2011 Pollinator Monitoring Program, U.S. Fish and Wildlife Service, Region 1

Prepared by: Joseph Engler, Assistant Regional Refuge Biologist, R1 Pollinator Conservation Coordinator

Overview:

Pollinators are becoming increasingly important conservation species as biological indicators of environmental health due to their susceptibility to habitat fragmentation, environmental toxins, and habitat alterations due to agricultural and urban developments, and invasive species. Increasingly, pollinators are being recognized as key species for monitoring climate change, specifically with respect to phenological shifts within species as well as with their host plants, due to changes in long-term weather patterns. The consequences of these phenological shifts are speculative but otherwise potentially far-reaching and unknown. Likewise, subsequent changes in plant-pollinator interactions may be profound with ensuing negative consequences on the long-term viability of the pollinator and plant species themselves, as well as the ecological community at large. Despite their importance and in some cases ubiquitousness within the landscape, the habitat requirements and life cycles of pollinators are virtually unknown to the land management community and only rarely are pollinators considered in land management decisions.

Pollinating species include a range of insects, birds, and mammals and are responsible for the pollination and thus continued persistence of over 75% of flowering plants. While bees and butterflies are the most widely recognized pollinators, other insects such as moths, flies and beetles also provide pollination services. Some species function as pollinators in only an incidental role while pursuing plant nectar, while others such as bees are primary pollinators that purposefully gather pollen for provisioning young. There is growing evidence that pollinators are declining world-wide. In the United States, four species of bumble bees are considered vulnerable to extinction, including the western bumble bee (*Bombus occidentalis*) which was once considered to be the most abundant bumble bee in the western United States. The Franklin's bumble bee (*Bombus franklinii*) endemic to northern California and southwestern Oregon is approaching extinction as repeated intensive surveys have not re-located this species since 2006. Within Region 1 (excluding Hawaii), the Xerces Society's Red List of at-risk to endangered pollinators includes five species of butterflies and twenty species of bees; in Hawaii, one butterfly and twenty-five bees are listed.

In order to address the growing concern for pollinators, their needs in a changing climate and landscape, and their role in perpetuating functional Refuge habitats, the USFWS Region 1 Branch of Refuge Biology has initiated two region-wide pilot bee monitoring projects. The first project is to identify the primary bee fauna of select refuges within Region 1. The second is to identify the bee fauna associated with shrub-steppe habitat along a north-south gradient from northern Washington to northern Nevada.

PROJECT 1: BASELINE SURVEYS

Objectives:

1. Identify the common bee fauna, their seasonal phenology, and relative abundance on specific refuges within Region 1.
2. Identify the taxonomic breadth of the bee fauna residing on Region 1 Refuges, exclusive of Hawaii, and their relative abundance.
3. Evaluate the feasibility and efficacy of a staff-implemented bee monitoring project.
4. Provide bee fauna distribution data to national databases.
5. Provide representative specimens of the regional bee fauna for refuge-based educational programs.
6. Utilize volunteers, seasonal staff, and Youth Conservation Corps to assist with collection and processing of bee specimens to provide them a greater understanding of the diversity and importance of bees within the landscape.
7. Provide surplus bees to museums and universities as voucher specimens, for research purposes, and/or for genetic classification.

Discussion:

This baseline monitoring will utilize a variation of a standard bee bowl monitoring method developed by the USGS. Bee bowls are visual attractants that kill insects by drowning. Susceptible bees (and other insects) are limited to those bees that cue visually to bowl color and are flying close enough to the bowls to inadvertently alight on and then fall into the bowl. Susceptibility relies on many factors including bee species, flight distance and height from bowl, vegetative cover, presence and abundance of nectaring plants, seasonality, and weather conditions. This method, while quite effective on some species is relatively ineffective on others, thus this sampling technique will not capture the full range of bee fauna present in a given area. Other methods may be utilized in the future to further elucidate the full range of bee species present on a refuge.

