtained during this study. While we did not document any grizzly bears in the study area, because the survey covered a limited area, we could not conclude they were absent from the area at that time. In 2019, a collared male grizzly bear that dispersed from the CYE in 2019, spent several weeks within and immediately to the north of the recovery zone, and subsequently returned to the CYE to den. There have been multiple confirmed individuals in the area immediately surrounding the BE recovery zone since 2007, including a male grizzly bear that dispersed from the SE documented in 2019, a male grizzly bear that dispersed from the NCDE in 2018 that was subsequently trapped and returned to the NCDE, two subadult grizzly bears (one male and one female) that dispersed from the NCDE documented in 2022 and returned to the NCDE after they were preemptively trapped and moved to avoid conflict, a subadult male grizzly bear that dispersed from the NCDE that was trapped in 2023, and multiple verified sightings of unknown sex from 2017 to 2023 (MFWP, unpublished data; Service, unpublished data). However, because we have not documented a population or any female bears in the BE, we view the BE as currently unoccupied, as per the definition of a population adopted in this document (see *Summary of Methods Used to Measure Population Trends and Annual Estimates*).

Both male and female immigration into the BE is needed to establish a population. In grizzly bears, dispersal is characterized as male-biased; males most often disperse longer distances to avoid inbreeding, while females typically remain close to their maternal home range (McLellan and Hovey 2001, pp. 839, 843). Female dispersal distances average 9.8 to 14.3 km (6.1 to 8.9 mi) away from the center of their mother's home range (McLellan and Hovey 2001, p. 842; Proctor *et al.* 2004, p. 1108), and there is approximately 9.2 km (5.7 mi) between the current distribution of females in the NCDE and the BE recovery zone (Costello *et al.* 2023, p. 14). While females occasionally disperse long distances (up to 80–90 km (50–56 mi)), female dispersal is typically a slow, gradual process and colonization of new areas can take quite some time (Swenson *et al*. 1998, pp. 822–824; Jerina and Adamič 2008, pp. 1495–1497; Proctor *et al.* 2012, p. 35). This slow process can also result in prolonged exposure to fragmentation and human-caused mortality (Proctor *et al*. 2015, p. 2).

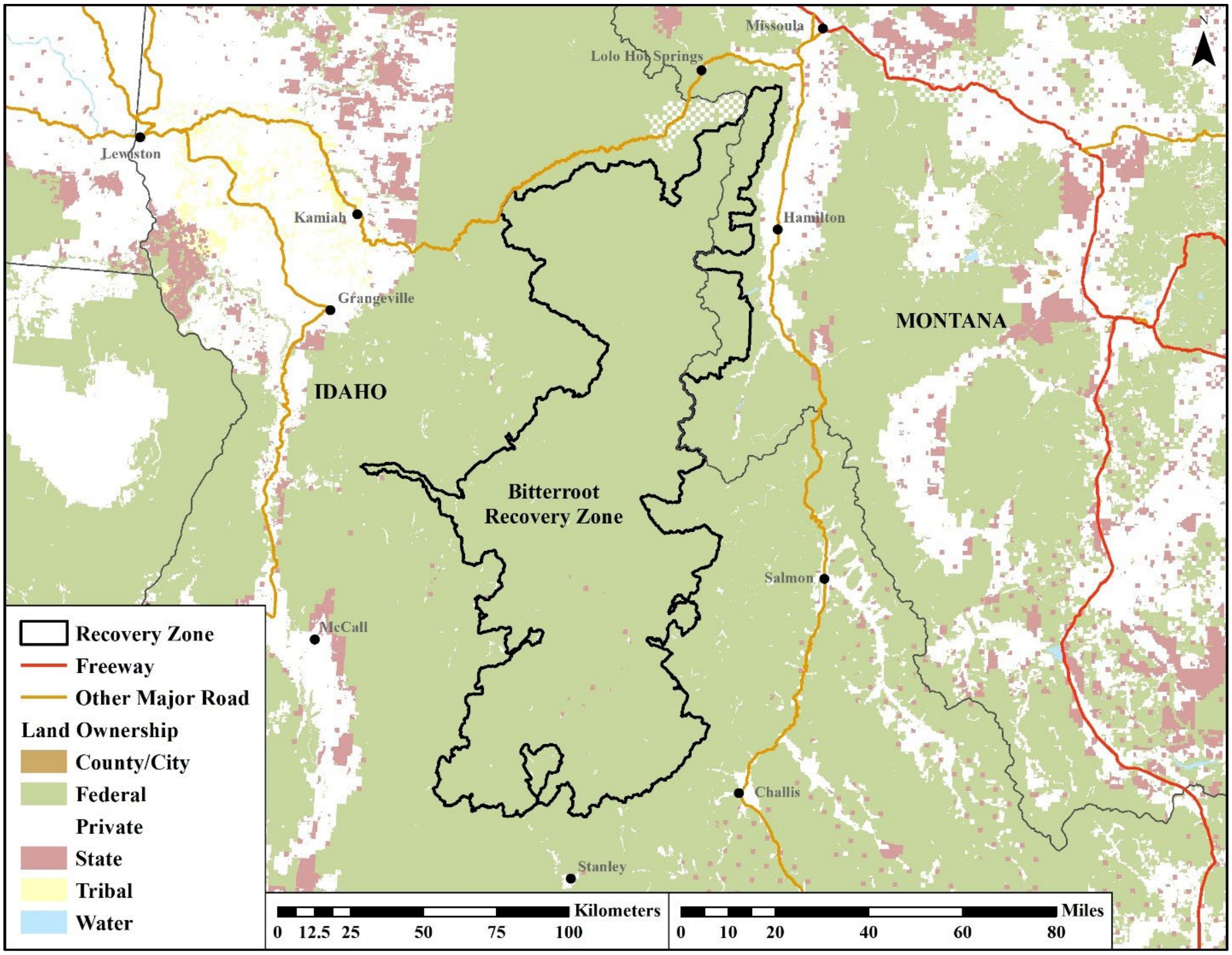

Figure 21. Map of the Bitterroot Ecosystem (BE). Land ownership and the recovery zone boundary, as identified in the 2000 Final EIS under the preferred alternative, reintroduction, is shown for the BE.

North Cascades Ecosystem

The North Cascades Ecosystem (North Cascades) is the larger ecological system surrounding the recovery zone in Washington, which contains the NCNP Complex (Figure 22). There is no confirmed evidence of a grizzly bear population within the North Cascades recovery zone for at least 30 years (Rine *et al*. 2020, entire). The Ministry of Forest, Lands and Natural Resource Operations (MFLNRO) estimated the population in the adjacent B.C. portion of the North Cascades to be about six grizzly bears in 2018 (MFLNRO 2020, p. 6). Only one confirmed grizzly bear sighting has been documented within the greater North Cascades during the past decade, which occurred in B.C. (Rine *et al*. 2020, p. 1). While the listed entity includes only the U.S. portion of this contiguous grizzly bear habitat, information from B.C. grizzly bears detected immediately north of the border are included as they may occasionally move into the U.S. The most recent confirmed observation within the U.S. portion of the North Cascades was in 1996, south of Glacier Peak (Rine *et al*. 2018, p. 18). The most recent direct evidence of reproduction was a confirmed observation of a female and cub on upper Lake Chelan in 1991 (Almack *et al.* 1993, p. 34). The lack of recent evidence of reproduction indicates that a grizzly bear population, as per the definition adopted in this document (see *Summary of Methods Used to*

Measure Population Trends and Annual Estimates), no longer exists within the North Cascades (NPS and Service 2024a, p. 52). Lyons *et al*. (2018, p. 29) estimated the carrying capacity of the North Cascades at approximately 278 bears (or 139 females). Ransom *et al.* (2023, p. 6) estimate that carrying capacity will increase from 139 female bears to 241–289 female bears in the North Cascades due to changes in habitat resulting from climate change.

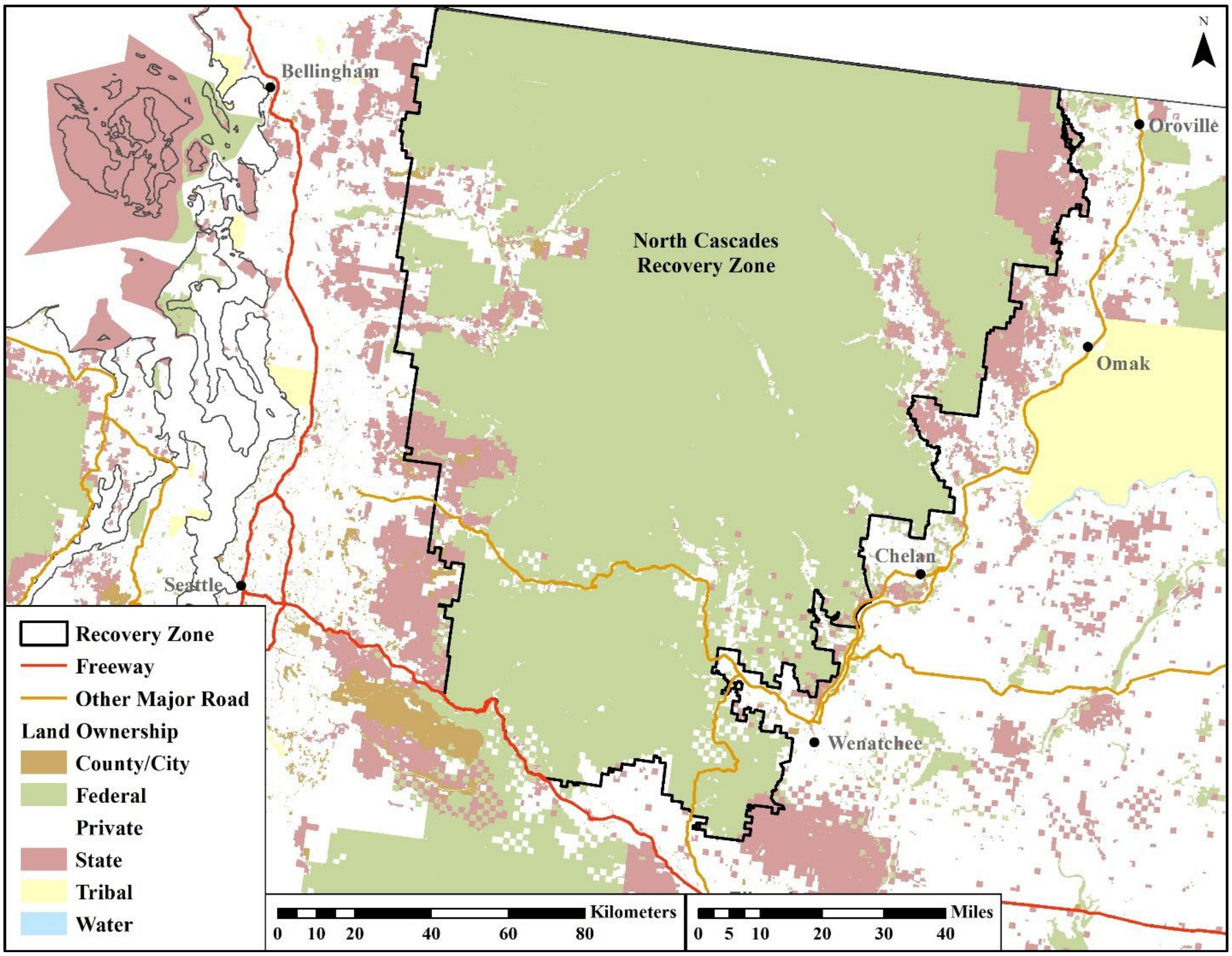

Figure 22. Map of the North Cascades Ecosystem. Land ownership and the recovery zone boundary is shown for the North Cascades.

Summary of Current Range, Distribution, and Trends

Estimated population size and distribution in both the GYE and NCDE have more than tripled since listing (Cowan *et al.* 1974, pp. 32, 36; Craighead *et al.* 1974, p. 16; McCullough 1981, p. 175; Dood *et al.* 1986, p. 166; Service 1993, pp. 11–12; Costello *et al.* 2016b, p. 2; Costello *et al.* 2023, p. 10; Dellinger *et al.* 2023, p. 23; Costello *et al.* 2024, *in prep.*; Gould *et al.* 2024c, *in prep.*). The SE and CYE have also experienced positive population growth rates and increases in population sizes (Kasworm *et al.* 2024a, pp. 38–42; Kasworm *et al*. 2024b, pp. 26–29). Although the BE contains no known population, multiple verified sightings have occurred in areas important for connectivity (Figure 15) (Sells *et al.* 2023, p. 6). The BE is 9.2 km (5.7 mi) from the current distribution of females in the NCDE and there is less than 5 km (3 mi) between the current estimated occupied range for the NCDE grizzly bear population and the BE recovery zone boundary (Costello *et al.* 2023, p. 14). The North Cascades is currently unoccupied by a grizzly bear population.

Chapter 3: Regulatory History and Recovery Planning

In this chapter, we summarize our regulatory history for the grizzly bear. We also summarize recovery planning efforts for grizzly bears in the lower-48 States and provide summaries of recovery progress for each ecosystem. We have a 45-year history of working with a number of dedicated partners towards the recovery of grizzly bears in the lower-48 States. These efforts have led to increases in the number of and distribution of bears across Idaho, Montana, Washington, and Wyoming, and unprecedented collaboration in grizzly bear management and conservation.

Regulatory History

On July 28, 1975, we published a rule to designate the grizzly bear as threatened in the conterminous (lower-48) United States (40 FR 31734). When we listed the grizzly bear, we identified the dramatic decreases in historical range and land management practices (e.g., timber harvest and livestock grazing) in formerly secure grizzly bear habitat and excessive human-caused mortalities as the primary stressors (40 FR 31734, July 28, 1975). In the 1990s, the Service received a number of petitions to change the status of grizzly bear populations in the North Cascades, SE, and CYE. We determined that reclassifying grizzly bears in those ecosystems to endangered was warranted but precluded by higher priorities beginning in 1991 for the North Cascades (56 FR 33892, July 24, 1991), 1993 for the CYE (58 FR 8250, February 12, 1993), and 1999 for the SE (64 FR 26725, May 17, 1999). In 2014, the Service determined that the CYE and SE populations had recovered to the point that they were no longer warranted but precluded from uplisting to endangered and should instead remain listed as threatened (79 FR 72487, December 5, 2014). In 2017, in *Alliance for the Wild Rockies* v. *Zinke et al.*, the District Court of Montana remanded the determination that the CYE grizzly bear was not warranted but precluded for endangered status back to the Service for further consideration. In 2022, the Service again determined that the CYE population had recovered to the point that it was no longer warranted but precluded from uplisting to endangered and should remain listed as threatened (87 FR 21653, May 3, 2022). In 2023, the Service determined that the North Cascades population was no longer warranted for uplisting because the population in the U.S. is extirpated (88 FR 41560, June 27, 2023). In accordance with the Act, we developed a Grizzly Bear Recovery Plan (Service 1982, entire) and have revised that plan as necessary (in their entirety: Service 1993, 1996, 1997, 2007a, 2007b, 2017, 2018).

In 2000, the Service designated the BE as a nonessential experimental population with special status under section 10(j) of the Act and published a final EIS and Record of Decision (ROD) to release an experimental population of grizzly bears in that ecosystem (65 FR 69624, November 17, 2000). In 2001, the Service published a proposed rule to remove the 10(j) regulations, but the rule was never finalized. The ROD remains in effect, but it has never been funded for implementation. The current section 10(j) rule for grizzly bears in the Bitterroot Grizzly Bear Experimental Population Area (50 CFR § 17.84(1)) does not apply to grizzly bears that have dispersed into the area on their own. The Service has not released or reintroduced any grizzly bears into the area; therefore, grizzly bears that have dispersed into the area on their own, including all recent verified sightings, are not covered by the 10(j) rule and are protected as threatened under the Act. In November 2021, the Service was challenged in federal district court for alleged unreasonable delay in implementing non-discretionary actions described in the action alternative selected in the Final EIS (*Alliance for the Wild Rockies et al.* v. *Cooley et al.,* 9:21-cv-136-DWM (D. Mont. 2021)). The court remanded this matter to the Service and ordered the Service to propose a timeline and plan for completion of a supplemental EIS and, if warranted, a new ROD and final rule. In April 2023, the court issued an order approving the Service's proposal and timeline to complete this process within 43 months (*Alliance for the Wild Rockies et al.* v. *Cooley et al.,* 9:31-cv-136-DWM (April 26, 2023)). The Service published a notice to initiate the public scoping process, on January 17, 2024.

On November 17, 2005, we proposed to designate the GYE population of grizzly bears as a Distinct Population Segment (DPS) and to remove (delist) this DPS from the Federal List of Endangered and Threatened Wildlife (70 FR 69854). On March 29, 2007, we finalized this proposed action, designating the GYE population as a DPS and removing (delisting) grizzly bears in the GYE from the Federal List of Endangered and Threatened Wildlife (72 FR 14866). This final determination was vacated and remanded by the U.S. District Court for the District of Montana on September 21, 2009, in *Greater Yellowstone Coalition* v. *Servheen, et al.,* 672 F.Supp.2d 1105 (D. Mont. 2009). The District Court ruled against the Service on two of the four points brought against it: that the Service was arbitrary and capricious in its evaluation of whitebark pine and that the identified regulatory mechanisms were inadequate because they were not legally enforceable. In compliance with this order, the GYE grizzly bear population was once again made a threatened population under the Act (16 U.S.C. 1531 *et seq*.) (see 75 FR 14496, March 26, 2010). The Service appealed the District Court decision and on November 15, 2011, the Ninth Circuit Court of Appeals issued an opinion affirming in part and reversing in part the district court's decision vacating and remanding the final rule delisting grizzly bears in the GYE (*Greater Yellowstone Coalition* v. *Servheen, et al.,* 665 F.3d 1015 (9th Cir. 2011)). The Ninth Circuit held that the Service's consideration of regulatory mechanisms was permissible because the elements of the 2007 GYE Conservation Strategy were incorporated into binding regulatory documents, specifically NF Plans and NPS Superintendent's Compendia. However, the Ninth Circuit found that the Service inadequately explained why the loss of whitebark pine was not a threat to the GYE grizzly bear population. In compliance with this order, the GYE population of grizzly bears remained federally listed as "threatened" under the Act, and the IGBST initiated more thorough research into the potential impact of whitebark pine decline on GYE grizzly bears.

On March 11, 2016, we proposed to designate the GYE population of grizzly bears as a DPS and to remove (delist) this DPS from the Federal List of Endangered and Threatened Wildlife (81 FR 13174). On June 30, 2017, we finalized this proposed action, designating the GYE population as a DPS and removing (delisting) grizzly bears in the GYE from the Federal List of Endangered and Threatened Wildlife (82 FR 30502). In this final rule, among the other findings, we responded to the District Court's remand and the Ninth Circuit's determination that the Service failed to support its conclusion that whitebark pine declines did not threaten GYE grizzly bears. This final determination was vacated and remanded by the U.S. District Court for the District of Montana on September 24, 2018, in *Crow Indian Tribe, et al.* v. *United States, et al.*, 343 F. Supp.3d 999 (D. Mont. 2018). The district court cited three main issues in vacating the rule: (1) the Service did not sufficiently assess the effect of delisting the GYE population on the recovery of grizzly bears in the rest of the lower-48 States; (2) the Service and its partners did not commit to recalibration of potential new population estimators in the future to ensure the ongoing applicability of the 2016 GYE Conservation Strategy's mortality limits; and (3) the Service inadequately analyzed the genetic health of the GYE grizzly bear population. In compliance with this order, the GYE grizzly bear population was once again made a threatened population under the Act (16 U.S.C. 1531 *et seq.*) (see 84 FR 37144, July 31, 2019). The Service appealed the District Court decision, and on July 8, 2020, the Ninth Circuit Court of Appeals issued an opinion affirming the Montana District Court's decision vacating and remanding the final rule delisting grizzly bears in the GYE (*Crow Indian Tribe v. United States*, 965 F.3d 662 (9th Cir. 2020).

On December 17, 2021, we received a petition from the State of Montana to establish and delist a NCDE DPS of the grizzly bear under the Act. On January 21, 2022, we received a petition from the State of Wyoming to establish and delist a GYE DPS of the grizzly bear under the Act. On March 9, 2022, we received a petition from the State of Idaho to delist the grizzly bear in the lower-48 States. On February 6, 2023, we announced our 90-day findings on these three petitions (88 FR 7658). Based on our review, we found that the petitions pertaining to the NCDE and GYE presented substantial scientific or commercial information indicating that the petitioned actions may be warranted, and we initiated a status review to determine whether the petitioned actions are warranted. We found that the petition to delist the grizzly bear in the lower-48 States on the basis of it not being a valid listable entity did not present substantial scientific or commercial information indicating that the petitioned action may be warranted; therefore, we are taking no further action on that petition. We are currently evaluating 12-month findings for the GYE and NCDE.

In 2023, the State of Idaho raised counter-claims against the Service in *Save the Yellowstone Grizzly* v. *Williams et al.,* 4:23-cv-00363-DCN (Dist. Idaho). The State of Idaho alleged that: (1) the lower 48 listing is invalid and the Service has exceeded their ESA jurisdiction by keeping the listing in place; (2) the Service unlawfully denied Idaho's petition to delist grizzlies in the lower 48 U.S.; and (3) take of the three grizzly bears was consistent with the grizzly 4(d) rule. As part of a legal settlement with the Plaintiff, Save the Yellowstone Grizzly, and the State of Idaho, a co-defendant, the Service has agreed to submit to the Office of the Federal Register a final rule that revises or removes the listed entity of the grizzly bear in the lower-48 States based on the best available science and information by January 31, 2026.

Partners in Grizzly Bear Recovery

Grizzly bear recovery has required, and will continue to require, cooperation among numerous state and Federal government agencies, Tribes, nongovernmental organizations (NGOs), and the public for a unified management approach. These agencies have been funding and performing actions to increase grizzly bear recovery, management, monitoring, and enforcement efforts within their jurisdictions for decades.

The interagency group guiding grizzly bear conservation efforts throughout the six ecosystems identified in the recovery plans is the Interagency Grizzly Bear Committee (IGBC). The IGBC was created in 1983 to coordinate Federal and state management efforts and research actions to recover grizzly bears in the lower-48 States. One of the objectives of the IGBC is to coordinate implementation of the Grizzly Bear Recovery Plan through member's respective roles, responsibilities, and authorities (USDA and USDOI 1983, entire). The IGBC mission is "to achieve recovery and delisting, and to support ongoing conservation of grizzly bear populations and their habitats after delisting in areas of the western United States through interagency coordination of policy, planning, management, research and communication" (IGBC 2019, p. 2).

IGBC Executive Committee members include upper-level managers from the Service, USFS, NPS, U.S. Geological Survey (USGS), BLM, the States of Idaho, Montana, Washington, and Wyoming, and B.C. and Alberta, Canada provincial wildlife agencies (IGBC 2019, p. 4). The leader for each ecosystem Science/Technical Team, the USFS National Carnivore Program Leader, the Information, Education & Outreach Subcommittee Chair, and the Service Grizzly Bear Recovery Coordinator are advisors to the IGBC providing scientific information on grizzly bear populations and their habitat as well as information, education, and outreach. The IGBC Executive Committee has seven subcommittees: the Information and Education Subcommittee, the Science Subcommittee, and subcommittees for each of the ecosystems, including the Yellowstone Ecosystem Subcommittee (YES)[3], NCDE Subcommittee[4], SE and CYE Subcommittee[5], North Cascades Subcommittee[6], and BE Subcommittee[7]. Ecosystem subcommittee members are representatives from each State, Federal, and Tribal agency with management jurisdiction for grizzly bear populations or habitat, as well as representatives from county governments. Each subcommittee has a Science/Technical Team to provide relevant information on the grizzly bear population(s) and their habitat, and an Information, Education & Outreach working group. The leaders or chairs of these teams/groups advises the subcommittee on these matters. The Science Subcommittee consists of the leaders from each ecosystem subcommittee science/technical team, the Service Grizzly Bear Recovery Coordinator, and the USFS National Carnivore Program Leader. The role of the Science Subcommittee is to

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[3] Subcommittee members include mid-level managers and representatives from the Service; the five GYE NFs (the Shoshone, Beaverhead Deerlodge, Bridger Teton, Custer Gallatin, and Caribou-Targhee); Yellowstone National Park (YNP); Grand Teton National Park (GTNP); the Wyoming Game and Fish Department (WGFD); Montana Fish, Wildlife, and Parks (MFWP); the Idaho Department of Fish and Game (IDFG); the Bureau of Land Management (BLM); U.S. Fish and Widlife Service (Service) Ecological Services; county representatives from each affected State; and the Shoshone Bannock, Northern Arapahoe, and Eastern Shoshone Tribes (IGBC 2019, p. 7–8).

[4] Subcommittee members include mid-level managers and representatives from the Service; the four NCDE NFs (the Flathead, Helena-Lewis and Clark, Kootenai, and Lolo); GNP; MFWP; BLM; Montana Department of Natural Resource Conservation (DNRC); U.S. Fish and Widlife Service (Service) Ecological Services; wildlife agencies in British Columbia and Alberta; a county representative from the State of Montana; the Blackfeet Tribe; and the Confederated Salish and Kootenai Tribes (CS&KT) (IGBC 2019, p. 8).

[5] Subcommittee members include mid-level managers and representatives from the Service; the four SE/CYE NFs (the Colville, Idaho Panhandle, Lolo, and Kootenai); MFWP; IDFG; Washington Department of Fish & Wildlife (WDFW); Idaho Department of Lands; U.S. Fish and Widlife Service (Service) Ecological Services; a county representative from each affected state; the Kootenai Tribe of Idaho; the Kalispel Tribe of Indians; and the British Columbia Ministry of Forests (IGBC 2019, p. 8).

[6] Subcommittee members include mid-level managers and representatives from the Service; the two North Cascades NFs (the Okanogan-Wenatchee and Mt. Baker-Snoqualmie); North Cascades National Park; WDFW; U.S. Fish and Widlife Service (Service) Ecological Services; BLM; and British Columbia Ministry of Environment; a county representative fom the State of Washington; and the Okanagan Nation Alliance (IGBC 2019, p. 9).

[7] Subcommittee members include mid-level managers and representatives from the Service; the seven BE NFs (Salmon-Challis, Bitterroot, Idaho Panhandle, Lolo, Nez Perce-Clearwater, Payette, and Sawtooth); MFWP; IDFG; U.S. Fish and Widlife Service (Service) Ecological Services; the Nez Perce Tribe; the Shoshone-Bannack Tribe; and a county representative from each affected State (IGBC 2019, p. 9).

coordinate research across ecosystems and conduct cross-ecosystem research as needed (IGBC 2019, p. 13). The I&E Subcommittee consists of a representative from each ecosystem and the IGBC Executive Coordinator. The role of the I&E subcommittee is to "coordinate information, education, and outreach among IGBC member agencies in support of grizzly bear recovery and conservation" (IGBC 2019, p. 12).

The IGBST in the GYE is unique from other subcommittee science teams in that it was created by a formal MOU in 1973, with the USGS serving as its coordinating agency. The IGBST collects, manages, analyses, and distributes the scientific-based information regarding habitat and demographic parameters necessary to make informed management decisions about grizzly bear habitat and conservation in the GYE. Since its formation in 1973, the published work of the IGBST has made the GYE grizzly bear population one of the most studied in the world. The wealth of biological information produced by the IGBST over the years includes 30 annual reports, hundreds of articles in peer-reviewed journals, dozens of theses, and other technical reports (*https://igbconline.org/grizzly-bear-study-team/*). Members of the IGBST include scientists and wildlife managers from the Service, USGS, NPS, USFS, academia, the Eastern Shoshone and Northern Arapaho Tribes, and each State wildlife agency involved in GYE grizzly bear recovery. The Science/Technical teams from the BE, North Cascades, SE and CYE, and NCDE also include representatives from state and Federal agencies and Tribes. These teams determine research needs for the respective populations, coordinate monitoring efforts, and advise the subcommittee on biological questions.

Many NGOs support grizzly bear recovery in significant ways. Defenders of Wildlife and People and Carnivores fund and implement preventative equipment, such as electric fences. Yellowstone to Yukon (Y2Y), Vital Ground, and the Nature Conservancy purchase or arrange easements on important grizzly bear habitat and fund needed research. Blackfoot Challenge and Heart of the Rockies are local partnerships that coordinate efforts to conserve natural resources while also preserving working landscapes and implement several non-lethal techniques to prevent grizzly bear livestock depredations. The National Wildlife Federation, Rocky Mountain Elk Foundation, Wild Sheep Foundation, Vital Ground, Greater Yellowstone Coalition, Sierra Club, and Western Watersheds have purchased grazing allotments from willing sellers in many important grizzly bear habitats. Groups, such as Swan Valley Connections, Be Bear Aware, and many others, promote bear education.

Overview of Recovery Planning

In accordance with section 4(f)(1) of the Act, the Service completed a Grizzly Bear Recovery Plan (Recovery Plan) in 1982 (Service 1982, p. ii). Recovery plans serve as road maps for species recovery—they lay out where we need to go and how to get there through specific actions. Recovery plans are not regulatory documents and are instead intended to provide guidance to the Service, States, and other partners on methods of minimizing threats to listed species and on criteria that may be used to determine when recovery is achieved. The Recovery Plan, and subsequent supplements, identified six recovery ecosystems, each containing a recovery zone at its core, within the lower-48 States thought to support grizzly bears (see *Geographic Boundaries for Recovery Planning* for further details) (Service 1993, pp. 10–13, 17–

18). Today, current grizzly bear distribution is primarily within and around these areas identified as recovery zones.

In 1993, the Service completed a revision to the Recovery Plan to include additional tasks and new information that increased the focus and effectiveness of recovery efforts (Service 1993, pp. 41–58). In 1996 and 1997, we released supplemental chapters to the Recovery Plan to guide recovery in the BE and North Cascades, respectively (in their entirety: Service 1996, 1997). For the GYE, we updated the demographic recovery criteria and supplemented the Recovery Plan chapter for the GYE with habitat-based recovery criteria in 2007 (72 FR 11376, March 13, 2007; Service 2007a, 2007b, entire). We proposed revisions to the demographic recovery criteria for the GYE in 2013, but never finalized them (78 FR 17708, March 22, 2013; Service 2013, entire). We again proposed revisions to recovery criteria for the GYE concurrent with the proposed delisting rule in 2016 (81 FR 13174, March 11, 2016) to reflect the best available science and the final revised demographic recovery criteria were appended to the Recovery Plan in 2017 (Service 2017, entire). Although it is not necessary to update recovery plans prior to delisting, the *Recovery Plan Supplement: Revised Demographic Recovery Criteria* was updated to reflect the best available science because the 2016 GYE Conservation Strategy directly incorporates the Recovery Plan for post-delisting monitoring. In 2018, we supplemented the Recovery Plan chapter for the NCDE with habitat-based recovery criteria (Service 2018, entire). Below, we report the status of recovery criteria for all ecosystems.

Recovery Criteria

The 1993 Recovery Plan, and subsequent supplements, outlined three demographic recovery criteria for each ecosystem. For all ecosystems, the first criterion establishes a minimum population size through the monitoring of unduplicated females with cubs. The second criterion ensures reproductive females (i.e., females with young) are well distributed across the recovery zone and are not concentrated in one portion of the ecosystem. The third criterion outlines annual human-caused mortality limits that would allow the population to achieve and sustain recovery. We updated the GYE demographic recovery criteria in 2007 and again in 2017 to reflect the best available science, including expansion of mortality limits in the third criterion to include total mortality (in their entirety: Service 2007b, 2017). For more information on the methods we used to determine these criteria, refer to the 1993 Recovery Plan and subsequent supplements (in their entirety: Service 1993, 1996, 1997, 2007a, 2017).

Due to a settlement agreement in *Fund for Animals* v. *Babbitt*, 967 F.Supp. 6 (D.D.C. 1997) regarding the 1993 Recovery Plan, the Service agreed to establish habitat-based recovery criteria for each ecosystem prior to publishing any proposed rule to delist that grizzly bear population. In addition, the Service agreed to convene a workshop during the public comment period on the draft habitat-based recovery criteria. Habitat-based recovery criteria were published as supplemental chapters to the 1993 Recovery Plan for the GYE and the NCDE in 2007 and 2018, respectively (in their entirety: Service 2007a, 2018). The Service has not yet developed habitat-based recovery criteria for the remaining ecosystems.

There is no published method to deductively calculate minimum habitat values (i.e., quantitatively measure minimum habitat characteristics) required for a healthy and recovered population. Grizzly bears are long-lived, opportunistic omnivores whose food and space requirements vary depending on a multitude of environmental and behavioral conditions and on variation in the experience and knowledge of each individual bear. Grizzly bear home ranges overlap and change seasonally, annually, and with reproductive status. While these considerations make the development of habitat criteria difficult, we established criteria by assessing the habitat features that were compatible with a stable to increasing grizzly bear population in the past, and then used these habitat conditions as threshold values that must be maintained to ensure a healthy population (i.e., a “no net loss” or baseline approach), as suggested by Nielsen *et al.* (2006, p. 227). The most crucial element in grizzly bear recovery is an adequate amount of habitat that is diverse, provides a wide range of foods, and is isolated from development and human activities, where human-bear interactions, which often result in higher bear mortalities, are minimal (Service 1993, p. 21; Craighead and Mitchell 1982, p. 530). The Service found in the 1993 Recovery Plan that motorized access posed the most imminent stressor to grizzly bear habitat and recommended that road management be given the highest priority for grizzly bear recovery (Service 1993, pp. 21–22). Motorized access management is focused on both habitat security and mortality reduction and is therefore an important management tool for grizzly bear populations. By reducing motorized route densities and thus mortality rates in grizzly bear habitat, it provides habitat security, especially for females, by allowing them to utilize their habitat for reproduction while optimizing survival by minimizing human-caused mortality. For this reason, both the GYE and NCDE habitat-based recovery criteria define threshold levels for secure core/habitat (areas with no motorized access), livestock allotments, and developed sites as their habitat-based recovery criteria (Service 2007a, pp. 2–6; Service 2018, pp. 5–8).

Recovery Progress

Below, we summarize recovery planning efforts and progress toward meeting recovery goals for each ecosystem.

Recovery Planning and Progress in the GYE

Habitat-based Recovery Criteria for the GYE

On June 17, 1997, we held a public workshop in Bozeman, Montana, to develop and refine habitat-based recovery criteria for the grizzly bear, with an emphasis on the GYE. This workshop was held as part of the settlement agreement in *Fund for Animals* v. *Babbitt*, 967 F.Supp. 6 (D.D.C. 1997). A *Federal Register* notice notified the public of this workshop and provided interested parties an opportunity to participate and submit comments (62 FR 19777, April 23, 1997). After considering 1,167 written comments, we developed biologically based habitat recovery criteria, which were appended to the 1993 Recovery Plan in 2007 (Service 2007a, entire), with the overall goal of maintaining or improving habitat conditions at levels that existed in 1998.

As discussed above in *Recovery Criteria*, because of the inability to calculate minimum habitat values for a recovered population, we use a “no net loss” approach by assessing what habitat factors are compatible with a stable to increasing grizzly bear population. The 1998 baseline for habitat standards was chosen because the levels of secure habitat and developed sites on public lands remained relatively constant in the 10 years preceding 1998 (USDA FS 2004, pp. 140–141), and the selection of 1998 ensured that habitat conditions existing at a time when the population was increasing at a rate of 4 to 7 percent per year (Schwartz *et al.* 2006c, p. 48) would be maintained. In addition, levels of motorized routes were decreasing during the years preceding the 1998 baseline as exhibited by an average reduction (elimination) of 59.9 km (37.2 mi) of road per year from 1986 to 2002 on NF lands within the recovery zone (USDA FS 2006a, p. 200). The 1998 baseline was determined through a GIS analysis of the amount of secure habitat, open and total motorized route densities, the number and capacity of livestock allotments, and the number and capacity of developed sites on public lands for each of the 40 bear management subunits located in the recovery zone.

The 2016 GYE Conservation Strategy identified the need for a multi-agency effort to develop long-term solutions that alleviate pressures from increased visitation while maintaining grizzly bear populations and habitat security. Chapter 3 and Appendix E of the GYE Conservation Strategy were revised in 2022 with updated habitat standards related to developed sites by adopting a "footprint" approach (YES 2024, Chapter 3 and Appendix E). The 1998 baseline mapped all developed sites, including major developments such as Grant Village in YNP, and sites with more limited infrastructure, such as trailheads, as points on the landscape. The "footprint" approach delineates areas of concentrated human use associated with developed sites, such as visitor overnight lodges on USFS lands, developed campgrounds, administrative sites, and major developments on NPS lands. This approach more accurately accounts for the reduction in secure habitat due to the extent of human development. Changes in reported values of secure core are a result of accounting for the extent of existing developed sites (e.g., lodges and associated parking lots or campgrounds and pit toilets), as the full extent was not previously mapped (and not subtracted from secure habitat) and are not an actual change in secure habitat since 1998. Inside delineated footprints, the revisions include application rules that allow for an increase in day-use and administrative sites and a limited increase in the amount of overnight visitor use, as this would not detract from secure habitat. Other developed sites associated with isolated point-source human activity with minimal infrastructure, such as trailheads and picnic areas, do not have a delineated footprint. The application rules allow for a limited increase in day-use and administrative sites outside of existing footprints.

For the GYE, secure habitat refers to those areas with no motorized access that are at least 10 acres (0.31 km^2 (0.016 mi^2)) in size and more than 500 m (1,650 ft) from a motorized access route (road or trail), prescribed footprint of a developed site, or recurring helicopter flight line (USDA FS 2004, p. 18; YES 2024, Chapter 3 and Appendix E). Our definition of secure habitat includes areas as small as 10 acres (0.31 km^2 (0.016 mi^2)) in size because both the IGBST and YES concluded that all secure habitats are important for grizzly bears in the GYE, regardless of size, particularly in peripheral areas. Research by Schwartz *et al*. (2010a, p. 661) supported this conclusion and demonstrated a direct link between this definition and grizzly bear survival in the GYE. Non-motorized trails were not excluded from secure habitat because research indicates that non-motorized trails do not significantly affect grizzly bear survival in the GYE, and that survival is better explained by the absence of motorized routes (Schwartz *et al*. 2010a, p. 659). See *Chapter 5: Recreation* for more discussion on effects to grizzly bears from non-motorized trails.

Habitat-based recovery criteria—The habitat-based recovery criteria established objective, measurable values for levels of motorized access, secure habitat, developed sites, and livestock allotments (i.e., "the 1998 baseline") for the GYE (see the GYE Conservation Strategy for 1998 baseline values) (YES 2024, Chapter 3 and Appendix E). The 1998 baseline values will not change through time, unless the changes will benefit bears (e.g., expansion of existing administrative sites to enhance public land management if other viable alternatives are not available, modifications to dispersed or developed sites to reduce grizzly bear conflicts, such as installing bear-resistant storage structures). As each of these criteria are central to potential present or threatened destruction, modification, or curtailment of habitat or range, they are discussed in detail under Chapter 5. The Grizzly Bear Annual Habitat Monitoring Report includes changes and corrections to the 1998 baseline and is included in the IGBST Annual Reports.

Status: These habitat-based recovery criteria have been met or improved upon since their incorporation into the Recovery Plan (Service 2007a, entire; GBHMT 2024, entire).

Additionally, we developed several monitoring items that may help inform management decisions or explain population trends: (1) trends in the location and availability of food sources such as whitebark pine (*Pinus albicaulis*), cutthroat trout (*Oncorhynchus clarkii*), army cutworm moths (*Euxoa auxiliaris*), and ungulates (bison and elk); and (2) grizzly bear mortality numbers, locations, and causes; human-grizzly bear conflicts; conflict bear management actions; hunter-bear conflicts; and livestock-bear conflicts (YES 2024, Chapter 3). Federal and State agencies monitor these items, and the IGBST produces an annual report of the results. This information is used to examine relationships between food availability, human activity, and demographic parameters of the population such as survival, population growth, or reproduction.

Demographic Recovery Criteria for the GYE

Since the 1993 Recovery Plan was released, we have evaluated and updated how we assess those recovery criteria in the GYE as newer, better science became available. These revisions include implementing new scientific methods to determine the status of the GYE grizzly bear population in the DMA, estimate population size, and determine what levels of mortality the population could withstand to maintain recovery goals (i.e., the sustainable mortality rate). The Wildlife Monograph: "Temporal, Spatial, and Environmental Influences on The Demographics of Grizzly Bears in The Greater Yellowstone Ecosystem" (Schwartz *et al.* 2006c, entire); the report: "Reassessing Methods to Estimate Population Size and Sustainable Mortality Limits for the Yellowstone Grizzly Bear" (IGBST 2005, entire); and the report: "Reassessing Methods to Estimate Population Size and Sustainable Mortality Limits for the Yellowstone Grizzly Bear Workshop Document Supplement 19–21 June, 2006" (IGBST 2006, entire) provided the scientific basis for revising the demographic recovery criteria in the GYE in 2007 (72 FR 11376, March 13, 2007; Service 2007b, entire). Similarly, we once again revised the demographic recovery criteria in the GYE in 2017 (81 FR 13174, March 11, 2016; Service 2017, entire) based on updated demographic analyses that used the same methods as previous assessments (Schwartz *et al.* 2006c, pp. 9–16) and were reported in the IGBST's 2012 report: "Updating and Evaluating Approaches to Estimate Population Size and Sustainable Mortality Limits for Grizzly Bears in the Greater Yellowstone Ecosystem" (hereafter referred to as the 2012 IGBST Report). Based on recommendations in the 2012 IGBST report, the Service modified the area where mortality limits apply to match the area that is monitored for unique adult female grizzly bears with cubs-of-the-year and in which the population size is estimated (i.e., the DMA).

Below, we detail each of the most current demographic criteria that were appended to the 1993 Recovery Plan in 2017 (Service 2017, entire).

Demographic Recovery Criterion 1 for the GYE—Maintain a minimum population size of 500 grizzly bears and at least 48 females with cubs-of-the-year in the DMA (Figure 18, above) as indicated by methods established in published, peer-reviewed scientific literature and calculated by the IGBST using the most updated Application Protocol as described in the IGBST annual reports. If the estimate of total population size drops below 500 in any year or below 48 females with cubs-of-the-year in 3 consecutive years, this criterion would not be met.

A minimum population size of at least 500 animals within the DMA will ensure short-term genetic health (Miller and Waits 2003, p. 4338) and is not a population goal. Five hundred is a minimum population threshold and will ensure the short-term fitness of the population is not threatened by losses in genetic diversity in such an isolated population. The goal is to maintain the population well above this threshold to ensure that genetic issues are not a detriment to the short-term genetic fitness of the GYE grizzly bear population.

Status: In 2023, based on estimates derived from the IPM there were 87[8] females with cubs within the DMA. Applying the updated vital rates, 80 females with cubs equates to an estimated population of 1,030 individuals (Gould *et al.* 2024c, *in prep.*). This recovery criterion has been met since 2003.

Demographic Recovery Criterion 2 for the GYE—Sixteen of 18 BMUs within the recovery zone (Figure 23) must be occupied by females with young, with no two adjacent BMUs unoccupied, during a 6-year sum of observations. This criterion is important as it ensures that reproductive females occupy the majority of the recovery zone and are not concentrated in one portion of the ecosystem. If less than 16 of 18 BMUs are occupied by females with young for 3 successive 6-year sums of observations this criterion would not be met.

Status: This recovery criterion has been met since at least 2001. See Table 8 below for most current 6-year sum of observations data.

[8] The revised Chao2 approach which addressed two limitations of the model-averaged Chao2 method and is an input to the IPM (IGBST 2022, entire). First, the revised Chao2 approach adjusts the distance criterion in the rule set from 30 km to 16 km to address the underestimation bias in differentiating sightings of females with cubs into unique individuals. Second, it uses generalized additive models (GAMs) instead of the model-averaging approach to more effectively detect population trends including population stability, in females with cubs.

Table 8. Demographic recovery criterion 2 is measured by the number of bear management units (BMUs) occupied by females with young (cubs, yearlings, 2-year-olds, or young of unknown age), as determined by verified reports, for each 6-year sum of observations.

Bear Management Unit	2018	2019	2020	2021	2022	2023
Hilgard	X	X	X	X	X	X
Gallatin	X	X	X	X	X	X
Hellroaring/Bear	X	X	X	X	X	X
Boulder/Slough	X	X	X	X	X	X
Lamar	X	X	X	X	X	X
Crandall/Sunlight	X	X	X	X	X	X
Shoshone	X	X	X	X	X	X
Pelican/Clear	X	X	X	X	X	X
Washburn	X	X	X	X	X	X
Firehole/Hayden	X	X	X	X	X	X
Madison	X	X	X	X	X	X
Henry's Lake	X	X	X	X	X	X
Plateau	X	X	X	X	X	X
Two Ocean/Lake	X	X	X	X	X	X
Thorofare	X	X	X	X	X	X
South Absaroka	X	X	X	X	X	X
Buffalo/Spread Creek	X	X	X	X	X	X
Bechler/Teton	X	X	X	X	X	X
Occupied during last 6 years						**18**

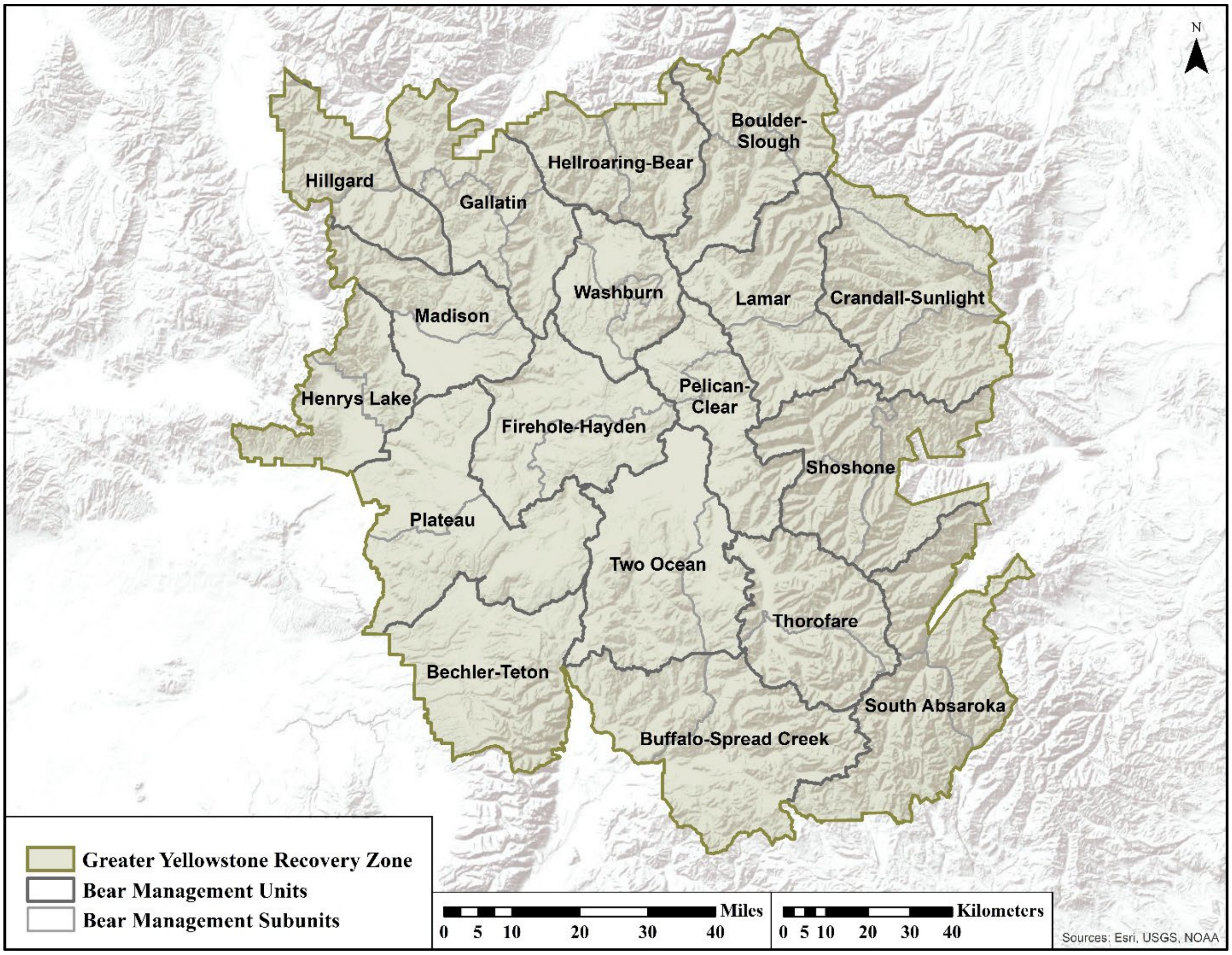


Figure 23. Bear Management Units (BMUs) and subunits for the Greater Yellowstone Ecosystem recovery zone.

Demographic Recovery Criterion 3 for the GYE—Maintain the population within the DMA around the 2002–2014 model-averaged Chao2 population estimate average size (average = 674; 95% CI = 600–747; 90% CI = 612–735) by maintaining annual mortality limits for independent females (2 years old or older), independent males (2 years old or older), and dependent young as shown in Table 9. These adjustable mortality rates were calculated as those necessary to manage the population to the modeled-averaged Chao2 population estimate of 674 bears, which occurred during the time period that this population had a relatively flat population trajectory (2002–2014). If mortality limits are exceeded for any sex/age class for 3 consecutive years and any annual population estimate falls below 612 (the lower bound of the 90 percent confidence interval), the IGBST will produce a Biology and Monitoring Review to inform the appropriate management response. If any annual population estimate falls below 600 (the lower bound of the 95 percent confidence interval), this criterion would not be met and there would be no discretionary mortality (mortalities that are the result of hunting or management removals) except as necessary for human safety.

Criterion 3 counts known and probably mortalities from all causes of independent (at least 2 years old) male and female grizzly bears from all sources against annual mortality limits while counting only known and probable human-caused mortalities against annual mortality limits for dependent young (less than 2 years old). For independent females and males, counted mortalities include: (1) known and probable human-caused mortalities; (2) reported deaths due to natural and undetermined-causes; and (3) a statistical estimate for unknown/unreported human-caused mortalities. The IGBST will continue to use the methods of Cherry *et al*. (2002, entire) to estimate unknown/unreported mortalities each year based on the number of known, reported human-caused deaths (Cherry *et al*. 2002, p. 179; IGBST 2005, pp. 39–41) until and unless new and improved scientifically methodology becomes available.

The population estimates derived from the model-averaged Chao2 estimates of females with cubs had stabilized during the period of 2002–2014, and the mean population estimate over that time period was 674 (95% CI = 600–747), which is not statistically different from the population size of 683 when the GYE population was considered recovered and delisted in 2007 (72 FR 14866, March 29, 2007). This recovery criterion was selected because it represents: a population level that is sufficiently robust to provide for the viability of the species, a period where the ecosystem was likely at or near long-term carrying capacity, and the conservative nature of a population estimate derived from counts of females with cubs (Schwartz *et al.* 2008, entire). The population naturally stabilized primarily because of reduced survival of dependent young and lower reproduction in areas with higher grizzly bear densities, suggesting density-dependent effects associated with the population approaching carrying capacity (van Manen *et al.* 2016, entire).

In 2018, the Montana District Court identified three main issues in vacating the Service's 2017 final rule designating and delisting the GYE DPS. One of those issues included a failure by the Service and its partners to commit to recalibration of potential new population estimators in the future to ensure the ongoing applicability of the 2016 GYE Conservation Strategy's mortality limits. "Recalibration refers to calibrating a new model's estimates for a given year (e.g., 1000 bears in 2020) to the Chao2 population estimates generated for the 2002–2014 time period (average of 674 bears) ..... if a new model estimates 1000 bears where Chao2 found 700, the states will be able to treat the jump in population as they would treat it on paper—-as if 300 new individuals had moved into the Greater Yellowstone Ecosystem." *Crow Indian Tribe et al*. v. *United States et al*., 343 F. Supp.3d 999 (D. Mont. 2018). Beginning with 2022 grizzly bear demographic data, the IGBST began implementing an IPM to estimate vital rates, population size, and mortality within the GYE population. In January 2024, the States of Idaho and Wyoming amended the Tri-State MOA to incorporate new commitments to maintain a biologically recovered population including population objectives, total mortality thresholds, a threshold at which discretionary mortality ceases, and reproductive female distribution. The Montana Fish and Wildlife Commission adopted the Tri-State MOA in June 2024. The Yellowstone Ecosystem Subcommittee and the IGBC approved incorporation of the new commitments into the Conservation Strategy in May 2024 and June 2024, respectively.

Status: In 2020 there were 41 known and probable grizzly bear mortalities within the DMA: 10 independent females, 14 independent males, 2 independent-age bears of unknown sex, and 15 dependent young (1 male and 14 of unknown sex) (Haroldson and Frey 2021, p. 39). Using randomly assigned sex for the 2 independent-age bears for which sex was unknown, the estimated total mortality was 7.5 percent of the estimated population of independent females and 8.7 percent of the estimated population of independent males. The estimated documented human-caused mortalities for dependent young within the DMA in 2020 was 1.8 percent of the estimated population of dependent young. Documented known and probable mortality rates for all age and sex classes were below the total mortality limits in 2020. This criterion has been met for all age and sex classes since 2012. While mortality rates within the DMA have been above mortality thresholds in several years (2011 and 2015 for independent females; 2010, 2011, 2012 for independent males), the average has remained under the threshold over the recent period of 2010 to 2020 with 7.2 percent for independent females and 11.4 percent for independent males (Haroldson 2022, *in litt.*). The IGBST has adopted a new population estimation framework, an IPM, which replaces the previously used model-averaged Chao2 population estimation method. Demographic recovery criterion 3 relies on the model-averaged Chao2 method, therefore we cannot assess the mortality limits as set forth in the recovery plan. However, based on the 2023 IPM population estimate of 1,030 individuals in the GYE DMA, total mortality rates were 5.8 percent for independent males and 5.1 percent for independent females (Gould *et al.* 2024b, *in prep.*). Human-caused mortality for dependent young was 2 percent; only human-caused mortalities are counted against the mortality threshold for dependent young (Gould *et al.* 2024b, *in prep.*). These mortality rates were consistent with a population growth rate from 2020 to 2023 of 3.4 percent (Gould *et al.* 2024a, p. 12). Therefore, we believe that the GYE grizzly bear population has met the intent of this demographic recovery criterion.

Table 9. Total mortality rate used to establish annual total mortality limits for independent females and independent males, and human-caused mortality limits for dependent young inside the Demographic Management Area (DMA). These mortality limits are on a sliding scale to achieve the population goal inside the DMA of the model-averaged Chao2 population size of 674 between 2002–2014 (95% CI = 600–747). For populations less than 600, there will be no discretionary mortality unless necessary for human safety.

	Total Grizzly Bear Population Estimate*		
	≤674	675–747	>747
Total mortality rate for independent FEMALES	<7.6%	9%	10%
Total mortality rate for independent MALES	15%	20%	22%
Human-caused mortality rate for dependent young	<7.6%	9%	10%
Total mortality: Documented known and probable grizzly bear mortalities from all causes including but not limited to: management removals, illegal kills, mistaken-identity kills, self-defense kills, vehicle kills, natural mortalities, undetermined-cause mortalities, grizzly bear hunting, and a statistical estimate of the number of unknown/unreported mortalities.			

* using the model-averaged Chao2 estimate

Recovery Planning and Progress in the NCDE

Habitat-based Recovery Criteria for the NCDE

On July 7, 2016, and January 3, 2018, we held public workshops in Missoula, Montana, to develop and refine habitat-based recovery criteria for the grizzly bear, with an emphasis on the NCDE. *Federal Register* notices and notices in local newspapers notified the public of these workshops and provided interested parties an opportunity to participate and submit comments (81 FR 29295, May 11, 2016; 82 FR 58444, December 12, 2017). After considering 282 written and oral comments, we developed biologically relevant habitat-based recovery criteria with the overall goal of maintaining or improving habitat conditions at levels that existed in 2011. Habitat-based recovery criteria for the NCDE were proposed in 2017, and then finalized as a supplement to the 1993 Recovery Plan in 2018 (Service 2018, entire).

The habitat-based recovery criteria established objective, measurable values for levels of motorized access, secure core habitat, developed sites, and livestock allotments for the NCDE (see the NCDE Conservation Strategy for 2011 baseline values) (NCDE Subcommittee 2020, Appendices 4 and 5). As discussed above in *Recovery Criteria*, because of the inability to calculate minimum habitat values for a recovered population, we use a “no net loss” approach by assessing which habitat factors are compatible with a stable to increasing grizzly bear population. We selected 2011 levels (i.e., the “baseline”) as our baseline year because secure core habitat was increasing and motorized route density was decreasing between 2004 and 2011 (NCDE Subcommittee 2020, Chapter 1; Service 2018, pp. 24–25), and the NCDE grizzly bear population was increasing at a rate of 2 to 3 percent annually during this time (Mace *et al.* 2012, p. 124; Mace 2012, *in litt.*; Costello *et al.* 2016b, p. 2; Service 2018, p. 3). For example, in the Flathead NF, the amount of core habitat (IGBC 1998, p. 4) increased by approximately 400 km^2 (155 mi^2) from 1995 to 2004, and by another 170 km^2 (65 mi^2) from 2004 to 2011 (Ake 2018, *in litt.*). Habitat conditions in 2011 are believed to be representative of conditions that supported and contributed to the population growth observed from 2004 to 2011. For each of the 126 BMUs located in the recovery zone, the baseline was determined through a GIS analysis of the amount of secure core habitat, open and closed road densities, the number and capacity of livestock allotments, and the number and capacity of developed sites on public lands (NCDE Subcommittee 2020, Chapter 3, Appendices 4 and 5).

For the NCDE, we define secure core habitat as those areas on Federal lands within the analysis area more than 500 m (1,650 ft) from an open or gated motorized access route and at least 2,500 acres (10.1 km^2 (3.9 mi^2)) in size (Service 2018, pp. 5, 12). Non-motorized trails were not excluded from secure core because research indicates that non-motorized trails do not significantly affect grizzly bear survival in the GYE, and that survival was better explained by the absence of motorized routes (Schwartz *et al*. 2010a, p. 659).

The habitat-based recovery criteria ensure that the baseline values will not change through time, except as allowed under the application rules. The habitat-based recovery criteria include an objective to limit increases in the number and capacity of new developed recreation sites on Federal lands for overnight use by the public during the non-denning season to one per decade per BMU. This allowance was based on the rate and type of increase that occurred during the decades preceding the evaluation of the baseline in 2011. We are currently re-evaluating the need for limitations on the size of any new or current developed site expansion under this objective. As the management objectives in the habitat-based recovery criteria are central to potential present or threatened destruction, modification, or curtailment of habitat or range, each of these criteria are discussed in detail under Chapter 5. The habitat-based recovery criteria were appended to the Recovery Plan in 2018.

Status: These habitat-based recovery criteria have been met or improved upon since their incorporation in the draft NCDE Conservation Strategy in 2013 (in their entirety: NCDE Subcommittee 2020, Chapter 3, Appendices 4 and 5; Service 2018; Ake 2022, 2023a, 2023b).

Demographic Recovery Criteria for the NCDE

The 1993 Recovery Plan outlines three demographic recovery criteria for the NCDE recovery zone:

Demographic Recovery Criterion 1 for NCDE—Maintain 10 females with cubs inside GNP and 12 females with cubs outside GNP over a running 6-year average both inside the recovery zone and within a 10-mile area immediately surrounding the recovery zone, excluding Canada. The Recovery Plan identified this criterion as a method to estimate the minimum population size for the NCDE, which equates to a minimum population size of 391 grizzly bears (Service 1993, pp. 61–62). This estimate is thought to be an underestimate of the actual number due to “the forested nature of much of the NCDE” (Service 1993, p. 62).

Status: We attempted to reconstruct the original criterion using radio-telemetry data and public sightings. High grizzly bear densities have been documented within GNP (Kendall *et al.* 2009, pp. 11–12; Costello *et al.* 2016b, pp. 22–23). Since 2010, GNP has recorded yearly sightings of females with young, averaging 44 females with young annually after removing duplicates based on date, time, and descriptions. These family group sightings include females with cubs and yearlings, and so estimates are higher than for females with cubs alone; however, family group observations within GNP are 4 times higher than the original recovery criterion for observations of females with cubs. With a 3-year reproductive cycle approximately a third of the family groups would be females with cubs. Combined with the conservative nature of observation-based estimates within the NCDE, the Service believes the target of 10 females with cubs inside GNP has been met and exceeded. In addition, radio-telemetry data indicate that the target of 12 females with cubs outside GNP has been met since 2012 (Costello 2017, pp. 1–3).

Recognizing the limitations of this methodology, Kendall *et al.* (2009, p. 9) developed a scientifically reliable population estimate of 765 bears (95% CI = 715–831) in 2004 by genetically sampling the recovery zone and the surrounding occupied areas. Since that survey, radio-telemetry (location), DNA, and mortality data have been collected annually to calculate population distributions and annual growth rates for the population. Together, these data are combined in stochastic demographic models to project total population size for the NCDE, with a 2023 estimate of 1,163 bears (95% CI = 971–1,366) (Costello *et al.* 2016b, pp. 69–70; Costello *et al.* 2024, *in prep.*). Given that the 2023 lower 95 percent confidence interval of 971 bears is more than double the minimum population size target of the Recovery Plan (391 bears), the

Service concludes that the NCDE grizzly bear population has well exceeded this demographic criterion.

Demographic Recovery Criterion 2 for the NCDE—Twenty-one of 23 BMUs within the recovery zone (Figure 24) must be occupied by females with young, with no two adjacent BMUs unoccupied, during a 6-year sum of observations. The Recovery Plan (Service 1993, p. 61) established this criterion to ensure that reproductive females occupy the majority of the recovery zone and are not concentrated in one portion of the ecosystem.

Status: This criterion has been met since 2009, with females with young occupying 23 of 23 BMUs within the NCDE during the 6-year sum of observations since from 2018–2023 (NCDE Subcommittee 2020, table 2; Costello *et al.* 2024, *in prep.*). See Table 10 below for most current 6-year sum of observations data.

Table 10. Demographic recovery criterion 2 is measured by the number of bear management units (BMUs) occupied by females with young (cubs, yearlings, 2-year-olds, or young of unknown age), as determined by verified reports, for each 6-year sum of observations.

Bear Management Unit	2018	2019	2020	2021	2022	2023
Murphy Lake			X		X	X
Upper North Fork Flathead		X	X	X	X	X
Northeast Glacier	X	X	X	X	X	X
Stillwater River	X	X	X	X	X	X
Lower North Fork Flathead	X	X	X	X	X	X
Hungry Horse	X	X	X	X		
Lower Middle Fork Flathead	X	X	X	X	X	X
Southeast Glacier	X	X	X	X	X	X
Sullivan	X	X	X	X	X	X
Upper Middle Fork Flathead	X				X	X
Badger Two Medicine	X	X	X		X	X
Mission Range	X	X	X	X	X	X
Bunker	X	X	X	X		X
Continental Divide			X		X	
Birch Teton	X	X	X	X		X
Big Salmon	X	X	X	X	X	X
North Fork Sun River	X	X	X		X	X
Teton Sun River		X	X	X	X	X
Rattlesnake				X		
Upper South Fork Flathead				X		
South Fork Sun Beaver Willow	X	X	X	X	X	X
Monture Landers Ford		X	X	X	X	X
Dearborn Elk Creek		X	X	X	X	X
Occupied during last 6 years						**23**

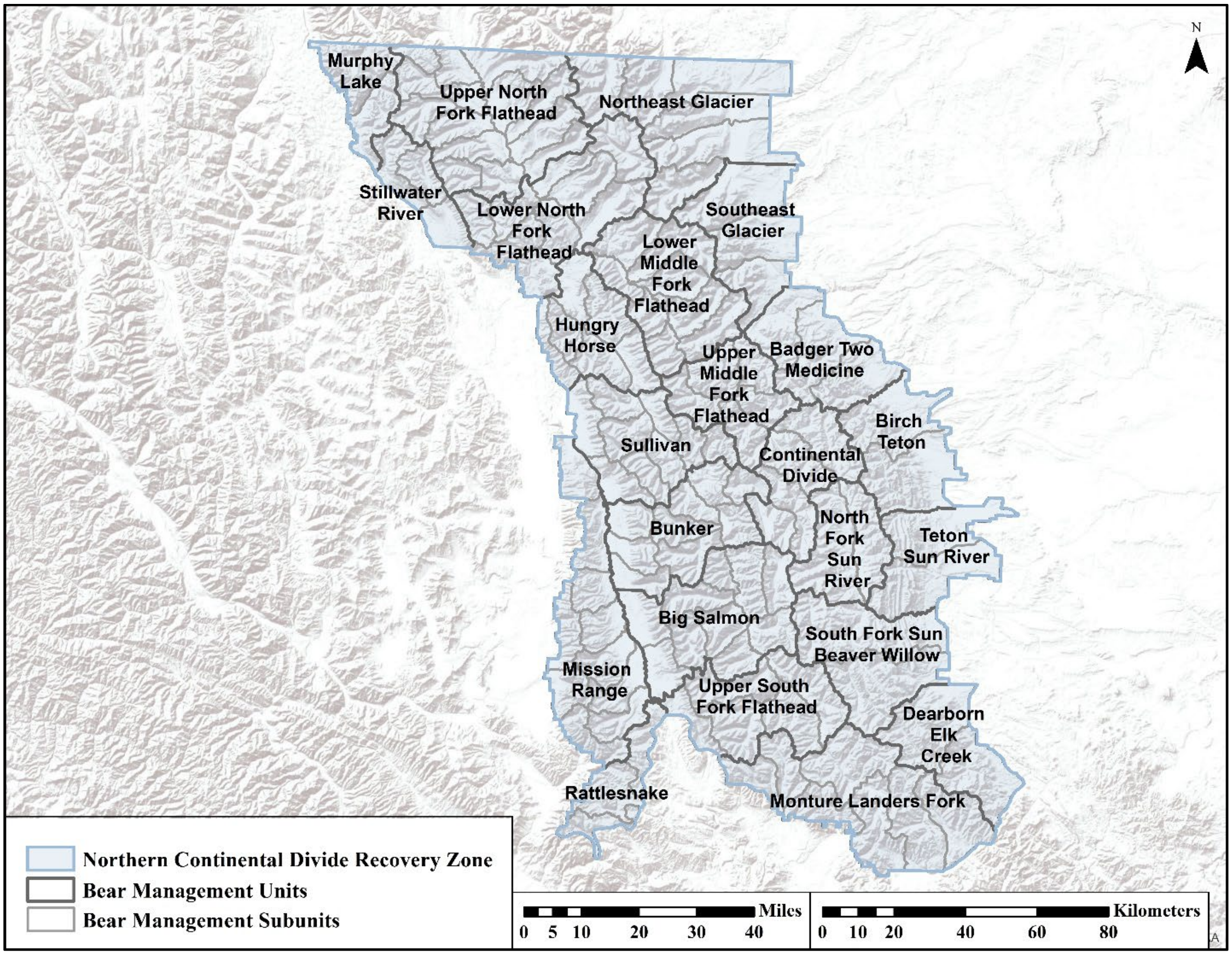


Figure 24. Bear Management Units (BMUs) and subunits for the Northern Continental recovery zone.

Demographic Recovery Criterion 3 for the NCDE— The Recovery Plan identified this criterion as a method to limit known human-caused mortality to a level that is sustainable for a recovered NCDE grizzly bear population (Service 1993, p. 61; Servheen 2001, entire). The criterion limits the 6-year average of known and probable human-caused mortality to 4 percent or less of the minimum population estimate based on the most recent 3-year sum of unduplicated females with cubs; no more than 30 percent of this 4 percent mortality limit shall be females; these human-caused mortality limits cannot be exceeded during any 2 consecutive years for recovery to be achieved. In other words, human-caused female mortality cannot exceed 1.2 percent of the minimum population estimate. The known and probable, human-caused mortality threshold was set conservatively at 4 percent because unknown and/or unreported human-caused mortality was known to occur but current methods to estimate these unknown/unreported mortalities were not available when the Recovery Plan was written (Service 1993, p. 62). In 2002, Cherry *et al.* (entire) developed a method to estimate unknown/unreported mortalities; therefore, we can now more accurately estimate total mortality levels and ensure sustainable levels of mortality (NCDE Subcommittee 2020, Chapter 2 and Appendix 2; see also *Human-caused Mortality in the NCDE,* below). Total reported and unreported (TRU) mortality includes known and probable mortality from all causes (e.g., human-caused, natural, and undetermined) as well as an estimate of unknown/unreported mortality (using the methods of Cherry *et al.* 2002, entire; Costello *et al.* 2016b, p. 29).

Status: To estimate minimum population size, we used the index described in *Demographic Recovery Criterion 1*, the lower 95th percentile of the estimated population size using a stochastic demographic model to project forward from a known population size in 2004. For 2023, the lower 95th percentile of the population size (1,163) was 971 bears (Costello *et al.* 2016b, pp. 69–70; Costello *et al.* 2024, *in prep.*). For the original 4 percent mortality criterion, the most recent 6-year average (2018–2023) of known and probable human-caused mortality, the limit was 38.8 bears/year for total mortality and 11.7 bears/year for female mortality. The documented 6-year average for this time period was 37.3 bears/year for total mortality and 14.3 bears/year for female mortality. Since 2009, the 6-year average for human-caused total mortality has been less than 4 percent of the minimum population size. The female proportion of human-caused mortality was greater than the 1.2 percent of the minimum population size in 2021, 2022, and 2023 (1.25, 1.3, and 1.47, respectively) (Costello *et al.* 2016b, p. 69; Costello 2017, pp. 2, 6; Costello 2022 and 2024, *in litt.*; Costello *et al.* 2024, *in prep.*; MFWP, unpublished data).

Table 11. Assessment of human-caused mortalities inside the NCDE Demographic Monitoring Area (DMA) from 2004 to 2023 for demographic recovery criterion 3. This table includes all known and probable human-caused mortalities for independent females, independent males, and dependent young.

Year	Lower 95th percentile of estimated population size	Documented annual human-caused mortality		Documented 6-year average human-caused mortality		Limit for 6-year average human-caused mortality	
		Female	Total	Female	Total	Female	Total
2004	694	14	24				
2005	703	8	18				
2006	717	3	13				
2007	732	1	22				
2008	747	7	13				
2009	765	5	14	7.3	17.3	9.2	30.6
2010	780	4	16	5.7	16.0	9.4	31.2
2011	795	13	28	6.5	17.7	9.5	31.8
2012	810	3	17	6.5	18.3	9.7	32.4
2013	823	13	28	7.5	19.3	9.9	32.9
2014	835	12	19	8.3	20.3	10.0	33.4
2015	851	8	19	8.3	21.2	10.2	34.0
2016	864	11	16	10.0	21.2	10.4	34.6
2017	876	2	20	8.2	19.8	10.5	35.0
2018	892	12	41	9.7	23.8	10.7	35.7
2019	890	16	40	10.2	25.3	10.7	35.6
2020	923	16	35	10.5	27.2	11.1	36.9
2021	938	14	40	11.8	32.0	11.3	37.5
2022	958	15	39	12.5	35.8	11.5	38.3
2023	971	13	34	14.3	37.3	11.7	38.8

Despite the fact that the female mortality occasionally exceeded the limits in this recovery criterion, we believe that the NCDE population meets the intent of this criterion. In 1993, the mortality limits were set conservatively to compensate for TRU mortalities, which we could not measure. As discussed in the NCDE Conservation Strategy (NCDE Subcommittee 2020, Chapter 2 and Appendix 2), our assessment now includes an estimate of unknown/unreported mortality which allows us to more accurately estimate and calculate sustainable levels of TRU mortality. During the 6-year period of 2018–2023, average TRU mortalities were 16 (independent female) and 22 (independent male), below the maximum thresholds of 26 and 31 for independent female and male mortality respectively (Costello *et al.* 2024, *in prep.*). Moreover, independent female and male TRU mortality have been compatible with an annual 2.3 percent growth in the population since 2004 (Costello *et al.* 2016b, p. 2; MFWP, unpublished data). Therefore, we believe that the NCDE grizzly bear population has met the intent of this demographic recovery criterion.

Recovery Planning and Progress in the CYE

The 1993 Recovery Plan outlines three demographic recovery criteria for the CYE recovery zone:

Demographic Recovery Criterion 1 for the CYE—Maintain six females with cubs over a running 6-year average both inside the recovery zone and within a 10-mile area immediately surrounding the recovery zone, excluding Canada.

Status: Unduplicated females with cubs (excluding Canada) varied from two to five per year and averaged 3.2 per year from 2018–2023 (Kasworm *et al.* 2024a, p. 17). This recovery criterion has not been met.

Demographic Recovery Criterion 2 for the CYE—Maintain eighteen of 22 BMU's (Figure 25) occupied by females with young from a running 6-year sum of verified evidence.

Status: Sixteen of 22 BMUs had sightings of females with young during 2018–2023 (Kasworm *et al.* 2024a, p. 17). Therefore, this recovery criterion has not been met. See Table 12 below for most current 6-year sum of observations data.

Table 12. Demographic recovery criterion 2 is measured by the number of bear management units (BMUs) occupied by females with young (cubs, yearlings, 2-year-olds, or young of unknown age), as determined by verified reports, for each 6-year sum of observations.

Bear Management Unit	2018	2019	2020	2021	2022	2023
Cedar				X		X
Snowshoe			X	X		X
Spar						
Bull		X	X			
St. Paul	X	X	X	X	X	X
Wanless	X			X	X	X
Silver Butte						
Vermilion						
Callahan						
Pulpit					X	
Roderick		X	X	X	X	X
Newton	X	X	X	X	X	X
Keno	X		X	X	X	
Northwest Peak	X		X	X	X	
Garver			X	X	X	X
East Fork Yaak			X	X	X	X
Big Creek		X	X	X	X	X
Boulder						
Grouse			X			
North Lightning					X	
Scotchman					X	
Mt. Headley						
Occupied during last 6 years						**16**

Demographic Recovery Criterion 3 for the CYE—Known, human-caused mortality cannot exceed 4 percent of the population estimate based on the most recent 3-year sum of females with cubs. No more than 30 percent shall be females. These mortality limits cannot be exceeded during any 2 consecutive years for recovery to be achieved.

Status: The target for the minimum number of unduplicated females with cubs in the first recovery criterion equates to the recovery goal of approximately 100 grizzly bears in the CYE recovery zone (Service 1993, p. 83). The 2021–2023 sum of unduplicated females with cubs (10) equates to a minimum estimated population size of 35 individuals (Service 1993, p. 102; Kasworm *et al.* 2024a, p. 17). Utilizing the minimum estimated population size, the total mortality limit is 1.4 bears per year and the female mortality limit is 0.4 bears per year. Ten known or probable human-caused mortalities of grizzly bears have occurred in or within 10 miles of the CYE recovery zone in the U.S. during 2018–2023, including 5 females and 5 males (Kasworm *et al.* 2024a, p.17). This means that average annual human-caused mortality for 2018–2023 was 1.7 bears per year and 0.5 females per year, which exceeds the calculated mortality limits for both total bears and for females. The recovery plan established a goal of zero human-caused mortality for this recovery zone until the minimum population reached approximately 100 bears. However, it also stated “In reality, this goal may not be realized because human-bear conflicts are likely to occur at some level within the ecosystem.” Therefore, even if the goal of zero mortality is not met, it is important to evaluate the recovery criterion to determine if we are making progress towards recovery. During the 2018–2023 reporting period total mortality and female mortality exceeded the limit by 0.3 bears per year and 0.1 bears per year, respectively. Recovery targets for 2010–2023 are shown in Table 13.

Table 13. Annual CYE recovery zone grizzly bear unduplicated counts of females with cubs, known and probable human-caused mortality, and recovery plan targets, 2010–2023.

YEAR	ANNUAL Females With Cubs	ANNUAL HUMAN-CAUSED ADULT FEMALE MORTALITY	ANNUAL HUMAN-CAUSED ALL FEMALE MORTALITY	ANNUAL HUMAN-CAUSED TOTAL MORTALITY	4% TOTAL HUMAN-CAUSED MORTALITY LIMIT	30% ALL FEMALE HUMAN-CAUSED MORTALITY LIMIT	TOTAL HUMAN-CAUSED MORTALITY 6-YEAR AVERAGE	FEMALE HUMAN-CAUSED MORTALITY 6-YEAR AVERAGE
2010	4	0	0	1	1.9	0.6	1.3	0.7
2011	1	0	0	4	1.4	0.4	1.3	0.3
2012	3	1	1	2	1.6	0.5	1.7	0.5
2013	2	0	0	0	1.2	0.4	1.5	0.3
2014	3	0	0	1	1.6	0.5	1.5	0.3
2015	2	0	0	3	1.6	0.5	1.8	0.2
2016	3	0	0	0	1.9	0.6	1.7	0.2
2017	3	0	0	0	1.9	0.6	1.0	0.2
2018	5	1	1	2	2.3	0.7	1.0	0.2
2019	2	1	1	2	1.9	0.6	1.3	0.3
2020	5	1	1	2	2.1	0.6	1.5	0.5
2021	2	0	0	0	1.6	0.5	1.0	0.5
2022	3	1	2	3	1.9	0.6	1.5	0.8
2023	2	0	0	1	1.4	0.4	1.7	0.5

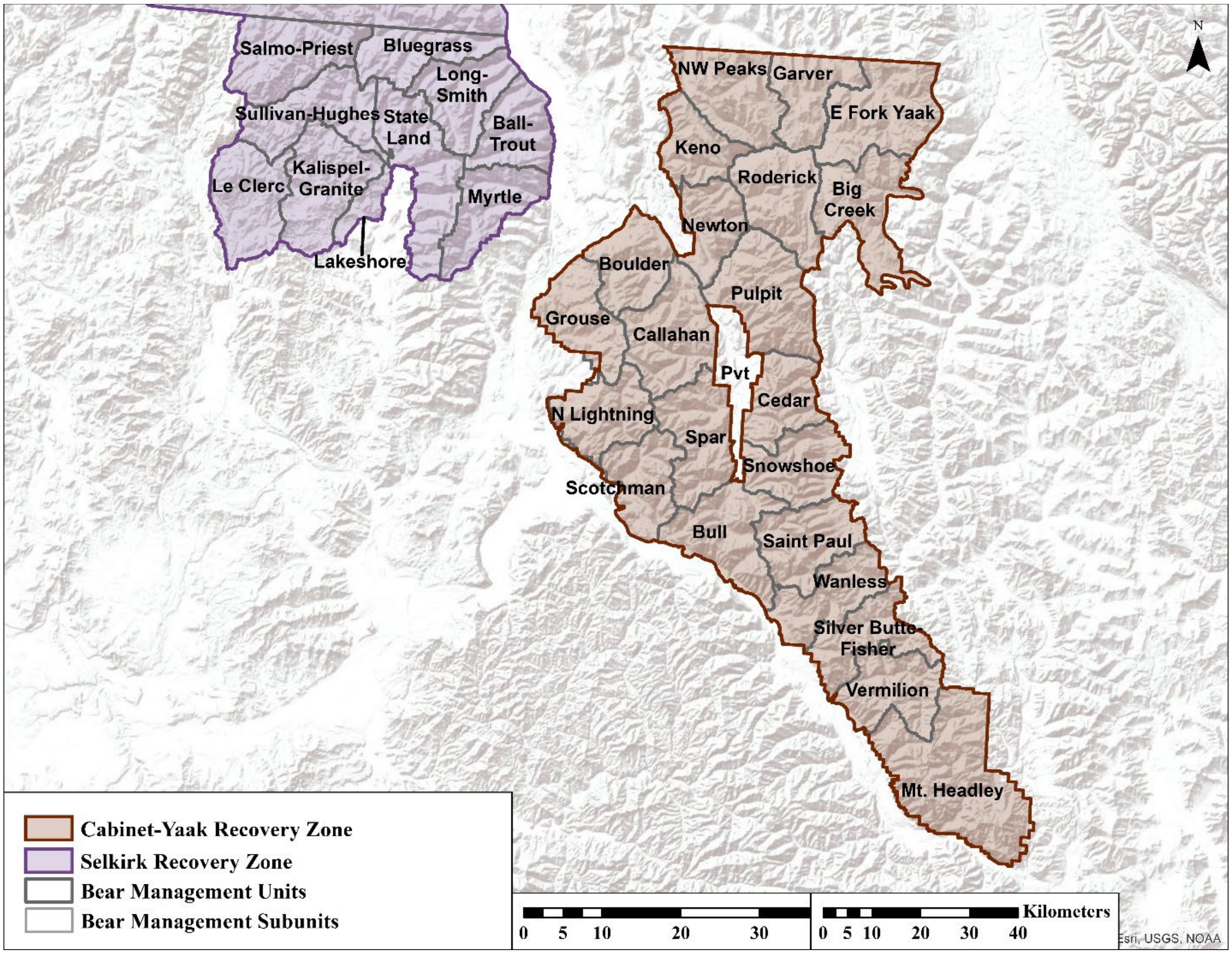


Figure 25. Bear Management Units (BMUs) for the Cabinet-Yaak and Selkirk Ecosystems.

Recovery Planning and Progress in the SE

The Selkirk area in the U.S. is the southern tip of the Selkirk Mountain Range that extends northward into B.C. The area of the U.S. portion is limited by the fact that the Selkirk range ends approximately 60 km (23 mi) south of the border. Because there is not sufficient area for a viable grizzly bear population on the U.S. side, and because the bears in the area regularly move across the border, a portion of the Selkirk Range on the B.C. side was included in the designated SE recovery zone (Service 1993, p. 101). The inclusion of this area brought the size of the SE to approximately 5,180 km^2 (2,000 mi^2), the size thought to be necessary to support a minimum population of 90 bears. It is recognized that the SE is contiguous with grizzly bear habitat northward into B.C., and that the 90 bears projected as the goal in this recovery zone are a subset of a much larger population. The population goal for the recovery zone is set to ensure sufficient bears exist throughout the area to ensure a continued population in the U.S. portion of this recovery zone.

The 1993 Recovery Plan outlines three demographic recovery criteria for the SE recovery zone:

Demographic Recovery Criterion 1 for the SE—Maintain six females with cubs over a running 6-year average both inside the recovery zone and within a 10-mile area immediately surrounding the recovery zone, including Canada.

Status: Unduplicated sightings of females with cubs (including Canada) varied from two to four per year and averaged 3.3 per year from 2018–2023 (Kasworm *et al.* 2024b, p. 13). This recovery criterion has not been met.

Demographic Recovery Criterion 2 for the SE—Maintain 7 of 10 BMU's (Figure 25) occupied by females with young from a running 6-year sum of verified evidence.

Status: Females with young occupied 9 of the 10 BMUs during 2018–2023 in the U.S. portion of the recovery zone (Kasworm *et al.* 2024b, p. 13). Therefore, this recovery criterion has been met. See Table 14 below for most current 6-year sum of observations data.

Table 14. Demographic recovery criterion 2 is measured by the number of bear management units (BMUs) occupied by females with young (cubs, yearlings, 2-year-olds, or young of unknown age), as determined by verified reports, for each 6-year sum of observations.

Bear Management Unit	2018	2019	2020	2021	2022	2023
Ball-Trout		X			X	
Blue Grass	X	X	X	X	X	X
Kalispell-Granite				X	X	
Lakeshore						
LeClerc	X			X	X	
Long-Smith	X	X	X	X		X
Myrtle	X		X	X	X	
Salmo-Priest				X	X	
State Idaho	X	X	X	X	X	X
Sullivan-Hughes				X	X	
Occupied during last 6 years						**9**

Demographic Recovery Criterion 3 for the SE—Known, human-caused mortality cannot exceed 4 percent of the population estimate based on the most recent 3-year sum of females with cubs. No more than 30 percent shall be females. These mortality limits cannot be exceeded during any 2 consecutive years for recovery to be achieved.

Status: The target for the minimum number of unduplicated females with cubs in the first recovery criterion equates to the recovery goal of approximately 90 grizzly bears in the SE recovery zone (Service 1993, p. 101). The 2021–2023 sum of unduplicated females with cubs (10) equates to a minimum estimated population size of 50 individuals (Service 1993, p. 102; Kasworm *et al.* 2024b, p. 14), the total mortality limit is 2.0 bears per year and the female mortality limit is 0.6 bears per year. Twelve known or probable human-caused mortalities of grizzly bears occurred in or within 10 miles of the SE recovery zone in the U.S. or in the B.C.

portion of the SE during 2018–2023, including 3 females (2 in the U.S. and 1 in B.C.), 8 males (6 in the U.S. and 2 in B.C.), and 1 unknown sex or age (in B.C.) (Kasworm *et al.* 2024b, pp. 13–14). This means that average annual human-caused mortality for 2018–2023 was 2.0 bears per year and 0.5 females per year, which were at or below calculated limits. The Recovery Plan established a goal of zero human-caused mortality for this recovery zone until the minimum population reached approximately 90 bears. However, it also stated "In reality, this goal may not be realized because human-bear conflicts are likely to occur at some level within the ecosystem." Therefore, even if the goal of zero mortality is not met, it is important to evaluate the recovery criterion to determine if we are making progress towards recovery. During the 2018–2023 reporting period we met the mortality limits. Recovery targets for 2010–2023 are shown in Table 15.

Table 15. Annual SE recovery zone grizzly bear unduplicated counts of females with cubs, known and probable human-caused mortality, and recovery plan targets, 2010–2023.

YEAR	ANNUAL Female with Cubs	ANNUAL HUMAN-CAUSED ADULT FEMALE MORTALITY	ANNUAL HUMAN-CAUSED ALL FEMALE MORTALITY	ANNUAL HUMAN-CAUSED TOTAL MORTALITY	4% TOTAL HUMAN-CAUSED MORTALITY LIMIT	30% ALL FEMALE HUMAN-CAUSED MORTALITY LIMIT	TOTAL HUMAN-CAUSED MORTALITY 6 YEAR AVERAGE	FEMALE HUMAN-CAUSED MORTALITY 6 YEAR AVERAGE
2010	0	1	1	1	0.0	0.0	1.5	0.7
2011	0	0	0	4	0.0	0.0	2.0	0.7
2012	1	1	1	2	0.0	0.0	1.8	0.7
2013	1	0	0	0	0.2	0.1	1.3	0.3
2014	3	2	2	2	0.4	0.1	1.5	0.7
2015	4	0	0	1	1.2	0.4	1.7	0.7
2016	3	0	0	1	1.6	0.5	1.7	0.5
2017	6	1	2	5	2.4	0.7	1.8	0.8
2018	4	0	0	0	2.4	0.7	1.5	0.7
2019	2	2	2	4	1.8	0.5	2.2	1.0
2020	4	0	1	2	1.6	0.5	2.2	0.8
2021	2	0	0	1	1.2	0.4	2.2	0.8
2022	4	0	0	3	2.0	0.6	2.7	0.8
2023	4	0	0	1	2.0	0.6	2.0	0.5

Recovery Planning and Progress in the BE

The 1996 Recovery Plan Supplement outlines three demographic recovery criteria for the BE recovery zone: (1) 14 females with cubs over a running 6-year average, subject to revision as more information becomes available; (2) delineation and occupancy of BMUs will be determined at a future date; (3) the goal for known, annual human-caused mortality remains zero until at least 90 grizzly bears are established. At that time, known, human-caused mortality is not to exceed 4 percent of the minimum estimate, with no more than 30 percent of this mortality limit shall be females (Service 1996, p. 4). The target for the minimum number of unduplicated females with cubs in the first recovery criterion equates to the recovery goal of approximately 280 grizzly bears.

Status: In the BE there is no known population and none of these demographic criteria have been met.

On April 26, 2023, the U.S. District Court of Montana ordered the Service to initiate a supplemental NEPA process and complete a Final EIS and, if warranted, a new ROD and final rule within 43 months. The Service published a notice to initiate the public scoping process, on January 17, 2024.

Recovery Planning and Progress in the North Cascades

The Recovery Plan Supplement for the North Cascades did not establish specific demographic criteria for numbers of females with young, BMUs occupied (Figure 26), or sustainable levels of human-caused mortality due to a lack of information for the ecosystem (Service 1997, p. 3). However, the Recovery Plan sets a recovery goal in the North Cascades of 200–400 grizzly bears in the U.S. portion of the ecosystem (Service 1997, p. 3). The first action set forth in the supplement is to "establish the population objective for recovery and identify the limiting factors" (Service 1997, p. 5). The supplement established a goal of zero known, human-caused mortalities (Service 1997, p. 4). There have been zero human-caused grizzly bear mortalities in the North Cascades. However, we are not meeting recovery goals in the North Cascades, and we do not have a verified grizzly bear population on the U.S. side at this time. The supplement describes a recovered population as "one that: (a) has the capability to offset human-caused mortality; (b) is large enough to survive the effects of demographic and environmental stochasticity; and (c) is well distributed throughout the ecosystem (based on BMU occupancy by females with young)."

In 2017, the Service and North Cascades National Park released a range of alternatives to recover the grizzly bear population in the North Cascades. The draft EIS addressed several proposed action alternatives, all of which proposed to achieve a restoration goal of 200 grizzly bears in the North Cascades. The action alternatives differed in the rate and total number of grizzly bears released, and the timeframe for achieving the restoration goal of 200 grizzly bears. The proposed restoration proved controversial, and in response to a congressional request included in an appropriations bill, a second comment period on the draft EIS was opened in July 2019. On July 7, 2020, the Service and NPS announced their decision to discontinue the proposal to develop and implement a Grizzly Bear Restoration Plan for the North Cascades Ecosystem. In November 2022, the Service and NPS announced initiation of a new EIS process to evaluate options for restoring and managing grizzly bears in the North Cascades, including a 10(j) experimental population designation. On September 29, 2023, the NPS and Service opened a public comment period on a draft EIS to evaluate restoration of grizzly bears to the North Cascades (88 FR 67277; NPS and Service 2023, entire) and on a proposed 10(j) rule that would allow management flexibility for a reintroduced population (88 FR 67193, September 29, 2023). On March 21, 2024, the Service and NPS released a final EIS identifying translocation of grizzly bears to the North Cascades with an experimental designation as the preferred alternative (NPS and Service 2024a, entire). On April 25, 2024, the NPS and Service published a ROD to release an experimental population of grizzly bears in that ecosystem with the goal of establishing an initial population of 25 grizzly bears and then continuing to monitor and adaptively manage the population (NPS and Service 2024a, pp. v–vi; 2024b, entire). In addition, the Service designated the North Cascades as a nonessential experimental population under section 10(j) of the Act (89 FR 36982, May 3, 2024, codified at 50 CFR 17.84(y)).

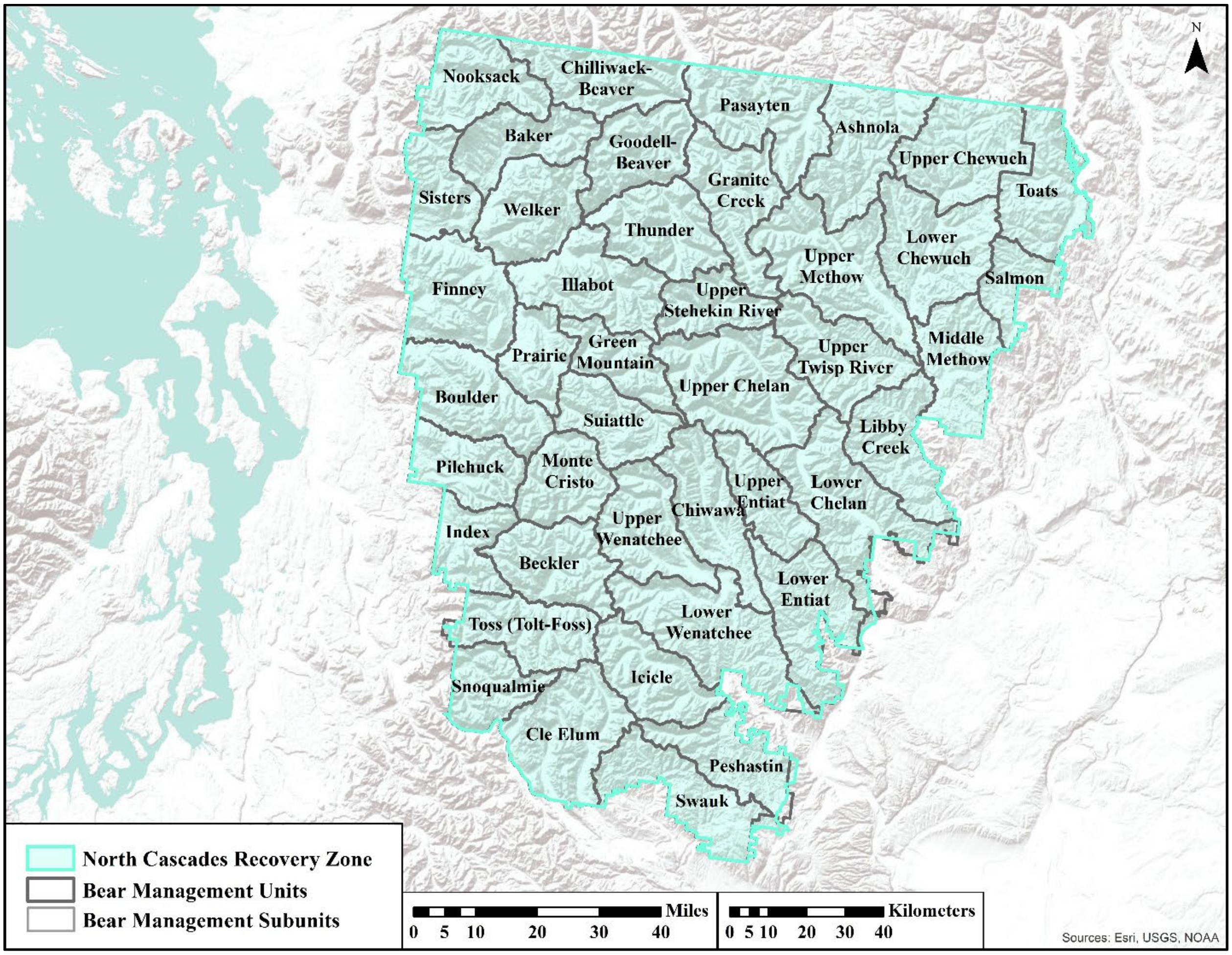


Figure 26. Bear Management Units (BMUs) for the North Cascades Ecosystem.

Conservation Strategies

A conservation strategy is one of two separate delisting requirements outlined in the Recovery Plan. The plan sets forth two criteria for delisting: that recovery criteria are met, and the development and completion of an interagency conservation strategy that will ensure that adequate regulatory mechanisms will continue to be present after delisting (Service 1993, p. 16). The strategy should list legal authorities, policy, management programs, and the continued commitment of management agencies to maintain a high standard of management after delisting of the grizzly bear population. Interagency groups have completed conservation strategies for the GYE and NCDE. In 2022, the Selkirk-Cabinet-Yaak Subcommittee convened a technical team to draft a Conservation Strategy. The Conservation would include the development of a mortality-management framework in partnership with the States, other Federal Agencies, and Tribes in the CYE and SE, and is not yet complete.

Chapter 4: Needs of the Grizzly Bear in the Lower-48 States

The needs of a species can be evaluated hierarchically, starting at the lowest level with an individual's basic resource needs for breeding (including all stages of reproduction), feeding, sheltering, and dispersal. Then, needs can be described at the population and species levels by describing resiliency needed for populations to withstand stochastic events, redundancy to withstand catastrophic events, and representation to adapt to environmental change. In this chapter, we summarize these needs for grizzly bear individuals, grizzly bears at the ecosystem level, and grizzly bears in the lower-48 States. Our understanding of individual, ecosystem, and lower-48 States needs presented were derived from our discussion of life history and ecology in Chapter 2. For the grizzly bear in the lower-48 States, habitat factors that individuals need are habitat security, cover, high-caloric foods, and dens (Figure 27). Demographic factors important to monitor for grizzly bears within each ecosystem include, fecundity, survival, genetic diversity, population trend, abundance, and connectivity, depending on the population size (Figure 27). Together, the habitat and demographic factors influence the resiliency of grizzly bears within each ecosystem. In general, the grizzly bear in the lower-48 States needs a sufficient number and distribution of ecosystems with ecological and genetic diversity across the range to withstand catastrophic events and adapt to environmental change. We discuss these needs below.

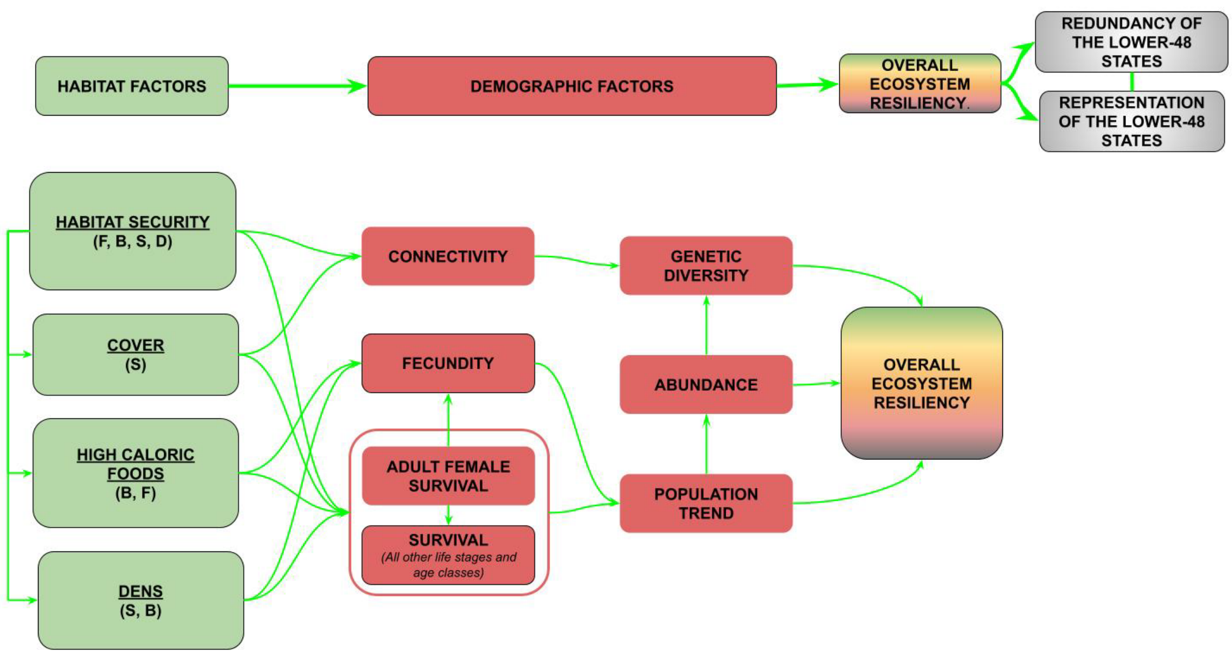


Figure 27. Conceptual model for grizzly bear ecosystem resiliency, in terms of habitat factors (green boxes) needed by individuals to breed (B; includes all stages of reproduction), feed (F), shelter (S), and disperse (D), and demographic factors (red boxes) that ecosystems need to be resilient. Green arrows represent positive relationships between nodes. The core conceptual model is provided at the top of the figure for reference.

Individual Needs

In general, a grizzly bear's individual habitat needs, and the daily movements needed to find these resources, are largely driven by the search for food, water, mates, cover, security, or den sites. We identified the following four habitat factors needed by individual grizzly bears to successfully move from one life stage to the next:

- Habitat security (i.e., habitat that is relatively undisturbed by human influence), needed by all life stages to breed, feed, shelter, and disperse;
- Cover, needed by all life stages to shelter;
- High-caloric foods, needed by all life stages to feed and breed; and
- Dens as shelter for all life stages, and specifically for females that are pregnant or with offspring.

Habitat security influences the quality and quantity of the other three resource needs, which highlights the importance of this habitat factor to all life stages. The larger, more secure, and diverse the habitat, it follows that high-caloric foods, dens, and cover would be more readily available to individuals. We describe each of these habitat needs in more detail below.

Habitat Security

Grizzly bears need habitat security of sufficient size to accommodate their large annual home range sizes (Table 5) and provide breeding range, high-caloric foods, cover for shelter, dens for hibernation, and areas for dispersal (Mace *et al.* 1996, pp. 1402–1403; Schwartz *et al.* 2010a, p. 661). Grizzly bears also need habitat with limited human influence and thus low potential for displacement and human-bear interactions that could result in human-caused mortality or other conflicts, such as development or livestock grazing (Service 1993, p. 21; Craighead and Mitchell 1982, p. 530; Schwartz *et al.* 2010a, p. 661–662). Secure large blocks of land generally have protections with limited motorized access and developed sites, and low risk of habitat loss and fragmentation.

High-Caloric Foods

As described in Chapter 2, grizzly bears need high-caloric foods throughout the non-denning period to satisfy nutritional requirements for feeding and breeding. Before winter, high-caloric foods are particularly important as bears prepare to hibernate in dens, where they will rely on fat stores to overwinter. In general, grizzly bears need a sufficient quantity and diversity of natural, high-caloric foods.

Dens (Breeding and Sheltering)

As described in Chapter 2, hibernation is a central aspect of grizzly bear life history. Hibernation is a life history strategy bears use to cope with seasons of low food abundance. All life-stages of bears use this strategy when and where foot shortages exist. In order to successfully hibernate, grizzly bears need dens that provide sufficient protection from environmental conditions and from human disturbance.

Cover (Sheltering)

As described in more detail in Chapter 2, grizzly bears need sufficient cover to shelter from environmental or human-caused factors. Grizzly bears need cover to avoid humans and rest safely. Cover may include forests, riparian areas, or other vegetative or structural sources.

Ecosystem-Level Needs

We evaluated the ecosystem-level needs of grizzly bears in terms of the demographic factors each ecosystem needs to be resilient. We identified six primary demographic factors that are important to resiliency of an ecosystem (Figure 27, above):

- Abundance;
- Population trends;
- Adult female survival;
- Survival of all other life stages;
- Fecundity;
- Connectivity; and
- Genetic diversity.

In general, an ecosystem needs sufficient levels of each of these demographic factors in order to be resilient. The greater each demographic factor, the greater the resilience of grizzly bears within the ecosystem. Adult female survival influences abundance and population trends more than survival rates of males or dependent young (Eberhardt 1977, p. 210; Knight and Eberhardt 1985, p. 331; Schwartz *et al.* 2006c, p. 48). For example, low adult female survival contributed to the grizzly bear population decline in the GYE prior to the mid-1980s (Knight and Eberhardt 1985, p. 331). Female movement within and between ecosystems influences population trend (Proctor *et al.* 2012, pp. 5, 26–28) and abundance (Service 1993, pp. 27, 83, 101; Service 1997, p. 29). Connectivity also influences the genetic diversity of grizzly bears in the ecosystem. Male and female movements within and between ecosystems can enhance genetic diversity and reduce genetic fragmentation (Miller and Waits 2003, pp. 4337–4338; Proctor *et al.* 2005, pp. 27–28; Proctor *et al*. 2018, p. 361).

Lower-48-States-Level Needs

We evaluate needs at the lower-48 States level in terms of the circumstances that support the redundancy and representation of grizzly bears in the lower-48 States.

Redundancy

Redundancy describes the ability of a species to withstand catastrophic events. Redundancy gauges the likelihood that grizzly bears in the lower-48 States can withstand or "bounce back" from catastrophic events such as rare destructive natural events or episodes involving multiple or large portions of ecosystems. In general, well-distributed species are considered more redundant than species confined to a narrower geographic distribution (Carroll *et al.* 2010, pp. 5–6; Redford *et al.* 2011, entire; Smith *et al.* 2018, pp. 306–307). Grizzly bears in the lower-48 States need multiple resilient ecosystems distributed across a geographical area to reduce the risk of catastrophic events. A sufficiently wide distribution of grizzly bears across multiple ecosystems reduces the risk of all populations being exposed to the same catastrophic event at the same time, thereby reducing risk to the species.

Representation

Representation describes the ability of a species to adapt to changing environmental conditions. The breadth of genetic, ecological, behavioral, morphological, and physiological diversity within and among populations can be a measure of representation (Smith *et al.* 2018, pp. 306–307). Ultimately genetic diversity provides for morphological and behavioral plasticity that allows a species to respond to various environments (i.e., inhabit and thrive in various habitat types). Representation gauges the probability that the grizzly bear is capable of responding to a change in its environment. The more representation or diversity a species has (genetic, morphological, and/or behavioral), the more capable it is of adapting to changes (natural or human caused) in its environment. For grizzly bears in the lower-48 States, we considered genetic and ecological diversity for representation across the six ecosystems. Grizzly bears need sufficient genetic and ecological diversity across their range in the lower-48 States to adapt to changing environmental conditions. Grizzly bears also display dietary adjustability across ecosystems and exploit a broad diversity of habitat types.

Summary of Grizzly Bear Needs in the Lower-48 States

Grizzly bears in the lower-48 States need access to habitat security that provide cover, high-caloric foods, dens, and areas for dispersal. The specific quality and quantity of these resources influence the ability of individual grizzly bears to reproduce, grow, and survive at different life stages. These resources support resilient ecosystems, which may be characterized generally by abundance, trends, survival rates, and connectivity levels that are sufficient to withstand environmental stochasticity and support fecundity. Specific quantities or qualities needed for each of these factors may vary by ecosystem. In general, grizzly bears in the lower-48 States need multiple, resilient ecosystems distributed across a broad range in order to be redundant and withstand catastrophic events. Additionally, grizzly bears in the lower-48 States in general need genetic and ecological diversity to preserve variation and adapt to changing conditions.

Chapter 5: Cause-and-Effects – Stressors and Conservation Efforts

Before we evaluate current and future conditions, we explore the environmental changes, whether natural or anthropogenic, that may have occurred to result in the species' current condition and that may influence condition into the future (Service 2016, p. 14). In this chapter, we discuss the causes-and-effects that may influence the viability of the grizzly bear in the lower-48 States, by either directly or indirectly affecting the habitat or demographic resources that we identified as needs in Chapter 4. In order to inform our evaluations of current and future condition, we evaluated the sources, stressors, and activities that can positively (conservation actions) or negatively (stressors) affect grizzly bears at the individual, ecosystem, or lower-48 States level, either currently or into the future. By identifying the anthropogenic and natural factors that influence the habitat and demographics of the grizzly bear, we can evaluate the current and future resiliency of each ecosystem, and the cumulative effects on those ecosystems determine conditions related to redundancy and representation.

A stressor is a change in a habitat or demographic resource, such as a decrease in high-caloric foods or decrease in abundance. Some stressors may directly influence the demographics of an ecosystem through mortality of individuals resulting from actions or activities, such as vehicular strikes, while others, such as development on private lands, may affect habitat factors that may indirectly affect individuals by influencing demographic factors. Some stressors may directly affect individuals and habitat factors at the same time. The stressors that we evaluated for grizzly bears include:

- Motorized access and its management;
- Developed recreation sites;
- Livestock allotments;
- Mineral and energy development;
- Recreation;
- Vegetation management, such as prescribed burns and riparian area protections;
- Habitat fragmentation;
- Development on private lands;
- Activities that may disturb dens;
- Sources of human-caused mortality, including;
    - Management removals;
    - Accidental killings (automobile and train collisions, drowning, poisoning, capture-related);
    - Mistaken-identity kills;
    - Illegal killings;
    - Defense-of-life kills; and
    - Undetermined human-caused mortalities;
- Natural mortality;
- Connectivity and genetic health;
- Changes in food resources;
- Effects of climate change; and
- Stochastic events, such as earthquakes and volcanic eruptions.

Conservation efforts that either reduce a stressor(s) or improve the condition of habitat or demographics include:

- Federal land protections, such as motorized access restrictions, the Wilderness Act, and Inventoried Roadless Areas (IRAs);
- Attractant removal or storage, such as food storage orders and community sanitation measures;
- Conservation easements and other private land trust acquisitions;
- Information and education (I&E) programs;
- Augmentation or translocation programs;
- State and private forestlands with motorized access restrictions; and
- Effective law enforcement.

Figure 28 provides a conceptual model for how stressors and conservation efforts may influence individuals and the resiliency of grizzly bear ecosystems. Although conservation efforts occur primarily on Federal lands, they occur across multiple ownerships including but not limited to State, Tribal, and private lands.

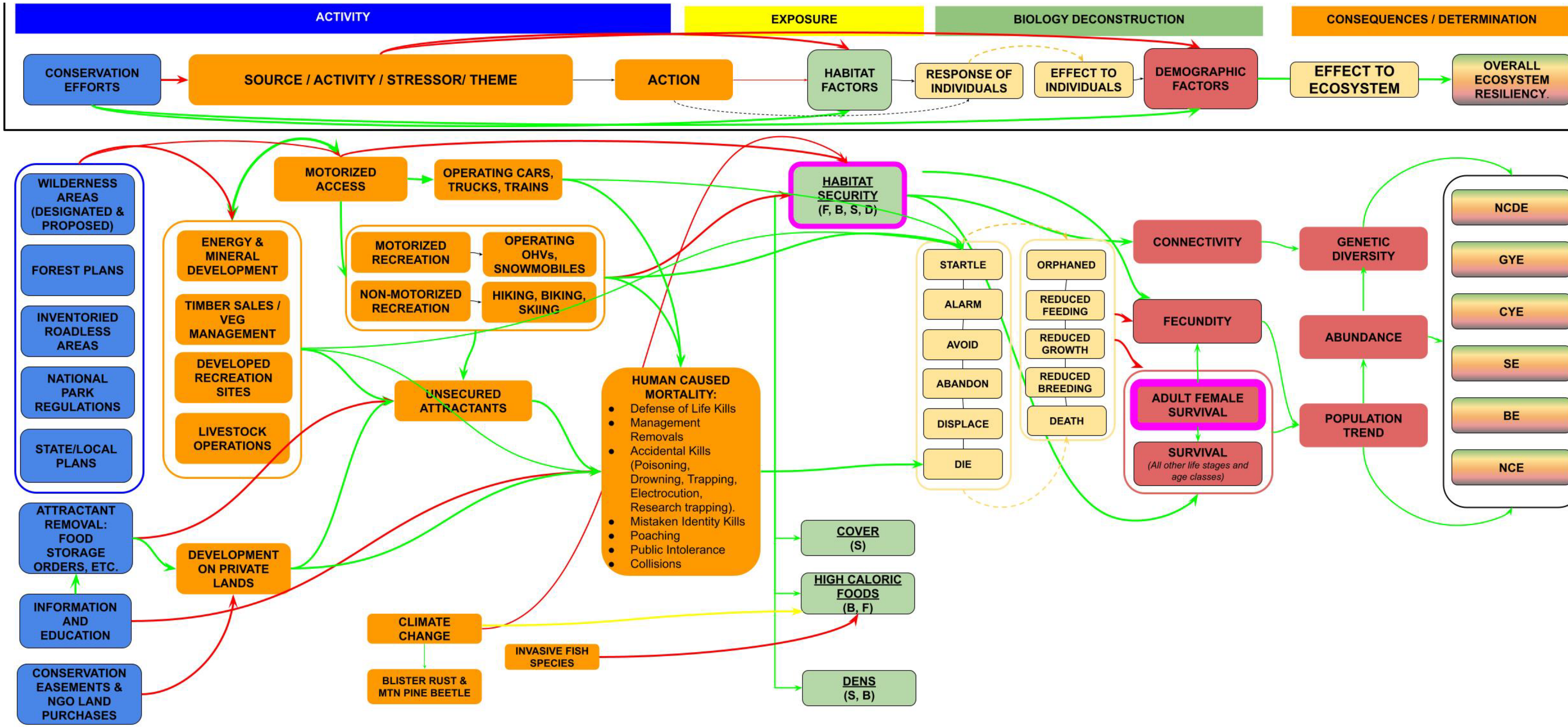


Figure 28. A conceptual model for the primary causes-and-effects (stressors and conservation efforts) that may influence the resiliency of grizzly bear populations within ecosystems in the lower-48 States. The core conceptual model for resiliency at the top of the figure has been expanded to include activity and exposure pathways and is included for reference. We also evaluated potential effects of natural mortality, connectivity and genetic health, stochastic events such as earthquakes and volcanic eruptions, potential future effects associated with legal hunting, which are not displayed in this conceptual model. Green arrows represent positive relationships between nodes, red arrows represent negative relationships between nodes, and yellow arrows represent relationships that can be a combination of positive and negative. B = breeding (includes all stages of reproduction); F = feeding; S = sheltering; D = dispersal. There are numerous other relationships that have less significant influences that are not represented with arrows in this figure, such as the contribution of demographic connectivity to abundance and population trend.

Habitat-Related Effects

Protected Areas

Wilderness Areas, Proposed Wilderness, Recommended Wilderness, Wilderness Study Areas (WSAs), and IRAs can enhance the security of habitat for grizzly bears since these designations protect grizzly bear habitat from new road construction, new oil and gas development, new livestock allotments, and timber harvest (Figure 29).

The Wilderness Act of 1964 (16 U.S.C. 1131 *et seq.*) does not allow for timber harvest, new road construction, new livestock allotments, new developed sites, or new mining claims in designated Wilderness areas, with the exception of valid existing rights. If pre-existing valid mining claims are pursued, the plans of operation are subject to reasonable regulation to protect wilderness values with mitigation to offset any remaining potential impacts from development.

Recommended wilderness is managed as wilderness until Congress either formally designates the lands as wilderness or releases them to non-wilderness multiple use management (NPS 2006, pp. 79–80). These areas were recommended by the land management agency, based on a wilderness study, for consideration for designation as Wilderness. WSAs (Wilderness Study Act of 1977) have been designated by Congress as areas having wilderness characteristics and warranting further study by Federal land management agencies (e.g., USFS or BLM) and consideration by Congress as formally designated Wilderness. Individual NFs manage WSAs to maintain their wilderness characteristics, generally until Congress acts to either designate them as permanent Wilderness or releases them to multiple use management. This generally means that individual WSAs are protected from timber harvest, new road construction, new livestock allotments, and new developed sites, subject to valid existing rights. If mining claims are pursued, the plans of operation are subject to reasonable regulations to protect wilderness values with mitigation to offset any remaining potential impacts from development. Existing uses at the time of creation of the WSAs are generally allowed to continue so long as the wilderness characteristics of the area are maintained.

The 2001 Roadless Areas Conservation Rule (66 FR 3244, January 12, 2001; hereafter referred to as the "Roadless Rule") prohibits new road construction, road re-construction, and commercial timber harvest in IRAs on Federal lands. The Roadless Rule contains limited exceptions that allows for some timber harvest and road reconstruction (see 66 FR 3272–3273, January 12, 2001). If mining claims are pursued, the plans of operation are subject to reasonable regulations to protect roadless characteristics with mitigation to offset any remaining potential impacts from development. Motorized roads and trails may exist within IRAs subject to forest travel management plans. Potential changes in the management of these areas are not anticipated because the Roadless Rule was upheld by the Tenth Circuit Court of Appeals in 2011. (See *Wyoming* v. *USDA*, 661 F.3d 1209 (10^{th} Cir. 2011)).

These lasting land designations ensure that large proportions of recovery zones and additional areas outside the recovery zones remain secure for grizzly bears into the future without the development of new roads, extractive industries, or other human structures.

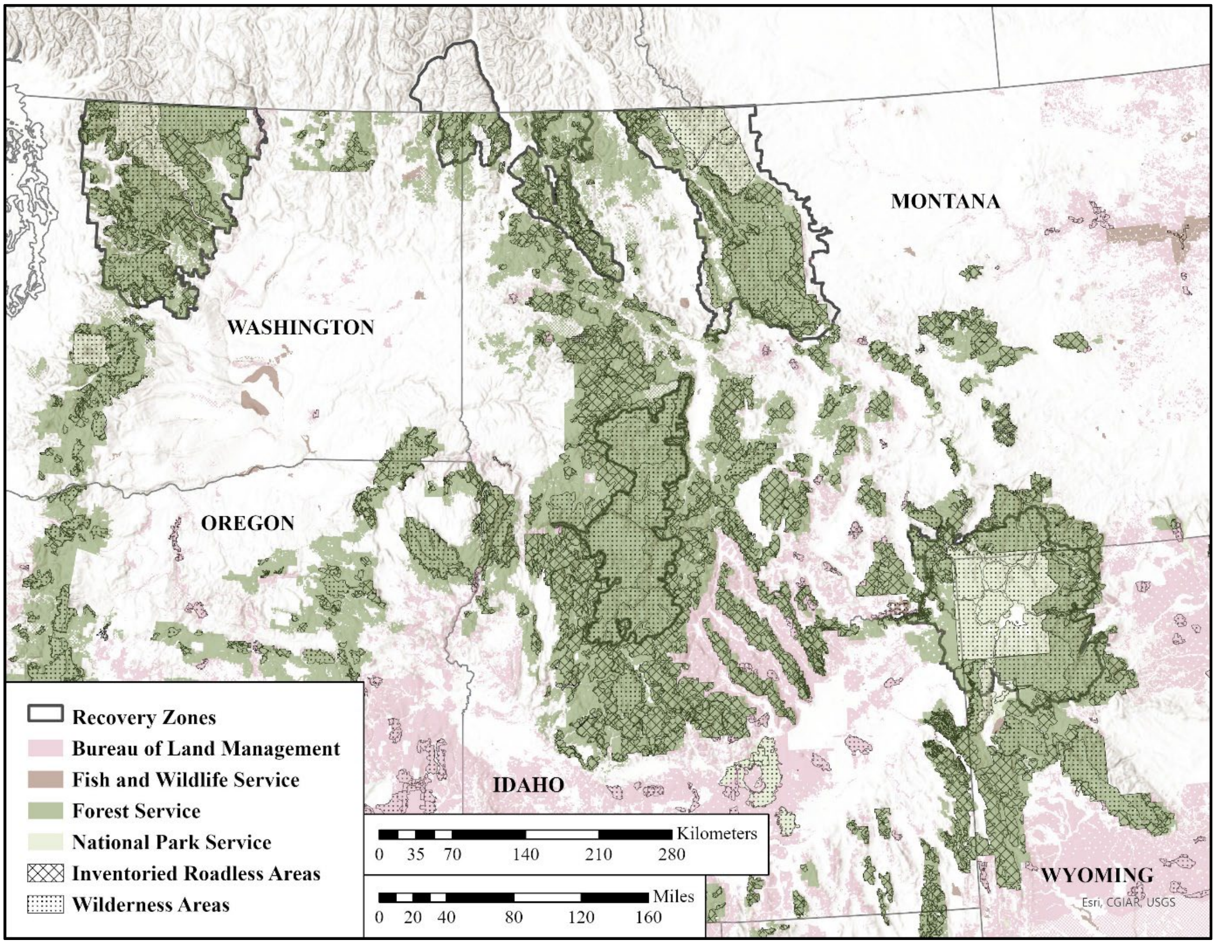


Figure 29. Federal lands, Wilderness Areas, and Inventoried Roadless Areas within and between the six grizzly bear recovery zones. Wilderness areas include congressionally designated Wilderness Areas, Wilderness Study Areas, and recommended Wilderness Areas within Glacier, Yellowstone, and Grand Teton National Parks.

Protected Areas inside the GYE

The GYE recovery zone is 23,853 km^2 (9,210 mi^2) in size. Ninety-eight percent of the Recovery Zone is federally managed land, including all of YNP, as well as portions of GTNP, the Shoshone, Beaverhead-Deerlodge, Bridger-Teton, Caribou-Targhee, and Custer Gallatin NFs. Approximately 82 percent (19,642 km^2 of 23,853 km^2 (7,583 mi^2 of 9,210 mi^2)) of lands inside of the GYE recovery zone are considered "protected lands." These protected lands include Congressionally designated Wilderness Areas (36 percent: Absaroka-Beartooth, Jedediah Smith, Lee Metcalf, North Absaroka, Teton, Washakie, and Winegar Hole Wilderness Areas), other Wilderness (35 percent; e.g., Recommended, Potential, and Eligible Wilderness in YNP, GTNP, and the John D. Rockefeller, Jr. Memorial Parkway), and IRAs (11 percent of the recovery zone).

Specifically, 16,950 km^2 (6,544 mi^2) of the recovery zone is Wilderness (8,610 km^2 (3,324 mi^2)), recommended wilderness (8,253 km^2 (3,187 mi^2)), or eligible wilderness (87 km^2 (33 mi^2)). This secure suitable habitat is biologically significant to the GYE grizzly bear population because it allows for protections against human activities inside the recovery zone, in addition to the 1998 baseline (for further details on the protections provided by the 1998 baseline, see *Motorized Access in the GYE*, *Developed Sites in the GYE,* and *Livestock Allotments in the GYE,* below). Recommended wilderness in YNP and GTNP will be managed as wilderness until Congress has either formally designated the lands as wilderness or releases them to non-wilderness multiple use management (NPS 2006, pp. 79–80).

IRAs currently provide 2,239 km^2 (864 mi^2) of secure habitat for grizzly bears inside the recovery zone. This amount of secure habitat is less than the total area contained within IRAs (2,692 km^2 (1,039 mi^2)) because some motorized use occurs due to roads that existed before the area was designated as roadless.

In addition, a large proportion of suitable habitat outside the recovery zone remains secure for grizzly bears into the future without the development of new roads, extractive industries, or other human structures because of lasting designation as Wilderness, WSAs, and IRAs. Of the 23,131 km^2 (8,931 mi^2) of suitable habitat outside of the recovery zone in the GYE, 59 percent (13,685 km^2 (5,284 mi^2)) is managed and protected by the USFS as Congressionally designated Wilderness (6,799 km^2 (2,625 mi^2)), WSAs (708 km^2 (273 mi^2)), or IRAs (6,179 km^2 (2,386 mi^2)). This area of secure habitat is less than the total area contained within IRAs (8,871 km^2 (3,425 mi^2)) because some motorized use occurs due to roads that existed before the area was designated as roadless.

Protected Areas inside the NCDE

The NCDE recovery zone is 23,135 km^2 (8,932 mi^2) in size. Seventy-nine percent of the recovery zone is federally managed land, including all of GNP, as well as portions of the Flathead, Helena-Lewis and Clark, Kootenai, and Lolo NFs, and the Flathead (FIR) and Blackfeet Indian Reservations (BIR). Nearly 67 percent (15,653 km^2 of 23,119 km^2 (6,044 mi^2 of 8,926 mi^2)) of lands inside the recovery zone are considered "protected lands." These protected lands include Congressionally designated Wilderness Areas (30 percent: Bob Marshall, Great Bear, Mission Mountains, Rattlesnake, and Scapegoat Wilderness Areas), other Wilderness (18 percent; e.g., WSAs, Recommended Wilderness, and Confederated Salish & Kootenai Tribes (CS&KT) Wilderness), and restricted motorized-use areas (19 percent; IRAs, Tribal roadless areas, Tribal Primitive Areas, and NRAs). This secure core habitat is biologically significant to the NCDE grizzly bear population because it allows for protections against human activities inside the recovery zone, in addition to the 2011 baseline (for further details on the protections provided by the 2011 baseline, see *Motorized Access in the NCDE*, *Developed Sites in the NCDE,* and *Livestock Allotments in the NCDE,* below).

As discussed above, the Wilderness Act of 1964 does not allow for new road construction, new developed sites, or mining claims in designated Wilderness, with the exception of valid existing rights. There are approximately 196 pre-existing mining claims on USFS lands located in 1 of the 23 BMUs inside the recovery zone (Krenzelok 2024, *in litt.*). If pre-existing valid mining claims are pursued, the plans of operation are subject to reasonable regulation to protect wilderness values with mitigation to offset any remaining potential impacts from development.

There are two Tribal wilderness areas within the recovery zone, the Mission Mountains and the Sleeping Woman (Ninemile Divide) that are designated through Tribal Ordinances (Ordinance 79A; Resolution 82-173) which prohibits the building of roads or the use of motorized equipment "except as necessary to meet the minimum requirements for administration of the Area." In addition, Resolution 86-47 provides for a Buffer Zone around the Mission Mountain wilderness area to reduce the impacts of activities that may occur in non-wilderness areas on Tribal Wilderness. Additional protections occur on the FIR in Tribal primitive areas and Tribal roadless areas. There is one Tribal primitive area on the FIR within the recovery zone, the South Fork Jocko Primitive Area that is 181 km^2 (70 mi^2) (Tribal Resolutions 4575), on which there will be no commercial forest activities and no net increase in open roads (CS&KT 2000, p. 91). Tribal primitive areas are only open to Tribal members and their immediate non-member family members to provide for "solitude and an unconfined type of recreation." In addition, there are several roadless areas, the Ravalli/Valley (Hewolf) Complex (32 km^2 (12 mi^2)) and Burgess (7 km^2 (3 mi^2)), that are unavailable to motorized use and logging or only allow helicopter logging (CS&KT 2000, pp. 91, 141).

Proposed and recommended wilderness on the Flathead NF, Lolo NF, and GNP will be managed as wilderness until Congress has either formally designated the lands as wilderness or releases them to non-wilderness multiple use management (USDA FS 1986c, p. III-37; GNP 1999, p. 8; NPS 2006, pp. 79–80; USDA FS 2018c, pp. 89–90; USDA FS 2018f, p. 318). Portions of the Rattlesnake NRA on the Lolo NF are recommended wilderness. The non-wilderness portion of the Rattlesnake NRA is designed to balance the needs of dispersed, non-motorized recreation and restoration (USDA FS 1986c, pp. III-144–149).

In addition, five percent (748 km^2 (289 mi^2)) of Zone 1 is protected as Wilderness, WSAs, or IRAs. At 105 km^2 (40 mi^2), the Rattlesnake NRA overlaps the recovery zone but primarily occurs within Zone 1. Within the Ninemile DCA, 22 percent of the lands are managed by the Lolo NF as IRAs and 18 percent are managed by the CS&KT as wilderness and roadless areas. In Zone 2, 10 percent (1,944 km^2 (751 mi^2)) is protected as Wilderness, WSAs, or IRAs.

Protected Areas inside the CYE

The Cabinet-Yaak recovery zone is 6,705 km^2 (2,589 mi^2) in size. Nearly 98 percent of the recovery zone is federally managed land, including portions of the Kootenai, Idaho Panhandle, and Lolo NFs. Blocks of contiguous habitat extend into B.C., making this an international population. Within the CYE recovery zone, 44 percent of lands are protected as designated Wilderness (Cabinet Mountain Wilderness: 379 km^2 (146 mi^2)) or IRAs (2,568 km^2 (992 mi^2)).

Protected Areas inside the SE

The Selkirk Mountains recovery zone is 6,575 km^2 (2,539 mi^2) in size and is unique in that the recovery zone extends north into Canada, with approximately half of the recovery zone (3,020 km^2 (1,116 mi^2) occurring in the U.S. Nearly 79 percent of the recovery zone in the U.S. is federally managed land, including portions of the Idaho Panhandle and Colville NFs. Within the U.S. portion of the SE recovery zone, nearly 38 percent of lands are protected as designated

Wilderness (Salmo-Priest Wilderness: 167 km^2 (65 mi^2)), recommended wilderness (60 km^2 (23 mi^2) on the Colville National Forest Plan also includes) or IRAs (907 km^2 (350 mi^2). In B.C., 82 percent of the recovery zone is managed by the province.

Protected Areas inside the BE

The BE recovery zone includes about 14,984 km^2 (5,785 mi^2) of contiguous national forest lands in central Idaho and western Montana. The recovery zone focuses on wilderness, with 98 percent (14,840 km^2 (5,730 mi^2)) of the recovery zone designated Wilderness, including the Selway-Bitterroot Wilderness and the Frank Church-River of No Return Wilderness. Additional protected areas surround the recovery zone, including the Gospel Hump Wilderness Area (810 km^2 (313 mi^2)) to the west of the recovery zone and large areas to the north of the recovery zone that are protected as IRAs (18,325 km^2 (7,075 mi^2)).

Protected Areas inside the North Cascades

The North Cascades recovery zone is 25,322 km^2 (9,777 mi^2) in size, including 97 percent public lands. The recovery zone includes all of the NCNP Complex, most of the Mount Baker-Snoqualmie and Wenatchee-Okanogan NFs, and the westernmost unit of the Colville NF. Eleven percent (2,755 km^2 (1,064 mi^2)) of the recovery zone is protected by the NPS (NCNP Complex). Sixty-four percent of lands are protected as designated Wilderness (10,843 km^2 (4,189 mi^2)) or as IRAs (5,123 km^2 (1,978 mi^2)). Eight of the Wilderness areas are contiguous to each other for a combined area of 9,052 km^2 (3,497 mi^2). As a whole, 53 percent (13,480 km^2 (5,205 mi^2)) of the North Cascades is comprised of contiguous Wilderness and IRAs to support grizzly bear restoration into the future without the development of new roads, extractive industries, or other human structures.

Motorized Access

When we listed the grizzly bear in 1975, we acknowledged that human access to formerly secure grizzly bear habitat made bears more susceptible to human-caused conflicts and increased human-caused mortality (40 FR 31734, July 28, 1975). We recognized that managing human access to grizzly bear habitat would be the key to effective habitat management by reducing human-caused mortality and increasing habitat effectiveness. An extensive body of literature supports this approach (Mattson *et al.* 1987, pp. 269–271; McLellan and Shackleton 1988, pp. 458–459; McLellan 1989, pp. 1862–1864; Mace *et al.* 1996, pp. 1402–1403; Schwartz *et al.* 2010a, p. 661; Boulanger *et al.* 2013, p. 283; McLellan 2015, p. 12; Proctor *et al.* 2019, entire). Unmanaged motorized access impacts grizzly bears

- Increasing human-grizzly bear interaction and grizzly bear mortality risk;
- Increasing displacement from important habitat;
- Increasing habituation to humans; and
- Decreasing available habitat where energetic requirements can be met.

The Interagency Grizzly Bear Committee Taskforce Report recognized that these impacts could be minimized through motorized access management (IGBC 1998, p. 1). The Taskforce Report recommended three parameters for a consistent approach to motorized access management between and within the grizzly bear ecosystems: (1) open motorized route density, (2) total motorized route density, and (3) core areas (IGBC 1998, p. 1). Although the Taskforce Report defined each of these parameters, it recognized that each ecosystem subcommittee would apply the recommendations based on ecosystem-specific information and recommend ecosystem specific habitat conditions that should be maintained to provide habitat security. See *Appendix B* for further details on the differences in secure core/core area/secure habitat definitions between ecosystems.

In general, motorized access brings humans into grizzly bear habitats, and increased human presence may disturb, displace, or kill grizzly bears if human-interactions trigger activities that are associated with human-caused mortality, such as defense-of-life kills or management removals (Figure 28, above). Motorized access includes the operation of vehicles and other equipment along roads, highways, trails, and tracks, and it facilitates motorized and non-motorized forms of recreation into grizzly bear habitats. In addition to facilitating access to recreation, energy and mineral development, vegetation management, developed sites, and livestock operations may also necessitate motorized routes and thus provide additional sources of this stressor (Figure 28, above). Motorized access may indirectly influence the resiliency of ecosystems by reducing the quality and quantity of habitat security (Figure 28, above). It may also directly influence the resiliency of ecosystems by reducing demographic factors, such as abundance or survival, if individuals are startled, dispersed, or killed (Figure 28, above). Direct mortality from motorized access may occur following strikes or from activities associated with human-caused mortality (Figure 28, above). An effective habitat management tool for reducing grizzly bear mortality risk is managing motorized access to ensure bears have secure areas away from humans (Nielsen *et al.* 2006, p. 225; Schwartz *et al.* 2010a, p. 661; Proctor *et al.* 2019, pp. 19–20). Well-managed motorized access provides large proportions of secure core habitat on Federal lands that helps ameliorate the impacts of displacement and increased human-caused mortality risk in grizzly bear habitat. Motorized access that is well-managed on state, local, or private lands also provides conservation benefits to bears.

Motorized Access in the GYE

The 1998 baseline and associated management policies help ensure adequate secure habitat and amelioration of impacts from motorized access inside the recovery zone (USDA FS 2006b, entire). In the GYE, secure habitat is defined as areas more than 500 m (1,650 ft) from a motorized access route, prescribed footprint of a developed site, or reoccurring helicopter flight line and greater than or equal to 10 acres (0.31 km^2 (0.016 mi^2)) in size (Service 2007a, p. 4; YES 2024, Chapter 3). In the 1998 baseline, secure habitat comprised 45.4 to 100 percent of the total area within a given bear management subunit with an average of 85.6 percent throughout the entire recovery zone (YES 2024, Appendix E). The draft habitat-based recovery criteria determined that 37 of the 40 subunits have sufficient levels of secure habitat (Service 2007a, pp. 34–35). These levels of secure habitat have been successfully maintained and we expect they will be maintained or improved upon in the future by keeping levels of open and total motorized route densities at or below baseline levels, with allowances for authorized Federal projects according to the application rules (see the GYE Conservation Strategy for a detailed description of the application rules; USDA FS 2006b, entire; YES 2024, Chapter 3), as directed by the GYE

Conservation Strategy and the MOU signed by all State and Federal partner agencies (YES 2024, Chapter 1). Three subunits were identified as "in need of improvement" from 1998 levels (Service 2007a, p. 4). These three subunits have shown on average a 7.5 percent increase in secure habitat and these improved levels serve as the new baseline for these three subunits with the implementation of the 2006 Gallatin National Forest Travel Management Plan (USDA FS 2006c, pp. 30, 83–84). Although there are no standards for motorized route density, monitoring protocols requires that open motorized route density (OMRD) and total motorized route density (TMRD) inside the recovery zone be annually monitored and reported against 1998 levels (YES 2024, Chapter 3).

The GYE Conservation Strategy indicates that temporary changes in secure habitat may not exceed 3 years, can affect no more than 1 percent of the largest subunit size within that BMU, may occur in only one subunit at a time, and that project roads will not be open to public use (YES 2024, Chapter 3). It is reasonable and biologically sound to provide management flexibility and discretion to land management agencies so they can fulfill their mandates of balancing and accommodating multiple uses (USFS) and providing for public recreation while conserving resources (NPS). These allowances for temporary changes to secure habitat were based on known levels of project activities occurring during the 1990s, a time during which the GYE grizzly bear population was known to be increasing (Harris *et al*. 2006, p. 48). There are no biological data to demonstrate that a temporary 1 percent disturbance to secure habitat in any subunit has had any detrimental effect on the grizzly bear population. These temporal and spatial restrictions, in combination with the requirement to restore secure habitat upon completion of a temporary project, mean there will be no permanent loss of secure habitat in any subunit. For permanent changes, replacement habitat must be in place for at least 10 years before it can be used for mitigation of future projects, including logging.

Of the 23,131 km^2 (8,931 mi^2) of suitable habitat outside of the GYE recovery zone, all of which occurs within the DMA boundary, the USFS manages 17,581 km^2 (6,788 mi^2), or 76 percent. Secure habitat is tracked and reported for Bear Analysis Units (BAUs) on USFS lands in suitable habitat outside of the recovery zone. As of 2022, secure habitat in BAUs averaged 65.4 percent and ranged from 30.1 to 99.6 percent (GBHMT 2023, pp. 121–122). In the Idaho portion, the 1997 Targhee Forest Plan includes motorized access standards and management prescriptions outside the recovery zone that provide for long-term security in 59 percent of existing secure habitat in Idaho outside of the recovery zone (USDA FS 2006a, pp. 78, 109). Outside of the recovery zone in Montana and Wyoming, 61 percent of all suitable habitat and 81 percent of suitable habitat on USFS lands are protected as wilderness, WSAs, and IRAs (see *Protected Areas Inside the GYE* above for further details). On the 947 km^2 (366 mi^2), or 4 percent, of suitable habitat managed by the BLM in the DMA boundary, the BLM will manage habitat for connectivity between ecosystems and to achieve lower road densities (BLM 2009, p. 33). The Eastern Shoshone and Northern Arapaho Tribes manage the 1,373 km^2 (530 mi^2) of suitable habitat within the boundaries of the Wind River Reservation (WRR), all of which is outside the recovery zone. The WRR Forest Management Plan calls for no net increase in roads in the Wind River Roadless Area and the Monument Peak area of the Owl Creek Mountains. In the remaining lands occupied by grizzly bears, open road densities of 0.6 km/km^2 (1 mi/ mi^2) or less will be maintained (Eastern Shoshone and Northern Arapaho Tribes 2009, p. 11). GTNP manages 829 km^2 (320 mi^2), or 3.5 percent, of suitable habitat outside of the recovery zone.

Protections for grizzly bears throughout NPS lands include, but are not limited to, seasonal area closures and food storage orders, provided through the GTNP Superintendent's Compendium (GTNP and JDR 2024, pp. 9–10, 16–17, 27–28).

State grizzly bear management plans add another layer of habitat protection outside the recovery zone. Habitat management on Federal public lands is largely directed by Federal land management plans, not State management plans. However, the three State grizzly bear management plans recognize the importance of areas that provide security for grizzly bears in suitable habitat outside of the recovery zone on public lands. Idaho Department of Lands (IDL) manages approximately 53 km^2 (202 mi^2) within the recovery zone and an additional 132 km^2 (51 mi^2) outside of the recovery zone but inside the DMA. IDFG personnel review IDL management plans to ensure planned activities are compatible with the needs of the grizzly bear. In addition, the Montana and Wyoming plans recommend limiting average road densities to 0.6 km/km^2 (1 mi/mi^2) or less in these areas and will consider wildlife in any road construction or reconstruction proposals (WGFD 2016, pp. 18–20; MFWP 2022, p. 11). Both States have similar standards for elk habitat on State lands and note that these levels of motorized access benefit a variety of wildlife species while maintaining reasonable public access. Similarly, the Idaho plan recognizes that management of motorized access outside the recovery zone should focus on areas that have road densities of 0.6 km/km^2 (1 mi/mi^2) or less (Idaho's Yellowstone Grizzly Bear Delisting Advisory Team 2002, p. 10).

Because of the positive effect that secure habitat has on grizzly bear survival and reproduction, one of the objectives of the habitat-based recovery criteria and the GYE Conservation Strategy is no net decrease in the 1998 baseline levels of secure habitat inside the recovery zone so that the recovery zone can continue to function as a source area for grizzly bears in the GYE. Meeting this objective limits negative impacts of motorized access in the GYE.

Motorized Access in the NCDE

The 2011 baseline and associated management policies help ensure adequate secure core habitat and amelioration of impacts from motorized access inside the recovery zone. In the NCDE, secure core habitat is defined as those areas on Federal lands more than 500 m (1,650 ft) from an open or gated motorized access route and at least 2,500 acres (10.1 km^2 (3.9 mi^2)) in size (Service 2018, pp. 5, 12). In the baseline, secure core habitat comprised 45.4 to 100 percent of the total area within a given BMU subunit with an average of 76.4 percent throughout the entire recovery zone (NCDE Subcommittee 2020, Appendix 4). These levels of secure core habitat have been successfully maintained and will continue to be maintained or improved on Federal lands within the recovery zone by maintaining levels of open and total motorized route densities at or below baseline levels (USDA FS 2018a, p. 31; USDA FS 2018d, pp. 10–11; NCDE Subcommittee 2020, Chapter 3 and Appendix 4). Moreover, projects on Federal lands that temporarily change the amount of secure core habitat will be subject to the motorized access objectives in the NCDE Conservation Strategy as codified in land management plans. These objectives limit temporary increases to OMRD to 5 percent, temporary increases to TMRD to 3 percent, and temporary decreases to secure core to two percent per bear management subunit as running averages per decade (NCDE Subcommittee 2020, Chapter 3; USDA FS 2018c, pp. 65–66; USDA FS 2018d, pp. 1-7, 1-19, 1-31, 1-42). The rationale for allowing temporary changes is that similar levels of temporary changes were evaluated on Federal lands through the ESA section 7 consultation while the grizzly bear was listed as threatened and were associated with an increasing grizzly bear population in the NCDE (NCDE Subcommittee 2020, Chapter 3).

State and Tribal land management entities in the recovery zone have also agreed to manage motorized access on non-Federal lands in accordance with their existing plans (in their entirety: CS&KT 2000; Blackfeet Nation 2008; DNRC 2011). Lands managed under the Montana Department of Natural Resources and Conservation (DNRC) Habitat Conservation Plan (HCP) will minimize construction of new open roads with caps on the total miles of open and restricted roads during the life of the HCP (DNRC 2011, pp. 13, 18). On other State lands, there will be no permanent net increase of open road density (Administrative Rule of Montana (ARM) 36.11.433). The Blackfeet Nation Forest Management Plan will not allow increases in open motorized route densities in any of the BMU subunits (Blackfeet Nation 2008, p. 11). Total road densities will be improved by closing non-essential roads to reduce the high road densities where they occur (Blackfeet Nation 2008, p. 32). On the FIR, in accordance with the CS&KT Forest Management Plan, no permanent increases in open or total motorized road densities and no permanent decreases in secure core habitat will be allowed in the Mission Mountain Tribal Wilderness Area and there will be no net increase in open roads in the South Fork Jocko Primitive Area (CS&KT 2000, p. 141). The remaining FIR lands will be managed such that open road densities will not exceed 2.4 km/km^2 (4 mi/mi^2) and total roads will remain at or below levels that existed in 1999 (CS&KT 2000, pp. 294–295). Total road densities will be improved by removing 15 percent of road spurs in currently roaded areas over the life of the Plan, by 2030 (CS&KT 2000, p. 295).

Additional limitations on motorized routes occur on USFS, BLM, and DNRC lands outside of the recovery zone but inside Zone 1. Outside the recovery zone, the USFS manages 4,241 km^2 (1,637 mi^2), or 22 percent, of lands in Zone 1, on which there will be no net increase in the linear miles or density of roads that are open for public motorized use during the non-denning season (USDA FS 2018c, pp. 132–133; USDA FS 2018d, pp. 10–11, 1-14–1-15, 1-27, 1-50). The BLM has 374 km^2 (144 mi^2) in Zone 1 in which there will be no net increase in the linear miles or road densities of open roads (BLM 2021a, p. II-26; BLM 2021b, p. II-26). The DNRC HCP regulates motorized access management on 586 km^2 (226 mi^2) of State land in Zone 1 to minimize construction of new open roads and prohibit commercial forest activities during the spring period in identified spring habitat (DNRC 2011, p. 11). Limitations on open motorized routes in Zone 1 were meant to maintain habitat conditions that existed in 2011 that were compatible with a stable to increasing grizzly bear population. We are reevaluating the current method used to measure (i.e., linear miles or road densities) and meet this intent.

The two DCAs in Zone 1, the Salish and Ninemile, are intended to provide opportunities for female grizzly bears to establish home ranges and exist at low densities in areas between the NCDE and CYE and the NCDE and BE, as is consistent with female dispersal and connectivity requirements (McLellan and Hovey 2001, p. 842; Proctor *et al.* 2005, pp. 2413–2415; Proctor *et al.* 2012, p. 35; Proctor *et al.* 2015, pp. 8–12; Proctor *et al.* 2018, pp. 356–361). A recently released connectivity model by Sells *et al*. (2023, p. 6) confirms that the DCAs encompass the areas with the highest predicted female use in between the NCDE and the CYE and BE (Figure 15). The USFS manages 79 percent of lands within the Salish DCA (1,505 of 1,901 km^2 (581 of

734 mi^2)). On the Kootenai NF, the Salish DCA overlaps almost entirely with the Tobacco BORZ; increases in permanent linear miles of open or total roads or motorized trails are not allowed within the Tobacco BORZ (USDA FS 2018d, p. 10; USDA FS 2018f, p. 73). On the Flathead NF portion of the Salish DCA, there will be no net increase above the baseline in linear miles of open motorized routes (USDA FS 1986a, pp. II-62–63; USDA FS 2018e, pp. 179–180). Seventy percent of lands within the Ninemile DCA are managed by the USFS and the CS&KT. On the Lolo NF, 22 percent of USFS lands are IRAs. The remainder of USFS lands in the Ninemile DCA will be managed for no net increase above the baseline density of motorized access routes during the non-denning season (USDA FS 2018d, pp. 10–11). See the NCDE Conservation Strategy for linear route densities in the DCAs (NCDE Subcommittee 2020, Appendix 6). Eighteen percent of the lands managed by the CS&KT in the Ninemile DCA are wilderness and roadless areas. Open road densities are managed remain at or below 2.4 km/km^2 (4 mi/mi^2) and total road miles are managed to remain at or below what existed in 1999 on the remaining lands managed by the CS&KT in the Ninemile DCA (CS&KT 2000, pp. 294–295). Limitations on open motorized routes in the DCAs were meant to maintain habitat conditions at levels known to support reproductive female occupancy and eventual dispersal to the CYE and BE. We are reevaluating the current method used to measure (i.e., linear miles or road densities) and meet this intent.

In Zone 2, regulatory mechanisms are in place to ensure habitat management direction is compatible with providing genetic connectivity to other populations on land managed by BLM, USFS, and DNRC (BLM 2009, pp. 30, 33; DNRC 2010b, pp. 1-27, 2-9–2-16; USDA FS 2021, pp. 57, 129, 133, 149, 153, 157, 160, 199, 202). Connectivity pathways predicted by Sells *et al.* (2023, pp. 6–7) also show high predicted use for both females and males in Zone 2 (Figure 15). BLM, USFS, and DNRC lands constitute 35 percent of Zone 2. The remainder is privately owned (62 percent) or local government, water, or other state and Federal lands (3 percent). As of 2022, 15 percent of Zone 2 was occupied, however there have been multiple verified sightings in Zone 2 between the NCDE and GYE occupied areas. Other areas within the NCDE are referred to as Zone 3. In contrast to Zones 1 and 2, Zone 3 does not provide habitat linkage to other grizzly bear ecosystems. As mentioned above, Zone 3 is largely private land with agricultural land-uses, making it less suitable for continual occupancy by grizzly bears. Therefore, there is no need for habitat protections specifically developed for grizzly bears on Federal, State, or Tribal lands in Zone 3 in order to support the NCDE grizzly bear population. However, habitat protections exist on some public lands for other species that may benefit grizzly bears. The extent of Zone 3 will be determined in future Service decisions and may include some opportunities for grizzly bear occupancy.

Because of the positive effect that secure core habitat has on grizzly bear survival and reproduction, one of the habitat-based recovery criteria objectives and NCDE Conservation Strategy is no net decrease in levels of secure core habitat inside the recovery zone so that the recovery zone can continue to function as a source area for grizzly bears in the NCDE. Meeting this objective will limit negative impacts of motorized access in the NCDE. We will continue to monitor the effectiveness of this objective and can modify motorized access management as new information becomes available.

Motorized access in the CYE and SE

The majority of lands within the CYE and SE recovery zones are managed by the USFS, which has incorporated motorized route density standards into its management plans to effectively provide secure habitat (core) for grizzly bears. In the CYE recovery zone, 97 percent of land (6,530 km^2 (2,589 mi^2) of 6,705 km^2 (2,589 mi^2)) is managed by the Kootenai, Idaho Panhandle, and Lolo NFs. Forty-six percent (3,020 km^2 (1,166 mi^2) of 6,575 km^2 (2,539 mi^2)) of the SE recovery zone is in the U.S., with the remainder in B.C., Canada. In the U.S. portion of the SE recovery zone, 79 percent of land (2,376 km^2 (917 mi^2) of 3,020 km^2 (2,609 mi^2)) is managed by the Idaho Panhandle and Colville NFs. Standards for motorized access management in the CYE and SE grizzly bear recovery zones were first incorporated into forest plans for the Kootenai, Lolo, and Idaho Panhandle NFs through the "Forest Plan Amendments for Motorized Access Management within the Selkirk and Cabinet-Yaak Grizzly Bear Recovery Zones" (2011 Amendment) (USDA FS 2011a, entire). The 2011 Amendment established BMU-specific levels for motorized route densities and core areas based on the recommendations of Wakkinen and Kasworm (1997, entire), who summarized data from female grizzly bears that survived to successfully reproduce to provide recommendations for levels of motorized route densities and core areas (USDA FS 2011a, p. 36; USDA FS 2011c, pp. 23–27). In the CYE and SE, core areas are defined as those areas greater than 500 m (1,650 ft) from any open motorized route or high-use non-motorized route. These motorized access management standards have subsequently been incorporated into the Kootenai, Idaho Panhandle, and Colville NFs Land Management Plans (USDA FS 2015b, 2015c; USDA FS 2019, pp. 60, 63–64).

The motorized access standards established in the 2011 Amendment affect 22 BMUs in the CYE recovery zone (USDA FS 2011a, p. 31; USDA FS 2024b, p. 4; USDA FS 2024c, p. 2; USDA FS 2024d, *in prep.*). As of 2023, 18 BMUs within the CYE recovery zone meet the management standards under the new access management plans and 4 do not (USDA FS 2011a, p. 31; USDA FS 2024b, p. 4; USDA FS 2024c, p. 2; USDA FS 2024d, *in prep.*). Of the four that do not yet meet standards, two BMUs are within 1 percent of meeting the standard for all of the criteria. The USFS is currently working on an implementation schedule for the remaining BMUs to achieve all standards.

The motorized access standards established in the 2011 Amendment and 2019 Colville Forest Plan affect 9 of the 10 BMUs in the U.S. portion of the Selkirk Recovery area (USDA FS 2011a, p. 31; USDA FS 2019, p. 63). As of 2023, two of the nine BMUs within the U.S. portion of the SE recovery zone did not meet its proposed access management standards under the new Access Management plans (USDA FS 2011a, p. 6; USDA FS 2024a, p. 2; USDA FS 2024b, p. 4; USDA FS 2023h, p. 9). One of the BMUs that does not meet the standards is within 1 percent of meeting the standard for all criteria. The USFS is currently working on an implementation schedule for the remaining BMUs to achieve all standards.

The BMU unaffected by the 2011 Amendment or 2019 Colville NF Plan motorized access standards is administered by the IDL (State BMU). There are no road or habitat security data available for the State BMU and the above-mentioned standards do not apply to this BMU.

The checkerboard land ownership patterns in the LeClerc BMU limits any single landowner from implementing BMU-wide motorized access management, however the Colville NF manages NF lands in this BMU for no net increases in motorized access (USDA FS 2018b, pp. 63–64). Additionally, Stimson Lumber Company, the primary private landowner in the LeClerc BMU, voluntarily manages its timber harvest activities through a Conservation Agreement with the FWS and the Colville NF (Service 2001, Appendix A). This Conservation Agreement and the FWS Biological Opinion (Service 2001, entire) commit Stimson and the Colville NF to leave hiding cover within created openings, along open roads, and within riparian habitats. Stimson also committed to log during the winter in some areas to reduce disturbance, and report logging activities and road-use annually. The Conservation Agreement was upheld in a challenge brought by the Selkirk Alliance before the 9th Circuit Court of Appeals (see *Selkirk Conservation Alliance. v. Forsgren*, 336 F.3d 944 (9th Cir. 2003), and has now been implemented for 20 years.

Overall, motorized route densities have been reduced and core areas have increased in the CYE and SE since the grizzly was listed (Summerfield *et al*. 2004, entire; USDA FS 2024a, p. 2; USDA FS 2024b, p. 4; USDA FS 2024c, p. 2; USDA FS 2024d, *in prep.*). For the CYE, between 2002 and 2023 there was a 10 percent decrease in open motorized routes, a 59 percent reduction in total motorized routes, and a 53 percent increase in core areas across the 22 BMUs (USDA FS 2011a, pp. 70–72; USDA FS 2024b, p. 4; USDA FS 2024c, p. 2; USDA FS 2023h, p. 9; USDA FS 2024d, *in prep.*). For the SE, between 2002 and 2023 there was a 9 percent increase in open motorized routes, a 16 percent reduction in total motorized routes, and a 15 percent increase in core areas across the 10 BMUs (USDA FS 2011a, p. 73; USDA FS 2024a, p. 2; USDA FS 2024b, p. 4). Some increases in OMRD and TMRD in individual BMUs in the CYE and SE from 2002 to 2023 were a result of corrections to the road layer, which does not reflect a change in conditions on the ground but a more accurate reflection of roads.

The portion of the SE in B.C. outside of protected areas has varying levels of open roads, however a large portion (700 km^2 (270 mi^2)) of that area lies within ownership of the Nature Conservancy of Canada that limits access to their lands (Proctor *et al.* 2018, p. 358). The B.C. South Selkirk had an average open road density of 1.2 km/km^2 and 50 percent secure habitat, as defined in MacHutchon and Proctor (2016, p. vi) as further than 500 m (1,650) from an open road and greater than 10 km^2 (3.86 mi^2) in size. The B.C Yahk area north of the CYE is heavily roaded (average 1.6 km/km^2 and 24 percent secure habitat) with little access control (MacHutchon and Proctor 2016, p. 84, see *Appendix E* for more information on Canadian management).

In addition to the standards inside the recovery zone, BORZ were incorporated into NF Plans for the Kootenai, Idaho Panhandle, and Lolo NFs in 2004 (USDA FS 2004). The motorized access standards established in the 2011 Amendment affect 4,045 km^2 (1,562 mi^2) outside the recovery zone known to be occupied by grizzly bears (BORZ) in the CYE and 476 km^2 (184 mi^2) outside the recovery zone known to be occupied by grizzly bears (BORZ) in the SE (USDA FS 2011a, p. 31; USDA FS 2024b, p. 22). USFS plan direction does not allow increases in open or total linear miles of road above the baseline values in the 2011 Amendment in BORZ (USDA FS 2011a, p. 22; USDA FS 2015b, pp. 154–155; USDA FS 2015c, pp. 150–151). This approach is based on the premise that because the area has been determined to be occupied by bears, then management should at least maintain status quo. Also, timber harvest activities in these areas are coordinated across multiple watersheds to minimize disturbance from road-use to grizzly bears (USDA FS 2011a, p. 23; USDA FS 2015b, p. 150; USDA FS 2015c, p. 155).

The USFS submits annual reports to the Service summarizing compliance with the 2011 Forest Plan Amendment that detail annual changes by BMU. The 2023 monitoring reports confirmed compliance with the ROD (in their entirety: USDA FS 2024a, 2024b, 2024c, 2024d). Full implementation of the motorized access standards in the Amendment, road densities, and core areas will be managed in a way that minimizes negative impacts of motorized access. Further monitoring of the populations and cause-specific mortality would help determine the success of this management strategy.

IDL manages approximately 395 km^2 (153 mi^2) within the SE recovery zone and 62 km^2 (24 mi^2) within the CYE recovery zone. IDFG personnel review IDL management plans to ensure planned activities are compatible with the needs of the grizzly bear. Additionally, a MOA between IDL and IDFG for cooperative road closures in the SE and CYE to reduce human-caused grizzly bear mortality between outlines closure standards, signage, reporting standards and funding (IDL and IDFG 2012, entire). Additional measures include shorter timber sale seasons and required bear behavior training for field staff.

Motorized Access in the BE

Nearly 100 percent of land (15,086 km^2 (5,825 mi^2) of 15,100 km^2 (5,830 mi^2)) within the BE recovery zone is managed by the USFS, including the Salmon-Challis, Bitterroot, Lolo, and Nez Perce-Clearwater NFs. Although BMU boundaries and motorized access standards have not yet been determined for the BE recovery zone, the BE recovery zone is more than 98 percent Wilderness (see *Protected Areas*) and therefore, any impact of motorized access on grizzly bears in the BE recovery zone is likely very minimal. However, consideration should be given to motorized access in potential connectivity areas between other ecosystems and the BE to facilitate natural recolonization.

Motorized Access in the North Cascades

In the North Cascades recovery zone, 86 percent of land (24,449 km^2 (9,439 mi^2) of 25,322 km^2 (9,777 mi^2)) is managed by NCNP Complex and by the Mount Baker-Snoqualmie, Wenatchee-Okanogan, and Colville NFs. Core areas for the North Cascades are defined as those areas greater than 500 m (1,650 ft) from any open motorized route or high-use non-motorized route. Federal land management agencies identified an approach to protect secure habitat (core) for 42 BMUs in the recovery zone in 1997 (USDA FS 1997, entire). Motorized access standards were not set but the Federal land management agencies manage for "no net loss" of core areas from the 1997 baseline. The interim direction allows for one change to be made in secure habitat in each BMU without review by the North Cascades IGBC Subcommittee. The amount of secure habitat varies by BMU, ranging from 21 to 92 percent with an average of 59 percent secure habitat. This criterion for "no net loss" has been met for all BMUs with the following changes in secure habitat made since 1997: two situations in which a small reduction in secure habitat was approved in BMUs that contained more than 90 percent secure habitat; and minor reductions in secure habitat proposed due to high-use trail construction in some BMUs currently exceeding 80 percent secure habitat.

Access management direction for North Cascades National Park was published in the Ross Lake NRA General Management Plan (NPS 2012, entire). It stipulated that: (1) BMUs within the park complex would be managed for greater than 70 percent core (IGBC 1998, p. 4); (2) that NPS would consult with USFS on any proposal for a high-use trail in the park that would tip a shared BMU below 70 percent, or if the shared BMU was already below the 70 percent target; and (3) North Cascades NP would "strive to minimize, avoid or mitigate impacts on high-quality spring and fall grizzly bear habitat" (NPS 2012, p. 82). One mile of road is scheduled to be removed (awaiting funding) and the new proposed trails would remove less than 1 percent core from each of the 4 BMUs in which they occur, none of which is high-quality grizzly bear habitat (NPS 2012, p. 82).

The Okanogan-Wenatchee NF published a Notice of Intent in the Federal Register on June 30, 2011, to begin the process of revising their forest plan, but that action is currently on hold. In the interim, the Okanogan-Wenatchee NF continues to implement the "no net loss" policy. A Travel Analysis Report was completed in 2015 and recommended decommissioning or closing approximately 3,172 km (1,970 mi) of the 127,800 km (7,950 mi) of roads to OHV use on the Okanogan-Wenatchee NF (USDA FS 2015d). A final decision on the travel management plan for the Okanogan-Wenatchee NF has not yet been made. Any action taken in this regard will require a NEPA process. The Mount Baker Snoqualmie NF has not started a plan revision as of 2023 and continues to use the "no net loss" policy (USDA FS 1997, entire).

Current OMRD and TMRD levels are unknown on the USFS lands, though the primary factors related to past destruction and modification of grizzly bear core areas have been reduced under the "no net loss" policy. Partly because of the lack of data regarding OMRD or TMRD levels on USFS lands and lack of a population by which to assess effects, the influence of motorized access on the resiliency of the North Cascades is limited. Further monitoring of any potential future population and cause-specific mortality will determine the success of the current "no net loss" policy. The Service is currently coordinating with the U.S. Forest Service (USFS) and NPS through the Interagency Grizzly Bear Committee (IGBC) North Cascades Subcommittee Technical Team to review and update the baseline and to memorialize the "no net loss" agreement for the North Cascades Recovery Zone.

Summary of Motorized Access

Motorized access, which brings humans and their vehicles into grizzly bear habitats, may indirectly influence grizzly bears by reducing the availability of habitat security or directly by disturbing, displacing, or killing individual bears through increased noise, activity, presence, vehicle strikes, or other activities associated with human-caused mortality (Figure 28, above). A variety of conservation efforts or mechanisms, such as the Wilderness Act, IRAs, and Federal land management plans help reduce the potential effects of motorized access on the resiliency of ecosystems. Currently, conservation mechanisms have reduced the negative effects of motorized access in the GYE and NCDE, and these conservation mechanisms are expected to continue into the future. Although land protections are expected to minimize potential effects of motorized access in the BE recovery zone, additional data are needed to inform effects of motorized access in potential connectivity areas that could facilitate natural recolonization of the BE. Motorized access remains an issue for the CYE, SE, and North Cascades, where conservation mechanisms to address motorized access are not yet finalized or standards have not been met. Although progress has been made towards meeting the standards in the CYE and SE, additional improvements are needed. One challenge in the CYE and SE is that they have a much lower proportion of protected areas (i.e., Federal lands that have wilderness protections) than the other ecosystems (see *Protected Areas* above for further discussion). In the North Cascades, approximately 64 percent of public lands are designated Wilderness or IRAs, and the remaining federal lands operate under 'no net loss' of core habitat. Additional data are needed to inform the potential effect of motorized access in the North Cascades. The Service and partner land management agencies will continue to monitor the effectiveness of these objectives and can modify motorized access management as new information becomes available.

Developed Sites

The primary concern related to developed sites is direct mortality from human-bear conflicts, such as those caused by unsecured attractants (e.g., garbage), and resulting management removals (Harding and Nagy 1980, p. 277; McLellan and Shackleton 1988, p. 451; Mattson and Knight 1991, p. 3; Mattson *et al.* 1992, p. 432; Mace *et al.* 1996, p. 1403; McLellan *et al.* 1999, p. 918; Woodroffe 2000, entire; Johnson *et al.* 2004, pp. 974–975) (Figure 28, above). While human-grizzly bear conflicts at developed sites on public lands continue to occur, agencies have successfully worked to reduce conflicts and resulting mortalities. However, human-bear conflicts on private land have been increasing due to expanding grizzly bear distributions and are now more common than those on public lands (Cooley *et al*. 2018, entire). Secondary concerns include temporary or permanent habitat loss and displacement due to increased length of time of human use and increased human disturbance to surrounding areas (Harding and Nagy 1980, p. 277; McLellan and Shackleton 1988, p. 451; Mattson 1990, entire; White *et al.* 1999, pp. 3–5; Fortin *et al.* 2016, pp. 9–19).

"Developed sites" refer to those sites or facilities on public land with features intended to accommodate public use or recreation, such as toilets, picnic tables, and garbage containers. "Administrative sites" are those sites or facilities constructed for use primarily by government employees to facilitate the administration and management of public lands. In contrast to developed or administrative sites, "dispersed sites" are those not associated with a developed site, such as camping outside of designated campgrounds where no services are provided. These sites typically have minimal to no site modifications, have informal spacing, and possibly include primitive road access. Dispersed sites are not counted as developed sites.

Developed Sites in the GYE

Examples of developed sites in the GYE include, but are not limited to, campgrounds, picnic areas, trailheads, boat launches, rental cabins, summer homes, lodges, service stations, restaurants, visitor centers, and permitted resource exploration or extraction sites such as oil and gas exploratory wells, production wells, plans of operations for mining activities, and work camps. Administrative sites are tracked as developed sites, and examples include headquarters, ranger stations, patrol cabins, park entrances, Federal employee housing, and other facilities supporting government operations.

In the GYE, the 1998 baseline and management policies limit the impact of developed sites on grizzly bears. Developed sites on public lands are currently inventoried and tracked in GIS databases. As of 1998, there were 594 developed sites on public land within the recovery zone (YES 2024, Chapter 3). As of 2023, the number of developed sites on public lands had decreased to 577 (GBHMT 2024, *in prep.*). Regulatory mechanisms in place ensure that the NPs and NFs within the GYE recovery zone will continue to manage developed sites with measurable side boards on levels of human activity to maintain developed sites at or below 1998 levels within each bear management subunit, with some exceptions for administrative and maintenance needs (USDA FS 2006b, entire; YES 2024, Chapter 3). Exceptions to the 1998 baseline for administrative and maintenance needs are narrow in scope and require mitigation (i.e., food storage structures) to reduce potential detrimental impacts to grizzly bears (see the GYE Conservation Strategy for a detailed description of the exception guidance, which are referred to as application rules; YES 2024, Chapter 3). In areas of suitable habitat inside the recovery zone, the NPS and the USFS enforce food storage rules aimed at decreasing grizzly bear access to human foods (YES 2024, Chapters 1 and 3). These regulations will continue to be enforced and are in effect for nearly all currently occupied grizzly bear habitat within the GYE (YES 2024, Chapters 1 and 3).

The 1998 baseline mapped all developed sites, including major developments such as Grant Village in YNP, and sites with more limited infrastructure, such as trailheads, as points on the landscape. The "footprint" approach delineates areas of concentrated human use associated with developed sites, such as visitor overnight lodges on USFS lands, developed campgrounds, administrative sites, and major developments on NPS lands. The revisions include application rules that allow for an increase in day-use and administrative sites and a limited increase in the amount of overnight visitor use inside authorized footprints, as this would not detract from secure habitat. Other developed sites associated with isolated point-source human activity with minimal infrastructure, such as trailheads and picnic areas, do not have an authorized footprint. The application rules allow for a limited increase in day-use and administrative sites outside of existing footprints.

Management strategies and regulations also address developed sites outside the recovery zone in the GYE. There are over 500 developed sites on the five NFs in the areas identified as suitable habitat outside of the recovery zone and within the DMA (USDA FS 2004, p. 138). Existing USFS food storage regulations and outreach and education in these areas will continue to reduce the potential for human-grizzly bear conflicts. The number and capacity of developed sites are subject to management direction established in Forest Plans. If data indicate that management removals at developed sites on public lands are related to increased mortality above the sustainable limits discussed above, managers may choose to close specific developed sites or otherwise alter management in the area in order to maintain resiliency and maintain a population that continues to meet recovery criteria.

Developed Sites in the NCDE

In the NCDE, examples of developed recreation sites include, but are not limited to, campgrounds, picnic areas, trailheads, boat launches, rental cabins, summer homes, lodges, restaurants, and visitor centers. Examples of administrative sites in the NCDE include headquarters, ranger stations, patrol cabins, park entrances, Federal employee housing, and other facilities supporting government operations. Administrative sites will be reported but are not counted as developed recreation sites.

As of 2011, there were 1,074 developed recreation sites on public land within the recovery zone (NCDE Subcommittee 2020, Appendix 5; USDA FS 2018e, p. 155; USDA FS 2018f, p. 226). Plans in place direct GNP and the NFs within the recovery zone to manage overnight developed recreation sites at 2011 levels within each bear management subunit with limited increases (NCDE Subcommittee 2020, Chapter 3; USDA FS 2018c, p. 60; USDA FS 2018d, pp. 1-7, 1-19, 1-31, 1-42; GNP 2024, p. 2). The number of or capacity of developed recreation sites managed for overnight use can increase no more than once (e.g., a net of one campground may be added or expanded) in each BMU every 10 years (NCDE Subcommittee 2020, Chapter 3; USDA FS 2018c, p. 60; USDA FS 2018d, pp. 1-7, 1-19, 1-31, 1-42). This was chosen as a threshold because similar levels of increases occurred in the period prior to 2011 during the time when the population of grizzly bears in the NCDE continued to increase (Ake 2017, entire). All increases were reviewed via ESA section 7 consultation. Such increases allowed managers to actively respond to resource damage, safety, and attractant concerns, and to respond to increasing public demand for recreation facilities. However, we are currently re-evaluating this objective. Developed recreation sites on public lands are currently inventoried and tracked in GIS databases.

The NCDE Conservation Strategy contains exceptions for administrative and maintenance needs (NCDE Subcommittee 2020, Chapter 3). These exceptions to the baseline for administrative and maintenance needs are narrow in scope and require mitigation (i.e., food storage structures) to reduce potential detrimental impacts to grizzly bears (see the NCDE Conservation Strategy for a detailed description of the exception guidance, which are referred to as application rules; NCDE Subcommittee 2020, Chapter 3; USDA FS 2018c, pp. 77–78; USDA FS 2018d, pp. 1-11–1-13, 1-23–1-26, 1-35–1-38, 1-46–1-49).

In conclusion, the NPS and USFS within the NCDE recovery zone will continue to manage overnight developed recreation sites, with regulated increases, to 2011 levels within each bear management subunit, with some exceptions under the application rules (NCDE Subcommittee 2020, Chapter 3; USDA FS 2018c, p. 60; USDA FS 2018d, pp. 1-7, 1-19, 1-31, 1-42). In addition, food storage regulations are in place on these public lands (see *Preventative Measures: Food Storage Orders* for further details; NPS 2010, p. 4; USDA FS 2018d, pp. 9, 1-5, 1-17, 1-29, 1-40; USDA FS 2018e, p. 182; NCDE Subcommittee 2020, Chapter 4; GNP 2024, pp. 16–20). These commitments are in place and will help to maintain resiliency of the NCDE.

Outside the recovery zone in the NCDE, there are approximately 66 overnight developed recreation sites on the four NFs in Zone 1 (Krenzelok 2024, *in litt.*). The number and capacity of overnight developed recreation sites are subject to management direction established in Forest

Plans. Additionally, existing USFS food storage regulations will continue to minimize the potential for human-grizzly bear conflicts through food storage requirements, outreach, and education. Should the Monitoring Team determine developed sites on public lands in Zone 1 are related to increases in mortality beyond the sustainable limits discussed above, managers may choose to close specific developed sites or otherwise alter management in the area in order to maintain a population that continues to meet recovery criteria and population objectives in the NCDE Conservation Strategy. Commitments by the USFS and BLM to manage lands to maintain a population that continues to meet recovery criteria (USDA FS 2018a, p. 3; USDA FS 2018c, p. 1; USDA FS 2018d, p. 26; BLM 2021a, p. II-25; BLM 2021b, p. II-26; NCDE Subcommittee 2020, Chapter 3) will help to maintain resiliency of the NCDE.

Developed Sites in the SE, CYE, BE and North Cascades

There are currently no standards or tracking for developed sites inside the CYE, SE, BE, or North Cascades. However, the BE, CYE, and North Cascades recovery zones, are characterized by large acreage of Wilderness Areas and IRAs. These designations increase the security of habitat for grizzly bears. Within the CYE recovery zone, 44 percent of lands are protected as designated Wilderness (379 km^2 (146 mi^2)) or IRAs (2,568 km^2 (992 mi^2)). Within the U.S. portion of the SE recovery zone, nearly 35 percent of lands are protected as designated Wilderness (167 km^2 (65 mi^2)) or IRAs (907 km^2 (350 mi^2). The BE recovery zone is 98 percent designated Wilderness (14,840 km^2 (5,730 mi^2)). In the North Cascades, 64 percent of lands are protected as designated Wilderness (10,843 km^2 (4,189 mi^2)) or as IRAs (5,123 km^2 (1,978 mi^2)). These designations are supported by regulatory mechanisms, as discussed above in *Protected Areas*, independent of the Act that protect grizzly bear habitat from new road construction, new oil and gas development, new livestock allotments, and timber harvest. While developed sites are not prohibited in IRAs, the lack of road construction limits development. In addition, food storage regulations are in place on these public lands (see *Preventative Measures: Food Storage Orders* for further details; USDA FS 2011a, pp. 6–7; USDA FS 2015b, pp. 31, 33; USDA FS 2015c, pp. 31, 34; USDA FS 2019, p. 61; NCNP 2023, entire; USDA FS 2023e, entire).

Summary of Developed Sites

Increasing populations in the GYE and NCDE indicate that developed sites and any associated habitat loss or displacement are not limiting grizzly bear populations. Operation and maintenance of developed sites may result in mortality of grizzly bears if interactions result in activities associated with human-caused mortality; however, conservation strategies have reduced negative effects in the GYE and NCDE, and the Wilderness Act and other regulations minimize this stressor in the CYE, SE, BE, and North Cascades. Additional data would help inform the potential effects of developed sites on grizzly bear populations in the CYE, SE, BE, and North Cascades.

Livestock Allotments on Federal Lands

When grizzly bears were listed in 1975, the Service identified "livestock use of surrounding national forests" as detrimental to grizzly bears "unless management measures favoring the species are enacted" (40 FR 31734, July 28, 1975). Impacts to grizzly bears from livestock operations potentially include:

(1) Direct mortality from control actions resulting from livestock depredation;
(2) Direct mortality due to control actions resulting from grizzly bear habituation and/or learned use of bear attractants, such as livestock carcasses and feed;
(3) Increased chances of a grizzly bear-livestock conflict;
(4) Displacement due to livestock or related management activity; and
(5) Direct competition for preferred forage species.

Human-caused mortality resulting from management removals is the main impact to grizzly bears associated with livestock (for further discussion, see *Human-caused Mortality*, below). The effects of displacement and direct competition with livestock for forage are considered negligible to grizzly bear population dynamics because, even with direct grizzly bear mortality, current levels of livestock allotments have not precluded grizzly bear population growth and expansion.

Livestock Allotments in the GYE

In the GYE, the 1998 baseline and management policies limit the impact of livestock allotments on grizzly bears in the recovery zone. The Recovery Plan Supplement: Habitat-based Recovery Criteria for the Yellowstone Ecosystem (Service 2007a, entire) and the USFS ROD implementing their forest plan amendments (USDA FS 2006b, entire) established habitat standards regarding livestock allotments. The number of active livestock allotments, total acres affected, and permitted sheep animal months within the recovery zone will not increase above 1998 levels (USDA FS 2006b, p. 5; YES 2024, Chapter 3). Due to the higher prevalence of grizzly bear conflicts associated with sheep grazing, existing sheep allotments will continue to be phased out as the opportunity arises with willing permittees (USDA FS 2006b, p. 6; YES 2024, Chapter 3).

A total of 106 livestock allotments existed inside the recovery zone in 1998: 72 active and 13 vacant cattle allotments and 11 active and 10 vacant sheep allotments, with a total of 23,090 sheep animal months (GBHMT 2024, *in prep.*). Total acreage of grazed land is a more meaningful metric because individual allotments can be combined, divided, or the boundaries adjusted. Sheep animal months are calculated by multiplying the permitted number of animals by the permitted number of months. Any use of vacant allotments will be permitted only if the number and net acreage of allotments inside the recovery zone does not increase above the 1998 baseline (YES 2024, Chapter 3). Since 1998, the Caribou Targhee- NF has closed ten sheep allotments (6 active and 4 vacant) within the recovery zone, while the Shoshone NF has closed two vacant sheep allotments and converted two active sheep allotments into cattle allotments, and the Gallatin NF has closed six sheep allotments (2 active and 4 vacant) (GBHMT 2024, *in prep.*). This has resulted in a reduction of 21,120 sheep animal months, a 91 percent reduction, from the total calculated for 1998 within the recovery zone and a 98 percent reduction in the acreage grazed by sheep on public lands within the recovery zone (GBHMT 2024, *in prep.*). This is a testament to the commitment that land management agencies have to the ongoing success of the grizzly bear population in the GYE. As of 2023, there is only one active sheep allotment within the recovery zone on the Caribou-Targhee NF as part of the USDA Sheep Experiment Station, but this allotment has not been issued a grazing permit since 2008. In addition, the NFs have closed 15 active and 5 vacant cattle allotments within the recovery zone since 1998 (GBHMT 2024, *in prep.*). With the closure of the only cattle allotment within the recovery zone in GTNP in 2011, there is currently no livestock grazing occurring on NPS lands within the GYE (GBHMT 2024, *in prep.*). The closure of cattle allotments on NF and NPS lands has resulted in a 32 percent reduction in the total acreage of active cattle grazing on public lands within the recovery zone (GBHMT 2024, *in prep.*). Grizzly bear conflicts related to livestock have also been reduced in the recovery zone through requirements to securely store and/or promptly remove attractants associated with livestock operations (e.g., livestock carcasses, livestock feed, etc.). Phasing out livestock allotments would not have been possible without partnerships with multiple NGOs who negotiated and funded the buyouts from leaseholders. This effort was led by the National Wildlife Federation and included the Rocky Mountain Elk Foundation, Wild Sheep Foundation, Vital Ground Foundation, Greater Yellowstone Coalition, Sierra Club, and Western Watersheds Project.

The mandatory restriction on creating new livestock allotments and the voluntary phasing out of livestock allotments (cattle and sheep) with recurring conflicts further ensure that the recovery zone will continue to function as source habitat (USDA FS 2006b, p. 6). Although it is possible to reopen closed allotments, such an action would be subject to NEPA review and the majority of allotments would have a low probability of reopening because the rationale behind closing them is still applicable (e.g., limited forage).

In 2004, there were roughly 150 active cattle allotments and 12 active sheep allotments in suitable habitat outside the recovery zone on USFS lands (USDA FS 2004, p. 129). The Targhee NF closed two of these sheep allotments in 2004, the Shoshone NF closed one of these sheep allotments in 2005, the Bridger Teton NF converted one sheep allotment to a cattle allotment, and there have not been any new allotments created since then (USDA FS 2006a, p. 168; Pils 2024, *in litt.*). The BLM does not allow conversion of grazing permits from cattle to sheep within suitable habitat in the Centennial Mountains, Snowcrest Mountains, Gravelly Range, Greenhorn Mountains, Axolotl Lake area, and along the Continental Divide from Monida to Lemhi Pass to avoid potential conflicts with grizzly bears (BLM 2006, pp. 21, 43). GTNP currently allows cattle to graze in the park at the East Elk Ranch Pastures/Allotment, longhorns to graze in the park under a Life Lease Agreement, horses under the Triangle-X concessions contract, and horse grazing privileges associated with the Moosehead Ranch appurtenant to the land within the park prior to the park's expansion. In areas with chronically high levels of livestock depredations, grizzly bear management removals are often higher. However, mortality limits in the revised demographic recovery criteria and GYE Conservation Strategy minimize the risk of population-level impacts and revisions currently in progress are anticipated to function the same. In addition, the IGBST regularly monitors and spatially maps all grizzly bear mortalities (both inside and outside the recovery zone), causes of death, and the source of the problem (e.g., attractant storage), and will conduct a Biology and Monitoring review if these objectives have not been achieved. These commitments and controls currently in place limit negative impacts of livestock grazing on the GYE grizzly bear population.

Livestock Allotments in the NCDE

In the NCDE, the 2011 baseline and management policies limit the impact of livestock allotments on grizzly bears in the NCDE recovery zone. The Recovery Plan Supplement: Habitat-based Recovery Criteria for the NCDE (Service 2018, entire), the Revised Forest Plan for the Flathead NF (USDA FS 2018c, p. 80), and the USFS ROD implementing their forest plan amendments for the Helena-Lewis and Clark, Kootenai, and Lolo NFs (USDA FS 2018d, p. 20) established habitat standards regarding livestock allotments. A total of 60 active livestock (59 cattle, 1 sheep) allotments existed on Federal lands inside the recovery zone in the 2011 baseline, with a total of 133 sheep animal unit months (USDA FS 2018e, p. 468–469; USDA FS 2018f, p. 256; NCDE Subcommittee 2020, Chapter 3).

Land managers within the recovery zone have also agreed to manage livestock allotments into the future to maintain grizzly bear recovery in the NCDE. Specifically, within the recovery zone, management direction limits the number of cattle allotments on Federal or FIR lands to at or below the baseline (CS&KT 1997, pp. 6, 19–20; USDA FS 2018e, p. 183; USDA FS 2018f, p. 15; NCDE Subcommittee 2020, Chapter 3). In addition, the number of sheep allotments and permitted sheep animal months within the recovery zone will not increase above the baseline on Federal, State, and FIR lands (CS&KT 1997, pp. 6, 19–20; DNRC 2010b, pp. 2-18; USDA FS 2018e, p. 156; USDA FS 2018f, p. 15; NCDE Subcommittee 2020, Chapter 3, Appendix 10). A total of 128 active allotments, mainly cattle, exist on State lands inside the recovery zone in the 2011 with 974 sheep animal unit months (Baty 2020, *in litt.*; NCDE Subcommittee 2020, Chapter 3). All BIR lands within the recovery zone are currently allotted for livestock grazing. Due to the higher prevalence of grizzly bear conflicts associated with sheep grazing, existing sheep allotments will be phased out as the opportunity arises with willing permittees (USDA FS 2018d, pp. 1-11, 1-23, 1-35, 1-46; NCDE Subcommittee 2020, Chapter 3). Currently there is one sheep allotment on USFS land within the recovery zone on the Helena-Lewis and Clark NF (USDA FS 2018f, p. 138). All other sheep allotments have been phased out or relocated outside of the recovery zone (USDA FS 2018f, p. 138). Any use of vacant allotments will only be permitted if the number of allotments inside the recovery zone does not increase above the baseline (USDA FS 2018c, pp. 80–81; USDA FS 2018d, pp. 1-10–1-11, 1-22–1-23, 1-34–1-35, 1-45–1-46; NCDE Subcommittee 2020, Chapter 3).

The restriction on creating new livestock allotments and the voluntary phasing out of livestock allotments with recurring conflicts further ensure that the recovery zone will continue to function as source habitat. Although it is possible to reopen closed allotments, such an action would be subject to NEPA. Moreover, the majority of allotments would have a low probability of reopening because the rationale behind closing them would still be applicable (i.e., the allotments were no longer viable grazing areas). In the future, there will continue to be no net increase above baseline levels in cattle or sheep allotments allowed on public lands inside the recovery zone.

Outside the recovery zone, there were 31 active cattle allotments and 2 active sheep allotments in Zone 1 in 2015 (USDA FS 2018f, p. 256). On the Flathead NF alone, the number of livestock allotments in the DMA has decreased by more than 50 percent since 1986 (USDA FS 2018e, p. 468). The BLM will not allow new sheep allotments or new livestock allotments of any kind in

Zone 1 (BLM 2021a, p. II-27; BLM 2021b, p. II-26). On USFS lands, there will be no increase in the number of active sheep allotments or in the permitted animal months above the baseline. The USFS is committed to working with willing permittees to retire allotments with recurring conflicts that cannot be resolved by modifying grazing practices (USDA FS 2018d, p. 1-11, 1-23, 1-35, 1-46; NCDE Subcommittee 2020, Chapter 3). Under the DNRC HCP, small livestock allotments will be discouraged and conservation measures will be taken to minimize the risk of grizzly bear conflicts (DNRC 2010a, p. 4-347). These controls and commitments currently in place limit negative impacts of public land livestock allotments on the NCDE grizzly bear population.

Livestock Allotments in the CYE, SE, BE, and North Cascades

There are currently no standards for livestock allotments inside the CYE, SE, BE, and North Cascades. However, the BE, CYE, and North Cascades, recovery zones, are characterized by large acreages of Wilderness Areas and IRAs, where the lack of road construction limits access. These designations are supported by regulatory mechanisms that protect grizzly bear habitat from new livestock allotments, among other resources and result in a low overall number of allotments relative to the NCDE and GYE. There are four active cattle allotments on the Kootenai NF within the CYE recovery zone (USDA FS 2020b, entire). There are two active cattle allotments on the Idaho Panhandle NF and one active cattle allotment on the Colville NF within the SE recovery zone (USDA FS 2020b, entire). On the Colville NF, livestock grazing permits include food storage measures, livestock depredation and carcass removal, grizzly bear conflict situations, and closed road access measures (USDA FS 2019, pp. 63, 82). The BE recovery zone has two active cattle allotments and two active horse allotments on the Salmon-Challis NF. The area between the BE, CYE, and NCDE contains six active cattle allotments on the Lolo NF (USDA FS 2020b, entire). There are 24 cattle and 9 sheep allotments on the Okanogan-Wenatchee NF in the North Cascades recovery zone (USDA FS 2020a, entire).

Summary of Livestock Allotments

The expanding populations in the GYE and NCDE indicate that livestock allotments and associated habitat loss are not limiting grizzly bear populations. Operation and maintenance of livestock operations often results in mortality of grizzly bears through management removals of grizzly bears that repeatedly prey on livestock; however, conservation strategies have minimized the negative impact of increased grizzly bear mortality from conflicts with livestock on public land allotments in the GYE and NCDE, and the Wilderness Act and the low number of allotments reduces this stressor in the CYE, SE, and BE. The potential effects of livestock allotments on grizzly bear in the North Cascades is unknown because there is currently no known population.

Energy and Mineral Development

The primary concerns related to mineral and energy development are human-caused mortalities and displacement due to habitat loss. Oil and gas development is associated with higher road densities, increased human access, and resultant human-bear encounters and human-caused grizzly bear mortalities (McLellan and Shackleton 1988, pp. 458–459; McLellan and Shackleton

1989b, pp. 377–379; Mace *et al.* 1996, pp. 1402–1403). Mineral and energy development could also cause displacement and habitat loss.

Disturbance in the den could result in increased energetic costs and possibly den abandonment, which, in theory, could ultimately lead to a decline in physical condition of the individual or even cub mortality (Swenson *et al*. 1997, p. 37; Graves and Reams 2001, p. 41). However, den disturbance or abandonment is rarely observed, and there have been no documented cases of such abandonment as the result of energy and mineral development by grizzly bears in the lower-48 States. Harding and Nagy (1980, p. 278) documented two instances of den abandonment during fossil fuel extraction operations in northern Canada. One bear abandoned its den when a seismic vehicle drove directly over the den (Harding and Nagy 1980, p. 278). The other bear abandoned its den when a gravel mining operation destroyed the den (Harding and Nagy 1980, p. 278). Reynolds *et al.* (1986, entire) also examined the effects of tracked vehicles and tractors pulling sledges. In 1978, there was a route for tractors and tracked vehicles within 100 m (328 ft) of a den inhabited by a female with three yearlings. This family group did not abandon their den at any point (Reynolds *et al.* 1986, p. 174). They describe one instance of possible den abandonment within 200 m (656 ft) of a seismic line; however, they also describe other cases where a supply train came within 100 m (328 ft) of a den with no abandonment (Reynolds *et al.* 1986, p. 174). Information on whether and how seismic exploration associated with oil and gas development or mining disturbs denning grizzly bears is lacking, bear responses are mixed, and existing information is from areas further north of the listed entity.

Energy and Mineral Development in the GYE

Inside the GYE recovery zone, management of oil, gas, and mining are tracked as part of the developed site standard (YES 2024, Chapter 3). There were no active oil and gas leases inside the recovery zone as of 1998 (USDA FS 2006a, p. 209); however, in 2024 there were two active phosphate leases partially in the recovery zone and six suspended oil and gas leases in or partially in the recovery zone (Gresl 2024, *in litt.*). Based on Forest Plan direction, there are approximately 243 km^2 (94 mi^2) of secure habitat that could allow surface occupancy for oil and gas projects within the recovery zone (USDA FS 2006a, Figures 48 and 96). This comprises less than 4 percent of all suitable habitat within the recovery zone. Additionally, 1,354 pre-existing mining claims were located in 10 of the subunits inside the recovery zone (YES 2024, Appendix E), but only 28 of these mining claims had operating plans. These operating plans are included in the 1998 developed site baseline. While claimants under the 1872 General Mining Law have a right to explore for and develop valuable mineral deposits on their claims, the USFS develops appropriate conservation measures for these claims through analysis and the NEPA process (42 U.S.C. 4321–4347.1970, as amended).

Under the conditions of the GYE Conservation Strategy regulatory mechanisms ensure that any new oil, gas, or mineral project will be approved only if it conforms to secure habitat and developed site standards (Service 2007a, pp. 5–6; YES 2024, Chapter 3). For instance, any oil, gas, or mineral project that permanently reduces the amount of secure habitat will have to provide replacement secure habitat of similar habitat quality (based on our scientific understanding of grizzly bear habitat); any change in developed sites will require mitigation equivalent to the type and extent of the impact, and such mitigation must be in place before project initiation or be provided concurrently with project development as an integral part of the project plan (YES 2024, Chapter 3). Only one project that temporarily changes the amount of secure habitat is allowed in any subunit at any time (YES 2024, Chapter 3). Mitigation of any project will occur within the same subunit and will be proportional to the type and extent of the project (YES 2024, Chapter 3).

In suitable habitat outside the GYE recovery zone, oil and gas development presents another potential influence on the grizzly bears. According to current Forest Plan direction, less than 19 percent (3,213 km^2 (1,240 mi^2)) of suitable habitat outside the recovery zone on USFS land allows surface occupancy for oil and gas development. As of 2024, there were no active oil and gas wells in suitable habitat but there were 23 active and suspended oil and gas leases in, or partially in, suitable habitat (6 of which overlap with the recovery zone), and 2 active phosphate leases in, or partially in, suitable habitat that overlap with the recovery zone (Gresl 2024, *in litt.*). Any proposed mineral development on Federal land would be subject to environmental review under the NEPA process, which requires Federal agencies to consider environmental effects that include, among others, impacts to wildlife, including possible conservation and mitigation measures. Additionally, only a small portion of this total land area will contain active projects at any given time, if at all. For example, as of 2024 there are approximately 4 km^2 (1.5 mi^2) of active oil and gas leases in suitable habitat where surface occupancy for oil and gas development may be allowed per the terms of the lease (Gresl 2024, *in litt.*). At this time there are no leasing decisions authorizing new leases in suitable habitat in the GYE.

Because any new mineral or energy development is approved, and will continue to be approved, only if it conforms to the secure habitat, developed site, and motorized access standards set forth in the habitat-based recovery criteria and the GYE Conservation Strategy, negative impacts of such development on grizzly bear populations in the GYE will be limited.

Energy and Mineral Development in the NCDE

Management of oil, gas, and mining are tracked as part of the habitat standards (NCDE Subcommittee 2020, Chapter 3). Forty-seven percent of lands within the recovery zone are unavailable to oil and gas leasing and new mining claims due to their status as congressionally designated Wilderness Areas, National Park, or other special designations (NCDE Subcommittee 2020, Chapter 3). Public Law 109-432 made additional lands outside of designated Wilderness Areas on the Rocky Mountain Ranger District of the Helena-Lewis and Clark NF, some areas of the Flathead NF, and BLM lands along the Rocky Mountain Front unavailable to future leasing, location, and entry.

As of 2012, there were 247 oil and gas leases inside the recovery zone, 94 percent of which occurred on USFS lands (NCDE Subcommittee 2020, Chapter 3). No surface occupancy[9] will be allowed for new oil and gas leases on Federal lands within the recovery zone and Zone 1 (USDA FS 2018c, p. 78; USDA FS 2018d, pp. 1-13, 1-25, 1-37, 1-48). Based on Forest Plan direction, there are approximately 8,500 km^2 (3,250 mi^2) within the recovery zone that could

[9] No surface occupancy: a fluid mineral leasing stipulation that prohibits use or occupancy of the land surface in order to protect identified resource values. Lessees may develop the oil and gas or geothermal resources under the area restricted by this stipulation through use of directional drilling from sites outside the no surface occupancy area.

allow surface occupancy for oil and gas projects (Krenzelok 2024, *in litt.*), which comprises approximately 37 percent of the recovery zone; however, currently all oil and gas leases are suspended within the recovery zone. Additionally, there are approximately 196 pre-existing mining claims on USFS lands located in 1 of the 23 BMUs inside the recovery zone (Krenzelok 2024, *in litt.*). One mine, the Cotter Mine, is expected to be developed in the Helena NF (USDA FS 2018f, p. 50). Otherwise, there are no Plans of Operations or Notices of Intent to explore or operate any commercial mines inside the recovery zone on USFS or BLM lands (USDA FS 2018f, p. 50; NCDE Subcommittee 2020, Chapter 3). There is some copper and silver exploration occurring at this time, but all new Plans of Operation and permits for mineral activities will include measures to reasonably mitigate potential impacts to grizzly bears or their habitat (USDA FS 2018c, pp. 77–79; USDA FS 2018d, pp. 1-11–1-14; NCDE Subcommittee 2020, Chapter 3). Appropriate conservation measures, including food/attractant storage requirements, will be included in any future Plans of Operation inside the recovery zone and Zone 1 (i.e., the DMA).

Moreover, any new projects not subject to the Mining Law of 1872 or the Federal Onshore and Gas Leasing Reform Act of 1987, including oil, gas, or mineral projects, will be approved by land management agencies only if they conform to secure core habitat and developed site standards (USDA FS 2018c, pp. 65–67; USDA FS 2018d, Appendix 1; NCDE Subcommittee 2020, Chapter 3). For instance, an oil, gas, or mineral project that reduces the amount of secure core habitat permanently will have to provide replacement secure core habitat of similar habitat quality (based on our scientific understanding of grizzly bear habitat) (USDA FS 2018c, pp. 78–79; USDA FS 2018d, pp. 1-11–1-14, 1-23–1-26, 1-35–1-38, 1-46–1-49; NCDE Subcommittee 2020, Chapter 3). Any such mitigation must be in place before project initiation or be provided concurrently with project development as an integral part of the project plan (USDA FS 2018c, pp. 50, 61; USDA FS 2018d, pp. 1-9, 1-21, 1-33, 1-44; NCDE Subcommittee 2020, Chapter 3).

Outside the recovery zone, on lands managed by the USFS, BLM, and DNRC in Zone 1, habitat protections for mineral projects and conservation and mitigation measures for oil and gas will be identical to those described for the recovery zone (see above). According to current Forest Plan and BLM direction, no surface occupancy is allowed for oil and gas development in Zone 1. Currently there are 140 oil and gas leases in Zone 1, 87 percent of which are on USFS lands (NCDE Subcommittee 2020, Chapter 3). Any proposed mineral development on Federal land would be subject to environmental review under the NEPA process, which requires Federal agencies to consider environmental effects that include, among others, impacts to wildlife, including possible conservation measures.

Because any new mineral or energy developments are approved, and will continue to be approved, only if they conform to the motorized access standards and food/attractant storage requirements set forth in the USFS plans and the NCDE Conservation Strategy, negative impacts of such development on grizzly bear populations in the NCDE will be limited.

Energy and Mineral Development in the CYE, SE, BE, and North Cascades

There are currently no standards or tracking for energy and mineral development inside the CYE, SE, BE or North Cascades. However, motorized access standards in the CYE and SE, the “no net loss" policy in the North Cascades, and the large wilderness areas and IRAs in the BE, CYE, and North Cascades may help avoid or minimize energy and mineral development effects by de facto increasing habitat security for grizzly bears. In 2019, reauthorization of the Land and Water Conservation Fund permanently withdrew 1,376 km^2 (531 mi^2) in the Methow Headwaters in the North Cascades from new mineral exploration and mine development.

Two major mining proposals are currently in various stages of permitting in the Cabinet Mountains portion of the CYE. The proposals involve mining silver and copper deposits underground below the Cabinet Mountains Wilderness (USDA FS 2016a, entire; USDA FS 2018b, entire). Each project would employ 200–300 people and have a life expectancy of approximately 20–30 years. Mine construction and operation effects analysis included mortality and displacement and recommended several avoidance, minimization, and mitigation strategies including habitat replacement through acquisition and easement, motorized access restrictions, two bear conflict management specialists, and an additional warden enforcement position (USDA FS 2016a, pp. Attach 4:1–25, USDA FS 2018b, pp. Attach 5:1–14).

Summary of Energy and Mineral Development

Habitat loss or destruction caused by energy and mineral development are not limiting populations in the GYE and NCDE. Operation and maintenance of energy and mineral development may result in mortality of grizzly bears if interactions result in activities associated with human-caused mortality; however, conservation plans have reduced negative effects in the GYE and NCDE, and the Wilderness Act and other regulations minimizes this stressor in the North Cascades, CYE, SE, and BE. Additional data would help inform the potential effects of energy and mineral development in the CYE, SE, BE, and North Cascades.

Recreation

Recreation can be divided into six basic categories based on season of use (winter or all other seasons), mode of access (motorized or non-motorized), and level of development (developed or dispersed) (USDA FS 2006a, p. 187; USDA FS 2018e, pp. 316–2018). There is a national trend of increased outdoor recreation (White *et al.* 2016, pp. 3–4, 7). During the Covid Pandemic, both NPS and USFS lands saw a large increase in visitor use. The primary concern related to increased recreation is that it may increase the probability of human-grizzly bear encounters, with subsequent increases in human-caused mortality (Mattson *et al.* 1996, p. 1014). See *I&E Programs*, below, for discussion on ways to reduce human-grizzly bear conflicts related to recreation. In addition, individuals recreating in bear country could cause displacement from high-quality habitat. Developed sites associated with recreation (see *Developed Sites*) and motorized recreation (see *Motorized Access* and *Appendix B*) can also directly limit secure grizzly bear habitat. Increases in overnight developed sites could also have indirect impacts on grizzly bears by increasing the amount of recreation on public lands surrounding campgrounds and lodges. The magnitude of potential impacts, including displacement, are unclear.

Grizzly bears exhibit a range of responses to non-motorized recreation depending on age and sex of the bear (Jope 1985, p. 34; Gibeau *et al.* 2002, p. 232; Ladle *et al.* 2018, p. 6; Loggers 2022, p. 66), reproductive status (Ladle *et al*. 2018, p. 6), season (Elmeligi 2016, p. 113), and individual bear behavior (Elmeligi 2016, pp. 131–134; Ordiz *et al.* 2019, p. 232; Sahlén *et al*. 2015, p. 7). Non-motorized human recreation can lead to spatial and/or temporal displacement of grizzly bears (Coleman *et al.* 2013, pp. 1317–1318; Lamb *et al.* 2020, pp. 2–3; Loggers 2022, p. 66), which may lead to an increase in energetic costs and disruption from access to food resources (like army cutworm moth aggregation sites and huckleberry fields) (Fortin *et al*. 2016, pp. 9–13; Linden 2018, pp. 16–18). The impacts of displacement, and associated costs, can be partially minimized through managing human recreation so that it is temporally and/or spatially predictable, such as limiting hiking to certain periods of the day or to designated trails, which allow bears to temporally and/or spatially avoid human presence (Fortin *et al*. 2016, pp. 13–15). For example, since 1982, YNP has implemented seasonal restrictions on human access in 15 Bear Management Areas to prevent displacement of grizzly bears from seasonally important habitat and to reduce human-bear interactions (YNP 1982, pp. 5–8). Recent research confirms that grizzly bears preferentially use habitat in BMAs (Loggers 2022, p. 29) and that restrictions in BMAs effectively reduce displacement from seasonally important foraging opportunities and reduce human-bear interactions (Coleman *et al.* 2013, pp. 1317–1318). In addition, some individual bears may habituate to human activities, particularly if they occur in a predictable manner, reducing the impacts of displacement (Fortin *et al*. 2016, pp. 13–15; Ladle *et al.* 2018, p. 6; Ordiz *et al.* 2019, pp. 231–232).

Although non-motorized trails may cause displacement of individual grizzly bears to varying degrees, grizzly bear mortality related to non-motorized recreation is rare and population-level impacts have not been documented (Jope 1985, pp. 34–36; McLellan and Shackleton 1989a, pp. 270–274; Kasworm and Manley 1990, p. 81, 84; Mace and Waller 1996, pp. 463–465; White *et al*. 1999, p. 149; Naidoo and Burton 2020, p. 7). Therefore, we do not have information suggesting that current and projected levels of non-motorized recreation (with the exception of hunting, see below), including mountain biking, require limitations at this time. However, because the potential for disturbance to impact reproductive success and body condition exists, partner Federal, State, and Tribal researchers have identified this topic (the impacts of non-motorized recreation on grizzly bears) as a research priority.

Motorized recreation impacts grizzly bears directly through increased mortality from human-bear encounters (defense-of-life mortality or vehicle collisions), and indirectly through displacement, habitat loss, and fragmentation (Proctor *et al*. 2019, p. 18). Most studies combine motorized trails and motorized roads for analysis, but studies that focus solely on motorized recreation documented that grizzly bears avoided trails with motorized activity (Graves 2002, p. 48; Ladle *et al*. 2018, p. 6). Therefore, including motorized trails in motorized access management can effectively minimize impacts of motorized recreation. Motorized routes (trails and roads) are buffered by 500 m and detract from secure core/habitat. In addition, seasonal habitat quality maps can be used to inform seasonal motorized trail closures or to inform placement of new motorized trails to minimize impacts to grizzly bears (Proctor *et al.* 2019, p. 28). Recent research shows that important hyperphagic food resources, such as huckleberries, in non-secure habitat near open roads contributed significantly less to female bear density, fitness, and reproductive success than foods in secure habitat away from roads (Proctor *et al.* 2023, p. 47).

Recreational hunting (e.g., elk, black bears, upland birds) within grizzly bear habitat can also increase the chances of grizzly bear mortalities due to defense-of-life and mistaken identification killings (see *Human-caused Mortality* for further details). Hunting of grizzly bears is not currently allowed in the lower-48 States. Mistaken identification killings of grizzly bears by black bear hunters are both accidental and illegal. Mistaken identification is prosecuted as illegal take, and all such grizzly bear mortality is fully investigated to determine cause. Black bear hunting using bait is allowed in portions of Idaho and Wyoming but is not allowed in Montana or Washington. Hunting over bait can be a potential source of mortality (due to mistaken-identity killings) and conflicts (due to conditioning to human foods). While there is potential for both of these, minimal research has been done on the impacts of conflicts as a result of food conditioning. A bear identification test is required in the States of Montana and Washington and voluntary in the States of Idaho and Wyoming to minimize mistaken identification mortalities (see *Mistaken-Identity Killings* for further details). Under current regulations (under Section 4(d) of the Act), it is legal for private citizens to kill grizzly bears if it is in self-defense or defense-of-others (50 CFR § 17.40). These self-defense situations have occurred with ungulate hunters during surprise encounters, at hunter-killed carcasses or gut piles, or when packing out carcasses.

Snowmobiling and other winter sports (i.e., backcountry skiing) are other forms of recreation that can potentially affect grizzly bears by increasing the probability of human-grizzly encounters and potential disturbance of denning grizzly bears. Disturbance of grizzly bears in the den can result in cub abandonment or early den exit, which could kill a grizzly (if they leave before food is readily available). Although there are no data or information suggesting winter recreational use is negatively affecting grizzly bear populations in the lower-48 States, the potential for disturbance and impacts to reproductive success exists and monitoring will continue to support adaptive management decisions about winter recreation use in areas where disturbance is documented or likely to occur. Potential impacts of winter recreation are discussed in further detail in *Appendix F*.

Recreation in the GYE

Over 8 million people visit and recreate in the National Parks and NFs of the GYE annually (USDA FS 2006a, pp. 176, 184; Schwabedissen and Wilmot 2022, pp. 51–52; Gunther 2022, pp. 53–56; NPS 2023, entire). Based on past trends, visitation and recreation are expected to increase in the future. For instance, YNP has shown an approximate 19 percent increase in the number of people visiting each decade since the 1950s (Gunther 2022, pp. 53–56), and a 30 percent increase in visitation in just the last decade (NPS 2023, entire). However, the number of backcountry overnight stays in YNP has remained relatively constant from the 1970s through 2010s (Gunther 2022, pp. 53–56).

Inside the recovery zone, the vast majority of lands available for recreation are accessible through non-motorized travel only (USDA FS 2006a, p. 179). Motorized recreation during the summer, spring, and fall inside the recovery zone is limited to existing roads under standards in the habitat-based recovery criteria and the GYE Conservation Strategy that restrict increases in roads or motorized trails. Recreation at developed sites such as lodges, downhill ski areas, and campgrounds are limited by the developed sites habitat standard described in the habitat-based recovery criteria and the GYE Conservation Strategy. Ongoing I&E efforts at these recreation sites are an important contributing factor to successful grizzly bear conservation and will continue under the GYE Conservation Strategy (YES 2024, Chapter 5). The number and capacity of existing developed sites on Federal lands has not increased from the 1998 baseline and are limited under the habitat-based recovery criteria and the GYE Conservation Strategy. For a more complete discussion of projected increases in recreation in the GYE NFs, see the Final EIS for the Forest Plan Amendment for Grizzly Bear Habitat Conservation for the GYE NFs (USDA FS 2006a, pp. 176–189). Baiting for black bear hunting is currently allowed in portions of estimated occupied range of the GYE in the States of Idaho and Wyoming. This may be a potential source of mortality (due to mistaken-identity) and conflicts (due to conditioning to human foods), particularly in areas of dispersal from the other ecosystems in Idaho to the BE. While there is potential for both of these, minimal research has been done on the impacts of conflicts as a result of food conditioning.