Methods:

A detailed explanation of the methods utilized is included in attachment 1. The sampling period is from April through October, which coincides with early and late bee emergence. The basic survey technique utilizes fifteen 2.5 ounce bowls of 3 colors (white, yellow, blue). The yellow and blue are painted with a specialized paint conducive to attracting pollinators. Bowls are placed in alternating colors along a transect with a 5 meter spacing between bowls. Bowls are filled with soapy water to capture the insects. Each refuge is provided with thirty bowls in order

to run two separate transects. The two transects should be set far enough apart to potentially collect a different bee fauna. This should take into account potential differences in bee fauna that may result from adjacent habitats. Examples of sites could include: an open meadow adjacent to deciduous riparian; an open meadow adjacent to shrub-steppe; a headquarters lawn, etc. In all cases, the transect should be positioned to receive the maximum exposure to sunshine during the day. Each of the 2 transects should be placed in the same respective location throughout the season.

Transects are set out once every two weeks, generally in an open meadow or other open habitat, in the early morning and picked up in the late afternoon, or next morning. The 2 week sampling interval is based on the knowledge that some bee species have a very limited flight period and sampling intervals of greater than 3 weeks may miss some of these short-duration species. The sample from a single transect (15 bowls) is strained through a fine mesh net, rinsed with water, and placed in a whirl-pak bag. A label is placed inside the bag which includes a minimum of the date/time set, date/time picked up, refuge, location or transect identifier, collector's initials or name. A solution of 70% ethyl alcohol (or isopropyl alcohol) is placed in the bag, just enough to cover the specimens.

Additional data collected should include: a GPS location for the center of each transect, and a basic habitat description (needed only once, as repeated sampling should occur at the same site). Basic weather parameters (temperature, cloud cover, wind, precipitation) should be collected when the transect is set out and then again when it is picked up. Any unusual occurrences will be noted, such as bowls that are knocked over by wildlife or otherwise disturbed, abnormal weather activity, etc.

Samples are sent to the Branch of Refuge Biology, Vancouver, WA for processing (washing, drying, pinning, labeling, sorting) and preliminary identification. All data is currently entered into a database housed within the BRB. Selected specimens will be sent to a contractor for verification of BRB identifications, and for additional species identification.

There are 9 refuges committed to collecting baseline data in 2011. These include Willapa NWR, Ridgefield NWR, Steigerwald Lake NWR, Pierce NWR, Conboy Lake NWR, Little Pend Oreille NWR, Kootenai NWR, Deer Flat NWR, Malheur NWR.

PROJECT 2: SHRUB-STEPPE ARRAY

Objectives:

1. Identify the common bee fauna of various shrub-steppe habitats, their seasonal phenology, and relative abundance along a north-south gradient from northern Washington to northern Nevada.
2. Identify the taxonomic breadth of the bee fauna residing within shrub-steppe habitats in Region 1.
3. Evaluate the feasibility of adapting this national method as a permanent long-term technique for evaluating climate change impacts on shrub-steppe bee fauna.
4. Provide long-term site data to the USGS-led bee monitoring program developed to assess nation-wide changes in bee fauna due to climate change.
5. Evaluate the feasibility and efficacy of a long-term staff-implemented bee monitoring project.
6. Provide bee fauna distribution data to national databases.
7. Provide representative specimens of the regional bee fauna for refuge-based educational programs.
8. Utilize volunteers, seasonal staff, and Youth Conservation Corps to assist with collection and processing of bee specimens to provide them a greater understanding of the diversity and importance of bees within the landscape.
9. Provide surplus bees to museums and universities as voucher specimens, for research purposes, and/or for genetic classification.