Recreation in the NCDE

At least 3 million people visit and recreate in GNP and another 3 million on the NFs of the NCDE annually (NPS 2018a, entire; USDA FS 2018e, p. 322; USDA FS 2018f, p. 287; NPS 2023, entire). Based on past trends, visitation and recreation are expected to increase in the future. For instance, GNP has shown an approximate 8 percent increase in the number of people visiting each year since 1930 (NPS 2018a, entire), and an increase of 25 percent over the last decade (NPS 2023, entire). However, the number of people recreating in the backcountry in GNP has remained relatively constant from the 1970s through 2010s (NPS 2018f, entire).

Inside the recovery zone, approximately 67 percent of lands available for recreation are accessible only through non-motorized travel because of their status as protected areas (see *Protected Areas* above for further discussion; NCDE Subcommittee 2020, Chapter 3, Figure 7). In order to reduce the risk of human-grizzly bear conflicts when constructing new trails, the USFS employs measures such as locating trails outside of seasonally important grizzly bear habitat (i.e., riparian management zones or avalanche chutes) (USDS FS 2018e, p. 183). A Comprehensive Plan was released by the USFS in 2023 that evaluated management, development, and use of the congressionally designated Pacific Northwest National Scenic Trail, which bisects the NCDE (USDA FS 2023a, entire). However, the plan does not address trail relocations or implementation for some sections of the trail, which will be addressed through future efforts (USDA FS 2023a, pp. 73–79). Motorized recreation during the summer, spring, and fall inside the recovery zone are limited to roads and trails open to such use under the standards in the NCDE Conservation Strategy and land management plans that restrict increases in roads or motorized trails (USDA FS 2018a, p. 31; USDA FS 2018d, pp. 9–11; NCDE Subcommittee 2020, Chapter 3). Similarly, overnight recreation at developed sites such as lodges and campgrounds are limited by the developed sites habitat standard described in the NCDE Conservation Strategy and land management plans. Increases in the number and capacity of existing developed sites on public lands are limited under the habitat-based recovery criteria and the NCDE Conservation Strategy (Service 2018, entire; USDA FS 2018a, p. 31; USDA FS 2018d, pp. 1-7, 1-19, 1-31, 1-42; NCDE Subcommittee 2020, Chapter 3). The habitat-based recovery criteria include an objective to limit increases in the number and capacity of new developed recreation sites on Federal lands for overnight use by the public during the non-denning season to one per decade per BMU. We are currently re-evaluating the need for limitations on the size of any new or current developed site expansion under the NCDE Conservation Strategy.

Recreation in the CYE and SE

Visitor use is not available specifically for the CYE and SE recovery zones. The USDA FS National Visitor Use Monitoring program provides estimates for the volume and type of recreational visitation to each NF at least once per decade. In the past decade, NFs in the CYE had over 3 million site visits and the SE had over 2 million site visits annually (USDA FS 2023g, entire). However, these forests encompass an area that is much larger (approximately 4 and 2 times) than the area of the CYE and SE recovery zones, respectively. A Comprehensive Plan was released by the USFS in 2023 that evaluated management, development, and use of the congressionally designated Pacific Northwest National Scenic Trail, which bisects both the CYE and SE (USDA FS 2023a, entire). However, the plan does not address trail relocations or implementation for some sections of the trail, which will be addressed through future efforts (USDA FS 2023a, pp. 73–79). Potential impacts of the trail are unknown at this time; however, if user levels increase such that they are considered high-use trails, the trail could create a decrease in core areas as defined in Forest plans (USDA FS 2011a, p. 36; USDA FS 2011c, pp. 23–27). Huckleberry picking is a common recreational activity within the CYE and SE. Permits are not required for this activity and therefore no means of tracking the amount of use occurring for this activity exists. Motorized vehicle restrictions on the NFs help limit the location or amount of this activity in grizzly bear habitat. Baiting for black bear hunting is currently allowed on portions of estimated occupied range of the CYE and SE in the State of Idaho. This may be a potential source of mortality (due to mistaken-identity) and conflicts (due to conditioning to human foods), particularly in areas of dispersal from the CYE to the BE. While there is potential for both of these, minimal research has been done on the impacts of conflicts as a result of food conditioning.

Recreation in the BE

Visitor use is not available specifically for the BE recovery zone. The USDA FS National Visitor Use Monitoring program provides estimates for the volume and type of recreational visitation to each NF at least once per decade. In the past decade, NFs in the BE had over 5.8 million site visits annually (USDA FS 2023g, entire). However, these forests encompass an area that is approximately 3 times the area of the BE recovery zone. Inside the recovery zone, approximately 98 percent of lands available for recreation are accessible through non-motorized travel only because of their status as designated Wilderness (see *Protected Areas* above for further discussion). Baiting for black bear hunting is currently allowed in the Idaho portion of the BE. This may be a potential source of mortality (due to mistaken-identity) and conflicts (due to conditioning to human foods) should grizzly bears recolonize this ecosystem. The first known grizzly bear to move into the BE was killed by a black bear hunter using bait in 2007. While there is potential for both of these, minimal research has been done on the impacts of conflicts as a result of food conditioning.

Recreation in the North Cascades

The North Cascades Park Complex and surrounding forests within the North Cascades provide a diverse array of recreational opportunities, including hiking, backpacking, camping, climbing, fishing, horseback riding, bicycling, boating, winter sports, and wildlife viewing. The North Cascades Park Complex contains North Cascades National Park, Ross Lake NRA, and Lake Chelan NRA. It is estimated that recreational use of Federal lands in the North Cascades is 8 million visitor days per year; however, visitor use is not equally distributed (NPS and Service 2024a, pp. 117–118). The majority of trails in the North Cascades occur in wilderness and roadless areas (NPS and Service 2024a, pp. 117–118). Based on past trends, visitation and recreation are expected to increase in the future. For instance, the North Cascades Park Complex has shown an approximate 7 percent increase in the number of people visiting each year from 2003–2022 (NPS 2022).

Inside the recovery zone, approximately 64 percent of lands available for recreation are accessible through non-motorized travel only because of their status as protected areas (see *Protected Areas* above for further discussion). The Federal land managers agreed to manage for "no net loss" of core areas within the North Cascades recovery zone until the agreement is superseded by a forest/park plan amendment or revision (USDA FS 1997, p. 1). The 2012 Ross Lake Recreation Area General Management Plan (GMP) includes provisions that any new trails proposed within the Ross Lake GMP would constitute reductions of less than 1 percent in each of the four BMUs with an intent to retain core area levels of 70 percent or higher per BMU (NPS 2012, p. 82). In addition, any new trails will be located in areas that are not high-quality grizzly bear habitat (NPS 2012, p. 74). A Comprehensive Plan was released by the USFS in 2023 for public comment that evaluated management, development, and use of the congressionally designated Pacific Northwest National Scenic Trail, which bisects the North Cascades (USDA FS 2023a, entire). However, the plan does not address trail relocations or implementation for some sections of the trail, which will be addressed through future efforts (USDA FS 2023a, pp. 73–79).

Summary of Recreation

Recreation can result in the direct mortality of grizzly bears through increased human-grizzly bear encounters and resultant self-defense kills, management removals, or mistaken-identity kills while hunting or trapping. Grizzly bears may also be displaced by motorized and non-motorized recreation, which may result in negative impacts to individuals. However, we do not have evidence indicating that current levels of recreation are limiting to grizzly bear populations.

Vegetation Management

Vegetation management projects typically include timber harvest, thinning, prescribed fire, and salvage of burned, diseased, or insect-infested stands. Depending on the type of project, vegetation management can be beneficial, neutral, or harmful to grizzly bears. Vegetation management programs can negatively affect grizzly bears by:

- Temporarily or permanently removing cover;
- Disturbing or displacing bears from habitat during the vegetation management activity;
- Increasing human-grizzly bear conflicts or mortalities as a result of unsecured attractants; and

- Increasing mortality risk as a result of increased human-grizzly bear encounters or displacement due to new roads into previously roadless areas and/or increased vehicular use on existing restricted roads, especially if roads remain open to the public after vegetation management is complete (McLellan and Shackleton 1988, pp. 458–459; McLellan and Shackleton 1989b, pp. 377–379; Mace *et al.* 1996, pp. 1402–1403; Schwartz *et al.* 2010a, p. 661; Boulanger and Stenhouse 2014, p. 15; Proctor *et al.* 2017, pp. 53–54; Lamb *et al.* 2018, pp. 1412–1415; Proctor *et al.* 2019, entire).

Vegetation management can also result in positive effects on grizzly bear habitat once the project is complete, provided key habitats such as riparian areas and food production areas are maintained or enhanced. For instance, tree removal for thinning or timber harvest and prescribed burning or weed control, can result in localized increases in bear foods through increased growth of mushrooms, grasses, forbs, and berry-producing shrubs (Zager *et al.* 1983, p. 124; Kerns *et al.* 2004, p. 675). In addition, federal land management agencies, including the USFS and BLM, are involved in ongoing whitebark pine restoration efforts throughout it range (Service 2021, p. 47). Vegetation management may also benefit grizzly bear habitat by controlling undesirable invasive species and improving riparian management in important food production areas. Changes in the distribution, quantity, and quality of cover are not necessarily detrimental to grizzly bears as long as they are coordinated on a landscape scale to ensure that grizzly bear needs are addressed throughout the various projects occurring on at any given time.

Vegetation Management in the GYE

In the GYE, vegetation management occurs throughout the GYE on lands managed by the USFS and NPS. Although there are known, usually temporary, impacts to individual bears from timber management activities, these impacts have been adequately minimized using the Interagency Grizzly Bear Guidelines (Guidelines) in place since 1986 (USDA FS 1986b, pp. 6–12), and will continue to be managed at levels compatible with a recovered grizzly bear population under the GYE Conservation Strategy. In addition, approximately 82 percent of the recovery zone in the GYE are considered “protected lands” (see *Protected Areas* above for further details), which does not allow timber harvest. State and private forestlands with motorized access restrictions add additional conservation protections.

Timber harvest can disturb, displace, or remove cover for grizzly bears. According to current Forest Plan direction, 11 percent (2,563 km^2 (990 mi^2)) of suitable habitat outside the recovery zone on USFS land has both suitable timber and a management prescription that allows scheduled timber harvest. Only a small portion of this total land area will contain active projects at any given time, if at all. For example, less than 0.1 percent (2.4 km^2 (0.9 mi^2)) of the roughly 2,563 km^2 (990 mi^2) identified as having both suitable timber and a management prescription that allows timber harvest, was actually logged annually from 2003 to 2023 (Jackson 2024, *in litt.*).

Vegetation Management in the NCDE

Vegetation management occurs throughout the NCDE on lands managed by the USFS, NPS, DNRC, BLM, FIR, BIR, and Montana Fish, Wildlife and Parks (MFWP). Despite potential negative impacts from vegetation management, mortality risk from vegetation management activities are and will continue to be largely minimized through motorized access standards and food storage requirements on Federal lands (NPS 2010, p. 4; USDA FS 2018a, p. 31; USDA FS 2018c, pp. 42–43; USDA FS 2018d, pp. 8–11; NCDE Subcommittee 2020, Chapters 3 and 4; NCNP 2023, entire; USDA2023e, entire; GNP 2024, p. 2), and motorized access restrictions on State and private forestlands. Nearly 67 percent of the recovery zone is unavailable for general, commercial timber harvest through Federal and Tribal designations (such as Wilderness Areas, WSAs, and other protective designations; see *Protected Lands* above for further information). Although there are known, usually temporary, impacts to individual bears from timber and other vegetation management activities, these impacts have been adequately minimized using the Guidelines in place since 1986 (USDA FS 1986b, pp. 6–12), and will continue to be managed at levels compatible with a recovered grizzly bear population under the NCDE Conservation Strategy and land management plans (CS&KT 2000, p. 284; Blackfeet Nation 2008, pp. 10–12; DNRC 2010b, pp. 1-26–1-27; USDA FS 2018a, pp. 42–43; USDA FS 2018d, 1-9–1-10, 1-21–1-22, 1-33–1-34, 1-44–1-45; NCDE Subcommittee 2020, Chapter 3).

Vegetation management projects are designed to: enhance forage production, except in areas that are frequented by people such as campgrounds; retain or develop cover adjacent to forest openings and highway crossing areas; protect important habitats such as avalanche chutes, riparian areas, and berry-producing shrubs; and minimize the impacts of motorized access (USDA FS 2018e, pp. 143, 184–185; USDA FS 2018f, p. 16). The extent of protected lands inside the recovery zone and management standards in the NCDE Conservation Strategy and land management plans regarding vegetation management, limit potential negative impacts of vegetation management to the NCDE grizzly bear population.

Outside the NCDE recovery zone, 55 percent of Zone 1 outside the DCAs, 65 percent of Zone 1 inside the DCAs, and 29 percent of Zone 2 on USFS land has both suitable timber and a management prescription that allows scheduled timber harvest according to current Forest Plan direction (Krenzelok 2024, *in litt*.). On USFS lands from 2004 to 2024, an average of less than 1 percent of Zone 1 outside the DCAs, 0 percent of Zone 1 inside the DCAs, and less than 1 percent of Zone 2 was actually logged annually (Krenzelok 2024, *in litt.*). Motorized access commitments by the Federal, State, and Tribal agencies in Zone 1, both inside and outside the DCAs, add additional conservation protections. Additionally, only a small portion of this total land area will contain active projects at any given time, if at all.

Additional protections occur on Federal (BLM and USFS) and Tribal lands outside of the recovery zone but inside the DMA in Zones 1 and 2. Of the 19,460 km^2 (7,514 mi^2) in Zone 1 and the 18,854 km^2 (7,280 mi^2) in Zone 2, the USFS manages 4,351 km^2 (1,680 mi^2) of Zone 1 and 4,655 km^2 (1,797 mi^2) of Zone 2, or 22 percent and 24 percent respectively. An additional 29 and 6 percent in Zones 1 and 2, respectively, is managed by the BLM, FIR, and BIR. The Blackfeet Tribe manages the 1,605 km^2 (620 mi^2) of Zone 1 within the boundaries of the BIR. Under the Blackfeet Reservation Forest Management Plan forestry activities are not allowed during critical periods in identified denning and spring foraging habitat (Blackfeet Nation 2008, p. 12). In addition, the Blackfeet Fish and Wildlife Department implement measures to prevent human-grizzly bear conflicts, such as attractant storage (Blackfeet Tribal Business Council 2013, p. 9). The CS&KT manage the 3,559 km^2 (1,374 mi^2) of Zone 1 within the boundaries of the

FIR. The FIR Forest Management Plan focuses on reducing human-bear conflicts and providing secure, high-quality habitat for grizzly bears through forest management practices such as selective logging and prescribed fire (CS&KT 2000, p. 111).

Vegetation Management in the CYE, SE, BE, and North Cascades

Despite potential negative impacts from vegetation management, mortality risk from vegetation management activities is and will continue to be largely minimized through motorized access standards in the CYE and SE and the "no net loss" policy in the North Cascades. Motorized access standards identify core habitat which must remain in place for 10 years at a minimum. In reality many of these core blocks remain in place for much longer than 10 years. In addition, USFS plan direction has a "no net loss" policy for BORZ in the CYE and SE. This designation does limit some vegetation management activities that rely on motorized access, but it does not preclude prescribed burning or helicopter-supported timber harvest. These activities must also go through the consultation process under ESA Section 7 to determine their effects on listed species. The large acreage of Wilderness Areas and IRAs reduce the effects of vegetation management in the CYE, BE, and North Cascades. State and private forestlands with motorized access restrictions further reduce the potentially negative effects of vegetation management.

Summary of Vegetation Management

The building of roads is the largest potential threat to grizzly bear populations as a consequence of vegetation management projects. However, motorized access standards in recovery zones and in some areas surrounding recovery zones effectively reduce this threat. Other vegetation management projects are generally short-term and small-scale in nature and are not currently limiting grizzly bear populations. Vegetation management that improves food resources, such as berry producing shrubs, tubers or corms, succulent broadleaves, or grasses, can benefit grizzly bears. Manipulations that can produce these effects occur in the form of prescribed fire, thinning, or timber harvest, but all actions must consider the individual site and desired condition post treatment.

Habitat Fragmentation

Habitat fragmentation can cause loss of connectivity and may be caused by human activities, such as habitat modification, road building, and human developments and settlement (Proctor *et al.* 2012, p. 23; Lamb *et al.* 2017, p. 62). Human activities can result in human-caused mortality, such as automobile collisions and management removals, that also cause demographic fragmentation. Because grizzly bears live at relatively low population densities, disperse slowly, and are vulnerable to human-caused mortality, anthropogenic habitat fragmentation may influence grizzly bear populations that occur in close proximity to human population centers and continuous linear rural development associated with highways (Forman and Alexander 1998, pp. 222–223; Proctor *et al.* 2012, pp. 23–28, 35; Lindenmayer and Fischer 2006, entire). In general, habitat fragmentation and isolation can increase vulnerability to threats, such as decreased demographic or genetic connectivity. Females are more susceptible to habitat fragmentation than males for several reasons (Proctor *et al.* 2005, p. 2414; Proctor *et al.* 2012, p. 23). Female dispersal is gradual (McLellan and Hovey 2001, p. 843), usually significantly shorter distances than males (McLellan and Hovey 2001, p. 841; Proctor *et al.* 2004, p. 1113), and holds the potential for small population augmentation and/or demographic rescue through their ability to produce offspring post-immigration into small, isolated populations. For these reasons, females tend to be the focus of demographic fragmentation/connectivity goals (Proctor *et al.* 2005, p. 2414; Proctor *et al.* 2012, pp. 26–27). In addition, dispersal patterns suggest that to enhance or re-establish female connectivity, female occupancy of connectivity areas is necessary to facilitate inter-generational connectivity (McLellan and Hovey 2001, p. 843; Proctor *et al.* 2005, p. 2414; Proctor *et al.* 2015, p. 8; Proctor *et al.* 2018, pp. 363–364). Long distance dispersal by males enables immigrants to act as a counter to genetic fragmentation and loss of nuclear genetic diversity (e.g., GYE) (Proctor *et al.* 2012, p. 27; Peck *et al.* 2017, p. 15).

To minimize future habitat fragmentation and degradation, Federal agencies evaluate road construction projects on Federal lands throughout the GYE, NCDE, CYE, and SE for impacts to grizzly bear habitat connectivity (USDA FS 2018a, p. 33; USDA FS 2018d, p. 2; Service 2007a, pp. 38–41; NCDE Subcommittee 2020, Chapter 3; YES 2024, Chapter 3). By identifying areas used by grizzly bears, officials can minimize potential impacts from road construction during and after a project. Federal agencies will continue to identify important crossing areas by collecting information about known grizzly bear crossings and sightings, ungulate road mortality data, grizzly bear home range analyses, and locations of game trails. The data will be used to reduce grizzly bear mortality due to vehicle collisions, identify bear access to seasonal habitats, to help maintain traditional dispersal routes, and to decrease the risk of fragmentation of individual home ranges. For example, action agencies will often commit to measures such as work crews placing temporary work camps in areas with lower risk of displacing grizzly bears, and food and garbage being kept in bear-resistant containers. Highway planners incorporate warning signs and crossing structures such as culverts or underpasses into projects when possible to facilitate safe highway crossings by all wildlife. Crossing structures must be paired with wildlife exclusion fencing for effectiveness. Without adequate exclusion fencing to guide wildlife to structures, grizzly bears will likely not use them. Fencing without crossing structures will inhibit passage for grizzly bears, causing fragmentation.

Valleys tend to be mostly privately owned and can become mortality sinks for grizzly bears as a result of attractants in these areas (human foods, livestock, etc.) (Servheen *et al*. 1981, pp. 2–3, 17–29; Blackfeet Tribal Business Council 2013, pp. 6–10; NCDE Subcommittee 2020, Chapter 4; MFWP 2022, p. 85). Conflict prevention, response, and outreach elements of conservation strategies and agency plans play an important role in minimizing habitat and demographic fragmentation and preventing these valleys from becoming mortality sinks. To reduce conflict, Federal, State, and Tribal management authorities remove the source of conflict (e.g., removing or securing attractants) and use non-lethal solutions (e.g., aversive conditioning) when possible. I&E efforts and community sanitation measures emphasize keeping private property (including livestock and domestic pets) bear resistant, use of electric fencing to keep bears out of attractants (e.g., orchards, chicken coops, garbage, and bee yards), and use of bear-resistant garbage containers to keep bears out of garbage.

Fragmentation in the GYE

The GYE grizzly bear population is currently a contiguous population across its range, and there are no data to indicate habitat fragmentation within this population is occurring. In other words, there is no indication that human activities are preventing grizzly bears from moving freely within the ecosystem.

Fragmentation in the NCDE

Kendall *et al.* (2009, p. 10) identified human-caused habitat fragmentation within the NCDE across the U.S. Hwy. 2 / BNSF rail line corridor. Although this corridor does not currently prevent demographic and genetic connectivity within the NCDE (Waller and Servheen 2005, pp. 996–998; Mikle *et al.* 2016b, supplementary table 3), Waller and Miller (2015, pp. 34–36) documented substantial increases in traffic volume along U.S. Hwy. 2, particularly during nighttime hours when grizzly bears are most likely to cross the highway (see *Genetic Health* for further details). Measures of genetic diversity from the NCDE are similar to those from undisturbed populations in Canada and Alaska leading to the conclusion that the NCDE population has high genetic diversity and is sufficiently connected to other populations as discussed below in *Genetic Health in the NCDE*.

Fragmentation in the CYE, SE, BE, and North Cascades

Inside the CYE, SE, BE, and North Cascades recovery zones, habitat-based recovery criteria will be developed prior to any proposed delisting that includes thresholds to address the threat identified at the time of listing of destruction and modification of habitat. These standards will limit human-bear interactions and resultant mortality, but also will limit impacts to grizzly bear habitat connectivity. Land management practices that result in road construction and the conversion of large tracts of private land into residential subdivisions can prevent grizzly bears from moving between populations (Proctor *et al.* 2012, p. 35). There is no indication that such potential barriers exist within the SE, BE, and North Cascades recovery zones.

Fragmentation has occurred, and currently still occurs, between the Yaak and Cabinet Mountains portions of the CYE and is related to human settlement, U.S. Hwy. 2, and a busy rail line (Proctor *et al*. 2018, p. 350). B.C. has identified linkage corridors (Proctor *et al*. 2015, p. 11) and management to re-establish connectivity between these two areas has included non-lethal management of appropriate conflict bears, land purchases, electric fencing programs to reduce attractants and conflicts, and more (Proctor *et al*. 2018, pp. 366–367). There is recent evidence that some movements are starting to take place (Kasworm *et al*. 2024a, p. 34) and functional connectivity remains a management objective.

Private Land Development

Private land development may lead to habitat fragmentation (see *Habitat Fragmentation* above for further discussion). Rapidly accelerating growth of human populations in some areas outside of the recovery zones continue to define the limits of grizzly bear range, and will likely limit:

- the expansion of the grizzly bear populations onto private lands in some areas outside the recovery zones;
- connectivity between ecosystems; and
- natural recolonization of the BE and North Cascades.

Urban and rural sprawl (low-density housing and associated businesses) has resulted in increasing numbers of human-grizzly bear conflicts with subsequent increases in grizzly bear mortality rates in more human-dominated landscapes. Private lands account for a disproportionate number of bear deaths and conflicts (Service 2007c, Figures 15 and 16; Schwartz *et al.* 2010a, p. 661; Proctor *et al.* 2012, p. 33; MFWP, unpublished data).

Conservation easements on private lands (Figure 30) maintain open lands for wildlife use by protecting against potential future subdivision and development while maintaining traditional land-uses. Public agencies (e.g., the Service) or qualified land trusts (e.g., The Nature Conservancy, The Vital Ground Foundation, Y2Y) place conservation easements, in cooperation with the landowner. In addition, land trusts or other private conservation organizations have purchased land for the purpose of wildlife conservation. Easements and land trusts can be especially effective at reducing habitat fragmentation and increasing connectivity of secure grizzly bear habitat. Private lands that limit road access also contribute to conservation benefits for bears. Further easement acquisition in recovery zones, demographic monitoring areas, and connectivity areas (Figure 15) by public agencies (e.g., the Service within conservation areas) or qualified land trusts will be important to minimize the impacts of habitat fragmentation on grizzly bears.

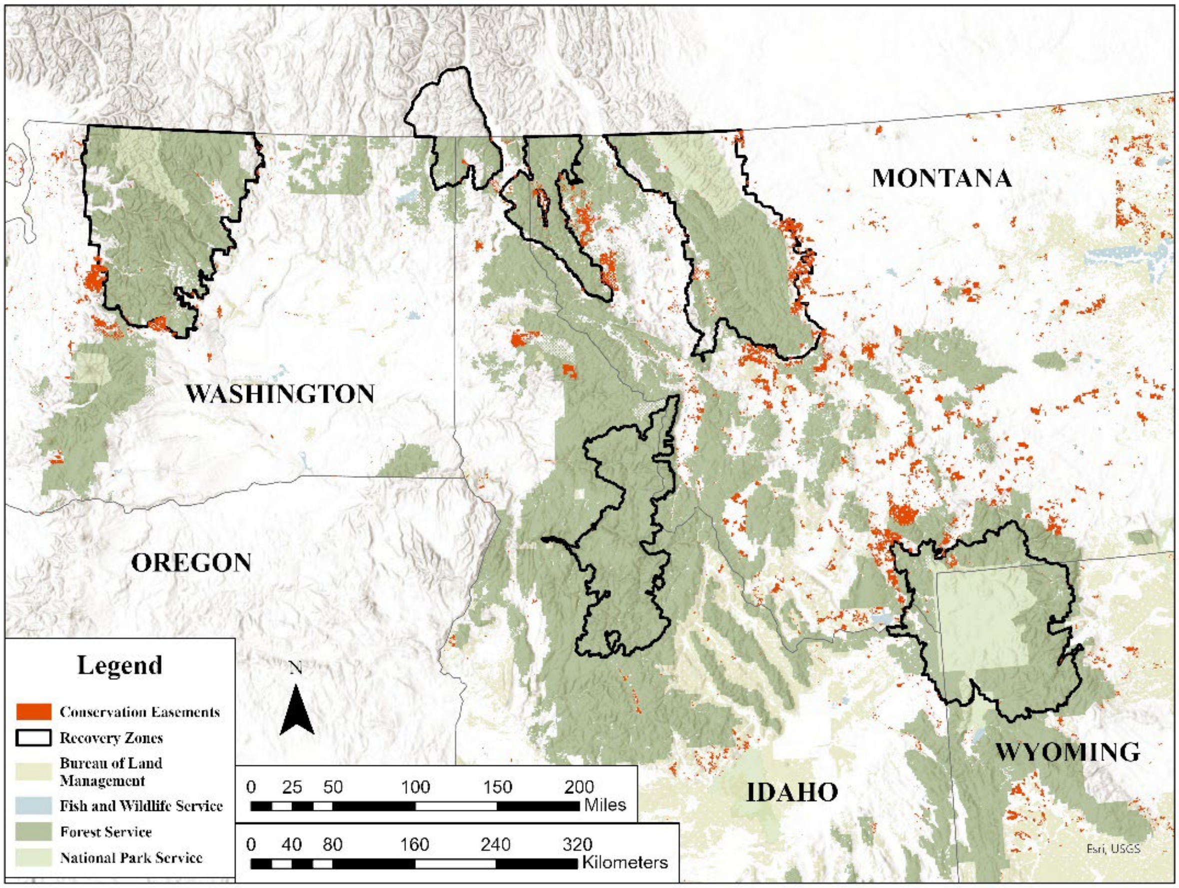


Figure 30. Conservation easements and Federal Lands within and between the six grizzly bear recovery zones as of 2023.

In addition to addressing threats from private land development through conservation easement programs, Federal, State, and Tribal wildlife management agencies respond to conflicts on public and private lands. While human-grizzly conflicts at developed sites on public lands do occur, the most frequent reason for management removals are conflicts on private lands (Servheen *et al.* 2004, p. 21; MFWP, unpublished data). Depending on the situation, appropriate responses may include proactively removing or securing attractants; public outreach and education; discouraging the grizzly bear from visiting the area using non-lethal methods; capturing and relocating a grizzly bear to a new area; and/or removing the grizzly bear from the population (Servheen *et al*. 1981, pp. 2–3, 17–29; Idaho's Yellowstone Grizzly Bear Delisting Advisory Team 2002, pp. 14–18; Blackfeet Tribal Business Council 2013, pp. 6–10; WGFD 2016, pp. 20–22; NCDE Subcommittee 2020, Chapter 4; MFWP 2022 pp. 88–98; YES 2024, Chapter 4). Proctor *et al.* (2018, entire) describe a comprehensive program to reduce human-bear conflicts on a fragmented landscape. They were able to reduce human-caused mortality and increase connectivity in and between ecosystems through land trust acquisitions and easements, attractant management, non-lethal management of appropriate conflict bears, and public outreach and education. Other methods to reduce conflicts on private land include effective enforcement of regulations and food storage regulations. The feeding of grizzly bears is prohibited on private lands in Montana (ARM 87-6-216) and Washington (RCW 77.15.790, RCW 77.15.792) and in some counties and cities in Idaho and Wyoming.

Private Land Development in the GYE

In the GYE, one percent of the recovery zone and nearly 13 percent of the DMA outside of the recovery zone is privately owned. From 2010–2021 counties within or partially overlapping the DMA saw a 16.1 percent increase in human populations (Headwaters Economics 2023). Gallatin County, Montana and Teton County, Idaho experienced a 33.1 and 22.1 percent increase in human population, respectively. In addition, counties fully outside the DMA but wholly or partially within estimated occupied range experienced a 21.4 percent increase in human population. Madison County, Idaho experienced a 40 percent increase human population. As private lands are developed and secure habitat on private lands declines, State and Federal agencies will work together through the Coordinating Committee to balance impacts from private land development (Idaho's Yellowstone Grizzly Bear Delisting Advisory Team 2002, p. 10; WGFD 2016, p. 15; MFWP 2022, pp. 8–9).

Easements and the purchase of private lands by land trusts (e.g., The Nature Conservancy, The Vital Ground Foundation) or public agencies (e.g., the Service) have protected 40 percent (101 of 251 km^2 (39 of 97 mi^2) of the privately owned land inside the recovery zone and 24 percent (733 of 3,289 km^2 (299 of 1,270 mi^2) of privately owned land inside the DMA outside the recovery zone. In addition, 1,223 km^2 (472 mi^2) of privately owned land that is to the north and northwest of the DMA, including lands that straddle the DMA boundary, that are inside the GYE are protected by easements or owned by land trusts. These lands occur in potential connectivity areas between the GYE and both the BE and the NCDE (Figure 15) (Sells *et al.* 2023, p. 6). State and Federal agencies will continue to assist NGOs and other entities to identify and prioritize potential lands suitable for permanent conservation through easements and other means as much as possible (Service 2007c, p. 54).

The large areas of widely distributed suitable habitat on public lands in the GYE that are protected by Federal legislation help to minimize risk posed by human population growth on private lands and ensure that the grizzly bear population continues to meet recovery criteria.

Private Land Development in the NCDE

In the NCDE, 7 percent of habitat within the recovery zone and nearly 47 percent of habitat in Zones 1 and 2 is privately owned. From 2010–2021, human population in counties that are within or overlap the DMA as well as estimated occupied range increased by a 10.5 percent (Headwaters Economics 2023). Flathead County, Montana saw a 15.9 percent increase in human population. Lewis and Clark County, Montana saw a 14.1 percent increase in human population. From 2010–2021 counties outside the DMA within the distribution area saw a 5.1 percent increase in human population. Granite County, Montana saw a 9.5 percent increase in human population. As private lands are developed and as secure habitat on private lands declines, State and Federal agencies will work together through the Coordinating Committee to balance impacts on the grizzly bear population (NCDE Subcommittee 2020, Chapters 1 and 3; MFWP 2022, pp. 8–9, 21).

Public agencies (e.g., the Service) or qualified Land Trusts (e.g., The Nature Conservancy, The Vital Ground Foundation) have placed conservation easements, in cooperation with the land owner, or purchased private lands, on 45 percent (741 of 1,655 km^2 (286 of 639 mi^2)) of privately owned land in the recovery zone, 22 percent (1,592 of 7,160 km^2 (614 of 2,764 mi^2)) of privately owned land in Zone 1, and 11 percent (1,257 of 11,723 km^2 (485 of 4,526 mi^2)) of privately owned land in Zone 2. Zones 1 and 2 provide potential connectivity areas from the NCDE to the GYE, BE, and CYE (Figure 15) (Sells *et al*. 2023, pp. 6–7). State and Federal agencies will continue to assist NGOs and other entities to identify and prioritize potential lands suitable for permanent conservation through easements and other means as much as possible (Servheen *et al*. 1981, pp. 34–35; USDA FS 2018c, pp. 70, 131; USDA FS 2018d, p. 2; NCDE Subcommittee 2020, Chapter 3).

Private Land Development in the CYE

In the CYE, nearly 2 percent of habitat within the recovery zone is privately owned. From 2010–2021 the human population in counties within the CYE increased 9.8 percent (Headwaters Economics 2023). One of those counties, Bonner County, Idaho, experienced a 14.2 percent increase within those 10 years. Agencies and NGOs are working to reduce fragmentation that has occurred due to private land development in important linkage areas (Proctor *et al*. 2015, p. 8) between the CYE and SE.

Land acquisition and exchange has placed additional areas within the CYE recovery zone in the public domain, which benefits the long-term conservation of the species. There have been several major land exchanges in particular that have been beneficial to grizzly bear habitat within the CYE. In 1997 the Kootenai NF completed a land exchange in which 87 km^2 (33 mi^2) of land owned by Plum Creek Timber Company were placed in public ownership and administered by the Kootenai NF for the benefit of grizzly bear and other species. Motorized access is managed under the BMU-specific standards described above. Almost all of this land was within the CYE grizzly bear recovery zone. In 2005, MFWP purchased almost 5 km^2 (2 mi^2) in the Bull River Valley between the East and West Cabinet Mountains. A conservation easement on an adjacent 2 km^2 (1 mi^2) was accepted by the State of Montana from the Avista Company. The area, now known as the Bull River Wildlife Management Area is managed by MFWP and provides linkage of public land across the river valley and will have value for a number of species including bull trout, westslope cutthroat trout, grizzly bear, lynx, and bald eagle. This acquisition and easement limit motorized access, limit future subdivision and home site development, and protect population linkage across the Bull River valley. In 2007, another adjacent 2 km^2 (1 mi^2) was added to the management area by purchase and cooperative management with Revett Minerals. In addition, in 2017 and 2018, Vital Grounds and the Yukon Conservation Initiative have acquired or purchased easements on 10.7 km^2 (4.1 mi^2) of habitat in or on the periphery of the CYE since 2007. Three of these projects occurred within the Hwy. 2 linkage zone near the confluence of the Yaak and Kootenai Rivers which divides the Yaak and Cabinet Mountains. Overall, these conservation efforts are important first steps to ensuring habitat fragmentation does not become a larger threat to this population of grizzly bears.

In 2013, an easement with the Stimson Lumber Company was finalized that will protect almost 110 km^2 (42 mi^2) of private timber lands near Troy, Montana. MFWP holds this easement, which will maintain working forests, conserve fish and wildlife habitat, and maintain public recreation access while avoiding sale and subdivision of these lands. This easement complements the purchase in 2011 of 0.32 km^2 (0.12 mi^2) along the Kootenai River by Vital Ground to protect and promote habitat linkage across the Kootenai River between the Yaak River and Cabinet Mountains portions of the CYE. In 2019 an additional Stimson Lumber Company easement on 90.2 km^2 (34.8 mi^2) was completed near Libby. Easements have also been placed on 8.8 km^2 (3.5 mi^2) of additional lands either inside or on the periphery of the CYE grizzly bear recovery zone from 1995 to 2011. These easements protect grizzly bear and its habitat by limiting further subdivision and sale of these lands.

The Forest Legacy Program of USDA has been active in Kootenai Valley between the CYE and SE in Idaho with the purchase of easements in the Hall Mountain project protecting 22 km^2 (8.5 mi^2) of forest habitat in this important connectivity area. The project protects timberlands from subdivision while contributing recreation opportunities to local communities as well as timber production for the local economy. A similar Forest Legacy project has been active south of Bonners Ferry, Idaho near McArthur Lake. The project, completed in 2019, protected 76.1 km^2 (29.4 mi^2) of low elevation habitat in another connectivity area between the CYE and SE.

The Nature Conservancy of Canada and the Transboundary Grizzly Bear Project have protected 2.9 km^2 (1.1 mi^2) of private lands in three sites along Hwys. 3 and 3A. These acquisitions and easements occurred in linkage areas between Canadian grizzly bear populations and the CYE grizzly bear population. These acquisitions and easements will benefit the CYE by protecting important linkage habitat between the Purcell and Selkirk Mountain ranges in B.C. and immediately north of the Yaak portion of the CYE.

Private Land Development in the SE

In the SE, 14 percent of habitat within the recovery zone is privately owned. From 2010–2021 the human population in counties within the SE increased 11.4 percent (Headwaters Economics 2023). Bonner County, Idaho which has experienced a 14.2 percent increase during this time period, which overlaps both the SE and CYE and potential connectivity areas in between these two ecosystems. As discussed in *Private Land Development in the CYE*, there is an ongoing effort to reduce fragmentation that has occurred due to private land development in important linkage areas between the CYE and SE.

The Nature Conservancy of Canada purchased 550 km^2 (213 mi^2) of private land within the SE recovery zone in Canada in 2008. The location of these lands directly connects to an existing network of parks and wildlife management areas, creating a contiguous protected area of more than 1,012 km^2 (391 mi^2), enough for wide-ranging animals like mountain caribou and grizzly bears to maintain connectivity with U.S. populations of these species. There is currently a team of managers and biologists writing a management plan for the area that includes considerations for grizzly bears. This private land purchase represents a significant improvement to grizzly bear habitat in the SE recovery zone. In 2013, the Nature Conservancy of Canada and the Transboundary Grizzly Bear Project protected 1.5 km^2 (0.6

mi^2) of lands linking the Purcell and Selkirk Mountain ranges at the south end of Kootenay Lake through a combination of acquisition and conservation covenants. These lands will be managed through a plan being developed by the Nature Conservancy of Canada. Since 2001, Vital Ground has completed five land acquisitions or easements in or on the periphery of Bismark Meadows, protecting 8.4 km^2 (3.2 mi^2) of valuable, low-lying spring habitat. Overall, these conservation efforts are important first steps to ensuring habitat fragmentation does not become a larger threat to this population of grizzly bears.

Private Land Development in the BE

In the BE, less than 1 percent of habitat within the recovery zone is privately owned. From 2010–2021, the human population in counties within the BE increased by 8.7 percent (Headwaters Economics 2023). Valley County, Idaho experienced a 16.6 percent increase within those 10 years. Ravalli County, Montana experienced a 9.6 percent increase. In the GYE, more than 444 km^2 (171 mi^2) of privately owned land are protected by easements or owned by land trusts in potential connectivity areas between the GYE DMA and the BE. Eight percent of privately owned land (more than 89 km^2 (34 mi^2)) is protected by easements or owned by land trusts in potential connectivity areas between the NCDE DMA and the BE. To facilitate natural recolonization of the BE, strategies to minimize human-caused mortality will need to be applied in the intervening areas of connectivity, potentially including access management.

Private Land Development in the North Cascades

Approximately 3 percent (873 km^2 (338 mi^2)) of the North Cascades recovery zone is private land. From 2010–2021, the human population in counties within the North Cascades increased by 17.9 percent (Headwaters Economics 2023). King County, Washington experienced a 19.2 percent increase within those 10 years. More than 180 km^2 (69 mi^2) of privately owned lands in the North Cascades recovery zone are protected by easements. In addition, more than 50 km^2 (19 mi^2) of privately owned land are protected by easements in potential connectivity areas between the North Cascades and the SE recovery zone. To facilitate natural recolonization of the North Cascades, strategies to minimize human-caused mortality will need to be applied in the intervening linkage areas and may include access management.

Summary of Habitat-Related Effects

As summarized above, the following stressors could reduce or fragment grizzly bear habitats:

- Motorized access management,
- Developed sites,
- Livestock allotments,
- Mineral and energy development,
- Recreation, and
- Vegetation management.

We also discussed potential stressors of disturbance at den sites, habitat fragmentation, and land development, as they pertain to successful grizzly bear recovery and management.

Within the GYE and NCDE recovery zones, the Service developed objective and measurable habitat-based recovery criteria to limit habitat degradation and human-caused mortality risk related to motorized access, developed sites, and livestock allotments (i.e., the 1998 and 2011 baselines, respectively). Habitat-based recovery criteria will be developed for each of the remaining ecosystems in the future. In the meantime, motorized access standards are in place for Federally managed lands within the CYE and SE, Federal lands within the North Cascades are managing for a "no net loss" policy, and the BE is 98 percent Wilderness.

Recreation in all ecosystems is limited through existing road and developed site standards. Additionally, I&E campaigns educate visitors about how to recreate safely in bear country and avoid human-bear conflicts. There are no data available on the impacts of snowmobiling or other winter recreation on grizzly bears to suggest an effect on grizzly bear survival or recovery of the population. Although vegetation management may temporarily impact individual grizzly bears, these activities are coordinated on a BMU or subunit scale according to the Guidelines to minimize potentially negative impacts. As a result of vegetation management, there may also be positive effects on grizzly bears where key habitats are maintained or enhanced. Finally, there are no data to indicate that habitat fragmentation is having population-level effects within any of the ecosystems, with the exception of U.S. Hwy. 2 in the CYE.

In addition to the protections discussed by individual land management plans discussed above, Federal agencies evaluate proposed road construction, developed site, livestock allotment, vegetation, and mineral and energy development projects on Federal lands throughout areas where grizzly bears may occur through ESA Section 7 consultation.

Summary of Habitat-Related Effects within the GYE

Within suitable habitat, different levels of management and protection are applied to areas based on importance to the population. Restrictions on motorized access, developed sites, and livestock allotments ensure that they will be maintained within the recovery zone at or below 1998 levels, a time when the population was increasing at a rate of 4 to 7 percent per year (Schwartz *et al.* 2006c, p. 48). Additionally, secure habitat will be maintained at or above 1998 levels within the recovery zone. The GYE NFs and NPs will continue their more than 15-year history of implementation of the appropriate planning documents that incorporate the 1998 baseline values as habitat standards (USDA FS 2006b, p. 26). Together, these two Federal agencies manage 98 percent of lands within the recovery zone. The primary factors related to past habitat destruction and modification have been reduced through changes in management practices that have already been formally incorporated into regulatory documents. As it has done for the last decade, the IGBST will continue to monitor compliance with the 1998 baseline values and will also continue to monitor grizzly bear body condition, fat levels, and diet composition. Accordingly, the recovery zone, which comprises 51 percent of the suitable habitat within the DMA boundaries and contained 69 percent of all females with cubs-of-the-year for all or part of the year from 2021–2023 (Gould 2024b, *in litt.*), will remain a highly secure area for grizzly bears, with habitat conditions maintained at or above levels documented in 1998.

Maintenance of the 1998 baseline values inside the recovery zone will continue to adequately ameliorate negative impacts on grizzly bear habitat.

Suitable habitat outside the recovery zone provides additional ecological resiliency and habitat redundancy to allow the population to respond to environmental changes. Together, the USFS and NPS manage nearly 80 percent of suitable habitat within the DMA outside of the recovery zone. Habitat protections specifically for grizzly bear conservation are not necessary here because other binding regulatory mechanisms are in place for 59 percent of suitable habitat outside the recovery zone. Specifically, in these areas, the Wilderness Act, the Roadless Areas Conservation Rule, and NF Land Management Plans limit development and motorized use. Management of individual projects on public land outside the recovery zone will continue to consider and minimize impacts on grizzly bear habitat. Continued efforts by NGOs and Tribal, State, and county agencies will reduce human-bear conflicts on private lands (YES 2024, Chapter 4).

Other management practices on Federal lands have been changed to provide security and to maintain or improve habitat conditions for grizzly bears. All operating plans for oil and gas leases must conform to secure habitat and developed site standards, which require mitigation for any change in secure habitat.

In summary, the stressors discussed under *Habitat-Related Effects* continue to occur across the current range of the GYE but have been minimized such that they likely impact only a small proportion of the population. Additionally, although population growth has slowed in the DMA, expansion of estimated occupied range outside the DMA continues and habitat protections are in place to reduce the effects of this stressor and maintain resiliency of the GYE currently and into the future.

Summary of Habitat-Related Effects within the NCDE

Within the NCDE recovery zone, which includes the range with the highest density of females with cubs (Costello *et al.* 2016b, p. 22), habitat protections are in place specifically for grizzly bear conservation. Inside the recovery zone, restrictions on motorized access, developed sites, and livestock allotments ensure that they will be maintained at or improve upon baseline levels, with limited allowances for increases in developed recreation sites. We are currently re-evaluating the allowance for increases in developed recreation sites. Additionally, secure core habitat will be maintained at or above baseline levels. The primary factors related to past habitat destruction and modification have been reduced through changes in management practices that have already been incorporated into regulatory documents (in their entirety: CS&KT 2000; Blackfeet Nation 2008; DNRC 2010a, 2010b; USDA FS 2018a, 2018d, 2018e; BLM 2021b; MFWP 2022). The NCDE NFs and GNP will continue their history of implementing the appropriate planning documents that incorporate the baseline values as habitat standards (in their entirety: USDA FS 2018a, 2018c, 2018d; NCDE Subcommittee 2020, Chapter 3, Appendices 4 and 5). Together, these two Federal agencies manage 79 percent of lands within the recovery zone.

Regulations have been put into place by the BLM, BIR, FIR, and DNRC to implement habitat protections on an additional 13 percent of lands in the recovery zone (in their entirety: CS&KT 2000; Blackfeet Nation 2008; DNRC 2010a, 2010b; BLM 2021a, 2021b). Accordingly, the recovery zone, which comprises 54 percent of the DMA, will remain a highly secure area for grizzly bears, with habitat conditions maintained at or improved upon the baseline. Maintenance of the baseline values inside the recovery zone by Federal land management agencies (i.e., USFS, NPS, and BLM) and habitat protections on State and Tribal lands will continue to adequately ameliorate the multitude of stressors on grizzly bear habitat. As it has done for the last decade, the Monitoring Team will continue to monitor compliance with the baseline values and will also continue to monitor grizzly bear body condition, fat levels, and diet composition.

Habitat in Zone 1 outside the recovery zone provides additional ecological resiliency and redundancy to allow the population to respond to environmental changes. Regulations have been put into place by the USFS, BLM, BIR, FIR, and DNRC to implement habitat protections on 47 percent of lands (or 100 percent of non-private lands) in Zone 1 (in their entirety: CS&KT 2000; Blackfeet Nation 2008; DNRC 2010a, 2010b; USDA FS 2018a, 2018c, 2018d; BLM 2021a, 2021b; NCDE Subcommittee 2020, Chapter 3). We are reevaluating the current method used to measure (i.e., linear miles or road densities) and meet the intent of motorized route objectives in Zone 1 and the DCAs. Management of individual projects on public land in Zone 1 will continue to consider and minimize impacts on grizzly bear habitat. NGOs and State and county agencies will seek to minimize human-bear conflicts on private lands (Servheen *et al*. 1981, pp. 2–3, 17–29; Blackfeet Tribal Business Council 2013, pp. 6–10; NCDE Subcommittee 2020, Chapter 4; MFWP 2022, pp. 8–9, 21). These and other conservation measures ensure that changes to habitat outside the recovery zone in Zone 1 will continue to be protected.

Other management practices on Federal lands have been changed to provide security and to maintain or improve habitat conditions for grizzly bears. All operating plans for oil and gas leases within the recovery zone and Zone 1 must conform to secure core habitat and developed site standards, which require mitigation for any change in secure core habitat (USDA FS 2018c, pp. 77–79; USDA FS 2018d, pp. 1-11–1-14, 1-23–1-26, 1-35–1-38, 1-46–1-49).

In summary, the stressors discussed under *Habitat-Related Effects* occur across the current range of the NCDE but have been minimized such that they only affect a small proportion of the population. Additionally, the population has increased while its current range has expanded. We are currently reevaluating some of the habitat protections that are in place are to assess whether they are sufficient to maintain resiliency of the NCDE currently and into the future.

Summary of habitat-related effects in the CYE, SE, BE, and North Cascades

Numerous improvements in habitat security for grizzly bears, such as motorized access standards, land acquisitions, and conservation easements in the CYE and SE have occurred since 2011 and will remain in place. However, most BMUs in the CYE are currently in compliance with the Forest Plan standards. Most BMUs on Federal lands in the SE are meeting their access management standards and a conservation agreement is in place in the LeClerc BMU, for which motorized access standards do not apply because of the high level of non-Federal lands. However, it would be desirable to have more information and management certainty about motorized access management in the State BMU and in the Canadian portion of the SE recovery zone. Additional improvements to habitat security are described in the USFS's 2011 ROD and the USFS is currently working on an implementation schedule for the remaining BMUs to achieve all standards. In the North Cascades, 64 percent of the recovery zone is protected from motorized routes due to designation as Wilderness or IRA. However, access management standards have not been developed or implemented for BMUs in the recovery zone and without an inventory of OMRD and TMRD we are unable to assess the degree of these impacts. In the BE, 98 percent of the recovery zone is protected from motorized routes due to designation as Wilderness. Standards are needed to maintain resiliency of the CYE, SE, BE and North Cascades grizzly bear populations.

Mortality-Related Effects

The stressors and conservation actions we describe below can also increase or decrease direct mortality of grizzly bears. In our monitoring and reporting, we categorize grizzly bear mortalities into three categories: natural mortalities, mortalities with undetermined-cause, and human-caused mortalities. Below, we evaluate mortality for 2002–2023, as it represents the most recent and best available information on the subject. See *Appendix G* for a detailed summary of mortalities by cause for each ecosystem prior to 2002.

Human-Caused Mortality

Excessive human-caused mortality by European settlers and subsequent Euro-Americans, including "indiscriminate illegal killing" and management removals, was the primary factor contributing to grizzly bear decline during the 19th and 20th centuries (Leopold 1967, p. 30; Koford 1969, p. 95; Servheen 1990, p. 1; Servheen 1999, pp. 50–52; Mattson and Merrill 2002, pp. 1129, 1132; Schwartz *et al.* 2003b, p. 571), eventually leading to their listing as a threatened species in 1975 (40 FR 31734, July 28, 1975). Grizzly bears were seen as a threat to livestock and human safety and, therefore, an impediment to westward expansion. Both the Federal Government and most early settlers were dedicated to eradicating large predators. Grizzly bears were shot, poisoned, trapped, and killed wherever humans encountered them (Servheen 1999, p. 50). In the early 20th century, regulations recognizing bears (black and grizzly) as game animals, protecting females and their offspring, and setting harvest limits (either season or bag limit) were designed to stop future extirpations. In some areas, the protections came too late. By the time grizzly bears were listed under the Act in 1975, there were only a few hundred remaining in the lower-48 States in less than 2 percent of their former range (Service 1993, pp. 8–10).

Negative human attitudes towards grizzly bears fueled historical grizzly bear declines (see *Historical Range and Distribution* above for further discussion) and continues to be an important factor in grizzly bear conservation and management. Human-caused mortality continues to be the leading cause of mortality for independent-aged grizzly bears range-wide. While there has been a positive shift in public perceptions and attitudes towards grizzly bears in the last several decades, human tolerance much more than habitat, genetics, or food resources, will determine where bears exist and at what density levels into the future.

We differentiate types of human-caused mortalities into: (1) accidental killings; (2) management removals; (3) mistaken-identity killing; (4) defense-of-life kills; and (5) illegal killings or poaching (Figure 28, above). In addition, methods by Cherry *et al.* (2002, entire) are used to calculate a statistical estimate of the number of unknown/unreported human-caused mortalities (see *Mortality Limits* for further details). Dependent mortalities include those that have died, orphaned individuals that were captured and moved to authorized facilities, and orphaned cubs whose fate is unknown and are presumed dead. This section discusses current sources and impacts of human-caused mortalities on the grizzly bear populations; summarizes current and future preventative measures being taken to proactively reduce human-caused grizzly bear mortalities and improve public attitudes towards grizzly bears; and discusses how mortality thresholds prevent future detrimental effects of human-caused mortalities on grizzly bear populations. It does not include an estimate of unknown/unreported human-caused mortalities although the inclusion of that statistical estimate is discussed further in *Mortality Limits* below.

In the GYE DMA, from 1980 to 2001, 81 percent (147) of the 181 known and probable grizzly bear mortalities of independent-age bears and 43 percent (23) of the 53 known and probable mortalities of dependent young were human-caused (Haroldson 2020d, *in litt.*). In the NCDE DMA, from 1975 to 2001, 95 percent (357) of the 375 known and probable grizzly bear mortalities of independent-age bears and 83 percent (68) of the 82 known and probable mortalities of dependent young were human-caused (MFWP, unpublished data). In the CYE, from 1982 to 2001, 62 percent (13) of the 21 known and probable grizzly bear mortalities, including independent-age bears and dependent young, were human-caused (Kasworm *et al.* 2024a, pp. 18–19). In the SE, from 1982 to 2001, 75 percent (12) of the 16 known and probable grizzly bear mortalities, including independent-age bears and dependent young, were human-caused (Kasworm *et al.* 2024b, pp. 14–15). The main types of human-caused mortality were human site conflicts, self-defense, mistaken identification kills, and illegal kills, all of which can be partially minimized through management actions (Servheen *et al.* 2004, p. 21). See *Appendix G* for a more detailed summary of human-caused mortality for each ecosystem prior to 2002.

Below, we evaluate human-caused mortality for 2002–2023, as it represents the most recent and best available information on the subject. Causes for mortalities include all age classes in the CYE and SE, while for the GYE and NCDE, mortalities for independent-age bears and dependent young are reported separately to reflect differences in mortality limits between the ecosystems (see *Mortality Limits* below for further discussion). As both human and grizzly bear populations have expanded in number and range, human-caused conflicts and resulting mortalities have increased. Therefore, the estimated population size and number and sex/age class of all mortalities must be considered in estimates of sustainable mortality.

Accidental killings encompass a broad range of mortality sources such as deaths from vehicle collisions, train strikes, unintentional poisoning, electrocution, drowning, and research trapping.

Management removals must be consistent with 50 CFR 17.40(b) (“4(d) rule”). These types of removals encompass grizzly bear mortalities resulting from conflicts at developed sites (e.g., bears attracted to anthropogenic food sources), livestock depredation, and other situations where wildlife management agencies consider human life or property threatened by bear presence. While lethal to the individual grizzly bears involved, management removals can promote conservation grizzly bears by reducing illegal killing of bears, providing an opportunity to educate the public about avoiding conflicts, and promoting tolerance of grizzly bears by responding promptly and effectively when bears pose a threat to public safety or repeatedly depredate livestock. Without the support of the people that live, work, and recreate in grizzly bear country, grizzly bear conservation will not be successful.

Although mistaken identification by black bear hunters is the most common cause of mistaken-identity killings, wolf and black bear hunting and trapping may also result in incidental take. Although unintentional, grizzly bears killed due to mistaken-identity is a form of illegal take. Black bear hunting using bait is allowed in portions of grizzly bear range outside of the GYE, CYE, and SE in Idaho and Wyoming and has resulted in some mistaken-identity mortality. Black bear hunting using bait is not allowed in Montana or Washington. Conversely, under current regulations, it is legal to kill grizzly bears if it is in self-defense or defense-of-others (50 CFR § 17.40); we call deaths from this source "defense-of-life kills."

We define poaching as intentional, illegal killing of grizzly bears or the deliberative concealment of an unintentional killing of grizzly bears. People may illegally kill grizzly bears for several reasons, including a general perception that grizzly bears in the area may be dangerous, frustration over livestock depredations, or to protest land-use and road-use restrictions associated with grizzly bear habitat management (Servheen *et al.* 2004, p. 21).

Human-Caused Mortality in the GYE

From 2002 to 2023, 82 percent (433) of the 529 known and probable grizzly bear mortalities of independent-age bears and 52 percent (119) of the 231 known and probable mortalities of dependent young within the GYE DMA were human-caused (Table 16) (Gould 2024a, *in litt.*). Although the number of human-caused mortalities of independent female and male grizzly bears have increased gradually over this time period as the grizzly bear population increased, human-caused mortality as a proportion of estimated population size (i.e., the rate of mortality) has remained relatively constant (Gould 2024a, *in litt.*). Overall, human-caused mortality rates have been low enough to allow the GYE grizzly bear population to increase in number and range (Schwartz *et al.* 2006b, pp. 64–66; Schwartz *et al.* 2006c, p. 48; Bjornlie *et al*. 2014a, p. 184; Dellinger *et al.* 2023, p. 23; Gould *et al.* 2024c, *in prep.*).

Table 16. Causes of grizzly bear mortalities in the GYE, 2002–2023. This table includes all known and probable mortalities for independent-age bears and dependent young, as displayed in parenthesis (), inside and outside the demographic monitoring area (DMA).

GYE Grizzly Bear Mortality, 2002–2023						
	Inside DMA			**Outside DMA**		
Cause of mortalities (all sources)	**Number of mortalities**	**Avg./ year**	**Percent total**	**Number of mortalities**	**Avg./ year**	**Percent total**
Natural	42 (100)	1.9 (4.5)	8 (43)	1 (5)	<0.1 (0.2)	<1 (14)
Undetermined	54 (12)	2.5 (0.5)	10 (5)	2 (1)	0.1 (<0.1)	1 (3)
Human-caused	433 (119)	19.7 (5.5)	82 (52)	163 (29)	7.4 (1.3)	98 (83)
Total mortalities	**529 (231)**	**24.0 (10.5)**		**166 (35)**	**7.5 (1.6)**	
Human-caused mortalities*	**Number of mortalities**	**Avg./ year**	**Percent of human-caused**	**Number of mortalities**	**Avg./ year**	**Percent of human-caused**
Accidental						
Automobile collision	42 (15)	1.9 (0.7)	10 (13)	5 (0)	0.2 (0)	3 (0)
Capture related	8 (5)	0.4 (0.2)	2 (4)	0 (2)	0 (0.1)	0 (7)
Drowning	0 (0)	0 (0)	0 (0)	6 (2)	0.2 (0.10)	4 (7)
Poisoning	1 (0)	<0.1 (0)	<1 (0)	0 (0)	0 (0)	0 (0)
Defense-of-life	134 (60)	6.1 (2.7)	12 (17)	15 (4)	0.7 (0.2)	7 (14)
Illegal **	27 (6)	1.2 (0.3)	6 (5)	4 (1)	0.1 (<0.1)	2 (3)
Management removal						
Site conflicts/Human safety***	101 (27)	4.6 (1.2)	23 (23)	56 (12)	2.5 (0.5)	34 (41)
Injured or diseased bear	2 (5)	0.1 (0.2)	<1 (4)	0 (3)	0 (0.1)	0 (10)
Livestock depredation	91 (1)	4.1 (<0.1)	21 (1)	70 (5)	3.2 (0.2)	43 (17)
Mistaken identification****	27 (0)	1.3 (0)	6 (0)	7 (0)	0.3 (0)	4 (0)

* Orphaned dependent offspring were classified according to cause of death of their mother.
** Illegal includes poaching, malicious, and defense-of-property kills.
*** Site conflicts/human safety include anthropogenic food and property damage related management removals in the front- and backcountry.
**** Mistaken identification includes grizzly bear kills by black bear hunters using bait. Four instances of bears killed by black bear hunters using bait are included.

Human-Caused Mortality in the NCDE

From 2002 to 2023, 90 percent (357) of the 398 known and probable grizzly bear mortalities of independent-age bears and 89 percent (162) of the 181 of known and probable grizzly bear mortalities of dependent young within the NCDE DMA were human-caused (Table 17) (MFWP, unpublished data). In addition to the categories of human-caused mortalities discussed above, legal hunting of grizzly bears (i.e., recreational purposes) was allowed in the NCDE from 1975 until 1991, under a special rule authorizing take in the 1975 listing (40 FR 331734, July 28, 1975). While human-caused mortalities of grizzly bears have increased gradually each year as the grizzly bear population has increased, the level of these mortalities as a proportion of the estimated population size (i.e., mortality rate) has remained relatively constant (MFWP, unpublished data). Overall, human-caused mortality rates have been low enough to allow the NCDE population to increase in number and range (Costello 2019, *in litt.*; MFWP, unpublished data).

Table 17. Causes of grizzly bear mortalities in the NCDE, 2002–2023. This table includes all known and probable mortalities for independent-age bears and dependent young, as displayed in parenthesis (), inside and outside the demographic monitoring area (DMA).

NCDE Grizzly Bear Mortality, 2002–2023						
	Inside DMA			**Outside DMA**		
Cause of mortalities (all sources)	**Number of mortalities**	**Avg./ year**	**Percent total**	**Number of mortalities**	**Avg./ year**	**Percent total**
Natural	11 (14)	0.5 (0.6)	3 (8)	0 (3)	0 (0.1)	0 (10)
Undetermined	30 (5)	1.4 (0.2)	7 (3)	3 (1)	0.1 (<0.1)	6 (3)
Human-caused	357 (162)	16.0 (7.4)	90 (89)	48 (27)	2.2 (1.2)	94 (87)
Total mortalities	**398 (181)**	**18.0 (8.2)**		**51 (31)**	**2.4 (1.4)**	
Human-caused mortalities*	**Number of mortalities**	**Avg./ year**	**Percent of human-caused**	**Number of mortalities**	**Avg./ year**	**Percent of human-caused**
Accidental						
Automobile collision	45 (45)	2.0 (2.0)	13 (28)	8 (4)	0.4 (0.2)	16 (15)
Capture related	9 (5)	0.4 (0.2)	3 (3)	1 (0)	<0.1 (0)	2 (0)
Drowning	0 (0)	0 (0)	0 (0)	1 (0)	<0.1 (0)	2 (0)
Poisoning	2 (0)	0.1 (0)	<1 (0)	0 (2)	0 (0.1)	0 (7)
Train collision	22 (18)	1.0 (0.8)	6 (11)	2 (2)	0.1 (0.1)	4 (7)
Defense-of-life	49 (20)	2.2 (0.9)	14 (12)	5 (6)	0.2 (0.3)	10 (22)
Illegal **	67 (15)	3.0 (0.7)	19 (9)	12 (5)	0.5 (0.2)	24 (19)
Management removal						
Augmentation**	15 (0)	0.7 (0)	4 (0)	0 (0)	0 (0)	0 (0)
Site conflicts/Human safety****	56 (33)	2.5 (1.5)	16 (20)	4 (4)	0.2 (0.2)	8 (15)
Injured or diseased bear	9 (7)	0.4 (0.3)	3 (4)	1 (1)	<0.1 (<0.1)	2 (4)
Livestock depredation	62 (15)	2.8 (0.7)	17 (9)	13 (2)	0.6 (<0.1)	27 (7)
Mistaken identification	16 (2)	0.7 (0.1)	4 (1)	0 (0)	0 (0)	0 (0)
Unknown	5 (2)	0.2 (0.1)	1 (<1)	1 (1)	<0.1 (<0.1)	2 (4)

* Orphaned dependent offspring were classified according to cause of death of their mother.
** Illegal includes poaching, malicious, and defense-of-property kills.
*** When bears are relocated from the NCDE to augment the CYE population, they are counted as mortalities in the NCDE.
**** Site conflicts include both anthropogenic food and property damage related management removals. Human safety includes incidents in both the front and backcountry.

Human-Caused Mortality in the CYE, SE, BE, and North Cascades

From 2002 to 2023, 72 percent (34) of the 47 known and probable grizzly bear mortalities in the CYE were human-caused (Table 18) (Kasworm *et al.* 2024a, pp. 18–19). We recognize that some grizzly bears in the CYE and SE have home ranges that overlap the international border; however, it is most appropriate to discuss human-caused mortality for the U.S. portion of the SE because that is the area encompassed by the listed entity, the lower-48 States. From 2002 to 2023, 82 percent (18) of the 22 known and probable grizzly bear mortalities in the U.S. portion of the SE recovery zone were human-caused (Table 18) (Kasworm *et al.* 2024b, pp. 14–15). There have been no known, human-caused mortalities in the North Cascades since 1967, however the last verified sighting in the North Cascades occurred in 1996. In the BE recovery zone, the last known, human-caused mortality occurred in 1932 and there has only been one verified sighting in the recovery zone since the 1940s, a collared bear from the CYE that spent several weeks in the northern part of the recovery zone in 2019. There have been three known human-caused mortalities inside the lower-48 States outside these areas. In 2007, a subadult male grizzly bear was killed by a black bear hunter using bait in a case of mistaken-identity approximately 20 km (12.5 mi) northwest of the BE recovery zone. In 2009, a subadult male grizzly bear was killed due to mistaken-identity near Rose Lake, Idaho at an elk farm. In 2015, another subadult male grizzly bear was killed by a black bear hunter using bait in a case of mistaken-identity north of Kellogg, Idaho.

Table 18. Causes of known and probable grizzly bear mortalities from 2002 to 2023 in the CYE and the U.S. portion of the SE. Mortalities in the CYE and SE include independent-age bears and dependent young, and apply within the recovery zone plus a 10-mile buffer, excluding Canada.

CYE and SE Grizzly Bear Mortality, 2002–2023						
	CYE			SE		
Cause of mortalities (all sources)	**Number of mortalities**	**Avg./ year**	**Percent total**	**Number of mortalities**	**Avg./ year**	**Percent total**
Natural	9	0.4	19	4	0.2	18
Unknown/undetermined	4	0.2	9	0	0.0	0
Human-caused	34	1.5	72	18	0.8	82
Total mortalities	**47**	**2.1**		**22**	**1.0**	
Human-caused mortalities*	**Number of mortalities**	**Avg./ year**	**Percent of human-caused**	**Number of mortalities**	**Avg./ year**	**Percent of human-caused**
Accidental	3	0.1	9	2	0.1	11
Defense-of-life	6	0.3	18	2	0.1	11
Illegal	7	0.3	21	2	0.1	11
Management removal	2	0.1	6	4	0.2	22
Mistaken identification	4	0.2	12	5	0.2	28
Unknown* **	12	0.5	35	3	0.1	17

* Orphaned dependent offspring were classified according to cause of death of their mother.
** Illegal includes poaching, malicious, and defense-of-property kills.
*** Includes mortalities that are under investigation.

Sources and Impacts of Human-Caused Mortality

No grizzly bears have been removed from the lower-48 States since 1975 for commercial, scientific, or educational purposes. Outside of the limited time period in which hunting was allowed in the NCDE, no grizzly bears have been removed from the rest of the lower-48 States since 1975 for recreational purposes. Hunting of grizzly bears in the lower-48 States is not currently allowed. The remaining sources of human-caused mortalities can be broken down into five main categories:

- Management removals,
- Accidental killings,
- Mistaken-identity killings,
- Illegal killings, and
- Defense-of-life killings.

We summarize each of these below.

Management Removals

Management removals encompass grizzly bear mortalities resulting from conflicts at developed sites (e.g., bears attracted to anthropogenic food sources), livestock depredation, and other situations where wildlife management agencies consider human life or property threatened by bear presence. Most management removals result from attractant-related conflicts at sites associated with frequent or permanent human presence (i.e., developed sites) and livestock depredations. Management removals must be consistent with 50 CFR 17.40(b) ("4(d) rule") and conducted by trained Federal, State, and Tribal bear managers. The 4(d) rule sets forth the conditions under which bears constituting a demonstrable but non-immediate threat to human safety, bears constituting an immediate threat to human safety, or bears committing significant depredations to lawfully present livestock, crops, or beehives may be removed (50 CFR 17.40(b)(1)(i)(C)). The 4(d) rule refers to the IGBC Guidelines (Guidelines), which provide a framework to guide management actions for grizzly bears in conflict (USDA FS 1986b, pp. 53–54). Non-lethal management removals in which bears were placed in zoos or research facilities are counted as mortalities.

In the GYE, between 2002 and 2023, management removals resulted in 194 mortalities of independent-age bears and 33 mortalities of dependent young, accounting for 45 percent and 17 percent, respectively, of human-caused mortalities within the DMA (Gould 2024a, *in litt.*). In the NCDE, management removals resulted in 142 mortalities (including 15 augmentation bears) of independent-age bears and 55 mortalities of dependent young within the DMA, accounting for 40 percent and 34 percent of all human-caused mortalities, respectively (MFWP, unpublished data). Management removals resulted in 2 mortalities in the CYE and 5 mortalities in the SE, accounting for 6 percent and 28 percent, respectively, of all human-caused mortalities (Kasworm *et al.* 2024a, pp. 18–19; Kasworm *et al.* 2024b, pp. 14–15). Below we discuss two types of management removals in further detail, site conflicts and livestock depredation.

Site Conflicts

Management removals at site conflicts usually involve unsecured attractants, including garbage, human foods, chickens, pet/livestock foods, bird food, livestock carcasses, wildlife carcasses, barbeque grills, compost piles, orchard fruits, or vegetable gardens. These conflicts often involve food-conditioned bears actively seeking out unsecured attractants or bears that were habituated to human presence seeking natural sources of food in areas near human structures or roads. While these mortalities are directly related to unsecured, human-attractants, they are also related to human attitudes, knowledge, and tolerance toward grizzly bears. Many of these mortalities can be prevented through changes in human perceptions and actions including limiting bear access to human-related food sources and increasing human understanding and tolerance towards grizzly bears (see *Preventative Measures* below for further discussion). These factors are common targets of the GYE Conservation Strategy and Federal, State, and Tribal I&E Programs (discussed in detail below in *I&E Programs*). In the GYE, conflicts at front- or back-country sites (on either public or private lands) were responsible for 52 percent (101 of 194) of management removals and 23 percent (101 of 433) of all human-caused mortality of independent-age bears within the DMA between 2002 and 2023 (Gould 2024a, *in litt.*). In addition, they were responsible for 81 percent (27 of 33) of management removals and 23 percent (27 of 119) of all human-caused mortalities of dependent young (Gould 2024a, *in litt*.).

In the NCDE, the majority of management removals result from attractant-related conflicts at sites associated with frequent or permanent human presence, either in the front- or back-country. Conflicts at developed sites (on both public and private lands) were responsible for 39 percent (56 of 142) of management removals and 16 percent (56 of 357) of all human-caused mortalities of independent-age bears within the DMA conducted between 2002 and 2023 (MFWP, unpublished data). In addition, they were responsible for 60 percent (33 of 55) of management removals and 22 percent (33 of 162) of all human-caused mortalities of dependent young (MFWP, unpublished data).

In the CYE site conflicts accounted for both management removals (Kasworm *et al.* 2024a, pp. 18–19). In the SE, site conflicts accounted 2 of 5 of management removals (Kasworm *et al.* 2024b, pp. 14–15).

Livestock Depredation

In the GYE, management removals due to grizzly bear conflicts with livestock accounted for 47 percent (91 of 194) of management removals and 21 percent (91 of 433) of all human-caused mortalities of independent-age bears in the DMA between 2002 and 2023 (Gould 2024a, *in litt.*). In addition, they were responsible for less than one percent (1 of 33) of all management removals and less than one percent (1 of 119) of all known and human-caused mortalities of dependent bears (Gould 2024a, *in litt*.). Only 2 of these 91 mortalities of independent-age bears and 1 of the 32 mortalities of dependent-age bears occurred inside the recovery zone where multiple measures to reduce livestock conflicts are in place (Gould 2024a, *in litt.*). The USFS phases out sheep allotments within the DMA as opportunities arise to resolve conflicts (see discussion in *Livestock Allotments* in *Habitat Destruction and Modification*, above). Additionally, the alternative chosen by the USFS during its NEPA process to amend the five NF plans for grizzly bear habitat conservation inside the recovery zone includes direction to resolve recurring conflicts on livestock allotments through retirement of those allotments with willing permittees (USDA FS 2006b, pp. 16–17; YES 2024, Chapter 3). Livestock grazing permits throughout occupied grizzly bear habitat inside the GYE include special provisions regarding reporting of conflicts, proper food and attractant storage procedures, and carcass removal to reduce the potential for depredations. The USFS monitors compliance with these special provisions associated with livestock allotments annually (Servheen *et al.* 2004, p. 28). Moreover, all three State management plans contain direction on reducing grizzly bear-livestock conflicts and cooperating with private landowners to reach this goal (Idaho's Yellowstone Grizzly Bear

Delisting Advisory Team 2002, pp. 15–16; WGFD 2016, pp. 22–23; MFWP 2022, pp. 40–42). The GYE Conservation Strategy also recognizes that removal of individual conflict bears is sometimes required, as a few individual bears often are responsible for multiple livestock depredations (Jonkel 1980, p. 12; Knight and Judd 1983, p. 188; Anderson *et al.* 2002, pp. 252–253).

In the NCDE, management removals due to grizzly bear conflicts with livestock (on both public and private land) accounted for nearly 44 percent (62 of 142) of all management removals and 17 percent (62 of 357) of all known and probably mortalities of independent-age bears within the DMA between 2002 and 2023 (MFWP, unpublished data). In addition, they were responsible for 27 percent (15 of 55) of all management removals and 9 percent (15 of 162) of all known and probable mortalities of dependent bears (MFWP, unpublished data). None of these mortalities occurred inside the recovery zone within NF lands where several measures to reduce livestock conflicts are in place. The USFS phases out sheep allotments within the recovery zone as opportunities arise and only one active sheep allotment remains inside the recovery zone (USDA FS 2018f, p. 64). The USFS also has closed sheep allotments outside the recovery zone and there are only two active sheep allotments in Zone 1 (USDA FS 2018f, p. 64). Livestock grazing permits on Federal lands include special provisions regarding reporting of conflicts, proper food storage and attractant storage procedures, and carcass removal to reduce the potential for depredation (USDA FS 2018c, pp. 80–81; USDA FS 2018d, pp. 1-10, 1-22, 1-34, 1-45). We expect the USFS will continue to implement these measures that reduce grizzly bear conflicts with livestock and limit allotments to baseline levels (see *Habitat Destruction and Modification* for further discussion; USDA FS 2018c, pp. 80–81; USDA FS 2018d, pp. 1-10, 1-22, 1-34, 1-45). The NCDE Conservation Strategy also recognizes that removal of individual conflict bears is sometimes required, as many livestock depredations involve a few individual bears (Jonkel 1980, p. 12; Knight and Judd 1983, p. 188; Anderson *et al.* 2002, pp. 252–253; NCDE Subcommittee 2020, Chapter 4).

In the SE, management removals due to grizzly bear conflicts with livestock accounted for 33 percent (3 of 5) of all management removals (Kasworm *et al.* 2024b, pp. 14–15). There were no management removals as the result of conflicts in the CYE (Kasworm *et al.* 2024a, pp. 18–19).

Strategy for Management Removals

The Guidelines guide decisions about management removals of conflict bears and how to keep this source of human-caused mortality within the mortality limits (USDA FS 1986b, pp. 53–54), emphasizing the individual's importance to the entire population. Females will continue to receive a higher level of protection than males. Location, cause of incident, severity of incident, history of the bear, health, age, and sex of the bear, and demographic characteristics are all considered in any relocation or removal action. State, Tribal, and NPS bear managers coordinate and consult with each other and relevant Federal agencies (i.e., Service, USFS, BLM) about conflict bear relocation and removal decisions (50 CFR 17.40). The Guidelines, the GYE Conservation Strategy, and the NCDE Conservation Strategy emphasize removal of the cause of the conflict when possible, or management and education action to limit such conflicts. In addition, the I&E team coordinates the development, implementation, and dissemination of programs and materials to aid in preventative management of human-bear conflicts. Federal, State, and Tribal partners recognize that successful management of human-grizzly bear conflicts requires an integrated, multi-agency approach to continue to keep human-caused grizzly bear mortality within sustainable levels.

Overall, we consider agency management removals a necessary component of grizzly bear conservation. Conflict bears can become a threat to human safety and erode public support if they are not addressed. However, we recognize the importance of managing these sanctioned removals within sustainable levels, and Federal, Tribal, and State management agencies are committed to working with citizens, landowners, and visitors to address unsecured attractants to reduce the need for grizzly bear removals. Mortality limits (see discussion on *Mortality Limits* below) currently in place ensure that overall mortality, including management removals, remains within sustainable limits.

Accidental Killings

Humans kill grizzly bears unintentionally in a number of ways, including: vehicle collisions, train collisions, unintentional poisoning, drowning, electrocution, and mortalities associated with research trapping. Accidental killings as a result of unintentional poisoning, electrocution, and drowning in irrigation canals are extremely low, as evidenced in the discussion below.

Accidental Killings in the GYE

From 2002 to 2023, there were 51 reported accidental mortalities of independent-age bears and 20 reported accidental mortalities of dependent young inside the DMA (totaling 12 percent and 17 percent, respectively, of human-caused mortality for this time period) (Gould 2024a, *in litt.*).

Automobile collisions accounted for 10 percent (42 of 433) of human-caused mortality of independent-age bears and 13 percent (15 of 119) of human-caused mortality of dependent young from 2002 to 2023 (Gould 2024a, *in litt.*). One conservation measure to reduce vehicle collisions with grizzly bears is to remove roadkill carcasses from the road so that grizzly bears are not attracted to the roadside (Servheen *et al.* 2004, p. 28). Cost-effective minimization efforts to facilitate safe crossings by wildlife will be voluntarily incorporated in highway construction or reconstruction projects on Federal lands within suitable grizzly bear habitat (YES 2024, Chapter 3).

For the first time since 1982, there were grizzly bear mortalities of independent-age bears possibly associated with scientific research capture and handling in 2006. That year, four different bears died within 4 days of being captured, most likely from clostridium infections, but the degraded nature of the carcasses made the exact cause of death impossible to determine. In 2008, two more grizzly bear mortalities suspected of being related to research capture and handling occurred. A necropsy confirmed the cause of death for one of these bears as a clostridium infection at the anesthesia injection site. Once the cause of death was confirmed, the IGBST changed its handling protocol to include antibiotics for each capture (Haroldson and Frey 2009, p. 21). There has not been a research-related capture mortality from clostridium infection since. In 2013, a snared subadult female grizzly bear was killed by a large, probably male bear (Haroldson and Frey 2013, p. 27). In 2019, a subadult male died from exertional myopathy in a culvert trap before it was drugged (Haroldson 2020a, *in litt.*). In addition, there were 5 capture related mortalities of dependent young within the DMA from 2002 to 2023 (Gould 2024a, *in litt.*). These mortalities were the result of: non-target trapping, drugging related handling, injury from a trap, and the killing of a cub by another bear while its mother was captured (Haroldson 2020e, *in litt.*). IGBST's rigorous protocols and adaptive approach dictating proper bear capture, handling, and drugging techniques have effectively reduced the risk of mortality due to captures.

Accidental poisonings accounted for less than 1 percent (1 of 433) of human-caused mortality of independent-age from 2002 to 2023 (Gould 2024a, *in litt.*). This accidental poisoning was the unintended result of a grizzly bear consuming rat poison and Coleman fuel when it raided a backcountry camp (Haroldson 2019c, *in litt.*).

Accidental killings of grizzly bears in the GYE comprise a small portion of total mortalities and are factored into total mortality limits (described in detail in *Mortality Limits* below), which limit their impact on population resiliency.

Accidental Killings in the NCDE

From 2002 to 2023, 78 reported accidental mortalities accounted for nearly 22 percent of known and probable human-caused mortalities of independent-age bears and 68 mortalities accounted for nearly 42 percent of known and probable human-caused mortalities of dependent young in the DMA (MFWP, unpublished data). Since 2002, there have been 9 capture related mortalities of independent bears and 5 capture related mortalities of dependent bears (totaling 3 percent of human-caused mortality for both independent and dependent bears) (MFWP, unpublished data). However, from 2004 to 2023, only around 1 percent of captures resulted in mortality; more than half of these mortalities occurred in situations where bear managers were responding to conflict situations, when and where conditions for capture are sometimes problematic (MFWP, unpublished data). For example, when trapping at a livestock carcass for a livestock killing bear, multiple bears, including family groups, are frequently attracted to the trap site and this may increase chances of intraspecific mortality. This type of accidental mortality is rare because of the rigorous protocols and adaptive approach dictating proper bear capture, handling, and drugging techniques.

Automobile and train collisions accounted for 13 percent (45 of 357) and 6 percent (22 of 357), respectively, of human-caused mortality of independent-age bears from 2002 to 2023 (MFWP, unpublished data). In addition, automobile and train collisions accounted for 28 percent (45 of 162) and 11 percent (18 of 162), respectively, of human-caused mortalities of dependent bears (MFWP, unpublished data). These mortality sources have increased significantly since 2000, likely due to the growth and expansion of grizzly bear populations and increasing vehicle traffic. Measures to reduce vehicle and train collisions with grizzly bears include removing roadkill carcasses from the road and spilled grain and carcasses from railways so that grizzly bears are not attracted to the roadside/railway (Servheen *et al.* 2004, p. 28; Service 2004, entire; Mundinger *et al.* 2020, p. 3). Wildlife crossing structures, with guide fencing, can also be very effective at reducing highway collisions; however, they require significant resources and long-term planning. All of these measures are being implemented to varying degrees in different parts of the NCDE (Mundinger *et al.* 2020, pp. 5–7; MFWP 2022, p. 46). In the early-2000s to mid-

2010s, implementation measures were successful in reducing grizzly bear mortalities caused by train collisions (Mundinger *et al.* 2020, pp. 19–20). However, recent mortalities suggest that there is room for improvement in implementing preventative measures, such as prompt carcass pickup and fence maintenance, to reduce train collisions (MFWP, unpublished data). Recent research found that grizzly bears use railways more frequently in areas where food is more abundant, both natural and train related (i.e., spilled grain or train-killed ungulates), and in areas where the railway offers easier travel through rugged terrain (Pollock *et al.* 2019, pp. 1793–1794). Additional measures, such as vegetation management and warning systems, could reduce trail collision mortality in areas of concentrated use or where approaching trains are more difficult to detect (Pollock *et al*. 2019, p. 1795; St. Clair *et al.* 2019, p. 5). In addition, the signatories to the NCDE Conservation Strategy have been cooperating for many years to improve protections for wildlife traversing highways and this is expected to continue (USDA FS 2018a, p. 33; USDA FS 2018d, p. 2; MFWP 2022, p. 46; NCDE Subcommittee 2020, Chapter 3). Montana Department of Transportation and MFWP recently signed an MOA to institutionalize cooperation and collaboration on wildlife and transportation issues (MT Department of Transportation and MFWP 2020, entire). Also, the two agencies co-convened the Montana Wildlife and Transportation Summit to strengthen working relationships between stakeholders, share information, and develop strategies to plan and implement wildlife accommodations; reduce animal-vehicle collisions; and protect wildlife and their movement across state highways.

Accidental killings of grizzly bears in the NCDE comprise a small portion of total mortalities and are factored into total mortality limits (described in detail in *Mortality Limits* below), which limit their impact on population resiliency.

Accidental Killings in the CYE and SE

From 2002 to 2023, 9 percent (3 of 34) of all human-caused mortalities in the CYE and 11 percent (2 of 18) of all human-caused grizzly bear mortalities in the SE were accidental (Kasworm *et al.* 2024a, pp. 18–19; Kasworm *et al.* 2024b, pp. 14–15). In the CYE, three females were killed by trains and one female was killed by a vehicle. In the SE, one male was killed by a train and one female was killed by a vehicle.

Measures to reduce vehicle and train collisions with grizzly bears include: removing roadkill carcasses from the road, removing spilled grain and carcasses from railways so that grizzly bears are not attracted to the roadside/railway, and constructing crossing structures with fencing over roads or railways (Servheen *et al.* 2004, p. 28; Service 2004, entire). Although these measures can be successful in reducing the percentage of human-caused mortalities caused by train collisions, there are currently no HCPs in the CYE or SE mandating adoption of such measures. There are three rail lines that pass through or alongside the CYE and SE operated by BNSF, Montana Rail Link, and Union Pacific Railroad. Without conservation measures and conservation plans in place, there is potential for the frequency of vehicle and train collisions to increase as the population recovers, such that train mortalities could influence the resiliency of the CYE and SE.

Mistaken-Identity Killings

Mistaken-identity mortalities include mistaken identification by black bear or other hunters and mortalities that result from wolf and black bear hunting and trapping. Mistaken-identity killings are both accidental and illegal. Mistaken identification is prosecuted as illegal take, with any grizzly bear mortality fully investigated to determine cause. This will likely always be a source of mortality due to the similarity of appearance between black bears and grizzly bears. However, preventative actions, such as I&E programs targeted at hunters to emphasize patience, awareness, and correct identification of targets can reduce this type of mortality. Black bear hunting using bait is allowed in portions of Idaho and Wyoming in portions of occupied grizzly bear range in the GYE, CYE, and SE and has resulted in some mistaken-identity mortality. As of December 31, 2023, black bear hunting using bait is not allowed in Montana or Washington.

Although mistaken identification by black bear hunters is the most common cause of this type of killing, hunters may kill a grizzly bear as a result of hunting and trapping tools for wolves (*Canis lupus*) and black bears. For example, a grizzly bear may accidentally be caught in a neck snare set for another species.

Mistaken-Identity Killings in the GYE

Twenty-seven mortalities (6 percent of human-caused mortality) of independent-age bears were associated with mistaken identification of grizzly bears by black bear hunters within the DMA from 2002–2023 (Gould 2024a, *in litt.*). Two of these mistaken-identity mortalities occurred when a hunter using bait shot a grizzly bear in Wyoming (Gould 2024a, *in litt.*). The GYE Conservation Strategy identifies I&E programs targeted at hunters that emphasize patience, awareness, and correct identification of targets to help reduce grizzly bear mortalities by inexperienced black bear and ungulate hunters (YES 2024, Chapter 5). Beginning in license year 2002, the State of Montana required that all black bear hunters pass a Bear Identification Test before receiving a black bear license (see *https://fwp.mt.gov/hunt/education/bear-identification* for more information and details). Idaho and Wyoming provide a voluntary bear identification test online (IDFG 2011, entire; WGFD 2016, p. 16). In addition, all three States include grizzly bear encounter management as a core subject in basic hunter education courses. Although we have no information on the effectiveness of these programs, we assume they have some positive impact on reducing the threat of mortality due to mistaken identification. Mistaken-identity killings of grizzly bears in the GYE comprise a small portion of total mortalities and are factored into total mortality limits (described in detail in *Mortality Limits* below), and I&E programs aimed at preventing mistaken identification killings limit potential risks to the GYE grizzly bear population from this stressor.

Wolf trapping and snaring and black bear hunting have the potential to incidentally take grizzly bears. Recent legislation in Montana and Idaho that expanded hunting and trapping tools available for wolves and black bears may increase incidental take of grizzly bears. Reporting of all target and non-target trapped wildlife is required and mortalities from these sources would count towards allowable mortality thresholds. However, there may be some mortalities that go unreported due to unknown mortalities/injuries resulting from grizzly bears breaking away from the site with the snare and/or trap still attached. In Idaho and Montana, there are regulations to allow the commission to issue emergency closures of any hunting season (Idaho Code 36-104(b); MFWP 2023b, p. 2; MFWP 2023c, p. 15). There are measures in place to limit potential incidental take, including prohibiting black bear hound hunting in most of the estimated occupied grizzly bear range Montana and delaying Montana's wolf season in grizzly bear occupied range until most grizzly bears have entered the den based on collar data and field reports. This is important because, over the last several years, we have verified numerous bears dispersing outside grizzly bear estimated occupied range and through potential connectivity areas between the GYE and NCDE populations and between the GYE population and the currently unoccupied BE. There are no grizzly bear mortality limits in areas outside of the DMAs for the GYE and NCDE populations, therefore the number of grizzly bears that might be killed incidental to wolf and black bear hunting and trapping in these areas would not be limited. Incidental take of grizzly bears in these areas could reduce the potential for natural connectivity between the GYE and NCDE populations, and natural recolonization of the BE.

Mistaken-Identity Killings in the NCDE

Mistaken identification of grizzly bears by black bear hunters accounted for 4 percent (16 of 357) of human-caused grizzly bear mortalities of independent-age bears and 1 percent (2 of 162) of human-caused grizzly bear mortalities of dependent young in the DMA from 2002 to 2023. Beginning in license year 2002, the State of Montana required that all black bear hunters pass a Bear Identification Test before receiving a black bear license (see *https://fwp.mt.gov/hunt/education/bear-identification*). In addition, the NCDE Conservation Strategy identifies I&E programs targeted at hunters that emphasize patience, awareness, and correct identification of targets to help reduce grizzly bear mortalities from inexperienced black bear and ungulate hunters (NCDE Subcommittee 2020, Chapters 1 and 4). As in the GYE, mistaken-identity killings of grizzly bears in the NCDE comprise a small portion of total mortalities and are factored into total mortality limits (described in detail in *Mortality Limits* below), and I&E programs aimed at preventing mistaken identification killings limit potential risks to the population.

Wolf trapping and snaring and black bear hunting have the potential to incidentally take grizzly bears. As stated above, recent legislation in Montana expanding hunting and trapping tools available for wolves and black bears will likely increase incidental take of grizzly bears. Reporting of all target and non-target trapped wildlife is required and mortalities from these sources would count towards allowable mortality thresholds and mortalities from these sources would count towards allowable mortality thresholds. However, there may be some mortalities that go unreported due to unknown mortalities/injuries resulting from grizzly bears breaking away from the site with the snare and/or trap still attached. In Montana, there are regulations to allow the commission to issue emergency closures of any hunting season (MFWP 2023b, p. 2; MFWP 2023c, p. 15). There are measures in place to limit potential incidental take, including prohibiting black bear hound hunting in most of the estimated occupied grizzly bear range Montana and delaying Montana's wolf season in grizzly bear occupied range until most grizzly bears have entered the den based on collar data and field reports. However, Montana expanded a trapping and snaring season outside occupied range to begin earlier in November. This expansion includes potential connectivity areas. This is important because, over the last several years, we have verified numerous bears dispersing outside the occupied range and through potential connectivity areas between the NCDE and GYE populations and between the NCDE population and the currently unoccupied BE. There are no grizzly bear mortality limits in areas outside of the DMAs for the NCDE and GYE populations, therefore the number of grizzly bears that might be killed incidental to wolf and black bear hunting and trapping in these areas would not be limited. Incidental take of grizzly bears in these areas could reduce the potential for natural connectivity between the NCDE and GYE populations, and natural recolonization of the BE.

Mistaken-Identity Killings in the CYE, SE, BE, and North Cascades

From 2002 to 2023, mistaken identification killings of grizzly bears by black bear or other hunters accounted for 12 percent (4 of 34) of human-caused mortalities in the CYE and 28 percent (5 of 18) of human-caused grizzly bear mortalities in the SE (Kasworm *et al.* 2024a, pp. 18–19; Kasworm *et al.* 2024b, pp. 14–15). In addition, there have been three mistaken identification killings of grizzly bears outside of the CYE, SE, and BE recovery zones, two of which occurred during a hunt in which the hunter used bait. One of these mistaken identification killings was of a grizzly bear that originated from the SE outside but in close proximity to the BE recovery zone. The other two instances occurred in the area between the CYE and BE. Both Idaho and Washington launched educational campaigns in 2011 to reduce mistaken-identity by black bear hunters by teaching them how to correctly identify the two bear species. Idaho also offers a voluntary online bear identification test (*https://idfg.idaho.gov/hunt/bear-info/overview*). Beginning in 2019, Washington State required black bear hunters hunting in grizzly bear recovery areas to take the bear identification test on the WDFW website or an equivalent test from another state (WDFW 2019, p. 70). Reducing this source of human-caused mortality is especially desirable in the CYE and SE due to the small population size, in the BE and North Cascades where there are currently no known populations, and in potential connectivity areas between the ecosystems.

Although mistaken identification by black bear hunters is the most common cause of this type of killings, one in the SE was the result of a grizzly bear caught in a neck snare set for another species. In the CYE, one of the of the grizzly bears mistakenly killed by a black bear hunter had a neck snare around its neck that may have ultimately killed the bear had it not been shot. In addition, a grizzly bear in the CYE was detected by a trail camera at a hair corral site with what appears to be a neck snare in 2022. Wolf trapping and snaring and black bear hunting have the potential to incidentally take grizzly bears. Recent legislation in Montana and Idaho expanded hunting and trapping tools available for wolves and black bears will likely increase in incidental take of grizzly bears. Reporting of all target and non-target trapped wildlife is required and mortalities from these sources would count towards allowable mortality thresholds. However, there may be some mortalities that go unreported due to unknown mortalities/injuries resulting from grizzly bears breaking away from the site with the snare and/or trap still attached. In Idaho and Montana, there are regulations to allow the commission to issue emergency closures of any hunting season (Idaho Code 36-104(b); MFWP 2023b, p. 2; MFWP 2023c, p. 15). There are measures in place to limit potential incidental take, including prohibiting black bear hound hunting in most of the estimated occupied grizzly bear range Montana and delaying Montana’s wolf season in grizzly bear occupied range until most grizzly bears have entered the den based on collar data and field reports. However, Montana expanded a trapping and snaring season outside occupied range to begin earlier in November. This expansion includes potential connectivity areas. This is important because, over the last several years, we have verified numerous bears dispersing outside the occupied range and through potential connectivity areas between the SE and CYE populations and the currently unoccupied BE. There are no grizzly bear mortality limits in areas outside of the recovery zones for the SE and CYE populations, therefore the number of grizzly bears that might be killed incidental to wolf and black bear hunting and trapping in these areas would not be limited. Incidental take of grizzly bears in these areas could reduce the potential for natural recolonization of the BE from the SE and CYE populations.

Illegal Killings

We define poaching as intentional, illegal killing of grizzly bears or the deliberative concealment of an unintentional grizzly bear killing. People may illegally kill grizzly bears for several reasons, including a general perception that grizzly bears in the area may be dangerous, frustration over livestock depredations, or to protest land-use and road-use restrictions associated with grizzly bear habitat management (Servheen *et al.* 2004, p. 22). Regardless of the reason, poaching continues to occur.

State and Federal law enforcement agents have cooperated to ensure consistent enforcement of laws protecting grizzly bears. Currently, State and Federal prosecutors and enforcement personnel from each State and Federal jurisdiction work together to make recommendations to all jurisdictions, counties, and States on uniform enforcement, prosecution, and sentencing relating to illegal grizzly bear kills. This cooperation means illegal grizzly bear mortalities are often prosecuted under State statutes instead of the Act. The U.S. Department of Justice's "McKittrick Policy" requires proof of intent, that the individual knowingly killed a listed species under the Act, for Federal prosecution. However, intent is not necessary for prosecution under State law. During an investigation, the investigative officers usually meet with both local and Federal attorneys to decide if prosecution will be more successful under State or Federal jurisdiction. In most instances where the U.S. Attorney has declined prosecution conflicts, the States have taken over those prosecutions through State courts. There have been successful prosecutions under both Federal and State laws. There is a long record of this enforcement approach being effective, and no reason to doubt its effectiveness.

Illegal killings are factored into mortality limits for each ecosystem, and I&E campaigns (described in detail in *Preventative Measures*) are used to reduce the potential threat of poaching. These programs address illegal killing by working to change human perceptions and beliefs about grizzly bears, and increase tolerance to some restrictions on use of Federal lands designed for grizzly bear protection (Servheen *et al.* 2004, p. 27).

Illegal killings in the GYE

We are aware of at least 27 illegal killings of independent-age bears and 6 illegal killings of dependent young in the GYE DMA between 2002 and 2023 (Gould 2024a, *in litt.*). This constituted 6 percent of human-caused mortalities of independent-age bears and 5 percent of human-caused mortalities of dependent young from 2002 to 2023. These illegal killings occurred during a period when poaching was subject to Federal prosecution. Unfortunately, poaching still occurs, however these mortalities are factored into total mortality limits (described in detail in *Mortality Limits* below), which limit their impact on population resiliency.

Illegal killings in the NCDE

From 2002 to 2023, at least 67 illegal killings of independent-age bears and 15 illegal killings of dependent bears occurred within the NCDE DMA, constituting nearly 19 percent and 9 percent of human-caused mortalities, respectively (MFWP, unpublished data). Illegal killings continue to occur but are not at a level significant to hinder population stability or range expansion.

Illegal killings in the CYE, SE, BE, and North Cascades

From 2002 to 2023, at least 7 illegal killings occurred in the CYE, constituting 21 percent of human-caused grizzly bear mortalities (Kasworm *et al.* 2024a, pp. 18–19). Two illegal killings occurred in the SE from 2002 to 2023 (Kasworm *et al.* 2024b, pp. 18–19). While we recognize that illegal killings will never be eliminated entirely, reducing this source of human-caused mortality is desirable in the CYE and SE due to the small population sizes.

Defense-of-Life Killings

Grizzly bears may be legally taken in self-defense or in defense-of-others (50 CFR 17.40(b)). In the GYE DMA, from 2002 to 2023, 31 percent (134 of 433) of human-caused mortalities of independent-age bears and 50 percent (60 of 119) of human-caused mortalities of dependent young were defense-of-life kills (Gould 2024a, *in litt.*). In the NCDE DMA, 14 percent (49 of 357) of human-caused grizzly bear mortalities of independent-age bears and 12 percent (20 of 162) of human-caused mortalities of dependent young were defense-of-life kills (MFWP, unpublished data). In the CYE, 18 percent (6 of 34) of human-caused mortalities were from defense-of-life kills (Kasworm *et al.* 2024a, pp. 18–19). Two defense-of-life killings occurred in the U.S. portion of the SE from 2002–2023, constituting 11 percent of human-caused mortalities (Kasworm *et al.* 2024b, pp. 14–15). These grizzly bear mortalities occurred primarily with ungulate hunters on public lands during the fall, but also at other times and locations (IGBST 2009, p. 18; Haroldson 2019b, *in litt.*; MFWP, unpublished data). Defense-of-life situations often occur during surprise encounters, at hunter-killed carcasses or gut piles, or when packing out carcasses. In addition, the use of hounds to hunt black bears may increase the likelihood of a defense-of-life kill if hounds chase a grizzly bear instead of a black bear. Federal and State agencies have many options to potentially reduce conflicts with hunters (IGBST 2009, pp. 21–31), but defense-of-life mortalities will always be a reality when conserving a species that is capable of killing humans. By promoting the use of bear spray and continuing I&E programs pertaining to food and carcass storage and retrieval, risk to hunters can be substantially minimized and many of these grizzly bear deaths can be reduced, though potential for injury and fatalities to humans and grizzly bears cannot be completely avoided. Defense-of-life mortalities are factored into mortality limits (see discussion on *Mortality Limits* below), and this source of mortality is not currently a limiting factor to the resiliency of grizzly bear populations in the lower-48 States.

Preventative Measures to Address Public Attitudes towards Grizzly Bears and Reduce Mortality

This section discusses preventative measures used to affect human attitudes toward grizzly bears, thereby reducing future human-caused mortality. Public support is paramount to any successful large carnivore conservation program (Servheen 1998, p. 67; Sjölander-Lindqvist *et al*. 2015, entire; Nesbitt *et al*. 2023, pp. 13–16). Historically, human attitudes played a primary role in grizzly bear population declines by promoting a culture and government framework that encouraged excessive, unregulated, human-caused mortality. Through government endorsed eradication programs and perceived threats to human life and economic livelihood, Europeans settling the Western United States were able to effectively eliminate most known grizzly bear populations after less than 100 years of westward expansion. Today, public attitudes towards bears vary greatly, and are often based on individuals' perception of risk and experience with conflict (Lute and Carter 2020, entire). We discuss three strategies that proactively prevent human-grizzly bear conflicts and grizzly bear mortality: (1) I&E programs; (2) livestock depredation prevention programs; (3) food storage orders; (4) and hazing guidelines.

I&E Programs

Management removals in response to human-grizzly bear conflicts, defense-of-life kills, mistaken-identity killings, and illegal killings are responsible for the majority of known and probable human-caused mortalities. These human-caused sources of mortality can be minimized if adequate I&E are provided to people who live, work, and recreate in occupied grizzly bear habitat and if proper management infrastructure is in place (Linnell *et al.* 2001, p. 345). However, some research suggests that there may be a threshold level of success for I&E efforts (Nelson *et al*. 2011, pp. 71–78). I&E efforts will continually need to adapt to changing human landscapes, including changes in user groups, increasing human populations, and changes in the way humans access information (i.e., increased reliance on social media for community-relevant information). Although not everyone in a community will attend outreach events, public outreach presents an opportunity to effectively integrate human and ecological concerns into comprehensive programs that can modify societal beliefs about, perceptions of, and behaviors toward grizzly bears.

The objective of I&E is to proactively address human-grizzly bear conflicts by informing and engaging with the public about the root causes of these conflicts and providing support and ideas on how to prevent them (YES 2024, Chapter 5). Increasing awareness of grizzly bear behavior, ecology, and biology, can enhance appreciation of the grizzly bear, increase public involvement, and correct common misconceptions about its temperament and feeding habitats. Public attitudes, norms, and values vary by community (location and affiliation) and may change over time (McFarlane *et al.* 2007, pp. 283–285; Manfredo *et al.* 2021, pp. 3–5). By identifying current attitudes, norms, and values common to certain user groups, I&E working groups can disseminate appropriate materials and provide workshops tailored to these values, contributing to the continued coexistence between grizzly bears and humans. Conflict management specialists often meet one-on-one with landowners to provide site specific education and support, such as securing attractants on their property. I&E programs and working with individual property owners fosters relationships and builds trust between the general public in a community and government agencies by initiating communication, dialogue, and securing attractants. Effective

I&E programs have been an essential factor contributing to progress towards the recovery of the grizzly bear populations in the lower-48 States since its listing in 1975.

Servheen *et al.* (2004, p. 15) estimated that from 1980 through 2002, at least 36 percent (72 out of 196) of human-caused mortalities in the GYE may have been avoided if relevant I&E materials had been presented and used by involved parties. Educating back- and front-country users about the importance of securing potential bear attractants can reduce grizzly bear mortality risk. Similarly, adhering to hiking recommendations, such as making noise, hiking with other people, hiking on designated trails, and hiking during daylight hours, can further reduce grizzly bear mortalities by decreasing the likelihood that hikers will encounter bears (Herrero 1985, pp. 249–250; Gunther and Haroldson 2020, p. 13). Hunter-related mortalities may involve hunters defending their life because of carcasses that are left unattended or stored improperly. Because human-grizzly bear conflicts may arise even when carcasses are stored properly, hunter education includes other conflict avoidance measures, such as hanging meat in an area that can be viewed from several hundred yards upon returning to retrieve meat. Grizzly bear mortalities also occur when hunters mistake grizzly bears for black bears. Many of these circumstances can be further minimized through I&E programs.

Another source of animosity towards grizzly bears is disagreement over land-use restrictions in place to enhance recovery of the species; effective I&E programs can address this too. Traditionally, stakeholders involved in resource extraction industries, such as loggers, miners, livestock operators, and hunting guides, were opposed to land-use restrictions that were perceived to place the needs of the grizzly bear above human needs (Kellert 1994, p. 48; Kellert *et al.* 1996, p. 984). Surveys of these user groups have shown that they tolerate large predators when they are not seen as direct threats to their economic stability or personal freedoms (Kellert *et al.* 1996, p. 985). To address the concerns of user groups who have objections to land-use restrictions that accommodate grizzly bears, Federal and State agencies market the benefits to multiple species of restricting motorized access. For example, both Montana and Wyoming have recommendations for elk habitat security similar to those for grizzly bears (road densities of less than 0.6 km/km^2 (1 mi/mi^2)). This level of motorized access for elk habitat security meets the needs of a variety of wildlife species, while maintaining reasonable opportunities for public access.

I&E teams for the GYE, NCDE, SE/CYE, BE, and North Cascade IGBC Subcommittees and the IGBC Executive Committee coordinate the development, implementation, and dissemination of programs and materials to aid in preventative management of human-bear conflicts. I&E team members include the Service, State wildlife agencies, Tribal wildlife agencies, the NPS, and the USFS. These partners recognize that public I&E programs are a crucial component to preventing human-grizzly bear conflicts, which is evidenced by the fact that they have been actively involved in grizzly bear I&E outreach for over a decade. The IGBC recently finalized a Bear Smart Community framework and guidance documents to support communities that want to increase their human-bear conflict prevention strategies (available at: *https://igbconline.org/programs/bear-smart-communities/*).

In the GYE, all three States, the NPS, the NFs, and NGOs have been actively involved in I&E outreach for several decades, and their respective management plans contain chapters detailing efforts to continue current programs and expand them when possible. For example, the WGFD created a formal human-grizzly bear conflict management program in July 1990 and has coordinated an extensive I&E program since then. Similarly, since 1993, MFWP has implemented countless public outreach efforts to minimize human-bear conflicts, and the IDFG has organized and implemented education programs and workshops focused on private and public lands on the western periphery of the grizzly bear's range. In 2019, YES held a workshop in Jackson, WY, summarized by a 2020 report with recommendations for reducing bear-human conflicts in the GYE, which demonstrate ongoing commitments and efforts to reduce grizzly bear mortality (Pils *et al.* 2020, entire). To address public attitudes and knowledge levels, I&E programs present grizzly bears as a valuable public resource while acknowledging the potential dangers associated with them and ways to avoid conflicts. I&E programs are integral components of the GYE Conservation Strategy and will continue to be implemented by all partners whether the GYE grizzly bear is listed or not (YES 2024, Chapter 5).

In the NCDE, the State of Montana, the NPS, the NFs, Tribal entities, and NGOs recognize that public I&E programs are a crucial component to preventing human-grizzly bear conflicts. The State of Montana, CS&KT, and Blackfeet Nation have been actively involved in grizzly bear I&E outreach for several decades, and their respective grizzly bear management plans contain chapters detailing efforts to continue current programs and expand them when possible (Servheen *et al.* 1981, pp. 17–29; Blackfeet Tribal Business Council 2013, pp. 3–4, 9–10; NCDE Subcommittee 2020, Chapter 4; MFWP 2022, pp. 10, 88–98). Their management plans also acknowledge that public outreach is the most effective, long-term solution to human-grizzly bear conflicts and that I&E programs are paramount in driving successful coexistence between humans and bears in the NCDE. The Blackfoot Challenge, a grassroots watershed group, has successfully reduced carnivore related conflicts in the Blackfoot River watershed over the past two decades through the fostering of mutual respect and cooperation (Wilson 2023, entire). We have no independent data to confirm the success of the I&E programs, but we consider the increase in the NCDE grizzly bear population since 2004 to be some evidence of success (Costello *et al.* 2016b, p. 2; Costello 2018, *in litt.*), since this 2.3 percent annual growth rate occurred despite large increases in people living and recreating in the NCDE over the last 3 decades.

In the CYE, SE, and BE, the States of Montana, Idaho, and Washington, NFs, Tribal entities, and NGOs recognize that public I&E efforts are crucial to preventing human-grizzly bear conflicts. These entities have been actively involved in grizzly bear I&E outreach for over a decade. I&E efforts include: public meetings; community events; informational posters, brochures and bear identification sheets; bear-resistant containers; electric fencing; and funding of outreach by NGOs. The State of Montana contains detailed I&E efforts in its grizzly bear management plan (MFWP 2022, pp. 88–98) and hired a bear conflict specialist for northwest Montana in 2007. A recent study documented the success of these efforts with a decrease in the level of human-caused grizzly bear mortality in the northwest Montana portion of the CYE after the hiring of the bear conflict specialist, supporting the success of these I&E programs (Proctor *et al.* 2018, p. 359). Further support of this success is the recent increase in the CYE grizzly bear population and the positive population trend since 2012 after a decade-long decline (Kasworm *et al.* 2024a,p. 42). In 2021, Idaho began hiring a seasonal bear conflict management specialist for the CYE and SE to help address the increasing human population and expanding bear distribution.

In the North Cascades, I&E efforts include: an NPS bear-resistant canister loan program to improve attractant storage in the backcountry; outreach to backcountry users; working to increase attractant storage compliance among campers at NPS and USFS campgrounds; bear resistant food storage lockers at many USFS campgrounds bear-resistant residential containers; community conflict prevention workshops; electric fencing; and bear spray. Although black bears are the species of focus, measures to reduce conflict are largely the same for both species and fostering coexistence with one species helps foster coexistence with the other.

Public attitude surveys towards grizzly bears and their management have been conducted in both the North Cascades and CYE (Duda *et al*. 1996, entire; Canepa *et al.* 2008, entire). These surveys posed questions about public understanding and perception of grizzly bear biology and management and then were used to craft I&E programs to address identified needs (Morgan *et al*. 2004, entire; Annis and Trimbo 2019, entire). The Defenders of Wildlife in the North Cascades is an example of a nongovernmental organization providing educational efforts in Washington with field representatives in small communities. A public attitude survey was recently completed across the State of Montana that will be used by wildlife management agencies to inform grizzly bear management, including I&E efforts (in their entirety: Costello *et al*. 2020; Nesbitt *et al*. 2020).

Livestock Conflict Prevention Programs

Carcass pickup programs and electric fences can reduce livestock depredations. Carcass removal can be helpful by reducing attractants that may draw grizzly bears into areas with livestock. Programs typically employ drivers to pick up carcasses on a regular basis and dispose of them at carcass composting sites. These programs are currently used throughout a number of Idaho, Montana, Wyoming communities. Idaho is in the process of developing a carcass pickup program in the SE and CYE. Livestock producers also often employ range riders to regularly ride large pastures or open range to monitor predator activity, actively haze predators, detect depredations, and group livestock to make them less vulnerable to predators. Electric fencing can be effective in protecting many types of human-attractants, including gardens, orchards, chickens, and livestock, from predators, including grizzly bears.

Food Storage Orders

Implementation and enforcement of food storage orders on public lands decrease the chance of human-grizzly bear conflicts and reduce risks for both humans and grizzly bears. In addition, State and Federal I&E programs reduce human-grizzly bear conflicts on both private and public lands by educating the public about potential grizzly bear attractants and how to store them properly. Accordingly, the majority of agency budgets for grizzly bear management is for human-grizzly bear conflict management, outreach, and education. The relationship between human food baiting by black bear hunters and subsequent conflict activity by bears may be a potential issue in areas of Idaho and Wyoming where baiting is allowed. Black bear baiting can and does attract grizzly bears. This could lead to direct mortality due to mistaken-identity kills, although such circumstances have not been reported for several years. Baiting may also have indirect impacts due to food conditioning. When grizzly bears find an easy food source, they can become food conditioned. If the food source is human-related, a food conditioned bear can begin aggressively seeking it out in human-occupied areas, forcing managers to take action (relocation or removal). Black bear baiting is limited and regulated by Idaho Department of Fish and Game (IDFG 2020, pp. 69–70) and Wyoming Fish and Game Department (WFGD 2020, pp. 3-2–3-6). Black bear baiting is not allowed in Montana or Washington.

In the GYE, food storage rules aimed at decreasing grizzly bear access to human foods are enforced on the 98 percent of lands inside the DMA managed by the USFS and NPS (USDA FS 2008, 2014a, 2014b, 2016b, 2022a, 2023b, 2023d, 2023f, entire; YNP 2023, pp. 35–36; GTNP and JDR 2024, pp. 27–28; YES 2024, Chapter 3). In addition, food storage restrictions include most USFS lands and some Montana wildlife management areas where connectivity with the NCDE and/or BE are most likely to occur (USDA FS 2014a, 2022a, 2023c, entire; Montana Fish and Wildlife Commission 2019, pp. 5, 7–9; YES 2024, Chapter 3).

In the NCDE, on NPS, USFS, and Tribal lands inside the recovery zone, Zone 1 including the DCAs, and Zone 2, food storage rules are aimed at decreasing grizzly bear access to human foods (NPS 2010, p. 4; Blackfeet Tribal Business Council 2018, p. 28; CS&KT 2018, p.10; USDA FS 2018c, p. 50; USDA FS 2018d, pp. 9, 1-5, 1-17, 1-29, 1-40; NCDE Subcommittee 2020, Chapter 4; USDA FS 2023c, entire; GNP 2024, pp. 16–20). In addition, food storage orders occur on most State lands (ARM 12.8.201 and 12.8.210; DNRC 2010a, pp. 4-436).

All three NFs (Idaho Panhandle, Lolo, and Kootenai) within the CYE and both NFs (Idaho Panhandle and Colville) in the SE have made food storage requirements in portions of the grizzly bear range (USDA FS 2011a, pp. 6–7; USDA FS 2015b, pp. 31, 33; USDA FS 2015c, pp. 31, 34; USDA FS 2019, p. 61).

In the BE recovery zone, there are no food storage orders on the NFs that manage nearly 100 percent of the BE recovery zone. The lack of food storage orders on USFS lands within the BE recovery zone may contribute to future grizzly bear mortality risk and inhibit natural recolonization. However, there are food storage orders on many USFS lands in potential connectivity areas between the GYE, NCDE, and the BE (in their entirety: USDA FS 2023c, 2-23h).

In the North Cascades recovery zone, food storage orders are in effect in NCNP (NCNP 2023, entire). The Mount Baker Snoqualmie National Forest instituted a food storage order in 2023 on the west portion of the North Cascades (USDA FS 2023e, entire). There are no food storage orders on the east portion of the North Cascades managed by the Okanogan-Wenatchee National Forest. The lack of food storage orders on all USFS lands within the North Cascades recovery zone may contribute to future grizzly bear mortality risk and inhibit restoration efforts.

Hazing Guidelines

As grizzly bear populations have expanded, more bears are using areas in or near human developments, causing concern from the public. Because of these concerns, the Service developed guidelines on safe, legal hazing techniques to discourage grizzly bears from using areas near homes and other human-occupied areas (Service 2020, entire). The guidance describes techniques that the public may use to deter grizzly bears away from the immediate vicinity of a human-occupied residence or potential conflict area. The use of safe and legal hazing techniques prevents grizzly bears from becoming habituated to humans or conditioned to human foods, which can become a human-safety issue and often results in removal of the bear. Successful hazing should result in fewer bears near homes, fewer human-bear conflicts, and, ultimately, improved attitudes.

Summary of Conservation Efforts that reduce Human-Caused Mortality

In addition to the I&E programs, livestock depredation prevention programs, food storage orders, and hazing guidelines discussed above, the States and NGOs have implemented other programs to help reduce conflicts with the people that are directly affected by grizzly bears. These efforts include livestock carcass removal programs, electric fencing subsidies for livestock, apiaries, and orchards, and sharing costs of bear-resistant garbage bins where appropriate. Moreover, annual reports are prepared by the IGBST for the GYE, MFWP for the NCDE, and the Service for the CYE and SE, analyzing the causes of conflicts, known and probable mortalities, and proposed management solutions (Servheen *et al.* 2004, pp. 1–29; Bowlin 2024, *in prep.*; Costello *et al.* 2024, *in prep.*; DeBolt *et al.* 2024, *in prep.*; Gunther *et al.* 2024, *in prep.*; Hnilicka and Lawson 2024, *in prep.*; Kasworm *et al.* 2024a, pp. 35–37; Kasworm *et al.* 2024b, p. 25; Schwabedissen and Wilmot 2024, *in prep.*; Smith and Orozco 2024, *in prep.*). The responsible agencies have committed to continuing to use these data to identify where problems occur and compare trends in locations, sources, land ownership, and types of conflicts to inform proactive management of human-grizzly bear conflicts. The IGBST and Yellowstone Grizzly Coordinating Committee[10] (YGCC) implemented this adaptive management approach when the GYE grizzly bear population was delisted between 2007 and 2009. After high levels of mortality in 2008, the IGBST provided management options to the YGCC about ways to reduce human-caused mortality. In fall 2009, the YGCC provided updates on what measures they had implemented since the report was released the previous spring. These efforts, conducted through I&E and State fish and game agencies, included: increased outreach on the efficacy of bear spray; development of a comprehensive encounter, conflict, and mortality database; and increased agency presence on USFS lands during hunting season (YGCC 2009, entire). In response to a recent increase in conflicts in the GYE and NCDE as their distributions expand, the IGBC and each ecosystem subcommittee continues to reevaluate recent sources of human-caused mortality and preventative measures. Based on the analysis provided above, we conclude that negative attitudes can be improved through I&E programs and proactive conflict reduction measures, such as food storage orders and hazing guidelines. In addition, based on population trends it does not appear that negative attitudes are currently limiting grizzly bear populations.

Mortality Limits

Human-caused mortality is the primary factor affecting grizzly bears at both the individual and population levels. Understanding and managing for sustainable mortality levels is necessary to facilitate and maintain recovery. Independent of the Act, the States of Idaho, Montana,

[10] The Yellowstone Grizzly Coordinating Committee replaces the Yellowstone Ecosystem Subcommittee (YES) upon delisting and implementation of the GYE Conservation Strategy. The YGCC replaced YES when grizzly bears in the GYE DPS were delisted between 2007 and 2009.

Washington, and Wyoming have regulations that make it illegal to kill a grizzly bear other than in defense-of-life, except for limited circumstances, as described below (ARM 14.9.1403; IDAPA 13.01.06.100.05; IDAPA 13.01.06.300.01; WAC 220-610-010; WS 23-1-101(a)(xii)(A); WS 23-3-102(a)). In Montana, upon delisting, a livestock owner or other authorized persons may take a grizzly bear at any time without a permit when a grizzly bear is attacking or killing livestock (MCA 87-5-301). Additionally, once delisted, the department may issue a kill permit to livestock owners when a grizzly bear is threatening livestock, subject to commission rules, which were finalized in December. The commission will annually set mortality limits for kill permits. In Idaho, upon delisting, a grizzly bear may be killed if it is "molesting or attacking livestock or domestic animals" (Senate Bill 1027: Section 7: 36-1107(d)).

Mortality limits in the GYE

In 2017, we developed a mortality-management framework in partnership with the States, other Federal Agencies, and Tribes in the GYE, to ensure sustainable mortality limits within the DMA to maintain recovery within the GYE. The population growth inside the DMA slowed starting in 2002, with the model-averaged Chao2 population estimate for 2002–2014 being 674 bears (95% CI = 600–747). This slowing of growth starting in 2002 is strong evidence that the population is exhibiting density-dependent population regulation inside the DMA, which has recently been documented (van Manen *et al.* 2016, entire) and is further evidence that the population has achieved recovery within the DMA. As described in the 2016 GYE Conservation Strategy, the population in the DMA is managed to maintain the population around the long-term average population size for 2002–2014 of 674 bears (95% CI = 600–747) (using the model-averaged Chao2 population estimate), consistent with the revised demographic recovery criteria (YES 2016a, pp. 38–40; Service 2017, entire). The 2016 Conservation Strategy commits to using the model-averaged Chao2 population estimator toachieve a population in the DMA that remains around the 2002–2014 average of 674. Total mortality limits for independent females and independent males were applied on a sliding scale within the DMA as summarized in Chapter 3 (Table 9). Total mortality includes documented known and probable grizzly bear mortalities from all causes, including but not limited to: management removals, illegal kills, mistaken-identity kills, self-defense kills, vehicle kills, natural mortalities, undetermined-cause mortalities, grizzly bear hunting, and a statistical estimate (Cherry *et al.* 2002, entire) of the number of unknown/unreported mortalities.

In 2018, the Montana District Court identified three main issues in vacating the Service's 2017 final rule designating and delisting the GYE DPS. One of those issues was that the Service and its partners did not commit to recalibration of potential new population estimators in the future to ensure the ongoing applicability of the 2016 GYE Conservation Strategy's mortality limits. Beginning with 2022 data, the IGBST began implementing an IPM to estimate vital rates, population size, and mortality within the GYE (Gould *et al.* 2024a, entire). In January 2024, the States of Idaho and Wyoming amended the Tri-State MOA to incorporate new commitments to maintain a biologically recovered population including population objectives, total- mortality thresholds, a threshold at which discretionary mortality ceases, and reproductive- female distribution. The Montana Fish and Wildlife Commission adopted the Tri-State MOA in June 2024. The Yellowstone Ecosystem Subcommittee and the IGBC approved incorporation of the new commitments into the Conservation Strategy in May 2024 and June 2024, respectively. In the amended Tri-State MOA and revised Conservation Strategy, Idaho, Montana, and Wyoming agree to manage the GYE grizzly bear population in the DMA within or above a range of 800 to 950 grizzly bears (applying the IPM population estimate) (Wyoming Game and Fish Commission *et al.* 2024, entire; YES 2024, Chapter 2). We are currently evaluating whether these and other conservation measures discussed in the GYE Conservation Strategy will ensure human-caused mortality threats to the GYE grizzly bear population will not become substantial enough to reduce resiliency of this ecosystem.

Independent of the Act, all three affected States and the Eastern Shoshone and Northern Arapaho Tribes of the WRR have enacted regulatory mechanisms that require State or Tribal authorization for grizzly bear take, with illegal poaching remaining prosecutable under State and Tribal laws because grizzly bears are designated as a game animal (WS 23-1-101(a)(xii)(A); WS 23-3-102(a); MCA 87-2-101(4); MCA 87-1-301; MCA 87-1-304; MCA 87-5-301; MCA 87-5-302; IC 36-201; IDAPA 13.01.06.100.05; IDAPA 13.01.06.300.01; IC 36-1101(a); Idaho's Yellowstone Grizzly Bear Delisting Advisory Team 2002, pp. 18–21; Eastern Shoshone and Northern Arapahoe Tribes 2009, p. 9; WGFD 2016, p. 9; MFWP 2022, p. 43; Shoshone and Arapaho Tribes Fish and Game Department 2023, pp. 20–21; YES 2024, Chapter 7). As discussed above, the States of Montana and Idaho have additional circumstances under which it would be legal to take grizzly bears upon delisting.

Mortality limits in the NCDE

In 2018, we developed a mortality-management framework in partnership with the State of Montana, other Federal Agencies, and Tribes in the NCDE, to ensure sustainable mortality limits within the DMA to maintain recovery within the NCDE. The agencies agreed to manage mortalities from all sources to support a greater than or equal to 90 percent estimated probability that the grizzly bear population within the DMA remains above 800 individuals, considering the uncertainty associated with the demographic parameters (NCDE Subcommittee 2020, Chapter 2; ARM 12.9.1403). In order to consider this uncertainty, the model that estimates the probability that the population is above 800 individuals incorporates the standard error associated with calculating survival rates for all age/sex classes (e.g., cubs, yearlings, independent males, and independent females) and reproductive parameters (e.g., proportion of females with cubs and litter size). The methods to determine thresholds for independent female survival, independent female mortality, and independent male mortality that allow achievement of this objective into the future are set forth in the NCDE Conservation Strategy (NCDE Subcommittee 2020, Chapter 2, Appendix 3).

The NCDE Conservation Strategy commits to developing and evaluating additional inputs to the model. Agencies are working to explicitly estimate the proportion of the population that has expanded outside of the DMA in order to exclude those individuals from the population estimate when calculating the mortality thresholds consistent with the probability that the population is above 800 individuals within the DMA (NCDE Subcommittee 2020, p. 238). If the population in the DMA is overestimated because it includes bears that have dispersed outside of the DMA, then the mortality limits are also overestimated. While mortality rates within the DMA were close to thresholds in several years (2021 for independent females and 2018, 2019, and 2021independent males), TRU mortalities as measured on a 6-year average have been below mortality limits since the implementation of this monitoring method in 2018 and are thus likely still sustainable.

Population modeling based on vital rates from Costello *et al.* (2016b, entire), indicates that the estimated probability that the NCDE grizzly bear population was greater than 800 bears was only 21 percent in 2004; increased to greater or equal to 90 percent in 2010; and has been greater or equal to 99 percent since 2015 (NCDE Subcommittee 2020, Chapter 2; Costello 2018, *in litt.*). Given the current rates and levels of uncertainty, managing the NCDE grizzly bear population with a greater than or equal to 90 percent estimated probability of being above 800 bears necessitates maintaining an estimated population size of approximately 950–1,000 bears. Larger estimated population sizes are needed if the level of uncertainty increases (NCDE Subcommittee 2020, Chapter 2).

As outlined in the NCDE Conservation Strategy (NCDE Subcommittee 2020, Chapter 2), managers use a 6-year running average for independent female survival, independent female TRU mortality[11], and independent male TRU mortality to:

- Maintain an estimated annual survival rate of independent females within the DMA of at least 90 percent and a rate at or above the minimum level consistent with a projected probability of at least 90 percent that the population within the DMA will remain above 800 bears based on population modeling;
- Limit the annual estimated number of TRU mortalities of independent females within the DMA to a number that is no more than 10 percent of the number of independent females estimated within the DMA based on population modeling and a number that is at or below the maximum level consistent with a projected probability of at least 90 percent that the population within the DMA will remain above 800 bears based on population modeling;
- Limit annual estimated number of TRU mortalities of independent males within the DMA to a number that is no more than 15 percent of the number of independent males estimated within the DMA based on population modeling.

Managers need a number of population parameters to follow this process for calculating allowable mortality limits that meet the population objective of supporting a greater than or equal to 90 percent estimated probability that the grizzly bear population within the DMA remains above 800 individuals: (1) the 6-year running average for the annual survival rate of independent females; (2) annual mortalities for independent males and females in the DMA (i.e., TRUM); and (3) population estimates.

First, the 6-year running averages for the annual survival rate of independent females and the estimated number of TRU mortality for independent females and males within the DMA is calculated and reported annually by the Monitoring Team to the NCDE Subcommittee. Survival

[11] Total reported and unreported mortalities (TRU mortality) – an estimate of the total number of mortalities of independent-age bears within the DMA, by sex, representing the sum of documented management removals, documented radio-marked deaths, and an estimate of other reported and unknown/unreported mortality calculated using the Cherry *et al.* (2002) method based on reported mortalities (excluding management removals and radio-marked removals) and the reporting rate observed among radio-marked bears.

is estimated from current and previously collected (preceding five years) radio-telemetry data, using a known-fates statistical analysis that will also incorporate survival data from monitoring since 2004 (NCDE Subcommittee 2020, Appendix 2). Six-year running averages account for two breeding cycles and make estimates less sensitive to sampling variance and annual variability. Survival of independent females has been monitored and reported previously (Mace *et al.* 2012, p. 119; Costello *et al.* 2016b, p. 1). Costello *et al.* (2016b, pp. 43–44) reported a mean annual survival of 0.95 for all independent females during 2004–2013, and found no evidence for change in the annual rate during that period.

Second, the annual TRU mortalities for each sex in the DMA are calculated and reported annually by the Monitoring Team to the NCDE Subcommittee, and includes documented mortalities from all causes, including known and probable human-caused, natural, and undetermined-causes. Estimated numbers of TRU mortality for independent females and males within the DMA have also been calculated and reported previously (Costello *et al.* 2016b, p. 32; Costello and Roberts 2016, pp. 8–9; Costello and Roberts 2017, pp. 8–9).

Third, the population estimates used to calculate survival and mortality thresholds for the NCDE DMA are produced by a stochastic population modeling incorporating: (1) the estimated population size of 765 for the NCDE reported by Kendall *et al.* in 2004 (2009, p. 9); and (2) interagency monitoring data estimating vital rates for the population (Costello *et al*. 2016b, p. 2). Costello *et al.* (2016b, p. 2) estimated the annual population growth rate from 2004 to 2014 at of 2.3 percent and the median estimated population size for the NCDE in 2014 at 960 bears (95% CI = 837, 1,089). No change in vital rates was observed during 2014 to 2017, and updated analyses indicates the NCDE grizzly bear population size in 2023 was 1,163 individuals (95% CI = 971–1,366) (Costello 2019, *in litt.*; Costello *et al.* 2024, *in prep.*).

Adherence to these survival and mortality thresholds for the DMA is evaluated by the Monitoring Team through continued demographic monitoring, application of stochastic population modeling to track size and trend, and management of mortality of independent female and independent male grizzly bears. The population modeling methods are set forth in detail in Appendices 2 and 3 of the NCDE Conservation Strategy (NCDE Subcommittee 2020) and currently represent the best available science.

Independent of the Act, the State of Montana and the Tribes have enacted regulatory mechanisms that require State or Tribal authorization for grizzly bear take, with illegal poaching remaining prosecutable under State and Tribal laws, since grizzly bears are designated as a game animal (MCA § 87-2-101(4); MCA 87-1-301; MCA 87-1-304; MCA 87-5-301; MCA 87-5-302; FIR Tribal Ordinance 44D; Blackfeet Tribal Business Council 2018, p. 29; NCDE Subcommittee 2020, Chapter 6). As discussed above, the State of Montana has additional circumstances under which it would be legal to take grizzly bears upon delisting.

Mortality Limits in the CYE and SE

For the CYE and SE, the mortality limits as set forth in demographic recovery criterion 3 of the Recovery Plan continue to apply (Service 1993, p. 33–34). These mortality limits apply within the recovery zone and a 10-mile buffer around the recovery zone. As discussed above in

Recovery Progress, the mortality limits for the CYE and SE are that known, human-caused mortality cannot exceed 4 percent of the population estimate based on the most recent 3-year sum of females with cubs. No more than 30 percent shall be females. These mortality limits cannot be exceeded during any 2 consecutive years for recovery to be achieved. Although the Recovery Plan established a goal of zero human-caused mortality for the CYE and SE until the minimum population reached approximately 100 bears in the CYE and 90 bears in the SE, it also stated "In reality, this goal may not be realized because human-bear conflicts are likely to occur at some level within the ecosystem."

Independent of the Act, the States of Idaho, Montana, and Washington have regulations that make it illegal to kill a grizzly bear other than in defense-of-life, except for limited circumstances, as described below (ARM 14.9.1403; IDAPA 13.01.06.100.01.5; IDAPA 13.01.06.300.01; Washington Administrative Code 220-610-010). As discussed above, the States of Montana and Idaho have additional circumstances under which it would be legal to take grizzly bears upon delisting.

Mortality Limits in the BE

For the BE, the mortality limits as set forth in demographic recovery criterion 3 of the Recovery Plan Supplement continue to apply (Service 1996, p. 4). The mortality limits apply within the recovery zone and a 10-mile buffer around the recovery zone. As discussed above in *Recovery Progress*, the mortality limits for the BE are that known, human-caused mortality cannot exceed 4 percent of the population estimate based on the most recent 3-year sum of females with cubs. No more than 30 percent shall be females. These mortality limits cannot be exceeded during any 2 consecutive years for recovery to be achieved. Although the Recovery Plan established a goal of zero human-caused mortality for BE until the minimum population reached approximately 90 bears in the BE, it also stated "In reality, this goal may not be realized because human-bear conflicts are likely to occur at some level within the ecosystem."

Independent of the Act, the States of Idaho and Montana have regulations that make it illegal to kill a grizzly bear other than in defense-of-life, except for limited circumstances, as described below (ARM 14.9.1403; IDAPA 13.01.06.100.01.5; IDAPA 13.01.06.300.01). As discussed above, the States of Montana and Idaho have additional circumstances under which it would be legal to take grizzly bears upon delisting. In addition, the Nez Perce Tribe prohibits the take of grizzly bears under Nez Perce Tribal Code (§3-1-52) as the species is classified as a threatened or endangered species (Nez Perce Tribal Code §3-1-49(g)).

Mortality limits in the North Cascades

Sustainable levels of human-caused mortality were not established in the Recovery Plan Supplement for the North Cascades due to a lack of information for the ecosystem; however, the supplement established a goal of zero known, human-caused mortalities until the "population is large enough to offset some level of human-induced mortality" (Service 1997, pp. 3–4; 89 FR 36982, May 4, 2024).

Legal Hunting

Legal hunting of grizzly bears has not been allowed in the lower-48 States, except the limited hunt in the NCDE during 1975–1991, since the grizzly bears in the lower-48 States were listed as a threatened species under the Act in 1975 (40 FR 331734, July 28, 1975).

Legal hunting of grizzly bears was allowed in the NCDE from 1975 until 1991, under a special rule authorizing take in the 1975 listing (40 FR 331734, July 28, 1975). During this time, recreational hunting accounted for 50 percent of human-caused mortality in the NCDE (124 of 249). The special rule allowing a limited hunt in the NCDE was removed in 1992 (57 FR 37478, August 19, 1992).

Independent of the Act, the States of Idaho, Montana, and Wyoming, and the Tribes have enacted regulatory mechanisms that require State or Tribal authorization for grizzly bear take, with illegal poaching remaining prosecutable under State and Tribal laws, since grizzly bears are designated as a game animal (IC 36-201; IDAPA 13.01.06.100.05; IDAPA 13.01.06.300.01; IC 36-1101(a); Idaho's MCA § 87-2-101(4); MCA 87-1-301; MCA 87-1-304; MCA 87-5-301; MCA 87-5-302; W.S. 23-1-101(a)(xii)(A); W.S. 23-3-102(a); FIR Tribal Ordinance 44D; Blackfeet Tribal Business Council 2018, p. 29; NCDE Subcommittee 2020, Chapter 6). Legal hunting is one source of discretionary mortality that would be regulated by mortality limits in the absence of Act. Hunting would not occur in Montana for a minimum of five years after delisting (ARM 12.9.1413).

Summary of Human-Caused Mortality

Human-caused mortality includes illegal kills, defense-of-life kills, accidental mortality, mistaken-identity kills, and management removals. Despite these mortalities, the GYE, NCDE, CYE, and SE grizzly bear populations have continued to increase in size and expand their estimated occupied range (Pyare *et al.* 2004, pp. 5–6; Schwartz *et al*. 2006b, pp. 64–66; Schwartz *et al.* 2006c, p. 48; IGBST 2012, p. 34; Bjornlie *et al.* 2014a, p. 184; Costello *et al.* 2016b, pp. 2, 10; Costello *et al.* 2023, p. 14; Dellinger *et al.* 2023, p. 23; Costello *et al.* 2024, *in prep.*; Gould *et al.* 2024c, *in prep.*; Kasworm *et al.* 2024a, pp. 41–42, 72–74; Kasworm *et al.* 2024b, pp. 28, 48–50). Although humans are still directly or indirectly responsible for the majority of grizzly bear deaths, this source of mortality is minimized through science-based management, monitoring, and outreach efforts. I&E programs reduce human-caused mortality by: (1) changing human perceptions and beliefs about grizzly bears; (2) educating recreationists and hunters on how to avoid encounters and conflicts, how to react during a bear encounter, how to use bear spray, and how to properly store food; and (3) educating black bear hunters on bear identification.

Agencies have committed to continuing to produce annual reports that monitor the causes of known and probable grizzly bear mortalities. Population monitoring data collected by the Federal, State, and Tribes is used to help identify where human-grizzly grizzly bear conflicts occur and compare trends in locations, sources, land ownership, and types of conflicts to inform proactive management of human-grizzly bear conflicts. Total mortality rates are managed consistent with recovery criteria and updated population objectives in the GYE and NCDE, with a goal of recovering and maintaining grizzly bear populations.

Natural Mortality

Numbers of documented mortalities due to natural causes represent a relatively small portion of total documented mortalities (GYE DMA: 8 percent for independent-age bears and 43 percent for dependent young; NCDE DMA: 3 percent for independent-age bears and 8 percent for dependent young; CYE: 19 percent; SE: 18 percent). Natural causes include avalanches, injuries, killing by other bears or wildlife species, old age, and starvation. Unlike many types of human-caused mortality, these natural types of mortality are often difficult to document, except when a bear is radio-collared. For example, in the GYE from 2002–2019, 17 percent of mortalities among independent-age radio-collared bears was due to natural causes, but only 4 percent of documented mortalities for the population were from natural causes (Haroldson 2020b, *in litt.*) because the probability of documenting natural mortality is greater for radio-collared bears; however, it is possible to use a statistical estimate to account for unknown natural mortalities. Evidence suggests that most mortality for dependent cubs and yearlings are natural causes; however, detection of these events is difficult and documented mortalities of dependent young are highly skewed towards human-caused sources.

Grizzly bears are sometimes killed by other grizzly bears or other species. These incidents are rarely documented, therefore the impact of predation on grizzly bear population dynamics is difficult to know. Intraspecific predation by adult grizzly bears on dependent young, including sexually selected infanticide, subadults, or other adults occurs (Stringham 1980, p. 337; Dean *et al.* 1986, pp. 208–211; Hessing and Aumiller 1994, pp. 332–335; McLellan 1994, p. 15; Schwartz *et al.* 2003b, pp. 571–572; McLellan 2005, entire), but is rarely documented (Stringham 1980, p. 337). Intraspecific killing of yearlings and cubs can be one indicator of density-dependent population regulation as a population approaches carrying capacity, as recently evidenced in the GYE (McLellan 1994, entire; van Manen *et al.* 2016, pp. 307–308). This type of intraspecific killing has only been observed among grizzly bears 32 times in the GYE DMA between 2002 and 2023 (Gould 2024a, *in litt.*) and 12 times in the NCDE between 2002 and 2023 (Costello 2022, 2023a, 2024, *in litt.*; MFWP, unpublished data). Between 2002 and 2023, intraspecific predation has not been observed among grizzly bears in the SE or the CYE; however, there have been six cubs, three yearlings, and a three-year-old, a four-year-old, and an adult in the CYE and two cubs and two yearlings in the SE lost to unknown causes (Kasworm *et al.* 2024a, pp. 18–19; Kasworm *et al.* 2024b, pp. 14–15). There have been no documented cases of natural predation in the North Cascades since 1967; however, the last verified sighting in the North Cascades occurred in 1996. There have been no documented cases of natural predation in the BE, but until the last few years, there had been no verified sightings since the 1940s.

Grizzly bears are occasionally killed by other wildlife. Wolves and grizzly bears often scavenge similar types of carrion and, sometimes, will interact with each other in an aggressive manner. Since wolves were reintroduced into the GYE in 1995, we know of 339 wolf-grizzly bear interactions with 6 incidents in which wolf packs likely killed grizzly bear cubs-of-the-year and 2 incidents in which wolves likely killed adult female grizzly bears (Gunther and Smith 2004, pp.

233–236; Gunther 2014, *in litt*.). Although interactions have been observed, there are no documented instances in which wolves have killed grizzly bears in the NCDE (MFWP, unpublished data). Overall, these types of aggressive interactions, intraspecific and interspecific, are rare and are an insignificant factor in population dynamics.

Although grizzly bears have been documented with a variety of bacteria and other pathogens, parasites, and disease, fatalities from disease are uncommon (LeFranc *et al.* 1987, p. 61) and do not appear to have population-level impacts on grizzly bears (Jonkel and Cowan 1971, pp. 31–32; Mundy and Flook 1973, p. 13; Rogers and Rogers 1976, p. 423). Researchers have found grizzly bears with brucellosis (type 4), clostridium, toxoplasmosis, canine distemper, canine parvovirus, canine hepatitis, and rabies (LeFranc *et al.* 1987, p. 61; Zarnke and Evans 1989, p. 586; Marsilio *et al.* 1997, p. 304; Zarnke *et al.* 1997, p. 474). Natural mortalities due to disease were not documented prior to 2022 in the lower-48 States (Craighead *et al.* 1988, pp. 24–84; IGBST 2005, pp. 34–35; Haroldson 2019c, *in litt.*; MFWP, unpublished data). However, in 2022, three grizzly bears and seven black bears in the U.S. and Canada were infected with highly pathogenic avian influenza (HPAIV) after presumably consuming waterfowl containing the virus (Harvey *et al.* 2023, p. 7). HPAIV normally occurs in wild birds with little or no mortality. All three grizzly bears were euthanized because of neurological symptoms. From 2021–2022, the predominant strain of avian influenza (H5N1) resulted in the largest outbreak recorded thus far, with an increase in the number of affected wild birds and detections in a much broader range of wild birds and terrestrial species (Harvey *et al*. 2023, p. 4). Terrestrial species become infected after ingesting infected birds or through environmental transmission. All infected bears were in areas where avian influenza mortality was previously identified in wild waterfowl and included a clinical component of neurologic dysfunction or unexplained death in a free-ranging or captive individual. There are no indications that more extensive mortality in grizzly bears went undocumented. Currently, H5N1 does not appear to pose significant population concerns for bears (Pybus and Cooley 2023, pp. 23–24). However, there is uncertainty in the future of HPAIV disease dynamics and the diversity of species impacted. Agencies are aware of the virus and monitoring and reporting protocols are in place.

Based on this absence in more than 50 years of data, we conclude that mortalities due to bacteria, pathogens, or disease are negligible components of total mortality for grizzly bears and are likely to remain an insignificant factor in population dynamics. Therefore, although disease may affect individuals, it does not significantly influence the resiliency of ecosystems.

Connectivity and Genetic Health

The isolated nature of the GYE and BE grizzly bear populations was identified as a potential threat when listing occurred in 1975 (40 FR 31734, July 28, 1975). The 1991, 1993, and 1999 findings of warranted but precluded for endangered status also identified the North Cascades, CYE, and SE, respectively, as small populations facing potential isolation (56 FR 33892, July 24, 1991; 58 FR 8250, February 12, 1993; 64 FR 26725, May 17, 1999). Although the 1993 Recovery Plan did not require connectivity for recovery of individual grizzly bear populations, the Recovery Plan calls for recovering self-sustaining populations. Natural connectivity between grizzly bear populations will benefit long-term grizzly bear conservation through potential genetic exchange (Service 1993, pp. 23–25) and demographic augmentation of smaller isolated or female-fragmented ecosystems (Proctor *et al.* 2005, p. 2414; Proctor *et al.* 2012, pp. 23–28). As shown in Figure 27, genetic diversity of small, isolated populations is influenced by connectivity which in turn is influenced by habitat security.

Small, isolated populations are vulnerable to extinction from demographic fluctuations resulting from environmental processes (e.g., poor food years, disease, human-caused mortality), and low genetic diversity due to genetic drift and inbreeding. Low genetic diversity can have deleterious effects on fitness and fecundity (Allendorf *et al.* 1991, p. 651; Burgman *et al.* 1993, p. 220), and ultimately reduces long-term population viability.

As populations decrease in size, inbreeding, or mating between related individuals (i.e., those with similar genetic make-up) increases, resulting in increased frequency of homozygous genes. Within a few generations, severe inbreeding in very small founding populations can cause inbreeding depression, or reduced biological fitness, resulting from the expression of deleterious traits coded by homozygous alleles. Examples of carnivore populations with observed inbreeding depression include the endangered Mexican wolf (*Canis lupus baileyi*) and the endangered Florida panther (*Puma concolor*), whose population sizes were reduced to 7 and possibly less than 30, respectively (Hedrick and Frederickson 2010, entire). Inbreeding depression was inferred from low fitness and, in the case of the Florida panther, several rare and potentially deleterious traits, including undescended testicles, kinked tails, atrial septal defects, and poor semen quality (Hedrick and Fredrickson 2010, pp. 618, 620). The inference of inbreeding depression was supported by improved fitness and decreased frequency of rare traits following outbreeding programs (Hedrick and Frederickson 2010, pp. 622–623).

Small, isolated populations are also more vulnerable to random loss of genetic variation known as genetic drift. In large populations, where even rare alleles are likely carried by multiple individuals, genetic variability is usually maintained because the loss of alleles through drift is counterbalanced by the addition of alleles through mutation. In small populations, rates of drift are higher than mutation rates because rare alleles are carried by fewer individuals, and over generations genetic variation declines. In very small populations, the increase in homozygosity resulting from inbreeding can intensify drift and lead to abrupt declines in genetic variation within a few generations, an event known as a genetic bottleneck.

Genetic health is typically assessed using a variety of metrics, including effective population size and measures of genetic diversity (e.g., allelic richness, heterozygosity, inbreeding rate). Modeling of population genetics has allowed scientists to estimate minimum population sizes needed to avoid the short-term effects of inbreeding depression and the long-term effects of loss of genetic variation. However, in these contexts population size does not refer to the census population size, but to a metric known as effective population size (N_e), usually derived using genetic data. Effective population size (N_e) is the size at which a hypothetical population begins losing genetic diversity at the same rate as the observed population (Kamath *et al.* 2015, p. 5507). To maintain short-term fitness (i.e., avoid inbreeding depression), Franklin (1980, pp. 140, 147) and Miller and Waits (2003, p. 4338) suggested that N_e should be greater than 50. Additionally, Franklin (1980, p. 147) suggested that an N_e of at least 500 is needed to maintain long-term evolutionary potential through additive genetic variance. These short- and long-term criteria are referred to as the "50/500 rule." The 50/500 rule is imprecise and does not account for human management but could be useful as a broad guideline when case-specific studies are not available (Franklin 1980, pp. 147–148). Reported ratios of N_e/N_c, where N_c is the census size for the population, for grizzly bear populations vary widely from 0.04 to 0.6 (Allendorf *et al.* 1991, pp. 652–653; Paetkau *et al.* 1998, p. 424; Miller and Waits 2003, p. 4337; Schregel *et al.* 2012, pp. 3483–3484). For the GYE, ratios of N_e/N_c of 0.27 to 0.42 have been reported (Miller and Waits 2003, p. 4338; Kamath *et al.* 2015, p. 5513). Ratios of N_e/N_c vary between species and can even vary within a species; therefore, conclusions based on inference should be viewed cautiously (Jamieson and Allendorf 2012, p. 579). In addition, several assumptions of estimating N_e, such as random mating, equal sex ratio, non-overlapping generations, and spatial structure, are violated in grizzly bear populations (Waples 2005, pp. 3349–3350; Waples and England 2011, pp. 633, 640; Neel *et al.* 2013, pp. 190, 194–196; Gilbert and Whitlock 2015, p. 2155).

Metrics to measure genetic diversity include allelic richness, heterozygosity, and inbreeding rate. Low heterozygosity values can be indicative of small and/or genetically isolated populations, which may reflect potential current or past population bottlenecks, whereas high heterozygosity values are indicative of genetic variability that is typically associated with larger and interconnected populations. Allelic richness (number of alleles/locus) is an index of genetic diversity, which reflects a population's long-term capacity to respond evolutionarily to selective pressures other than current ones. Inbreeding is a result of mating events among close relatives and may lead to expression of deleterious alleles, potentially affecting individual bears' ability to reproduce and survive at otherwise normal rates, which is referred to as "inbreeding depression." To maintain short-term fitness (i.e., evolutionary response), Franklin (1980, p. 140) suggested that the rate of inbreeding should be less than 1 percent per generation, which is equivalent to an N_e of 50. Other demographic factors that can reassure biologists that there are not manifestations in the population of inbreeding depression include: healthy reproduction and survival, such as normal litter size, no evidence of disease, high survivorship, an equal sex ratio, normal body size and physical characteristics, and a stable to increasing population.

Connectivity, or dispersal and successful immigration, of males or females enhances genetic diversity and reduces genetic fragmentation (i.e., provide genetic or demographic connectivity, respectively) (Miller and Waits 2003, pp. 4337–4338; Proctor *et al.* 2005, pp. 27–28). As few as one to two effective migrants per generation can maintain or enhance genetic diversity (Mills and Allendorf 1996, pp. 1510, 1516; Newman and Tallmon 2001, pp. 1059–1061; Miller and Waits 2003, p. 4338). In small populations, female immigration is necessary to enhance population growth (i.e., provide demographic connectivity) (Proctor *et al.* 2012, pp. 5, 26–28). Female grizzly bears generally disperse short distances, often overlapping with their maternal home range, and therefore demographic connectivity requires habitat to support female residents in potential connectivity areas between ecosystems (McLellan and Hovey 2001, pp. 841–843; Servheen *et al.* 2001, p. 164; Proctor *et al.* 2005, pp. 2413–2415; Proctor *et al.* 2012, p. 35; Proctor *et al.* 2015, pp. 8–12; Proctor *et al.* 2018, pp. 356–361). Because female immigration is a slow process, demographic connectivity is not expected to have a significant impact on population abundance and population trend. Additional data are needed to determine thresholds for adequate habitat to facilitate genetic and demographic connectivity. However, Proctor *et al.* (2018, pp. 358–363) documented improved connectivity in identified linkage areas after the implementation of measures to reduce human-caused mortality (i.e., attractant storage and motorized access reductions) and improve habitat security (i.e., motorized access reductions), which is particularly important for demographic connectivity as females will likely need to live in linkage areas.

Connectivity and Genetic Health in the GYE

Effective population size and genetic diversity (e.g., allelic richness, heterozygosity, inbreeding rate), in addition to other indicators of genetic health (e.g., reproduction, survival), are monitored by the IGBST for the GYE grizzly bear population (in their entirety: Miller and Waits 2003; Haroldson *et al.* 2010; Kamath *et al.* 2015). Recent data indicate an extremely low rate of inbreeding and an increase in the effective population size over the 25-year period of 1982 to 2007, substantially reducing the prospects of potential negative effects associated with isolation of the GYE population in the short term. These findings are likely a function of significant growth of the GYE grizzly population during the same 25-year period. Additionally, other measures of genetic health, such as heterozygosity and allelic richness, have not changed over a similar 25-year time period of 1985 to 2010 (Kamath *et al.* 2015, p. 5512).

Effective Population Size

Two studies have estimated N_e for the GYE grizzly bear population during different time periods over the last century using various methods. Both studies reported an increase in N_e over time, with the greatest increase indicated by the most contemporary data (Miller and Waits 2003, entire; Kamath *et al.* 2015, entire). Miller and Waits (2003, p. 4338) calculated maximum-likelihood estimates of N_e and found that N_e increased from ≈80 individuals across the period from the 1910s to the 1990s to more than 100 individuals during the late 1990s. Kamath *et al.* (2015, p. 5512) used a temporal-based method (variance effective population size or N_{ev}) to recalculate the data from Miller and Waits (2003, p. 4337) and found similar results (i.e., N_{ev} of ≈80 in the 1910s–1960s); however, they estimated an N_{ev} of ≈280 individuals for the more recent time period of 1982–2007, a 3- to 4-fold increase over the earlier period. In addition, Kamath *et al.* (2015, p. 5512) used the Estimator of Parentage Assignment (EPA) method to estimate N_e for the GYE grizzly bear at 469 (95% CI = 284–772) in 2007, a 4-fold increase from an estimator by parentage assignments (EPA)-based estimated N_e of 102 (95% CI = 64–207) in 1982 (Kamath *et al.* 2015, p. 5512). The mean EPA-derived N_e during 1982–2007 was estimated at 274, and the harmonic mean [a frequently used metric in population genetic analyses incorporating variability in size over time] as 213. Other approaches to estimate N_e yielded estimates of 202–319 for the time period 1982–2007. This increase in EPA-base N_e was evident regardless of the specified probability of parentage assignment used (i.e., 0.80 or 0.95), and is supportive of increases in population size, from approximately 136 to 312 individuals at the time of listing in 1975 (Cowan *et al.* 1974, pp. 32, 36; Craighead *et al.* 1974, p. 16; McCullough 1981, p. 175) to 571 individuals in 2007 using the model-averaged Chao2 estimator (Haroldson 2008, p. 10). The model-averaged Chao2 underestimates the number of bears, and the population in 2007 was likely 30–40 percent higher than the 571 reported (Schwartz *et al.* 2008, Figure 5; Cherry *et al.* 2007, p. 16). Kamath *et al.* (2015, p. 5514) noted that even for an isolated population such as the GYE grizzly bear population, increases in N_e will slow the loss of genetic variation over the long-term (100–200 years) and thus will decrease the risk of inbreeding depression.

The estimated N_e levels from these studies reflect a population with extremely low risk of inbreeding depression, or similar negative effects over the next few decades. To maintain short-term fitness (i.e., maintain response to natural selection and avoid inbreeding depression), Franklin (1980, pp. 140, 147) and Miller and Waits (2003, p. 4338) suggested that N_e should be greater than 50 individuals. Miller and Waits (2003, p. 438) conclude that "N_e is likely to be near or > 100 [and] … it is unlikely that genetic factors will have a substantial effect on the viability of the Yellowstone grizzly over the next several decades." The current estimates of EPA-based N_e of 280 to 469 grizzly bears in the GYE are sufficiently large for inbreeding avoidance (i.e., $N_e > 50$) over the short term, and are approaching, but have not yet achieved levels of N_e that would support long-term genetic viability ($N_e > 500$) (Franklin 1980, pp. 140, 147; Kamath *et al.* 2015, p. 5517).

Genetic Diversity

We use heterozygosity, allelic richness, and inbreeding rates to monitor genetic health of the GYE grizzly bear population. Given the isolated nature of the GYE population, it will likely lose some allelic richness and heterozygosity over time without genetic connectivity to the other ecosystems but evidence from multiple genetic studies indicate this loss would be extremely small due to the large population size. Heterozygosity values for the GYE grizzly bear population have been relatively stable over the last few decades (heterozygosity = 0.60–0.61) (Haroldson *et al.* 2010, p. 4338; Kamath *et al.* 2015, p. 5512). When limited to eight microsatellites common to Miller and Waits (2003, p. 4337) and corrected for differences in sample sizes, heterozygosity indices were stable from 1985 to 2010 (Kamath *et al.* 2015, p. 5512). Based on observed heterozygosity and year of birth of 1,130 grizzly bears in the GYE, Paetkau (2019, *in litt.*) calculated a rate of decline in heterozygosity of 0.0007 per year, implying a total loss of heterozygosity of 0.028 over the past 40 years, from 1979 to 2019. These heterozygosity values (0.6549) are slightly below average for 19 North American brown bear populations (Cronin *et al.* 2012, p. 875) and lower than values in the NCDE (heterozygosity = 0.730) (Kendall *et al.* 2009, p. 12), which is connected to populations in Canada. Heterozygosity values for the GYE are higher than the Selkirk Mountains (heterozygosity = 0.54), which was isolated for several decades but likely experienced greater genetic drift than the GYE due to its much smaller population size (Proctor *et al.* 2005, p. 2411; Proctor *et al.* 2012, pp. 12, 16, 33). They are also higher than the naturally isolated Kodiak brown bear (*Ursus arctos middendorffi*) (heterozygosity = 0.2985) (Paetkau *et al.* 1998, p. 421; Proctor *et al.* 2012, pp. 12, 16).

Kamath *et al.* (2015, p. 5512) also demonstrated no statistical support for a decline in mean allelic richness (A) for the GYE grizzly bear population from 1985 to 2010 ($A_{1985} = 4.65$, $A_{2010} = 4.52$). When limited to eight microsatellites common to Miller and Waits (2003, p. 4337) and corrected for differences in sample sizes, allelic richness for the 1990s were similar across studies, and there was no significant evidence of a decline in allelic richness from 1985 to 2010 (Kamath *et al.* 2015, p. 5512). These values fall within the range of allelic richness (2.13 to 8.13) for grizzly bear populations within North America (Paetkau *et al.* 1998, p. 421; Cronin and MacNeil 2012, p. 875).

The rate of inbreeding for the GYE grizzly bear population has been well below the 1 percent theoretical guidance set forth by Franklin (1980, p. 140), and has improved over the last several decades. Kamath *et al.* (2015, p. 5512) reported a 0.2 percent rate of inbreeding from 1985 to 2010, or approximately 0.1 percent per generation, an improvement from the 0.5 percent per generation estimated by Miller (2006, *in litt.*) based on an N_e approaching 100 in the late 1990s. These trends match those observed for the N_e estimates and strengthen overall inference of the contemporary genetic analyses by Kamath *et al.* (2015, entire).

Evidence from other of small and/or isolated brown bear populations suggest that the GYE population may be able to withstand long-term genetic effects. The brown bear population on Kodiak Island, Alaska, has been isolated for thousands of years on an island similar in size (9,311 km^2 (3,595 mi^2)) to YNP (8,983 km^2 (3,468 mi^2)), and has one of the lowest documented heterozygosity (0.265) and allelic richness (2.13) values in brown bear populations worldwide. However, the population appears to be healthy and productive with an estimated annual population growth of 1.4 percent during 1995–2005, while supporting a sustainable harvest that has consistently yielded some of the largest bears in North America (Troyer and Hensel 1964, pp. 770–772; Barnes and Smith 1998, p. 6; Paetkau *et al.* 1998, p. 421; Van Daele and Barnes 2010, entire). The GYE population is smaller than the estimated population size for Kodiak brown bears (approximately 2,600 individuals) (Barnes and Smith 1998, p. 1), but genetic diversity in the GYE is more than double the values reported for Kodiak bears. No phenotypic signs (i.e., physically observable characteristics) of inbreeding have been documented in either population.

Connectivity

Genetic diversity in species consisting of disjunct populations is typically maintained through genetic connectivity between populations and as few as one to two effective migrants per generation can maintain or enhance genetic diversity (Mills and Allendorf 1996, pp. 1510, 1516; Newman and Tallmon 2001, pp. 1059–1061; Miller and Waits 2003, p. 4338). An effective migrant is an individual that immigrates into an isolated population from a separate area, survives, breeds, and whose offspring survive. No effective migrants into the GYE have been detected to date; however, based on the 2022 estimates of occupied range for grizzly bears in the GYE and NCDE, and verified outlier observations, the likelihood of genetic connectivity through natural bear movement is better now than at any other time since listing in 1975. The Euclidean distance between GYE and NCDE grizzly bear estimated occupied range in 2022 is 98 km (61 mi; Figure 31) (Costello *et al.* 2023, p. 14; Delllinger *et al*. 2023, p. 23), a decrease from 135 km (84 mi) in 2010 and 176 km (110 mi) in 2000. In addition, there have been numerous confirmed sightings outside of estimated occupied range between the two ecosystems, such as Big Hole Valley, and the Big Belt, Bitterroot, Little Belt, Elkhorn, Deer Lodge, and Pioneer Mountains (Figure 31). Nonetheless, successful immigration events will likely remain rare due to distance and barriers unless current distributions continue to expand (Peck *et al*. 2017, pp. 15–16). Peck *et al*. (2017, entire) modeled potential male dispersal paths between the NCDE and GYE. In addition, Sells *et al.* (2023, entire) modeled potential female dispersal paths between grizzly bear ecosystems in western Montana (Figure 15). These dispersal paths could be used to identify and prioritize conservation efforts that foster connectivity.

To document natural connectivity between the GYE and the NCDE, Federal, Tribal, and State agencies monitor bear movements with telemetry on the northern periphery of the GYE grizzly bear range and the southern periphery of NCDE estimated occupied range, and collect genetic samples from all captured or dead bears to document possible gene flow between the two ecosystems (YES 2024, Chapter 2; NCDE Subcommittee 2020, pp. 29–30; MFWP 2022, p. 47). An "assignment test" based on these genetic samples can detect a migrant, or their descendants, and identify the population from which it most likely originated based on their unique genetic signature (Paetkau *et al.* 1995, p. 348; Waser and Strobeck 1998, p. 43; Paetkau *et al.* 2004, p. 56; Proctor *et al.* 2005, pp. 2410–2412, Haroldson *et al.* 2010, p. 7). This technique can also identify offspring of reproduction between grizzly bears from the GYE and NCDE, or other source populations (Dixon *et al.* 2006, p. 158; Haroldson *et al.* 2010, p. 7). However, detection of a migrant or their descendants is dependent on the intensity of sampling efforts.

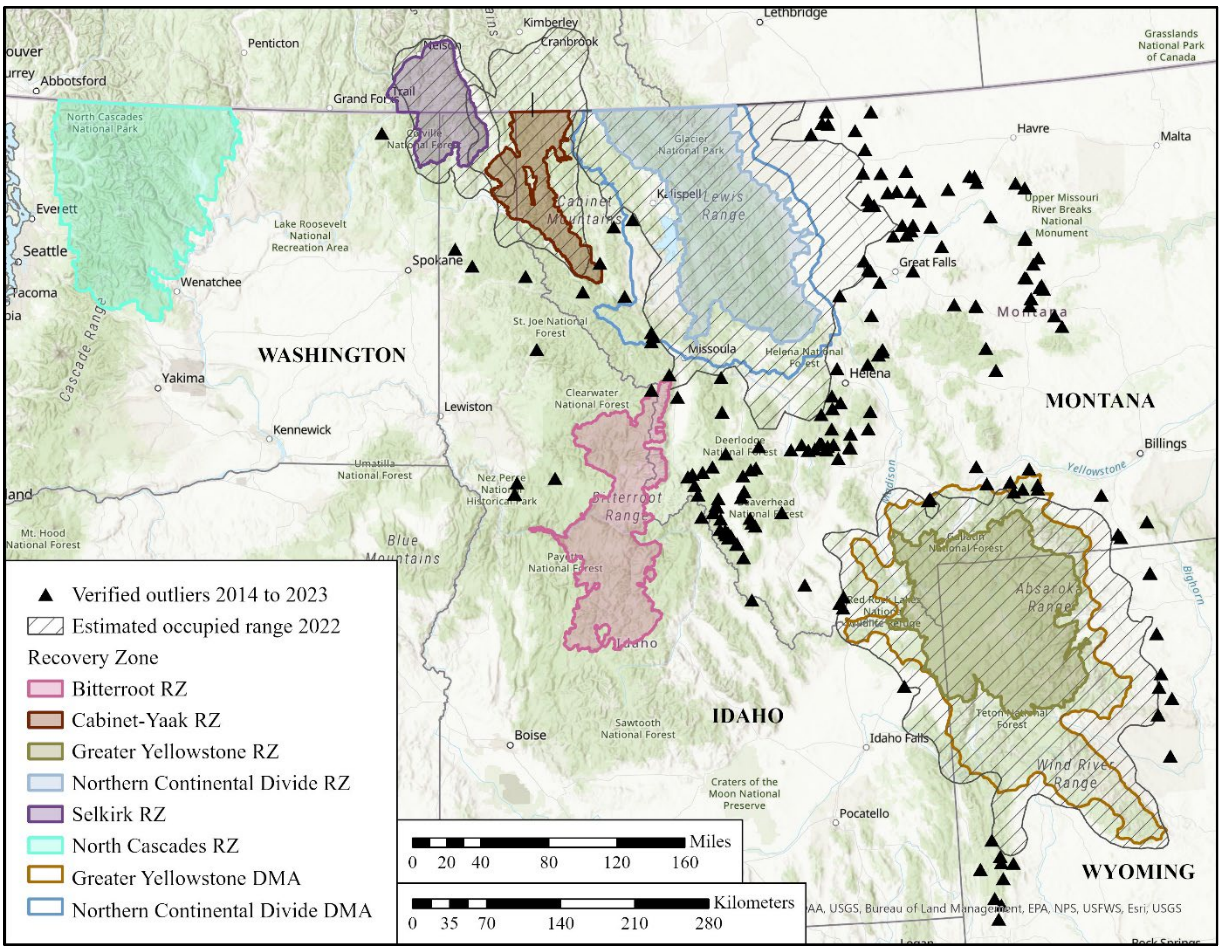


Figure 31. Estimated occupied range of grizzly bears in the NCDE (2008–2022 data; Costello et al. 2023, p. 14), GYE (2008–2022 data; Delllinger et al. 2023, p. 23), CYE (2000–2022 data; Kasworm et al. 2024a, p. 74), and SE (2000–2022 data; Kasworm et al. 2024b, p. 50), and verified grizzly bear outlier observations between the ecosystems based on data from 2014 to 2023.

In addition to monitoring gene flow and movements, the signatories to the GYE Conservation Strategy identified and committed to a protocol to encourage maintaining or enhancing landscape conditions that promote grizzly bear movement between the GYE and other ecosystems (YES 2024, Chapter 3). Connectivity between the GYE and the NCDE is a long-term goal for the

State of Montana, as set out in their draft Grizzly Bear Management Plan, however several statements in the draft plan contradict this statement and the plan does not include any concrete commitments to promote connectivity (NCDE Subcommittee 2020, pp. 20, 31; MFWP 2022, pp. 82–84, 107). If and when grizzly bears are documented to be present in areas between the NCDE management area and the DMA of the GYE, such as the Tobacco Root and Highland Mountains, maintaining their presence through reducing conflict-related mortality would likely facilitate potential grizzly bear movements between the NCDE and GYE. However, there are no mortality thresholds in connectivity areas outside of the GYE and NCDE DMAs for grizzly bears, as discussed above under *Mortality Limits*. In addition, recent legislation in Montana and Idaho expanding hunting and trapping tools available for wolves and black bears could reduce the probability of natural connectivity between the GYE and NCDE populations, as discussed above in *Mistaken-Identity Killings*.

Additional mechanisms to promote natural connectivity include public outreach and education, attractant storage rules, highway crossing structures, and habitat protection (e.g., easements and conservation trust land acquisitions). Attractant storage rules on public lands between the GYE and other grizzly bear recovery zones in the NCDE and BE would help to reduce human-grizzly bear conflicts (see *Preventative Measures* for further details on attractant storage), increasing the likelihood that bears within connectivity corridors will survive. Highway planning can facilitate connectivity (YES 2024, Chapter 3), where state transportation agencies are actively requesting information about grizzly bear data, including locations of highway-related mortalities and documented crossings, and information from state and Federal wildlife agencies on proposed projects. Grizzly bears successfully used crossing structures in Alberta, Canada with increasing use over time and a preference for larger structures in terms of height, width, and length (Clevenger and Waltho 2005, p. 453; Sawaya *et al.* 2014, p. 7). Distance to forest cover was also positively correlated with grizzly bear use of crossing structures, whereas human activity (i.e., traffic noise) was negatively correlated with use (Clevenger and Waltho 2005, p. 459). Lastly, the Service currently partners with several NGOs who work on conservation of important habitat linkage areas (see *Land Development* for further discussion). We do not consider connectivity to the east or south a relevant issue to the GYE grizzly bear population's long-term viability because there are no extant populations in these directions to enhance the genetic diversity of the GYE population. However, we recognize the GYE grizzly bear population could be a possible source population to re-colonize the BE to the west and could provide an indirect connection to the NCDE.

Translocation

The current estimated effective population size of approximately 280 to 469 animals (Kamath *et al.* 2015, p. 5512) in the GYE is sufficiently large to avoid substantial accumulation of inbreeding depression and maintain genetic health over the short term. However, the long-term capacity of the GYE grizzly bear population to respond to future changes in selective pressures would improve by occasional gene flow (one to two effective migrants per generation interval (10–15 years)) from nearby grizzly bear populations, such as the NCDE. Additionally, the Ninth Circuit concluded that adequate measures to ensure long-term genetic health are necessary (*Crow Indian Tribe v. United States*, 965 F.3d 662 (9th Cir. 2020).

Efforts mentioned above (I & E programs, attractant storage rules, highway crossing structures, and habitat protection) to facilitate natural connectivity between the NCDE and GYE will continue. These efforts, however, cannot ensure connectivity. Translocation of bears between these ecosystems could act as a precautionary measure to maintain or enhance genetic diversity (Miller and Waits 2003, p. 4338). Translocation has been successfully deployed in the CYE (Kasworm *et al*. 2024a, pp. 25–29). Kasworm *et al*. (2024a, p. 28) documented reproduction of 5 of the 14 individuals that stayed in the target area and survived for more than 4 months after release (see *Augmentation Program in the CYE* below for further details).

A Tri-State MOA commits the States of Idaho, Montana, and Wyoming to translocate grizzly bears from other grizzly bear populations into the GYE when necessary for genetic fitness (Wyoming Game and Fish Commission *et al.* 2024, p. 5). If migration from outside the GYE is not detected prior to 2025, the States will translocate at least two grizzly bears from outside the GYE into the GYE. Monitoring for genetic diversity and connectivity will continue and additional translocations will occur at least every generation interval (i.e., 14 years for the GYE) if natural connectivity is not detected.

Connectivity and Genetic Health in the NCDE

The NCDE grizzly bear population is genetically diverse, large enough to ensure genetic health, and genetically and demographically well connected to Canadian populations, and we have no reason to believe genetic health will affect the continued existence of the population. Nevertheless, ongoing genetic sampling and radio telemetry enables scientists to examine movements, genetic diversity, and population structure within the NCDE grizzly bear population (in their entirety: Kendall *et al.* 2008; Kendall *et al.* 2009; Mace *et al.* 2012; Proctor *et al.* 2012; Mikle *et al.* 2016a; Morehouse *et al.* 2016).

Effective Population Size

Currently, no reliable effective population size estimates have been calculated for the NCDE grizzly bear population. Pierson *et al.* (2018b, entire), estimated that N_e in the NCDE ranged from 61 to 191, depending on the method used to estimate N_e. However, the authors note that N_e for the NCDE is underestimated because of substructuring within the population (i.e., reduced gene flow between subpopulations within the NCDE), this underestimation is particularly notable because estimates for N_e are higher inside GNP, a segment of the NCDE, than for the estimate for the entire NCDE (Pierson *et al.* 2018a, p. 7). As previously discussed, several assumptions of estimating N_e, such as random mating, equal sex ratio, non-overlapping generations, and spatial structure, are violated in grizzly bear populations (Waples 2005, pp. 3349–3350; Waples and England 2011, pp. 633, 640; Neel *et al.* 2013, pp. 190, 194–196; Gilbert and Whitlock 2015, p. 2155).

Given that the NCDE has a current estimated population size of approximately 1,163 bears, if the NCDE were assumed to have the same N_e/N_c ratio as the GYE, its current N_e would be approximately 296–460 bears. However, we believe that the N_e is likely larger than this estimate because, unlike the GYE, the NCDE population is not geographically isolated from other bear populations, and there is ongoing connectivity with Canadian populations (Service 1993, p. 12;

Kendall *et al.* 2009, pp. 3, 10, 12; Proctor *et al.* 2012, p. 28). The effective population size of the larger grizzly bear population to which the NCDE is connected likely has a N_e greater than 500; therefore, N_e is not considered a risk to the genetic health of the NCDE population.

Genetic Diversity

Measures of heterozygosity and allelic richness from the NCDE in 2004 (heterozygosity = 0.73, A = 8.6), are similar to those from undisturbed populations in Canada (heterozygosity ~ 0.68, A = 6.5) and Alaska (heterozygosity = 0.75, A = 7.6), leading to the conclusion that the NCDE population has high genetic diversity and is sufficiently connected to other bear populations (Paetkau *et al.* 1998, p. 421; Kendall *et al.* 2009, p. 12; Proctor *et al.* 2012, p. 12).

Fragmentation within the NCDE

Proctor *et al.* (2012, entire) used genetic information and movement data from radio-collared grizzly bears between 1979 and 2007, to assess fragmentation in grizzly bear populations in the U.S. and Canada (Figure 16). Data from radio-collared bears demonstrated that both male and female grizzly bears moved across the U.S.-Canadian border on the northern edge of the NCDE (Proctor *et al.* 2012, pp. 21, 25). Based on those movements and on recent measures of genetic diversity, there is currently little risk of significant reduction in the present high levels of genetic diversity (Proctor *et al.* 2012, p. 39).

Kendall *et al.* (2009, p. 10) identified six subpopulations in the NCDE that are a result of historically low levels of genetic interchange between these subpopulations; however, the difference in heterozygosity between the subpopulations was low. Subpopulation boundaries did not coincide with natural or anthropogenic geographic features and are most likely a result of multigenerational matrilineal assemblages (Støen *et al.* 2005, p. 6). The only suggestion of human-caused population fragmentation within the NCDE was on the western side of the U.S. Hwy. 2 / BNSF rail line corridor between GNP and USFS lands where historically mortality rates from vehicle and train collisions were higher compared to other areas of the ecosystem. However, the long-term trend in mortality as a result of train collisions has decreased as a result of avoidance, minimization, and mitigation measures that have been implemented by BNSF rail line (MFWP, unpublished data). Conversely, there was little genetic differentiation across the eastern portion of the corridor (Kendall *et al.* 2009, p. 10).

In recent years, connectivity within the ecosystem has mostly restored the genetic diversity across the NCDE. Genetic differentiation between subpopulations decreased when genetic data from 1976–1998, was compared to data from 1999–2006, a finding consistent with demographic recovery of the population (Kendall *et al.* 2009, p. 10). In addition, heterozygosity increased in three regions south of the Hwy. 2 corridor in the NCDE from 2004 to 2013 (2004: 0.69, 0.67, and 0.70; 2012: 0.76, 0.73, and 0.70) (Mikle *et al.* 2016b, supplementary table 3); these regions generally lined up with three of the subpopulations identified in Kendall *et al.* (2009, p. 4). While managers remain vigilant about the possible fragmenting effects of the U.S. Hwy. 2 corridor, frequent male and female movements have been documented across this corridor (Waller and Servheen 2005, pp. 992, 996), indicating that the current state of fragmentation along this corridor does not prevent demographic and genetic connectivity of grizzly bears within the NCDE (Waller and Servheen 2005, pp. 996–998).

Connectivity

The NCDE population (south of the Canadian border) is connected to and functions as part of a larger trans-border grizzly bear population (Proctor et al. 2012, pp. 20–21, 39). Habitat fragmentation and human-caused mortality along Hwy. 3 in Canada has created a partial fracture to bear movements, particularly for females, to the grizzly bear population north of Hwy. 3 in Canada (Proctor *et al.* 2002, pp. 156–158; Proctor *et al.* 2005, pp. 2412, 2414; Proctor *et al.* 2012, pp. 20–21, 39). Based on grizzly bear movements across Hwy. 3 in Canada and on recent measures of genetic diversity, males are providing genetic connectivity and there is currently little risk of significant reduction in the present high levels of genetic diversity (Proctor *et al.* 2012, p. 39). However, enhanced connectivity management is desirable across Hwy. 3 in Canada (Proctor *et al.* 2005, pp. 2414–2415). Additional information on populations and management in B.C. is provided in *Appendix E*.

Connectivity and Genetic Health in the CYE

Proctor *et al.* (2012, entire) used several metrics to evaluate the genetic status of grizzly bears in the CYE. They found that genetic diversity in the Yaak portion of the CYE was comparable to other healthy grizzly bear populations in North America. The sample size of native Cabinet bears was insufficient to include in the analysis. As discussed above, Miller and Waits (2003, p. 4338) recommended that effective population size remain above 100 animals in an isolated population to avoid negative, short-term genetic effects associated with small population size. Because habitat in the CYE recovery zone cannot support a grizzly bear population of this size, it is important to maintain connectivity with other populations. Female movement and reproduction provides demographic and genetic rescue to a population, whereas male movement and reproduction may only provide genetic rescue. Telemetry from collared animals indicates that grizzly bears move freely across the length of the international border from the CYE into and out of the Yahk grizzly bear population unit in B.C. immediately north of the international boundary (Kasworm *et al.* 2024a, pp. 81–112). B.C. Hwy. 3 is a potential fracture area that divides the north and south Purcell Mountains. Data suggests that the Yaak River portion of the CYE has experienced gene flow from B.C. grizzly bear populations. Using capture, telemetry, and DNA data, 36 individuals (33 males, 3 females) are known to have moved into the Yaak portion of the CYE from the NCDE, SE, and the North Purcells in Canada (north of Hwy. 3), not including augmentation bears. Reproduction was documented for 9 (8 males, 1 female) of these individuals, all were from the North Purcells, resulting in 27 offspring in the CYE (Kasworm *et al.* 2024a, p. 34). No gene flow is known to have occurred from the NCDE or SE into the Yaak or Cabinets portions of the CYE. While there is evidence of movement into the Cabinets from the Yaak, NCDE, and the SE, reproduction that would contribute to the genetic health of the population has not been documented for any immigrants (see *Augmentation Program in the CYE* below).

Of additional concern is population linkage between the Yaak and Cabinet portions of this recovery zone, which are split along Hwy. 2 (Proctor *et al.* 2012, p. 12; Kendall *et al.* 2016, pp. 320–321). The Yaak population is larger and connected to Canadian populations to the north, making it more genetically diverse than the Cabinet population (Proctor *et al.* 2012, p. 12; Kendall *et al.* 2016, pp. 320–321). Based on DNA analysis, eight individuals (all males) were detected on both sides of Hwy. 2 from 2012 to 2022 (Kendall *et al.* 2016, p. 325; Kasworm *et al.* 2024a, pp. 76–80).

Moreover, while the Yaak portion of the recovery zone is connected with Canadian populations to the north, these Canadian populations are becoming increasingly fragmented from the rest of Canada by Canadian Hwy. 3 (Figure 16) (Proctor *et al.* 2012, pp. 17, 18, 33; Proctor *et al.* 2015, pp. 10–11). This highway is at least a partial barrier to demographic connectivity, as females only accounted for 13 percent (4 of 30) of all known migrant movements between population units in the transborder areas and adjacent U.S. recovery zones (Proctor *et al.* 2005, p. 2411; Proctor *et al.* 2012, p. 25; Proctor *et al.* 2015, pp. 10–11). Of the four females documented migrating between population units in Canada, two moved from areas entirely within Canada to areas that straddled the international border (i.e., the SE and NCDE) (Proctor *et al.* 2012, p. 25). These female migration movements demonstrate that limited demographic connectivity with Canadian populations exists while highlighting the importance of maintaining connectivity between U.S. and Canadian populations.

Maintaining or increasing current levels of genetic diversity in the CYE would help ensure genetic concerns do not become a threat in the future. Small population size makes this grizzly bear population more vulnerable to genetic, demographic, and environmental stochasticity. Natural connectivity would alleviate potential future genetic concerns, reduce extinction risk due to small population size, and increase this population’s resilience to environmental and climate change impacts. Designation of the Salish DCA in the NCDE, with accompanying habitat protections, is designed to promote connectivity from the NCDE to the CYE over the 34–105 km (21–65 mi) distance between these areas.

Augmentation Program in the CYE

In the Cabinet Mountains portion of the CYE, researchers and managers have been augmenting the small population by introducing one to two grizzly bears a year from 1990–1994 and since 2005. All bears have originated from the NCDE or just north of the NCDE in B.C. Grizzly bear research indicated that only a small population remained (less than 15) in the Cabinet Mountains portion of the CYE as of 1988 (Kasworm and Manley 1988, p. 98). Concern over persistence of grizzly bear populations within this area resulted in a pilot program in 1990 that tested population augmentation techniques. Four subadult female bears with no history of conflicts with humans were captured in north fork of the Flathead in B.C. and moved to the Cabinet Mountains for release during 1990–1994 (Kasworm *et al.* 2013, p. 2). B.C. was selected as a source for augmentation bears because of the ability to capture non-conflict bears of appropriate age and sex; and similarity of habitat and food sources to the CYE (Service 1990, pp. 10, 23). By 2005, at least one augmentation bear was identified as remaining in the Cabinet Mountains and having reproduced (Kasworm *et al.* 2007, pp. 1263–1264). The success of the augmentation test program prompted additional augmentation between populations in the U.S. Beginning in 2005, in cooperation with MFWP, ten female bears and eight male bears were moved from the Flathead River to the Cabinet Mountains during 2005–2023 (Kasworm *et al.* 2024a, pp. 25–26).

Of 22 bears released through 2023, 14 were known to have remained in the target area for more than a year. One of the individuals that left the area initially was recaptured and brought back and another individual returned to the target area a year after leaving. DNA analysis from hair corrals has been occurring since 2000 and from rub trees since 2012. Based on this analysis, 1 female is known to have produced at least 10 first generation, 16 second generation, and 1 third generation offspring. This female was a 2-year-old female that was released in 1993 as part of the augmentation program. Two other females were known to have produced six offspring and two males were also known to have produced four offspring (Kasworm *et al.* 2024a, p. 26). Of 22 bears released through 2023, 8 left the target area (1 was recaptured and brought back, 2 returned in the same year, and one returned a year after leaving); 8 bears died (2 self-defense, 2 unknown but believed natural, 1 illegal, 1 train collision, 1 mistaken-identity by a black bear hunter and 1 bear was killed 16 years after release) (Kasworm *et al.* 2024a, p. 26). Annual survival rates of female augmentation bears (0.784) is lower than native subadult female CYE bears (0.875) (Kasworm *et al*. 2024a, pp. 39, 42).

Data collected since the 1988 population estimate now suggest the population may have been even smaller than the previously thought estimate of 15 or fewer individuals in 1988. However, this recent data also suggests that the number of grizzly bears in the Cabinet portion of the CYE has increased to 22–24 bears (Kendall *et al.* 2016, p. 314), almost exclusively through the augmentation effort and reproduction from those individuals (Kasworm *et al.* 2024a, pp. 25–29). Genetic diversity in the Cabinet Mountains portion of this population remains a concern. Forty offspring are known arising from seven founders in this population. Thirty of these 44 individuals had the same father (Kasworm *et al*. 2024a, p. 29). This male died in 2019 and other males are expected to contribute offspring in succeeding generations. The augmentation program began transplanting males in 2010 and at least three of those individuals is known to have sired offspring. Male and female augmentation is expected to continue. Eleven males from either the Yaak drainage, Selkirk Mountains, or NCDE are known to have traveled into this area, but no known reproduction has occurred (Kasworm *et al*. 2024a, pp. 76–80). Most of these individuals are known to have died or left the area prior to any breeding opportunities.

Our assessment of genetic health of the CYE is predicated on the management goal of this entity being one population. While that may not be true at this moment, we have seen recent events toward reconnecting the Cabinets and Yaak portions through the monitoring of bear movements in the last decade. Where previously we saw no movement from the Yaak to the Cabinets during 1980–2010, we have documented several instances in the last 10 years (Kasworm *et al*. 2024a, pp. 76–80). Though we have not yet seen any gene flow, we attempt to conservatively assess the genetic health of the CYE based on the Cabinets portion of this population and this lack of demonstrated gene flow.

While genetic issues may be a concern for this small population in the longer term, currently, demographic concerns outweigh those genetic concerns. Movement from other populations into the Yaak portion of this recovery area and the continued augmentation from the NCDE reduce the level of concern. Isolation of the CYE is more of a concern because of the small population size, but recent data indicate increasing movements by males and females and subsequent reproduction, resulting in limited, but increasing population connectivity, particularly in the Yaak portion of the CYE.

Connectivity and Genetic Health in the SE

Telemetry from collared animals indicates that grizzly bears move freely across the length of the international border in the SE (Kasworm *et al.* 2024b, pp. 61–79). The area on the B.C. side of the border is the South Selkirk population unit. B.C. Hwy. 3 bisects this unit but numerous home ranges of collared bears cross this highway (ten males and seven females) (Kasworm *et al.* 2024b, pp. 61–79).

Proctor *et al.* (2012, entire) used several metrics to evaluate the genetic status of grizzly bears in the U.S. and B.C. portions of the SE. They found genetic diversity was lower in the SE than in other grizzly bear populations in the lower-48 States and Canada and that the SE grizzly bear population had likely been isolated in the recent past. From capture, telemetry, and DNA data, 15 individuals (13 males, 2 female) are known to have moved into the SE from the CYE and the South Purcells north of Hwy. 3 in Canada between 2000 and 2023 (Proctor *et al.* 2022, p. 25; Kasworm *et al.* 2024b, p. 24). Reproduction has been documented for 4 males and 1 female from the South Purcells north of Hwy. 3, resulting in 26 offspring in the SE (Proctor *et al.* 2022, p. 25; Kasworm *et al.* 2024b, p. 24). These are examples of migration into the SE, in addition to an increase in expected heterozygosity from 0.54 (Proctor *et al.* 2005, p. 2411) to 0.56 (Proctor *et al.* 2022, p. 27). These changes demonstrate that the SE is starting to increase connectivity with other grizzly bear populations.

The lower genetic diversity in the SE is likely a result of a bottleneck effect (Van Dyke 2003, pp. 149–150). When the grizzly bear was listed in 1975, the SE recovery zone in the U.S. was thought to have only a few bears (Layser 1978, p. 78). These numbers gradually increased over the next 33 years to an estimated population of roughly 83 total animals in the U.S. and Canada in 2010 (25 of which were in the U.S.); however, the effects of such a small initial population size are evidenced by the lower genetic diversity values documented in 2007 (Proctor *et al.* 2012, pp. 12, 31).

Despite the lower levels of genetic diversity in the SE, there have been no detectable consequences on grizzly bear morphology, physiology, ecology, or biology related to these differences in genetic diversity as evidenced by normal litter size, little evidence of disease, an equal sex ratio, and normal physical characteristics such as body size and weight (Wakkinen and Kasworm 2004, pp. 71–72; Kasworm *et al*. 2024b, pp. 27, 41–44).

Because current levels of genetic diversity are not translating into any documented detectable deleterious effects, we do not consider genetic concerns to be a threat to grizzly bears in the SE. Because of the SE population's small size, its isolation is of more concern, but recent data indicate increasing connectivity and movements by both males and females. Maintaining or increasing current levels of genetic diversity in the SE would help ensure genetic concerns do not become a threat in the future. Small population size makes the SE grizzly bear population more vulnerable to genetic, demographic, and environmental stochasticity. Although connectivity has been documented in the SE, increased natural connectivity would alleviate potential future genetic concerns, reduce extinction risk due to small population size, and improve this population's resilience to environmental and climate change impacts.

Connectivity and Genetic Health in the BE

There is currently no known population in the BE and isolation is a concern for any future populations. However, multiple grizzly bears have been confirmed in areas immediately surrounding the recovery zone over the last 15 years. In addition, current distributions of grizzly bears in the GYE and NCDE continue to expand. The NCDE estimated occupied range is less than 5 km (3 mi) from the Bitterroot recovery zone, and multiple verified sightings have occurred between the GYE and NCDE estimated occupied range and the Bitterroot recovery zone. To date, all verified occurrences of grizzly bears entering the BE have been males and female immigration is also needed for natural recolonization. However, in 2022 a 2-year-old female that likely originated from the NCDE dispersed to within 5 km of the BE. After a preemptive relocation to prevent potential conflict, she returned to the NCDE (Costello *et al.* 2023, p. 17). Female immigration is anticipated to be slower given their shorter dispersal distances and potential barriers (e.g., I-90). However, these examples indicate that connectivity between other ecosystems (CYE, SE, GYE, NCDE) and the BE is possible.

Connectivity and Genetic Health in the North Cascades

There is currently no known population in the North Cascades and natural recolonization is unlikely in the near future due to the low numbers of bears in nearby populations and the highly fragmented landscape in between (NPS and Service 2024a, p. 7). However, if a population is established in the North Cascades, there are populations close enough that could provide a male immigrant, thereby ensuring long-term genetic fitness. There are at least three populations within long-distance male dispersal range (67–176 km (42–109 mi)) (Blanchard and Knight 1991, pp. 50, 55; McLellan and Hovey 2001, p. 841; Peck *et al.* 2017, p. 2), from the North Cascades, including the Stein-Nahatlatch, Squamish-Lillooet, and Garibaldi-Pitt Grizzly Bear Population Units in Canada. However, all three of these populations are small and ranked as high to extreme conservation concern (MFLNRORD 2020, p. 6). Only one confirmed grizzly bear sighting has been documented within the greater North Cascades during the past decade, which occurred in B.C. (Rine *et al*. 2020, p. 1).

Summary of Connectivity and Genetic Health

Genetic concerns are not an immediate threat to the GYE grizzly bear population (Miller and Waits 2003, p. 4338; Kamath *et al.* 2015, entire). The current effective population size is sufficiently large to avoid accumulation of inbreeding depression, thereby reducing concerns regarding genetic factors affecting the viability of GYE population (Kamath *et al.* 2015, p. 5517). The current level of genetic diversity in the GYE grizzly bear population also coincides with robust demographic vital rates (i.e., reproduction, survival) that are fully comparable with other growing or stable brown bear populations in North America (van Manen 2016, *in litt.*). However, the GYE has been isolated for many generations, and could benefit from restoration of gene flow (Kamath *et al.* 2015, p. 5517).

For the GYE grizzly bear population, potential decreases in genetic diversity would occur gradually over decades due to long generational time and relatively large population size (Miller and Waits 2003, p. 4338). We remain confident that genetic monitoring, and translocation, if necessary, will address the ability of future GYE bears to adapt evolutionarily (Hedrick 1995, p. 1004; Miller and Waits 2003, p. 4338). Reductions in conflict situations through attractant storage orders on public lands and other preventative measures (see *Preventative Measures* for further details), promotes genetic connectivity through natural movement. The IGBST monitors grizzly bear movements and observations, and the IGBST checks for the presence of alleles from grizzly bear populations outside the GYE grizzly bear (YES 2024, Chapter 2). The IGBST also monitors genetic diversity of the GYE grizzly bear population so that a possible reduction in genetic diversity will be detected and responded to accordingly with translocation of grizzly bears into the GYE originating from another population in the lower-48 States. In addition to possible translocations, measures described in the GYE Conservation Strategy are and will continue to be used to promote genetic connectivity through natural movements. These measures include habitat protections, population standards, mortality control, outreach efforts, and adaptive management.

Overall, the NCDE population is genetically and demographically well connected to Canadian populations, current levels of genetic diversity are sufficient to support healthy reproduction and survival, and the NCDE's current population size ensures genetic health. Accordingly, genetic health is not affecting the continued existence of the NCDE grizzly bear population, and we do not expect that to change in the future. In fact, due to its good genetic health, the NCDE has served, and will continue to serve, as a source population for genetic and demographic rescue of other grizzly bear populations in the lower-48 States.

Recent data indicates increasing genetic connectivity and movements between populations within the lower-48 States and between these populations and populations in Canada. However, because of the small populations sizes in the in CYE and SE, and the lack of known populations in the BE and North Cascades, isolation is still a potential future threat to the resiliency of these populations. To address this threat, interagency efforts are continuing to provide and maintain movement opportunities for grizzly bears, and reestablish natural connectivity and gene flow among all grizzly bear populations in the lower-48 States. To document natural connectivity, we monitor bear movements near the edges of all populations using a combination of radio-collared bears, non-invasive genetic sampling, and motion-triggered wildlife cameras, depending on available resources and opportunities. We also collect genetic samples from all captured or dead bears to document movements or gene flow between ecosystems. These monitoring efforts will continue in the future.

Food Resources

The lower-48 States is comprised of highly diverse landscapes containing a wide array of habitat types and bear foods. Plant communities vary from grasslands, grain fields, and hay fields at lower elevations to extensive conifer forests at mid-elevation to subalpine and alpine meadows at high elevations. Contraction of historical range could change the availability of highly energetic food resources, such as ungulates, army cutworm moths, and berries; that could influence grizzly bear reproduction, survival, or mortality risk (Mealey 1975, pp. 84–86; Pritchard and Robbins 1990, p. 1647; Craighead *et al.* 1995, pp. 247–252).

Grizzly bear diets are characterized by high variability among individuals, seasons, and years (Servheen 1981, p. 119–123,127–128; LeFranc *et al.* 1987, pp. 24–25; Mattson *et al.* 1991a, pp. 1621–1625; Mattson *et al.* 1991b, pp. 2433–2434; Schwartz *et al.* 2003b, pp. 568–569; Felicetti *et al.* 2004, pp. 496–499; Gunther *et al.* 2014, pp. 64–69). They display great diet plasticity and switch food habits according to which foods are most nutritious and available (Servheen 1981, pp. 119–123,127–128; Kendall 1986, pp. 12–18; Mace and Jonkel 1986, entire; Martinka and Kendall 1986, pp. 21–22; LeFranc *et al.* 1987, pp. 24–25; Aune and Kasworm 1989, pp. 64–72; Schwartz *et al.* 2003b, pp. 568–569; Gunther *et al.* 2014, pp. 65–69). Grizzly bears are successful omnivores, and in many areas almost entirely herbivorous (Kendall 1986, p. 12; Jacoby *et al.* 1999, pp. 924–927; Schwartz *et al.* 2003b, pp. 568–569; Teisberg *et al.* 2015, pp. 10–12). Grizzly bears will consume almost any food available, including living or dead mammals or fish, insects, worms, plants, human-related foods, and garbage (Mattson *et al.* 1991a, pp. 1621–1622; Mattson *et al.* 1991b, pp. 2433–2434; Schwartz *et al.* 2003b, pp. 568–569; Gunther *et al.* 2014; entire). In areas where animal matter is less available, berries, grasses, roots, bulbs, tubers, seeds, and fungi are often important in meeting protein and caloric requirements (LeFranc *et al.* 1987, pp. 24–25; Schwartz *et al.* 2003b, pp. 568–569; Gunther *et al.* 2014, p. 65). It is hypothesized that grizzly bears frequently sample new foods in small quantities so that they have options in years when preferred foods are scarce (Mattson *et al.* 1991a, p. 1625). Annual changes in feeding strategy have been documented in GYE grizzly bears (Mattson *et al.* 1991a, entire).

Though bear diets vary across the range of the species, bears seek to balance protein and carbohydrate intake over the nondenning seasons to provide the essential nutrients for growth, reproduction, and survival through the denning period (Robbins *et al.* 2007, pp. 1680–1681; Costello *et al*. 2016a, p. 19).

Food Resources in the GYE

A comprehensive study of the GYE grizzly bear diet documented over 266 distinct plant and animal species ranging from grasses, fungi, berries, and seeds, to fish, carrion, and other meat sources (e.g., young and weakened animals) (Gunther *et al.* 2014, entire). Monitoring foods comprising such a diverse diet is challenging, which is why IGBST's current monitoring efforts have focused on four foods with relatively high energetic value and for which abundance (or use by bears) is relatively easy to measure: ungulates, spawning cutthroat trout, army cutworm moths, and whitebark pine seeds (Mealey 1975, pp. 84–86; Pritchard and Robbins 1990, p. 1647; Craighead *et al.* 1995, pp. 247–252). The discussion below assesses the potential influence of the availability of these four food sources on grizzly bears. Although we briefly discuss ungulates, cutthroat trout, and army cutworm moths, more details on the specific ways in which changes in these food sources could affect the GYE grizzly bear population are discussed in detail in the 2007 final rule (72 FR 14866, March 29, 2007, 14928–14933). Our analysis focuses on the potential impacts that the loss of whitebark pine could have on the GYE grizzly bear population.

Ungulates

Grizzly bears opportunistically consume ungulates as winter-killed carrion in the early spring, prey upon calves, consume hunter-killed carcasses or gut piles, and prey upon adults weakened during the fall breeding season. Less frequently, grizzly bears also opportunistically prey upon healthy adult ungulates. Although bison and elk are the primary ungulate species consumed by grizzly bears in the GYE, they also feed on mule deer (*Odocoileus hemionus*), moose (*Alces alces*), pronghorn (*Antilocapra americana*), and bighorn sheep (*Ovis canadensis*). Ungulate populations may be affected by: brucellosis (*Brucella abortus*) and the resulting management practices that can result in bison removal; chronic wasting disease; hunting regulations outside of YNP; and decreasing winter severity. In addition, ungulate availability may be affected by competition with other top predators for ungulates as prey, including human hunters. Brucellosis does not affect bison as a food source for grizzly bears because it is not a threat to the long-term survival of the Yellowstone bison, and the subsequent removal program is managed to "maintain a wild migratory population of bison" (NPS 2024, p. 14). The Yellowstone bison population size has averaged 4,900 over the past 10-years, within the Interagency Bison Management Plan's recommended range of 3,500 to 6,000 bison after calving, averaging about 5,000 bison (NPS 2024, pp. 4, 6). Chronic wasting disease is fatal to deer and elk and has recently been detected in the GYE. Although chronic wasting disease would not result in local extinction of deer or elk populations, population levels may decline and the States of Idaho, Montana, and Wyoming are monitoring for prevalence and impacts to ungulate herds (Schauber and Woolf 2003, pp. 611–612; Galloway *et al.* 2021, pp. 6–12; IDFG 2021, entire; MFWP 2023a, entire; WGFD 2023, entire). The availability of ungulate carcasses is not anticipated to be impacted by either of these diseases. The reintroduction of gray wolves to the GYE in 1995 has created competition between grizzly bears and wolves for carrion; however, there has been no documentation of negative influence on the GYE grizzly bear population (Servheen and Knight 1993, p. 36; Gunther and Smith 2004, p. 236). Decreasing winter severity and length as a result of climate change could reduce spring carrion availability (Wilmers and Getz 2005, p. 574; Wilmers and Post 2006, p. 405). A reduction of winter-killed ungulates may be buffered by increased availability of meat to adult grizzly bears during the active season as a result of grizzly bears usually prevailing in usurping wolf-killed ungulate carcasses (Ballard *et al.* 2003, p. 262).

Cutthroat Trout

Grizzly bears opportunistically feed on cutthroat trout in tributary streams to Yellowstone Lake, with males being the primary consumer (Reinhert and Mattson 1990, pp. 345–346; Haroldson *et al.* 2005, pp. 173–175). Since the mid-1990s, a decline in the Yellowstone cutthroat trout population has resulted from a combination of factors: the introduction of nonnative lake trout (*Salvelinus naymaycush*), a parasite that causes whirling disease (*Myxobolus cerebralis*), and several years of drought conditions in the Intermountain West (Koel *et al.* 2005, p. 10). Although there has been a corresponding decrease in grizzly bear use of cutthroat trout, only a small portion of the GYE grizzly bear population has access to this food resource (Haroldson *et al.* 2005, p. 175). Cutthroat trout populations decreased over the last three decades and reached an all-time low around 2004 and in the late 2000s grizzly bears that fish in spawning streams only consume, on average, less than 5 kg of cutthroat trout per year (Fortin *et al.* 2013, p. 276). However, spawning cutthroat trout are now returning to some tributaries where grizzly bears once preyed on them (Gunther *et al.* 2023, pp. 44–47). The GYE grizzly bear population continued to increase and expand during this time period and grizzly bears compensated for the loss through diet shifts (Fortin *et al.* 2013, pp. 278–279; Schwartz *et al.* 2014a, pp. 75–78).

Army Cutworm Moths

Army cutworm moths aggregate on remote, high-elevation talus slopes where grizzly bears forage on them from mid- to late summer. Moth sites are limited to the southeast corner of the GYE and only about 25 percent of grizzly bears use moth sites (Haroldson 2020c, *in litt.*). Grizzly bears using moth sites could potentially be disturbed by backcountry visitors (White *et al.* 1999, p. 150), but this is currently not a major issue of concern due to the remoteness of these sites in the GYE (Nunlist 2020, pp. 83–90). Grizzly bear use of these sites is monitored by the WGFD and IGBST. Climate change may affect army cutworm moths by changing the distribution of plants that the moths feed on or the flowering times of the plants (Woiwod 1997, pp. 152–153). However, the GYE plant communities have a wide elevational range that would allow for distributional changes (Romme and Turner 1991, p. 382), and army cutworm moths display foraging plasticity (Burton *et al.* 1980, pp. 12–13).

Whitebark Pine

Background on Whitebark Pine

While we discussed notable declines in whitebark pine due to mountain pine beetle in the 2007 final rule, the data used to estimate population growth only went through 2002. The Ninth Circuit Court of Appeals questioned our conclusions about future population viability based on data gathered before the sharp decline in whitebark pine began (*Greater Yellowstone Coalition, Inc.* v. *Servheen*, *et al.*, 665 F.3d 1015, 1030 (9th Cir. 2011)). To assess vital rates for grizzly bears in the GYE since 2002, the IGBST completed a comprehensive demographic review using data from 2002–2011 (IGBST 2012, p. 7) and extensive analyses to determine if the decline in whitebark pine is driving observed changes in grizzly bear population vital rates (IGBST 2013, entire).

The Service published a final rule to list whitebark pine as a threatened species under the Act on December 15, 2022 (87 FR 76882). This status is primarily the result of direct mortality due to white pine blister rust, but additional threats include mountain pine beetles, altered fire patterns, and climate change.

Whitebark pine is a masting species, which means it produces large seed crops in some years and poor crops in other years. In the GYE, a good seed crop occurs approximately every two to three years. During years of low availability of whitebark pine seeds, human-grizzly bear conflicts tend to increase as bears use lower elevations for foraging, and those areas tend to be within less secure habitats (Gunther *et al.* 2004, pp. 13–15; Schwartz *et al.* 2010a, pp. 661–662). Approximately six more independent females and six more independent males die across the ecosystem in poor versus good whitebark pine years (IGBST 2013, p. 25, Figure 5). These mortalities are primarily due to defense-of-life encounters and management removals of conflict bears (Gunther *et al.* 2004, pp. 13–14; IGBST 2009, p. 4). Additionally, litter size and the likelihood of producing a litter may decrease slightly in years following poor whitebark pine crops (Schwartz *et al.* 2006c, p. 21). Therefore, an important question was whether decline of whitebark pine would make most years similar to those years with poor seed crops. In this section we will discuss the Food Synthesis Report, past studies on whitebark pine and grizzly bear mortality, density-dependent effects, and the GYE grizzly bear's high diet diversity.

Food Synthesis Report

Using data from 2002 to 2011, the IGBST documented an average annual population growth rate for the GYE grizzly bear population between 0.3 and 2.2 percent (IGBST 2012, p. 34). Although the population was still increasing in this more recent time period, it was increasing at a slower rate than in the previous time period (1983–2001) and coincided with the rapid decline of whitebark pine that began in the early 2000s. Therefore, the IGBST examined the potential influence of whitebark pine decline on the change in population growth rate. Because extrinsic, density-independent factors (e.g., availability of whitebark pine seeds) and intrinsic, density-dependent factors (i.e., a population with high bear density) can produce similar changes in population vital rates, the IGBST conducted several analyses to clarify and tease apart these two similar effects. The results of these analyses were summarized in a report titled "Response of Yellowstone grizzly bears to changes in food resources: a synthesis" (hereafter referred to as "the Food Synthesis Report") (IGBST 2013, entire). Regardless of whether these changes in population vital rates are being driven by declines in whitebark pine or are simply an indication of the population reaching high densities, the management response would be the same: to carefully manage human-caused mortality based on scientific monitoring of the population.

For this Food Synthesis Report, the IGBST developed a comprehensive set of research questions and hypotheses to evaluate grizzly bear responses to changes in food resources. Specifically, the IGBST asked eight questions:

(1) How diverse is the diet of GYE grizzly bears?
(2) Has grizzly bear selection of whitebark pine habitat decreased as tree mortality increased?
(3) Has grizzly bear body condition decreased as whitebark pine declined?
(4) Has animal matter provided grizzly bears with an alternative food resource to declining whitebark pine?
(5) Have grizzly bear movements increased during the period of whitebark pine decline (2000–2011)?
(6) Has home range size increased as grizzly bears sought alternative foods, or has home-range size decreased as grizzly bear density increased?
(7) Has the number of human-caused grizzly bear mortalities increased as whitebark pine decreased?
(8) Are changes in vital rates during the last decade associated more with decline in whitebark pine resources than increases in grizzly bear density?

The preliminary answers to these questions are contained in the Food Synthesis Report and the final results have been published in peer-reviewed journals (in their entirety: Bjornlie *et al.*

2014a; Costello *et al*. 2014; Gunther *et al*. 2014; Schwartz *et al*. 2014a and 2014b; van Manen *et al.* 2016; Ebinger *et al.* 2016).

Key findings of the Food Synthesis Report and subsequent publications are summarized below. To address the first question about how diverse diets of grizzly bears in the GYE are, Gunther *et al.* (2014, entire) conducted an extensive literature review and documented over 260 species of foods consumed by grizzly bears in the GYE, representing four of the five kingdoms of life (for more information, see *Nutritional Ecology* above). Regarding the second research question, if whitebark pine seeds were highly selected over other fall foods, grizzly bears would continue to seek this food even if availability declined. However, Costello *et al.* (2014, p. 2013) found that grizzly bear selection of whitebark pine habitat and duration of use decreased between 2000 and 2011. Additionally, regarding the third research question, if grizzly bears were dependent on whitebark pine to meet their nutritional requirements, we would expect body condition to have decreased during that time. Schwartz *et al.* (2014a, p. 75) and the IGBST (2013, p. 18) found body mass and percent body fat in the fall had not changed from 2000 to 2010. When they examined trends in females only, the data showed a moderate decline in female body fat during the fall, starting around 2006 (Schwartz *et al*. 2014a, p. 72). However, they suggested it could be the result of small sample sizes (n = 2.6 bears/year) and noted the data for 2011 (not included in their published paper) showed an increase in fall body fat for females, ultimately cautioning that more data were needed before it could be determined if there was truly a trend (Schwartz *et al*. 2014a, p. 76). In the Food Synthesis Report, the IGBST revisited this previous analysis with data collected since 2010, and concluded that body condition was not different between poor and good years of whitebark pine production (IGBST 2013, p. 18). Furthermore, grizzly bear body fat levels and rate of body fat accumulation did not significantly change from 2000–2020, when availability of some high-calorie foods substantially declined (Corradini *et al.* 2023, pp. 10–12).