Discussion:

This monitoring project utilizes a variation of a bee bowl monitoring method developed by the USGS and other researchers to address long-term changes in bee fauna due to climate change. The initial nation-wide pilot project was conducted in 2010 on US Forest Service lands (see XXX) and this methodology was validated as a long-term monitoring scheme to assess bee faunal changes on a national scale. The methodology is dependent on sufficient monitoring sites deployed across the country. The method also relies in part on maximizing capture rates at all sites. High capture rates generally occur in open sunny habitats that provide abundant floral resources, a diversity of bee genera and species, and maximize bee foraging efficiency. In Region 1, stepping this method down to a single semi-closed habitat type may result in insufficient captures to utilize this method as a long-term strategy for monitoring climate-induced bee faunal changes in shrub-steppe habitats.

It is also recognized that bee fauna and their seasonality will differ from north to south. There will likely be some bee species' differences between the different shrub-steppe types. In 2011, less emphasis is on the plant-shrub composition of each site, as it is anticipated that long-term changes will only be detected in relatively abundant species, which are likely to inhabit all/most

shrub-steppe types. The main goal in 2011 is to document the species captured, their relative abundance, and evaluate whether the species are shrub-steppe dependent. This evaluation will depend on concurrent trapping around the region via Project 1, and literature searches, and discussions with bee experts. Refinements to the methodology will occur in 2012 if the continuation of the project is deemed feasible. Therefore in 2011, this monitoring is considered a pilot project. The long-term validity of using this method on a regional basis in shrub-steppe will be evaluated at the end of the season.

Methods:

A detailed explanation of the methods utilized is included in attachment 2. The sampling period is from April through October, which coincides with early and late bee emergence. The basic survey technique utilizes nine 12 ounce cups of 3 colors (white, yellow, blue). The yellow and blue are painted with a specialized paint conducive to attracting pollinators. Cups are placed in alternating colors in a pin-wheel design (array) with 20 meter spacing between the center cup and each of the peripheral cups. Each peripheral cup is placed equidistant from each other along the arc of the circle. Cups are filled with non-toxic propylene glycol (which has had a small amount of soap added to break the surface tension) to capture the insects. The array is set in a relatively open stand of shrub-steppe, the plant composition representative of the refuge.

The array is set out as early in the season as weather allows. As bees may start emerging even when no flowers are evident and weather is cool, it is important to deploy the array as soon as possible. The array is set in relatively open shrub-steppe habitat, typically representative of the Refuge's overall shrub-steppe composition. Sagebrush is a desired component of the site. The array is checked at 2 week sampling intervals. The propylene glycol, unlike soapy water, acts as a preservative and therefore continual filtering of specimens is not needed. The sample from a single array (9 cups) is strained through a fine mesh net, rinsed with water, and placed in a whirl-pak bag. A label is placed inside the bag which includes a minimum of the date/time set, date/time picked up, refuge, location or array identifier, collector's initials or name. A solution of 70% ethyl alcohol (or isopropyl alcohol) is placed in the bag, just enough to cover the specimens.

Additional data collected should include: a GPS location for the center of each transect, and a basic habitat description (a more detailed habitat evaluation will be developed for 2012). Basic weather parameters are not required as the array operates continuously. Future evaluations based on weather will rely on regional data from a recognized weather station. Any unusual occurrences should be noted, such as bowls that are knocked over by wildlife or otherwise disturbed, abnormal weather activity, etc.

Samples are sent to the Branch of Refuge Biology, Vancouver, WA for processing (washing, drying, pinning, labeling, sorting) and preliminary identification. All data is currently entered into a database housed within the BRB. Selected specimens will be sent to a contractor for verification of BRB identifications, and for additional species identification.

There are 4 refuges committed to collecting bee faunal data within shrub-steppe in 2011. These include Turnbull NWR, McNary NWR, Malheur NWR, and Sheldon NWR. In addition, an additional site will be surveyed within the Baker City District (OR) of the Bureau of Land Management at the Oregon Trail Interpretive Center.