In response to the fourth research question, in years with poor whitebark pine seed production, grizzly bears shifted their diets and consumed more meat (Schwartz *et al.* 2014a, p. 68). These results were consistent with previous findings (Mattson 1997, p. 169). Given these observations of diet shifts, Ebinger *et al.* (2016, p. 705) examined whether grizzly bear use of ungulate carcasses in the fall had increased during the period of whitebark pine decline. This was indeed the case, supporting the interpretation that responses to changing food resources were primarily behavioral. In response to the fifth and sixth questions, if overall food resources were declining, one would expect daily movements, fall movements, and home range sizes to increase if bears were roaming more widely in search of foods. However, movement rates did not change during 2000 to 2011, suggesting that grizzly bears were finding alternate foods within their home range as whitebark pine seeds became less available over the past decade (Costello *et al.* 2014, p. 2013). For females, home ranges actually decreased in size from the period before (1989–1999) to the period after (2007–2012) whitebark pine decline. This decrease was greater in areas with higher grizzly bear densities but showed no relationship with the amount of live whitebark pine in the home range (Bjornlie *et al*. 2014b, pp. 4–6). Male home ranges did not change in size (Bjornlie *et al.* 2014b, pp. 4–6). Finally, at the population level, bear density, but not whitebark pine decline, was associated with lower cub survival and reproductive suppression, factors contributing to the slowing of population growth since the early 2000s. Combined, these findings suggest that changes in population vital rates since the early 2000s are more indicative of the population approaching carrying capacity than a shortage of resources (van Manen *et al.* 2016, p. 310).

In response to the seventh question, while land managers have little influence on how calories are spread across the landscape, we have much more influence on human-caused mortality risk. Consistent with findings from earlier studies, the IGBST (2013, p. 24) found that grizzly bear mortalities increased in poor whitebark pine seed production years as compared to good whitebark pine seed production years. Assuming the poorest observed whitebark pine cone production, the IGBST (2013, p. 25) predicted an increase of 10 annual mortalities ecosystem-wide of independent females comparing 2000 with 2012, encompassing the period that coincided with whitebark pine decline (IGBST 2013, p. 25). The greatest increase in predicted mortality occurred outside the recovery zone, which may be partially attributable to range expansion and continued population increase (IGBST 2013, p. 25). However, increased mortality numbers during poor whitebark pine cone production years have not led to a declining population trend (IGBST 2012, p. 34), and total mortality will be maintained within the total allowable mortality limits (see *Mortality Limits* above for further details).

In response to the eighth question, the IGBST found that while whitebark pine seed production can influence reproductive rates the following year, overall fecundity rates during the last decade (2002–2011) did not decline when compared with data from 1983–2001 (IGBST 2013, p. 32). This is important because fecundity rates are a function of both litter size and the likelihood of producing a litter, the two ways in which whitebark pine seed production may affect reproduction. Although Schwartz *et al.* (2006a, p. 21) found one-cub litters were more common in years following poor whitebark pine seed production, one-cub litters are still adequate for population growth. Furthermore, one-cub litters are still relatively uncommon following poor whitebark pine years, as evidenced by a very consistent average litter size around two cubs since the IGBST began reporting this metric. Fecundity and mean litter size did not change between the two monitoring periods (1983–2001 versus 2002–2011) examined by the IGBST even though the availability of whitebark pine seeds declined (IGBST 2013, pp. 33–34).

Past Studies on Whitebark Pine and Grizzly Bear Mortality

In contrast to previous studies that concluded increased mortality in poor whitebark pine cone production years led to population decline in those years (Pease and Mattson 1999, p. 964), the IGBST found the population did not decline despite increased mortality in poor whitebark pine cone production years. Therefore, we determined that the conclusions of Pease and Mattson (1999, p. 964) are inaccurate. First and foremost, estimating population growth for individual, non-consecutive years, as Pease and Mattson (1999, p. 962) did, is "not legitimate" and results in an "incorrect estimate" (Eberhardt and Cherry 2000, p. 3257). Even assuming their methods of separating out individual, non-consecutive years of data for a species whose reproduction and survival are inextricably linked to multiple, consecutive years (e.g., reproductive status in 1 year affects status in the following year), many other aspects of their analysis do not reflect the best available science. An important difference between Pease and Mattson (1999, p. 964) and other population growth rate estimates (Eberhardt *et al*. 1994, p. 362; Boyce 1995, entire; Schwartz *et al*. 2006c, p. 48; IGBST 2012, p. 34) is related to their treatment of conflict bears. Pease and

Mattson (1999, p. 967) assumed that grizzly bears with any history of conflict would experience lower survival rates associated with conflict bears for the rest of their lives.

The findings of Schwartz *et al*. (2006c, p. 42) challenge this assumption, finding that while survival of conflict bears decreases during the year of the conflict and the next year, survival returns to approximately normal within 2 years. In other words, management-trapped bears often return to foraging on naturally occurring food sources without causing conflict. Another assumption made by Pease and Mattson (1999, p. 967) was that 73 percent of the GYE grizzly bear population were conflict bears, with correspondingly lower survival rates. However, Schwartz *et al*. (2006c, p. 39) found only about 28 percent of the GYE grizzly bear population were ever involved in conflicts. Together, these two erroneous assumptions by Pease and Mattson (1999, p. 967) resulted in a gross underestimation of population trend. Empirical trend data based on the two most recent decades of data refute their conclusions (Haroldson *et al.* 2021b, p. 18). As a result, we do not consider Pease and Mattson (1999, entire) to be the best available science.

Earlier studies suggested that increased grizzly bear mortalities in poor whitebark pine cone production years are a result of bears roaming more widely in search of foods and exposing themselves to higher mortality risk in roaded habitats at lower elevations. However, Costello *et al.* (2014, p. 2014) showed that grizzly bears did not roam over larger areas or canvas more area within their fall ranges as whitebark pine declined rapidly starting in the early 2000s, and suggested bears found alternative foods within their fall ranges. Furthermore, Bjornlie *et al.* (2014b, p. 4) found that home range size has not increased after whitebark pine declined. In addition, Schwartz *et al.* (2010a, p. 662) found that when bears use lower elevations in poor whitebark pine seed production years, it is the amount of secure habitat that determines mortality risk: in both good and poor whitebark pine seed years, survival is determined primarily by levels of secure habitat. Therefore, our approach of maintaining these levels of secure habitat on Federal lands, which comprise 98 percent of lands within the recovery zone and 59 percent of suitable habitat outside the recovery zone, provides effective mitigation against any impacts the decline of whitebark pine may have on this grizzly bear population because the mechanism driving the increased mortality risk is secure habitat, not the presence or absence of whitebark pine, or their seed production.

While there was some concern that the rapid loss of whitebark pine could result in mortality rates similar to those experienced after the open-pit garbage dumps were closed in the early 1970s (Schwartz *et al.* 2006c, p. 42), we now know this has not been the case. This is most likely due to the fact that whitebark pine has never been a spatially or temporally predictable food source on the landscape like the open-pit garbage dumps were. The dumps were open year-round and provided high-calorie foods the entire time. They were in the exact same location every year and for the entire season. Grizzly bears congregated at these known locations in large numbers and in very close proximity to each other and to people. None of these circumstances are true for grizzly bears foraging on whitebark pine seeds.

Density-Dependent Effects

Evidence suggests that observed changes in population vital rates were driven by density-dependent effects and resulted in slowed population growth starting in the early 2000s (Gould *et al*. 2024a, p. 13). van Manen *et al.* (2016, entire) found cub survival, yearling survival, and reproductive transition (i.e., transition probability[12]) from no young to cubs all changed from 1983 to 2012, with lower rates evident during the last 10 years of that time period. Cub survival and reproductive transition were negatively associated with an index of grizzly bear density, indicating greater declines of those parameters where bear densities were higher. Their analysis did not support a similar relationship with estimates of decline in whitebark pine tree cover. Moreover, changes in vital rates started in the late 1990s and early 2000s (van Manen *et al.* 2016, pp. 307–308), which preceded the beginning and peak time period of whitebark pine decline. The results of van Manen *et al.* (2016, entire) support the interpretation that slowing of population growth during the last decade was associated more with increasing grizzly bear density than the decline in whitebark pine. More recently, Corradini *et al.* (2023, entire) analyzed data from a 21-year period (2000–2020) that encompassed multiple environmental changes, including the decline in cutthroat trout and whitebark pine. As population density increased, individual lean body mass decreased but body fat levels and rate of accumulation remained constant, indicating the dietary plasticity of grizzly bears (Corradini *et al.* 2023, pp. 10–11).

GYE Grizzly Bears' High Diet Diversity

GYE grizzly bears have high diet diversity (Gunther *et al.* 2014, p. 65) and use alternate foods in years of low whitebark pine seed production (Schwartz *et al.* 2014a, pp. 75–76). Nearly one third of grizzly bears in the GYE do not have whitebark pine in their home range, so they do not use this food (Costello *et al.* 2014, p. 2013). Grizzly bears in the GYE that do use whitebark pine are accustomed to successfully finding alternative natural foods in years when whitebark pine seeds are not available, and body mass and body fat are not different between good and poor whitebark pine seed years (Schwartz *et al.* 2014a, pp. 72–73, 75).

Grizzly bears are resourceful omnivores that will make behavioral adaptations regarding food acquisition (Schwartz *et al.* 2014a, p. 75). Diets of grizzly bears vary among individuals, seasons, years, and where they reside within the GYE (Mealey 1980, pp. 284–287; Mattson *et al.* 1991a, pp. 1625–1626; Felicetti *et al.* 2003, p. 767; Felicetti *et al.* 2004, p. 499; Koel *et al.* 2005, p. 14; Costello *et al.* 2014, p. 2013; Gunther *et al.* 2014, pp. 66–67), reflecting their ability to find adequate food resources across a diverse and changing landscape. In other nearby areas such as the NCDE (100 miles north of the GYE), whitebark pine has been functionally extinct as a bear food for at least 40 years (Kendall and Keane 2001, pp. 228–232), yet the NCDE grizzly bear population has continued to increase and thrive with an estimated 765 bears in 2004, and a subsequent average 2.3 percent annual rate of growth (Kendall *et al.* 2009, p. 9; Costello *et al.* 2016b, p. 2; Costello 2018, *in litt.*). Similarly, although whitebark pine seed production and availability of cutthroat trout in the Yellowstone Lake area varied dramatically over the last

[12] Transition probability: The probability of a transition for an adult female (greater than 3 years old) among reproductive states. The possible reproductive states are: no young, with cubs-of-the-year, or with 2-years-olds. Ten potential reproductive transitions are biologically feasible.

3 decades due to both natural and human-introduced causes (Reinhart and Mattson 1990, pp. 345–349; Podruzny *et al*. 1999, pp. 134–137; Felicetti *et al.* 2004, p. 499; Haroldson *et al*. 2005, pp. 175–178; Haroldson 2015, p. 47; Teisberg *et al*. 2014, pp. 375–376), the GYE grizzly bear population has continued to increase and expand during this time period despite these changes in food availability (Schwartz *et al.* 2006a, p. 66; IGBST 2012, p. 34; Bjornlie *et al.* 2014a, p. 184).

The GYE grizzly bear population has been coping with the unpredictable nature of whitebark pine seed production for millennia. Grizzly bears are not dependent upon whitebark pine seeds for survival, nor do they have a diet that is specialized on consumption of these seeds. Whitebark pine seed production can influence reproductive and survival rates; however, decline of whitebark pine seed production has not caused a negative population trend, as evidenced by continuing positive population growth since the early 2000s, albeit at a lower rate compared with the 1990s (Gould *et al.* 2024a, p. 13). As articulated in the Food Synthesis Report by the IGBST (IGBST 2013, pp. 32–35) and supporting studies (in their entirety: Bjornlie *et al*. 2014b; Costello *et al.* 2014; Gunther *et al.* 2014, Corradini *et al.* 2023), the demonstrated resiliency to declines in whitebark pine seed production and other high-calorie foods such as cutthroat trout shows that changes in food resources are not likely to become substantial impediments to the long-term viability of the GYE grizzly bear population.

Food Resources in the NCDE

The NCDE is comprised of a highly diverse landscape containing a wide array of habitat types and bear foods. Plant communities vary from mixed grass prairie, grain fields, and hay fields on the eastern foothills to extensive conifer forests at mid-elevation to subalpine and alpine meadows at high elevations. In the NCDE, historical grizzly bear presence was less common in prairie habitats (i.e., those areas outside the DMA) and was associated with rivers and streams where grizzly bears used bison carcasses as a major food source (Rollins 1935, p. 191; Wade 1947, p. 444; Burroughs 1961, pp. 57–60; Herrero 1972, pp. 224–227; Stebler 1972, pp. 297–298; Mattson and Merrill 2002, pp. 1128–1129). Most of the shortgrass prairie on the east side of the Rocky Mountains has been converted into agricultural land (Woods *et al.* 1999, entire), and high densities of traditional food sources (i.e., bison) are no longer available due to land conversion and human occupancy of urban and rural lands. Traditional food sources such as bison and elk have been reduced and replaced with domestic livestock such as cattle, sheep, chickens, goats, pigs, and beehives, which can become anthropogenic food sources for grizzly bears. Historically, grizzly bears on the prairie also fed on grasses, berries, and forbs commonly associated with riparian areas, which they continue to do today (Herrero 1972, p. 224; Stebler 1972, p. 299).

Grizzly bears are successful omnivores, and in many areas of the NCDE are almost entirely herbivorous (Kendall 1986, p. 12; Jacoby *et al.* 1999, pp. 924–927; Schwartz *et al.* 2003b, pp. 568–569; Teisberg *et al.* 2015, pp. 10–12). Using observed ratios of stable isotopes in food items, it is possible with sufficient sample sizes to infer information about assimilated diets of grizzly bears (Robbins *et al*. 2004, pp. 162–164). Stable isotope analysis indicates that grizzly bear consumption of animal matter has remained relatively constant within the NCDE over the last several decades. Animal matter comprises a larger percentage of adult male grizzly bear diets (60%) than adult females (35%) and subadults (46%) (Teisberg *et al.* 2015, p. 10). There was high variation across the ecosystem with bears on the southwestern, southern, and eastern periphery having higher levels of dietary animal matter and bears in the northwestern and interior periphery having lower levels of dietary animal matter (Teisberg *et al.* 2015, Figure 2). Grizzly bears on the East Front consumed the highest proportions of animal matter at 71 percent while the lower Swan River and lower South Fork of the Flathead had the lowest proportions of animal matter at 21 percent (Teisberg *et al.* 2015, p. 11). These findings are consistent with previous studies completed in the 1980s, 1990s, and early 2000s (Aune and Kasworm 1989, pp. 64–72; Jacoby *et al.* 1999, pp. 924–927; Mowat and Heard 2006, pp. 477–482), and indicate that NCDE grizzly bear consumption of animal matter has not varied greatly throughout the decades. Chronic wasting disease is fatal to deer and elk and has recently been detected in the NCDE. Although chronic wasting disease would not likely result in local extinction of deer or elk populations, population levels may decline and the State of Montana is monitoring for prevalence and impacts to ungulate herds (Schauber and Woolf 2003, pp. 611–612; Galloway *et al.* 2021, pp. 6–12; MFWP 2023a, entire).

Upon den emergence, bears in the NCDE may search avalanche chutes for animal carcasses and spring forage before descending to lower elevations seeking newly emerging vegetation. From den-emergence until early summer, grizzly bears typically subsist on the roots of sweet vetches (*Hedysarum* spp.), biscuit root (*Lomatium* spp.), glacier lilies (*Erythonium grandiflorum*) and western spring beauty (*Claytonia lanceolata*); berries from the previous year's crop of bearberry (*Arctostaphylos uva-ursi*); vegetation from grasses, sedges, cow parsnip (*Heracleum* spp.), and angelica (*Angelica* spp.); and deer (*Odocoileus* spp.), elk, or domestic livestock in the form of neonate fawns or calves and carrion resulting from winter related die-off and calving season mortality (Servheen 1981, pp. 99–102; Kendall 1986, pp. 15–16; Mace and Jonkel 1986, p. 108; Martinka and Kendall 1986, p. 22; LeFranc *et al.* 1987, pp. 111–114; Aune and Kasworm 1989, pp. 65–66). During summer, before berry crops are available, bears in the NCDE may eat the roots of western spring beauty and glacier lilies and the vegetation of *Ligusticum* species, sweet cicely (*Osmorhiza* spp.), grasses, *Equisetum* species, cow parsnip (*Heracleum lanatum*), and *Angelica* species (LeFranc *et al.* 1987, pp. 111–114; Aune and Kasworm 1989, pp. 65–66; McLellan and Hovey 1995, p. 708). Consumption of insects, especially ants, peaks during summer months. Many bears also begin to feed on army cutworm moths (*Euxoa auxiliaris*) in GNP from late June through mid-September (White *et al.* 1998, p. 223; Peterson 2022, pp. 59, 77–84). In the Mission Mountains, grizzly bears may feed on army cutworm moths and ladybird beetles (*Coccinnella* spp.) from the beginning of July through the end of August (Chapman *et al.* 1955, entire; Servheen 1983, p. 1031). Grizzly bears have also been observed feeding on army cutworm moths in the Scapegoat Wilderness (Sumner and Craighead 1973, p. 21) and the Rocky Mountain Front of Montana (Aune and Kasworm 1989, p. 70). Once berries become available, bears in the NCDE may consume huckleberries (*Vaccinium* spp.), soap berries (*Shepherdia canadensis*), service berries (*Amelanchier alnifolia*), hawthorn berries *(Crataegus douglasii*), and choke cherries (*Prunus* spp.); and to a lesser degree alderleaf buckthorn berries (*Rhamnus alnifolia)* and mountain ash berries (*Sorbus* spp.) (Servheen 1981, p. 101; Kendall 1986, pp. 12, 15–16; Mace and Jonkel 1986, p. 108; Martinka and Kendall 1986, p. 21; LeFranc *et al.* 1987, p. 111; McLellan and Hovey 1995, pp. 706–707). The amount and species of berries in bear diets vary annually based on annual fruit production and distributions (McLellan and Hovey 1995, pp. 706–707).

During late summer to fall, bears in the NCDE may continue to eat berries but will also consume more animal matter (mostly from hunter gut piles and hunter-wounded animals) and the roots/bulbs/corms of sweet vetches and biscuit roots (Kendall 1986, pp. 15–16; Mace and Jonkel 1986, p. 108; Martinka and Kendall 1986, p. 22; LeFranc *et al.* 1987, pp. 112–114; Aune and Kasworm 1989, pp. 64–72; McLellan and Hovey 1995, pp. 706–708). While the roots of sweet vetches are used by grizzly bear populations in Canada, Alaska, GNP, and the northern reaches of the lower-48 States during spring and fall (Hamer and Herrero 1987a, p. 205; LeFranc *et al.* 1987, pp. 112–114; McLellan and Hovey 1995, pp. 706–708; Munro *et al.* 2006, p. 1115), where *Hedysarum* is less common in the southern and eastern edges of the recovery zone, grizzly bears can consume biscuit roots and glacier lily bulbs instead (LeFranc *et al.* 1987, pp. 112–114; Aune and Kasworm 1989, pp. 64–72).

Prior to the spread of white pine blister rust (*Cronartium ribicola*) in the NCDE, grizzly bears opportunistically fed on whitebark pine seeds in the late summer through fall, primarily in the Whitefish Mountain range and along the Rocky Mountain Front (Shaffer 1971, pp. 39, 76, 78; Mace and Jonkel 1986, pp. 107–109; Aune and Kasworm 1989, pp. 64–72; Kendall and Arno 1990, pp. 264–265; Schwartz *et al.* 2003b, pp. 568–569). By the early to mid-1990s however, 42 to 58 percent of all trees surveyed were dead and 48 to 83 percent of the remaining live trees surveyed showed signs of blister rust infection within the NCDE (Kendall and Keane 2001, pp. 228–232). By 2006, nearly 75 percent of whitebark pine trees were dead and of the remaining live trees, 90 percent were affected by blister rust (Fiedler and McKinney 2014, p. 290). Due to this widespread mortality from blister rust, whitebark pine has been functionally extinct as a food resource for grizzly bears for the past 40 years (Kendall and Keane 2001, pp. 228–232). Despite this loss, during this same period, the NCDE grizzly bear population thrived and increased from as few as 300 grizzly bears in 1986 to an estimated 765 bears in 2004 (Kendall *et al.* 2009, p. 9), and a subsequent average 2–3 percent annual growth rate (Mace *et al.* 2012, p. 124; Costello *et al.* 2016b, p. 2).

Body fat content is measured for captured grizzly bears in the NCDE (Teisberg 2020, *in litt.*). As noted in the GYE, CYE, and SE, body fat varies by month, exhibiting a trend that is presumably dependent on denning and availability and quality of foods consumed during the active season (Schwartz *et al.* 2014a, p. 72; Kasworm *et al.* 2024a, pp. 61–64). For data from 2010–2017, adult males had significantly higher body fat content than subadult grizzly bears and adult females (Teisberg 2020, *in litt.*). Body fat content for NCDE grizzly bears also differed by month. October–November body fat values were significantly higher than those in all other months, and September fat values were higher than those in June and July. Upon den emergence, grizzly bears continue to lose body fat and start gaining fat as early as July. Body fat content is highest in the fall period prior to hibernation, suggesting that habitat and food resources are available to allow for body fat gain. In addition, fall levels for females are well above the minimum pre-denning body fat to produce cubs suggested by Robbins *et al.* (2012, p. 543).

Food Resources in the CYE and SE

The CYE and SE are both within the Rocky Mountains and are characterized by a Pacific maritime-continental climate, with wet, forested mountains. Mixed coniferous and deciduous tree stands are interspersed with riparian shrub fields and wet meadows along major drainages. Mixed shrub fields contain many species of berries, including huckleberries, buffaloberry (*Sheperdia canadensis*), and mountain ash. Understory and non-forested include graminoid parks. The small size of the CYE and SE provide a narrower range of habitats than the GYE and NCDE, and as a result may limit the diversity of foods available. In addition, their densely forested habitats may support less dense populations of ungulates and therefore ungulates may be less available as a food source. Chronic wasting disease is fatal to deer and elk and has recently been detected in portions of the CYE and SE in the States of Idaho, Montana, and Washington. Although chronic wasting disease would not likely result in local extinction of deer or elk populations, population levels may decline and the States of Idaho, Montana, and Washington are monitoring for prevalence and impacts to ungulate herds (Schauber and Woolf 2003, pp. 611–612; Galloway *et al.* 2021, pp. 6–12; IDFG 2021, entire; MFWP 2023a, entire; WDFW 2024, entire).

In the CYE, seasonal consumption of food resources was estimated based on scat analysis (Kasworm *et al.* 2024a, pp. 56–57). Upon den emergence in April and May, graminoids (i.e., grasses and sedges) and meat, presumably from winter-killed deer and moose, constituted 40 percent of the dry mater consumed. The use of forbs, such as cow parsnip, clover (*Trifolium* spp.), and dandelion (*Taraxacum officinale*) increased in June, but grasses and sedges were still the main food resource. As graminoids begin to cure in July they provide less digestible nutrition and the amount of grasses and sedges decreased while forbs increased, mainly cow parsnip. Grizzly bears began to feed upon berries (huckleberry, whortleberry, and serviceberry) and insects (mainly ants) in July as they became available. Berries were the primary food consumed in August and September; however, consumption of animal matter (elk, deer, and moose) began to increase in September and was the primary food consumed in October. This consumption correlates with the hunting season and consumption may involve entrails left by hunters or wounded animals. The SE has similar vegetation types, and we assume that food habitats are similar to that in the CYE.

Stable isotope analysis was used to investigate the proportion of animal matter and vegetation in grizzly bear diets in the CYE and SE (Kasworm *et al.* 2024a, p. 55; Kasworm *et al.* 2024b, p. 39). In the CYE, grizzly bears in the Yaak contained nearly 22 percent animal matter whereas grizzly bears in the Cabinets contained only about 13 percent. In addition, males in the Cabinets made greater use of animal matter than females (24 percent and 10 percent animal matter, respectively). Grizzly bears in the SE consumed less animal matter than the in CYE with an estimated 12 percent animal matter. Both males and females exhibited a shift in diet from spring to fall, consuming nearly double the animal matter in the fall.

Body fat content is measured for captured grizzly bears in the CYE and SE (Kasworm *et al.* 2024a, pp. 61–64). As noted in the GYE and NCDE, body fat varies by month, exhibiting a trend that is presumably dependent on denning and availability and quality of foods consumed during the active season (Schwartz *et al.* 2014a, p. 72). Male and female grizzly bears did not differ in their body fat content. Upon den emergence, grizzly bears continue to lose body fat and start gaining fat as early as July. Body fat content is highest in the fall period prior to hibernation, suggesting that habitat and food resources are available to allow for body fat gain.

In addition, fall levels for females are well above the minimum pre-denning body fat to produce cubs suggested by Robbins *et al.* (2012, p. 543).

Food Resources in the BE

The climate in the BE varies from warm and dry in the southern portion to cool and moist in subalpine areas. Low elevations are predominately grasslands, which with increasing elevation give way to open ponderosa pine types, subalpine fir, and several types of lodgepole pine, and near-alpine habitat at the highest elevational areas. Plentiful ungulates, including elk, mule deer, and white-tailed deer, occur throughout the BE during summer and fall (Service 2000, p. 3-11). Davis and Butterfield (1991, entire) did a comprehensive evaluation of habitat centered around the Frank Church-River of No Return Wilderness north of the Salmon River, the Selway-Bitterroot Wilderness, and Roadless areas north of the Selway-Bitterroot Wilderness mostly in the North Fork Clearwater drainage to the crest of the Mallard Larkins Mountains. In the area they evaluated, a wide variety of vegetation types were identified that were well distributed throughout the area and are comparable to occupied habitat in other grizzly bear ecosystems (Davis and Butterfield 1991, pp. 29–320). They concluded that these habitats would support adequate sources of known grizzly bear foods, including elk and deer, small mammals, herbaceous vegetation and tubers, and fruits and nuts (Davis and Butterfield 1991, pp. 32–40). The southern part of the BE recovery zone is drier and less productive and was not included in the analysis done by Davis and Butterfield (1991, entire). The final EIS for Grizzly Bear Recovery in the BE concluded that although the forb and berry production in these dry habitats is relatively low, the southern half of the BE recovery zone contains substantial stands of whitebark pine as well as populations of elk and deer that can provide food for grizzly bears (Service 2000, p. 3-20). Hogg *et al.* (1999, entire; Service 2000, p. 3-23) determined that bear foods in the form of primary and secondary berries are present in biologically significant amounts in both the northern and southern portions of the ecosystem, but generally decline in abundance moving from north to south. In contrast, whitebark pine tend to follow the opposite pattern with greater abundance and distribution south of the Salmon River and a general decline through the northern portions of the BE (Service 2000, Appendix 21, Figure 6-15).

The diet of grizzly bears that recolonize the BE will likely differ somewhat from historical diets. Current runs of anadromous fish would no longer provide a readily abundant food source and would be supplemental at best; however, other fish species such as cutthroat trout and kokanee salmon may provide supplemental food for grizzly bears (Brostrom 1996, as cited in Service 2000, p. 3-16). Prior to the most recent outbreak of mountain pine beetle, Keane and Arno (1996, p. 52) estimated whitebark pine to be at 20–40 percent of historical levels because of mortality from white pine blister rust. Davis and Butterfield (1991, p. 39) concluded that whitebark pine is still consistently present in the non-riparian subalpine habitats and may still be an important fall food source for grizzly bears that recolonize the BE. However, more recent data from the national forest inventory data suggests that blister rust and mountain pine beetle infestation rates have led to increased mortality of whitebark pine and subsequently reduced the availability of whitebark pine seeds since 2000 (Goeking and Izlar 2018, p. 4) to a level comparable to that in the GYE. However, data are currently not available to assess potential local impacts to availability to grizzly bears in the BE as a food resource.

Food Resources in the North Cascades

The North Cascades provides a variety of habitat types from temperate rainforests of the west side to the dry ponderosa pine forests and sage-steppe on the east side. The area provides a range of elevations from low elevation old growth forest to subalpine meadows to alpine environments. Grizzly bears in ecosystems with similar food economies to the North Cascades have been shown to rely heavily on herbaceous vegetation, graminoids, forbs, berries, and roots, depending on the season (McLellan and Hovey 1995, pp. 706–708; Munro *et al.* 2006, p. 1115). In these similar habitat types in west-central Alberta, Canada upon den emergence in early spring, grizzly bears dig for roots before beginning to hunt ungulates in late May and early June. Avalanche chutes, common on the west side of the North Cascades, have been identified as important spring food sources for grizzly bears in a number of studies (Waller and Mace 1997, pp. 1034–1037; Ramcharita 2000, p. 15; McLellan and Hovey 2001, pp. 96–97). Avalanche chutes provide spring and summer forage species as well as potential avalanche mortalities (carrion) in the spring (Waller and Mace 1997, p. 1034–1037). As herbaceous vegetation begins to green up, the predominant food items include grass-like plants and forbs. Grizzly bears shift to eating berries as they become available later in the summer. At the end of the berry producing period, grizzly bears again shift to consuming roots and ungulates prior to reentering their dens (McLellan and Hovey 2001, pp. 96–97). Data from the CYE (Kasworm *et al.* 2024a, p. 56), may be indicative of potential grizzly bear food habitats in the central and west side of the Cascade Mountains due to the similar Pacific maritime climate.

In addition, Almack *et al.* (1993, entire) and Gaines *et al.* (1994, entire) produced vegetation cover maps of the study area according to vegetation structure (e.g., forest, shrub, barren rock, etc.) and community composition. Analysis of the vegetation maps indicate that 100 of the 124 plant species known to be grizzly bear foods in other ecosystems exist in the study area. In addition, they found that ungulates were dispersed relatively evenly throughout the study area. Results led both teams to conclude that sufficient vegetative grizzly bear foods are readily available in the North Cascades, and the occurrence of wildlife prey species could sustain a grizzly bear population (in their entirety: Almack *et al.* 1993; Gaines *et al.* 1994; Lyons *et al.* 2018).

Several salmon species occur in the North Cascades, although current distribution is limited to lower elevation streams on the western slope of the North Cascades and occur at much lower levels than what was historically available. Most bears would not have access to salmon and would likely feed almost exclusively on terrestrial foods. Black bears catch live fish as well as consume spawned carcasses where available, but fish are not a resource throughout most of the ecosystem. Grizzly bears would likely feed almost exclusively on terrestrial foods, as black bears do currently. However, grizzly bears introduced into the North Cascades with no history of salmon consumption may be susceptible to salmon poisoning disease (Robbins *et al*. 2018, entire). Salmon poisoning disease is a potentially fatal condition caused by infective bacterium. Ongoing studies, including prevalence in the recovery area, are looking into whether this could be an impediment to grizzly bear recovery in the North Cascades.

Summary of Food Resources

There are no indications that long-term trends in food availability, other than whitebark pine nuts, cutthroat trout, and salmon, have changed in the GYE, NCDE, CYE, SE, BE, and North Cascades in the last several decades. Although grizzly bears in the GYE have experienced a decline in the availability of whitebark pine nuts and cutthroat trout, bears are finding sufficient alternative food resources to maintain body condition. While salmon abundance is reduced in the BE and North Cascades compared to historical numbers, several studies have concluded that there are sufficient alternative foods to maintain grizzly bear populations in those ecosystems. We anticipate that grizzly bears will be able to adapt to any future potential changes in individual food sources because of the great plasticity of grizzly bear diets and the range of available foods. Thus, the highly omnivorous and flexible diet of grizzly bears will enable the species to adapt to future changes in food availability. It is also clear that grizzly bears can compensate for changes in the availability of food as long as there is sufficient habitat security. In addition, the varying climate, topography, and vegetative conditions within the ecosystems provide a variety of habitats with foods grizzly bears can consume.

Potential Effects of Climate Change

We evaluated observed or likely future environmental changes resulting from ongoing and projected changes in climate. Effects related to climate change may result in a number of changes to grizzly bear habitat, including: a reduction in snowpack levels (McKelvey *et al*. 2011, entire; Schwartz *et al*. 2016, p. 317; Livneh and Badger 2020, pp. 453–454), which may shorten the denning season (Leung *et al.* 2004, pp. 93–94) or shift denning times (Craighead and Craighead 1972, pp. 33–34; Van Daele *et al.* 1990, p. 264; Haroldson *et al.* 2002, pp. 34–35); shifts in the abundance and distribution of some natural food sources (Rodriguez *et al.* 2007, pp. 41–42); and changes in fire regimes (Nitschke and Innes 2008, p. 853; McWethy *et al.* 2010, p. 55).

Background on Climate Change

As defined by the Intergovernmental Panel on Climate Change (IPCC), the term “climate” refers to the mean and variability of relevant quantities (e.g., temperature, precipitation, snowpack, etc.) over time (IPCC 2023a, p. 4), with 30 years being a typical period for averaging such measurements. The term “climate change” thus refers to a change in the state of the climate that can be identified by changes in the mean or the variability of relevant properties, which persists for an extended period, typically decades or longer, due to natural conditions (e.g., solar cycles or volcanic eruptions), or human-caused changes in the composition of the atmosphere or in land-use (IPCC 2023a, p. 4).

Scientific measurements spanning several decades demonstrate that changes in climate are occurring. In particular, warming of the climate system is unequivocal, and many of the observed changes since the 1970s are unprecedented over many centuries to millennia (IPCC 2023b, p. 11). The current rate of climate change may be as fast as any extended warming period over the past 65 million years and is projected to accelerate over the 21st century (National Research Council 2013, p. 5). Thus, rapid climate change is adding to other sources of extinction pressures, such as land-use and human-caused mortality, which will likely place extinction rates in this era among just a handful of the severe biodiversity crises observed in Earth's geological record (American Association for the Advancement of Sciences 2014, p. 17; Ceballos and Ehrlich 2023, entire).

Examples of various other observed and projected changes in climate and associated effects and risks, and the bases for them, are provided for global and regional scales in recent reports issued by the IPCC (in their entirety: 2021, 2023b), and similar types of information for the United States and regions within it are available via the National Climate Assessment (USGCRP 2018, entire). Results of scientific analyses presented by the IPCC show that human activities, primarily through emissions of greenhouse gases, have caused global warming (*high confidence*[13], IPCC 2023b, pp. 6–8).

Scientists use a variety of climate models, which include consideration of natural processes and variability, as well as various scenarios of potential levels and timing of greenhouse gas emissions, to evaluate the causes of changes already observed and to project future changes in temperature and other climate conditions. Model results yield very similar projections of average global warming in the near-term (2021 to 2040; IPCC 2023b, pp. 62–63), and thereafter the magnitude and rate of warming vary through the end of the century depending on the assumptions about human population levels, emissions of greenhouse gases, and other factors that influence climate change. Thus, absent deep and rapid stabilization of greenhouse gas emissions at a global level, there is strong scientific support for projections that warming will continue through the 21st century, and that the magnitude and rate of change will be influenced substantially by human actions regarding greenhouse gas emissions (IPCC 2021, entire; IPCC 2023b, pp. 48–51).

Global climate projections are informative, and, in some cases, the only or the best scientific information available for us to use. However, projected changes in climate and related impacts can vary substantially across and within different regions of the world (IPCC 2021 and 2023b, entire), and within the U.S. (Melillo *et al.* 2014, entire; Hayhoe et al. 2018, pp. 86–91). Therefore, we reference "downscaled" projections when they are available and have been developed through appropriate scientific procedures, because such projections provide higher resolution information that is more relevant to spatial scales used for analyses of a given species (see Glick *et al*. 2011, pp. 58–61, for a discussion of downscaling).

Hydrology

The western United States may experience milder, wetter winters with warmer, drier summers and an overall decrease in snowpack (Leung *et al.* 2004, pp. 93–94; Joyce *et al.* 2018, pp. 20–22;

[13] From IPCC 2023b, p. 4, "Each finding is grounded in an evaluation of underlying evidence and agreement. A level of confidence is expressed using five qualifiers: very low, low, medium, high and very high, and typeset in italics, for example, *medium confidence*. The following terms have been used to indicate the assessed likelihood of an outcome or result: virtually certain 99–100% probability; very likely 90–100%; likely 66–100%; more likely than not >50-100%; about as likely as not 33–66%; unlikely 0–33%; very unlikely 0–10%; and exceptionally unlikely 0–1%. Additional terms (extremely likely 95–100%; more likely than not >50–100%; and extremely unlikely 0–5%) are also used when appropriate. Assessed likelihood also is typeset in italics: for example, *very likely*. This is consistent with AR5. In this Report, unless stated otherwise, square brackets [x to y] are used to provide the assessed *very likely* range, or 90% interval."

McKelvey *et al.* 2011, entire; Schwartz *et al*. 2016, p. 317; Livneh and Badger 2020, pp. 453–454). While some climate models do not demonstrate significant changes in total annual precipitation for the western United States (Duffy *et al.* 2006, p. 893), an increase in "rain on snow" events are expected (Leung *et al.* 2004, p. 93; McWethy *et al.* 2010, p. 55). The amount of snowpack and the timing of snowmelt may also change, with an earlier peak stream flow each spring (Cayan *et al.* 2001, p. 410; Leung *et al.* 2004, p. 75; Stewart *et al.* 2004, pp. 223–224). While there is regional variability in anticipated losses of spring snow, for all regions losses are greatest at the locations where historical temperatures are nearest 0°C, and projected increases to temperature are expected to increase the frequency of winter and early-spring periods that exceed 0°C (Livneh and Badger 2020, pp. 453–454). Additionally, spring snow droughts (abnormally low snowpack) have become more prevalent, intensified, and lengthened across the western U.S. from 1980 to 2018 (Huning and AghaKouchak 2020, pp. 19754–19755). Interannual variability in snowpack is expected to continue to change in the future, with an increase in the frequency of spring snow droughts in the western U.S. (Marshall *et al*. 2019, p. 8885). The increase in the number of consecutive years of snow droughts will likely be greatest in the maritime regions of the Cascades, as well as the lower elevations of the Northern Rocky Mountains (Marshall *et al*. 2019, p. 8885). Although there is some disagreement about changes in the water content of snow under varying climate scenarios (Duffy *et al.* 2006, p. 893), reduced runoff from decreased snowpack could translate into decreased soil moisture in the summer (Leung *et al.* 2004, p. 75). Conversely, Goeking and Tarboton (2020, pp. 180–183) conducted a literature review and found that hydrologic responses to stand replacing and nonstand-replacing disturbances have varied positive, neutral, or negative responses.

The hydrologic regime in the Rocky Mountains has changed and is projected to change further (Bartlein *et al.* 1997, p. 786; Cayan *et al.* 2001, p. 411; Leung *et al.* 2004, p. 75; Stewart *et al.* 2004, pp. 223–224; Pederson *et al.* 2011, p. 1666). Despite the need for improved local water yield modeling, Pederson *et al.* (2011, p. 1682) found that increased spring precipitation in the northern Rocky Mountains is thus far offsetting impacts to total annual stream flow from expected declines in snowpack.

There are many other aspects of snow that are predicted to change as the climate warms. These include: changes in snow dynamics that modify microclimates and refugia potential (Marshall *et al*. 2019, p. 8883; Morelli *et al*. 2020, p. 232), frequency of rain-on-snow events (Musselman *et al*. 2018, p. 808), frequency of extreme winter storm events (Prein *et al*. 2017, p. 48), and how these events could buffer increased snowmelt from warming (Marshall *et al*. 2020, p. 1). Temporal and spatial scale issues affecting snowpack include cold air pooling and the potential for this pooling to create late-season snow refugia (Pastore *et al*. 2022, p. 10), small-scale microclimates influenced by forest features, local water balance, topography, and landscape composition (De Frenne *et al*. 2021, p. 2279), and the interplay of changing future snow dynamics on microclimate conditions. The interaction of these factors could influence future climate microrefugia and species distributions (Lenoir *et al*. 2017, p. 262).

Barsugli *et al*. (2020, pp. 8–10) reported greater reductions in future snow cover at lower elevations for GNP. This is partially explained by a greater percentage of future precipitation falling as rain due to higher temperatures, and earlier snowmelt onset for thinner snow and warmer conditions. In the mountains of Montana and Wyoming the fraction of total water that falls as snow precipitation is expected to decline by 25 to 40 percent by 2100 under higher climate change scenarios (USGCRP 2018, p. 944). Snowpack in the high country is not as affected by projected temperature increases, but is likely more strongly controlled by projected precipitation changes (Sospedra-Alfonso *et al*. 2015, p. 4429; Scalzitti *et al*. 2016, p. 5367; Barsugli *et al.* 2020, pp. 6–11).

Climate models also predict less overall snowpack and water availability in Montana and Wyoming (USGCRP 2018, p. 951). Hostetler *et al*. 2021 (pp. III, 40, 57) found that from 1950 to 2018, the Greater Yellowstone Area (GYA) had a 23-inch/25 percent decrease in snowfall and by the end of the century may see a 40 percent loss of snowpack compared to 1986–1950 values (Hostetler *et al*. 2021, pp. III, 57). Under RCP 4.5, the total area of the GYA dominated by winter snowfall is projected to decrease from 59 percent during the base period (1986–2005) to 27 percent at midcentury (2041–2060) and to 11 percent by the end of this century (2081–2099). Under RCP 8.5, the extent of snow-dominant area decreases to 17 percent and to 1 percent for the same time periods, respectively.

While a change in precipitation has been predicted for the North Cascades and Pacific Northwest, the magnitude and direction varies between models (Littell *et al.* 2011, pp. 57–64, Littell and Raymond 2014, entire). Average winter precipitation is expected to increase in the Pacific Northwest, as is interannual variability (USGCRP 2018, p. 1042). In Washington and Idaho, strong climate variability is likely to persist, owing in part to the multi-decade climate cycles associated with proximity to the Pacific Ocean, and has already contributed to increased flooding and wildfires (USGCRP 2018, p. 1039). Similar to the Rocky Mountains and GYE, increases in average temperature are almost certain to decrease the regional snowpack in extent and duration (Elsner *et al.* 2010, pp. 225–226; Mote 2003, p. 280).

Temperature

Climate models predict a warmer future for Montana and Wyoming within two to three decades (USGCRP 2018, p. 951). By mid-century, Montana temperatures are projected to rise by approximately 2.5–3.3°C (4.5–5.9°F), further increasing by 3.1–5.4°C (5.6–9.8°F) by the end of the century (depending on the emission scenario). These state-level changes are larger than the average changes projected globally and nationally (Whitlock *et al*. 2017, pp. 158, 203). Hostetler *et al*. 2021 (pp. III, 40) found that from 1950 to 2018, the GYA was 1.3°C (2.3°F) warmer. Their projections suggest that by 2100 (and compared to 1986–2005 values), the GYA will be about 3°C (5.4°F) warmer. Under RCP 4.5, they projected GYA mean annual temp to increase by 2.8°C (5.0°F) by the period 2061–2080 and stabilize thereafter. Under RCP 8.5, they projected GYA mean annual temp to increase > 5.5°C (9.9°F) by 2100.

The Pacific Northwest has warmed by about 1.1°C (2.0°F) since 1900 due to increased greenhouse gasses (USGCRP 2018, p. 1041). A vulnerability assessment of the North Cascades was conducted for the rest of the century by The North Cascadia Adaptation Partnership, a collaborative group with members from USFS, NPS, and the University of Washington (Littell and Raymond 2014, entire). The USFS analyzed historical climate data in conjunction with global climate models to project what changes in the climate are likely to occur in the Pacific Northwest. In addition, the Climate Impacts Group at the University of Washington developed datasets of downscaled climate and hydrologic projections to support the vulnerability assessments, which estimated an average regional temperature increase of 2.1°C (3.8°F) by 2040 and 3.8°C (6.8°F) by 2080. The highest relative increases in temperature are projected to occur during summer months (Littell *et al.* 2011, p. 35).

Climate Change Effects on Ecosystem Processes

Near-term risks (2021 to 2040) for biodiversity loss are moderate to high in forest ecosystems across the globe (medium confidence) (IPCC 2023b, p. 63). From the GYE to the North Cascades, climate change is likely to alter physical and hydrologic conditions in a way that will create shifts in vegetation communities (Littell *et al.* 2010, entire). Using dynamic models that take into account climate change, current vegetation community composition, and plant tolerances, Rogers *et al.* (2011, entire) predicted shifts in vegetation biomes for three different climate scenarios. The specific effects of climate change on grizzly bears are unknown. However, research in Alberta, Canada has shown that higher temperatures and earlier snowmelt have contributed to improved food resources for grizzly bears (Nielsen *et al.* 2013, pp. 9–10). Grizzly bears historically ranged as far south as northern Mexico and are both habitat and food generalists.

Climate change could also change the habitat as a result in changes in disturbance patterns such as wildfires (in their entirety: Barbero *et al.* 2014, Stavros *et al.* 2014, Brown *et al.* 2021, Gao *et al*. 2021). However, depending on their size and severity, fires may only have short-term consequences on grizzly bears while providing more long-term benefits (for further discussion, see *Stochastic Events: Fire* below). For example, "recently burned areas are generally avoided by bears for the first few years after a fire while vegetation recovers, but once vegetation recovers, food resources generally become plentiful and these areas often become highly used habitats by bears" (Hamer and Herrero 1987b, p. 185; Apps *et al*. 2004, p. 147). Ransom *et al.* (2023, pp. 6–8) modeled grizzly bear habitat in the North Cascades under future climate change scenarios and found that estimates for carrying capacity and potential grizzly bear density increase under all scenarios. Additionally, Ransom *et al*. (2018, pp. 25–26) concluded that the mixed benefits and consequences to grizzly bears from predicted increases in growing season length, winter and spring water availability, wildfire, and decreases in snowpack, grizzly bears will likely persist due to their adaptive capacity and ability to change their movements to accommodate shifting food resources.

Grizzly bears use several behavioral mechanisms to avoid hyperthermia, including: adjusting activity patterns to be less active during the hottest parts of the day (Schwartz *et al.* 2010b, p. 1633), selecting for areas with more cover that provided alternative forage or cool substrate for daybeds with increased temperatures (Moe *et al.* 2007, p. 521; Pigeon *et al.* 2016, pp. 1108–1109), and using water to cool (Gunther *et al.* 2015, p. 66; Rogers *et al.* 2021, p. 10). Although grizzly bears in one study became less active during the hottest part of the day when ambient temperatures exceeded 20°C (68°F) (Schwartz *et al.* 2010b, p. 1633), McLellan and McLellan (2015, p. 12) found that female grizzly bears in another study remained diurnal in temperatures above 30°C (86°F) and 40°C (104°F), as that likely maximized their foraging efficiency on berries that are only ephemerally available. The risk of hyperthermia is greater for lactating females and may increase with projected temperature increases predicted by climate change models (Rogers *et al.* 2021, pp. 7–9). Rogers *et al.* (2021, p. 10) modeled potential hyperthermia for non-lactating and lactating females under current ambient temperatures and a future temperature increase of 2.5°C (4.5°F) and concluded that grizzly bears can avoid hyperthermia through behavioral thermoregulation, particularly through the use of water for cooling.

Potential Impacts from Climate Change on Denning

Because timing of den entry and emergence is at least partially influenced by food availability and weather (Craighead and Craighead 1972, pp. 33–34; Van Daele *et al.* 1990, p. 264; Kurth *et al.* 2024, p. 8), less snowpack would likely shorten the denning season as foods become available later in the fall and earlier in the spring. For example, in the GYE, Haroldson *et al.* (2002, pp. 34–35) reported later den entry dates for male grizzly bears, corresponding with increasing minimum November temperatures from 1975 to 1999. This increased time outside of the den could increase the potential for conflicts with humans (Servheen and Cross 2010, p. 4; Kurth *et al.* 2024, p. 8). To monitor climate change impacts, den entry and exit times are recorded annually for research bears in the GYE, NCDE, CYE, and SE, and these provide a basis for comparison of data. Upon restoration or natural recolonization of grizzly bears into the North Cascades and BE, den entry and exit times would be recorded annually for research bears in these areas as well. As discussed in *Human-Caused Mortality*, above, any possible increase in grizzly bear mortality risk, including from changes in den entry and exit times, is not expected to significantly affect ecosystem resiliency because of management of grizzly bear mortalities to sustainable levels within each ecosystem.

Potential Impacts from Climate Change on Food Sources

Effects related to climate change could create temporal and spatial shifts in grizzly bear food sources (Rodriguez *et al.* 2007, pp. 41–42; Roberts *et al.* 2014, entire; Prevéy *et al.* 2020, entire; Kurth *et al.* 2024, pp. 3–6). Changes in plant communities have already been documented, with species' ranges shifting farther north and higher in elevation due to environmental constraints (Walther *et al.* 2002, pp. 390–391; Walther 2003, pp. 172–175; Walther *et al.* 2005, p. 1428) and increases in outbreaks of insects that reduce survival (Bentz *et al.* 2010, entire). A net loss in forested areas is anticipated as forest contraction occurs more rapidly than forest expansion, with an expected increase in productivity in montane, subalpine, and alpine areas and a decrease in productivity in lower elevation, warmer, and drier sites (Whitlock *et al.* 2017, p. 165). It is unclear whether avalanche chutes, an important habitat component to grizzly bears, will decrease, possibly as a result of decreased snowpack, or increase, as a result of increases in "rain on snow" events that may decrease the stability of snowpack. Changes in vegetative food distributions also may influence other mammal distributions, including potential prey species such as ungulates (White *et al.* 2018, entire).

Different plant species respond differently to climate at different locations, especially topography, resulting in complex patterns of vegetation response (in their entirety: Walther *et al.* 2002; Fagre *et al.* 2003; Roberts *et al*. 2014; Lira 2020). Forage availability may be influenced by changes in precipitation and temperature (Kurth *et al.* 2024, p. 3). For example, climate change is predicted to exacerbate the primary threats to whitebark pine, a food source that is used by a portion of grizzly bears in the GYE (see *Food Resources in the GYE: Whitebark pine* of this report for more detailed discussion). Whitebark pine range is expected to contract, moving both north and up in elevation (Service 2021, pp. 57–63). As conditions warm and become more favorable for other tree species, whitebark pine is likely to get outcompeted in some of its remaining habitat. Berry species have also been identified as an important food resource for grizzly bears, especially in the SE and CYE (see *Food Resources in the CYE and SE* of this report for more information). When one important food resource declines, another is often available. For example, one study in Alberta, Canada projected that grouseberry (*Vaccinium scroparium*) could lose over 90 percent of its habitat, while huckleberry and blueberry (*V. membranaceum* and *V. myrtilloides*) showed substantial projected increases in habitat (Roberts *et al*. 2014, p. 1149). Research in the Pacific Northwest, including the United States, projects a similar increase in northern latitudes and higher elevations, and contraction at lower elevations and more southern latitudes (Prevéy *et al*. 2020, entire). Expected changes in snowpack, and several other climate related variables will likely have a significant effect on development of huckleberry patches important for grizzly bears (Proctor *et al.* 2023, p. 31). Overall, there is general consensus that grizzly bears are flexible enough in their dietary needs that they will not be impacted directly by ecological constraints such as shifts in food distributions and abundance (Servheen and Cross 2010, p. 4; IGBST 2013, p. 35; Kurth *et al.* 2024, p. 4). Research in Alberta, Canada has shown that higher temperatures and earlier snow melt have contributed to improved food resources overall for grizzly bears (Nielsen *et al.* 2013, p. 9). Grizzly bears historically ranged as far south as northern Mexico and are both habitat and food generalists. Grizzly bears will consume almost anything available including vegetation, living or dead mammals or fish, insects, and human garbage (Knight *et al.* 1988, p. 123; Mattson *et al.* 1991a, entire; Schwartz *et al.* 2003b, pp. 568–569).

In years of natural food shortages, driven largely by drought, bears forage at lower elevations leading to an increase in human-bear interactions (Kurth *et al.* 2024, pp. 3–5). Timing and frequency of human-grizzly bear interactions and conflicts may change (Servheen and Cross 2010, p. 4; Kurth *et al.* 2024, pp. 4, 8, 10). Although humans are likely to continue to be directly or indirectly responsible for the majority of grizzly bear deaths, this source of mortality is minimized through science-based management, monitoring, and outreach efforts (see *Human-caused mortality* for further information). Monitoring will continue to support adaptive management decisions in changing climatic scenarios with the goal to meet recovery criteria and population objectives.

Potential Climate Change Impacts on Fire Regimes

The increase in frequency and severity of wildfires throughout the Western United States (in their entirety: Barbero *et al.* 2014, Stavros *et al.* 2014, Brown *et al.* 2021, Gao *et al*. 2021) could also potentially change the distribution of grizzly bear prey and forage species across the landscape. Fire and insect outbreaks have killed millions of hectares of forested area across the western United States in recent decades (Hicke *et al*. 2016, p. 141). Wildfires have burned at least 5,000 mi^2 (15,000 km^2) annually in all but 3 years between 2000 and 2016 (Vose *et al.*

2018, p. 234) and an annual average of 12,000 mi^2 (32,000 km^2) between 2017 and 2021 (National Interagency Fire Center 2022).

Fire regimes can affect the abundance and distribution of some vegetative bear foods (e.g., grasses, berry-producing shrubs) (LeFranc *et al.* 1987, p. 150). For instance, fires can reduce canopy cover, which usually increases berry production. However, on steep south or west slopes, excessive canopy removal due to fires or vegetation management may decrease berry production through subsequent moisture stress and exposure to sun, wind, and frost (Simonin 2000, entire). Fire frequency and severity may increase with late summer droughts predicted under climate change scenarios (Nitschke and Innes 2008, p. 853; McWethy *et al.* 2010, p. 55). Increased fire frequency has the potential to improve grizzly bear habitat, with low to moderate severity fires being the best. For example, fire treatment most beneficial to huckleberry shrubs is that which results in damage to stems, but does little damage to rhizomes (Simonin 2000, entire).

High-intensity fires may reduce grizzly bear habitat quality immediately afterwards by decreasing hiding cover, changing movement patterns, and delaying regrowth of vegetation. Predator responses to fires vary both among species and ecosystems (Geary *et al.* 2019, p. 962). Predators with large territories, like grizzly bears, have more flexibility to exploit resources in burned and unburned landscapes (as cited in Nimmo *et al.* 2019, p. 986). Moreover, in conifer-dominated forest ecosystems, wildfires transition forest to earlier succession stages, which can increase prey densities due to increases in the availability of vegetative food resources (Snobl *et al*. 2022, pp. 14–15). Even if cover is lost, movement is changed, and vegetation growth is delayed, depending on their size and severity, fires may only have short term adverse impacts on grizzly bears while providing more long-term benefits. For example, fire plays an important role in maintaining an open forest canopy, shrub fields, and meadows that provide for grizzly bear food resources, such as increased production of forbs, root crops, and berries (Hamer and Herrero 1987b, pp. 183–185; Blanchard and Knight 1996, p. 121; Apps *et al.* 2004, p. 148; Pengelly and Hamer 2006, p. 129). Because grizzly bears have shown resiliency to changes in vegetation resulting from fires, we do not expect altered fire regimes predicted under most climate change scenarios to have significant negative impacts on grizzly bear survival or reproduction, despite the potential short-term effects on vegetation important to grizzly bears.

Summary of Effects of Climate Change

Most grizzly bear biologists in the United States and Canada do not expect habitat changes predicted under climate change scenarios to have significant consequences for grizzly bears (Servheen and Cross 2010, p. 4). Climate change may even make some habitat more suitable and some food sources more abundant (Servheen and Cross 2010, Appendix D). In addition, we anticipate that grizzly bears will be able to adapt to any future potential changes in suitable habitat and food sources because they display great diet plasticity and switch foods according to which foods are most nutritious and available (Servheen 1981, pp. 119–123,127–128; Kendall 1986, pp. 12–18; Mace and Jonkel 1986, entire; Martinka and Kendall 1986, pp. 21–22; LeFranc *et al.* 1987, pp. 24–25; Aune and Kasworm 1989, pp. 64–72; Schwartz *et al.* 2003b, pp. 568–569; Edwards *et al.* 2011, pp. 883–886; Gunther *et al.* 2014, pp. 65–69). Timing and frequency of human-grizzly bear interactions and conflicts may change (Servheen and Cross 2010, p. 4; Kurth *et al.* 2024, pp. 4, 8, 10), and monitoring will continue to support adaptive management decisions. We expect that conservation plans and strategies with mortality limits will further limit any potential negative effects of climate change on grizzly bears.

Stochastic Events

Here we analyze a number of possible stochastic events, including fire, volcanic activity, and earthquake. Some stochastic events could be catastrophic events if they occur on a large enough scale to rise to the level of affecting the resiliency of an entire population. Volcanic activity is most relevant for the GYE given their geographic location; however, fires and earthquakes are the most plausible potential stochastic stressor to all of the ecosystems given their geographic location.

Fire

Fire is a natural part of all grizzly bear ecosystems. Even though fire frequency and severity may increase with late summer droughts predicted under climate change scenarios (Nitschke and Innes 2008, p. 853; McWethy *et al.* 2010, p. 55; Whitlock *et al.* 2017; pp. 123–131, 216, XXXII), increased frequency of low to moderate severity fires has the potential to improve grizzly bear habitat. Grizzly bears have evolved with fire as part of the natural landscape, and they are capable of adapting to changing ecological conditions. Wildfires have both positive and negative impacts on grizzly bears, but often provide significant long-term benefits by maintaining natural ecosystem processes (YNP 2005, p. 47). For instance, fires can reduce canopy cover, which usually increases berry production and early successional vegetation growth (LeFranc *et al.* 1987, p. 150; Simonin 2000, entire; Proctor *et al.* 2017, pp. 49, 51; Kurth *et al.* 2024, p. 3). Negative impacts of fire on berry production have been noted on steep south or west slopes, however, where excessive canopy removal may decrease berry production through subsequent moisture stress and exposure to sun, wind, and frost (Simonin 2000, entire).

Twentieth century forest management, which included extensive wildfire suppression efforts, promoted heightened potential for a large fire event. In 1988, the largest wildfires in YNP's recorded history burned a total of 3,213 km^2 (1,240 mi^2) or 36 percent of the Park. However, large mobile species such as grizzly bears and their ungulate prey were not meaningfully negatively affected. Surveys after the 1988 fires found that 345 elk, 36 deer, 12 moose, 6 black bears, and 9 bison died in GYE as a direct result of the conflagration (YNP 2011, p. 3). Blanchard and Knight (1990, p. 592) found that the 1988 fire resulted in the probable deaths of only a few grizzly bears and no increase in bear home range sizes or daily movement rates during or after the fire. Immediately after the fires had passed, grizzly bears moved into the burned areas to feed on the increased availability of burnt ungulate carcasses, roots, ants, and newly emerged grasses and forbs. Although some grizzly bears avoided burned sites in the year after the fire (1989), use of burned areas in subsequent years (1990 to 1992) suggested that fires increased production of forbs and roots and were, therefore, beneficial to grizzly bears (Blanchard and Knight 1996, pp. 120–121). The period of most robust grizzly bear growth (4 to 7 percent) occurred shortly after the 1988 fires, through the entire decade of the 1990s. YNP's fire management policy (YNP 2014, entire) indicates natural wildfires should be allowed to burn, so long as parameters regarding fire size, weather, and potential danger are not exceeded. Those fires that do exceed the standards set forth in the fire management policy, as well as all human-caused fires, are to be suppressed (YNP 2014, entire). NFs manage natural wildfires to allow them to play their "natural ecological role" while "minimizing negative effects to life, investments and valuable resources" (USDA FS 2005, p. 11; USDA FS 2011b, pp. 3–4; USDA FS 2012, p. 2; USDA FS 2015a, p. 8). Future fires are likely in grizzly bear ecosystems and while the other ecosystems have yet to experience a wildfire of a similar scale, we agree with the YNP conclusion (YNP 2005, Appendix H) that grizzly bears are adaptable and will benefit from fires in the long-term. Wildfires often lead to an increase in ungulate food supplies and an increase in ungulate numbers. Wildfire suppression activities, such as increased helicopter and plane flights in the area, may displace grizzly bears from habitat. Fire camps associated with fire suppression are potential sources of conflict due to improper food or attractant storage. NFs and NPs include conservation measures to minimize impacts from these activities to grizzly bears (e.g., identifying flight paths where possible, including bear safety education and fire camp safety design). While minor, localized, short-term impacts are likely, fire is not a major concern for grizzly bear ecosystems in the lower 48-States.

Volcanic Activity

Of the six ecosystems, only the GYE is potentially at risk from volcanic activity. The GYE has experienced several large volcanic eruptions in the past 2.1 million years. Super eruptions occurred 2.1 million, 1.3 million, and 640,000 years ago (Lowenstern *et al.* 2005, pp. 1–2). Such a similar event would devastate the GYE. While one could argue "we are due" for such an event, scientists with the Yellowstone Volcano Observatory maintain that they "see no evidence that another cataclysmic eruption will occur at Yellowstone in the foreseeable future… [and that] recurrence intervals of these events are neither regular nor predictable" (Lowenstern *et al.* 2005, p. 6). Such an event is not likely within the 30-to-45-year timeframe for this SSA.

Slightly more probable is a nonexplosive lava flow eruption or a hydrothermal explosion. There have been 30 nonexplosive lava flows in YNP over the last 640,000 years, most recently 70,000 years ago (Lowenstern *et al.* 2005, p. 2). During such an eruption, flows ooze slowly over the surface, moving a few hundred feet per day for several months or several years (Lowenstern *et al.* 2005, p. 2). Any renewed volcanic activity at YNP would most likely take this form (Lowenstern *et al.* 2005, p. 3). In general, such events would have localized impacts and be far less devastating than a large eruption (although such an event could also cause fires; fire as a stressor is discussed above). Hydrothermal explosions, triggered by sudden changes in pressure of the hydrothermal system, also occasionally affect the region. More than a dozen large hydrothermal explosion craters formed between 14,000 and 3,000 years ago (Lowenstern *et al.* 2005, p. 4). The largest hydrothermal-explosion crater documented in the world is along the north edge of Yellowstone Lake in an embayment known as Mary Bay; this 2.6-km (1.5-mi) diameter crater formed about 13,800 years ago (Lowenstern *et al.* 2005, p. 4). We do not consider either nonexplosive lava flow eruptions or a hydrothermal-explosion likely to occur within the 30-to-45-year timeframe for this analysis. However, even if one did occur, the impact to grizzly bears would likely be localized within the GYE, temporary, and not a significant concern for grizzly bear populations.

Earthquakes

Earthquakes also occur within the region and can impact the surrounding environment through fire damage, rockslides, ground cracks, and changes in ground water (Pardee 1926, entire). The most notable earthquake in YNP's recent history was a magnitude 7.5 in 1959 (Lowenstern *et al.* 2005, p. 3). Similarly, a magnitude 6.5 earthquake hit within YNP in 1975 (Lowenstern *et al.* 2005, p. 3). The 1959 earthquake killed 28 people, most of them in a massive landslide triggered by the quake (Lowenstern *et al.* 2005, p. 3). The highest magnitude earthquake originating within the NCDE in recent history was a 6.9 magnitude earthquake in Townsend, Montana, in 1925 (Pardee 1926, entire), and seismic effects from other high magnitude earthquakes have also occurred within the NCDE (Lowenstern *et al.* 2005, p. 3). Most earthquakes in the CYE, SE, BE, and North Cascades have been lower than a 3.5 magnitude (Earthquake Tracker 2020), however larger earthquakes have occurred, and there is a potential that large earthquakes will occur in the future. Although massive landslides and other earthquake-related impacts could also affect wildlife, as with other potential stochastic events, the impact of a large earthquake to grizzly bears would be localized, temporary, and are not a significant concern for grizzly bear populations.

Summary of Stochastic Events

We considered catastrophic and stochastic (random probability) events that might reasonably occur in the each of the ecosystems within the 30-to-45-year future, to the extent possible. Most stochastic events discussed above are unpredictable and unlikely to occur within the biologically meaningful timeframe for our SSA. Other events that might occur within the future would likely cause only localized and temporary impacts that would not significantly reduce the resiliency of any of the six ecosystems.

Conservation Efforts

The following existing regulatory mechanisms, as of December 31, 2023, are specifically considered and discussed as they relate to the stressors under each relevant discussion, affecting grizzly bears in the lower-48 States. Under *Habitat-Related Effects*:

- Conservation Strategy for the Grizzly Bear in the Greater Yellowstone Ecosystem and the Appendices (YES 2024);
- Conservation Strategy for the Grizzly Bear in the Northern Continental Divide Ecosystem (NCDE Subcommittee 2020);
- 2006 Forest Plan Amendment for Grizzly Bear Habitat Conservation for the Greater Yellowstone Area National Forests (USDA FS 2006a, 2006b);
- 2011 Forest Plan Amendments for Motorized Access Management within the Selkirk and Cabinet-Yaak Grizzly Bear Recovery Zones for the Kootenai, Lolo, and Idaho Panhandle National Forests (USDA FS 2011c);
- 2015 Revision of the Land Management Plan for the Kootenai National Forest (USDA FS 2015c);
- 2015 Revision of the Land Management Plan for the Idaho Panhandle National Forest (USDA FS 2015b);

- 2019 Colville National Forest Land Management Plan (USDA FS 2019);
- 2000 Conservation Agreement between Stimson Lumber Company, Colville National Forest, and the Service (Service 2001);
- 1997 interim Forest direction for the North Cascades Federal land management agencies (USDA FS 1997);
- Flathead National Forest Land Management Plan (USDA FS 2018c);
- Custer Gallatin National Forest Land Management Plan (USDA FS 2022b);
- Helena-Lewis and Clark National Forest Land Management Plan (USDA FS 2021);
- Final Environmental Impact Statement for the Forest Plan Amendments: Incorporating Habitat Management Direction for the Northern Continental Divide Ecosystem Grizzly Bear Population for the Helena-Lewis and Clark, Kootenai, and Lolo National Forests (USDA FS 2018f);
- Blackfeet Forest Management Plan (Blackfeet Nation 2008);
- Flathead Indian Reservation Forest Management Plan (CS&KT 2000);
- Final Environmental Impact Statement for the Montana Department of Natural Resources and Conservation Forested Trust Lands Habitat Conservation Plan (DNRC 2010a, 2010b);
- Administrative Rules of Montana 36.11.432 and 12.9.1401;
- Wilderness Act of 1964;
- The 2001 Roadless Rule;
- Glacier National Park Superintendent's Compendium implemented under the National Park System Organic Act (GNP 2024). The Organic Act of 1916, 16 U.S.C. Section 1, created the NPS and assigned it the responsibility to manage the NPs. The Organic Act requires the NPS to manage park units to conserve scenery, natural and historic objects within parks, and wildlife, and to provide for their enjoyment in a manner that leaves them unimpaired for the enjoyment of future generations;
- Yellowstone National Park (YNP 2023) and Grand Teton National Park Compendia (GTNP and JDR 2024) implemented under the National Park Service Organic Act;
- Billings Field Office Approved Resource Management Plan 2015 (BLM 2015a);
- Hiline Approved Resource Management Plan 2015 (BLM 2015b);
- Butte Field Office Approved Resource Management Plan 2009 (BLM 2009);
- Missoula Field Office Approved Resource Management Plan 2021 (BLM 2021a);
- Record of Decision and Approved Lewiston Resource Management Plan 2021 (BLM 2021b); and
  Dillion Field Office Approved Resource Management Plan 2006 (BLM 2006).

Under *Human-Caused Mortality*:

- Conservation Strategy for the Grizzly Bear in the Greater Yellowstone Ecosystem and the Appendices (YES 2024);
- Conservation Strategy for the Grizzly Bear in the Northern Continental Divide Ecosystem (NCDE Subcommittee 2020);
- 2011 Forest Plan Amendments for Motorized Access Management within the Selkirk and Cabinet-Yaak Grizzly Bear Recovery Zones for the Kootenai, Lolo, and Idaho Panhandle National Forests (USDA FS 2011c);

- 2015 Revision of the Land Management Plan for the Kootenai National Forest (USDA FS 2015c);
- 2015 Revision of the Land Management Plan for the Idaho Panhandle National Forest (USDA FS 2015b);
- 2019 Colville National Forest Land Management Plan (USDA FS 2019);
- Draft Montana Grizzly Bear Management Plan (MFWP 2022);
- Flathead Indian Reservation Grizzly Bear Management Plan (Servheen *et al.* 1981);
- Bear Management Plan and Guidelines for Bear Management on the Blackfeet Indian Reservation (Blackfeet Tribal Business Council 2013);
- Blackfeet National Fish and Wildlife Code (Blackfeet Tribal Business Council 2018);
- Nez Perce Tribal Code §3-1-52;
- Flathead Indian Reservation Tribal Ordinance 44D;
- Grizzly Bear Management Plan for the Wind River Reservation (Eastern Shoshone and Northern Arapaho Tribes 2009);
- Administrative Rules of Montana (ARM) 12.9.1401, 12.9.1403, 12.9.1405, and 12.9.1413;
- Montana Codes Annotated (MCA) 87-2-101(4), 87-1-301, 87-1-304, 87-5-301, and 87-5-302;
- Idaho Administrative Rules (IDAPA) 13.01.06.100.05 and 13.01.06.300.01;
- Idaho Codes Annotated (IC) 36-201 and 36-1101(a);
- Washington Administrative Code (WAC) 220-610-010;
- Wyoming Statutes (WS) 23-1-101(a)(xii)(A) and 23-3-102(a);
- State of Idaho Yellowstone Grizzly Bear Management Plan (Idaho's Yellowstone Grizzly Bear Delisting Advisory Team 2002);
- Proclamation of the Idaho Fish and Game Commission Relating to the Limit of the Take of Grizzly Bear in the Greater Yellowstone Ecosystem (Idaho Fish and Game Commission 2016);
- Draft Idaho State wildlife action plan 2023 (IDFG 2023);
- Grizzly Bear Management Plan for Southwestern Montana (MFWP 2013);
- Montana Hunting Regulations for Grizzly Bear (MFWP 2016);
- Wyoming Grizzly Bear Management Plan (WGFD 2016);
- Wyoming Game and Fish Commission (2016) Chapter 67 Grizzly Bear Management Regulation; and
- Tri-State Memorandum of Agreement Regarding the Management, Genetic Health, and Allocation of Discretionary Mortality of Grizzly Bears in the Greater Yellowstone Ecosystem (Wyoming Game and Fish Commission *et al.* 2024).

Cumulative Effects

Many of the stressors faced by grizzly bears are interrelated and could be synergistic, or act cumulatively. When stressors act synergistically, or in concert with one another, the potential combined effects on the species are called cumulative effects. Principal stressors discussed above include habitat loss through road building and the resulting increased human access to grizzly bear habitat, human-caused mortality of grizzly bears, and the legal mechanisms that direct habitat and population management. The principal stressors assessed in previous sections may cumulatively impact individual grizzly bear populations beyond the scope of each individual stressor. For example, expected increases in human populations across the Western United States and climate change both have the potential to increase grizzly bear conflicts and human-caused mortality (Servheen and Cross 2010, entire; Kurth *et al.* 2024, pp. 4, 8, 10). Historically, each of these factors impacted grizzly bears in each of the ecosystems and cumulatively acted to reduce their range and abundance over time.

We note that, by using the SSA framework, we have not only analyzed individual effects of stressors on individuals, ecosystems, and the lower-48 States, but we have also analyzed their potential cumulative effects. Because the SSA uses metrics for demographics, distribution, and diversity, the effect of multiple stressors is inherent in the assessment and helps to assess how populations and, ultimately the species, responds cumulatively to the interactive effects of stressors and conservation efforts included in the future scenarios (Smith *et al.* 2018, p. 6). We incorporate the cumulative effects into our analysis when we characterize the current and future condition of the species across six ecosystems. Our assessment of the current and future conditions encompasses and incorporates the stressors individually and cumulatively. Our current and future condition assessment is iterative because it accumulates and evaluates the effects of all the factors that may be influencing the subspecies, including negative influences from stressors and positive influences from conservation efforts. We evaluate potential effects from these influences consistently across the same subset of habitat and demographic needs for the subspecies, both currently and into the future. Because the SSA framework considers not just the presence of the factors, but also to what degree they collectively influence risk to the entire species, our assessment integrates the cumulative effects of the factors and replaces a standalone cumulative effects analysis.

It is important to recognize that grizzly bears are a "conservation reliant" species (Scott *et al.* 2005, p. 384; Scott *et al.* 2010, pp. 92, 95). According to Scott *et al*. (2010, p. 91), for "conservation reliant" species, "Even when management actions succeed in achieving biological recovery goals, maintenance of viable populations of many species will require continuing, species-specific intervention." As a "conservation reliant" species, grizzly bears will require ongoing management and conservation efforts to remain recovered.

While stressors on grizzly bear viability are numerous and challenging to conservation, our experience demonstrates that if human-caused mortality can be sufficiently limited, it is possible for large carnivore conservation to be compatible with them (Linnell *et al.* 2001, p. 48). We consider estimates of population trend (i.e., "lambda") to be the ultimate metric to assess cumulative impacts to the population. Population trend reflects all of the various stressors on the population. This calculation reflects total mortality, changes in habitat quality, changes in population density, change in current range, displacement effects, and so forth. Despite the various stressors discussed above, the best available data indicate that, due to ongoing conservation efforts in the GYE, NCDE, CYE, and SE, grizzly bear population trends in these ecosystems are stable or increasing, and estimated occupied range has continued to expand. Ongoing conservation efforts have reduced the multiple negative effects to such levels that these populations are currently stable or increasing. As long as conservation efforts continue, existing threats are not significantly impacting the 3Rs in the ecosystems, but stressors are still operating within each ecosystem, either individually or cumulatively. In addition, the likelihood of natural recolonization of the BE is better now than at any point since listing. Natural recolonization of the North Cascades is unlikely in the near future due to the low numbers of bears in nearby populations and the highly fragmented landscape in between.

Summary of Cause-and-Effects

We evaluated the following stressors (we provide the relevant listing factors under the Act for reference only):

- Effects due to habitat destruction and modification (Factor A);
- Human-caused mortality (Factors B and C);
- Natural mortality (Factor C);
- Effects due to genetic health (Factor E);
- Effects due to changes in food resources (Factor E);
- Effects due to climate change (Factor E);
- Effects due to stochastic events (Factor E); and
- Cumulative effects.

We summarize each of these stressors by ecosystem below.

Summary of Cause-and-Effects in the GYE

The primary factors related to past habitat destruction and modification have been reduced through changes in management practices that have been formally incorporated into regulatory documents. In the GYE, maintenance of the 1998 baseline values for secure habitat, developed sites on public lands, and livestock allotments inside the recovery zone will adequately reduce the multitude of stressors on grizzly bear habitat such that they do not become threats to the GYE grizzly bear population in the future. We expect many of these stressors to continue to occur at some level, but, assuming that current regulatory mechanisms remain in place, these stressors are currently reduced so that they affect only a small proportion of the population.

The GYE NFs and NPs will continue to implement and maintain the 1998 baseline. Together, these two Federal agencies manage 98 percent of lands within the GYE recovery zone and 88 percent of all suitable habitat within the DMA. Suitable habitat outside the recovery zone provides additional ecological resiliency and habitat redundancy to allow the population to respond to environmental changes. Habitat protections specifically for grizzly bear conservation are not necessary here because other regulatory mechanisms that limit development and motorized use are already in place for 59 percent of suitable habitat outside the recovery zone (e.g., Wilderness Areas, WSAs, and IRAs). These and other conservation measures discussed in the USFS's ROD (2006b, pp. 4–6) ensure threats to the GYE grizzly bear population's habitat outside the recovery zone will not become substantial enough to reduce resiliency.

Human-caused mortality, mainly "indiscriminate illegal killing" and management removals, historically reduced the resiliency of all ecosystems. Since the 1975 listing, the GYE grizzly bear population has tripled in size and range (Eberhardt *et al.* 1994, pp. 361–362; Knight and Blanchard 1995, pp. 2–11; Boyce *et al.* 2001, pp. 1–11; Schwartz *et al.* 2006c, p. 48; Pyare *et al.* 2004, pp. 5–6; Schwartz *et al.* 2006b, pp. 64–66; IGBST 2012, p. 34; Dellinger *et al.* 2023, p. 23;

Gould *et al.* 2024c, *in prep.*). Inside the DMA, population growth slowed in the early 2000s but has remained positive during the 2000s and 2010s and is exhibiting density-dependent population regulation (van Manen *et al.* 2016, entire; Gould *et al.* 2024a, p. 13). Although humans are still directly or indirectly responsible for most independent-age grizzly bear deaths, this source of mortality is minimized through science-based management, State regulations, careful population monitoring, and education and outreach efforts. Since 1975, no grizzly bears have been removed from the GYE for commercial, recreational, scientific, or education purposes. In the future, although the States may choose to institute carefully regulated grizzly bear hunting outside of the National Parks, it would be within scientifically determined sustainable levels to maintain the population in the long-term and would not occur if other sources of human-caused mortality were excessive. While human-caused mortality will continue to occur, State regulatory mechanisms limit total mortality to sustainable levels detailed in *Mortality Limits in the GYE*. However, new revisions to the demographic criteria will need to be evaluated.

The importance of continued regulatory mechanisms and effective wildlife management infrastructure to large carnivore conservation cannot be understated, as described under *Habitat Destruction and Modification* and *Human-Caused Mortality* (see Linnell *et al.* 2001, p. 348). Regulatory mechanisms in place include NP Superintendent's Compendia, the USFS Amendment for Grizzly Bear Habitat Conservation for the GYE NFs, and State and Tribal commission regulations controlling mortality, as described under *Habitat Destruction and Modification* and *Human-Caused Mortality*. The management infrastructure for habitat is already in place and described in the GYE Conservation Strategy (YES 2024, Chapter 3). However, as discussed under *Mortality Limits in the GYE*, new revisions to the demographic criteria will need to be evaluated once complete. Because the signatory agencies to the GYE Conservation Strategy are the same agencies that have been managing grizzly bear habitat, population, and monitoring for the last 40 years, a post-delisting management transition would be minimal. Further evaluation is needed as to whether existing regulatory mechanisms ensure the GYE grizzly bear population will continue to meet the recovery criteria and maintain resiliency.

The GYE grizzly bear population has experienced population growth and range expansion since 1975 (Pyare *et al.* 2004, pp. 5–6; Schwartz *et al*. 2006b, pp. 64–66; Schwartz *et al.* 2006c, p. 48; IGBST 2012, p. 34; Dellinger *et al.* 2023, p. 23; Gould *et al.* 2024c, *in prep.*), and potential threats from disease, predation, genetic health, changes in food resources, climate change, and stochastic events have not manifested themselves such that they currently negatively affect the population. Essentially, the management response to all these potential threats would be to limit human-caused mortality through conflict prevention and management as well as managing discretionary mortality. Because of the manageable nature of these potential threats through conflict prevention and response efforts and the large amount of suitable, secure habitat within the GYE, we do not expect these other natural or manmade factors to become threats to the GYE grizzly bear population.

Many of the stressors faced by grizzly bears are interrelated and could cumulatively impact the GYE grizzly bear population through excessive grizzly bear mortality. While these numerous stressors on grizzly bear viability are challenging to conservation, our experience demonstrates it is possible for large carnivore conservation to be compatible with them as long as regulatory mechanisms remain in place (Linnell *et al*. 2001, p. 48), particularly given the rigorous scientific monitoring protocols established for the GYE grizzly bear population. There will always be stressors that influence individuals, and potentially ecosystems, but if these are not causing the population to decline, we do not consider them to reduce resiliency.

Summary of Cause-and-Effects in the NCDE

The primary factors related to past destruction and modification of grizzly bear habitat have been reduced through changes in management practices that have been formally incorporated into regulatory documents. Maintenance of the baseline values for secure core habitat, developed sites on public lands, and livestock allotments inside the recovery zone will adequately minimize the stressors on grizzly bear habitat. We expect many of the threats discussed under *Habitat Destruction and Modification* to continue to occur at some level, but they are reduced so they affect only individuals or a small proportion of the population.

The NCDE NFs and GNP, which manage 79 percent of lands within the recovery zone, will continue to implement and maintain the baseline. The BLM, FIR, and DNRC have implemented habitat protections on an additional 13 percent of lands within the recovery zone. The USFS, BLM, BIR, FIR, and DNRC have put habitat protections in place in Zone 1 that protect 47 percent of lands and provide additional ecological resiliency and habitat redundancy to allow the population to respond to environmental changes (in their entirety: CS&KT 2000; Blackfeet Nation 2008; DNRC 2010a, 2010b; USDA FS 2018a, 2018c, 2018d; BLM 2021a, 2021b). As discussed under *Motorized Access in the NCDE* and *Developed Sites in the NCDE*, we are currently reevaluating whether these and other conservation measures discussed in the NCDE Conservation Strategy (NCDE Subcommittee 2020, entire) will ensure threats to the NCDE grizzly bear population's habitat will not become substantial enough to reduce resiliency of this ecosystem.

When grizzly bears were listed in 1975, we identified human-caused mortality, mainly "indiscriminate illegal killing" and management removals, as threats to the population under *Human-Caused Mortality*. In response, we implemented demographic recovery criteria in the 1982 Recovery Plan (Service 1982, pp. 59–81). These criteria were then updated in the 1993 Recovery Plan to maintain a minimum population size and a well-distributed population and to establish total mortality limits based on scientific data and direct monitoring of the population (Service 1993, pp. 61–79). Since implementing these criteria, the NCDE grizzly bear population has more than tripled in size (from approximately 300 to 1,163 grizzly bears) and range (from 24,800 km^2 (9,600 mi^2) to 67,652 km^2 (26,120 mi^2)) (Dood *et al.* 1986, p. 166; Service 1993, pp. 11–12; Mace *et al.* 2012, p. 124; Costello *et al.* 2016b, p. 2; Costello *et al.* 2023, p. 14; Costello *et al.* 2024, *in prep.*). The population in the NCDE has grown at a rate of 2.3 percent annually since 2004 (Costello *et al.* 2016b, p. 2; Costello 2018, *in litt.*).

Although humans are still directly or indirectly responsible for the majority of independent-age grizzly bear deaths, this source of mortality is being effectively minimized through science-based management, State and Tribal regulations, careful population monitoring, and outreach efforts. In addition, recent levels of human-caused mortality have not precluded an annual population growth rate of 2.3 percent since 2004 (Costello *et al.* 2016b, p. 2; Costello 2018, *in litt.*). Since 1975, no grizzly bears have been removed from the NCDE for commercial, scientific, or education purposes. Legal hunting was allowed in the State of Montana under a special exception from 1975 until 1991, but no grizzly bears have been removed from the NCDE for recreational purposes since 1991. Although the State of Montana may choose to institute carefully regulated grizzly bear hunting outside of GNP and the BIR and FIR if the NCDE is delisted, hunting would be within scientifically determined sustainable levels to maintain the population in the long-term and would not occur if other sources of human-caused mortality were excessive. Overall, the NCDE Conservation Strategy and existing regulatory mechanisms include provisions to ensure discretionary mortality will be limited to sustainable levels and ensure resiliency is maintained.

The importance of regulatory mechanisms and effective wildlife management infrastructure to large-carnivore conservation cannot be overstated, as described under *Habitat Destruction and Modification, and Human-Caused Mortality* (see Linnell *et al.* 2001, p. 348). The regulatory mechanisms that are now in place or will be in place before publication of any future final rule to delist include: (1) as described under *Habitat Destruction and Modification*: GNP's Superintendent's Compendium; the USFS revised Flathead NF Plan; the USFS Plan Amendments to Incorporate Habitat Management for the NCDE Grizzly Bear Population on the Helena-Lewis and Clark, Kootenai, and Lolo NFs; BLM's Garnet Resource Management Plan; BLM's Draft Lewistown Resource Management Plan; BLM's Draft Resource Management Plan and EIS Statement for the Missoula Field Office; the Blackfeet Forest Management Plan; the FIR Forest Management Plan; DNRC's HCP; ARM 36.11.433 and 12.9.1401; the Wilderness Act of 1964; and the 2002 Roadless Rule; and (2) as described under *Human-Caused Mortality*: the Grizzly Bear Management Plan for Western Montana; the FIR Grizzly Bear Management Plan; the Bear Management Plan and Guidelines for Bear Management on the BIR; the Blackfeet National Fish and Wildlife Code; and ARM 12.9.1401 and 12.9.1403. The management infrastructure to maintain habitat conditions and limit mortality is or will be in place, as described in the NCDE Conservation Strategy, prior to any final rule. Because the signatory agencies to the NCDE Conservation Strategy are the same agencies that have been managing grizzly bear habitat, population, and monitoring for the last 40 years, a management transition post-delisting would be minimal. Regulatory mechanisms are currently not final and therefore we cannot evaluate their adequacy to ensure the NCDE grizzly bear population will continue to meet the recovery criteria and maintain resiliency.

The NCDE grizzly bear population has experienced population growth and range expansion since 1993 (Dood *et al.* 1986, p. 164; Kendall *et al.* 2009, p. 3; Mace *et al.* 2012, p. 124; Costello *et al.* 2016b, p. 2; Costello *et al.* 2023, p. 14; Costello *et al.* 2024, *in prep.*), in spite of potential threats from disease, predation, genetic health, potential changes in food resources, climate change, and stochastic events. Many of these are infrequent and unpredictable and are not currently a significant concern for the NCDE population.

Many of the threats faced by grizzly bears are interrelated and could cumulatively impact the NCDE grizzly bear population through excessive grizzly bear mortality. While these numerous stressors on grizzly bear viability are challenging to conservation, our experience demonstrates it is possible for large-carnivore conservation to be compatible with them (Linnell *et al.* 2001, p.

48), particularly given the rigorous scientific monitoring protocols established for the NCDE grizzly bear population. There will always be stressors to the NCDE grizzly bear population, but if these are not causing the population to decline, we do not consider them currently to be significant threats to the long-term viability of the population.

Summary of Cause-and-Effects in the CYE, SE, BE, and North Cascades

When grizzly bears were listed in 1975, we identified habitat destruction and modification, isolation, and human-caused mortality, mainly "indiscriminate illegal killing" and management removals, as threats to the population. The States of Idaho, Montana, and Washington have regulations, independent of the Act, that make it illegal to kill a grizzly bear other than in defense-of-life, except for limited circumstances, as described further in *Mortality Limits* (ARM 14.9.1403; IDAPA 13.01.06.100.01.5; IDAPA 13.01.06.300.01; Washington Administrative Code 220-610-010). Human-caused mortality will continue to be the limiting factor, but it can be managed within levels that prevent population decline. Human-caused mortality has been reduced to levels that have allowed the CYE population to increase at a rate of 2.7 percent annually (Kasworm *et al.* 2024a, p. 41) and the SE to increase 2.5 percent annually (Kasworm 2024b, p. 28). There is currently no known population in either the BE or the North Cascades. Because of the small population sizes in the in CYE and SE, isolation is still a potential threat to the resiliency of these grizzly bear populations. Trans-boundary connectivity has been observed in the NCDE and limited demographic and genetic connectivity has been observed between Canadian populations and the SE and the Yaak portion of the CYE. While gene flow has not yet been documented between the CYE and SE, movements between the CYE, SE, and NCDE and Canada have increased. In addition, movements between the CYE, SE, NCDE and the BE have increased, there is approximately 9.2 km (5.7 mi) between the current estimated occupied range of females in the NCDE and the BE recovery zone (Costello *et al.* 2023, p. 14), and there are multiple verified sightings between the GYE and NCDE distributions and the BE (Figure 2).

Habitat standards currently exist only in the CYE and SE recovery zones and BORZ are managed under a "no net loss" policy (in their entirety: USDA FS 2011a, 2015b, 2015c, 2019). These standards should reduce human-caused mortality risk. Inter-ecosystem connectivity could be enhanced by higher female survival rates in connectivity areas, as research indicates female occupancy in these intervening connectivity areas is necessary for demographic connectivity (Proctor *et al.* 2015, pp. 8–11; Proctor *et al.* 2018, pp. 356–364). Habitat standards are not yet in place in the two unoccupied recovery zones, the BE and North Cascades. We do not view the lack of standards in the BE as a threat, however, because it is 98 percent Wilderness. In the North Cascades, approximately 64 percent of the public lands are designated Wilderness or IRAs, and existing regulatory mechanisms regulate the remaining Federal lands under a "no net loss" policy for secure core habitat. However, existing motorized access levels are unknown on USFS lands and we are unable to assess the adequacy of existing levels. Further monitoring of the population and cause-specific mortality will determine the success of the current "no net loss" policy. Habitat protections within the CYE and SE and in potential connectivity areas in the form of easements and purchases have protected additional lands. Because habitat in the SE and CYE may only support relatively small grizzly bear populations, and the North Cascades and BE are unoccupied, connectivity with other grizzly bear populations, including Canada, is necessary for their long-term conservation.

The principal land management agency in the CYE and SE, the USFS, amended forest plans with regulatory requirements for food storage orders requiring forest users to keep foods and attractants inaccessible to bears in the recovery zones and BORZ (in their entirety: USDA FS 2011a, 2015b, 2015c, 2019). Food storage orders should reduce human-caused mortality risk. There are no food storage orders within the BE recovery zone. In the North Cascades, food storage orders are in effect in NCNP and the Mount Baker Snoqualmie NF instituted a food storage order in 2023 on the west portion of the North Cascades (NCNP 2023, entire; USDA FS 2023e, entire); however, there are no food storage orders on the east portion of the North Cascades managed by the Okanogan-Wenatchee NF. The lack of food storage orders within all of the North Cascades and any of the BE recovery zones may contribute to future grizzly bear mortality risk and inhibit restoration efforts or natural recolonization. As grizzly bear distribution expands, food storage orders in areas outside the recovery zones would likely facilitate connectivity.

Effective I&E programs have been an essential factor in the progress towards recovery of the CYE, SE, NCDE, and GYE grizzly bear populations since its listing in 1975 and have likely played a crucial supporting role to the success of other grizzly bear management strategies implemented for the population. In addition, I&E programs in the BE and North Cascades lay the foundation for minimizing human-bear conflict and facilitating restoration of grizzly bears in these two ecosystems.

Chapter 6: Current Condition

In this chapter, we describe the current condition, as of 2023, of the grizzly bear in the lower-48 States in terms of resiliency, redundancy, and representation. We do this by evaluating the current condition of the habitat and demographic factors that we identified as needs in Chapter 4. In Chapter 5, we summarized our evaluation of potential stressors and conservation efforts that influence the condition for each ecosystem. The stressors that influence current resiliency of ecosystems include sources of human-caused mortality and motorized access. As also summarized in Chapter 5, a variety of conservation measures help reduce the influence of these stressors on ecosystem resiliency.

We begin our evaluation of current condition with a description of the methodology that we used to evaluate resiliency consistently across all six ecosystems. We developed a categorical model, called a condition category table, to calibrate resiliency in terms of stochastic risk based on the condition of two habitat factors and six demographic factors. We then used this table to evaluate resiliency for each ecosystem and summarized our evaluation of current condition for the grizzly bear in terms of the 3Rs.

Methodology to Evaluate Current and Future Condition

As summarized in Chapter 4, we identified habitat security, cover, high-caloric foods, and dens as habitat needs for the grizzly bear in the lower-48 States. For demographic needs, we identified connectivity, adequate fecundity and survival, genetic diversity, population trend, and abundance as ecosystem-level needs for resiliency. For our analysis of current and future condition, we selected a subset of these needs, two habitat factors and six demographic factors that are most influential to ecosystem resiliency and that we could measure relatively consistently across all six ecosystems. The two habitat factors and six demographic factors that we used to evaluate condition were:

- **Natural, high-caloric foods**, as measured by available data on body fat, stable isotope analyses, and where available, the direct monitoring of food sources;
- **Habitat security**, as measured by the status of meeting habitat standards, where applicable, and the existence of other protections that influence the security of habitats;
- **Adult female survival**, as measured by estimates of survival rates using data from radio-collared individuals;
- **Abundance,** as measured by progress toward meeting **Population Targets** outlined in relevant conservation plans, and the **Number of Bears**. While the overall number of bears is most important to resiliency, we also evaluated population targets to acknowledge that some recovery zones are small in size (and therefore rely on connectivity to larger populations nearby) and carrying capacity is more limited. Population targets consider both biological and social factors and do not represent carrying capacity for each ecosystem;
- **Population trend**, as measured using long-term trend data available for each ecosystem;
- **Reproductive female distribution,** a measure of fecundity, as measured by occupancy of BMUs by reproductive females;

- **Inter-ecosystem connectivity,** or natural connectivity between ecosystems either within the U.S. or between the U.S. and Canada, as measured by monitoring data on immigration. Natural connectivity can facilitate a small population to become self-sustaining, an objective of the recovery plan (Service 1993, p. 15); and
- **Genetic diversity,** as measured by the effective population size, heterozygosity, allelic richness, and inbreeding rates, as available for each ecosystem.

We describe each of these habitat and demographic factors needed by individuals and ecosystems in more detail in Chapters 2 and 4.

We then developed a categorical model, called a condition category table, for these two habitat and six demographic factors, to calibrate our evaluation of resiliency in terms of a plausible range of stochastic risk, from highest to lowest risk, for each factor (Table 19). The categories we used to describe resiliency are high, moderate, low, very low, and functionally extirpated, which represent relative levels of stochastic risk for each factor, with high being the most resilient, and functionally extirpated being the least resilient, based on the condition of the factor as described in the table's rows. For the two habitat factors (high-caloric foods and habitat security), and one demographic factor (population trend), resiliency categories did not include a 'very low' score due to evaluation metrics.

We used a condition category table to calibrate our understanding of resiliency and to evaluate the condition of each habitat and demographic factor for each ecosystem. As we considered the condition, we used metrics that were available consistently for all ecosystems, including compiled information from peer-reviewed literature, surveys and reports, and input from scientific experts. For several factors, other accurate metrics exist (e.g., carrying capacity to measure population target); however, we did not have accurate estimates of those metrics for all ecosystems and therefore used different metrics commonly available to evaluate condition. Throughout our evaluation, we considered the life history and ecology of grizzly bear in the lower-48 States, as summarized in Chapter 2, data on the current distribution and trends, as summarized in Chapter 2, and our cause-and-effect analysis of stressors and conservation efforts, as summarized in Chapter 5. The SE recovery zone extends into Canada, but we analyzed the SE for the lower-48 States portion only where possible; however, there are some demographic factors that are assessed for the entire recovery zone, and we note where this is the case.

To calculate an overall score for resiliency, we assigned weighted values to the resiliency categories and then calculated a weighted average using the formula in Figure 32. We assigned 4 to high, 3 to moderate, 2 to low, 1 to very low, and 0 to the functionally extirpated category. We weighted the demographic factor for abundance, the number of bears, three times, due to its relative importance to the resiliency of each ecosystem and to balance its weight proportionally to four other demographic factors. Adult female survival and fecundity influence the number of bears, population trend reflects changes in the number of bears, and population target is a different metric of the same factor (number of bears) (Figure 32). Population target is an objective or threshold from existing plans and conservation strategies and considers biological and social factors; it does not represent carrying capacity.

We based the overall condition score thresholds on the difference between the highest and lowest possible condition scores, divided into five equal intervals. A weighted average of 3.2 or greater was classified as a High Condition; 2.4–3.19 a Moderate Condition; 1.6–2.39 a Low Condition; 0.8–1.59 a Very Low Condition; and less than 0.79 a Functionally Extirpated (X) Condition (Figure 32). For any ecosystem, if the demographic factor for abundance, the number of bears, received a Functionally Extirpated Condition (X), then the overall resiliency for the ecosystem is categorized as Functionally Extirpated (X), regardless of the condition category assigned to any of the other habitat or demographic factor. This methodology allowed us to summarize the condition of habitat factors needed by individuals to breed, feed, and shelter, to the demographic factors needed by ecosystems to be resilient, to the redundancy and representation needed by the lower-48 States to withstand catastrophes and adapt to environmental change. In general, ecosystems with higher resiliency have greater viability over the next 30 to 45 years than ecosystems with lower resiliency.

$$\boldsymbol{Overall\ Resiliency = (High\ Caloric\ Foods + Habitat\ Security + Adult\ Female\ Survival + Population\ Target + 3 * (Number\ of\ Bears) + Population\ Trend + Reproductive\ Female\ Distribution + InterEcosystem\ Connectivity + Genetic\ Diversity)/11}$$

Calculation of Thresholds for Overall Resiliency Condition

Max Score	4	
Intervals	0.8	
	Min	**Max**
High (4)	3.2	4
Moderate (3)	2.4	3.2
Low (2)	1.6	2.4
Very Low (1)	0.8	1.6
Extirpated – X (0)	0.0	0.8

Figure 32. Formula and thresholds used to calculate an overall score for resiliency for each ecosystem based on our evaluation of condition for the two habitat factors and six demographic factors.

Table 19. Condition category table (categorical model) used to evaluate resiliency in terms for the six ecosystems of grizzly bear in the lower-48 States, in terms of two habitat factors and six demographic factors.

Resiliency Categories	Habitat Factors		Demographic Factors						
				Abundance					
	Natural, High-Caloric Foods	Habitat Security	Adult Female Survival	Population Target	Number of Bears (3x)	Population Trend	Reproductive Female Distribution	Inter-Ecosystem Connectivity	Genetic Diversity
Evaluation Metrics	Body fat data, stable isotope analysis, and/or direct monitoring of food sources	Status of meeting various habitat standards; existence of other protections that ensure habitat security	Estimated survival rates using peer-reviewed methodology[14]	Recovery criteria and/or Conservation Strategies indicate population target; the methods we use to estimate the number of bears depends on the ecosystem	The methods we use to estimate the number of bears varies by ecosystem	The method we use to estimate population trend varies by ecosystem and reflects the long-term trend	A BMU is occupied by a reproductive female at least once in a 6-year window	Monitor natural immigration into ecosystems during the most recent generation interval (10 to 15 years) (through radio-collared bears, DNA sampling, marked individuals)	Effective population size, heterozygosity, allelic richness, inbreeding rates
High (4)	Diverse, high-caloric, natural foods are not limiting	Availability of secure habitat is sufficient to meet individual needs	Survival rate is above 0.93	At or above target	More than 800 bears	Lambda stable or increasing (≥ 1)	All BMUs within the recovery zone are occupied	Females have immigrated and bred (demonstrating demographic connectivity)	Sufficient for long-term fitness
Moderate (3)	Diverse, high-caloric, natural foods are somewhat limiting	Availability of secure habitat to meet individual needs is somewhat limiting	Survival rate is between 0.90–0.93	80–99 percent of target	400–799 bears	Lambda is slightly declining (between 0.98 and 1)	70–99% of the BMUs within the recovery zone are occupied	Males have immigrated and bred (demonstrating genetic connectivity)	Sufficient for short-term fitness
Low (2)	Diverse, high-caloric, natural foods are limiting	Availability of secure habitat to meet individual needs is limiting	Survival rate is below 0.90	50–79 percent of target	91–399 bears	Lambda is declining (between 0.95 and 0.98)	50–69% of the BMUs within the recovery zone are occupied	Evidence of an immigrant that has established a home range within the ecosystem but no documented breeding	Sufficient for short-term fitness, but with high levels of inbreeding
Very Low (1)			Female survival rate cannot be accurately estimated as a result of inadequate monitoring, small samples size, or a newly established population.	Less than 50 percent of the target and has evidence of reproduction.	Fewer than 90 bears and a known population	Lambda is precipitously declining (below 0.95). A population may also be considered very low if lambda cannot be accurately estimated as a result of inadequate monitoring, small sample size, or a newly established population.	Less than 50% of the BMUs are occupied	Immigrant is documented within the ecosystem but no evidence of home range establishment or breeding	Insufficient for short-term or long-term fitness or newly established population.
Extirpated (0)	Diverse, high-caloric, natural foods are absent	There is no secure habitat	No known population	No known population	No known population	No known population	No BMUs occupied	No connectivity	No known population

[14] Data from radio-collared individuals is currently used to estimate survival rates.

Current Condition: Resiliency

Table 20 summarizes the current demographic data in each ecosystem for five of the demographic factors used to evaluate resiliency.

Table 20. Summary of current data, as of 2023, for five demographic factors used to evaluate resiliency. Values are point estimates and do not reflect sampling errors associated with estimates.

	Adult Female Survival	Reproductive Female Distribution	Population Trend	Population Target	Number of Bears
GYE	0.96	18 out of 18 BMUs occupied	1.03	Above target of 800–950	1,030
NCDE	0.93	23 out of 23 BMUs occupied	1.023	Above target of 800	1,163
CYE	0.92	16 out of 22 BMUs occupied	1.027	Below target of 100	70 bears
SE	0.92	9 out of 10 BMUs occupied	1.025	Below target of 90 (including Canada)	Minimum of 51 bears (in U.S.)
BE	0	0	0	Below target of 280	X
North Cascades	0	0	0	Below target of 200	X

Table 21 presents our evaluation of current condition for grizzly bears in the six ecosystems in the lower-48 States. Currently, there are two ecosystems with high resiliency (GYE and NCDE), one ecosystem with moderate resiliency (SE), and one ecosystem with low resiliency (CYE). Two ecosystems (BE and North Cascades) are currently in a functionally extirpated condition, with no resiliency. There may be one or more individuals in the BE, however there is no known population, so it currently is in a functionally extirpated condition. We summarize our evaluation of current condition for ecosystem below.

*Table 21. Current condition, as of 2023 , for six ecosystems for the grizzly bear in the lower-48 States, evaluated used the condition category table for resiliency. *Overall Current Condition was calculated as the weighted average of all factors, with "number of bears" weighted three times due to its importance to resiliency. High=4, Moderate = 3, Low=2, Very Low=1, and Functionally Extirpated (X) = 0, with score thresholds as Moderate= 2.4–3.19, Low= 1.6–2.39, Very Low=0.8–1.59; and less than 0.79 = Functionally Extirpated (X) Condition. An X in number of bears results in an overall condition of X, regardless of the other factors. In general, ecosystems with higher resiliency have greater viability over the next 30 to 45 years, based on their ability to withstand stochastic events, than ecosystems with lower resiliency.*

CURRENT CONDITION										
	Habitat Factors		Demographic Factors							
Ecosystem	Natural, High-Caloric Foods	Habitat Security	Adult Female Survival	Abundance		Population Trend	Reproductive Female Distribution	Inter-Ecosystem Connectivity	Genetic Diversity	RESILIENCY*
				Population Target	Number of Bears (3x)					
GYE	High	High	High	High	High	High	High	X	Moderate	**High**
NCDE	High	High	Moderate	High	High	High	High	High	High	**High**
CYE	Moderate	Moderate	Moderate	Low	Very Low	High	Moderate	Moderate	Low	**Low**
SE	Moderate	Moderate	Moderate	Moderate	Very Low	High	Moderate	Moderate	Moderate	**Moderate**
BE	Moderate	High	X	X	X	X	X	Very Low	X	**X**
North Cascades	Moderate	Moderate	X	X	X	X	X	X	X	**X**

Current Condition in the GYE

Overall Current Condition: HIGH

High-Caloric Foods: HIGH
- High-caloric foods are readily available and diverse.

Habitat Security: HIGH
- A variety of land protections influence the current condition of these habitat factors (Chapters 2 and 5).

Adult Female Survival: HIGH
- Adult female survival = 0.96.

Reproductive Female Distribution: HIGH
- Females with young occupy 18 of 18 BMUs.

Population Trend: HIGH
- Population growth rate = 1.03 (annual growth from 2020 to 2023; Gould *et al.* 2024a, p. 12)

Population Target: HIGH
- Population size = 1,030 individuals inside the DMA, as estimated by IPM (Gould *et al.* 2024c, *in prep.*). Beginning with 2022 grizzly bear demographic data, the IGBST began implementing an integrated population model (IPM) to estimate population size. In January 2024, the States of Idaho and Wyoming amended the Tri-State MOA to incorporate new commitments to maintain a biologically recovered population including population objectives. The Montana Fish and Wildlife Commission accepted the Tri-State MOA in June 2024. The Yellowstone Ecosystem Subcommittee and the IGBC approved incorporation of the new commitments into the Conservation Strategy in May 2024 and June 2024, respectively. We believe that the GYE grizzly bear population has met the intent of the population target set forth in demographic recovery criterion 3.

Number of Bears: HIGH
- 1,030 individuals, large population size increases population fitness. The increase from moderate to high condition is the result of the IGBST implementing an IPM which more accurately estimates the population size.

Genetic Diversity: MODERATE
- Heterozygosity is moderate and the population remains isolated.

Inter-Ecosystem Connectivity: FUNCTIONALLY EXTIRPATED
- Population is currently isolated, but given the increased occupied distributions of the GYE and NCDE and the increasing number of verified sightings in between these distributions (Figure 22), if current trends continue, we expect that natural immigration

into the GYE will occur in the future and improve the condition of inter-ecosystem connectivity.

Current Condition in the NCDE

Overall Current Condition: HIGH

High-Caloric Foods: HIGH

- High-caloric foods are readily available and diverse.

Habitat Security: HIGH

- A variety of land protections influence the current condition of these habitat factors (Chapters 2 and 5).

Adult Female Survival: MODERATE

- Adult female survival = 0.93 (Costello *et al.* 2024, *in prep.*).

Reproductive Female Distribution: HIGH

- Females with young occupy 23 of the 23 BMUs in the NCDE. We note that due to its forested habitats, which make surveying females with cubs challenging, this factor is difficult to measure in the NCDE. Additionally, one BMU in the NCDE is entirely a Wilderness area that is not actively monitored, which also suggests that occasionally this condition could be underestimated in the NCDE.

Population Trend: HIGH

- Population growth rate = 1.023.

Population Target: HIGH

- Estimated number of individuals = 1,163 individuals (target for the lower 90% confidence bound, taking into account sampling uncertainty associated with demographic parameters = 800). Given current rates and levels of uncertainty, managing for a population with a greater than or equal to 90 percent estimated probability of being above 800 bears requires maintaining an estimated population size of approximately 950–1,000 bears.

Number of Bears: HIGH

- 1,163 individuals, large population size increases population fitness.

Genetic Diversity: HIGH

- Due to high population size and relatively high levels of heterozygosity and allelic richness (Kendall *et al.* 2008, pp. 1698–1704; Kendall *et al.* 2009, pp. 9–12; Mace *et al.* 2012, pp. 124–125; Proctor *et al.* 2012, pp. 33–34; Mikle *et al.* 2016a, pp. 4–6; Morehouse *et al.* 2016, pp. 1160–1163).

Inter-Ecosystem Connectivity: HIGH

- Female grizzly bears have naturally entered the NCDE from Canada and bred (Proctor *et al.* 2012, entire).

Current Condition in the CYE

Overall Current Condition: LOW

High-Caloric Foods: MODERATE
- The CYE is smaller than the GYE and NCDE, with a narrower range of habitats, which may limit the diversity of foods available. Only a few alternatives to huckleberries exist in the CYE, and its forested habitats may make ungulates less available as a food source. Although foods are less diverse in the CYE, individuals have body fat levels to indicate that natural, high-caloric foods are not limiting.

Habitat Security: MODERATE
- Habitat security is somewhat limiting in the CYE. Although there are large, protected areas within the CYE recovery zone (with 44 percent designated as Wilderness or IRAs), additional protections outside the recovery zone, and recent conservation efforts on private lands, habitat standards for motorized route densities established for the CYE recovery zone have not yet been met.

Adult Female Survival: MODERATE
- Adult female survival = 0.92.

Reproductive Female Distribution: Moderate
- Females with young occupy 16 of 22 BMUs. The number of BMUs with verified female reproduction has increased with population growth over the decade and reached a high in 2022. This increase led to an improvement from low to moderate in reproductive female distribution since our previous SSA report. We expect that over time, if the population trend and adult female survival rates remain high in the CYE, the population in this ecosystem will likely expand, which would improve the condition of reproductive female distribution. Due to the small size of BMUs in the CYE, a single female home range will likely still overlap multiple BMUs contributing to reproductive female distribution.

Population Trend: HIGH
- Population growth rate = 1.027.

Population Target: LOW
- The population target of 100 for the CYE is not currently being met.

Number of Bears: VERY LOW
- Approximately 70 individuals (Kasworm *et al*. 2024a, p. 43). This low estimate likely reflects the fact that the CYE is a smaller ecosystem that is still slowly recovering from being close to historical extirpation, particularly in the Cabinets portion of the CYE.

Genetic Diversity: LOW

- The low rating is driven by the Cabinets portion of the CYE. Though we have documented some movement and gene flow from the Purcells north of Hwy. 3 into the Yaak, we have only recently detected movement by males but no gene flow into the Cabinets. Despite concerns about potential inbreeding due to a small population size, evidence of connectivity suggests there is short-term genetic fitness in the CYE.

Inter-Ecosystem Connectivity: MODERATE

- Males have naturally immigrated into the Yaak portion of the CYE and subsequently bred, but we have only detected movements into or out of the Cabinets portion (Kasworm *et al.* 2024a, pp. 76–80; Proctor *et al.* 2018, p. 363). Emigration out of the CYE has occurred and may benefit other ecosystems.

Current Condition in the SE

The recovery zone extends into Canada, therefore, some of the demographic information (i.e., female survival and population trend) we have is based on the entire recovery zone (so includes bears in Canada).

Overall Current Condition: MODERATE

High-Caloric Foods: MODERATE

- Foods are less diverse in the SE, likely due to its small size and narrower range of habitats. The SE is also forested, which may reduce the availability of ungulates as a food source. Although high-caloric foods are somewhat limiting in the SE, body fat levels indicate that individuals are relatively healthy.

Habitat Security: MODERATE

- Although there are large, protected areas within the SE recovery zone (with nearly 36 percent designated as Wilderness or IRAs), motorized route densities do not yet meet applicable habitat standards, although they are close. There have been recent conservation efforts on private lands in Canada and there are some regulations that manage motorized access outside the recovery zone. However, motorized access standards have not been fully implemented, and motorized route densities somewhat limit the availability of habitat security in the SE.

Adult Female Survival: MODERATE

- Adult female survival rate = 0.92.

Population Trend: HIGH

- Population growth rate = 1.025.

Population Target: MODERATE

- We cannot currently conclude whether the population target of 90 bears, including Canada, is being met. Kasworm *et al.* (2024b, p. 21) identified a minimum of 51 individuals in the U.S. portion of the SE and Proctor *et al.* (2022, p. 16) estimated 69 individual bears in the Canadian SE. However, due to the open U.S.-Canadian border for this population, some individuals are thought to have been counted in both estimates and these two estimates cannot be added to derive a population estimate (Proctor *et al.* 2022, p. 20). Future modeling is planned to determine an overall population estimate for the SE.

Number of Bears: VERY LOW

- An estimate of 83 bears for the international population was made in 2010 (Proctor *et al.* 2012, p. 31). A minimum of 51 individuals was identified in the U.S. portion as of 2023. Small population size decreases population fitness. Some individuals in the U.S. minimum population estimate have home ranges that crossed the international border, for which an updated population estimate is in progress.

Reproductive Female Distribution: MODERATE

- Nine of the 10 BMUs had sightings of females with young. The number of BMUs with verified female reproduction has increased with population growth over the last several decades. We expect that if the SE population continues to expand and maintains a positive population trend, females with cubs will occupy more of the BMUs, which would improve the condition of reproductive female distribution in the SE. Due to the small size of BMUs in SE, a single female home range will likely still overlap multiple BMUs contributing to reproductive female distribution.

Genetic Diversity: MODERATE

- Heterozygosity values in the SE, as measured in the trans-boundary population, remain low, due to the small number of bears, historical bottleneck, and past isolation. However, heterozygosity has increased some in the past decade with increased immigration and breeding from other populations (Proctor *et al.* 2018, p. 361).

Inter-Ecosystem Connectivity: MODERATE

- Multiple males and a single female have been observed moving into the SE from other ecosystems and reproducing (Kasworm *et al.* 2024b, p. 24). Emigration out of the SE has occurred and may benefit other ecosystems.

Current Condition in the BE

Overall Current Condition: FUNCTIONALLY EXTIRPATED

- There is at least one known grizzly bear near the recovery zone, but no known population.

High-Caloric Foods: MODERATE

- High-caloric foods may be less diverse in the drier southern part of the BE.

Habitat Security: HIGH

- Approximately 98 percent of the BE recovery zone is designated Wilderness. In our previous SSA report we categorized habitat security as moderate because motorized access standards that may facilitate recovery have not been developed on lands adjacent to the recovery zone. The change from moderate to high from our previous SSA report is the result of a change in our analysis to focusing on the recovery zone. Connectivity from occupied populations to the BE is needed to recolonize and recover the currently unoccupied BE and is assessed under *Inter-Ecosystem Connectivity*.

Adult Female Survival: FUNCTIONALLY EXTIRPATED

Reproductive Female Distribution: FUNCTIONALLY EXTIRPATED

Population Trend: FUNCTIONALLY EXTIRPATED

Population Target: FUNCTIONALLY EXTIRPATED
- The population target of 280 bears (Service 2000, p. ii) is not currently being met.

Number of Bears: FUNCTIONALLY EXTIRPATED
- There is no known population but in 2019, a collared bear dispersed from the CYE into the BE recovery zone and returned north to the CYE to den. Multiple additional grizzly bears have been confirmed in areas immediately surrounding the recovery zone over the last 15 years, indicating that connectivity is possible.

Genetic Diversity: FUNCTIONALLY EXTIRPATED

Inter-Ecosystem Connectivity: Very LOW
- Despite its relative isolation from other ecosystems, recent sightings suggest that inter-ecosystem connectivity is currently very low for the BE. In 2019, at least one bear from the CYE spent time in the BE recovery zone, two subadult grizzly bears that dispersed from the NCDE documented in 2022 and returned to the NCDE after they were preemptively trapped and moved to avoid conflict, a subadult male grizzly bear that dispersed from the NCDE that was trapped within miles of the BE in 2023, and there have been multiple, verified sightings to the north and west of the recovery zone, one of which is known to have originated from the SE. There have also been verified sightings in potential connectivity areas between all four occupied ecosystems, although it is unknown for every case from which ecosystem the individuals originated. Numerous conservation easements on private lands and the purchase of land by land trusts have increased the potential for future natural recolonization of the BE from other ecosystems. While these conservation measures are helpful for connectivity, and the distance between the BE and the current distribution of females NCDE is small (9.2 km (5.7 mi)), significant impediments remain in place (e.g., I-90) that act to slow down immigration. To date, all but one of the verified occurrences of grizzly bears entering the BE have been males and female immigration is also needed for natural recolonization. Female immigration is anticipated to be slower given their shorter dispersal distances and potential barriers (e.g., I-90).

Current Condition in the North Cascades

Overall Current Condition: FUNCTIONALLY EXTIRPATED

High-Caloric Foods: MODERATE

- Berries and herbaceous material are the primary foods available; ungulate food sources are less available and salmon availability is limited to streams on the westerns slope.

Habitat Security: MODERATE

- For the BMUs in the North Cascades, there is a habitat standard of "no net loss" of core areas developed from a 1997 baseline. Federal land managers have met this baseline; however, we have not evaluated whether this 1997 "no net loss" approach provides an adequate amount of secure habitat for a healthy grizzly bear population. Approximately 64 percent of the North Cascades is designated Wilderness or IRAs. Therefore, although the North Cascades has protected areas and meets its "no net loss" approach, uncertainty associated with the adequacy of the baseline means that the condition of habitat security is currently moderate for the North Cascades. We note that the North Cascades likely has sufficient habitat resources to support a population (Servheen *et al*. 1991, p. 6; Almack *et al*. 1993, pp. 21–22; Gaines *et al*. 1994, pp. 540–543; Lyons *et al.* 2018, p. 30). The Service is currently coordinating with the U.S. Forest Service (USFS) and NPS through the Interagency Grizzly Bear Committee (IGBC) North Cascades Subcommittee Technical Team to review and update the baseline and to memorialize the "no net loss" agreement for the North Cascades Recovery Zone.

Adult Female Survival: FUNCTIONALLY EXTIRPATED

Reproductive Female Distribution: FUNCTIONALLY EXTIRPATED

Population Trend: FUNCTIONALLY EXTIRPATED

Population Target: FUNCTIONALLY EXTIRPATED

- The restoration goal of 200 bears (NPS and Service 2024a, p. 6) is not currently being met.

Number of Bears: FUNCTIONALLY EXTIRPATED

Genetic Diversity: FUNCTIONALLY EXTIRPATED

Inter-Ecosystem Connectivity: FUNCTIONALLY EXTIRPATED

- The North Cascades is currently isolated and does not contain a known population.

Summary of Current Resiliency

Currently, the GYE and NCDE have high resiliency. The SE has moderate resiliency and the CYE has low resiliency. Resiliency of the GYE and NCDE is currently high due to the generally high and moderate conditions for the habitat and demographic factors that influence resiliency (Figure 33). Despite high population trends and high and moderate adult female survival, both the CYE and SE currently have very low numbers of bears, although this factor could improve as bears reproduce and expand in the future. Despite the moderate condition of habitats, without known populations, the BE and North Cascades are currently in functionally extirpated condition, and therefore have no resiliency.

Although the BE and North Cascades currently do not support populations and are in overall functionally extirpated condition, I&E programs provide an important foundation for minimizing human-bear conflicts and human attitudes and support for potential future restoration of grizzly bears in these two ecosystems. The I&E team for the North Cascades and BE IGBC Subcommittee coordinates the development, implementation, and dissemination of programs and materials to aid in preventative management of human-bear conflicts. I&E team members include the Service, State fish and game agencies, Tribal wildlife agencies, the NPS, and the USFS. These partners recognize that public I&E programs are crucial in preventing human-grizzly bear conflicts, which is evidenced by the fact that they have been actively involved in grizzly bear I&E outreach for over a decade. I&E efforts include: public meetings; community events; informational posters, brochures, and bear identification sheets; bear-resistant containers; electric fencing; and funding of outreach by NGOs. In contrast to these I&E efforts, there are currently no food storage orders on the NFs in the BE, which manage nearly 100 percent of the BE recovery zone. Similarly, there are currently no food storage orders on the east portion of the North Cascades managed by the Okanogan-Wenatchee NF; food storage orders are in effect in NCNP and on the Mount Baker Snoqualmie NF on the west portion of the North Cascades (NCNP 2023, entire; USDA FS 2023e, entire). The lack of food storage orders on USFS lands within all of the North Cascades and any of the BE recovery zones could reduce potential future improvements in the condition of the demographic factors for these ecosystems.

Current Condition: Redundancy

Redundancy describes the number and distribution of ecosystems, such that the greater the number and the wider the distribution of the ecosystems, the better able grizzly bear in the lower-48 States can withstand catastrophic events. Grizzly bears in the lower-48 States currently occupy four ecosystems, with two ecosystems with high resiliency, one with moderate resiliency, and one with low resiliency. Two ecosystems are currently in functionally extirpated condition, with no resiliency, so do not contribute to redundancy. The four ecosystems are currently distributed from north to south and east to west as illustrated in Figure 33.

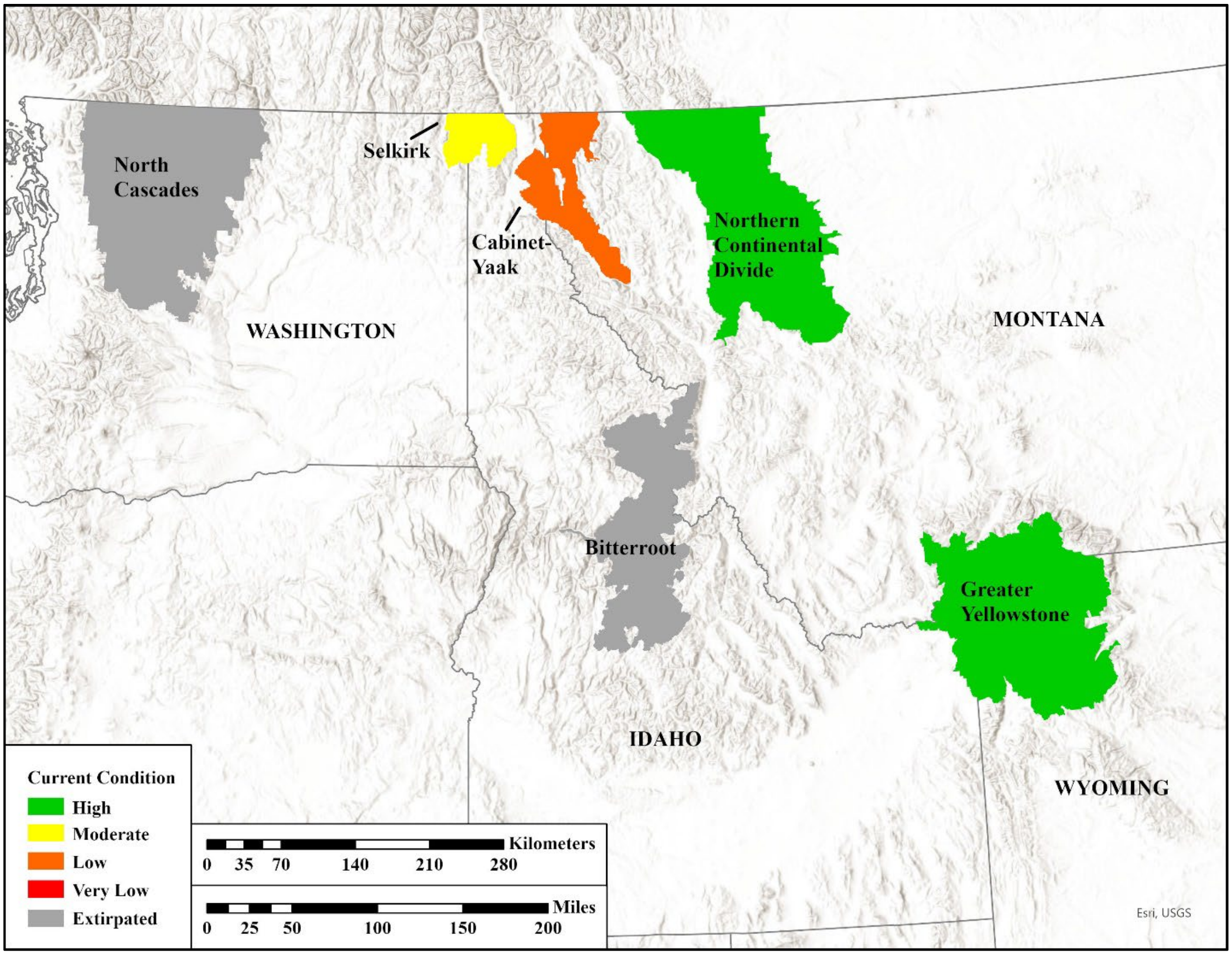


Figure 33. Map of the overall current condition for the six grizzly bear ecosystems in the lower-48 States, in terms of resiliency, redundancy, and representation. Colors represent the current resiliency for each ecosystem, based on the current condition of two habitat factors and six demographic factors for each ecosystem. Ecosystems with higher levels of resiliency are at less risk from environmental and demographic stochasticity. Currently, the Greater Yellowstone (GYE) and Northern Continental Divide (NCDE) ecosystems have high resiliency, the Selkirk ecosystem (SE) has moderate resiliency, and the Cabinet-Yaak ecosystem (CYE) has low resiliency. The North Cascades and Bitterroot (BE) ecosystems are in a functionally extirpated condition currently, so have no resiliency. Four ecosystems (GYE, NCDE, SE, and CYE) distributed as illustrated on the map contribute to redundancy and these ecosystems feature a diversity of ecological types used by the grizzly bear for representation.

Current Condition: Representation

Representation describes the breadth of ecological, genetic, behavioral, and morphological diversity across the six ecosystems. Representation is currently captured by ecological diversity inherent within the grizzly bear populations in the four resilient ecosystems (Figure 33, above). For example, the GYE, contained in the Middle Rockies ecoregion, is dominated by forested, mountainous habitat, and dry sagebrush to the east and south, and includes hydrothermal features and other unique geologic features. The NCDE includes parts of the Great Plains, Middle Rockies, and Northern Rockies ecoregions, and habitat varies from wet forested lands west of Glacier Park to much drier habitat to the east, including prairie grasslands. The CYE and SE are both contained within the Rocky Mountains, and are characterized by wet, forested mountains. The BE is primarily contained in the Idaho Batholith ecoregion, and contains mountainous regions, canyons, dry, partly wooded mountains, grasslands, high glacial valleys, and hot dry canyons. The North Cascades part of the North Cascades ecoregion and is characterized by steep, rugged, glaciated peaks dividing moderate temperate forests on the west side to semi-arid forests and shrub-steppe grasslands to the east.

Summary of Current Condition

Of the six ecosystems, two ecosystems currently have high resiliency, one ecosystem has moderate resiliency, and one ecosystem has low resiliency. Two ecosystems are currently in functionally extirpated condition, with no resiliency. The four resilient ecosystems, the NCDE, GYE, CYE, and SE, contribute to redundancy as they are distributed north to south and east to west across the lower-48 States, and the ecological diversity inherent within these ecosystems contributes to representation (Figure 33, above).

Chapter 7: Future Conditions

In Chapter 6 we described the current condition for the grizzly bear in the lower-48 States in terms of resiliency, redundancy, and representation. In this chapter, we consider how the viability of the grizzly bear in the lower-48 States could change from its current condition in the future. To evaluate future condition, we used the same methodology used to evaluate current condition, but instead considered the plausible conditions for the two habitat factors and six demographic factors projected into the future under a range of plausible scenarios. We developed future scenarios to capture the range of uncertainty associated with how stressors and conservation efforts could influence viability in the future.

We evaluated future condition for the grizzly bear 30 to 45 years into the future. We selected this timeframe because it captures approximately two to three generation intervals for grizzly bears. A generation interval is the approximate time that it takes a female grizzly bear to replace herself in the population. Given the longevity of grizzly bears, two to three generation intervals represent a time period during which a complete turnover of the population would have occurred; any positive or negative changes in the status of the population would be evident. Additionally, this timeframe considers the possibility that USFS land management plans, which may provide important conservation measures to reduce potential stressors, could go through at least one revision. Below we discuss our future scenarios and evaluation of future condition under each scenario.

Future Scenarios

Future scenarios allow us to explore a range of possible future conditions for the grizzly bear in the lower-48 States, given the uncertainty in both the stressors it may face, the potential response to those stressors, and the potential for possible conservation efforts to improve future conditions. For all scenarios, we assumed that stressors and conservation efforts in Canada remain the same and that climate change would not impact grizzly bears within the 30-to-45-year timeframe considered under all future scenarios. For this assessment, we developed five scenarios that capture a range of plausible, future possibilities for the grizzly bear and its habitats, based largely on the conservation efforts and other mechanisms that influence resiliency of ecosystems that we described in Chapter 5. Scenarios are qualitative in nature, include a high level of uncertainty, and are intended for use in evaluating general impacts of potential future stressors and conservation actions. Although there may be different probabilities associated with our future scenarios, all five of our scenarios are plausible for the purposes of our SSA analysis. The future scenarios that we used to evaluate condition for the grizzly bear in the lower-48 States are (see Table 22 below for further details):

- **Future Scenario 1 – Significantly Decreased Conservation**: Under this scenario, conservation actions decrease significantly, largely through the termination or non-renewal of plans or regulations, and rate of private land development increases dramatically;
- **Future Scenario 2 – Decreased Conservation**: Under this scenario, conservation actions decrease, but not as significantly as Scenario 1, due to decreased effectiveness

and implementation of conservation actions and mechanisms, and rate of private land development increases;

- **Future Scenario 3 – Continuation of Conservation:** Under this scenario, conservation actions continue at their same rate, magnitude, and effectiveness as current condition, and rate of private land development remains the same;
- **Future Scenario 4 – Increased Conservation:** Under this scenario, conservation actions increase or improve, and rate of private land development decreases; and
- **Future Scenario 5 – Significantly Increased Conservation:** Under this scenario, conservation actions increase significantly, and rate of private land development decreases dramatically.

Table 22 details the five future scenarios in terms of the expected outcome for stressors and conservation actions under the range from significantly decreased conservation to significantly increased conservation. We describe the causes-and-effects for the sources, stressors, activities, and conservation actions in more detail in Chapter 5.

Table 22. Five future scenarios used to evaluate future condition for the six grizzly bear ecosystems in the lower-48 States.

Source, Stressor, Activity, or Conservation Action	SCENARIO 1: Significantly decreased conservation	SCENARIO 2: Decreased conservation	SCENARIO 3: Continuation of current levels of conservation	SCENARIO 4: Increased conservation	SCENARIO 5: Significantly increased conservation
Monitoring	Significantly decreased research and monitoring. Monitoring level is insufficient to accurately assess population status and/or adequately manage.	Slight decrease in research and monitoring.	The level of research and monitoring by the Service and partners remains consistent. Continued Service and partner cooperation for research and monitoring. Monitoring level is sufficient to accurately assess population status and to adequately manage.	Slight increase in research and monitoring.	Funding assurances in place that ensure research and monitoring will continue indefinitely. Significant increase in funding for research on stressors and the effectiveness of conservation actions and efforts (improved adaptive management).
Motorized Access	Some regulations/management plans currently enforcing motorized access standards are eliminated, new road building occurs, and there is a significant increase in motorized access inside recovery zones and/or other areas designated for grizzly bear occupancy and/or connectivity.	Some motorized access standards decrease and there is an increase in motorized access inside recovery zones and other areas designated for grizzly bear occupancy and/or connectivity.	Management plans, regulations, and protections enforcing and influencing levels of motorized access remain in place inside recovery zones and some other areas designated for grizzly bear occupancy and/or connectivity.	Motorized access standards improves inside recovery zones and other areas designated for grizzly bear occupancy and/or connectivity. As a result, there is a decrease in motorized access.	There is a significant decrease in motorized access in key habitats. There are new/additional regulations limiting motorized access in connectivity areas. There is a decrease in motorized access in recovery zones and other areas designated for grizzly bear occupancy and/or connectivity.
Protected Areas	Some IRAs are rescinded. There is a significant increase in the number of motorized trails in IRAs. All non-designated wilderness areas (e.g., recommended, proposed, WSAs) lose this status and are no longer managed as wilderness.	There is a decrease in the number of IRAs and/or an increase in the number of motorized trails within the IRAs. Some of the non-designated wilderness areas (e.g., recommended, proposed, WSAs) lose this status and are no longer managed as wilderness.	The number of IRAs stays the same. The level of motorized trails within IRAs stays the same. Non-designated wilderness areas (e.g., recommended, proposed, WSAs) continue to be managed as wilderness.	There is a reduction in the number of motorized trails within the IRAs. Some proposed and recommended wilderness and WSAs become designated as wilderness (especially in the CYE).	Some IRAs are converted to Wilderness areas. All proposed and recommended wilderness and WSAs become designated as wilderness (especially in the CYE).
Trains	Carcasses and grain spills are not removed from the tracks. Existing fencing along tracks is not effectively maintained. The HCP with BNSF is not finalized and/or not renewed. The HCP is not expanded to cover all appropriate areas as grizzly bear populations expand.	HCP with BNSF is implemented but not renewed, and voluntary conservation measures that reduce the impact/potential of train collisions are not implemented.	Voluntary conservation measures that reduce the impact/potential of train collisions continue to be implemented. However, all carcasses and spills are not promptly removed, and there is insufficient fencing.	All carcasses and grain spills are cleaned from the tracks and rights of way promptly. There is increased fencing to keep livestock off the tracks and existing fencing is effectively maintained. The HCP with BNSF is finalized and fully implemented	In addition to prompt clean-up of carcasses and spills, increased fencing, and a final HCP with BNSF, the conservation measures in the HCP expand throughout all ecosystems, as appropriate (i.e., if grizzly bear activity in and around train tracks increases such that a collision becomes reasonably likely to occur or if a grizzly-train collision occurs). The HCP is also renewed regularly. There is improved effectiveness and implementation of other conservation actions to reduce the impacts of train collisions, such as noise deterrents, electric fencing on trestles.
Highways	Highways are reconstructed with increased capacity and speed without crossing structures. Fencing is installed to keep wildlife off roads without installation of crossing structures in several key grizzly bear movement areas.	Decreased maintenance of wing fencing around existing crossing structures. New projects include inadequate fencing, particularly in high mortality areas.	Existing crossing structures and fencing are maintained. Partners continue working together to recommend types and locations of crossing structures to facilitate connectivity as opportunity arise. State Departments of Transportation continue to remove vehicle-killed animals to reduce grizzly bear mortality.	Wing fencing is improved around existing crossing structures. Agencies are given adequate time to review and comment on new highway projects in grizzly bear range. For new highway projects that include crossing structures, structures meet minimum recommended sizes for grizzly bear use. Alternative funding sources identified and mechanisms to accept outside funding are established. Crossing structures and fencing are constructed on some highways with high numbers of vehicle-caused mortality.	All proposed projects that are identified as important for grizzly bears incorporate construction design that is beneficial for grizzly bears and are added to the programmed project list. Funding is secured for engineering and construction of projects important for grizzly bears within 5 years of being added to the programmed project list.

Source, Stressor, Activity, or Conservation Action	SCENARIO 1: Significantly decreased conservation	SCENARIO 2: Decreased conservation	SCENARIO 3: Continuation of current levels of conservation	SCENARIO 4: Increased conservation	SCENARIO 5: Significantly increased conservation
Livestock (Federal Allotments)	Increase in the number of livestock on Federal lands (increase in the number of active allotments and/or density of livestock). Depredation numbers indicate a significantly increasing trend.	Lower compliance with permit conditions (e.g., food storage orders, carcass removals). Transition allotments to more vulnerable types of livestock (e.g., sheep). Implement less effective animal husbandry practices that increase the potential for conflict. Depredation numbers indicate an increasing trend.	Current grazing practices on Federal allotments stay the same. Livestock operations continue to use existing active allotments (numbers, distribution, type of livestock, and management of livestock stay the same). Depredation numbers indicate a stable trend.	Maintain current number of allotments. Increased compliance with permit conditions (e.g., food storage orders, carcass removals). Transition current allotments to less vulnerable types of livestock. Implement improved animal husbandry practices to reduce potential for conflict. Depredation numbers indicate a declining trend.	Close high-conflict livestock allotments to reduce the number of livestock on Federal lands. Depredation numbers indicate a significantly decreasing trend.
Conflict Prevention	Regulatory mechanisms promoting securing of attractants (e.g., food storage orders, ordinances regarding feeding wildlife) become significantly less effective (either less restrictive or less enforcement) or significantly decrease. Significant increase in the number of livestock on private lands where grizzly bears may occur. Decreased implementation of effective animal husbandry practices to reduce the potential for conflict. Significant decrease in funding for conflict prevention tools.	Regulatory mechanisms promoting securing of attractants (e.g., food storage orders, ordinances regarding feeding wildlife) become less effective (either less restrictive or less enforcement) or decrease. Decreased implementation of effective animal husbandry practices to reduce potential for conflict with livestock on private lands. Decrease in funding for conflict prevention tools.	Existing attractant storage orders and ordinances prohibiting and preventing the feeding of wildlife currently on Federal, state, Tribal, local government and private lands stay in place. The number and locations of livestock currently on private lands remain the same. Current animal husbandry practices remain the same. Continuation of current conflict prevention (i.e., electric fencing) efforts.	Additional attractant storage orders and ordinances prohibiting the feeding of wildlife are implemented so they exist on all public lands where grizzly bears may occur. Additional communities implement attractant ordinances and pursue Bear Smart community recognition. Increased implementation of effective animal husbandry practices to reduce potential for conflict with livestock on private lands. Increased and consistent funding for conflict prevention tools.	Regulations or standards are implemented to secure all attractants on public land where grizzly bears may occur. Significantly more communities implement attractant ordinances and pursue Bear Smart community recognition. Significantly increased implementation of effective animal husbandry practices to reduce potential for conflict with livestock on private lands. Significantly increased and consistent funding for conflict prevention tools (electric fencing, bear spray, bear-resistant garbage cans).
Developed Sites	Existing management plans change or continue to allow for increases in developed sites, and these increases are significant.	Existing management plans change or continue to allow for increases in developed sites, but these increases are in lower quality habitat areas, and they are consolidated near existing development.	Management plans, regulations, and protections limiting the increase in developed sites remain in place inside recovery zones and other designated areas. There are no restrictions on developed sites in the CYE, BE, SE, or North Cascades but development continues to occur at a minimal rate on USFS lands.	There is no increase in developed sites in the GYE recovery zone outside of designated footprints. In the NCDE recovery zone, sideboards on the allowed increases are developed to ensure compatibility with a recovered population. There are restrictions on developed sites in the other recovery zones.	Management plans, regulations, and protections that limit the increase in developed sites to levels compatible with grizzly bear management goals are in place in all recovery zones and connectivity areas.
Forest Plans and National Park Management Plans	The standards that benefit grizzly bears in some (but not all) Forest Plans are eliminated. NPS changes some of their standards so that they are less effective. There are no standards in the connectivity areas.	Standards that benefit grizzly bears in some Forest Plans revised to allow for more motorized access, and allow for increases in other activities (e.g., recreation, timber harvest).	Standards and protections in USFS and NPS land management plans that benefit grizzly bears stay the same. Standards that currently exist in some of the connectivity areas remain in place.	Improvement and expansion of standards that benefit grizzly bears in USFS and NPS management plans in all recovery zones and some other areas designated for grizzly bear occupancy and/or connectivity.	There are habitat management standards that benefit grizzly bears in USFS and NPS management plans in recovery zones and other areas designated for grizzly bear occupancy and/or connectivity improving the security of habitat.
State and Tribal Plans, Policies, and Regulations	State and/or Tribal management plans are terminated or are revised to significantly reduce effectiveness of habitat and mortality management. State and/or Tribal regulations result in unregulated intentional or incidental take.	State and/or Tribal plans revised to incorporate less effective measures to manage habitat and mortality. State and/or Tribal regulations result in some unregulated intentional or incidental take.	Existing State and Tribal plans remain in place. State and/or Tribal regulations may result in some unregulated intentional or incidental take.	Existing State and Tribal plans are updated as appropriate and include legally binding regulatory mechanisms to manage mortality and habitat in additional recovery zones and connectivity areas.	State and Tribal plans are finalized and expanded with legally binding regulatory mechanisms to manage mortality and habitat in all recovery zones and other areas designated for grizzly bear occupancy and/or connectivity.
Private Land Development Rate/Human Populations	Rate of private land development increases dramatically. Significant increases in attractant-related conflicts and mortalities; numbers of recreationists (motorized and non-motorized) on public lands; and economic pressure/more jobs for timber harvest. Restrictions on the use of easements increase.	Rate of private land development increases. Human population increases in areas where grizzly bears are reasonably certain to occur. Restrictions on the use of easements increase.	Rate of private land development remains the same. Conservation easements remain in good standing in key areas inside recovery zones and other areas designated for grizzly bear occupancy and/or connectivity. New easements are considered. Private landowners currently using conflict prevention tools continue.	Rate of private land development decreases. Conservation easements are proactively identified and supported in several key areas. Easements include conflict prevention measures for grizzly bears. Private landowner participation in confliction prevention tools increases.	Rate of private land development decreases dramatically. Significant increases in easements and land transfers to protect development of large tracts of private land (agriculture, timber, etc.) areas. Recreational use is conducted in habitats and manners to reduce impacts to bears.

Source, Stressor, Activity, or Conservation Action	SCENARIO 1: Significantly decreased conservation	SCENARIO 2: Decreased conservation	SCENARIO 3: Continuation of current levels of conservation	SCENARIO 4: Increased conservation	SCENARIO 5: Significantly increased conservation
Translocation, Augmentation, Human-facilitated restoration of bears, or Relocation	Human-facilitated restoration of bears in extirpated ecosystems does not occur. Augmentation into the CYE does not continue, even though the population is not resilient. There are no translocations into the GYE even if needed for long-term genetic health. Relocation of bears is not in line with connectivity needs and there are no commitments or plans to provide for relocation in connectivity areas.	CYE augmentation does not continue. Translocations do not occur. Bears captured in between ecosystems (i.e., management, pre-emptive, or incidental) are returned to the core of occupied populations, regardless of proximity to capture.	Continuation of current augmentation program in the CYE. Commitment to translocate bears into the GYE by 2025 if immigration from another population into the GYE is not detected. Natural connectivity between the ecosystems continues to improve where it is currently limited and natural connectivity is established to ecosystems that are currently isolated or extirpated. Relocation sites are identified in some areas important for connectivity and recovery as to allow bears to remain where they dispersed independently.	Bears are successfully reintroduced into the North Cascades. CYE augmentation continues. Commitment to translocate bears into the GYE by 2025 if immigration from another population into the GYE is not detected. Relocation sites are identified in all areas important for connectivity and recovery to allow bears to remain where they naturally dispersed.	A founder population of 25 bears has been established in the North Cascades. Augmentation has bolstered the CYE and natural connectivity has occurred to a degree that augmentation is no longer needed. Long-term genetic health of GYE is secure by natural connectivity so that translocation is no longer needed. Bears are reintroduced into the BE. Commitments or plans are in place to move bears in the best interests of connectivity and recovery.
Information and Education Programs	Significant reduction in the number of IEO/conflict specialists or in coverage of occupied areas. This reduction causes increased conflicts and significantly reduced public tolerance.	Reduced number of IEO/conflict specialists or coverage of occupied areas. Reduced stakeholder engagement and funding for prevention efforts. This reduction causes increased conflicts and reduced public tolerance.	Continuation of current programs to conduct IEO programs, stakeholder engagement, and funding for prevention efforts.	Additional IEO/conflict specialists in some areas coordinating across ecosystems. Regular review and adaptation of IEO messaging to increase effectiveness. Increased requirements for bear identification training/testing for hunters. Hunter ed increases effectiveness of bear safety messaging. Increased stakeholder engagement and funding for prevention efforts.	IEO/conflict specialists exist in all areas where grizzly bears are present and in connectivity areas where grizzly bears are expanding/dispersing. These actions significantly increase tolerance.

Future Condition: Resiliency, Redundancy, and Representation

Using the same methodology that we used to evaluate current condition, we projected the resiliency for the six ecosystems 30 to 45 years into the future. First, we projected the future condition for the two habitat factors and six demographic factors that we identified as needs in Chapter 5, for each future scenario. Next, we used the same weighted average to calculate an overall resiliency score for each ecosystem under each scenario. In general, ecosystems with higher resiliency have greater viability than ecosystems with lower resiliency, based on their ability to withstand stochastic events. After evaluating resiliency, we evaluated redundancy and representation for each future scenario.

As we evaluated the future condition of reproductive female distribution, as a measure of fecundity, under the five future scenarios, we considered the uncertainty associated with how this demographic factor is measured. Reproductive female distribution may be underestimated, because detecting breeding females depends on how and where surveys occur, and on the overall survey effort. As a result, we used our best professional judgement to project the future condition of reproductive female distribution assuming no issues with measuring. Our evaluations therefore reflect the actual projected condition for reproductive female distribution, not what measurement techniques would likely detect. Similarly, because inter-ecosystem connectivity is measured within a 10-to 15-year window, we projected whether immigrants move between ecosystems between years 2040 and 2055.

We also highlight uncertainty associated with measuring a population target for the SE. Although grizzly bears in the lower-48 States is the subject of our SSA, the demographic information we have for the SE is for the whole recovery zone, which includes a small portion of Canada. Therefore, our evaluation of conditions for the SE may overestimate conditions because we must rely on data that includes individuals in Canada. Below, we summarize our evaluation of future conditions under each of the five future scenarios.

Future Scenario 1 – Significantly Decreased Conservation

Future Scenario 1 is a pessimistic scenario. Under Scenario 1, conservation decreases significantly, due largely to significant revisions to the current regulatory framework and decreases in funding for conservation actions and other mechanisms, research, and conflict management tools that reduce habitat loss which increases the potential for conflicts and increases human-caused mortality. Under this scenario, motorized access increases significantly, as new roads are constructed, and all regulations and management plans that enforce motorized access standards disappear. IRAs also disappear. Existing regulations that reduce habitat loss and human-caused mortality from unsecured attractants, developed sites, livestock operations, and trains disappear. The rate of development of private lands increases dramatically. Augmentation and translocation efforts do not occur. Additionally, all non-designated Wilderness areas lose their designations and are no longer managed as Wilderness (Table 22, above).

With a significant decrease in conservation under Scenario 1, there are subsequent decreases in resiliency across the habitat and demographic factors (Figure 34 and Table 23). Both the GYE and NCDE decrease in overall resiliency from high to moderate, the SE declines from moderate to low, and the CYE declines from low to very low. While the four ecosystems are still distributed similarly to current condition within their respective ecological types, the resiliency of each ecosystem has decreased under this Scenario; given this decrease in resiliency, grizzly bears in the lower-48 States are also less able to withstand catastrophic risk and environmental change. In other words, as resiliency declines with decreased conservation under Scenario 1, redundancy and representation decrease correspondingly.

Table 23. Future conditions for habitat and demographic factors, 30 to 45 years under Future Scenario 1, where conservation decreases significantly.

FUTURE CONDITION SCENARIO 1 – SIGNIFICANTLY DECREASED CONSERVATION											
	Habitat Factors		**Demographic Factors**								
				Abundance							
	Natural, High-Caloric Foods	**Habitat Security**	**Adult Female Survival**	**Population Target**	**Number of Bears**	**Population Trend**	**Reproductive Female Distribution**	**Inter-Ecosystem Connectivity**	**Genetic Diversity**	**Future Resiliency**
GYE	High	Moderate	Low	Moderate	Moderate	Low	Moderate	X	Low	**Moderate**
NCDE	High	Moderate	Low	Moderate	Moderate	Low	Moderate	High	High	**Moderate**
CYE	Moderate	Low	Low	Very Low	Very Low	Very Low	Low	Very Low	Very Low	**Very Low**
SE	Moderate	Low	Low	Low	Very Low	Very Low	Low	Very Low	Low	**Low**
BE	Moderate	High	X	X	X	X	X	X	X	**X**
North Cascades	Moderate	Moderate	X	X	X	X	X	X	X	**X**

Natural high-caloric foods remain high or moderate for all ecosystems under Scenario 1, due in part to the large amount of Wilderness and National Parks within the GYE, NCDE, and BE, which help ensure that a diversity of food sources would continue to be available to the grizzly bear into the future. However, as conservation declines significantly under Scenario 1, habitat security declines from high to moderate for the GYE and NCDE, and from moderate to low in the CYE and SE but remains high for the BE and moderate for the North Cascades. In the GYE and NCDE, habitat security shifts from high to moderate as motorized access increases, but the quantity of Wilderness Areas and National Parks that remain in these ecosystems, and also the North Cascades, helps ensure that the condition of this habitat factor does not fall below moderate. Habitat security in the BE remains in high because 98 percent of the recovery zone is designated Wilderness. Habitat security in the CYE and SE are low under this scenario due also to increases in motorized access. Conditions also worsen in the CYE and SE because these ecosystems lack large Wilderness areas or National Parks to help reduce motorized access and sources of human-caused mortality.

Under Scenario 1, there are overall declines in condition for most of the demographic factors for the four ecosystems that are currently resilient (GYE, NCDE, CYE, and SE). Under this scenario, significant reductions in conservation actions that address unsecured attractants and other sources of human-caused mortality lead to increased mortality and hence declines in adult female survival, abundance, population trend, and reproductive female distribution. Without effective management of human-caused mortality, such as HCPs to help reduce human-caused mortality along railroads, the population estimate declines below the population target such that the status of the population target in the NCDE shifts from high to moderate under Scenario 1. Human-caused mortalities would likely increase if state regulations are enacted that allow grizzly bears to be killed by the public (e.g., if attacking or threatening livestock). The NCDE and GYE both decrease from high to moderate because these populations would likely have significantly higher mortality without effective conservation actions to address these stressors. For example, potential for significant increases in the number and/or capacity of developed site within the core of ecosystems increases the risk of human-caused mortalities and displacement. Given the small population sizes of the CYE and SE populations, small differences in adult female survival have a larger impact on all other demographic factors. The population estimate declines further below the population target such that the status of the population target of the CYE decreases from moderate to very low because it currently has approximately 60–65 individuals, compared to the SE, which decreases from high to low because the population estimate is closer to its population target.

Reproductive female distribution declines from high to moderate in the NCDE under Scenario 1, due to the quantity of wilderness areas and National Parks, which help reduce motorized access and other sources of human caused mortality such that at least 70 percent of the BMUs will likely be occupied but at least one BMU would likely not be occupied. Reproductive female distribution in the GYE declines from high to moderate, as at least one BMU in this ecosystem would not likely be occupied as a result of significantly decreased conservation, more than likely in the southwest corner of YNP where occupancy is often relatively low. Reproductive female distribution in the CYE and SE also declines due to the significantly decreased conservation under this scenario; however, due to the small size of BMUs in these ecosystems, single female home range will likely still overlap multiple BMUs contributing to reproductive female distribution.

Under Scenario 1, inter-ecosystem connectivity remains high in the NCDE, because we assumed that conservation efforts would remain the same in Canada, regardless of reduced conservation in the lower-48 States. If Canadian conservation efforts remain the same under this scenario, individuals could continue to move into the NCDE from Canada. Even with significantly reduced conservation, at least one female grizzly bear would likely move down from Canada into the NCDE and successfully breed, so inter-ecosystem connectivity remains high in the NCDE. Inter-ecosystem connectivity for the CYE and SE drops from moderate to very low under Scenario 1, because increased motorized access (and resultant human-caused mortality) reduces the quality of habitats and discourages immigrating males and females from establishing new home ranges. The impact to inter-ecosystem connectivity under Scenario 1 is greater for the CYE and SE because of the smaller population size and currently lower levels of connectivity. Inter-ecosystem connectivity decreases from very low to no connectivity for the BE and there continues to be no connectivity to the GYE.

Finally, under Scenario 1, genetic diversity remains high in the NCDE, due to moderate abundance. However, in the GYE, CYE, and SE genetic diversity declines as abundance declines due to increasing human-caused mortality. Additionally, augmentation efforts in the CYE cease under this scenario, which would decrease the size and genetic health of this ecosystem. The Cabinet mountains portion of the CYE would be susceptible to high level of inbreeding due to fragmentation from the Yaak. Genetic diversity in the SE is currently moderate, with lower heterozygosity than the other ecosystems. Human-caused mortality increases under this scenario, resulting in decreased immigration, abundance, and genetic diversity. In general, under Scenario 1, increased human-caused mortality could exacerbate declines in genetic diversity across all four ecosystems.

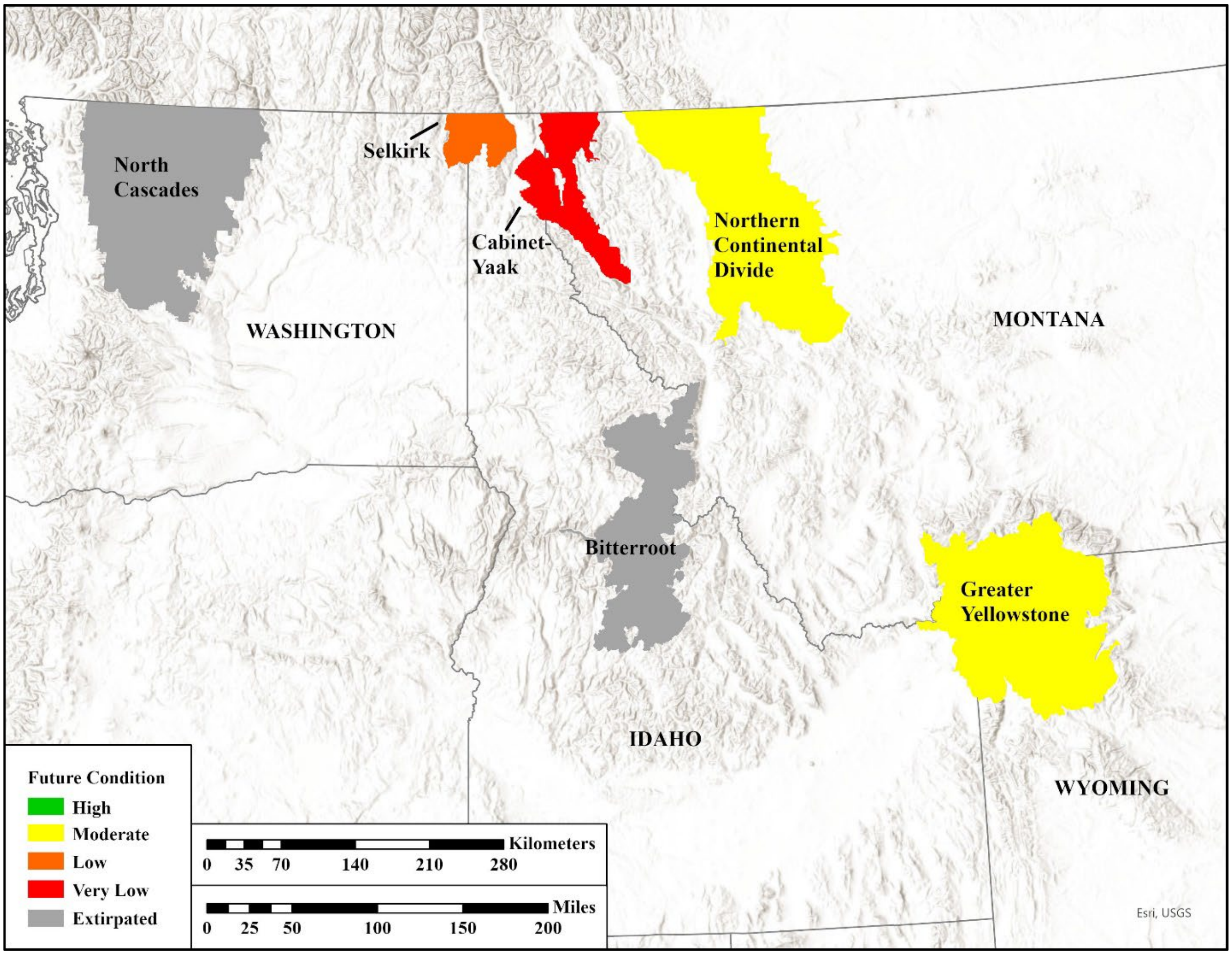


Figure 34. Map of future Scenario 1 – Significantly decreased conservation 30 to 45 years into the future, which illustrates the 3Rs under this scenario.

Future Scenario 2 – Decreased Conservation

Like Scenario 1, Future Scenario 2 is a pessimistic scenario. Under Scenario 2, there is a decrease in conservation, but the decrease is not as significant. Under Scenario 2, overall declines result from slight decreases in funding levels and in the quantity and effectiveness of conservation actions and regulations, but some efforts remain. As a result, motorized access increases as existing regulatory mechanisms remain in place, but are less effective, and the potential for conflict increases. There are no augmentations in the CYE and translocation in the GYE does not occur. There is a slight decline in the number of protected areas, as some areas are no longer managed as wilderness. The rate of development on private land increases.

With a decrease in conservation under Scenario 2, potential decreases in overall resiliency are less severe than under Scenario 1. Under Scenario 2, the NCDE remains in high overall resiliency, the GYE drops from high to moderate resiliency, the CYE remains in low resiliency, and the SE drops from moderate to low overall resiliency (Table 24 and Figure 35). While the four ecosystems are still distributed similarly to current condition within their respective ecological types, the resiliency of two ecosystems decrease under this Scenario; given this decrease in resiliency, grizzly bears in the lower-48 States are also slightly less able to withstand catastrophic risk and environmental change. In other words, as resiliency declines with decreased conservation under Scenario 2, redundancy and representation decrease correspondingly.

Table 24. Future conditions for habitat and demographic factors, 30 to 45 years under Future Scenario 2, where conservation decreases.

FUTURE CONDITION SCENARIO 2 – DECREASED CONSERVATION											
	Habitat Factors		**Demographic Factors**								**Future Resiliency**
	Natural, High-Caloric Foods	**Habitat Security**	**Adult Female Survival**	**Abundance**		**Population Trend**	**Reproductive Female Distribution**	**Inter-Ecosystem Connectivity**	**Genetic Diversity**	
				Population Target	**Number of Bears**					
GYE	High	Moderate	Moderate	Moderate	High	Moderate	Moderate	X	Moderate	**Moderate**
NCDE	High	Moderate	Moderate	Moderate	High	Moderate	Moderate	High	High	**High**
CYE	Moderate	Moderate	Moderate	Very Low	Very Low	Moderate	Moderate	Moderate	Low	**Low**
SE	Moderate	Moderate	Moderate	Low	Very Low	Moderate	Moderate	Moderate	Moderate	**Low**
BE	Moderate	High	X	X	X	X	X	Very Low	X	**X**
North Cascades	Moderate	Moderate	X	X	X	X	X	X	X	**X**

As conservation is reduced under Scenario 2, natural high-caloric foods remain the same as current condition for all ecosystems. In the GYE and NCDE, habitat security shifts from high to moderate as motorized access increases, but the quantity of Wilderness Areas and National Parks that remain in these ecosystems, and also the North Cascades, helps ensure that the condition of this habitat factor does not fall below moderate. Habitat security in the BE remains in high because 98 percent of the recovery zone is designated Wilderness and remains moderate for the CYE and SE.

Under Scenario 2, there are overall declines in condition for most of the demographic factors for the four occupied ecosystems (GYE, NCDE, CYE, and SE), although not as significantly as in Scenario 1. Under this scenario, reductions in conservation actions that address unsecured attractants and other sources of human-caused mortality lead to some increased mortality and resultant declines in adult female survival, abundance, population trend, and reproductive female distribution. Without effective management of human-caused mortality, such as HCPs to help reduce human-caused mortality along railroads, the population decreases and the status of the population target in the NCDE shifts from high to moderate under Scenario 2. Human-caused mortalities would likely increase if state regulations are enacted that allow grizzly bears to be killed by the public (e.g., if attacking or threatening livestock). Despite reduced conservation, the number of bears remains high for the GYE and NCDE under Scenario 2. However, the number of bears is likely to hover around the threshold between high and moderate condition and could drop below the population target such that the status decreases from high to moderate. In general, reduced conservation could increase human-caused mortality and reduce abundance in the GYE and NCDE, but there is some uncertainty regarding the magnitude of the reduction under this scenario. For example, potential for significant increases in the number and/or capacity of developed site within the core of ecosystems increases the risk of human-caused mortalities and displacement. Adult female survival remains at moderate for the CYE and SE. However, given the small population sizes of these populations, small differences in adult female survival can have a larger impact on all other demographic factors. The estimated population size declines further below the population target such that the status of the population target of the CYE decreases from the current condition of moderate to very low. The SE population estimate is closer to its population target and decreases from the current condition of high to low. Due to the increase in human-caused mortality, population trend decreases to moderate for all populations under Scenario 2.

Reproductive female distribution declines from high to moderate in the NCDE under Scenario 2, due to the quantity of wilderness areas and National Parks, which help reduce motorized access and other sources of human caused mortality such that at least 70 percent of the BMUs will likely be occupied. Reproductive female distribution in the GYE declines from high to moderate under this scenario, as at least one BMU would likely be unoccupied as a result of decreased conservation, more than likely in the southwest corner of YNP where occupancy is often relatively low. Reproductive female distribution in the CYE and SE would likely remain at moderate because a significant decline would be required to decrease distribution to less than 50 percent of BMUs occupied. Small BMU size in these ecosystems helps maintain this moderate condition, in part, because a female home range can overlap multiple BMUs, thereby contributing to reproductive female distribution in several BMUs.

Under Scenario 2, inter-ecosystem connectivity for the BE remains very low. Even with reduced conservation measures under this scenario, which would increase human-caused mortality in the SE, CYE, and NCDE, we believe that at least one individual could wander into the BE between years 2040 and 2050. Inter-ecosystem connectivity and genetic diversity stays the same for the remaining four ecosystems under Scenario 2. Despite the fact that genetic diversity does not drop from low to very low in the CYE, lack of augmentation would likely increase the chances of inbreeding in the Cabinet portion of the CYE population.

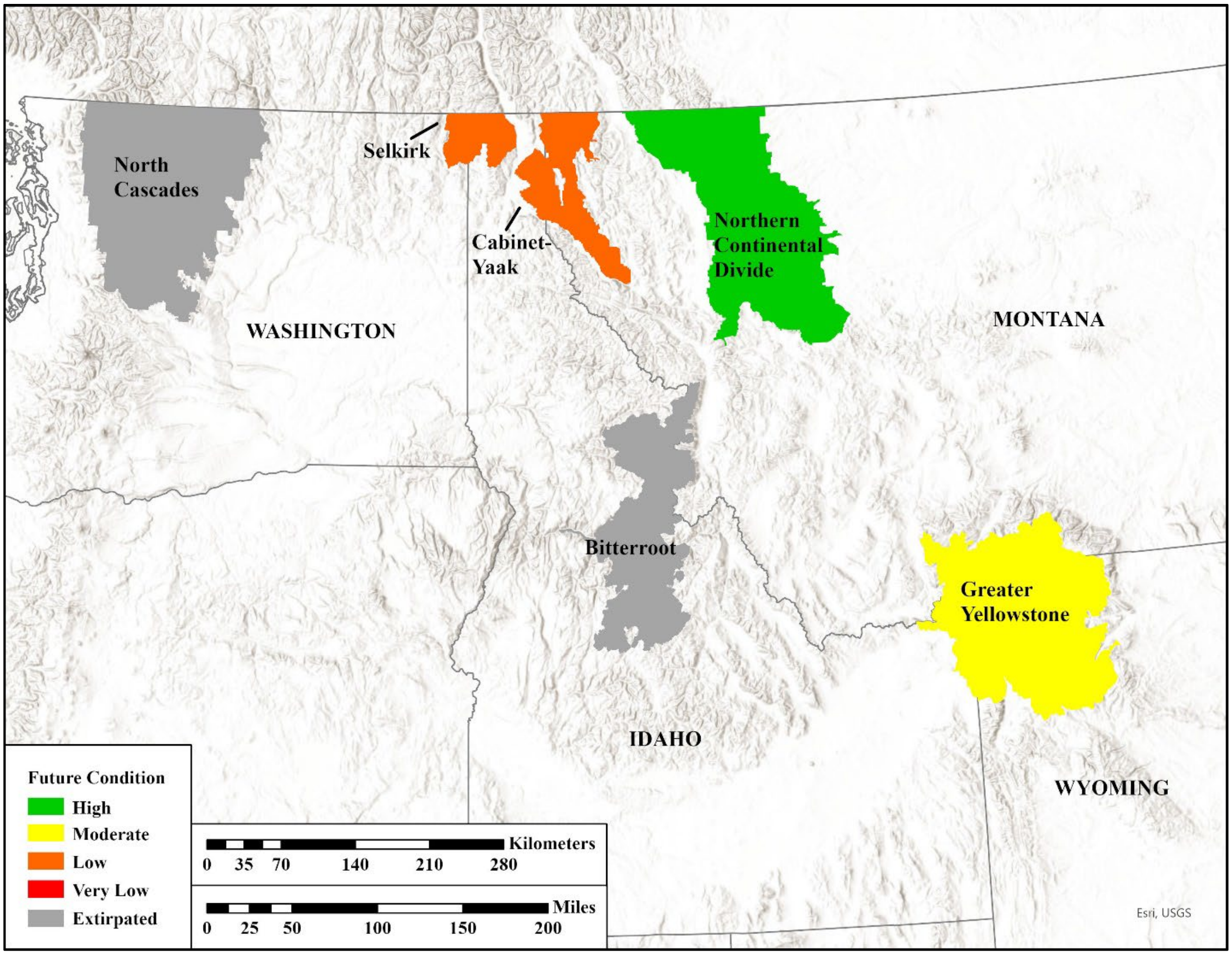


Figure 35. Map of future Scenario 2 – Decreased conservation 30 to 45 years into the future, which illustrates the 3Rs under this scenario.

Future Scenario 3 – Continuation of Conservation

Future Scenario 3 is a continuation scenario, where all stressors and conservation efforts continue at their same rate and magnitude 30 to 45 years into the future. The current levels of funding and effectiveness and implementation of conservation actions and mechanisms stay the same under this scenario. As a result, the GYE and NCDE remain in overall high resiliency, the SE stays moderate, but the CYE improves in overall resiliency from low to moderate and the BE improves from functionally extirpated to very low (Table 25 and Figure 36). Under Scenario 3, redundancy and representation improve, as the BE shifts from its currently functionally extirpated condition with no resiliency to very low resiliency. Risk from potential catastrophic events is now spread across five instead of four ecosystems (redundancy) with additional ecological diversity gained at the central extent of the overall range (representation) (Figure 36).

Table 25. Future conditions for habitat and demographic factors, 30 to 45 years under Future Scenario 3, where conservation continues at the same rate and effectiveness as current condition.

FUTURE CONDITION SCENARIO 3 – CONTINUATION OF CONSERVATION											
	Habitat Factors		Demographic Factors								
	Natural, High-Caloric Foods	Habitat Security	Adult Female Survival	Abundance		Population Trend	Reproductive Female Distribution	Inter-Ecosystem Connectivity	Genetic Diversity	Future Resiliency
				Population Target	Number of Bears					
GYE	High	High	High	High	High	High	High	Moderate	High	**High**
NCDE	High	High	High	High	High	High	High	High	High	**High**
CYE	Moderate	Moderate	High	Moderate	Very Low	High	Moderate	High	Moderate	**Moderate**
SE	Moderate	Moderate	High	High	Low	High	Moderate	High	Moderate	**Moderate**
BE	Moderate	High	Very Low	Very Low	Very Low	Very Low	Very Low	High	Very Low	**Very Low**
North Cascades	Moderate	Moderate	X	X	X	X	X	X	X	**X**

Habitat factors remain the same under Scenario 3 for all ecosystems. Despite ongoing conservation, habitat security remains moderate for the SE and CYE by virtue of their smaller size relative to the GYE and NCDE. However, we anticipate that conditions will improve due to ongoing implementation of current efforts to decrease motorized routes. Conditions improve for specific demographic factors, particularly in the CYE and SE, as continued conservation allows demographic factors to improve over time. Most notably in the SE, adult female survival improves from moderate to high under this scenario, as 30 to 45 years of additional implementation of motorized access conservation efforts help achieve secure habitat goals for each BMU. The status of population targets in the CYE and SE improve, from low to moderate and moderate to high, respectively, as abundance increases with ongoing conservation. With an additional 30 years of implementing conservation efforts at their current rate and effectiveness, we expect there could be at least an additional 10 individuals in the SE, for 90 total, which would meet the population target for this ecosystem, so the abundance as related to the population target would be high. We anticipate that a population will be established in the BE in the next 30 to 45 years with continuation of current dispersal into the ecosystem. Demographic factors are rated as very low largely due to the uncertainty around estimation resulting from small samples sizes and a newly established population.

If conservation continues as described under Scenario 3, inter-ecosystem connectivity for the GYE improves from a functionally extirpated to a moderate condition. Individuals moving south from the NCDE are already very close to the GYE, and we expect as these populations continue to expand occupied range that at least one male will enter the GYE, establish a home range, and breed within the next 30 to 45 years if conservation measures continue. We expect inter-ecosystem connectivity to increase from moderate to high for the CYE and SE with continuation of current conservation efforts that have already facilitated genetic connectivity. We have documented several bears in and near the BE over the last several years, and we anticipate that inter-ecosystem connectivity will improve from very low to high within 30 to 45 years as females disperse to the BE and establish a population, as per the definition adopted in this document (see *Summary of Methods Used to Measure Population Trends and Annual Estimates*).

Although female dispersal movements are much more limited than males, we believe it is likely that a breeding population will be established in the next 30 to 45 years due to the close proximity of reproducing females in the NCDE and the increased documentation of individuals in the intervening areas.

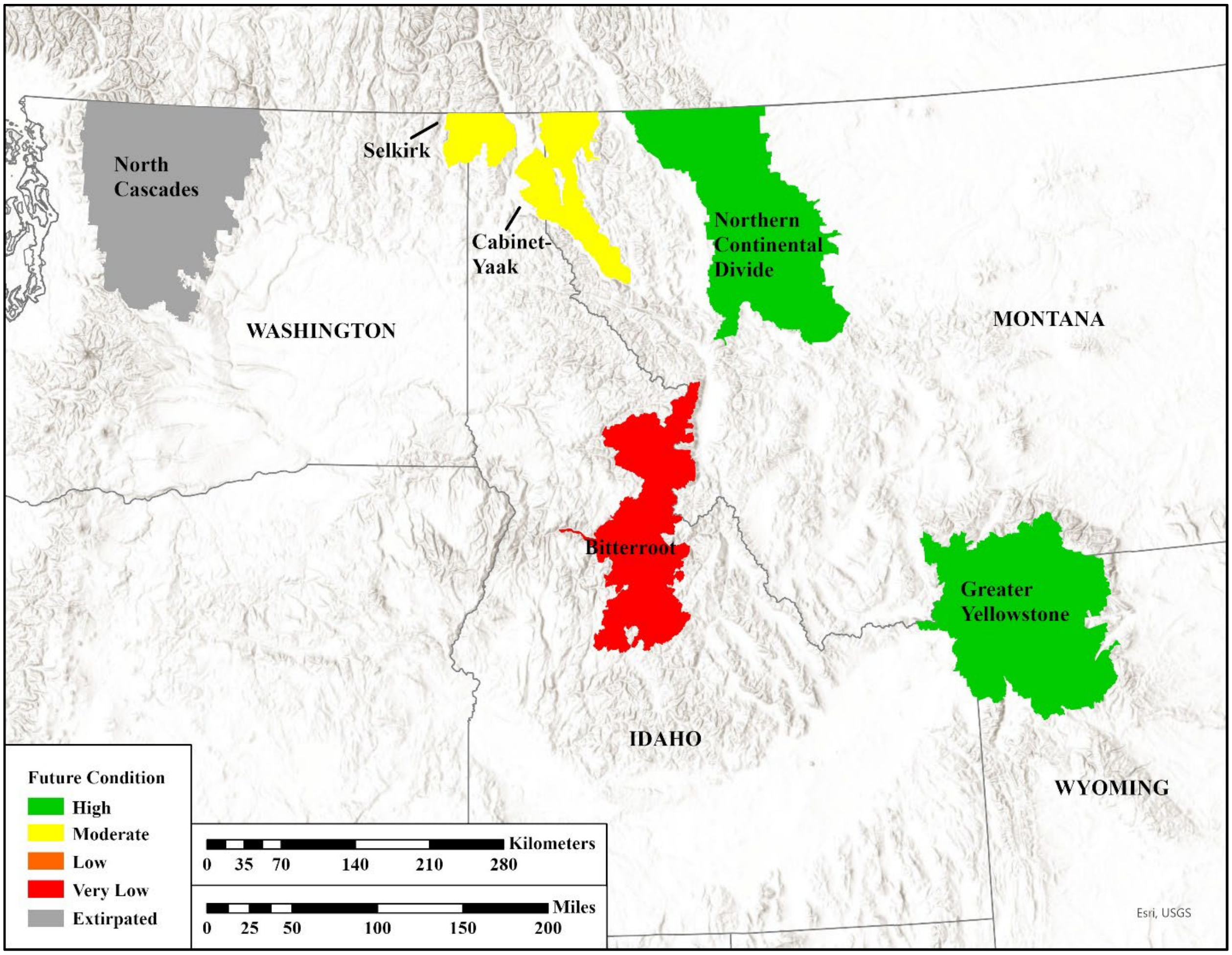


Figure 36. Map of future Scenario 3 – Continued conservation 30 to 45 years into the future, which illustrates the 3Rs under this scenario.

Future Scenario 4 – Increased Conservation

Future Scenario 4 is the first of two optimistic scenarios. Under Scenario 4, conservation increases, as funding increases and the mechanisms that reduce motorized access and human-caused mortality increase or are more effective. Rates of development on private lands decrease and there are increases in conservation easements, highway crossing structures for wildlife, and the amount of designated Wilderness and IRAs. Under this scenario, individuals are successfully moved into the North Cascades, augmentations continue into the CYE, and translocations occur in the GYE, as needed.

Under Scenario 4, redundancy and representation improve, as both the BE and North Cascades shift from currently functionally extirpated conditions with no resiliency to low resiliency. The

GYE and NCDE remain in overall high resiliency, the SE remains moderate, and the CYE improves from low to moderate resiliency (Table 26 and Figure 37). Risk from potential catastrophic events is now spread across six instead of four ecosystems (redundancy) with additional ecological diversity gained at the northwestern and central extents of the overall range (representation) (Figure 37).

Table 26. Future conditions for habitat and demographic factors, 30 to 45 years under Future Scenario 4, where conservation increases.

FUTURE CONDITION SCENARIO 4 – INCREASED CONSERVATION										
	Habitat Factors		Demographic Factors							
	Natural, High-Caloric Foods	Habitat Security	Adult Female Survival	Abundance		Population Trend	Reproductive Female Distribution	Inter-Ecosystem Connectivity	Genetic Diversity	Future Resiliency
				Population Target	Number of Bears					
GYE	High	High	High	High	High	High	High	Moderate	High	**High**
NCDE	High	High	High	High	High	High	High	High	High	**High**
CYE	Moderate	Moderate	High	Moderate	Low	High	Moderate	Moderate	Moderate	**Moderate**
SE	Moderate	Moderate	High	High	Low	High	Moderate	High	Moderate	**Moderate**
BE	Moderate	High	Very Low	Very Low	Very Low	Very Low	Very Low	High	Very Low	**Low**
North Cascades	Moderate	Moderate	Moderate	Very Low	Very Low	High	Very Low	X	Low	**Low**

Despite the increased conservation under Scenario 4, natural high-caloric foods and habitat security remain the same as current condition. Without additional Wilderness areas and IRAs, habitat security remains moderate for the CYE and SE. Habitat conditions remain the same in the North Cascades and BE under this scenario.

Under Scenario 4, demographic factors for the BE and North Cascades begin to improve from their currently functionally extirpated condition. In the BE, improvements in conservation measures associated with mistaken-identity kills by black bear hunters help improve adult female survival in the BE under this scenario. Local support for reintroduction in the North Cascades increases and a population is established via reintroduction. Abundance in the CYE and SE improves under this condition, with targets of 90 individuals achieved due to decreased motorized access, ongoing augmentation in the CYE, and positive population trend, but both ecosystems remain in overall moderate condition due to the small population size as a result of the size of the ecosystems. Additionally, with increased conservation, inter-ecosystem connectivity improves for the GYE, SE, and BE. Although the rate of natural recolonization in the BE under this scenario improves, demographic factors related to abundance and reproductive female distribution are rated as very low largely due to the slow process of recolonization (e.g., small population size). Adult female survival and population trend are rated very low due to the uncertainty around estimations resulting from small sample sizes.

We expect that successful reintroduction into the North Cascades would result in a positive population trend. However, the status for population target and number are very low because only a small number of bears would be reintroduced and even with a positive population trend, small populations take time to grow. Adult female survival is moderate because individuals introduced as subadults will have time to become established before they are included in this estimate. Distribution of reproductive females is very low because it will take time for the population to expand for reproductive females to overlap over half of the BMUs. We do not anticipate any connectivity for the North Cascades under Scenario 4 because conditions in Canada are assumed to remain the same. Genetic diversity increases from extirpated to low because of commitments to move bears if genetic issues are detected.

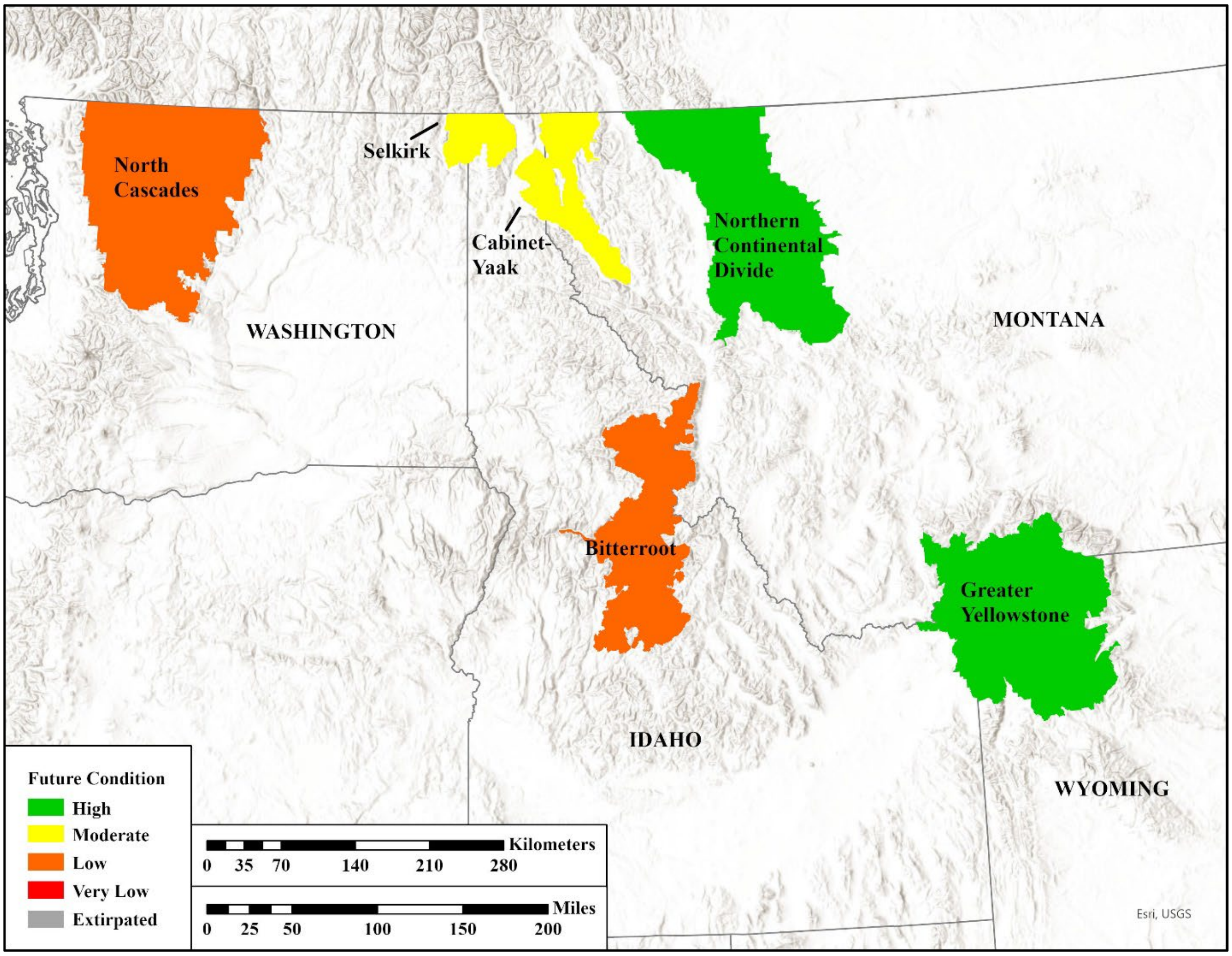


Figure 37. Map of future Scenario 4 – Increased conservation 30 to 45 years into the future, which illustrates the 3Rs under this scenario.

Future Scenario 5 – Significantly Increased Conservation

In future Scenario 5 conservation increases significantly. Tolerance and acceptance also significantly increases, and there is general acceptance of grizzly bears persisting in all ecosystems and the importance of connectivity. As a result, resiliency, redundancy, and representation improve. Under this scenario, the GYE and NCDE stay in high overall resiliency, but the CYE and SE improve to high overall resiliency. The BE and North Cascades improve from functionally extirpated to low overall resiliency under this scenario (Table 27 and Figure 38).

Table 27. Future conditions for habitat and demographic factors, 30 to 45 years under Future Scenario 5, where conservation increases significantly.

FUTURE CONDITION SCENARIO 5 – SIGNIFICANTLY INCREASED CONSERVATION										
	Habitat Factors		**Demographic Factors**							
	Natural, High-Caloric Foods	**Habitat Security**	**Adult Female Survival**	**Abundance**		**Population Trend**	**Reproductive Female Distribution**	**Inter-Ecosystem Connectivity**	**Genetic Diversity**	**Future Resiliency**
				Population Target	**Number of Bears**					
GYE	High	High	High	High	High	High	High	Moderate	High	**High**
NCDE	High	High	High	High	High	High	High	High	High	**High**
CYE	Moderate	High	High	High	Low	High	Moderate	High	High	**High**
SE	Moderate	Moderate	High	High	Low	High	High	High	High	**High**
BE	High	High	Moderate	Very Low	Very Low	High	Very Low	High	Low	**Low**
North Cascades	Moderate	High	Moderate	Very Low	Very Low	High	Very Low	X	Low	**Low**

Conditions under Scenario 5 generally improve similarly to conditions under Scenario 4, but with additional increases in genetic diversity and population trend. The condition for high-caloric foods remains consistent from current to future conditions for all six ecosystems, except for an improvement in condition for the BE from moderate to high under Scenario 5, where conservation increases significantly. Habitat security remains in moderate condition in the Selkirks because of the lack of opportunity to create Wilderness areas. The North Cascades improves to high due to implementation of new habitat standards. Under this scenario, the CYE would likely reach the population target of 100 individuals, especially given the ecosystem's currently positive population trend. However, reproductive female distribution in the CYE is moderate due to the uneven distribution of females across the ecosystem. Genetic health of the CYE would improve with increased abundance and improved connectivity with Canada and the SE.

We expect that successful reintroduction or augmentation into the BE would result in a positive population trend. However, the status for population target and number are very low because only a small number of bears would be reintroduced or augmented and even with a positive population trend, small populations take time to grow. Adult female survival is moderate because individuals will be introduced as subadults will have time to become established before they are included in this estimate. Distribution of reproductive females is very low because it will take time for the population to expand for reproductive females to overlap over half of the BMUs. Genetic diversity increases from extirpated to low because of commitments to move bears if genetic issues are detected.

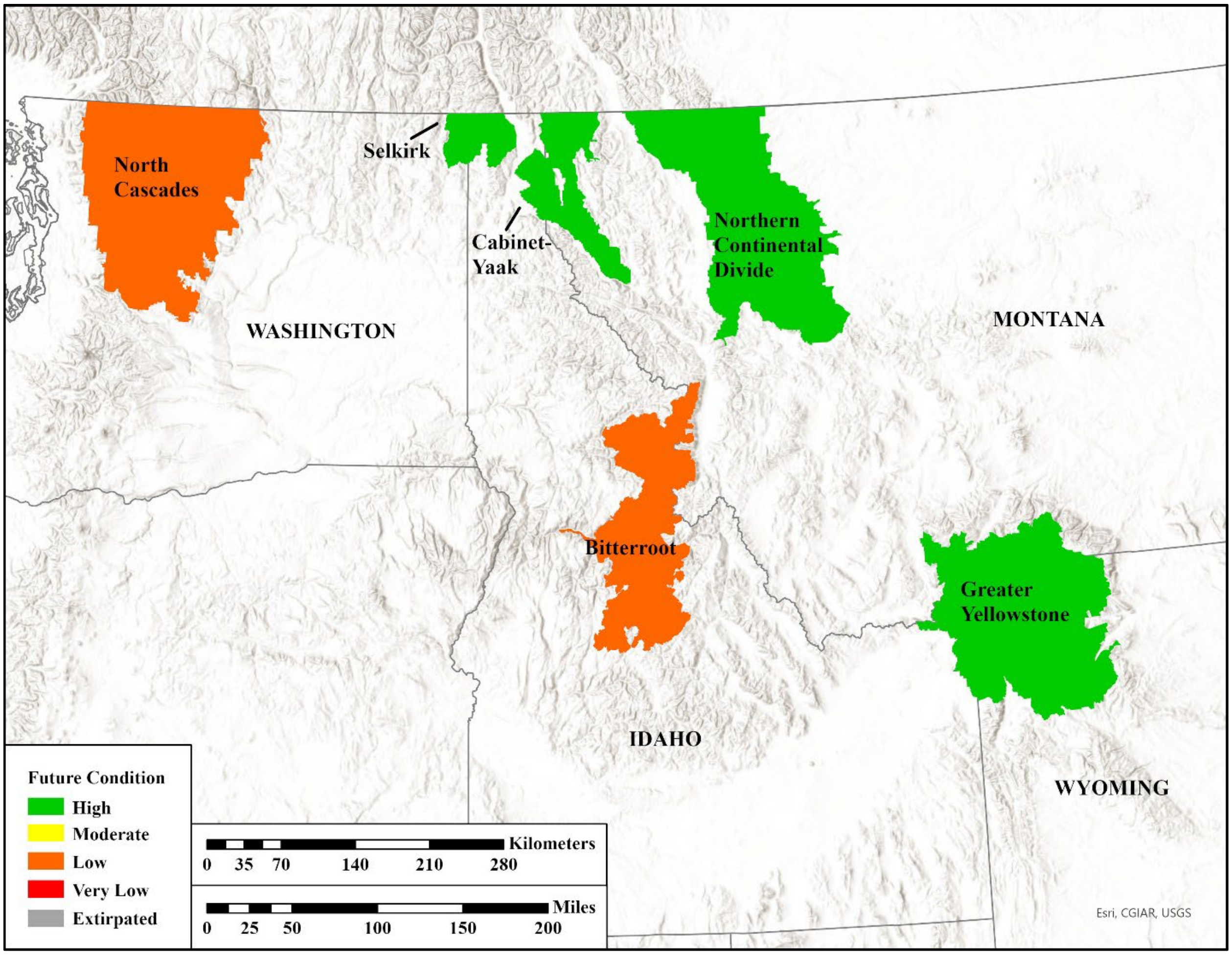


Figure 38. Map of future Scenario 5 – Significantly Increased conservation 30 to 45 years into the future, which illustrates the 3Rs under this scenario.

Chapter 8: Synthesis of Current and Future Condition

In this SSA of grizzly bear in the lower-48 States, we evaluated the current and future conditions in terms of resiliency, redundancy, and representation. Resiliency describes risk associated with stochastic events, redundancy with catastrophic events, and representation describes risk associated with long-term environmental change. We used future scenarios to capture a range of plausible futures and uncertainty associated with the future.

Currently, there are two ecosystems with high resiliency, one ecosystem with moderate resiliency, and one ecosystem with low resiliency (Table 28). Within 30 to 45 years in the future, there are improvements or reductions in resiliency projected across the ecosystems depending on the scenario; with reductions in resiliency under Scenario 1, the most pessimistic scenario where conservation efforts decline significantly; and improvements in resiliency under Scenario 5, the scenario where conservation efforts improve significantly. If conservation efforts remain the same, as under Scenario 3, the CYE improves from low to moderate resiliency and the BE improves from functionally extirpated to very low resiliency, which also represents an increase in redundancy and representation. Under this scenario, the GYE and NCDE remain in high resiliency and the SE remains in moderate resiliency. Under the scenarios where conservation efforts increase under Scenarios 4 and 5, the BE and North Cascades improve from functionally extirpated conditions with no resiliency to low resiliency, which represents additional increases in redundancy and representation. To summarize changes in resiliency from current to future conditions, there is less risk from stochastic events if conservation efforts continue or improve, but there is greater risk from stochastic events if conservation efforts decrease (Table 28).

Table 28. Current and future resiliency for the six ecosystems for the grizzly bear in the lower-48 states.

CURRENT AND FUTURE RESILIENCY						
	Current Condition	***Future Scenario 1*** ↓↓ ***Conservation***	***Future Scenario 2*** ↓ ***Conservation***	***Future Scenario 3*** ***Continuation Conservation***	***Future Scenario 4*** ↑ ***Conservation***	***Future Scenario 5*** ↑↑ ***Conservation***
GYE	High	Moderate	Moderate	High	High	High
NCDE	High	Moderate	High	High	High	High
CYE	Low	V Low	Low	Moderate	Moderate	High
SE	Moderate	Low	Low	Moderate	Moderate	High
BE	X	X	X	V Low	Low	Low
North Cascades	X	X	X	X	Low	Low

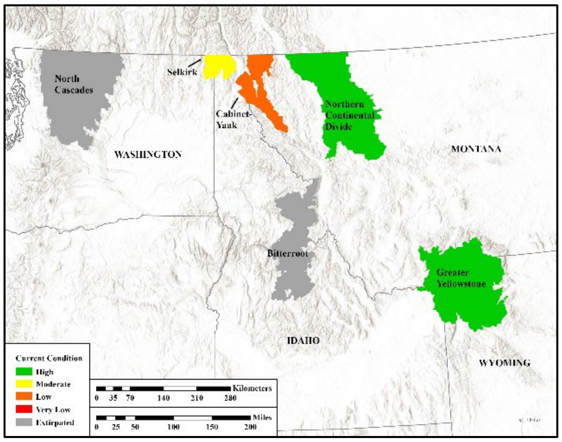
Currently, redundancy for the grizzly bear is described as four ecosystems, the NCDE, GYE, CYE, and SE, as they are distributed from north to south and east to west across the lower-48 States. Catastrophic risk is spread across these four ecosystems and their ecological diversity contributes to representation. Two ecosystems, the BE and North Cascades have no populations, are not resilient, so do not currently contribute to redundancy or representation. In 30 to 45 years, redundancy is maintained across the future scenarios and never falls below the four, currently resilient ecosystems as they are distributed. Although redundancy stays the same from now to the future, if conservation efforts decrease, as under Scenarios 1 and 2, resiliency decreases, and the four ecosystems are at greater risk to stochastic events. If conservation efforts continue under Scenario 3, resiliency in the BE would likely improve, as would redundancy, due to the number and distribution of ecosystems increasing from four to five ecosystems. But if conservation efforts increase, as under Scenarios 4 and 5, resiliency in the BE and North Cascades improves, as does redundancy, as the number and distribution of ecosystems increases from four to six ecosystems. This improvement in redundancy reduces risk to the grizzly bear from catastrophic events (Table 29 and Figure 39). To summarize redundancy across the future scenarios, catastrophic risk to the grizzly bear decreases if conservation efforts continue at their current rate and effectiveness due to improvements in resiliency of the BE, and catastrophic risk decreases even further with increased conservation as the BE and North Cascades improve in resiliency. Representation stays the same with decreased conservation. Ecological diversity increases with continuation of conservation efforts (due to improvements in the BE) and increases further if conservation efforts increase (due to improvements in the North Cascades).

Our SSA characterizes the viability for the grizzly bear in the lower-48 States, or its ability to sustain populations in the wild over time, based on the best scientific understanding of its current and future abundance, distribution, and diversity. Based on our assessment of the 3Rs, currently and 30 to 45 years into the future, viability for the grizzly bear in the lower-48 States improves slightly if conservation efforts continue at their current rate and levels of effectiveness. If conservation efforts declines, viability also decreases. If conservation efforts increase, viability improves.

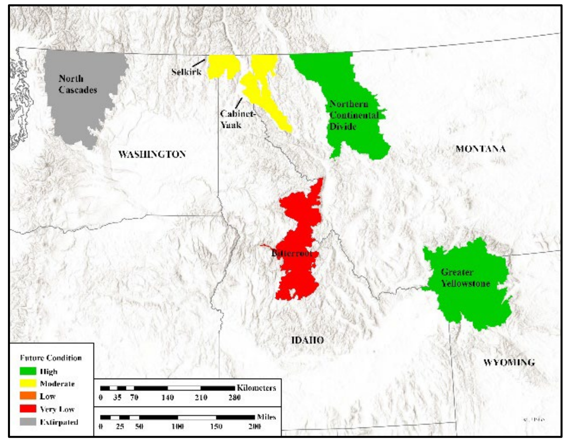
Table 29. Summary of current and future viability in terms of resiliency, redundancy, and representation for the six ecosystems of grizzly bear in the lower-48 States.

VIABILITY: CURRENT AND FUTURE 3Rs						
	Current Condition	***Future Scenario 1*** ↓↓ ***Conservation***	***Future Scenario 2*** ↓ ***Conservation***	***Future Scenario 3*** ***Continuation Conservation***	***Future Scenario 4*** ↑ ***Conservation***	***Future Scenario 5*** ↑↑ ***Conservation***
Resiliency	2 High 1 Moderate 1 Low 2 Extirpated	2 Moderate 2 Very Low 2 Extirpated	1 High 1 Moderate 2 Low 2 Extirpated	2 High 2 Moderate 1 Very Low 1 Extirpated	2 High 2 Moderate 2 Low	4 High 2 Low
Redundancy	4 ecosystems, as distributed	4 ecosystems, as distributed	4 ecosystems, as distributed	5 ecosystems, as distributed	6 ecosystems, as distributed	6 ecosystems, as distributed
Representation	Ecological diversity across 4 ecosystems	Ecological diversity across 4 ecosystems	Ecological diversity across 4 ecosystems	Ecological diversity across 4 ecosystems	Ecological diversity across 6 ecosystems	Ecological diversity across 6 ecosystems

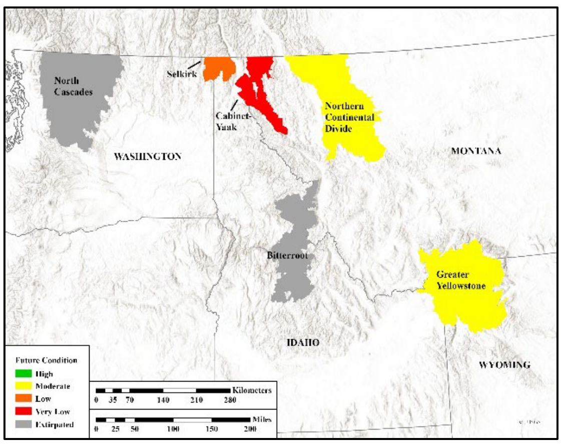
Current Condition



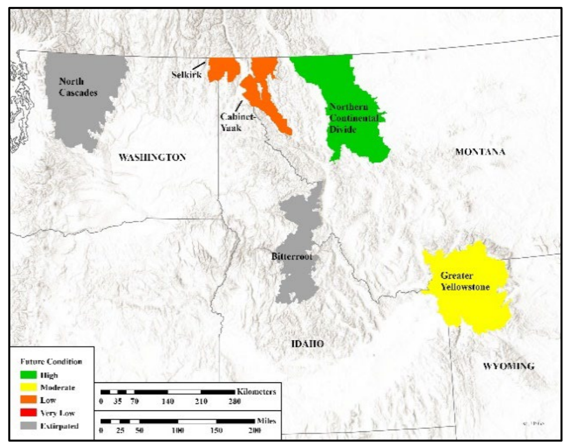
Future Scenario 3
Continuation of Conservation



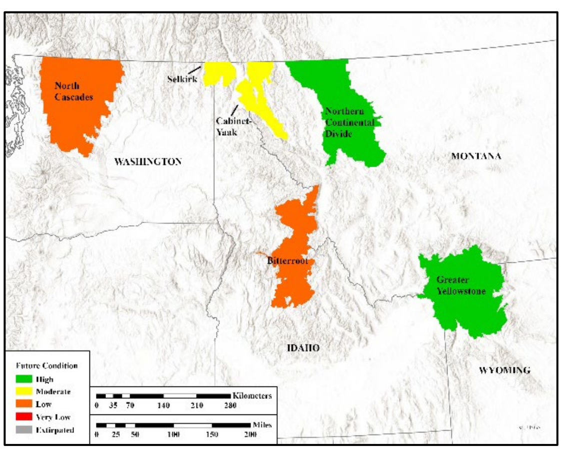
Future Scenario 1
Significantly Decreased Conservation



Future Scenario 2
Decreased Conservation



Future Scenario 4
Increased Conservation



Future Scenario 5
Significantly Increased

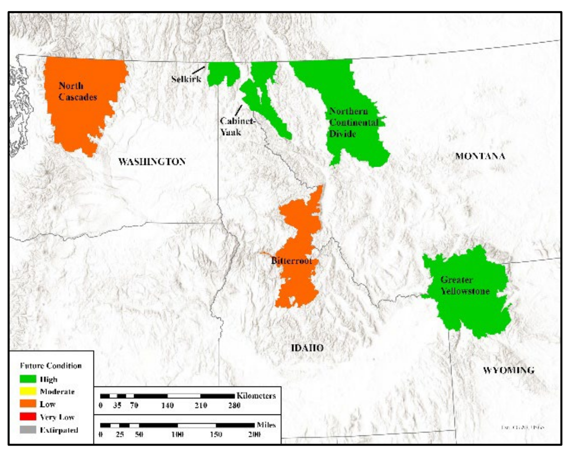


Figure 39. Current and future (30 to 45 years) conditions for resiliency, redundancy, and representation for the grizzly bear in the lower-48 States.

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Appendix A. Grizzly Bear Secure Core/Habitat Analysis for the San Juan and Sierra Nevada Mountains' Historical Range

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December 17, 2020

Introduction and Goals

This document describes the process and data used to analyze secure core for grizzly bears within historical range, as well as the results of that analysis. We first analyzed secure core for Federal, State, and Tribal lands within mapped historical grizzly bear range circa 1850 (Mattson and Merrill 2002). The largest area of secure core within grizzly bear historical range outside of the six ecosystems (NCDE, GYE, CYE, SE, BE, and North Cascades) is the Sierra Nevada Mountain Range in California (Figure 1). We also analyzed habitat security for the San Juan Mountains because of the Recovery Plan recommendation to do so (Service 1993). This document describes the process and data used to further analyze secure core/habitat within the San Juan and Sierra Nevada Mountains' historical range, as well as the results of that analysis. We report secure core using the definition from the Northern Continental Divide Ecosystem and secure habitat using the definition from the Greater Yellowstone Ecosystem. We report secure core as the percentage of Federal, state, or Tribal lands within the analysis area with no motorized routes, more than 500 meters from an open or gated motorized route, and at least 2,500 acres in size. In addition, we report secure habitat as the percentage of Federal, state, or Tribal lands within the analysis area with no motorized routes, more than 500 meters from an open or gated motorized route, and at least 10 acres in size. We lacked data for high-use trails in the San Juan and Sierra Nevada Mountains to analyze core areas as defined for the Cabinet-Yaak, Selkirk, and North Cascades Ecosystems.

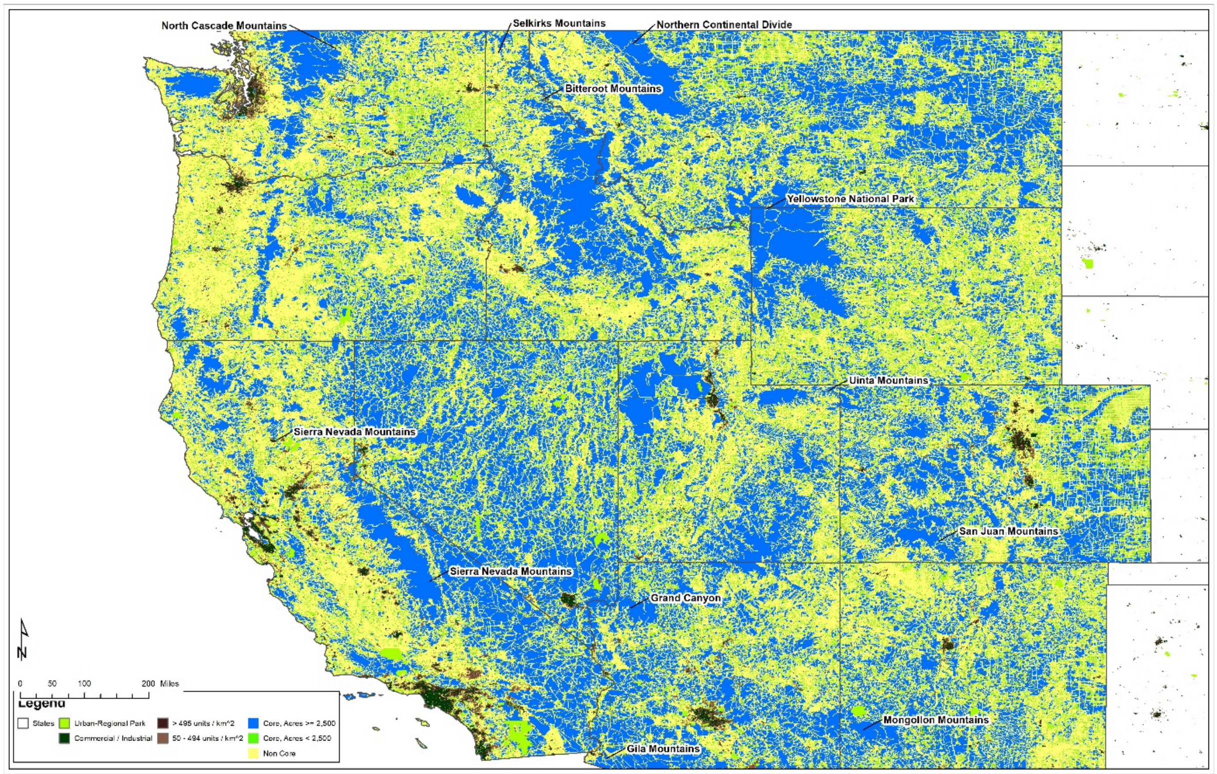

Figure 1. Secure core for the western United States.

GIS Layers Used:

This section describes the best available GIS data used in this analysis.

Surface Management Agency

Surface management agency (SMA) is authoritative spatial data from the Bureau of Land Management (BLM) representing land management across the U.S. We acquired the latest SMA from BLM, published 2017-11-03. As this layer has been known to include significant area overlaps, which can lead to double counting, we performed a quality control test within the areas of the San Juan and Sierra Nevada Mountains and found that overlaps were negligible.

San Juan Mountains Historical Range Analysis Area

An initial challenge to conducting this analysis was describing an analysis area for the San Juan Mountains, which has no official mapped boundary. To do this, we began by selecting the U.S. Forest Service (USFS) San Juan National Forest (NF) polygon in the BLM's SMA layer, and then moved outward from this polygon and selected contiguous Federal lands. We used mapped mountain peaks described on Wikipedia as being within the San Juan Mountains to help delineate where the San Juan Mountains end. We used the extent of the selected polygons as a boundary and limited the northern and southern USFS extent by stopping the area into the Rio Grande NF on the north at U.S. Highway 50 and by stopping the area into the Santa Fe NF on the south at U.S. Highway 64. Both U.S. 50 and U.S. 64 in these National Forests were included in the analysis. We left all non-Federal lands found within the analysis area on edges and interstitial to Federal lands. Federally managed lands within the San Juan Mountains' historical range are made up of BLM, USFS, and U.S. Bureau of Reclamation (USBR) lands.