Budget:

Contractor: Dr. Robbin Thorp, Professor Emeritus, University of California-Davis ((($9600)

Miscellaneous Equipment and Supplies ($1500)

Baseline Bee Monitoring Protocol for

U.S. Fish and Wildlife Service, Region 1 Refuges

(Adapted from the USGS Native Bee Inventory and Monitoring Laboratory, Beltsville Agriculture Research Center)

USGS has a number of short videos explaining the various aspects of bee collecting. Pertinent to this protocol is the video on "Surveying bees using bee bowls". For those who are helping to process

specimens, please view the videos on washing, drying, pinning, gluing. I have a slightly different preference for gluing, which will facilitate identification and museum acceptance, which we can discuss. The Bee Monitoring YouTube Station is: http://www.youtube.com/user/swdroege

Selecting a Site for Baseline Bee Monitoring

The site selected should receive sun most of the day and therefore be in an open meadow, HQ lawn, other open area, an old roadway, or along a trail; sites should be without public use. An open site will collect more and generally a higher diversity of bees (flies and other insects). Along an edge habitat can be productive, as long as the bowls are in the sun most of the day. Depending on the habitat and site chosen, ground cover (grasses) may have to be removed periodically so that the bowls remain visible. This might be accomplished with a string trimmer or mowing a swath with a mower. For 2011, I would like 2 sites to be chosen per refuge and run them all season.

If you do not have assistance during part/all of the season, it would be best to choose sites that are easily accessible so you limit the time you spend in the field (if that is even a consideration). The actual process of setting bee bowls takes 10 minutes or less; pickup is 15-20 minutes depending on number of specimens. The bulk of your time is spent in transit; so again, pick locations that are conducive to you being able to run the transects every 2 weeks.

In 2012, we can target specific habitats or flowering species, if that is an interest to you.

General Procedure

Fifteen bowls (of 3 alternating colors) will be placed ~5-meters apart along a transect, so the transect will need to be a minimum of 75-100 meters long; a straight line is not essential. You should run 2 transects on a day. These same transects should be run every 2 weeks throughout the season (April-October) to get the best representation of your bee fauna. For these baseline surveys, my suggestion is that you choose two sunny sites within/near different habitat types and operate 2 transects on the same day. The approximate middle of the transect should be GPS'd for labeling and data purposes, and for future re-location of the site. You might want to stake the starting end of the transect for easy detection. Bowls should be placed out in early morning and can be picked up in late afternoon or the next day – note the beginning and end times for each transect.

Because the bee fauna can change quickly due to short flight times for some species, a transect should be run once every 2 weeks, avoiding potential poor weather. This is critical to get a good representation of the bee fauna. If you have the time/staff/volunteers, you are free to setup additional sites and run them on alternate days or weeks. Consistency in getting out bowls every 2 weeks will be the key for collecting good baseline data.

Preparation

1. Put one heavy squirt of dish washing liquid in 1 gallon jug of water (Blue Dawn is the

standard; others are fine as long as they are NOT citrus-based or scented). Any soap will do in a pinch

Setting Out Bowls – equipment needed: bee bowls, soapy water, GPS for first setting

1. Place the first bowl down (first color) at the beginning of the transect and fill with soapy water. Pace off approximately 5 meters and set down and fill a bowl of the 2nd color. Repeat for the third color. Set bowls out in 15 bowl transects, alternating blue, yellow, and white. Place bowls level on the ground.
2. Fill each bowl with soapy water about ¾ or more full
3. Bowls can be left out for the middle part of the day or for 24 hours
4. Avoid putting bowls in any heavy shade as few to no bees will come to those bowls
5. There does not have to be flowers nearby to have bees come to bowls as often there are bees scouting over flowerless areas and these individuals are highly attracted to bowls
6. For your first trial of the season, GPS the approximate middle of the transect.