Sierra Nevada Mountains Historical Range Analysis Area

We were able to locate an official analysis area for the Sierra Nevada Mountains defined as part of the USFS's EcoMap project (https://data.fs.usda.gov/geodata/edw/datasets.php?xmlKeyword=Ecomap**)**. We reviewed this area in relation to the historical range of the grizzly bear and concluded that the boundaries of the region that the USFS defined were appropriate for use as an analysis area. Federally managed lands within the Sierra Nevada Mountains' historical range are made up of BLM, USFS, National Park Service (NPS), U.S. Bureau of Reclamation (USBR), U.S. Fish and Wildlife Service (USFWS), and Department of Defense (DOD) lands.

Roads

We used road and trails data from the U.S. Census Bureau TIGER 2018 All Roads line file (https://www2.census.gov/geo/tiger/TGRGDB18/tlgdb_2018_a_us_roads.gdb.zip). These data include the best available data from a Federal data steward. The All Roads line file includes all primary, secondary, local neighborhood, and rural roads, city streets, vehicular trails (4wd), ramps, service drives, alleys, parking lot roads, private roads for service vehicles (logging, oil fields, ranches, etc.), bike paths or trails, bridle/horse paths, walkways/pedestrian trails, and stairways. We selected the following road types from the data for use in secure core analysis using the codes MTFCC IN ('S1100' , 'S1200' , 'S1400' , 'S1500' , 'S1630' , 'S1640' , 'S1730' , 'S1740', 'S1780'):

- Alley
- Local neighborhood road, rural road, city street
- Parking lot road
- Primary road
- Private road for service vehicles (logging, oil fields, ranches, etc.)
- Ramp
- Secondary road
- Service drive usually along a limited access highway
- Vehicular trail (4WD)

Population Density by Block

The best available data for population density at a census block level is based on the 2010 census. We pulled these data from the Census Bureau, and joined it to the tlgdb_2015_a_us_block layer available at https://www2.census.gov/geo/tiger/TGRGDB18/tlgdb_2018_a_us_block.gdb.zip. We then calculated persons per square km for each block.

BLM and USFS Sheep Allotments

The U.S. Forest Service makes their range allotment data available nationally. We downloaded the June 2018 update of this layer (https://catalog.data.gov/dataset/range-allotment-feature-layer). The field "Sheep" in the layer describes if a particular allotment is allotted for sheep grazing. BLM also makes their allotment data available nationally (https://gis.blm.gov/EGISDownload/LayerPackages/BLM_National_Grazing_Allotments.zip) and we downloaded the November 2018 update of this layer. Unfortunately, BLM does not provide information on grazing type in these data, so we used the BLM's online RAS system (https://reports.blm.gov/reports/RAS/) to pull sheep grazing data for all of the field offices and populate a new field called "RAS_AuthUse20190510" in the BLM allotment data to indicate if a specific allotment was allotted for sheep. We then merged the USFS and BLM sheep allotment data and dissolved to remove overlaps (BLM_USFS_Sheep_Allotments_SNMtns_dis and BLM_USFS_Sheep_Allotments_SJMtns_dis).

Analysis

Secure Core and Secure Habitat Calculations

Grizzly bear secure core and secure habitat analyses utilizes a buffering process to determine contiguous areas that are a distance of greater than 500 meters away from roads. Secure core are core areas managed as Federal, Tribal, or state lands that are at least 2,500 acres in size. Secure habitat are core areas managed as Federal, Tribal, or state lands that are at least 10 acres in size. We also wanted to understand the amount of area within these secure core/habitat areas that were authorized for sheep grazing by BLM or the USFS or were in areas with populations greater than 50 persons per kilometer within census blocks. We used the following process to calculate secure core in the western U.S.

- We clipped the roads and BLM surface management layers to the western U.S. (RoadsClpWesternStatesAlbSubset).
- Because of the large size of this data set and processing limitations, we split it into four parts and then buffered each line file by 500 meters and dissolved the results:
    - Final_FinalRoadsBuff500_Part1_dis
    - Final_FinalRoadsBuff500_Part2_dis
    - Final_FinalRoadsBuff500_Part3_dis
    - Final_FinalRoadsBuff500_Part4_dis
- We then unioned the four files together with a polygon file representing all areas in the western U.S. Prior to this step and then coded a field called "Core" with "Non Core" for the road buffers, and "Core" for the western states. This created a polygon file with information about which polygons were made up non core area and which were made up core area based on distance from roads. We then added a field called "Final Core" and assigned all polygons a designation of core or non core based on the original "Core" fields (WestwideSecureCore).
- To further speed processing, we clipped the Westwide core layer (WestwideSecureCore), the BLM surface management layer, the density per square km by block layer, and the

BLM and USFS sheep allotments layers to the San Juan and Sierra Nevada Mountains analysis area layers.

- We then unioned the core layers for each analysis area to the BLM surface management layer and calculated a new field called "ManagementCore" indicating those areas that were Federal, state, or Tribal areas or not. Using this field and the "Final Core" field we lastly calculated a field called "CoreByMgmt", which allowed us to code for core managed by Federal, state, or Tribal agencies (federally managed core), core not managed by these agencies (non federally managed core), and non core:
  - SanJuanMtnsStudyArea and
  - SierraNevadaMtnsStudyArea
- We next dissolved on the "CoreByMgmt" field (without multipart features checked). We then recalculated acres and added a new field called "FinalSecCore" to calculate contiguous acreages of secure core (Federal, state and Tribal lands with core >= 2,500 acres in size) and secure habitat (Federal, state and Tribal lands with core >= 10 acres in size):
  - SanJuanMtnsStudyAreaDis_20201006
  - SierraNevadaMtnsStudyAreaDis_20201006
- Finally, we unioned these layers with the population per square kilometer by block, sheep allotment, and BLM surface management layers and recalculated acreages to create tabular output that could be used in a pivot table to summarize the findings of the analysis:
  - SanJuanMtnsStudyArea_Final20201006 and SanJuanMtnsStudyArea_Final20201006.XLSX
  - SierraNevadaMtnsStudyArea_Final20201006 and SierraNevadaMtnsStudyArea_Final20201006.XLSX

Results

Secure Core Acreages and Maps for the San Juan Mountains

The tables and maps below show the breakdown of acres of secure core and non secure core areas for the San Juan historical range analysis area. These areas are also tabulated by surface management, within sheep allotments, and by census blocks with a population of 50 or more people per square mile.

Table 1. San Juan Mountains Historical Range; Habitat areas by surface management.

San Juan Mountains Historical Range		
Habitat	**Acres**	**Percent Analysis Area**
Secure Core	**3,447,488**	**52.62**
Federal	3,381,062	51.61
State Government	40,594	0.62
Tribal Lands	25,832	0.39
Non Secure Core	**3,103,845**	**47.38**
Federal	1,812,869	27.67
Local Government	33,102	0.51
Private	1,171,934	17.89
State Government	50,226	0.77
Tribal Lands	35,714	0.55
Total Analysis Area	**6,551,333**	

Table 2. San Juan Mountains Historical Range; Habitat area within BLM or USFS sheep allotments.

San Juan Mountains Historical Range		
Habitat within Sheep Allotments	**Acres**	**Percent Analysis Area**
Secure Core	281,795	4.30
Non Secure Core	177,639	2.71

Table 3. San Juan Mountains Historical Range; Habitat areas with population of 50 or more people per square mile.

San Juan Mountains Historical Range		
Habitat with Population >= 50 people / sq. mile	**Acres**	**Percent Analysis Area**
Secure Core	38	0.001
Non Secure Core	32,765	0.500

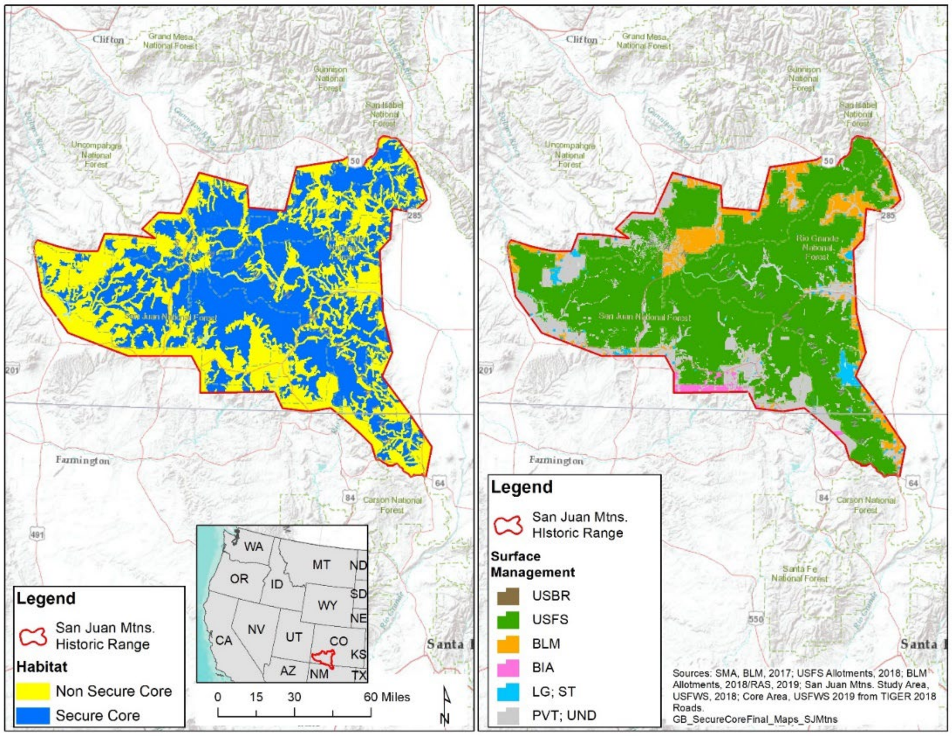

Figure 2. San Juan Mountains secure core and surface management.

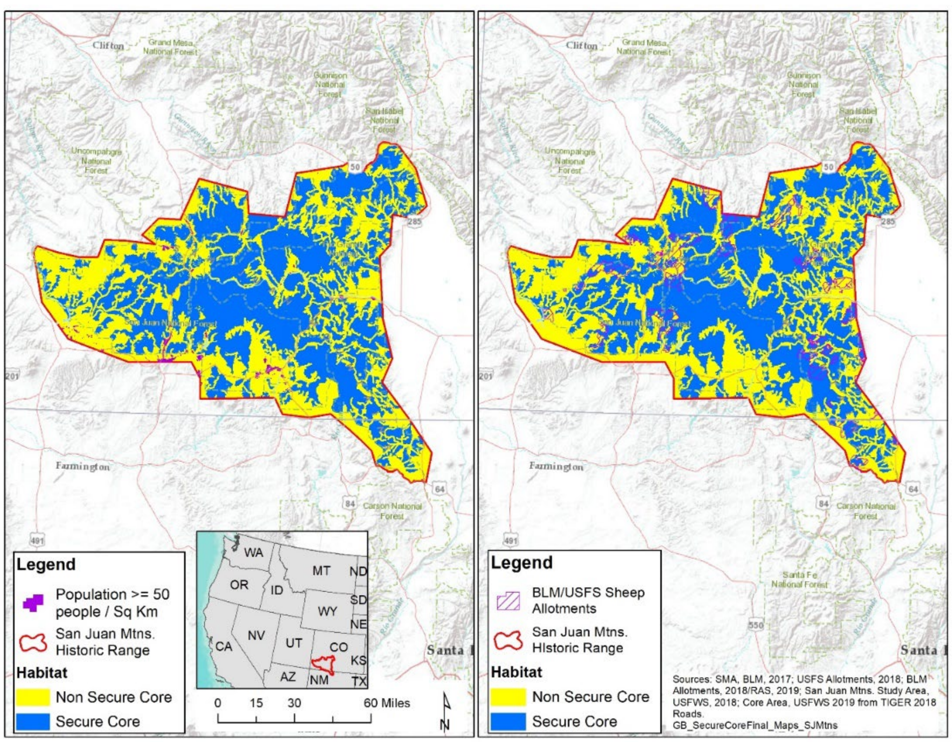

Figure 3. San Juan Mountains high population and sheep allotments in secure core and non secure core areas.

Secure Habitat Acreages and Maps for the San Juan Mountains

The tables and maps below show the breakdown of acres of secure habitat and non secure habitat areas for the San Juan historical range analysis area. These areas are also tabulated by surface management, within sheep allotments, and by census blocks with a population of 50 or more people per square mile.

Table 4. San Juan Mountains Historical Range; Habitat areas by surface management.

San Juan Mountains Historical Range		
Habitat	**Acres**	**Percent Analysis Area**
Secure Habitat	**3,677,890**	**56.14**
Federal	3,595,912	54.89
State Government	48,958	0.75
Tribal Lands	33,020	0.50
Non Secure Habitat	**2,873,440**	**43.86**
Federal	1,598,017	24.39
Local Government	33,103	0.51
Private	1,171,933	17.89
State Government	41,862	0.64
Tribal Lands	28,526	0.44
Total Analysis Area	**6,551,330**	

Table 5. San Juan Mountains Historical Range; Habitat area within BLM or USFS sheep allotments.

San Juan Mountains Historical Range		
Habitat within Sheep Allotments	**Acres**	**Percent Analysis Area**
Secure Habitat	302,989	4.62
Non Secure Habitat	156,445	2.39

Table 6. San Juan Mountains Historical Range; Habitat areas with population of 50 or more people per square mile.

San Juan Mountains Historical Range		
Habitat with Population >= 50 people / sq. mile	**Acres**	**Percent Analysis Area**
Secure Habitat	169	0.003
Non Secure Habitat	32,634	0.501

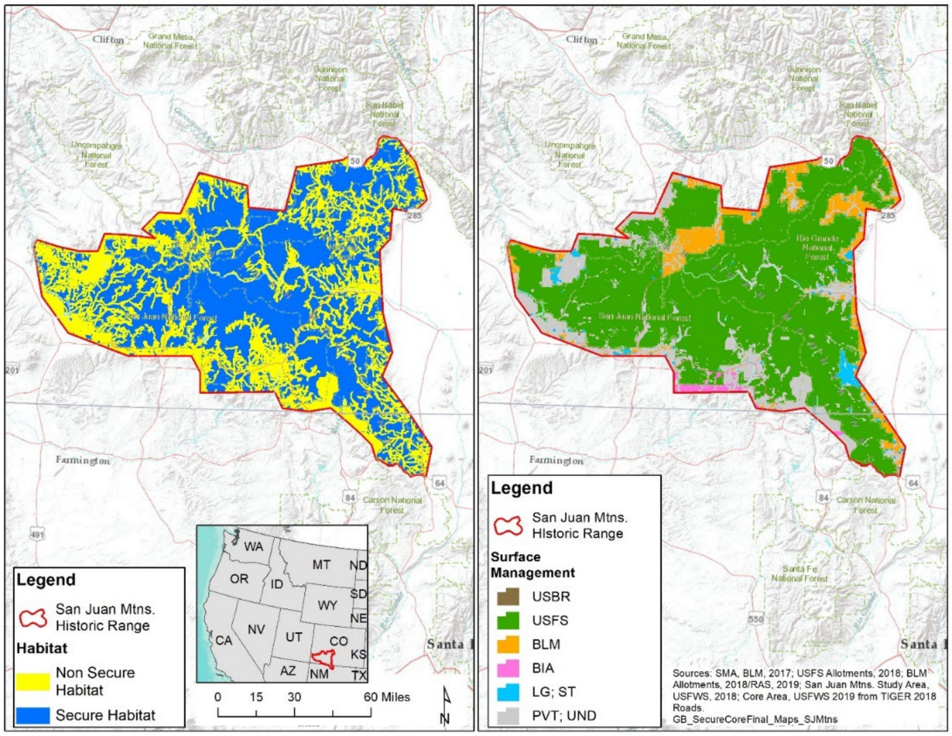

Figure 4. San Juan Mountains secure habitat and surface management.

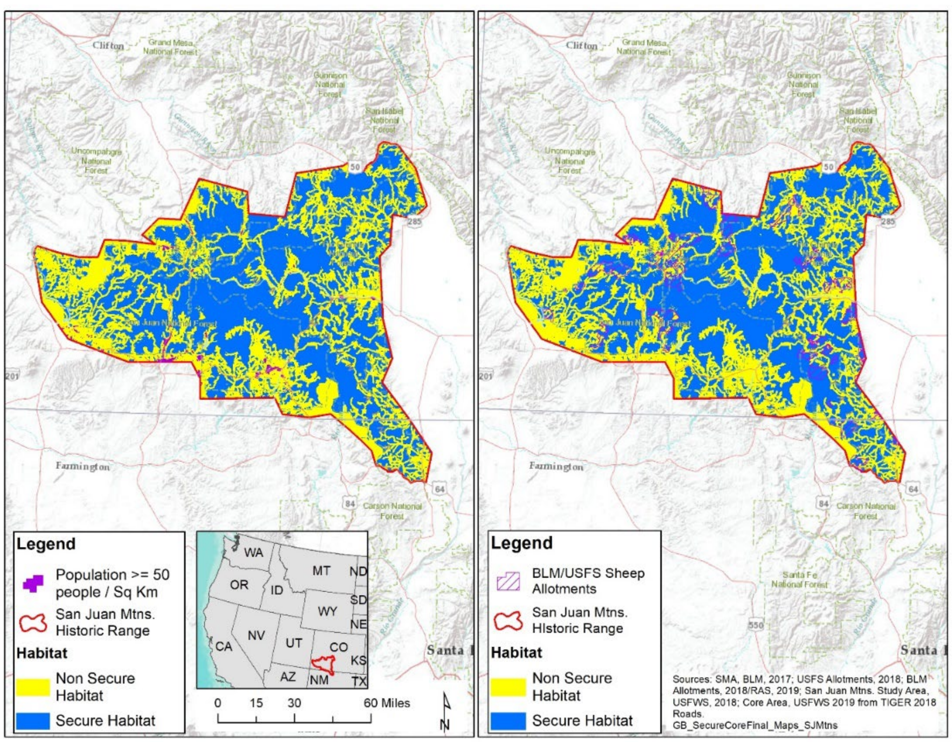

Figure 5. San Juan Mountains high population and sheep allotments in secure habitat and non secure habitat areas.

Secure Core Acreages and Maps for the Sierra Nevada Mountains

The tables and maps below show the breakdown of acres of secure core and non secure core (including areas not 500 m from an open or gated motorized route and "core; non secure," areas that are greater than 500 m from an open or gated motorized route but are not 2,500 acres in size) for the Sierra Nevada historical range analysis area. These areas are also tabulated by surface management, within sheep allotments, and by census blocks with a population of 50 or more people per square mile.

Table 7. Sierra Nevada Mountains Historical Range; Habitat areas by surface management.

Sierra Nevada Mountains Historical Range		
Habitat	**Acres**	**Percent Analysis Area**
Secure Core	**5,591,258**	**43.07**
Federal	5,566,680	42.88
State Government	15,382	0.12
Tribal Lands	9,196	0.07
Non Secure Core	**7,389,539**	**56.93**
Federal	4,158,418	32.04
Local Government	40,667	0.31
Private	3,106,631	23.93
State Government	66,771	0.51
Tribal Lands	17,052	0.13
Total Analysis Area	**12,980,797**	

Table 8. Sierra Nevada Mountains Historical Range; Habitat area within BLM or USFS sheep allotments.

Sierra Nevada Mountains Historical Range		
Habitat within Sheep Allotments	**Acres**	**Percent Analysis Area**
Secure Core	117,084	0.90
Non Secure Core	264,280	2.04

Table 9. Sierra Nevada Mountains Historical Range; Habitat areas with population of 50 or more people per square mile.

Sierra Nevada Mountains Historical Range		
Habitat with Population >= 50 people / sq. mile	**Acres**	**Percent Analysis Area**
Secure Core	525	0.004
Non Secure Core	314,090	2.42

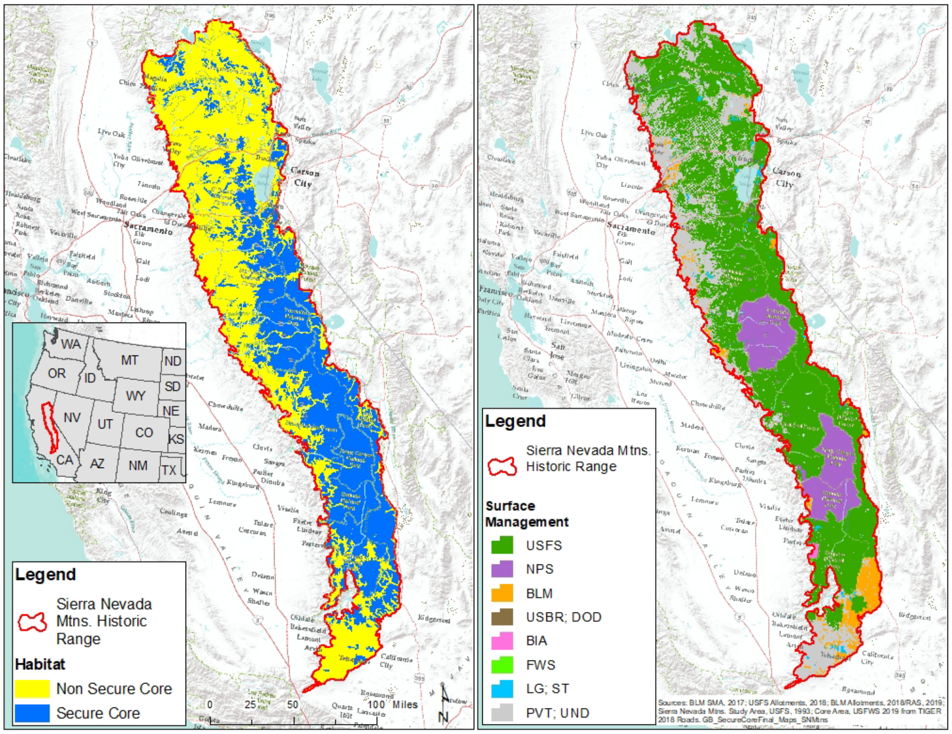

Figure 6. Sierra Nevada Mountains secure core and surface management.

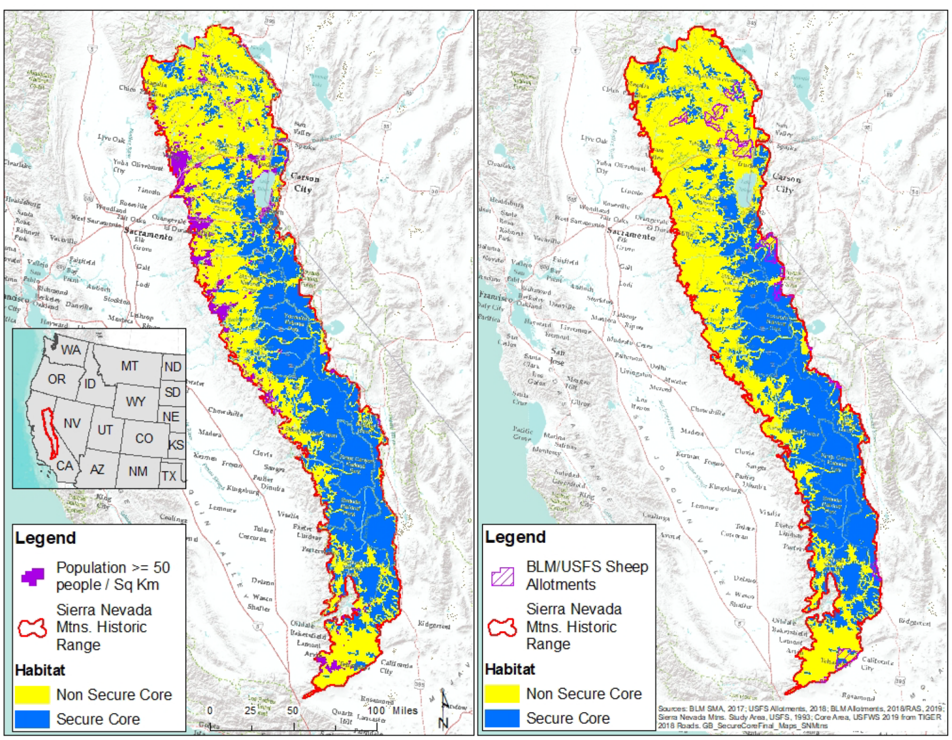

Figure 7. Sierra Nevada Mountains high population and sheep allotments in secure core and non secure core areas.

Secure Habitat Acreages and Maps for the Sierra Nevada Mountains

The tables and maps below show the breakdown of acres of secure habitat and non secure habitat (including areas not 500 m from an open or gated motorized route and "core; non secure," areas that are greater than 500 m from an open or gated motorized route but are not 10 acres in size) for the Sierra Nevada historical range analysis area. These areas are also tabulated by surface management, within sheep allotments, and by census blocks with a population of 50 or more people per square mile.

Table 10. Sierra Nevada Mountains Historical Range; Habitat areas by surface management.

Sierra Nevada Mountains Historical Range		
Habitat	**Acres**	**Percent Analysis Area**
Secure Habitat	**6,134,441**	**47.26**
Federal	6,098,860	46.98
State Government	24,333	0.19
Tribal Lands	11,248	0.09
Non Secure Habitat	**6,846,355**	**52.74**
Federal	3,626,236	27.94
Local Government	40,667	0.31
Private	3,106,631	23.93
State Government	57,820	0.45
Tribal Lands	15,000	0.12
Total Analysis Area	**12,980,796**	

Table 11. Sierra Nevada Mountains Historical Range; Habitat area within BLM or USFS sheep allotments.

Sierra Nevada Mountains Historical Range		
Habitat within Sheep Allotments	**Acres**	**Percent Analysis Area**
Secure Habitat	151,007	1.16
Non Secure Habitat	230,357	1.77

Table 12. Sierra Nevada Mountains Historical Range; Habitat areas with population of 50 or more people per square mile.

Sierra Nevada Mountains Historical Range		
Habitat with Population >= 50 people / sq. mile	**Acres**	**Percent Analysis Area**
Secure Habitat	1,1510	0.01
Non Secure Habitat	313,105	2.41

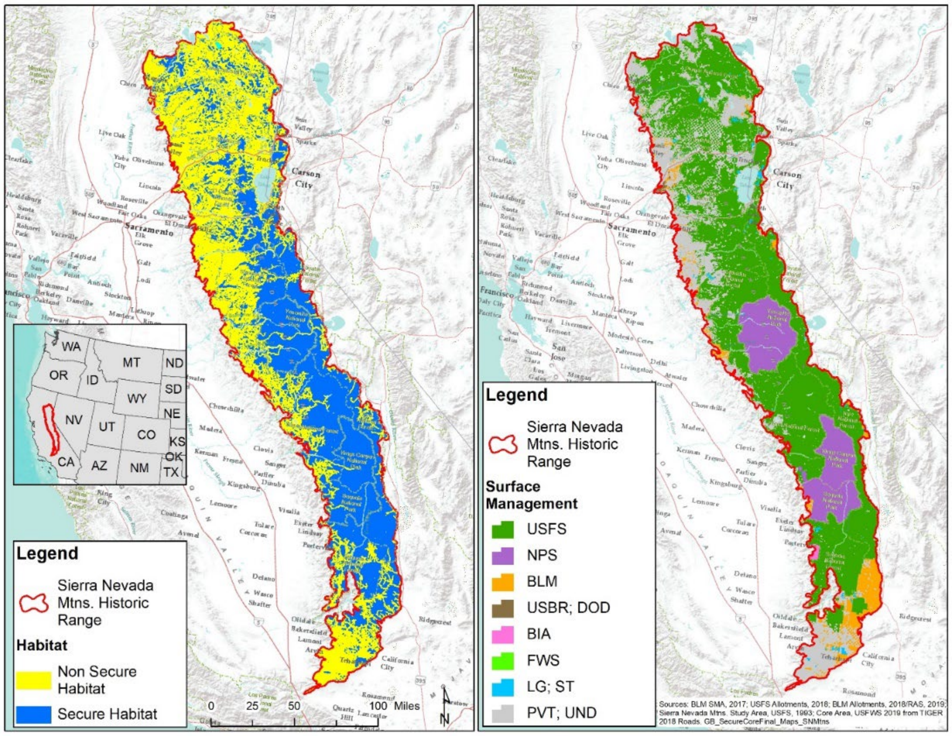

Figure 8. Sierra Nevada Mountains secure habitat and surface management.

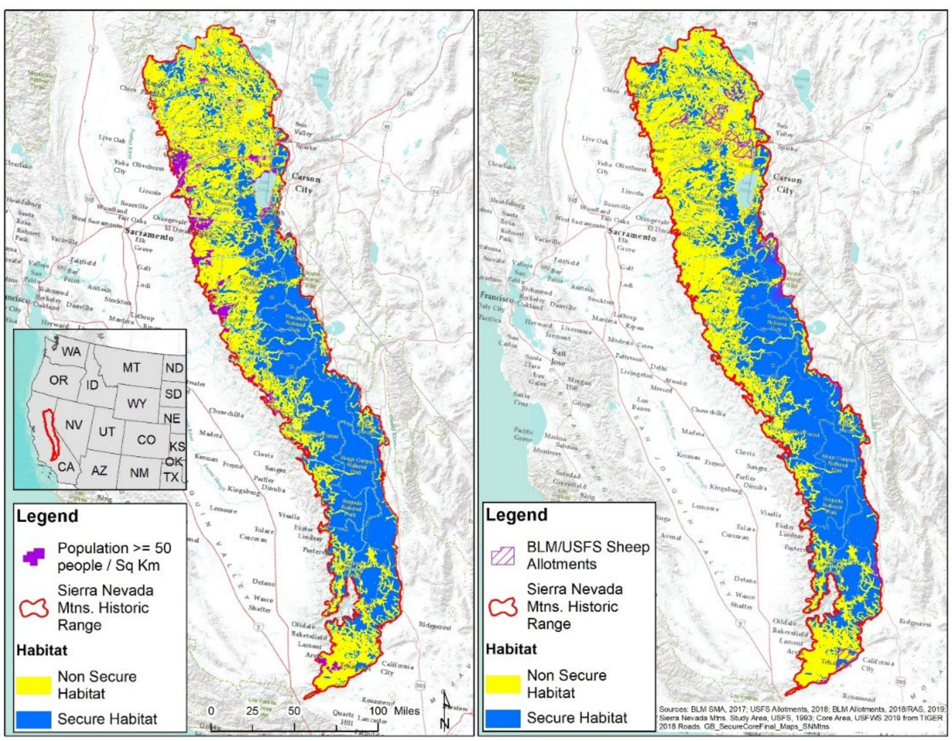

Figure 9. Sierra Nevada Mountains high population and sheep allotments in secure habitat and non secure habitat areas.

Appendix B. Secure Habitat Background

The Interagency Grizzly Bear Committee Taskforce Report on Grizzly bear/motorized access management was first released in 1994 and revised in 1998 (in their entirety: IGBC 1994, 1998). Management of motorized access is one of the most influential factors affecting habitat security for wildlife, including grizzly bears (Mattson *et al.* 1987; Mace and Manley 1993; Service 1993; Christensen *et al.* 1993). The Taskforce Report recognized that by managing motorized access, the following grizzly bear management objectives can be met (IGBC 1998, p. 1):

- Minimize human interactions and potential grizzly bear mortality;
- Minimize displacement from important habitats;
- Minimize habituation to humans; and
- Provide relatively secure habitat where energetic requirements can be met.

Historically, management of motorized use has been primarily accomplished through restriction of certain types of motorized use on established access routes. In addition to open and total road densities, the presence of core areas, areas free of motorized traffic and high levels of human use, are important to the management of human access (IGBC 1998, p. 1). The Taskforce Report recommended three parameters, with definitions and methods of measurement, to provide for a consistent approach to motorized access management between and within grizzly bear ecosystems: (1) open motorized route density (OMRD), (2) total motorized route density (TMRD), and (3) core areas (IGBC 1998, p. 1). Motorized route densities are calculated using a moving window analysis and are reported as the percentage of the analysis area with greater than 1 mi/mi^2 open motorized routes and 2 mi/mi^2 total motorized routes. Core areas are reported as the percentage of the analysis area that are greater than 500 m (1,650 ft) from any open motorized route or high-use non-motorized route and in place for at least 10 years. The Taskforce did not recommend minimum size for core areas. The Taskforce Report recognized that each ecosystem subcommittee would apply these recommendations based on ecosystem-specific information and recommend ecosystem specific habitat conditions that should be maintained to provide habitat security.

There is no published method to deductively calculate minimum habitat values required for a healthy and recovered population. Grizzly bears are long-lived, opportunistic omnivores whose food and space requirements vary depending on a multitude of environmental and behavioral conditions and on variation in the experience and knowledge of each individual bear. Grizzly bear home ranges overlap and change seasonally, annually, and with reproductive status. These characteristics make the development of habitat criteria complicated. We established criteria for the GYE and NCDE by assessing the habitat features that were compatible with a stable to increasing grizzly bear population in the past, and then used these habitat conditions as threshold values that must be maintained to ensure a healthy population (i.e., a "no net loss" or baseline approach), as suggested by Nielsen *et al.* (2006, p. 227). Because of the inability to calculate minimum habitat values for a recovered population, we use a "no net loss" approach by assessing what habitat factors are compatible with a stable to increasing grizzly bear population.

Greater Yellowstone Ecosystem (GYE)

The Service, in cooperation with the IGBC, held a workshop in 1997 to allow interested parties to present their ideas on the habitat needs for grizzly bear recovery and discuss proposals for habitat-based recovery criteria. Information gathered at the workshop was considered in drafting the habitat criteria for the Greater Yellowstone Area that were first released for public comment in 1999. These same criteria were included in the draft Conservation Strategy that was released for public comment in 2000. After analysis of public comment, we developed the habitat standards in the 2007 Conservation and the Recovery Plan Supplement: Habitat-based Recovery Criteria for the Yellowstone Ecosystem.

The 1998 baseline for habitat standards was chosen because the levels of secure habitat and developed sites on public lands remained relatively constant in the 10 years preceding 1998 (USDA FS 2004, pp. 140–141), and the selection of 1998 ensured that habitat conditions existing at a time when the population was increasing at a rate of 4 to 7 percent per year (Schwartz *et al.* 2006c, p. 48) would be maintained. In addition to measures for motorized routes and secure core, as recommended in the Taskforce Report, the baseline sets measures for developed recreation sites and livestock allotments. The overall habitat goal is to maintain habitat conditions at or improved upon baseline conditions, with limited exceptions as set forth in the GYE Conservation Strategy (YES 2022a, entire).

For the GYE, secure habitat refers to those areas with no motorized access that are at least 10 acres (0.31 km^2 (0.016 mi^2)) in size and more than 500 m (1,650 ft) from a motorized access route (road or trail), prescribed footprint of a developed site, or recurring helicopter flight line (YES 2022a, entire). Prescribed footprints were added in 2022 to delineate areas of concentrated human use associated with developed sites, such as visitor overnight lodges on USFS lands, developed campgrounds, administrative sites, and major developments on NPS lands (YES 2022a, entire). Our definition of secure habitat includes areas as small as 10 acres (0.31 km^2 (0.016 mi^2)) in size because both the IGBST and YES concluded that all secure habitats are important for grizzly bears in the GYE, regardless of size, particularly in peripheral areas. Research by Schwartz *et al*. (2010a, p. 661) supported this conclusion and demonstrated a direct link between this definition and grizzly bear survival in the GYE. If the minimum size of secure habitat was enlarged, the end result would be that thousands of acres of secure habitat would no longer be considered secure and would, therefore, not be subject to the "no net loss" standard. By using a smaller minimum acreage requirement, we are not excluding any of the larger blocks of secure habitat. Non-motorized trails were not excluded from secure core because research indicates that non-motorized trails do not significantly affect grizzly bear survival in the GYE, and that survival is better explained by the absence of motorized routes (Schwartz *et al*. 2010a, p. 659).

Northern Continental Divide Ecosystem (NCDE)

In a study of female grizzly bears in the South Fork of the Flathead River in the NCDE, female home ranges averaged 19 percent total road density >2 mi/mi^2, 19 percent open road density >1 mi/mi^2, and 68 percent core area (Manley 1993, *in litt*.). This level of secure core habitat was determined to be necessary for successfully reproducing adult female grizzly bears (Manley

1993, *in litt.*). As a result, Amendment 19 was used as a habitat management strategy for the 54 subunits on the Flathead National Forest (Service 1995, entire). Amendment 19 included no net increase in TMRD density greater than >2 mi/mi^2, no net increase in OMRD greater than >1 mi/mi^2, and no net decrease in the amount or size of security core. Furthermore, for subunits with more than 75 percent USFS lands, it established objectives: to limit OMRD densities of >1 mi/mi^2 to no more than 19 percent of a BMU subunit; to limit TMRD densities of >2 mi/mi^2 to no more than 19 percent of a BMU subunit; and to provide security core areas that equal or exceed 60 percent of each BMU subunit in 5 years and 68 percent in 10 years. For the 14 subunits with less than 75 percent USFS lands, improvements in OMRD, TMRD, or secure core habitat were maintained.

Significant efforts made by the USFS led to the majority of the BMU subunits in the NCDE meeting the Amendment 19 objectives. Monitoring of the NCDE grizzly bear population show that the number of bears substantially exceed the minimum population size goal stated in the 1993 Recovery Plan (391 bears) (Service 1993, p. 62), the population is well distributed throughout the recovery zone, and the population has expanded its geographic distribution well beyond the recovery zone boundary (Kendall *et al.* 2009; Mace *et al.* 2012; Costello *et al.* 2016b), even though not every BMU subunit meets the 19-19-68 percentage objective of Amendment 19. Based on updated NCDE grizzly bear population data and our understanding about grizzly bear responses to human activities and management, in 2009, a Conservation Strategy Technical Team was appointed by the NCDE Subcommittee and began to re-evaluate habitat standards for the NCDE grizzly bear population. A draft Conservation Strategy was released in 2013 for public comment and peer review. The NCDE Subcommittee re-assembled the Conservation Strategy Team and finalized the Conservation Strategy in 2018. The NCDE Conservation Strategy is periodically revised for clarifications and corrections, with the most recent version published in 2020.

Based on an estimated growth rate for the NCDE grizzly bear population of 2–3 percent annually from 2004–2011, the NCDE Subcommittee decided to establish habitat conditions on December 31, 2011, as a reasonable and conservative baseline that would likely support a robust, stable to increasing grizzly bear population. In addition to measures for motorized routes and secure core habitat, as recommended in the Taskforce Report, the baseline sets measures for developed recreation sites and livestock allotments. The overall habitat goal is to maintain habitat conditions at or improved upon baseline conditions, with limited exceptions as set forth in the NCDE Conservation Strategy (NCDE Subcommittee 2020).

For the NCDE, secure core habitat is defined as those areas on Federal lands within the analysis area more than 500 m (1,650 ft) from an open motorized access route during the non-denning season, or a gated route, and at least 2,500 acres (10.1 km^2 (3.9 mi^2)) in size (Service 2018, pp. 5, 12). The 2,500 acre (10.1 km^2 (3.9 mi^2)) minimum size for secure core habitat is based on the 1994 IGBC Guidelines that state minimum size will be recovery zone specific and that “the minimum size for the core area(s) be that area necessary to support a female grizzly bear for 24 hours of foraging.” Information and research specific to the NCDE indicated that 83 percent of documented locations of radio-collared females were in habitat that did not have motorized access that were usually at least 2,200 acres in size (Service 1995, p. 17). Non-motorized trails were not excluded from secure core because research in the GYE indicates that non-motorized trails do not significantly affect grizzly bear survival, and that survival was better explained by the absence of motorized routes (Schwartz *et al*. 2010a, p. 659).

Cabinet-Yaak (CYE) and Selkirk Ecosystems (SE)

Wakkinen and Kasworm (1997, entire) created road density and core area maps for the CYE and SE based on the definitions set forth in the Taskforce Report motorized routes. Based on female grizzly bear radiotelemetry data, they determined the proportion of home ranges with greater than 2 mi/mi^2 total road density, greater than 1 mi/mi^2 open road density, and the amount of core area for appropriate access management standards for the CYE and SE (Wakkinen and Kasworm 1997, p. 22). The female home ranges averaged 26 percent total road density greater than 2 mi/mi^2, 33 percent open road density greater than 1 mi/mi^2, and 55 percent core area. No minimum core area size was determined because of the small sample size (Wakkinen and Kasworm 1997, p. 23). Wakkinen and Kasworm (1997, pp. 24–25) speculated that differences in the percentage of core areas within home ranges between the NCDE and the CYE and SE may be due to the lack of larger core areas available in the CYE and SE, different computer software to conduct the analysis, and/or differences in levels of human use on roads between the ecosystems. In 1998, the IGBC Taskforce Report defined core areas as those areas greater than 500 m (1,650 ft) from any open motorized route or high-use non-motorized route (IGBC 1998, p. 4). The Forest Plan Amendments for the Motorized Access Management within the Selkirk and Cabinet-Yaak Grizzly Bear Recovery Zones (USDA FS 2011c, entire) incorporated the recommended levels of OMRD, TMRD, and percent core area from Wakkinen and Kasworm (1997, pp. 24–25) with the additional exclusion of high-use trails from core areas as recommended in the 1998 IGBC Taskforce Report.

North Cascades Ecosystem

Core areas for the North Cascades are defined as those areas greater than 500 m (1,650 ft) from any open motorized route or high-use non-motorized route, as set forth by the Taskforce Report (USDA FS 1997, entire). The North Cascades Ecosystem Subcommittee agreed to a phased approach to identify and protect “core area” (USDA FS 1997, p. 1). The Federal land management agencies agreed to manage for “no net loss” of core area until “seasonal habitat has been defined, mapped and its availability evaluated” (USDA FS 1997, p. 3). In addition, they identified the need to do further work to define “high use non-motorized trails” for the North Cascades (USDA FS 1997, p. 1).

Bitterroot Ecosystem (BE)

Ecosystem specific data are not available, and motorized access and core area standards have not yet developed for the BE. The BE recovery zone is 98 percent wilderness; however, motorized access standards have not been developed for adjacent areas to the north and east, where female occupancy is necessary for natural recolonization of the BE.

Appendix C. Suitable Habitat in the GYE

For the purposes of this SSA report, and as first described in our 2007 final rule designating and delisting the Greater Yellowstone Area DPS (72 FR 14866, March 29, 2007), “suitable habitat” is considered the area within the larger GYE ecosystem capable of supporting grizzly bear reproduction and survival now and in the future. Suitable habitat is generally associated with mountains and forested lands that are primarily owned and managed by Federal agencies. We defined “suitable habitat” for grizzly bears as areas having three characteristics:

(1) Being of adequate habitat quality and quantity to support grizzly bear reproduction and survival;
(2) Being contiguous with the current distribution of GYE grizzly bears such that natural recolonization is possible; and
(3) Having low mortality risk as indicated through reasonable and manageable levels of grizzly bear mortality.

Our definition and delineation of suitable habitat is built on the widely accepted conclusions of extensive research that grizzly bear reproduction and survival is a function of both the biological needs of grizzly bears and remoteness from human activities, which minimizes mortality risk for grizzly bears (Craighead 1980, pp. 8–11; Knight 1980, pp. 1–3; Peek *et al.* 1987, pp. 160–161; Merrill *et al.* 1999, pp. 233–235; Schwartz *et al.* 2010a, p. 661).

Our first criteria in defining suitable habitat involved analyzing land cover types. Mountainous areas provide hiding cover, the topographic variation necessary to ensure a wide variety of seasonal foods, and the steep slopes used for denning (Judd *et al.* 1986, pp. 114–115; Aune and Kasworm 1989, pp. 29–58; Linnell *et al.* 2000, pp. 403–405). Higher elevation, mountainous regions in the GYE (Omernik 1987, pp. 118–125; Omernik 1995, pp. 49–62; Woods *et al.* 1999, entire; McGrath *et al.* 2002, entire; Chapman *et al.* 2004, entire) contain high-energy foods such as whitebark pine seeds (Mattson and Jonkel 1990, p. 223; Mattson *et al.* 1991*a*, p. 1623) and army cutworm moths (Mattson *et al.* 1991*b*, 2434; French *et al.* 1994, p. 391). For our analysis of suitable habitat, we considered the Middle Rockies ecoregion, within which the GYE is contained (Omernik 1987, pp. 120–121; Woods *et al.* 1999, entire; McGrath *et al.* 2002, entire; Chapman *et al.* 2004, entire), to meet grizzly bear biological needs providing food, seasonal foraging opportunities, cover, and denning areas (Mattson and Merrill 2002, p. 1125).

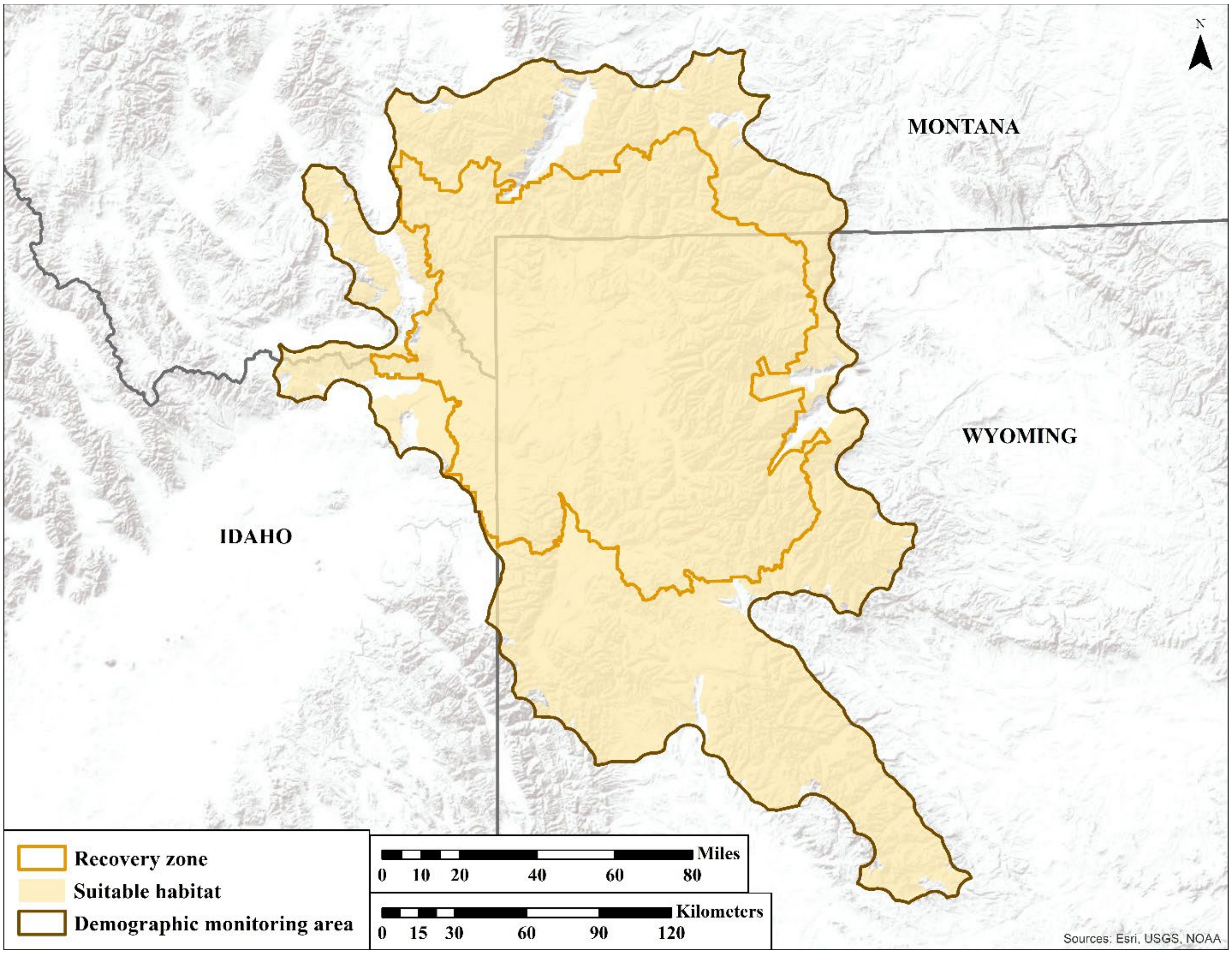

Figure 1. Map of the Greater Yellowstone Ecosystem (GYE). Boundaries are shown for: (1) the recovery zone; (2) the Demographic Monitoring Area; and (3) biologically suitable habitat.

Although grizzly bears historically occurred throughout the area of the larger GYE ecosystem (Stebler 1972, pp. 297–298), today many of these habitats are not biologically suitable for grizzly bears. For example, we did not include drier sagebrush, prairie, or agricultural lands within our definition of suitable habitat because these land types no longer contain adequate food resources (i.e., bison) to support grizzly bears. While there are records of grizzly bears in eastern Wyoming near present-day Sheridan, Casper, and Wheatland, even in the early 19th century, indirect evidence suggests that grizzly bears were less common in these eastern prairie habitats than in mountainous areas to the west (Rollins 1935, p. 191; Wade 1947, p. 444). Grizzly bear presence in drier, grassland habitats was associated with rivers and streams where grizzly bears used bison carcasses as a major food source (Burroughs 1961, pp. 57–60; Herrero 1972, pp. 224–227; Stebler 1972, pp. 297–298; Mattson and Merrill 2002, pp. 1128–1129). Most of the short-grass prairie on the east side of the Rocky Mountains has been converted into agricultural land (Woods *et al.* 1999, entire), and high densities of traditional food sources are no longer available due to land conversion and human occupancy of urban and rural lands. Traditional food sources, such as bison and elk, have been reduced and replaced with domestic livestock, such as cattle, sheep, chickens, goats, pigs, and beehives, which can become anthropogenic sources of prey for grizzly bears. While food sources such as grasses and berries are abundant in some years in the riparian zones within which the bears travel, these are not reliable every year and can only support a small number of bears. These nutritional constraints and the potential for human-bear conflicts limit the potential for a self-sustaining population of grizzly bears to develop in the prairies, although we expect some grizzly bears to live in these areas. Because wild bison herds no longer exist in these areas, and are mainly contained within YNP in the GYE, they are no longer capable of contributing in a meaningful way to the overall status of the GYE grizzly bear.

Bears in these peripheral areas (i.e., prairie habitats) will not establish self-sustaining, year-round populations due to a lack of suitable habitat, land ownership patterns, and the lack of traditional, natural grizzly bear foods (i.e., bison). Instead, bears in these peripheral areas will likely always rely on the GYE grizzly bear population inside the DMA as a source population. Grizzly bears in these peripheral areas are not biologically necessary to the GYE grizzly bear population and a lack of occupancy outside the DMA boundaries in peripheral areas will not impact the resiliency of the GYE grizzly bear population. Grizzly bear recovery in these portions of the species' historical range is unnecessary, because there is more than enough suitable habitat to support a viable grizzly bear population as set forth in the demographic recovery criteria.

Our second criteria in defining suitable habitat involved analyzing human-caused mortality risk, as this can impact which habitat might be considered suitable. Some human-caused mortality is unavoidable in a dynamic system where hundreds of bears inhabit large areas of diverse habitat with several million human visitors and residents. The negative impacts of humans on grizzly bear survival and habitat use are well documented (Harding and Nagy 1980, p. 278; McLellan and Shackleton 1988, pp. 458–459; Aune and Kasworm 1989, pp. 83–103; McLellan 1989, pp. 1862–1864; McLellan and Shackleton 1989b, pp. 377–378; Mattson 1990, pp. 41–44; Mattson and Knight 1991, pp. 9–11; Mace *et al.* 1996, p. 1403; McLellan *et al.* 1999, pp. 914–916; White *et al.* 1999, p. 150; Woodroffe 2000, pp. 166–168; Boyce *et al.* 2001, p. 34; Johnson *et al.* 2004, p. 976; Schwartz *et al.* 2010a, p. 661). These effects range from temporary displacement to actual mortality. Grizzly bear persistence in the contiguous U.S. between 1920 and 2000 was negatively associated with human and livestock densities (Mattson and Merrill 2002, pp. 1129–1134).

As human population densities increase, the frequency of encounters between humans and grizzly bears also increases, resulting in more human-caused grizzly bear mortalities due to a perceived or real threat to human life or property (Mattson *et al.* 1996, pp. 1014–1015). Similarly, as livestock densities increase in habitat occupied by grizzly bears, depredations follow. Although grizzly bears frequently coexist with cattle without depredating them, when grizzly bears encounter domestic sheep, they usually are attracted to such flocks and depredate the sheep (Jonkel 1980, p. 12; Knight and Judd 1983, pp. 188–189; Orme and Williams 1986, pp. 199–202; Anderson *et al.* 2002, pp. 252–253). If repeated depredations occur, managers either relocate the bear or remove it (i.e., euthanize or place in an approved American Zoological Association facility) from the population, resulting in such domestic sheep areas becoming population sinks (areas where death rates exceed birth rates) (Knight *et al.* 1988, pp. 122–123). Because urban sites and sheep allotments possess high mortality risks for grizzly bears, we did not include these areas as suitable habitat (Knight *et al.* 1988, pp. 122–123). Based on 2000 census data, we defined urban areas as census blocks with human population densities of more than 50 people per km^2 (129 people per mi^2) (U.S. Census Bureau 2005, entire). Cities within the Middle Rockies ecoregion, such as West Yellowstone, Gardiner, Big Sky, and Cooke City, Montana, and Jackson, Wyoming, were not included as suitable habitat. There are large, contiguous blocks of sheep allotments in peripheral areas of the ecosystem in the Wyoming Mountain Range, the Salt River Mountain Range, and portions of the Wind River Mountain Range on the Bridger Teton and the Targhee NFs (see Figure 1 in *Appendix C*).

This spatial distribution of sheep allotments on the periphery of suitable habitat results in areas of high mortality risk to bears within these allotments and a few small, isolated patches or strips of suitable habitat adjacent to or within sheep allotments. Due to the negative "edge effects" of this distribution of sheep allotments on the periphery of current grizzly bear range, our analysis did not classify linear strips and isolated patches of habitat as suitable habitat. These strips and patches of land possess higher mortality risks for grizzly bears because of their enclosure by and/or proximity to areas of high mortality risk. This phenomenon in which the quantity and quality of suitable habitat is diminished because of interactions with surrounding less suitable habitat is known as an edge effect (Lande 1988, pp. 3–4; Yahner 1988, pp. 335–337; Mills 1995, p. 396). Edge effects are exacerbated in small habitat patches with high perimeter-to-area ratios (i.e., those that are longer and narrower) and in wide-ranging species such as grizzly bears because they are more likely to encounter surrounding, unsuitable habitat (Woodroffe and Ginsberg 1998, p. 2126).

Finally, dispersal capabilities of grizzly bears were considered in our determination of which potential habitat areas might be considered suitable. For example, because the Bighorn Mountain range is disjunct from other suitable habitat and current grizzly bear distribution, our analysis did not classify the Bighorn Mountains as suitable habitat within the GYE. The Bighorn Mountains comprise 6,341 km^2 (2,448 mi^2) of habitat that is classified as part of the Middle Rockies ecoregion but are separated from the current grizzly bear distribution by approximately 100 km (60 mi) of a mosaic of private and BLM lands primarily used for agriculture, livestock grazing, and oil and gas production (Chapman *et al.* 2004, entire). Although there is a possibility that individual bears may emigrate from the GYE to the Bighorn Mountains occasionally, this dispersal distance exceeds the average dispersal distance for both males (30 to 42 km (19 to 26 mi)) and females (10 to 14 km (6 to 9 mi)) (McLellan and Hovey 2001, p. 842; Proctor *et al.* 2004, p. 1108). Without constant emigrants from suitable habitat, the Bighorn Mountains will not support a self-sustaining grizzly bear population.

Some areas that do not meet our definition of suitable habitat may still be used by grizzly bears (Schwartz *et al.* 2002, p. 209; Schwartz *et al.* 2006c, pp. 64–66). The records of grizzly bears in these unsuitable habitat areas are generally due to recorded human-grizzly bear conflicts or to transient animals. These areas are defined as unsuitable due to the high risk of mortality resulting from these human-grizzly bear conflicts. These unsuitable habitat areas may contain grizzly bears at lower densities as reproduction and survival may be lower because bears that repeatedly come into conflict with humans or livestock are usually either relocated or removed from these areas.

According to the criteria in defining suitable habitat, the GYE contains approximately 46,905 km^2 (18,110 mi^2) of suitable grizzly bear habitat. The Service concluded that this amount of suitable habitat is sufficient to meet all habitat needs of a recovered grizzly bear population and provide ecological resiliency to the population through the availability of widely distributed, high-quality habitat that will allow the population to respond to environmental changes.

Appendix D. Methods Used to Measure Population Trends and Annual Estimates

Wildlife managers and population ecologists monitor a number of factors to gauge the status of a population and make scientifically informed decisions. These measures include population size, population trend, density, and current range. While population size is a well-known and easily understood metric, it only provides information about a population at a single point in time. Wildlife managers often want to know how a population is changing over time and why. As managers and technical experts review new techniques or approaches for potential adoption, they should consider the technique's cost, field sampling logistics, utility to managers, and the ability to retroactively apply population estimates to previous years of data are considered.

Greater Yellowstone Ecosystem (GYE)

The IGBST uses an integrated population model (IPM) to estimate population abundance, trend, and other demographic parameters based on consistent, annual data collections since 1983. With recent advances in analytics and data collection in the field of wildlife science, more unified approaches allow consolidation of independent sources of data and analyses into a single, joint analysis. Based on Bayesian inference (where available knowledge about parameters in a statistical model is updated with information in observed data), this union of different data sources is realized in IPM: population-level count data are simultaneously linked with individual-based survival and reproductive data through what is termed a "state-space model." A state-space model is composed of a process and observation submodel with the former describing the true state of the population over time using a projection matrix and the latter linking temporal changes of population abundance with observation data (i.e., population count data). The addition of the population count data provides two benefits: 1) direct information on population abundance over time and 2) indirect, but limited, information on survival and reproduction as these parameters inherently control population abundance. Because of the limited demographic information provided by count data, additional information is needed to estimate survival and reproduction with analyses specific to each demographic parameter. By combining count, survival, and reproduction data into a single analysis, more information is available in the estimation of the parameters shared among the state-space, survival, and reproduction submodels.

Implementation of the IPM as part of the long-term grizzly bear population research program conducted by the IGBST provides multiple benefits. First, because parameters are linked across multiple submodels, estimates from different data sources must be "self-consistent" and reconcile with one another. For example, a specific change in population size from one year to the next must reconcile with mortality (losses to the population) and reproduction (additions to the population) estimates for the same period. This generally leads to greater precision and accuracy of estimates. The IPM framework allows the IGBST to annually update demographic parameters and understand changes in population structure over time. Because of their inherent flexibility, IPMs can accommodate a variety of data sources collected over different time periods and thus make optimal use of IGBST's extensive data collections. This flexibility also allows the IGBST to modify monitoring protocols and harness future analytical advancements and technological improvements in data collections.

The IPM used by the IGBST is composed of survival, reproduction, and state space submodels, each incorporating data from the long-term research and monitoring program. Telemetry and observation flight data inform a modified integrated event-time model for known and unknown fates that estimates survival for adult (≥3 years) and subadult (2–3 years old) females and males (Walsh *et al*. 2015, entire). The adult age class begins with 3-year-olds as females can breed and subsequently give birth to cubs-of-the-year (cubs) as 4-years-olds. A joint survival and reproduction model is used to estimate monthly survival of cubs (<1 year old) and yearling bears (1–2 years old), and impute litter size. The number of cubs born is estimated by multiplying litter size and the number of adult females estimated to give birth (in their entirety: Haroldson *et al*. 2006; Schwartz *et al*. 2006a; Schwartz and White 2008; IGBST 2012). The latter parameter is based on data from annual ground observations and standardized aerial surveys to estimate the total number of females with cubs in the Demographic Monitoring Area, as derived from Chao2 16 km estimates starting in 1997 (in their entirety: Knight *et al*. 1995; Keating *et al*. 2002; Cherry *et al*. 2007; Schwartz *et al*. 2008; IGBST 2012, 2021; van Manen *et al*. 2022). Data from aerial observation flights conducted during 2001–2019 are also analyzed within a mark-resight framework and included in the IPM as a second annual estimate of the total number of females with cubs (Higgs *et al*. 2013, entire). With ancillary data on the annual probability of females transitioning among reproductive states (no offspring, cubs, yearlings, 2-year-old offspring), the total number of adult females can be estimated. Combined with estimates of survival for each population segment, abundance of all remaining cohorts is estimated to obtain annual estimates of total population abundance and population growth. Finally, known, probable, and estimated unknown/unreported mortality data (Cherry *et al*. 2002, entire) collected since 1983 serve as additional population count data, providing information on the male and non-reproductive female population segments.

Northern Continental Divide Ecosystem (NCDE)

In the NCDE, the population trend is estimated using two methods: (1) a deterministic life table analysis, and (2) individual-based, stochastic population modeling (Costello *et al.* 2016b, p. 69). The population estimate is based on a genetic capture/recapture study conducted in 2004 (Kendall *et al.* 2009, entire) and subsequent estimates of population trend (Costello *et al.* 2016b, p. 16). MFWP's goal is to maintain a minimum of 25 adult female grizzly bears fitted with radio collars and collar males as resources allow, with a goal of five of males, spatially distributed throughout the ecosystem.

Deterministic Life Table Analysis

The deterministic life-table analysis approach involves estimates of vital rates, does not incorporate uncertainty, and is a female-only rate. It computes the deterministic asymptomatic rate of population growth (lambda; λ) using a standard, dynamic life table and solving iteratively for *r* (i.e., the intrinsic rate of growth). Costello *et al.* (2016b, p. 69) estimated λ using "three point estimates of independent female survival: (1) maximum (0.951), obtained when unknown-fate females were censured; (2) minimum (0.943), obtained when unknown-fate females were assumed dead; and (3) the mean of those two estimates (0.947)."

Individual-based, Stochastic Population Modeling

Individual-based, stochastic population modeling is based on vital rates of all sex/age classes and the uncertainty associated with each vital rate. This estimate uses RISKMAN to stochastically model population growth based on estimated recruitment rates, dependent bear survival rates, and independent bear survival rates for both males and females (Costello *et al.* 2016b, p. 69).

Genetic Capture/Recapture Population Estimate

In 2004, a noninvasive genetic sampling effort was conducted within occupied areas of the NCDE (Kendall *et al.* 2009, entire). DNA data was included from hair traps, bear rubs, and physical captures to construct individual bear encounter histories in a Huggins-Pledger closed mark-recapture model to estimate population size. Lured hair traps were systematically distributed using a grid of 7x7 km cells across estimated occupied areas. Placement of the hair snare within each cell was based on evidence of bear activity, presence of natural travel routes, seasonal vegetation characteristics, and indices of recent wildfire severity. Bears naturally rub on trees, power poles, wooden signs and fence posts, and barbed wire fences, and thus did not require the use of lure. Physical capture information included bears handled for research or management or that were identified during other hair sampling studies from 1975–2007.

Cabinet-Yaak and Selkirk Ecosystems (CYE and SE)

In the CYE and SE, the population trend is determined by female survival and fecundity rates determined through radio collar monitoring (Kasworm *et al.* 2024a, pp. 10–12, Kasworm *et al.* 2024b, pp. 8–9). Due to the small population sizes in the CYE and SE, the Service attempts to collar as many females and males as possible. Bootstrapping techniques are used to estimate lambda and associated confidence intervals (Hovey and McLellan 1996, entire).

Annual CYE population estimates are obtained by applying the rate of growth to a 2012 population estimate (Kasworm *et al.* 2024a, pp. 42–43). The 2012 estimate was developed from a mark-recapture effort using hair traps and rub trees (Kendall *et al*. 2016, entire). Kasworm *et al.* (2024a, p. 41) also estimate a minimum number of individuals identified in annual collared bear monitoring, captures, hair sampling, and trail camera photographs, minus any known mortality.

In the SE, population estimates are obtained by applying the rate of growth (Kasworm *et al.* 2024b, pp. 28–29) to a 2002 population estimate (Proctor *et al.* 2007, p. 3). The 2002 estimate was developed from a mark recapture effort using hair corrals in the B.C. portion of the SE in 2002 (Proctor *et al.* 2007, p. 3). A more recent B.C. population estimate from mark recapture work was made in during 2020–2021 (Proctor *et al.* 2022, p. 2). Kasworm *et al*. (2024b, pp. 20–21) also estimate a minimum number of individuals identified in annual collared bear monitoring, captures, hair sampling, and trail camera photographs, minus any known mortality.

The 1993 Recovery Plan details a method to calculate a minimum population estimate based on a 6-year average of unduplicated females with cubs to stabilize the averaged based on a 3-year reproductive cycle. The 6-year average of females with cubs is multiplied by three to estimate the number of adult females in the population given that on average, either 28 percent (CYE) or 33 percent (SE) of the population is made of adult females. The minimum number of females with cubs likely underestimates the actual number because reporting efficiency of females with cubs is estimated to be 60 percent. The proportion of adult females in the population is based on the proportion adults to subadults in the population and the sex ratio of males to females for both subadults and adults. The minimum population size is calculated by dividing 6-year average observed females with cubs by 0.6 then dividing by the adult female proportion of the population (Service 1993, pp. 83–84, 101–102; Kasworm *et al.* 2024a, p. 17; Kasworm *et al.* 2024b, p. 14).

Appendix E. Canadian Grizzly Bear Assessment

Assessment of grizzly bears (*Ursus arctos*) north of the Canada-U.S. border and their relationship to populations in the lower-48 States

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January 2021

We reference this report where it continues to contain the best available information and include this report in its entirety as written. In the body of the SSA, we include updated information and citations where we have more recent information than what is included in portions of this report.

Introduction

Grizzly bears in Canada are designated nationally as 'Special Concern' by the Canadian Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and the federal Species at Risk Act. This designation was made due to the bear's North American population decline over the past 150 years, its sensitivity to human disturbance and human-caused mortality, poor population data across its range, a few local population declines, and extensive fragmentation in the southern portion of its Canadian range (COSEWIC 2012). However, there is evidence of a stable population overall across their distribution in Canada (COSEWIC 2012). There are approximately 15,000 grizzly bears in British Columbia (B.C.), 700 in Alberta, and 13,000 north of the 60th parallel in the Yukon, Northwest Territories, and Nunavut (Figure 1). While bears live within generally large robust populations in northern portions of the provinces, their populations along the periphery of their distribution in Alberta and along the Canada-U.S. border have varying levels of conservation concern (McLellan 1998). This concern is dominated by fragmentation creating smaller populations, conflict related mortality on their periphery in the human-settled valleys of this mountainous landscape, and by backcountry mortalities related to motorized access. In contrast to the grizzly bear conservation status in the lower-48 States where their threatened status under the Federal Endangered Species Act affords them significant protection and resources for conservation management, the circumstances within Canada have not resulted in a similar level of conservation concern for grizzly bears. Thus, the overall conservation management is considerably less. Also, grizzly bear management is the realm of the Provinces. Grizzly bear conservation and management within B.C. is guided by the Wildlife Act and B.C.'s Conservation Strategy. Similarly, in Alberta, a provincial grizzly bear recovery plan provides the basis for bear conservation and management (Alberta Environment and Parks 2016).

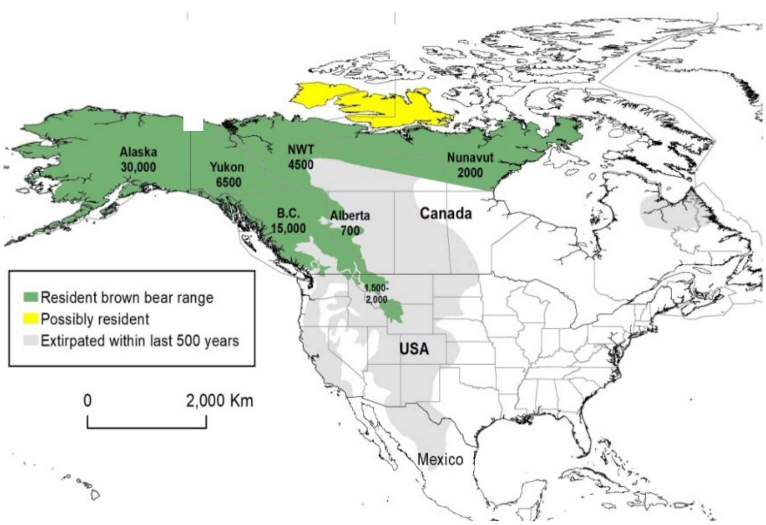

Figure 1: Grizzly bear distribution in western North America with abundance estimates. Adapted from Proctor et al. (2021a).

The main benefit of Canadian grizzly bears to those in the lower-48 States is the provision of genetic and demographic connectivity. Here we speak of connectivity in terms of movements between areas that are accompanied by breeding. Genetic connectivity resists losses of genetic diversity that usually occur in small, isolated populations and is more easily mediated by more vagile males (Proctor *et al.* 2005). Demographic connectivity offers a 'rescue' effect for small, isolated populations that may lose females (and reproductive capacity) through stochastic (chance) events (e.g., disease) or through more deterministic process (e.g., excessive human-caused mortality on the periphery of small populations) (Proctor *et al.* 2012, Lamb *et al.* 2016). For example, the international South Selkirk population had been totally isolated for decades (Proctor *et al.* 2005, 2012), but is currently experiencing increased connectivity and has been for the past decade (Proctor *et al.* 2018). This population's best opportunity for genetic and demographic connectivity from a larger healthier population occurs with the south Purcell Mountains of southern B.C. across the Creston Valley and B.C. Highway 3A (just north of Bonners Ferry, Id). This same Purcell Mountain grizzly population is the nearest population to reconnect the international Yahk/Yaak population. In fact, males have remained partially connected across B.C Highway 3 into the Yahk/Yaak population, mediating genetic connectivity, but demographic connectivity has been lacking (Proctor *et al.* 2005, 2012).

Additionally, B.C. and Alberta combined have many more bears than are in the lower-48 States, particularly B.C. (Figure 1), which until recently, allowed a decades-long sustainable grizzly bear hunt (McLellan *et al.* 2017a). In 2017, the B.C. grizzly bear hunt was halted on ethical grounds and public opposition, not conservation concern. This fundamental difference between bear populations in B.C and the lower-48 States has resulted in a difference in intensity of conservation management between the two jurisdictions. However, many of the conservation challenges present in the lower-48 States are also present in Canada, particularly for bear populations along the Canada-U.S. border. Fragmentation from human settlement patterns, human-caused mortality, and traffic on major highways has created small, fragmented or isolated threatened populations in the lower-48 States (i.e., the South Selkirk, Yaak, and Cabinets populations, Proctor *et al.* 2012). Canadian Highway 3, just north of the U.S.-Canada border, and its associated settlement is responsible for much of the fragmentation of Canadian bear populations and separates these trans-border populations from the larger Canadian grizzly bear populations to the north (Proctor *et al.* 2005). In that regard, there has been much research and conservation effort to reverse this fragmentation within Canada and some measure of success to date. A large network of government agencies, Environmental Non-government Organizations (ENGOs), and public interest groups from both countries are beginning to work cooperatively to solve this problem.

The other area of enduring conservation management in Canada is the challenge the provinces have with motorized access management, an important tool in grizzly bear conservation management (Proctor *et al.* 2020). While there have been local motorized access management plans initiated, some successfully, they have been a challenge to implement more broadly.

Here we review the research, management, conservation progress, and status of grizzly bear populations in British Columbia and Alberta, Canada with a focus on those just north of the 49th parallel. We briefly provide an overview of bear populations further north.

British Columbia Overview

Most (~80 percent) of British Columbia (B.C.) is grizzly bear habitat; grizzly bears were extirpated due to human settlement associated with excessive human-caused mortality over the past century from the lower mainland around the metropolis of Vancouver, south-central Okanagan valley, and a small corner in northeastern B.C. (Figure 1). Going north in B.C, the influence of humans decreases, and grizzly bears flourish. B.C. covers ~950,000 km^2 and grizzly bears occupy ~750,000 km^2. In contrast, in the lower-48 States, grizzly bears occupy a much smaller area of approximately 55,000 km^2. The ecology of B.C. is incredibly varied from moist mountainous forests in the east, to the semi-desert Okanagan in the dry central interior, to very wet coastal mountain forests in the west; grizzly bear habitat productivity also varies over this range (Mowat *et al*. 2013).

Grizzly bears were intentionally killed in B.C. during European settlement into the early 1900s' (McLellan 1998), and hunting went unregulated until the late 1960s when spring and fall hunts were initiated. In the mid-1970s, a Limited Entry Hunt (LEH) was instigated in the southern portion of the province (Peek *et al.* 2003). B.C. adopted a grizzly bear Conservation Strategy in 1995 (B.C. Conservation Strategy 1995), and in 1996 the LEH was extended to the entire province with limits on the numbers of females taken (Peek *et al.* 2003). With a few localized exceptions, the hunt was then sustainable for decades after the LEH was applied (McLellan *et al.* 2017a, Hatter *et al.* 2018), although concerns have been raised (Artelle *et al.* 2013). The biggest challenges in managing for an accurate sustainable mortality rate, were the inability to estimate the grizzly bear population across the province accurately and to account for unreported mortalities. After the DNA survey method was developed in 1995 (Proctor 1995, Woods *et al.* 1999), reliable population estimates were carried out over portions of the province and unreported mortality was estimated from telemetry research and hunting quotas were assessed and adjusted accordingly. In 2017, the legal hunt was halted due to public opposition, although First Nations are allowed to hunt for food, social, or ceremonial reasons (https://news.gov.bc.ca/releases/2017FLNR0372-002065). It is also legal to kill a grizzly bear in defense-of-life or property.

The current estimated grizzly bear population in B.C. is ~15,000, and bear densities vary from less than 10 to greater than 400 bears/1,000 km^2 (Mowat *et al.* 2013). Provincially, grizzly bears are ranked as 'Special Concern' by the B.C Conservation Data Center and federally under the Species at Risk Act (COSEWIC 2012, SARA 2018). While grizzly bears are internationally designated as 'Least Concern' by the IUCN Red List of Threatened Species, four populations within B.C were designated as 'Threatened', 3 of which span the Canada-U.S. border (North Cascades-Critically Endangered, South Selkirk-Vulnerable, and the Yahk/Yaak-Endangered) (McLellan *et al.* 2017b).

B.C.'s estimated 15,000 grizzly bears (B.C Min. FLNRORD 2020) are managed through 55 Grizzly Bear Population Units (GBPU), which were formed with natural and anthropogenic boundaries in mind (Figure 2a). Originally GBPUs were ranked as 'threatened', viable' or 'extirpated' based on the perceived relationship between their current bear numbers and their potential 'carrying capacity' (Austin and Hamilton 2004). This system was replaced recently by a more measurable, objective method based on principles developed by the IUCN and implemented by a Nature Serve–based system of conservation ranking (Figure 2a, Morgan *et al.* 2020). Current rankings span 5 categories M1 – M5 with the highest level of conservation concern in units labelled M1. The IUCN and Nature Serve labels are primarily designed to assess extinction risk, but because most GBPUs in B.C. are jurisdictional units that are often inter-connected with neighbouring units and not biologically isolated populations, their extinction risk is generally very low. For this reason, the B.C. government refers to their status with relative descriptors of 'conservation concern' M1 – M5. This applies to all of B.C.s GBPUs except a few that are biologically isolated or intensely fragmented and are separately designated by the IUCN Red List Assessment process as mentioned above (McLellan *et al.* 2017b).

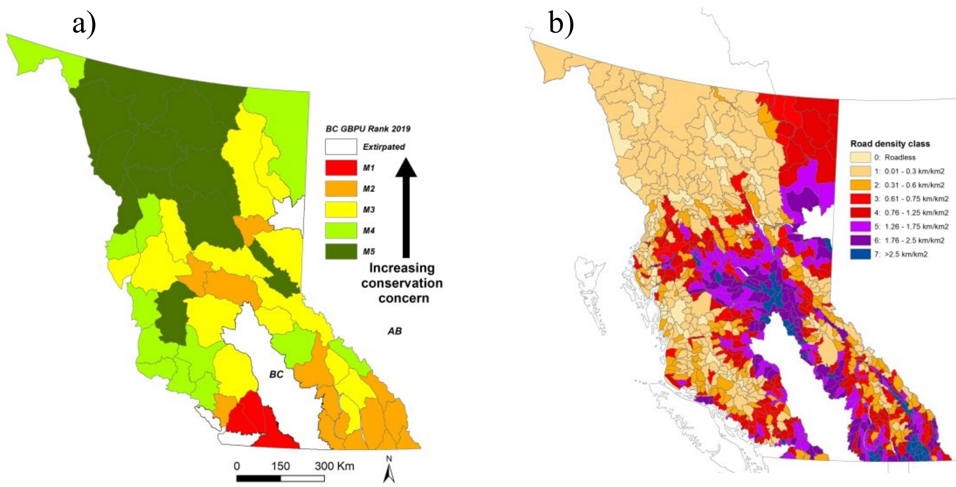

Figure 2: a) Grizzly Bear Population Units across B.C. ranked for conservation status using the Nature Serve threats assessment protocols (Morgan et al. 2020) and, b) road density by landscape unit across British Columbia (Adapted from Proctor et al. 2020).

The 1995 Grizzly Bear Conservation Strategy declared that B.C.'s grizzly bears would be managed to "maintain in perpetuity the diversity and abundance of Grizzly bears and the ecosystems on which they depend throughout British Columbia" and "to improve the management of Grizzly bears and their interactions with humans." In 2016, the B.C. Ministries of Environment and Climate Change Strategy and Forests, Lands, and Natural Resource Operations and Rural Development (FLNRORD) updated that commitment with 3 objectives:

1. Ensure Grizzly bear populations are sustainable, including managing for genetic and demographic linkage;
2. Continue to manage lands and resources for the provision of sustainable Grizzly bear viewing opportunities; and
3. Where appropriate, restore the productivity, connectivity, abundance and distribution of Grizzly bears and their habitats.

A Provincial Grizzly Bear Management Plan has been developed and is in review as of January 2021 in response to a report tabled by the B.C Auditor General in 2017 (OAG 2017, Garth Mowat, B.C Carnivore specialist, pers. comm.). The primary conservation concerns for grizzly bears in B.C. include human-bear conflicts, anthropogenic habitat alteration, and loss of connectivity.

Human-bear conflicts are responded to by the B.C. Conservation Officer Service (COS), though this is a small part of a B.C Conservation Officer's duties. The B.C. COS is responsible for enforcing a wide variety of wildlife related laws and regulations including natural resource compliance and enforcement, hunting regulations, human safety, property damage and conflict response relative to all wildlife, including grizzly bears. The B.C. COS has detailed bear conflict response protocols that apply a decision tree based on the type of conflict, the history of the bear, threat level to people and property, and other factors (B.C. COS 2020a and 2020b). Responses to human-grizzly bear conflicts vary and can include education and information sharing, attractant management improvements and the promotion of electric fencing through ENGO programs, translocation of grizzly bears within or (more rarely) outside their home range, or euthanasia. On average, 44 percent of grizzly bears involved in conflicts responded to by the B.C. COS are killed by Conservation Officers; that number rises to 61 percent when private citizen kills are included (B.C. government data).

To help prevent human-grizzly bear conflicts, British Columbia has a province-wide government-sanctioned WildSafe B.C. program. This program is collaboratively delivered and includes education and community-based solutions. The program evolved from the provincial Bear Aware program, is administered by the B.C. Conservation Foundation, and works cooperatively with the Ministry of Environment's Bear Smart Program and the B.C. COS. Community based 'specialists' live and work within sponsoring communities to help develop place-based conflict avoidance options; the cost of these positions is shared between WildSafe and the sponsoring communities.

Motorized access management is known to be an important habitat management tool for grizzly bear conservation (Mace *et al.* 1996, Schwartz *et al.* 2010, Boulanger and Stenhouse 2014, Lamb *et al.* 2018. Proctor *et al.* 2020, 2021b). However, its use in B.C has been limited and no province-wide or GBPU-specific targets exist (Proctor *et al.* 2019, Morgan *et al.* 2020, Figure 2b). Exceptions to this pattern are in the southeast corner of B.C. in the Flathead and South Rockies GBPUs just north of the U.S. Glacier National Park, in southwest B.C. with a local initiative, in the Granby-Kettle GBPU to the west of the South Selkirks (Lamb *et al.* 2018) and in the privately owned Nature Conservancy of Canada Darkwoods lands within the South Selkirk GBPU (Proctor *et al.* 2018, 2021b).

Finally, the loss of connectivity is an additional conservation challenge for southern B.C.'s bear populations. B.C. Highway 3 runs east-west and bisects several GBPUs in southern B.C just north of the Canada-U.S. border (Figure 3). The north-south mountain ranges create a series of valleys that act as transportation and settlement corridors in the region. The combination of the fragmentation of B.C. Highway 3 and the north-south settled valleys have left a series of isolated or partially isolated sub-populations across the region, several of which are international sub-populations that span the Canada-U.S. border (Figure 3). Varying amounts of conservation management are being applied to reverse some of this fragmentation as discussed in the GBPU summaries that follow.

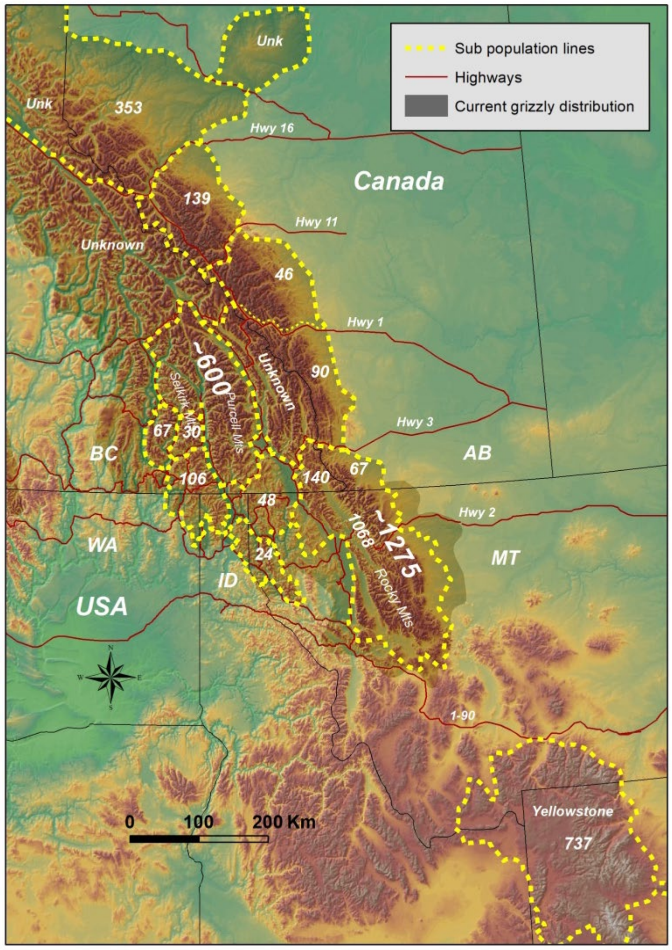

Figure 3: Fragmentation of grizzly bears, in the trans-border region spanning the Canada-U.S. border. Yellow dotted lines represent primarily female fragmentation, but with reduced male connectivity as well. Numbers are population estimates within these 'biological' subpopulations (adapted from Proctor et al. 2012).

British Columbia – U.S. border Grizzly Bear Population Units

There are 6 B.C. Grizzly Bear Population Units (GBPU) along the U.S. border that are immediately relevant to grizzly bear recovery ones in the lower-48 States (Figure 4). Here we review their status, research, conservation efforts, and relevance to grizzly bears in the lower-48 States.

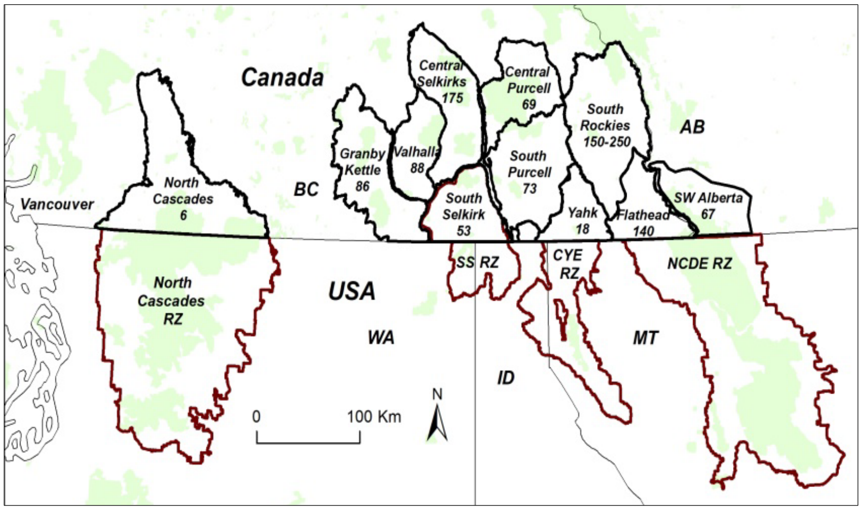

Figure 4: Grizzly Bear Population Units along the Canada-U.S. border in southern British Columbia, their estimated population size, and adjacent U.S. Recovery zones (B.C. Government 2020, Proctor et al. 2021b).

North Cascades

The North Cascade GBPU within Canada, up against the heavily human-populated lower mainland of B.C.'s southwest, is directly north of the U.S. North Cascades Recovery Zone and is estimated to have 6 bears within its ~9,800 km^2 area; however, this estimate is not backed up by reliable research (Figure 5, B.C. FLNRORD 2020). Between 1998 and 2003 several efforts were made to survey this population (DNA sampling, live trapping effort, aerial survey for a helicopter darting attempt,) with very little results beyond one DNA sample and few sightings that included a female with offspring (North Cascades Grizzly Bear Recovery Team 2004, McLellan *et al.* 2017b). This unit is designated as M1, the highest level of conservation concern, according to B.C.'s conservation ranking assessment (Figure 2a, Morgan *et al.* 2020). Approximately 20 percent of the GBPU is protected, (North Cascades Grizzly Bear Recovery Team 2004) and road densities vary across the GPBU and outside of the large, protected areas on the southern border; they range from 0.76 to 2.5 km/km^2 (Figure 6).

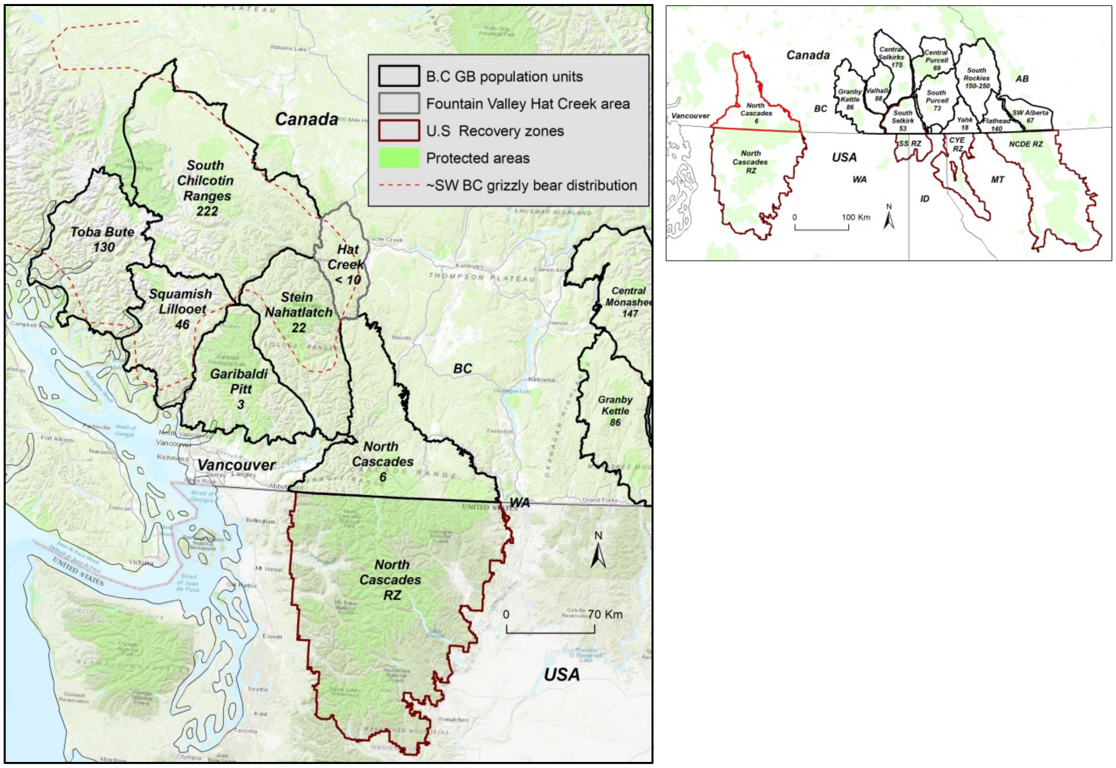

Figure 5: North Cascades region including the neighbouring Grizzly Bear Population Units to the northwest. The red dotted line is a data-based approximation of the grizzly bear distribution north of that line (Apps et al. 2014). The distribution in the North Cascades is unknown.

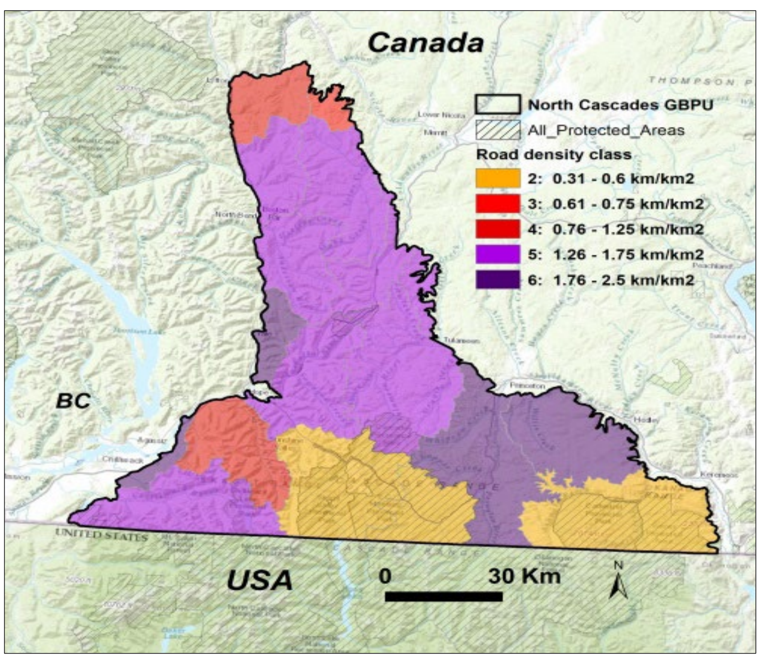

Figure 6: Road density classes in the North Cascade Grizzly Bear Population Unit of southwestern B.C.

The B.C. government developed a well-considered North Cascades Recovery Plan (North Cascades Grizzly Bear Recovery Team 2004) to recover and /or recolonize this population. Stated objectives included:

- conserve and enhance linkages (with the Stein Nahatlatch GBPU),
- augment the population genetically through the introductions of animals from other populations,
- manage habitat through motorized access controls, if necessary,
- minimize human-bear conflicts,
- initiate recreation trail planning,
- minimize human-caused mortality of grizzly bears,
- cooperate with the U.S. authorities on recovery efforts, and
- monitor recovery progress.

The plan was never implemented due to the public's concern for translocating bears into the area (OAG 2017). No outreach effort was undertaken to alleviate those concerns (OAG 2017). Recently, however, the Okanagan Nation Alliance has undertaken efforts to update this Recovery Plan in collaboration with other First Nations, ENGOS and the B.C. government.

The North Cascade 'population' is totally isolated from adjacent populations (North Cascades Grizzly Bear Recovery Team 2004). Connectivity from the east is unlikely as the nearest population is over 100 km across the heavily human-settled Okanagan Valley (North Cascades Grizzly Bear Recovery Team 2004, McLellan *et al.* 2017b). To assess connectivity from the northwest it is useful to consider the GBPUs in that area (Figure 5). The immediately adjacent GBPU is the recovering Stein-Nahatlatch, itself ranked M1, and estimated to have a very low density of bears (2.9 bears/1,000km^2, or 22 grizzlies, B.C. FLNRORD 2020, Morgan *et al*. 2020, Apps *et al.* 2008, 2014) and very low genetic diversity estimated through genetic heterozygosity (H_E = 0.51, Apps *et al.* 2014). Both the North Cascades and Stein-Nahatlatch GBPUs are designated as 'Critically Endangered' small, isolated populations by the IUCN Red List (McLellan *et al.* 2017b). While the adjacent Stein-Nahatlatch GPBU is within the dispersal distance of both male and female grizzly bears, only the northern half is occupied by grizzly bears (Figure 5, Apps *et al.* 2008, 2014). The fracture that separates the North Cascades and the Stein-Nahatlatch is significant and consists of the large Fraser River valley and canyon, the heavily travelled Trans-Canada Highway, two railways, human settlements and other developments.

The Stein-Nahatlatch GBPU has been completely isolated until recently when it has experienced a few male exchanges with the South Chilcotin Ranges GBPU to the northwest, but no female interchange has been documented (McLellan *et al.* 2017b). The fracture separating the Stein-Nahatlatch from the South Chilcotin Ranges is of minimal intensity with a low volume railroad and highway, sporadic rural settlement, and several lakes (McLellan *et al.* 2017b).

The South Chilcotin Ranges GBPU is the closest larger healthier population of grizzly bears (222 bears, FLNRORD 2020), known to also be increasing (McLellan *et al.* 2019), that would be a source of genetic and demographic connectivity to the Stein-Nahatlatch and ultimately the North Cascades. For natural connectivity to occur between the South Chilcotin Ranges through the Stein-Nahatlatch and into the North Cascade GBPU, a considerable amount of population and connectivity recovery needs to occur. Briefly, the South Chilcotin Ranges GPBU would need to continue its recovery trajectory (a reasonable assumption given current efforts and attention), and the Stein-Nahatlatch would have to do the same. That, however, is a bigger challenge because there are so few bears with limited distribution in this unit currently (McLellan *et al.* 2019). Beyond these improvements, the considerable fracture separating the Stein-Nahatlatch and the North Cascades created by the large highway, two railroads, large Fraser River, and human settlements would have to be overcome through extensive conservation management.

Considering the low density, limited distribution, fragmentation of the Stein Nahatlatch bears with the adjacent South Chilcotin Ranges GBPU to the north, and the severity of the fracture separating the Stein-Nahatlatch from the North Cascades, genetic or demographic connectivity to the North Cascades is unlikely in the near future. However, there are efforts in research and conservation management ongoing in the region that provide long-term potential for connectivity and recovery of the Stein-Nahatlatch and eventually the North Cascade GBPUs.

A considerable amount of conservation-oriented research has been occurring in the region to the northwest of the North Cascade GBPU (Apps *et al.* 2014, McLellan and McLellan 2015, McLellan *et al.* 2019), including work revealing population-level fragmentation (Apps *et al.* 2014) and identification of corridors across the valley fragmenting the Stein-Nahatlatch from the South Chilcotin Ranges GBPU (Figure 5, McLellan 2018). A consortium of ENGOs, First Nations, and the B.C. government have been working on implementing conservation solutions similar to those shown to be working in the South Selkirk GBPU (see below, Proctor *et al.* 2018), including conflict reduction strategies, purchase of private connectivity properties by a land trust, and initial motorized access management applications. A population augmentation program for the Stein-Nahatlatch GBPU is being planned as a cooperative effort between the B.C. Government and the local St'at'imc, NlaKa'pamux, and Simpcw First Nations (https://www.conservationnw.org/our-work/habitat/coast-range-to-cascades/). The source of non-salmon-dependent bears would likely come from healthy populations in central B.C. Plans are to continue this effort for 5 years and assess progress and success.

In addition to these GBPUs is the small Hat Creek area (~1,400 km^2) to the east of the Stein Nahatlatch GBPU (Figure 5) that possibly contains reproductive females (McLellan *et al.* 2017b). Also adjacent to the Stein-Nahatlatch GBPU is the Garibaldi Pitt GBPU which is possibly close to being functionally extirpated with an estimated 3 bears (FLNRORD 2020).

In summary, attaining natural or human-assisted genetic or demographic connectivity into the North Cascade GBPU will be a challenge that currently is not being considered as a management priority by the B.C. government (OAG 2017), but is within the long-term objectives of local First Nations and the aforementioned Coast to Cascades Grizzly Bear Initiative. Therefore, this unit is not considered a realistic source of bears to recolonize the U.S. North Cascades in the near future. However, First Nations reinvigoration of recovery plans for both the North Cascades and the Stein-Nahatlatch GBPUs in cooperation with the Coast to Cascades Grizzly Bear Initiative and the B.C government provides some hope for conservation progress in the region and should be of interest to authorities within the U.S. with interest in recovery of the North Cascades international population.

Granby-Kettle GBPU

The next GBPU in the trans-border area is the Granby-Kettle unit (Figure 7), east of the Okanagan Valley from which grizzly bears are extirpated. This unit is designated as M2, high conservation concern, according to B.C.'s conservation ranking assessment (Figure 2a, Morgan *et al.* 2020) suggesting that it is in need of conservation attention. Grizzly bears in the unit have not been legally hunted since 1995. The biggest threats to bears in this unit are the extensive and expanding forestry road network and its associated high ungulate hunter density and unreported mortalities (Morgan *et al.* 2020), although some recent progress has been made in motorized access management. There is limited human settlement or agriculture in the southern portion of this GBPU (black dots in Figure 7).

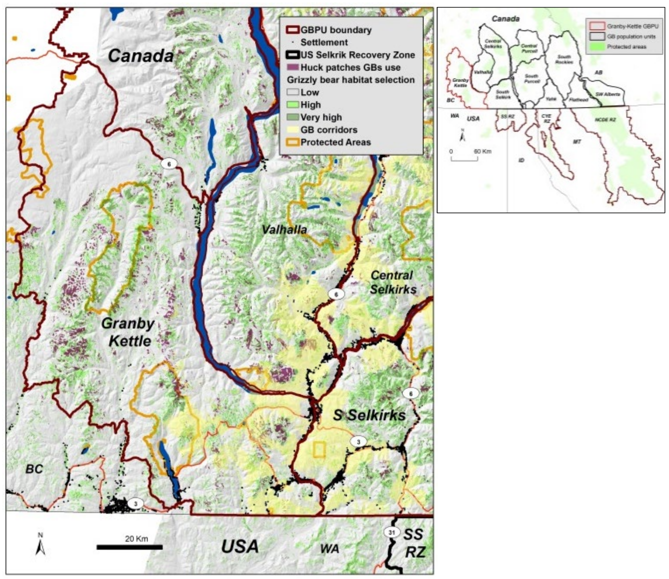

Figure 7: Granby-Kettle Grizzly Bear Population Unit along the Canada-U.S. border immediately northwest of the U.S. South Selkirk Recovery Zone. Habitat selection estimated by resource selection functions (green), grizzly corridors (yellow), and huckleberry patches (purple) are shown (Proctor et al. 2015, 2021b).

A recent DNA-based population survey estimated 87 grizzly bears (95% CI = 66–108) (Lamb *et al.* 2018) and represents an increase for this unit over an estimated 38 bears from a similar DNA survey in 1997 (Lamb *et al.* 2018). Between 1985 and 2001, 3 provincial parks were created in this unit encompassing 14 percent of the GBPU. In addition, two motorized access management areas (5 percent of unit area) were created to benefit grizzly bear recovery and other conservation goals. Lamb *et al.* (2018) estimated that the parks and motorized access management area helped increase the bear density by 27 percent and that habitats with road densities less than 0.6 km/km^2 had 3 times higher grizzly bears densities than habitats with road density greater than 0.6 km/km^2. Even with these efforts, the open road density in this unit is 1.64 km/km^2, short of a stated goal of 0.6 km/km^2 (B.C. Government Action Regulation 2004). The closest example of a GBPU-wide access management plan in B.C. occurred in this unit in 2010 when a government order was drafted to include a road density target, but it was only a recommendation in the final order. It was later determined by the B.C. Forest Practices Board that these targets were not being met in a significant number of areas primarily because they were not legally binding. This story is detailed in the Office of the B.C. Auditor General Report (OAG 2017).

The Granby-Kettle GBPU is bisected by B.C. Highway 3 and the degree of fragmentation it causes has not been researched. Regionally, fragmentation is mediated mainly by settlement and mortality patterns and secondarily by traffic along Highway 3 (Proctor *et al.* 2012, Lamb *et al.* 2016). There are extensive sections along B.C. Highway 3 across this unit with no-to-minimal human settlement, so extrapolating the results of Proctor *et al.* (2012), it is likely that grizzly bear connectivity occurs across this highway to some degree as is the case with the unsettled Highway 3 that bisects the South Selkirk GBPU (see below).

While no direct habitat quality or telemetry-based research has occurred in the Granby-Kettle unit, Proctor *et al.* (2015) extrapolated their extensively evaluated resource selection function habitat model and grizzly bear corridor predictions into much of this unit (Figure 7). Further, Proctor *et al.* (2021) applied their huckleberry patch 'important-for-grizzly-bears' model into this unit after satisfactory local field evaluation (Figure 7). Combined with the density surface and road density analyses (Lamb *et al.* 2018) and the Proctor *et al.* (2015, 2021b) efforts, enough preliminary data exists for this unit to implement targeted conservation management such as the one attempted by the provincial government in 2010 (described above) and expand access management to other areas within this GBPU as they have done in portions of the unit (Proctor *et al.* 2020, 2021b).

In summary, the Granby-Kettle GBPU shares a 35 km border with the western edge of the Canadian South Selkirk GBPU (Figure 7). The areas near this border within each GBPU contain a lower density of grizzly bears relative to other portions of the GBPUs and B.C. Highways 22 and 3B and their associated human settlement likely provide a degree of fragmentation between these two GBPUs. As such, the Granby-Kettle GBPU represents only minimal potential for grizzly bear connectivity with the South Selkirks. Likely a better potential exists for bears within the Granby-Kettle to be a source for bears into adjacent areas in northern Washington, although no known population exists there now.

South Selkirk GBPU

The Canadian South Selkirk GBPU is directly north of the U.S. South Selkirk and is part of the U.S. Recovery zone (Service 1993), although it is managed entirely by Canada (Figure 8a). Protected areas in this GBPU include the West Arm Provincial Park (253 km^2) along the northern border of the unit and the adjacent roadless Midge Creek Wildlife Management Area (created in 1998, 148 km^2). These protected areas adjoin the 700 km^2 Nature Conservancy Canada (NCC) property, currently being managed for grizzly bear and other conservation values (Figure 8b). This unit is designated as M2, high conservation concern, according to the B.C.'s conservation ranking assessment (Figure 2a, Morgan *et al.* 2020) suggesting that it is in need of conservation attention. Grizzly bears in the unit have not been legally hunted since 1995. The South Selkirk subpopulation was found to be completely isolated (at the time) from adjacent subpopulations to the north, east, and west (Proctor *et al.* 2005, 2012) and the IUCN Red List assessment designated this population as 'Vulnerable' (McLellan *et al.* 2017b). Its small population size, complete isolation (at the time), and threats assessment suggested it should be 'Endangered'. It was designated the lesser status of 'Vulnerable' because of ongoing research and effective conservation management applied by the Trans-Border Grizzly Bear Project, the

Service, and the B.C. Conservation Officer Service (Proctor *et al.* 2018, Kasworm *et al.* 2020*a*). These cumulative efforts greatly reduced its probability of extinction. More recently, Proctor *et al.* (2018) have documented increased genetic and demographic connectivity between the South Selkirk and Purcell GBPUs (see details below).

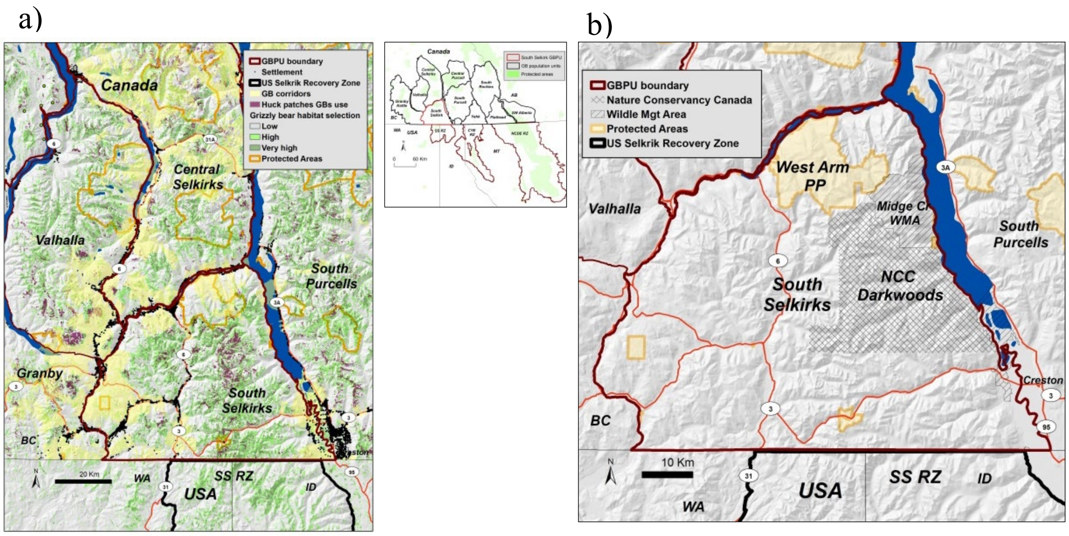

Figure 8: a) South Selkirk Grizzly Bear Population Unit along the Canada-U.S. border immediately north of the U.S. South Selkirk Recovery Zone. Habitat selection estimated by resource selection functions (green), grizzly corridors (yellow), and huckleberry patches (purple) are show, (Proctor et al. *2015, 2021b), and b) protected lands in the South Selkirk Grizzly Bear Population Unit.*

Threats to this population were (and still are to some degree), human-caused mortality primarily on the periphery, extensive forestry roads on public lands and the accompanying mortality (within Canada), and fragmentation. The Trans-border Grizzly Bear Project wrote a government sanctioned ('advice to government') Recovery Management Plan (MacHutchon and Proctor 2016). The recovery targets in this plan were patterned after targets used by the Service's recovery of the U.S. South Selkirk Recovery Zone with several changes to reflect the Canadian program. Most of the targets were designed to be measured in a unit-wide DNA-based population survey and include, abundance, density with explanatory covariates, female distribution, distribution of reproductive females, sustainable mortality rates, sex-specific connectivity with neighboring populations and more. A DNA-based population survey is being carried out in 2020–2021, to assess conservation status using the above metrics.

There has been a significant amount of conservation–oriented grizzly bear research in the South Selkirks by the Trans-border Grizzly Bear Project, in partnership with the Service's Libby Office. A DNA-based population survey was done in 2005, which estimated the Canadian South Selkirk unit to have 58 bears (95% CI = 50–70) (Proctor *et al.* 2007). A re-analysis of the same data using the more recent Spatial Explicit Capture Recapture (SECR) methodology estimated 53 bears (95% CI = 41–68) (Proctor *et al.* 2021b). Forty grizzly bears were collared with GPS telemetry between 2007–2017, the data of which were used to estimate habitat quality, important hyperphagia food patches, connectivity corridors, female reproduction, sources and rates of mortality, conflict management, and more (Figure 8a). Proctor *et al.* (2021b) identified and mapped huckleberry patches important for grizzly bears using GPS telemetry to find the patches and model their distribution (Figure 8a). Interestingly, they found that huckleberry patches in areas of high road density and low proportion secure habitat were not translating into grizzly bear densities. For example, the average open road density in the unit is 1.1 km/km^2 while the open road density in the Nature Conservancy Canada's land is 0.3 km/km^2 attained through an access management program on their lands. The average bear density for the entire unit is 13.1 grizzly bears/1,000 km^2, while the grizzly density in the NCC Darkwoods property is 33 grizzly bears/1,000 km^2. This higher bear density in the NCC Darkwoods lands is a result of the combination of a low road density and a higher huckleberry patch density (Figure 9a and b. Proctor *et al*. 2018, 2021). Proctor *et al.* (2021b) found that grizzly bear densities were 2.5 times higher in habitats less than 0.6 km/km^2 open road density, relative to habitats greater than 0.6 km/km^2.

a)

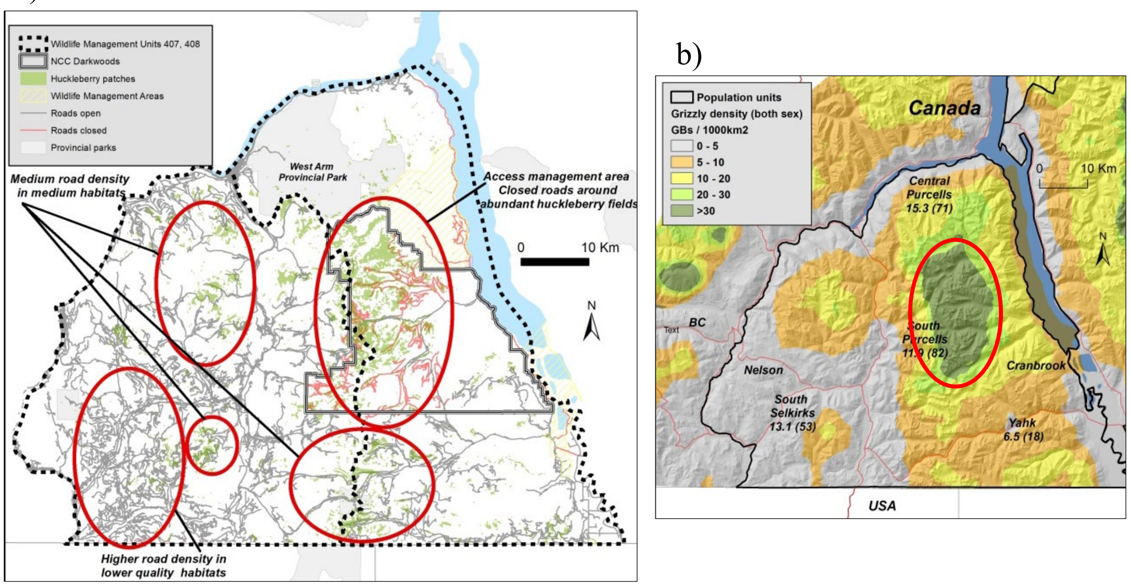

Figure 9: a) An example of resource road management on Nature Conservancy of Canada lands in the South Selkirk Mountains as a mitigation for backcountry mortality and to increase habitat effectiveness (adapted from Proctor et al. 2018). Public access was controlled around good huckleberry patches, and this resulted in increased female habitat use, density, and realized reproductive output (fitness). Adapted from Proctor et al. (2018), and b) Grizzly bear density in the South Selkirk Grizzly Bear Population Unit. Red oval indicated are of highest density that corresponds to the upper right red oval in a) where access management has been applied by the Nature Conservancy Canada and huckleberry patch density is high (Proctor et al. 2021b).

Road density and the proportion of secure habitat (greater than 500 m from an open road) varies across the South Selkirk GBPU. The Trans-border Grizzly Bear Project subdivided this unit (and other GBPUs in the Purcell Mountains) into 'Bear Management Units' (BMUs) for the purpose of understanding the spatial variability of these access metrics (Figure 10a and b). Note these BMUs are not legal entities but are used for conservation planning. This exercise exposes local areas within these units that would benefit from access management as recommended in Proctor *et al.* (2020).

a) b)

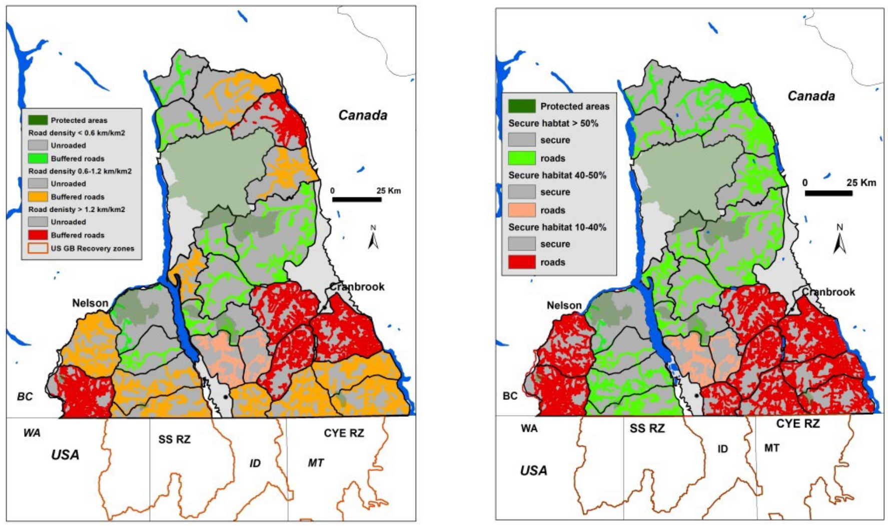

Figure 10: a) Road density categories within 'Bear Management Units' (created by the Trans-border Grizzly Bear Project to help understand road access, these are not legal entities) across the South Selkirk, Yahk, South Purcell and Central Purcell Grizzly Bear Population Units in southeastern B.C. Adapted from MacHutchon and Proctor 2016). Colors are open roads buffered by 500 m, and b) Percentage of secure habitat (> 500m form an open road) across the same Bear Management Units.

a) b)

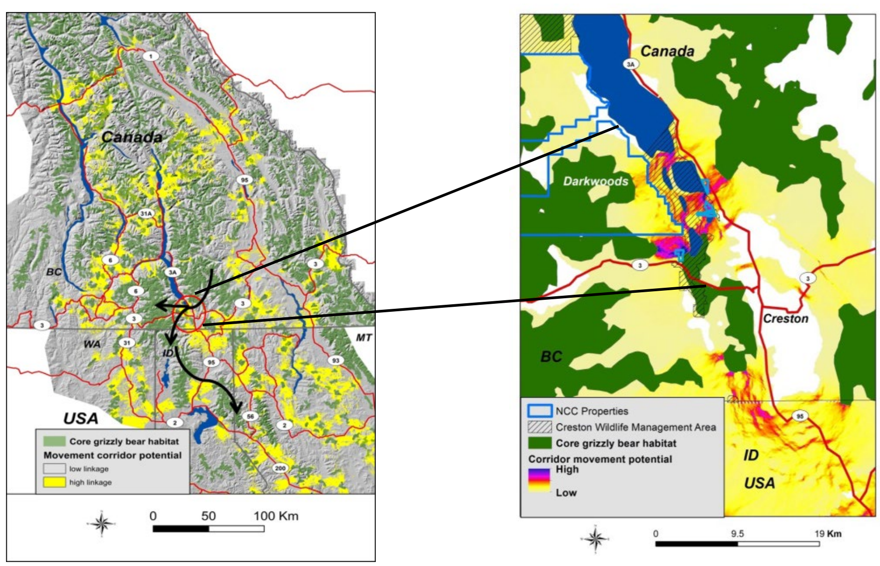

Figure 11: a) Research-identified grizzly bear corridors in the trans-border Canada-U.S. region (Yellow) connecting higher quality habitat patches (green). The black arrows represent the best corridor option connecting the U.S. South Selkirk grizzly bears to the larger Canadian population in the Purcell Mountains through the Creston Valley (red circle) and b) Close up of the Creston Valley showing the best linkage habitat (red flames) in relation to connectivity land purchases by the Nature Conservancy Canada (NCC, blue polygons, adapted from Proctor et al. 2018).

The fragmentation that originally created this previously isolated population was primarily from B.C. Highway 3A that runs north of Creston and west to Nelson along Kootenay Lake. B.C. Highway 3 cuts east-west through the South Selkirk unit but does not significantly fragment grizzly bears as there is virtually no human settlement along the highway as it crosses much of the unit (Proctor *et al.* 2012).

Proctor *et al.* (2015) identified the best options for establishing a grizzly bear corridor to a larger population to be across the north end of the Creston Valley into the south Purcell Mountains (Figures 11a and b). The Trans-border Grizzly Bear Project has implemented a suite of connectivity conservation and management actions over the past decade (Proctor *et al.* 2018). Activities included a cost-share electric fencing program, other attractant management activities, a private land purchase program (i.e., purchasing lands or conservation easements within identified corridors through the NCC and other land trust ENGOs, Figure 11b), and a non-lethal conflict response program in conjunction with the B.C. COS - patterned after the Montana Fish Wildlife & Parks bear management program. These activities have resulted in a decrease in human-caused mortality in the South Selkirk GBPU relative to the previous decade (Figures 12a, b, Proctor *et al.* 2018). Conversely, mortality trends in the adjacent population unit to the east that did not receive these management activities have continued to increase (Figure 12c).

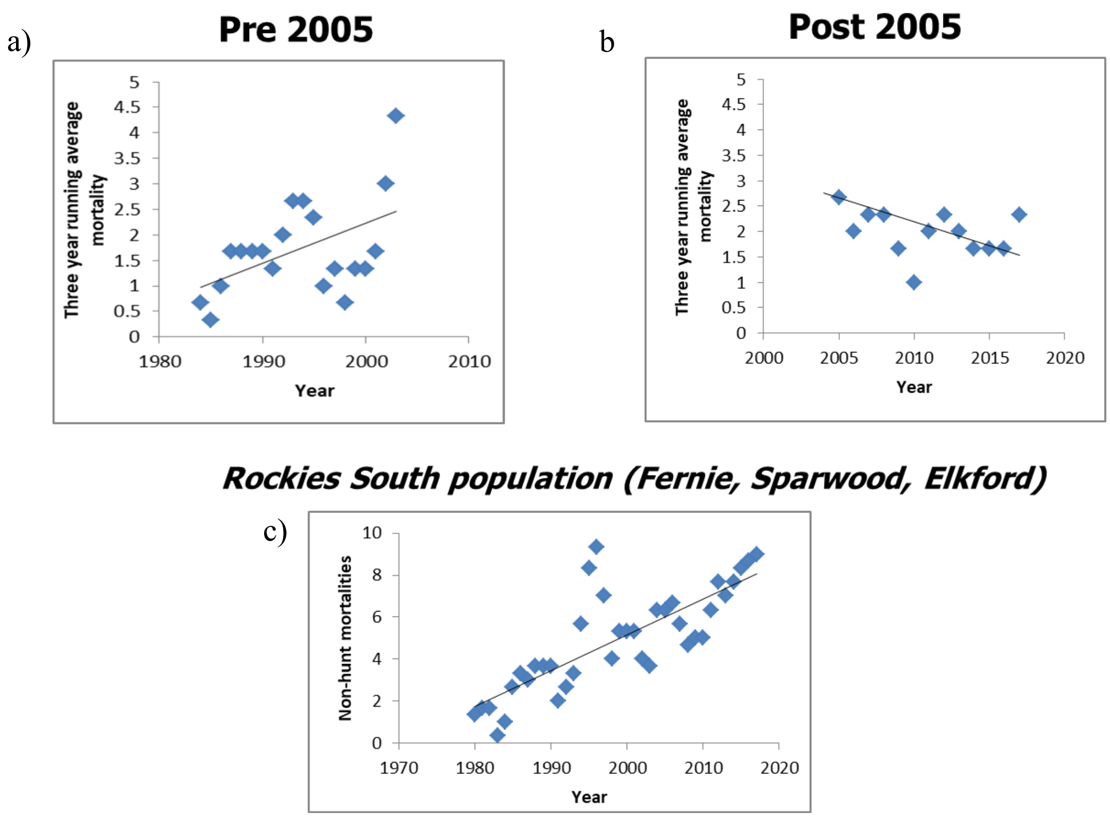

Figure 12: a) Conflict-related human-caused grizzly bear mortality in the Canadian South Selkirk Grizzly Bear Population Unit prior to the instigation of connectivity mortality reduction management actions, b) mortalities after the initiation of mortality reduction management, and c) human-caused mortality in the adjacent valley to the east where connectivity mortality reduction management was not applied with the same intensity as in the Creston Valley area (adapted from Proctor et al. 2018).

The South Purcell population unit is the southern tip of a much larger healthier population of approximately 600 grizzly bears (Proctor *et al.* 2012). The Creston Valley grizzly bear corridor is the best option for reconnecting the U.S. South Selkirk population to a large healthy population north of B.C. Highways 3 and 3A (Figures 7a and b). Recent research has found increasing levels of genetic and demographic connectivity to be occurring between grizzly bears in South Selkirk and South Purcell Mountains as a result of the above-mentioned conservation management actions (Figures 13 and 14, Proctor *et al.* 2018). Proctor *et al.* (2018) documented an increase in heterozygosity, a measure of genetic diversity, from 0.54 to 0.57, and 13 of 15 microsatellite loci tested increased their number of alleles between 2005 and 2017. They also documented an increase in the number of female and male immigrants into the Selkirk population from the Purcell Mountains to the east (1 female prior to 2005 to 4 females by 2017, and 0 males before 2005 to 6 males by 2017 (Figures 14a and b). They also documented movement into the South Selkirk GBPU from the South Purcell GBPU accompanied by breeding (Figure 13, Proctor *et al.* 2018). More recently the research team identified a female immigrant into the Selkirk GBPU that bred (unpublished data).

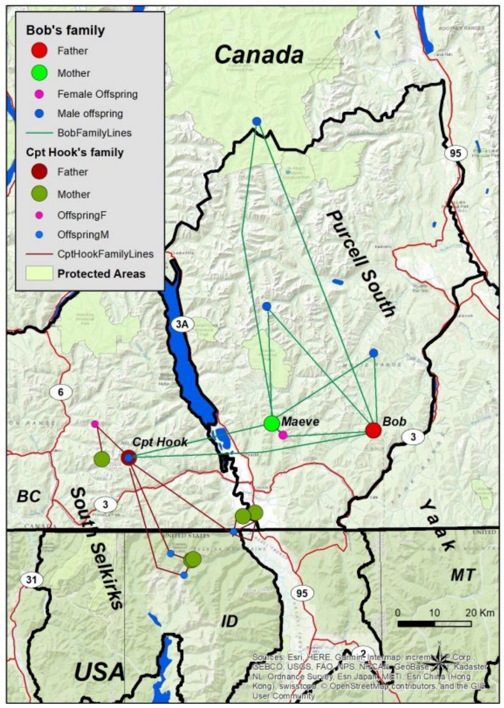

Figure 13: Example of grizzly bear (Ursus arctos) movement and gene flow across the Creston Valley from the South Purcell Mountains to the previously isolated South Selkirk population in the Canada-U.S. trans-border region. Example is a family pedigree where offspring all share 1 allele from each parent across 21 loci. Lines connect offspring to their parents. Dot locations represent each bear's capture or sample location. In this extended family, Bob and Maeve produced offspring Cpt. Hook who moved from the South Purcell into the South Selkirk Mountains where he mated with 5 separate females yielding six offspring (1 of the blue dots for male offspring represents 2 offspring sampled at the same location). Adapted from Proctor et al. 2018.

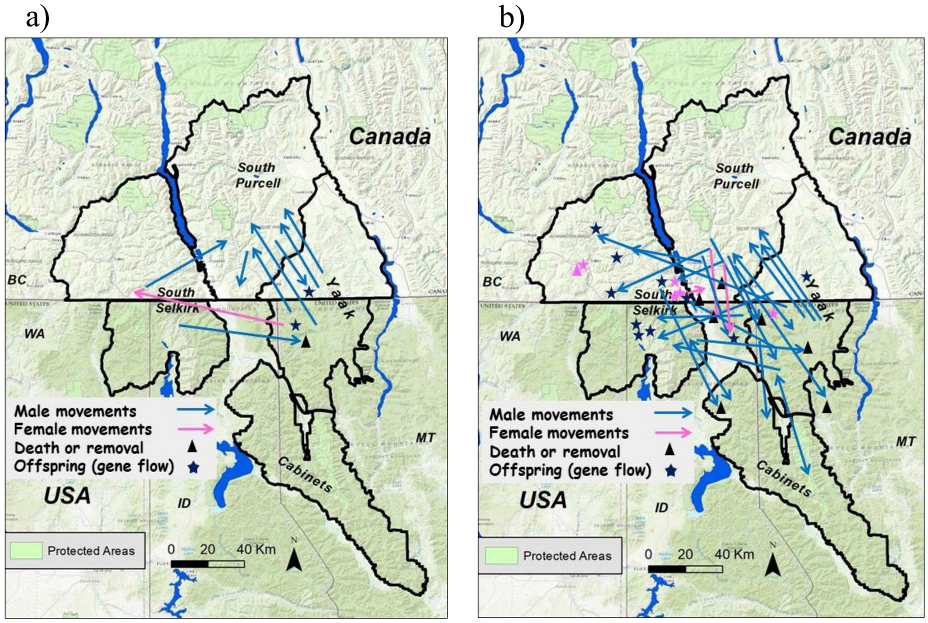

Figure 14: a) Cumulative evidence of inter-population grizzly bear (Ursus arctos) movements and gene flow (breeding events after movements) prior to 2006 and b) after mortality reduction management was applied post-2006 in the Canada-U.S. trans-border region of northwest Montana, northern Idaho, and southeast B.C (adapted from Proctor et al. 2018).

In summary, the Canadian South Selkirk GBPU is the most important link for the bears in the U.S. portion of the South Selkirk Recovery Zone to be connected to a larger grizzly bear population in Canada. This genetic and demographic connectivity has its best hope across the Creston Valley just north of the U.S. border north of Bonners Ferry, Idaho (Proctor *et al.* 2015). Recent and ongoing conservation efforts within Canada have measurably enhanced both genetic and demographic connectivity for the South Selkirk Recovery Zone (Proctor *et al.* 2018), however, the job is not complete. While progress in the right direction is apparent, sustained efforts are needed to make these improvements permanent and to install the management paradigms within Canadian society. This entails the B.C. Conservation Officer Service continuing its work to apply non-lethal management to appropriate conflict bears, the continuation of the privately run 50 percent cost-share electric fencing program, further and improved management of deadstock in the agricultural community of the Creston Valley, improved management (installed and maintained electric fences) of cherry orchards in the valley, and improved management of bear attractants on dairy farms. These solutions need to be made permanent fixtures in the way rural residents, farmers, and ranchers live and do business in the region. These have been the goals of the Trans-border Grizzly Bear Project and while they operate, there has been forward movement.

However, the Trans-border Grizzly Bear Project was not developed to be a permanent fixture on this landscape. Further, while the B.C. government has been an important partner in conservation management activities to this point in time, they are not currently prepared to be the leader of grizzly bear conservation and management into the future. Similarly, even government policies are not permanent and are subject to changing political climates. Facilitating coexistence between bears and people in multi-use landscapes is a persistent challenge, and one that requires engagement from multiple parties. Wildlife is a public good, and as such, responsibility for both facilitating and maintaining coexistence should not fall solely on one group. As such, we look to both public and private players to continue these promising conservation efforts.

Yahk GBPU

The Canadian Yahk GBPU is directly north of the Yaak portion of the U.S. Cabinet-Yaak recovery zone. While the two areas are fully connected across the international border, the Canadian Yahk, is not a part of the U.S. Cabinet-Yaak recovery zone (Figures 4 and 10). Provincial parks in the unit amount to approximately 1 percent (28 km^2) of the unit (Figure 10). This unit is designated as M2, high conservation concern, according to B.C.'s conservation ranking assessment (Figure 2a, Morgan *et al.* 2020) suggesting that it is in need of conservation attention. Grizzly bears in the unit have not been legally hunted since 1976. The international Yahk/Yaak subpopulation was found to be primarily female fragmented from adjacent subpopulations to the north, east, and west (Proctor *et al.* 2005, 2012). The IUCN Red List assessment designated this population as 'Endangered' (McLellan *et al.* 2017b) due to its small population size and female fragmentation. It was not down listed to 'Vulnerable" because at the time, its conservation metrics were not as promising as they are today (Kasworm *et al.* 2020b). In particular, the trend estimates and connectivity metrics have improved (become positive) in recent years (Kasworm *et al.* 2020b, Proctor *et al.* 2020). These improvements reduce its probability of extinction.

Threats to this population were (and still are to some degree), human-caused mortality primarily on the periphery, extensive forestry roads and the accompanying mortality (within Canada), and fragmentation. The Trans-border Grizzly Bear Project Recovery Management Plan discussed in the South Selkirk GBPU section also covers this population unit (MacHutchon and Proctor 2016). There is a possibility of a DNA-based population survey being carried out in the near future to assess conservation status using the metrics defined by the recovery management plan.

There has been a significant amount of conservation-oriented grizzly bear research in the Yahk by the Trans-border Grizzly Bear Project, in partnership with the Service's Libby Office. A DNA-based population survey was done in 2004–2005, which estimated the Canadian Yahk unit to have 20 bears (95% CI =16–24) (Proctor *et al.* 2007). A re-analysis of the same data using the more recent Spatial Explicit Capture Recapture (SECR) methodology estimated 18 bears (95% CI = 13–25 Proctor *et al.* 2021b). Grizzly bears were fitted with GPS telemetry between 2004–2010, the data of which were used to estimate habitat quality, important hyperphagia food patches, connectivity corridors, female reproduction, sources and rates of mortality, conflict management, and more (Figure 15). Proctor *et al.* (2021b) identified and mapped huckleberry patches-important-for-grizzly bears using their GPS telemetry to find the patches and model their distribution (Figure 15). The average open road density in the unit is 1.6 km/km^2. The average bear density for the entire unit is 6.5 grizzly bears/1,000 km^2 and is low relative to other units in the region (Figure 10, Proctor *et al.* 2012, B.C. Min. FLNRORD 2020). The low bear density in the Canadian Yahk is likely related to the overall low huckleberry patch density and higher road density (Figures 10 and 15, Proctor *et al.* 2021). Proctor *et al.* (2021b) estimated that there is potential for increased numbers of grizzly bears in the Yahk unit through the application of access management. Decreasing road density to the recommended target of 0.6 km/km^2 has the potential to double the numbers of bears in the Canadian Yahk (Proctor *et al.* 2021b).

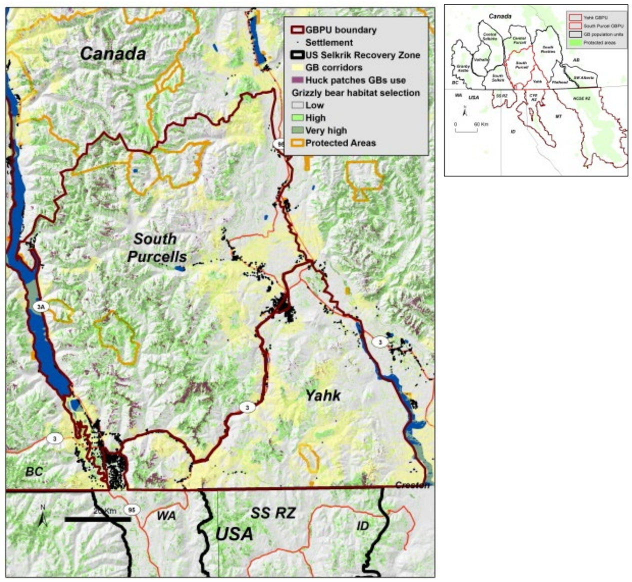

Figure 15: Yahk and South Purcell Grizzly Bear Population Units along the Canada-U.S. border immediately north of the US South Selkirk Recovery Zone. Habitat selection estimated by resource selection functions (green), grizzly corridors, (yellow), and huckleberry patches (purple) are shown (Proctor et al. *2015, 2021b).*

The fracture creating this female fragmented population is primarily from B.C. Highway 3 that runs east-west across the Purcell Mountains. This highway and associated settlement have been shown to limit female bears and reduce male movements (Proctor *et al.* 2005, 2012). Proctor *et al.* (2015) identified the best options for establishing a grizzly bear corridor to a larger population to be across B.C. Highway 3 into the South Purcell Mountains (yellow in Figure 15). As mentioned above for the South Selkirk GPBU, the Trans-border Grizzly Bear Project has implemented a suite of connectivity conservation management actions over the past decade. These activities have resulted in an increase in connectivity between the Yahk and the South Purcell population unit to the north (Figure 14, Proctor *et al.* 2018). The South Purcell population unit is the southern tip of a much larger healthier population of approximately 600 grizzly bears (Proctor *et al.* 2012). The research-identified corridors are the best option for reconnecting the U.S. Yaak grizzly bear population to a large healthy population north of B.C. Highway 3 (Figures 3 and 15).

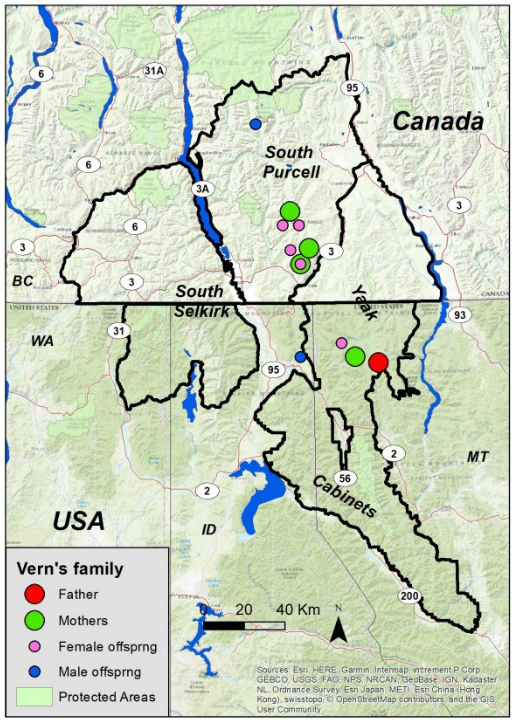

Figure 16: An example of male mediated gene flow across B.C. Highway 3 in the Purcell Mountains. Adult male Vern (red dot) mated with females (green dots) producing various offspring (smaller dots) north and south of B.C. Highway 3. Dot location are individual's capture or hair sample locations.

In summary, the Yahk GPBU is in need of access controls as the road densities in this unit (1.6 km/km^2) are well above the often-used target of 0.6 km/km^2 (Figure 10a and 18). If this target were adopted and met, there is the potential to double the number of bears in this GBPU (Proctor *et al.* 2021b). The other arena for improved conservation management is along the eastern edge, where human-caused mortalities have accumulated and significantly contribute to lower abundance and fragmentation of this population (Figure 17, Proctor *et al.* 2018). Conflict reduction measures have been slowly increasing in recent years in this area, so reductions in human-caused mortality are expected. To be fair, implementing access management across the Yahk GBPU will be a challenge due to strong public opposition and heavy industrial timber harvest.

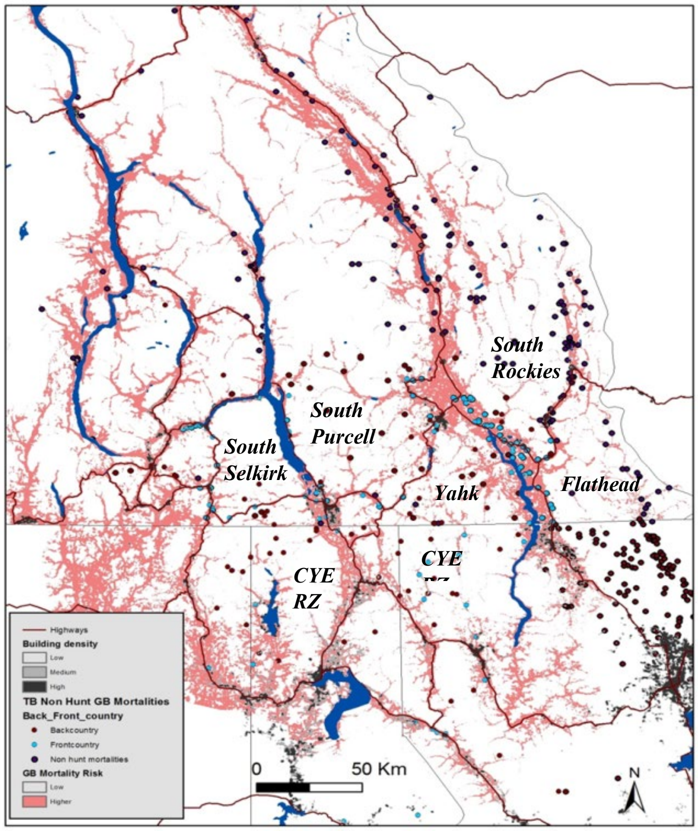

Figure 17: Cumulative non-hunt human-caused grizzly bear mortality in the Canada-U.S. trans-border area between 1984–2017. Blue dots are front country mortalities and dark red dots are backcountry mortalities. Red is modeled mortality risk.

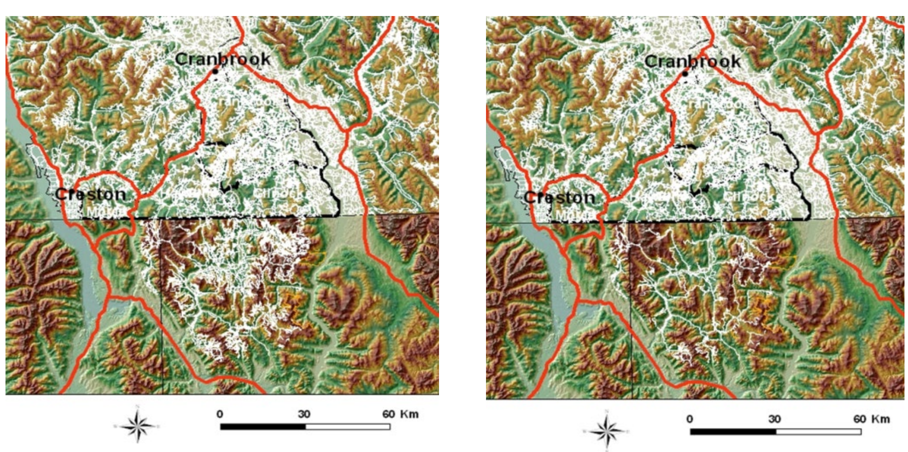

Figure 18: The pattern of access management applied in the international Yahk/Yaak ecosystem a) shows the total roads in both the U.S. and Canadian portions, and b) the U.S. portion show the open roads after access management has been applied.

South Purcell GBPU

The south Purcell GBPU is directly north of the Yahk unit and still close to the U.S. border (8 km at its closest) and thus plays a role in U.S. grizzly bear recovery (Figure 15). This unit is designated as M2, high conservation concern, according to the B.C.'s conservation ranking assessment (Figure 2a, Morgan *et al.* 2020) suggesting that it needs conservation attention. However, it is the southern edge of a larger healthier population of fully connected GBPUs partitioned for management convenience that extends northward approximately 250 km (~150 miles) and contains an estimated 600 grizzly bears (Figure 3, Proctor *et al.* 2012). The M2 designation reflects threats to this population including, human-caused mortality primarily on the periphery, and extensive forestry roads and the accompanying mortality. As such, this population unit represents the larger population that offers genetic and demographic connectivity to both the South Selkirk and Yahk GBPUs and their associated populations in the U.S. lower-48 States. Efforts to re-establish connectivity across B.C Highways 3 and 3A would benefit the long-term health of the U.S. South Selkirk and Yaak grizzly bears populations (Figures 3, 4, and 14) and are ongoing (Proctor *et al.* 2018).

There has been substantial conservation-oriented grizzly bear research in the South Purcell unit by the Trans-border Grizzly Bear Project, in partnership with the Service's Libby Office. A series of smaller DNA-based population surveys designed to assess fragmentation patterns (but useful for population estimation) were done between 1998 and 2005, and GPS telemetry occurred between 2004–2017. These data were used to estimate abundance, density, habitat quality, important hyperphagia food patches, connectivity corridors, female reproduction, sources and rates of mortality, conflict management, and more (Figure 15). Proctor *et al.* (2021b) identified and mapped huckleberry patches-important-for-grizzly bears as reported above for other GBPUs (Figure 15). The average open road density in the unit is 1.0 km/km^2. The average bear density for the entire unit is 11.9 grizzly bears/1,000 km^2 with 73 bears (95% CI = 56–96) estimated from data collected between 2001–2005 (Proctor *et al.* 2021b). This estimate is also 15 years old (in 2021), and the current density of the South Purcell unit is unknown. Grizzly bears in the unit were legally hunted up until the B.C.-wide grizzly bear hunt closure in 2017. Occasionally, the combination of non-hunt conflict mortality and the legal hunt exceeded total mortality limits for this population (Artelle *et al.* 2013). However, the hunt was closed periodically to mitigate the excessive mortalities and allow the bear numbers to recover as per provincial protocol (Hamilton and Austin 2004).

In summary, the South Purcell GBPU could benefit from an organized access management plan to lower road densities particularly around the best huckleberry patches identified in Proctor *et al.* (2021b). Continued and increased efforts to minimize human bear conflicts on the periphery of this unit would also be beneficial for population recovery as well as improving its ability to act as a source population for migrants into the Yahk and the South Selkirks. These two actions would work to increase the potential of connectivity with the Yahk and South Selkirk populations – and ultimately with the U.S. recovery zones of these ecosystems.

Flathead GBPU

The Canadian Flathead GBPU is directly north of the U.S. North Continental Divide Ecosystem (NCDE) recovery zone including portions of the U.S. Glacier National Park (Figures 4 and 19). While the two areas are fully connected across the international border, the Canadian Flathead is not a part of the U.S. NCDE recovery zone (Figure 4). This GBPU is designated as M2, high conservation concern, according to B.C.'s conservation ranking assessment (Figure 2a, Morgan *et al.* 2020) suggesting that it is in need of conservation attention. This concern comes from threats and fragmentation related to conflict mortality on the unit's periphery along B.C. Highways 3 and 97, forestry roads, and high ungulate hunter density and the accompanying mortality (Proctor *et al.* 2012, Lamb *et al.* 2016, McLellan *et al.* 2018, Morgan *et al.* 2020). Human-caused mortality related to human-bear conflicts on the periphery of this unit remain a significant issue in this unit (Figure 17, Mowat and Lamb 2016, Lamb *et al.* 2016, Proctor *et al.* 2018). With the goal of future mitigation of these human-caused mortalities, there is an ongoing research project to identify sources of unreported mortality in the area that separates the South Rocky, Flathead and Yahk GPBUs and to inform management actions (C. Lamb, pers. comm.). Recently, attractant management is beginning to be pursued in earnest.

B.C. Highway 3 transverses the Rocky Mountains east to west and creates the northern boundary of this GBPU as it does in the Purcell Mountains to the west. The big difference is that the number of bears to the south of B.C. Highway 3 in this relatively large biological population includes bears in B.C (~140), Alberta (~67), and Montana (~1,092) totaling more than 1,200 bears (Figure 3, Kendall *et al.* 2009, Proctor *et al.* 2012, Mace *et al*. 2012, Morehouse and Boyce 2016, B.C Min. of FLNRORD 2020, Costello and Roberts 2021, Service 2020). While the best (easiest to repair) and most important link to bears in the rest of Canada occurs across B.C. Highway 3, the relatively large size of this international population leaves it fairly secure. While there is evidence of reduced demographic and genetic gene flow across B.C. Highway 3, males have been mediating genetic connectivity (Proctor *et al.* 2005, 2012). However, development along B.C. Highway 3 is ever increasing and the window of opportunity to establish effective wildlife and grizzly bear corridors may be closing. Therefore, if grizzly bear connectivity is a priority in this area, connectivity management along this transportation and settlement corridor should be pursued.

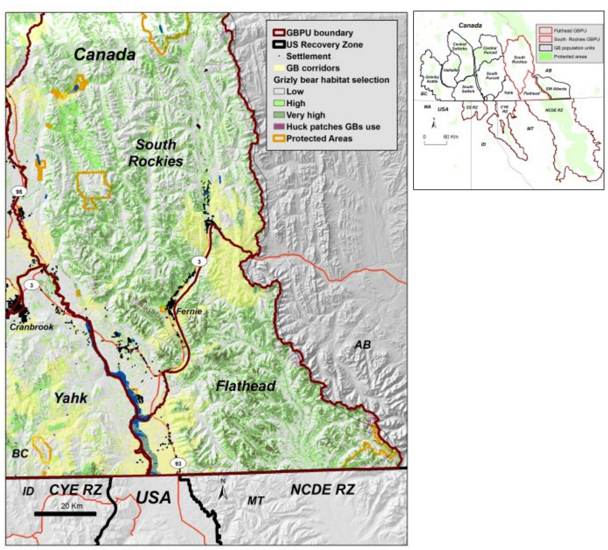

Figure 19: Flathead and South Rockies Grizzly Bear Population Units along the Canada-U.S. border immediately north of the U.S. NCDE Recovery Zone. Habitat selection estimated by resource selection functions (green), grizzly corridors, (yellow), and huckleberry patches (purple) are shown (Proctor et al. 2015, 2021).

Canadian bear researcher Dr. Bruce McLellan has been researching bears in the North Fork of the Flathead just north of the U.S. border since the late 1970s. This is one of the most extensively studied bear populations in North America (McLellan and Shackleton 1988, McLellan 1989a, b, c, McLellan and Hovey 1995, 2001a, b, McLellan 2011, 2015, McLellan *et al.* 2018). McLellan's study area was the southeastern portion of the Flathead GBPU, less than 15 percent of the unit's area. McLellan found a relatively high bear density that undulated with huckleberry productivity roughly corresponding to each of 3 decades between 1979–1988, 1989–1998 and 1999–2010 (McLellan 2015). He concluded that because this population was far from human settlements, and extensive post-forest-fire-induced huckleberry patches were separated from forestry roads in mid-to high elevation open slopes, grizzly bear densities were high relative to other interior non-salmon grizzly bear populations (McLellan 2011, 2015, Mowat *et al.* 2013). He found that densities of bears ***excluding*** independent males ranged from 16–55 bears/1,000 km^2 in spite of this area receiving the highest per bear capita legal hunt rate (McLellan 2015).

The current density of the entire GBPU is estimated to be 41 bears/1,000 km^2 (140 bears, B.C. Min. FLNRORD 2020), with an estimated average road density of 0.96 km/km^2. We note, however, that variability in this road density estimate exists due to access management (B.C. Min. FLNRORD 2017). Of note and in contrast, the density of grizzly bears in the adjacent Yahk GBPU is estimated to be 6.5 grizzly bears/1,000 km^2, due to a lower huckleberry patch density (30 percent of the Flathead huckleberry patch density) and higher open road density (1.6 km/km^2, Proctor *et al.* 2021b). DNA-based surveys have been done across the Flathead GPBU in 1997 and 2007 (Boulanger 2001, Proctor *et al.* 2010). A multi-method (DNA corral & rub trees) monitoring effort has been carried out since 2007 (Mowat *et al.* 2013, Mowat and Lamb 2016). They found that across the entire GPBU, the population declined between 2007 and 2010 and increased again between 2010 and 2014, similar to patterns McLellan (2015) reported for his smaller Flathead study area in the southeast portion of the unit. Grizzly bears in the unit have not been legally hunted since the province-wide hunt closure in 2017.

There has been a significant amount of conservation research and effort related to improving connectivity across B.C. Highway 3 separating the Flathead and South Rocky GBPUs (Apps 1997, Apps *et al.* 2007, Chetkiewicz and Boyce 2009, Clevenger *et al.* 2010, Proctor *et al.* 2012, 2015, Lamb *et al.* 2016, Lee *et al.* 2019). As a result of this attention, a spectrum of groups and government agencies are working to improve wildlife connectivity (including grizzly bears) across B.C. Highway 3 in the Rocky Mountains. Efforts include private land conservation by land trusts within identified linkage corridors, conflict mitigation efforts through WildSafe B.C. and the B.C. COS, and recent updated mitigation planning (Lee *et al.* 2019). A wildlife fencing program is being initiated to funnel wildlife into existing small highway crossing structures and underpasses and a larger wildlife crossing structure is being planned (C. Lamb, pers. comm.). Although, to our knowledge, there are no empirical data evaluating connectivity as a result of these activities, we believe they are likely positive initiatives for grizzly bear connectivity in this region.

South Rockies GBPU

North of B.C. Highway 3 in the Rocky Mountains is the South Rockies GBPU (Figure 4 and 19). This unit is designated as M2, high conservation concern, according to B.C.'s conservation ranking assessment (Figure 2a, Morgan *et al.* 2020) suggesting that it is in need of conservation attention. However, it is also the southern edge of a large area of contiguous grizzly bear habitat that extends 150–175 km (~100 miles) north to the Trans-Canada Highway 1 (Figure 2). As such, this population unit offers genetic and demographic connectivity to bears south of B.C Highway 3. The M2 designation reflects threats to this population including, human-caused mortality primarily on the periphery, and along B.C. Highway 43 that extends north into the unit to Elkford, B.C., extensive forestry roads, high ungulate hunter density and the accompanying mortality.

The South Rocky grizzly bear density is estimated to be 21 bears/1,000 km^2 (170 bears, B.C FLNRORD 2020). Many of the research and conservation efforts mentioned in the Flathead GBPU section above also apply to this unit as B.C. Highway 3 separates the two units and many efforts work to mitigate the human disturbance from this transportation settlement corridor (mentioned above). Grizzly bears in the unit were legally hunted up until the B.C.-wide grizzly bear hunt closure in 2017. As in the South Purcell GBPU, occasionally the combination of non-hunt conflict mortality and the legal hunt exceeded total mortality limits for this population (Artelle *et al.* 2013, Mowat and Lamb 2016). However, the hunt was closed periodically to mitigate the excessive mortalities and allow the bear numbers to recover as per provincial protocol (Hamilton and Austin 2004). The area continues to have significant human-caused mortality issues (Figures 12 and 17, Lamb *et al.* 2016, Mowat and Lamb 2016, Proctor *et al.* 2018). Provincial protected areas account for ~500 km^2 or 6 percent in the northern portion of the GPBU.

The area has several large coal mines (Figure 20) and as a result of conservation concerns a Cumulative Effects Management Framework has been instigated and is currently a cooperative effort between the B.C. FLNRORD and the Ktunaxa Nation Council to inform natural resource decisions (https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/cumulative-effects-framework/regional-assessments/kootenay-boundary/elk-valley-cemf).

In summary, the conservation situation of the combined Flathead and South Rockies GBPUs is dominated by the fact that south of B.C. Highway 3, the biological population including bears from B.C., Alberta, and the U.S. number more than1,200 bears, many of which live in protected areas. In both Canada and the U.S., bears in the Rocky Mountains north and south of B.C. Highway 3 represent a potential source of bears for the Yahk/Yaak populations. In that regard, both efforts to minimize conflict-related human-caused mortality on the periphery of these GBPUs is warranted. All indications suggest that there is significant room for improvement in this regard. Also, road management is warranted in some areas to allow survival of inter-population migrants.

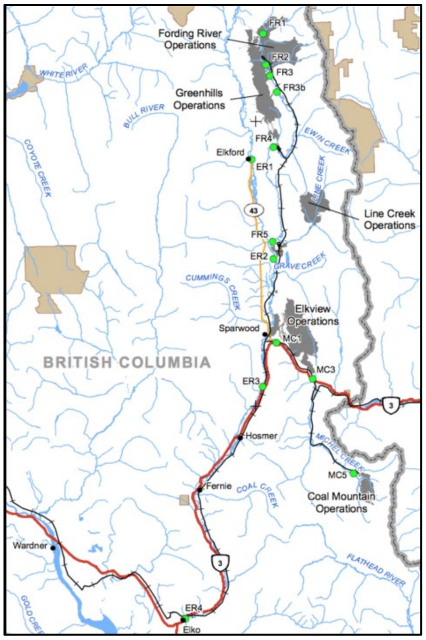

Figure 20. Coal mines in the Flathead Elk Valleys in southeast British Columbia.

British Columbia Summary

Connectivity

While perfect evidence is often lacking, it appears that connectivity across B.C. Highway 3 and 3A across southern B.C. is increasing, at least in some locations (Tables 1, 2). This is not likely the case in the North Cascades or the Granby Kettle GBPUs, but that possibility exists in the Granby-Kettle if population numbers continue to expand within that GPBU as they have over past 2 decades (Lamb *et al.* 2018). Highway 3 in the Granby-Kettle has virtually no human-settlement and likely would allow grizzly bear permeability. However, for this to occur it might require a unit-wide motorized access management plan be implemented that allowed for increased numbers of bears (OAG 2017, Proctor *et al.* 2021b).

Connectivity to U.S. grizzly bear populations has the most to gain from the Canadian portions of the South Selkirk and Yaak Recovery zones. For this to be realized, connectivity must be further improved across B.C. Highways 3 and 3A, to the larger Purcell grizzly bear population to the north. Connectivity into the South Selkirks across B.C. Highway 3A and across B.C. Highway 3 into the Canadian Yahk (fully connected to the CYE RZ) from the South Purcell Mountains is increasing (Proctor *et al.* 2018), and challenges predicting the future aside, is likely to continue improving. The same can be said for connectivity across B.C. Highway 3 in the Rocky Mountains north of the NCDE. Higher densities of bears in that area provide more possibilities for enhanced connectivity, but continued efforts to reduce human-caused mortality should be a priority. In other words, while the connectivity situation in Canada is improving, more work is required.

Table 1: Summary of trends in connectivity and abundance of Grizzly Bear Population Units in Southern B.C just north of the U.S. border.

	Trend	
GBPU	Connectivity	Abundance
North Cascades	No	No
Granby Kettle[1]	Unknown	Increasing
South Selkirk[2]	Increasing	Increasing
Yahk[2]	Increasing	Unknown
Flathead[3]	Unk, possibly increasing	Stable

[1] Lamb *et al.* (2018)
[2] Proctor *et al.* (2018)
[3] McLellan (2015)

Table 2: Summary of conservation management being applied within Grizzly Bear Population Units in southern B.C. just north of the U.S. border (access mgt refers to motorized management)

	Conservation management to improve:		Specific mgt actions		
GBPU	Connectivity	Population size	Non-lethal conflict response	Access mgt	Attractant mgt
North Cascades	No	No	No	No	No
Granby Kettle	No	Some access mgt	Some	Some	Yes
South Selkirk	Yes	Considerable	Yes	Some	Yes
Yahk	Yes	Some	Yes	No	Yes
Flathead	Some	Some access mgt	Some	Some	Yes

Abundance

Minimizing human-caused mortality and maintaining stable grizzly bear populations in Canada is also beneficial for the shared international populations. We summarize grizzly bear abundance trends in Table 1. There has been no recovery of grizzly bears in the North Cascades in the past 20 years. The Granby-Kettle has experienced a significant increase in bears in the past 20 years and further increases may require a unit-wide motorized access management plan (Lamb *et al.* 2018). Preliminary indications are that bears in the Canadian South Selkirk population are increasing (Kasworm *et al.* 2020a) and human-caused mortality is on a downward trend (Proctor *et al.* 2018). Further increases may also require more widespread access management beyond NCC lands within this unit (MacHutchon and Proctor 2016, Proctor *et al.* 2020, 2021b). An ongoing DNA survey (began in 2020) will verify this within 2021. The population trend in the Canadian Yahk is less clear, except that the international Yahk/Yaak has recently shown to be increasing – how much of that is due to Canadian bears is uncertain. Road densities remain relatively high in the Canadian Yahk, and this is where conservation effort needs to focus in this population (Proctor *et al.* 2020, 2021). The Flathead has a relative high density of bears, relative to neighbouring GBPUs, and has undulated over the decades around what might be considered a stable mean over time (McLellan 2015).

Motorized Access Management

Managing backcountry motorized vehicle access remains a challenge in B.C. While several localized motorized access management plans are being implemented (mentioned above), none of them have set targets to meet. Further, despite compelling evidence detailing the benefits of motorized access management to grizzly bear conservation and continued recommendations by scientists to implement a robust motorized access management plan (e.g., Boulanger and Stenhouse 2014, Lamb *et al.* 2018, Proctor *et al.* 2020, Proctor *et al.* 2021b), there is currently no region-wide plan – nor are there plans to develop one (Garth Mowat, B.C. Provincial Large Carnivore Specialist, FLRNORD, pers. comm.). Overcoming public resistance to motorized vehicle closures on a regional scale is challenging, particularly in the absence of pertinent legislation (OAG 2017).

To further work on motorized access management, the Trans-border Grizzly Bear Project is currently working on an analysis wherein they will use their recent huckleberry 'patches-important-for-grizzly-bears' model (Proctor *et al.* 2021b) as the basis for the development of a proposed motorized access management plan that optimizes the benefit to grizzly bear while simultaneously minimizing inconvenience to people. This work is informed by the literature review in Proctor *et al.* (2020) and recent results of Proctor *et al.* (2021b) that demonstrate that huckleberry patches in areas of high road density do not contribute significantly to bear densities. They will use the results of this new project as the basis for conversations with government officials with the goal of furthering the completion of motorized access controls in the South Selkirk, Yahk, and South Purcell GBPUs.

One final note, it is clear from the situation in British Columbia that the U.S. recovery ecosystems would benefit significantly from continued cooperation and collaboration with researchers, ENGOs, First Nations, and governments in Canada, but Canadian populations are not a panacea for recovery of populations in the U.S. along the Canadian border. The Yahk and South Selkirk populations are small physically as a result of mountain valleys and human transportation and settlement patterns. These physical limitations necessitate that these small populations become and remain connected to adjacent and larger populations over the long-term. That connectivity will not likely be a free flow of bears, but rather a limited number of individuals that move and survive through the human-dominated landscapes that make up the fractures. Thus, while it is essential that the smaller U.S. populations remain connected to Canadian populations, that connectivity is a hedge against loses of genetic diversity, an opportunity for natural demographic rescue and augmentation, and, in the extreme, a resistance against extirpation. The ultimate health of the bears in U.S. ecosystems, and those in Canada also requires that they be healthy populations internally, attained through minimized human-caused mortality and good habitat management.

Alberta Overview

Alberta is the eastern edge of grizzly bear distribution in western Canada (excluding territories north of the 60th parallel) (COSEWIC 2012). Primary grizzly bear habitat includes the Rocky Mountain and Foothills Natural Regions as well as the Central Mixwood Subregion of the Boreal Forest Natural Region (COSEWIC 2012). Alberta grizzly bears were first designated as a furbearer in 1928, but that changed the subsequent year (1929) when they became a big game animal (Festa-Bianchet 2010). More stringent hunting regulations were established in the 1960s and by 1988 a draw system and hunting quotas were in place (Festa-Bianchet 2010). In 2002, Alberta's Endangered Species Conservation Committee recommended that grizzly bears be designated as *Threatened* on the basis of the species' small population size, slow reproductive rate, increasing human activity in grizzly bear habitats, and limited immigration from populations outside of Alberta (Alberta Sustainable Resource Development 2008). That recommendation, however, was not accepted by the Minister of Sustainable Resource Development (Festa-Bianchet 2010). A recovery team was appointed, a recovery plan was developed, and from 2004 through 2008, a series of DNA-based population inventories occurred across the province (Alberta Sustainable Resource Development 2008, Festa-Bianchet 2010). Also, during this time period, a moratorium on grizzly bear hunting was established in 2006 (Festa-Bianchet 2010); the moratorium continues to be in place at the time of this document, although First Nation subsistence hunting is still allowed. Grizzly bears were listed as *Threatened* under Alberta's Wildlife Act in June 2010 (Alberta Environment and Parks 2016). The 2010 grizzly bear status assessment estimates the current total population of grizzly bears in Alberta as 691 plus additional bears in portions Banff and Jasper National Parks (Festa-Bianchet 2010). This estimate is based on the 2004–2008 DNA inventory data, habitat modelling, and expert opinion.

In 2016, Alberta Environment and Parks drafted an updated grizzly bear recovery plan (Alberta Environment and Parks 2016). Although the updated plan has not yet been approved by the Minister, it guides current grizzly bear management in the province. Alberta is divided into six different bear management areas (BMA, Alberta Environment and Parks 2016). Each BMA is further divided into a Recovery Zone and a Support Zone (Figure 21a, Alberta Environment and Parks 2016). The Recovery Zone is the area in which the province intends to recover grizzly bears, while the Support Zone is intended to allow for grizzly bears whose home ranges are not entirely within the Recovery Zone; management of bear attractants and other sources of human-wildlife conflict in the Support Zone are completed with the intent of supporting the grizzly bear population in the Recovery Zone (Alberta Environment and Parks 2016). Within the Recovery Zone, there are Core and Secondary Zones which inform Recovery Zone management (Figure 21b, Alberta Environment and Parks 2016). The new plan also identifies Habitat Linkage Zones which identify highway corridors where there is a risk of populations becoming more isolated over time (Alberta Environment and Parks 2016). Updated DNA-based population inventories were completed cross the province from 2011–2018; some density and abundance estimates have been released and others are still forthcoming. Updated population estimates for some BMAs suggest a population increase (Stenhouse *et al.* 2015, Morehouse and Boyce 2016). Because an updated provincial estimate has not yet been completed, the population estimate of 691 (plus additional bears in the mountain National Parks) currently guides grizzly bear management (Alberta Environment and Parks 2016). Threats to grizzly bears across the province include anthropogenic habitat alteration, loss of connectivity, and human-caused grizzly bear mortality (Alberta Environment and Parks 2016).

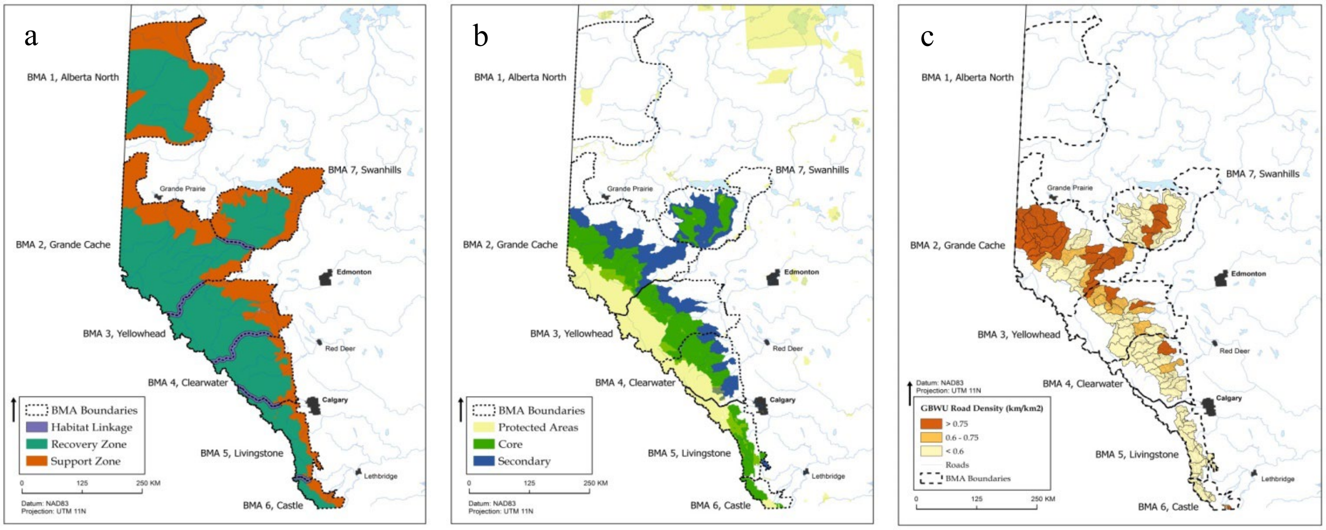

Figure 21: Grizzly Bear Management Areas (BMAs), (b) Core and Secondary habitats (adapted from Nielsen et al. 2009), and (c) Road density categories by Grizzly Bear Watershed Units across 7 BMAs in western Alberta (AEP 2016, adapted from Proctor et al. 2020).

Like many areas of North America, the anthropogenic habitat alteration caused by roads is a primary concern for grizzly bears in Alberta. Roads allow humans motorized access into high-quality grizzly bear habitat (Nielson *et al.* 2004, Schwartz *et al.* 2006), and human-related causes are the primary source of grizzly bear mortality across North America, even in unhunted landscapes (Peek *et al.* 1987, McLellan *et al.* 1999, Benn and Herrero 2002, Garshelis *et al.* 2005, Schwartz *et al.* 2006, McLellan 2015, Proctor *et al.* 2020). Increased road densities are linked to changes in bear movements, distributions, and behaviour; increased mortality risk; and decreased survival and reproduction (Roever *et al.* 2008, Northrup *et al.* 2012a, Boulanger *et al.* 2013, Boulanger and Stenhouse 2014). While road density itself is related to grizzly bear survival, traffic volume is also likely to influence bear behaviour and mortality risk (Northrup *et al.* 2012a, Boulanger and Stenhouse 2014). For example, in southwestern Alberta, grizzly bears use private agricultural lands that have a high road density but lower human use relative to the multi-use public lands (Northrup *et al.* 2012a). In Alberta, demographic models have suggested a road density threshold of 0.75 km/km^2 below which the survival of female grizzly bears with cubs is reduced (Boulanger and Stenhouse 2014). The current recommended road density thresholds within Alberta's draft recovery plan are 0.6 km/km^2 in the Core Zone and 0.75 km/km^2 in the Secondary Zone (Figure 21c, Alberta Environment and Parks 2016), but there are regional differences in the enactment of these recommendations and there is no province-wide mandate requiring their implementation. Additionally, there is a lack of clarity in terms of what constitutes a closed or restricted road that should be excluded from open-road density calculations (Proctor *et al.* 2020). Further, most BMAs have at least some grizzly bear watershed units that exceed these recommendations (Figure 21c, Alberta Environment and Parks 2016, Proctor *et al.* 2020). Habitat alteration in the form of linear features can also impact grizzly bears. Linear features developed for oil and gas exploration often become recreational trails over time, used by off highway vehicles (OHVs). Ladle's (2017) work suggests that some bears respond negatively to high levels of OHV use on trails. Although closing or restricting motorized access in high quality bear habitat has been identified as a powerful tool in grizzly bear management (Mace *et al.* 1996, Roever *et al.* 2010, Schwartz *et al.* 2010, Northrup *et al.* 2012a, Boulanger and Stenhouse 2014, Proctor *et al.* 2020), there is not currently a provincial motorized access management plan. Access management planning is part of Regional Land Use Plans, and it is through that framework that any future motorized access management will be implemented (Alberta Environment and Parks 2016). Although portions of Alberta's BMAs are subject to varying motorized access management plans as part of a protected area designation or a Public Land Use Zone, these plans do not necessarily include the recommended grizzly bear road density thresholds (Alberta Environment and Parks 2016). Indeed, one of the recommended recovery actions within the current draft recovery plan is that grizzly bear road density thresholds be incorporated into regional access management planning (Alberta Environment and Parks 2016).

Loss of connectivity between grizzly bear populations is also a concern at the provincial level. Proctor *et al.* (2012) demonstrated that major east-west highways in Alberta have resulted in differentiation in the genetic structure of bear populations; this genetic separation is greater than the effect of the continental divide separating Alberta and British Columbia. Highway 1 which bisects Banff National Park and Highway 3 through the Crowsnest Pass are particularly problematic (Proctor *et al.* 2012). To address the connectivity concern for wildlife, Banff National Park has installed 6 overpasses and 38 underpasses since 1996 (Ford *et al.* 2010). Research has shown both male and female grizzly bears use these highway crossing structures and there is evidence of bidirectional gene flow across the highway (Sawaya *et al.* 2014). In southwestern Alberta, Highway 3 bisects several small communities that collectively make up the Crowsnest Pass. Several groups are currently working collaboratively to try and develop crossings structures for Highway 3 (https://y2y.net/work/hot-projects/highway-3-wildlife-friendly/). To date, Alberta Transportation has installed jump-outs and wildlife fencing in the Crowsnest Pass. An underpass and wildlife fencing along Hwy 3 near Rock Creek in southwestern Alberta is included in the 2020 provincial highway budget and both projects are currently in the design stage (Alberta Government 2020). Additionally, there are several attractant management initiatives in the Crowsnest Pass lead primarily by the Crowsnest Pass BearSmart (discussed in more detail below).

Human-caused grizzly bear mortality also threatens grizzly bear populations in Alberta. Provincially, the greatest sources of human-caused mortality in order of prevalence are poaching, accidental collisions with highway vehicles or trains, self-defense kills, and misidentification of a grizzly bear as a black bear by hunters (Alberta Environment and Parks 2016). Grizzly bear mortality due to trains is particularly problematic in the mountain parks (St. Clair *et al.* 2020). Current provincial recovery objectives are to ensure that the known human-caused mortality rate for grizzly bears is less than or equal to 4 percent of which the female morality rate is less than or equal to 1.2 percent for all BMAs except for the southwestern corner of Alberta (BMA 5 and 6) were the known morality rate is less than or equal to 6 percent and less than or equal to 1.8 percent for female grizzly bears (Alberta Environment and Parks 2016).

Human-grizzly bear conflicts remain a challenge and can result in grizzly bears being translocated or killed. Within Alberta, when an individual has a complaint regarding grizzly bears, they have the option of reporting it to the Fish and Wildlife division of the provincial government. The details of the event are recorded as a text summary in a provincial occurrence database. Complaints are investigated by trained government staff. The government response to grizzly bear occurrences is guided by the provincial grizzly bear response guide (Alberta

Government 2016). In most situations, if the bear is not an immediate threat to humans, preventative action is the first response (Alberta Government 2016). Preventative responses can include any of the following: area closure/motorized access restrictions, monitoring, providing educational materials, attractant removal, electric fencing, hazing or aversive conditioning, or hard release of capture bears (Alberta Government 2016). Four main criteria are used to determine the government's response to human-bear conflict, including: age, sex, and reproductive status of the bear, location of the incident (e.g., Recovery Zone vs. Support Zone), the bear's behaviour, and the bear's known conflict history (Alberta Government 2016). Captured bears can be relocated within the same BMA, relocated outside of the BMA, or euthanized. In the case of orphaned cubs, retention in captivity is also an option (Alberta Government 2016). Provincially, captured bears were translocated out of the BMA 87 percent of the time (Alberta Environment and Parks 2016).

South of Highway 3 – BMA 6

BMA 6 is bounded by Highway 3 to the north, British Columbia to the west, Montana to the south, and the approximate edge of grizzly bear habitat to the east (Figure 22). Protected lands in this area include Waterton Lakes National Park, Castle Provincial Park, Castle Wildland Provincial Park, and Beauvais Lakes Provincial Park. The remainder of the public lands are crown land under the jurisdiction of the Alberta government. The Recovery Zone in BMA 6 is 1,814 km^2, while the Support Zone is 1,774 km^2. The Support Zone consists almost exclusively of privately owned lands, which are used predominately for agriculture – both livestock and crop production (Statistics Canada 2006). On the north end of BMA 6 is a Habitat Linkage Zone encompassing the Highway 3 region that divides BMA 5 and BMA 6. Southwestern Alberta is known for its strong winds, and there is a sharp transition from mountainous terrain in the west to prairies and agricultural lands in the east; there are limited foothills.

The grizzly bear population in Alberta's BMA 6 is contiguous with Montana's NCDE grizzly bear population as well as British Columbia's Flathead grizzly bear population. The most current density estimates for males in this BMA are 8.0/1,000 km^2 in the Recovery Zone and 7.1 male/1,000 km^2 in the Support Zone (Morehouse and Boyce 2016). For females, density estimates are 12.4/1,000 km^2 in the Recovery Zone and 10.0/1,000 km^2 in the Support Zone (Morehouse and Boyce 2016). The expected abundance of resident grizzly bears in BMA 6 is 67.4 (Morehouse and Boyce 2016). These numbers represent a 4 percent per year increase from the previous BMA 6 abundance estimate of 51 grizzly bears (Alberta Grizzly Bear Inventory Team 2008, Morehouse and Boyce 2016). It should be noted, however, that the methods were not identical between the 2007 and 2014 abundance estimates (Alberta Grizzly Bear Inventory Team 2008, Morehouse and Boyce 2016). BMA 6 is a small portion of a much larger ecological population and Morehouse and Boyce (2016) estimated that approximately 172 grizzly bears use the area each year. The area was also sampled in 1997 in conjunction with an additional DNA grid north of Highway 3 (Mowat and Strobeck 2000). The Mowat and Strobeck (2000) abundance was 74 bears (95% CI = 60–100), but the grid sampled a larger area, and the estimates are not directly comparable.

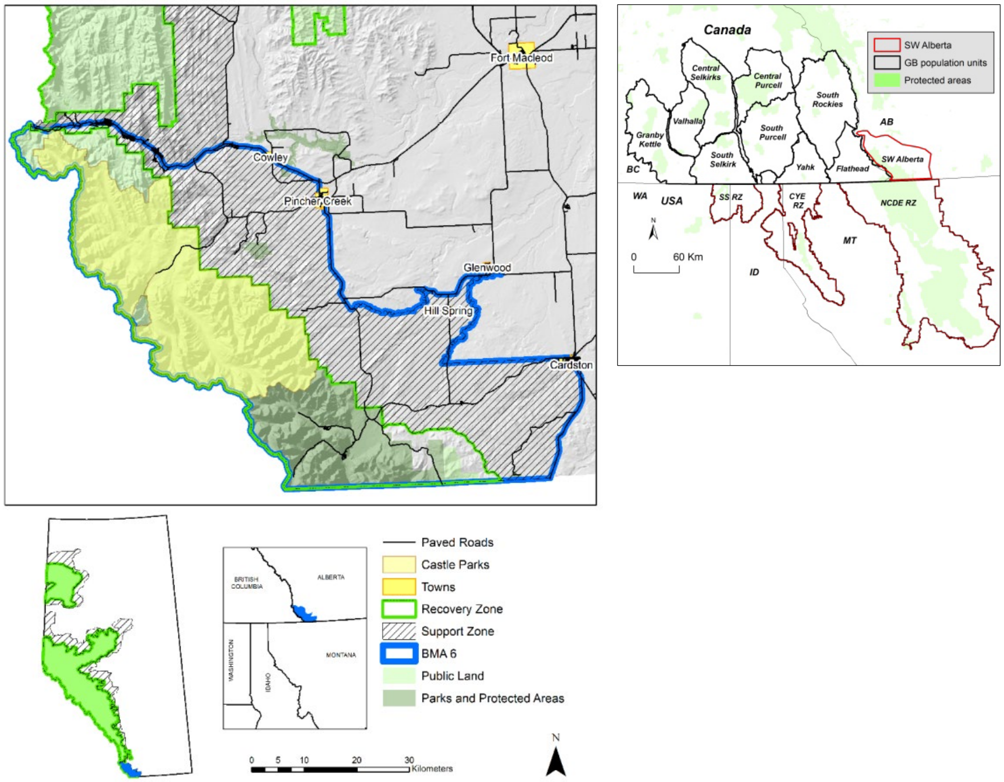

Figure 22: Grizzly bear management unit north of the Canada-U.S. border in southwest Alberta relative to the NCDE Recovery zone.

The Recovery Zone of BMA 6 is a multi-use landscape where uses include oil and gas development, forestry operations, cattle grazing, and several recreational activities (e.g., hiking, mountain biking, camping, OHV use, skiing, etc.). Much of the Recovery Zone has recently (2017) been designated as the Castle Parks (Figure 22, Castle Wildland Provincial Park and Castle Provincial Park), which is likely positive for bears as much of the area within the Recovery Zone has been identified as high-quality habitat for grizzly bears (Nielsen *et al.* 2009, Northrup *et al.* 2012b, Farr *et al.* 2017). Indeed, the Recovery Zone of BMA 6 contains areas of high habitat productivity, including several species of fruiting bear foods (Braid and Nielsen 2015). Although the road density at the watershed scale in the Castle region is relatively low (average 0.2 km/km^2) and below the suggested grizzly bear threshold of 0.6 km/km^2 (Farr *et al.* 2017), the total average linear footprint density (including off road vehicle trails) of 2.0 km/km^2 is over two times higher than that found in other parks of Alberta (Farr *et al.* 2017). The Castle Management Plan states that it will, "Monitor recreational trail use and, if necessary, limit density and frequency of use to minimize stressors on grizzly bears" (Alberta Environment and Parks 2018). Specific road density thresholds, however, are not included within the plan. Within the entirety of BMA 6, 37.5 percent (3 out of 8) grizzly bear watershed units in the Core Zone have road densities that exceed the recommended road density of 0. 6 km/ km^2. Further, this area has high traffic volumes, and traffic patterns have caused a distinct behaviour shift in grizzly bears with bear use of areas near roads and crossing of roads occurring at night when traffic is low (Northrup *et al*. 2012a, b). As an example of the juxtaposition of good habitat and mortality risk, Braid and Nielsen (2015) identified both source-like habitats (i.e., areas with high habitat productivity and low mortality risk) and sink-like habitats (i.e., areas with high habitat productivity and high mortality risk). They then used simulated annealing to prioritize these sites and identify areas where future development should be limited and road-related mortality risk should be mitigated (Braid and Nielsen 2015). Many of these high priority sites are within the Recovery Zone (Braid and Nielsen 2015). Thus, while the Recovery Region contains important bear habitat, it is not without challenges.

Outside of the Recovery Zone, the Habitat Linkage zone identifies the area of southwestern Alberta where there is a need to maintain or enhance the ability of grizzly bears to move between adjacent BMAs. As noted in the Alberta overview, Highway 3, which bisects the towns of the Crowsnest Pass, represents a barrier to movement for grizzly bears in this region (Proctor *et al.* 2012). Indeed, genetic work has revealed a limited number of bears cross the highway. Population inventory work occurred in the adjacent BMA 5 (north of Highway 3) in 2014 (northern half of BMA 5) and 2016 (southern half of BMA 5). Out of the more than 300 genotypes that were detected in the BMA 5 and BMA 6 inventory work, there were 9 bears (6 M, 3 F) that were detected both north and south of Highway 3 (Morehouse 2018). Of these 9 bears, 2 of them were translocated into BMA 5 from BMA 6 because of conflicts (Morehouse 2018). It is possible that additional bears were translocated between the BMAs and no hair samples were collected; some of the redetections are unlikely as natural movements (Morehouse 2018).

To help address the connectivity issue for grizzly bear, Chetkiewsicz and Boyce (2009) developed resource selection functions for grizzly bears in the Crowsnest and found that grizzly bear habitat selection was positively associated with greenness in all seasons and soil wetness and proximity to water in the summer – and both of these variables were associated with grizzly bear forage. Using these RSFs and least cost path analysis Chetkiewsicz and Boyce (2009) suggested potential highway crossing zones for the Crowsnest Pass. Highway 3 is a barrier for not only grizzly bears, but numerous wildlife species (Apps *et al.* 2007), and several organizations are working together to try and implement crossing structures (Clevenger *et al.* 2010).

In BMA 6, the Support Zone is almost exclusively private lands and there is extensive overlap between grizzly bear home ranges and human land uses (Figure 23, Northup *et al.* 2012b, Farr *et al.* 2017). The private lands of BMA 6 contain favourable grizzly bear habitat and often have lower human use than the adjacent public lands (Northrup *et al.* 2012, Northrup *et al.* 2012b). However, several attractants exist and the propensity for conflict is higher on private lands (Northrup *et al.* 2012b). Indeed, much of the private land within BMA 6 has been identified as an ecological trap for grizzly bears (Northrup *et al.* 2012). While human-grizzly bear conflicts are a concern across the province, southwestern Alberta is a hotspot (Alberta Environment and Parks 2016, Morehouse and Boyce 2017a). Most grizzly bear incidents in the area are related to some sort of attractant and the primary attractants for grizzly bears are grain and dead livestock (Morehouse and Boyce 2017a). Depredation of livestock is also a concern and depredation events have been increasing in recent years (Morehouse *et al.* 2018, Morehouse *et al.* 2020). Grizzly bear occurrences have also been spreading eastward over the last decade and grizzly bears now occur on prairie habitats outside of the provincially designated BMA boundaries (Figure 23, Morehouse and Boyce 2017a). Research also suggests that conflict behaviours might be being passed down from females to their offspring, potentially exacerbating the human-bear conflict problem (Morehouse *et al.* 2016). As a result of conflicts, grizzly bears can be translocated according to the grizzly bear response guidelines (Alberta Government 2016). Between 2009 and 2013, 42 grizzly bears were captured and translocated outside of BMA 6 – the highest number for the province for that time period (Alberta Environment and Parks 2016).

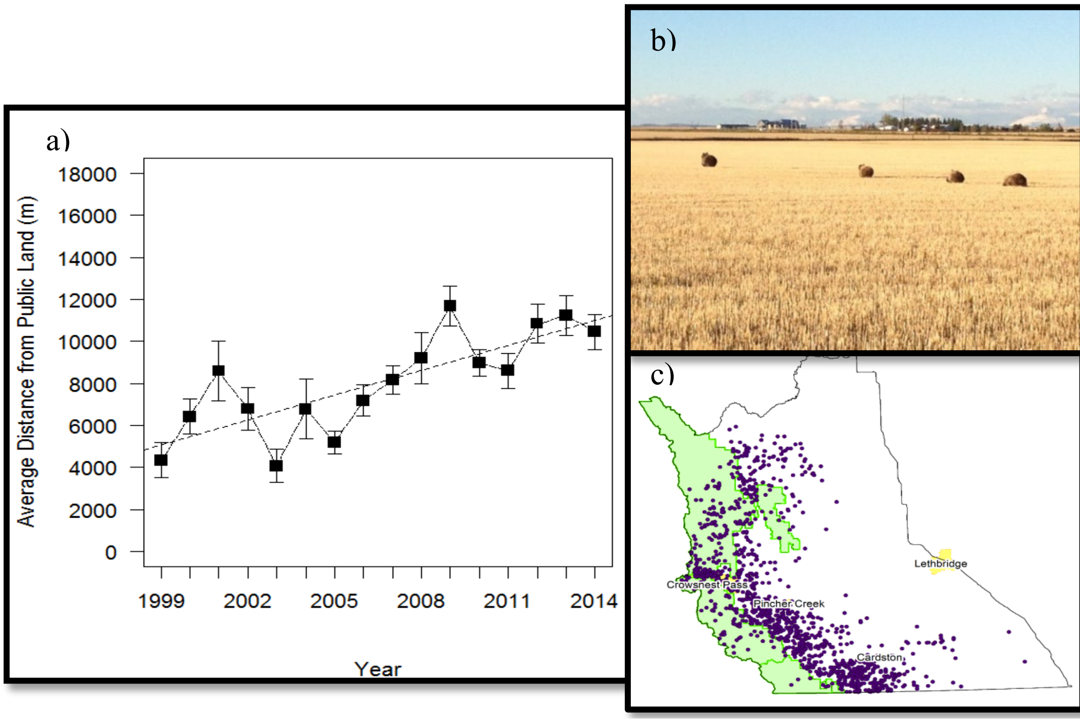

Figure 23: Increasing use of agricultural lands by grizzly bears to the east of the Rocky Mountains and foothills in southwest Alberta. Occurrence records (i.e., complaint data) show an eastward expansion over time (a, c). Photo (b) provided by Lyle Lester, Alberta Solicitor General. Adapted from Morehouse and Boyce (2017).

There are several initiatives in BMA 6 to try and mitigate or reduce human-grizzly bear conflicts including the Crowsnest Pass BearSmart program, the provincial intercept-feeding program, and the Waterton Biosphere Reserve's Carnivores and Communities Program. The Crowsnest Pass BearSmart Program is part of Alberta's provincial BearSmart effort, which aims to provide Albertans with the necessary information to make safe decisions while in bear country, keep bears safe, prevent bear encounters, and reduce bear-caused property damage (https://www.alberta.ca/alberta-bearsmart-program-overview.aspx). Garbage is one of the primary attractants in the Crowsnest Pass (Morehouse and Boyce 2017a). Although most human-bear conflicts in the Crowsnest Pass are related to black bears, grizzly bears are present as well (Morehouse and Boyce 2017a). The program works on several attractant management initiatives including attractant removal for seniors and other individuals unable to remove attractants such as apples or fruit trees, bear-resistant garbage cans for loan, and partnerships with municipal governments to develop bylaws aimed at assisting and enforcing the reduction of attractants (www.cnpbearsmart.com).

Specific to BMA 6, was the intercept feeding program wherein the provincial government slung road-killed ungulate carcasses into remote high elevation areas where grizzly bears were likely to encounter them once they emerged from hibernation. The program began in 1998 with the goal of reducing grizzly bear depredation of livestock during the spring calving season. Typically, two carcass drops occurred each year, once in mid-March and once in mid-April. Morehouse and Boyce (2017b) evaluated the program using non-invasive genetic sampling, remotely triggered trail cameras, and provincial complaint records. They found that the program was used largely by male grizzly bears and that grizzly bear depredation of livestock did not decrease during the intercept-feeding program nor did it increase after the program was suspended (Morehouse and Boyce 2017b). Annual operating costs for the program were estimated to be $43,850 CAD with an initial $19,000 CAD investment (Morehouse and Boyce 2017b). Thus, their results suggested that other mitigation efforts such as electric fencing of calving pastures might be a more cost-effective long-term solution (Morehouse and Boyce 2017b).

Perhaps the most active human-bear conflict mitigation initiative in BMA 6 is the Waterton Biosphere Reserve's (WBR) Carnivores and Communities Program (CACP). The program works with landowners, farmers, ranchers and rural residents to advance its goal of supporting coexistence between people and large carnivores. The program began in 2009 and the Alberta government is one of its primary funders and partners. The CACP has three primary on-the-ground initiatives: deadstock removal, cost-shared attractant management projects, and bear safety workshops. The deadstock removal program provides a direct service to livestock producers whereby livestock carcasses are picked up and completely removed from the property. Cost-shared attractant management projects are things such as electric fencing, bear-resistant grain bin doors, and upgraded grain storage that restrict bear access to agricultural attractants. Grain and deadstock are the primary bear attractants in this area (Morehouse and Boyce 2017a).

Finally, bear safety workshops have been developed in partnership with the Alberta government to specifically target farm and ranch families. The efficacy of the CACP was recently evaluated using a social survey and review of complaint records; both attractant and deadstock-based grizzly bear incidents changed from increasing to decreasing after the implementation of the CACP program in 2009; livestock depredation by grizzly bears, however, remains a challenge (Figure 24, Morehouse *et al.* 2020).

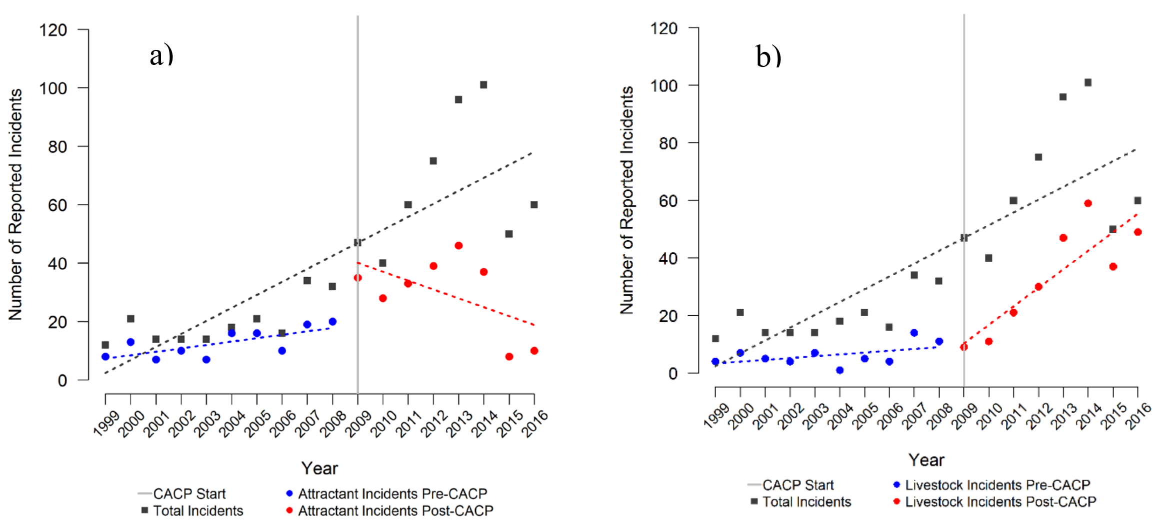

Figure 24: Reported grizzly bear attractant (a) and livestock (b) incidents before and after the implementation of conflict reduction management by the Waterton Biosphere Reserve's Carnivores and Communities Program (CACP) in southern Alberta which started in 2009. Adapted from Morehouse et al. (2020).

Yukon, Northwest Territories, and Nunavut

There are approximately 11,500–14,000 grizzly bears within Canada north of the 60th parallel in North America (Figure 1. Yukon, 6,000–7,000, Northwest Territories 4,000–5,000, Nunavut 1,500–2,000, COSEWIC 2012). Grizzly bear populations in this region are generally sustainable and appear to be expanding north into the islands of the Arctic Ocean (Figure 1, McLellan *et al.* 2017b). Bears are legally hunted in several local jurisdictions where habitat productivity is sufficient for a sustainable hunt (Yukon Conservation and Management Plan Working Group 2019). While human population densities are very low relative to southern Canada, grizzly bears are still susceptible to human disturbance and conflict mortality. As such, each territory has conflict reduction and human safety guidelines for living and working with bears (Yukon Conservation and Management Plan Working Group 2019, NWT, https://www.enr.gov.nt.ca/en/services/bear-safety). The distance between the bears in the lower-48 States and these northern populations is such that there is no link between them in terms of connectivity, genetic or demographic (Proctor *et al.* 2012).

Alaska

Grizzly bears, or brown bears as they are often called in Alaska, occupy most of Alaska except several islands along the southeast coast, the furthest portions of the Aleutian Island chain, and the lower reaches of the Yukon River in extreme southwest Alaska (Figure 1). Grizzly bear densities in Alaska range widely from more than 175 bears/1,000 km^2 in coastal populations where salmon are the primary food, to less than 40 bears/1,000km^2 in interior populations, to less than 7 bears/1,000km^2 in northern coastal plains areas (Miller & Schoen 1999). This variation in bear density is thought to be related to a region's bear food productivity (Hilderbrand *et al.* 1999, 2019, Mowat *et al.* 2013). Alaska has the largest grizzly bear population of any jurisdiction in North America (Figure 1, Miller and Schoen 1999). While a state-wide rigorous estimate of abundance is not available, manager and expert-derived estimates suggest there may be between 25,000 – 39,000 bears and, state-wide, the population is considered to be stable in abundance and distribution (Miller and Schoen 1999). That said, there are localized issues with conflict and hunt controversies (Peirce and Van Daele 2006, Miller *et al.* 2017).

Alaska is home to the only other sub-species of brown bear in North America – the bears of Kodiak Island (*Ursus arctos middendorffi*), of which there are an estimated 3,500 (Rausch 1963, Talbot and Shields 1996, Paetkau *et al.* 1998a and b, Alaska Department of Fish and Game https://www.adfg.alaska.gov/index.cfm?adfg=brownbear.trivia). Kodiak's brown bears have been isolated from the mainland for approximately 12,000 years and have a relatively low genetic diversity but show no negative population attributes due to inbreeding depression (Paetkau *et al.* 1998a and b).

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Appendix F. Winter Recreation

Grizzly bears are easily awakened in the den (Schwartz *et al.* 2003b, p. 567), and it is important to consider the potential impact from winter recreation. Disturbance of grizzly bears in the den can result in cub abandonment or early den exit, which could kill a grizzly (if they leave before food is readily available). However, information regarding impacts of winter recreation on grizzly bears is limited. We found no studies in the peer-reviewed literature documenting the effects of snowmobile use on any denning bear species and no records of litter abandonment by grizzly bears in the lower-48 States due to snowmobiling; the information that is available is based on opportunistic sightings and small sample sizes (in their entirety: Service 2002; Hegg *et al.* 2010). The one documented observation of snowmobiling at a known den site in the lower-48 States found the bear did not abandon its den, even though snowmobiles were operating directly on top of it (Hegg *et al.* 2010, p. 26). This, however, is only an opportunistic observation and is based on a sample size of one. We found no records of litter abandonment or den abandonment by grizzly bears in the lower-48 States due to snowmobiling activity (in their entirety: Service 2002; Hegg *et al.* 2010; Roberts 2018, *in litt.*).

Swenson *et al.* (1997, entire) monitored 13 male and female grizzly bears in Scandinavia for at least 5 winters each and documented 18 instances of den abandonment, 12 of which were related to human activities. Four of these instances were hunting related (i.e., gunshots fired within 100 m (328 ft) of the den), two occurred after "forestry activity *at* the den site," one had moose and dog tracks within 10 m (33 ft) of a den, one had dog tracks *at* the den site, one had ski tracks within 80 to 90 m (262 to 295 ft) from a den, one had an excavation machine working within 75 m (246 ft) of a den, and two were categorized as "human-related" without further details (Swenson *et al.* 1997, p. 37). Swenson *et al.* (1997) found that most den abandonment (72 percent) occurred early in the season before pregnant females give birth. However, there still may be a reproductive cost of these early den abandonments: 60 percent (sample size of 5) of female bears that abandoned a den site before giving birth lost at least one cub whereas only 6 percent (sample size of 36) of pregnant females that did not abandon their dens lost a cub in or near their den (Swenson *et al.* 1997, p. 37).

There are no data or information suggesting winter recreational use is negatively affecting grizzly bear populations in the lower-48 States, yet because the potential for disturbance and impacts to reproductive success exists, monitoring will continue to support adaptive management decisions about winter recreation use in areas where disturbance is documented or likely to occur.

Inside the GYE

In the GYE, the one documented observation of snowmobile use at a known den site found the bear did not abandon its den, even though snowmobiles were operating directly on top of it (Hegg *et al.* 2010, p. 26). Additionally, monitoring of den occupancy for 3 years on the Gallatin NF in Montana did not document any den abandonment (USDA FS 2006c, entire). In one rare instance of possible den disturbance, four backcountry skiers in GTNP reported seeing a collared grizzly bear close to where he had been denned three weeks earlier based on VHF locations from flights (Gustine 2019, *in litt.*). Of the 479 grizzly bear mortalities that occurred between 2002 and 2018, only 2 occurred between 1 December and 28 February. One of the mortalities was a radio-collared, 20-year-old male that died in January from natural causes in YNP, most likely from maladies associated with old age. The second mortality was a collared individual that likely died in an avalanche.

The Forest Plan Amendment includes guidance that, inside the recovery zone, localized area restrictions are to be used to minimize any conflicts during denning or after bear emergence in the spring. Bears tend to den in remote areas with characteristics that are not conducive to snowmobiling (i.e., steep, forested habitats). Suitable denning habitat is well distributed on the forests, and much of the general grizzly bear denning habitat identified in the Forest Plan Amendment Final EIS as being open to snowmobiling is not actually used by snowmobiles because of its steep and forested nature (USDA FS 2006a, p. 92). For example, 85.2 percent of the known dens in the GYE are located in areas where snowmobile use does not occur and, of the 13.9 percent of dens that do occur in areas open to snowmobiling, only 0.8 percent are classified as high potential for snowmobile use (Haroldson 2017, *in litt.*).

Inside the NCDE

Bears tend to den in remote areas with characteristics that are not conducive to snowmobiling (i.e., steep, forested habitats). Suitable denning habitat is well distributed on the forests, and under current forest plans, approximately 10 percent of USFS lands are both open for snowmobiling and are modeled denning habitat (Krenzelok 2024, *in litt*.). Forest Plans within the NCDE include direction that, inside the recovery zone, there will be no net increase in the area or miles or routes designated for over-snow vehicle use during the den emergence period (USDA FS 2018e, p. 181; USDA FS 2018f, p. 15). This measure will reduce the potential impacts to females with cubs that have high energetic costs and often spend several days to a few weeks near the den after emergence. In addition, snowmobiling is not allowed inside Glacier National Park or in designated Wilderness on USFS lands, which constitutes approximately 34 percent of the recovery zone.

Inside the CYE, SE, BE, and North Cascades

Suitable denning habitat appears to be well distributed on the forests within the CYE and SE (Service, unpublished data). There have been no documented cases of grizzly bears abandoning dens as a result of snowmobiling or other winter recreational activities in the CYE or SE (Kasworm 2018, *in litt.*). The BE and North Cascades have not had a known population in recent decades.

Appendix G. Pre-2002 Grizzly Bear Mortality Summary

Table 1. Causes of grizzly bear mortalities in the GYE 1980–2001. This table includes all known and probable mortalities of independent-age bears and dependent young, as displayed in parenthesis (), inside and outside the demographic monitoring area (DMA).

GYE Grizzly Bear Mortality, 1980–2001						
	Inside DMA			**Outside DMA**		
Cause of mortalities (all sources)	**Number of mortalities**	**Avg./ year**	**Percent total**	**Number of mortalities**	**Avg./ year**	**Percent total**
Natural	17 (27)	0.8 (1.2)	9 (51)	0 (0)	0.0 (0.0)	0 (0)
Undetermined	17 (3)	0.8 (0.1)	9 (6)	1 (0)	0.0 (0.0)	10 (0)
Human-caused	147 (23)	6.7 (1.0)	81 (43)	9 (2)	0.4 (0.1)	90 (100)
Total mortalities	**181 (53)**	**8.2 (2.4)**		**10 (2)**	**0.5 (0.1)**	
Human-caused mortalities	**Number of mortalities**	**Avg./ year**	**Percent of human-caused**	**Number of mortalities**	**Avg./ year**	**Percent of human-caused**
Accidental						
Automobile collision	5 (2)	0.2 (0.3)	3 (9)	0 (0)	0.0 (0.0)	0 (0)
Capture related	5 (5)	0.2 (0.2)	3 (22)	0 (0)	0.0 (0.0)	0 (0)
Drowning	0 (0)	0.0 (0.0)	0 (0)	0 (0)	0.0 (0.0)	0 (0)
Poisoning	0 (0)	0.0 (0.0)	0 (0)	0 (0)	0.0 (0.0)	0 (0)
Electrocuted	5 (0)	0.2 (0.0)	3 (0)	0 (0)	0.0 (0.0)	0 (0)
Defense-of-life	39 (7)	1.8 (0.3)	27 (30)	1 (0)	<0.1 (0.0)	11 (0)
Illegal *	36 (3)	1.6 (0.1)	24 (13)	0 (0)	0.0 (0.0)	0 (0)
Management removal						
Site conflicts/Human safety**	42 (6)	2.0 (0.3)	31 (26)	8 (2)	0.4 (0.1)	89 (100)
Injured or diseased bear	0 (0)	0.0 (0.0)	0 (0)	0 (0)	0.0 (0.0)	0 (0)
Livestock depredation	3 (0)	0.1 (0.0)	2 (0)	6 (0)	0.3 (0.0)	67 (0)
Mistaken identification***	12 (0)	0.5 (0.0)	8 (0)	0 (0)	0.0 (0.0)	0 (0)

* Illegal includes poaching, malicious, and defense-of property kills.

** Site conflicts/human safety include anthropogenic food and property damage related management removals in the front- and backcountry.

***Mistaken identification includes grizzly bear kills by black bear hunters using bait. Four instances of bears killed by black bear hunters using bait are included.

Table 2. Causes of grizzly bear mortalities in the NCDE 1980–2001. This table includes all known and probable mortalities of independent-age bears and dependent young, as displayed in parenthesis (), inside and outside the demographic monitoring area (DMA).

NCDE Grizzly Bear Mortality, 1980–2001						
	Inside DMA			**Outside DMA**		
Cause of mortalities (all sources)	**Number of mortalities**	**Avg./ year**	**Percent total**	**Number of mortalities**	**Avg./ year**	**Percent total**
Natural	10 (12)	0.4 (0.4)	3 (15)	0 (0)	0.0 (0.0)	0 (0)
Undetermined	8 (2)	0.3 (<0.1)	2 (2)	0 (0)	0.0 (0.0)	0 (0)
Human-caused	357 (68)	13.2 (2.5)	95 (83)	7 (0)	0.3 (0.0)	100 (0)
Total mortalities	**375 (82)**	**13.9 (3.0)**		**7 (0)**	**0.3 (0.0)**	
Human-caused mortalities	**Number of mortalities**	**Avg./ year**	**Percent of human-caused**	**Number of mortalities**	**Avg./ year**	**Percent of human-caused**
Accidental						
Automobile collision	5 (1)	0.2 (<0.1)	1 (2)	0 (0)	0.0 (0.0)	0 (0)
Capture related	11 (7)	0.4 (0.3)	3 (10)	0 (0)	0.0 (0.0)	0 (0)
Drowning	0 (0)	0.0 (0.0)	0 (0)	0 (0)	0.0 (0.0)	0 (0)
Poisoning	2 (0)	<0.1 (0)	<1 (0)	1 (0)	<0.1 (0.0)	14 (0)
Train collision	15 (15)	0.6 (0.6)	4 (22)	0 (0)	0.0 (0.0)	0 (0)
Defense-of-life	23 (3)	0.9 (0.1)	6 (4)	0 (0)	0.0 (0.0)	0 (0)
Illegal *	78 (17)	2.9 90.6)	22 (25)	2 (0)	<0.1 (0.0)	29 (0)
Legal hunting	124 (6)	4.6 (0.2)	35 (9)	0 (0)	0.0 (0.0)	0 (0)
Management removal						
Augmentation**	0 (0)	0.0 (0.0)	0 (0)	0 (0)	0.0 (0.0)	0 (0)
Site conflicts/Human safety***	54 (13)	2.0 (0.5)	15 (19)	0 (0)	0.0 (0.0)	0 (0)
Injured or diseased bear	1 (1)	<0.1 (<0.1)	<1 (2)	0 (0)	0.0 (0.0)	0 (0)
Livestock depredation	19 (2)	0.7 (<0.1)	5 (3)	3 (0)	0.1 (0)	43 (0)
Mistaken identification	22 (2)	0.8 (<0.1)	6 (3)	1 (0)	<0.1 (0)	14 (0)
Unknown	3 (1)	0.1 (<0.1)	<1 (2)	0 (0)	0.0 (0.0)	0 (0)

* Illegal includes poaching, malicious, and defense-of-property kills.
** When bears are relocated from the NCDE to augment the CYE population, they are counted as mortalities in the NCDE.
*** Site conflicts include both anthropogenic food and property damage related management removals. Human safety includes incidents in both the front and backcountry.

Table 3. Causes of known and probably grizzly bear mortalities from 1982 to 2001 in the CYE and the U.S. portion of the SE. Mortalities in the CYE and SE include apply within the recovery zone plus a 10-mile buffer, excluding Canada.

CYE and SE Grizzly Bear Mortality, 1982–2001						
	CYE			SE		
Cause of mortalities (all sources)	**Number of mortalities**	**Avg./ year**	**Percent total**	**Number of mortalities**	**Avg./ year**	**Percent total**
Natural	7	0.4	33	3	0.2	19
Unknown/undetermined	1	<0.1	5	1	<0.1	6
Human-caused	13	0.7	62	12	0.6	75
Total mortalities	**21**	**1.1**		**16**	**0.8**	
Human-caused mortalities*	**Number of mortalities**	**Avg./ year**	**Percent of human-caused**	**Number of mortalities**	**Avg./ year**	**Percent of human-caused**
Accidental	2	0.1	15	0	0.0	0
Defense-of-life	2	0.1	15	0	0.0	0
Illegal poaching	3	0.2	23	4	0.2	33
Management removal	1	<0.1	8	0	0.0	0
Mistaken identification	3	0.2	23	2	0.1	17
Unknown**	2	0.1	15	6	0.3	50

* Orphaned dependent offspring were classified according to cause of death of their mother.
** Includes mortalities that are under investigation.

In addition, there were two known human-caused mortalities inside the lower-48 States outside of these areas; one unknown and one mistaken identification.