Straining Bowls – equipment needed: small bucket or your soapy water jug, net, funnel, whirl-pak bag, ethyl or isopropyl alcohol

1. Strain insects from bowls by dumping water from bowls through the brine shrimp net; soapy water should be returned to the jug via the funnel or dumped into a small bucket until the transect pickup is complete, then returned to the jug, if the water is still clean.
2. After all bowls are strained, scoop out with a spoon or your fingers, put insects in whirlpak; fill enough to cover specimens with alcohol; using a squeeze bottle with alcohol works well. Any type of alcohol will do in a pinch. I usually pick up a small bottle at the pharmacy…it should be 70% or better. Best kind is ethanol (ethyl alcohol) but isopropyl alcohol will also work. Hardware store alcohol should be considered 100% alcohol and diluted to about 70%.
3. Add in with whirlpak a contents label written IN PENCIL on a piece of paper saying who collected, DATE (with month spelled out), location of transect. It would be useful to show where you collected on a map, but not absolutely critical.
4. Remove the air from the whirlpak with your fingers, then roll the top down to the level of the alcohol, bend the ends forward and twist the wires together. Tuck the ends of the wires in to the center of the bag so they don't poke other bags.
5. On an additional sheet of paper, write down the date (spelling out the month), county and state, refuge name, site name, transect # or other designation, collector's name, time bee bowls were set, time bee bowls were picked up. Make sure it is clearly written if bee bowls were left out overnight. Also indicate if any bowls were not used or contents spilled, etc.
6. We are working on a standard database for data entry and will distribute when ready. We would also like for you to describe the general habitat type of the transect and the surrounding area (within 100 meters).

Shipping

You can mail all specimens to Joe Engler in a padded envelope by regular mail or a small box. Be sure to put the specimens in several layers of zip locks so that nothing leaks out. Make sure there is only a small amount of alcohol and that the bags are rolled all the way down and tight. In other words, drain most of the alcohol out of the bags. Please indicate if specimens are in isopropyl or ethyl alcohol, as I may have to add alcohol once I receive them – and the 2 do not mix well. You can mail your samples every 2 weeks or once a month.

Specimen Issues or Considerations

Bee bowls generally work well for smaller insects, but not so much for bumble bees and/or carpenter bees, though they will catch them. Expect to catch a lot of flies and other miscellaneous insects. I will generally hold on to flies and wasps for future identification. I will usually try to identify Lepidoptera if there are any, but lepidoptera scales do not fair well after this ordeal so specimens are in bad shape and are discarded. Feel free to remove any of these non-bees yourself, dry and identify.

In some cases, you may catch a lot of insects. Remember that you are sampling a very small area and bee bowls are only attractive to cruising insects and do not draw them in from elsewhere. So there would be no population impacts. That said, be aware of two issues: 1) if you are catching 6 or more bumble bees in a day per transect and they appear to be the same species, you may be too close to a nesting site; 2) if you catch large numbers (dozens) of what appear to be a single species, you may be too close to an aggregate nesting site of solitary bees. If either of these occurs, please send me specimens ASAP and I will examine for genus/species identification and evaluate numbers. Look around the area and see if you can locate a nest site. Depending on the findings, we may want to discuss moving the transect. Again, these situations should not have any population level impacts even at a local level, but it is a real time-consuming exercise to have to process all of these redundant specimens. Our objective for this monitoring is to get genus/specimen level identifications, and some relative abundance data.

I will be making all identifications to the genus or species level when possible. Sometimes that is not possible for a variety of reasons including specimens are in poor shape, or there is simply no current available literature to a species level, some species are exceedingly difficult to ID to species even by experts, and my own lack of expertise. Ultimately, I hope to contract identifications out to individuals or universities, however this option is not setup yet or are the funds available.

Disposition of Specimens

I will keep a number of representative specimens for a synoptic collection here in the Vancouver Office. I can send excess specimens to refuges who wish to have their own collections; let me know. Otherwise, excess specimens will be sent to museums or universities.