Density, Distribution, & Habitat of American and Least Bitterns on Agassiz National Wildlife Refuge

Final Report

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Abstract- Line-transects were used to survey American bitterns (Botaurus lentiginosus) and least bitterns (Ixobrychus exilis) on Agassiz National Wildlife Refuge (NWR), Marshall County, Minnesota, May-July 1990. Agassiz Pool (12.7 mi^2) composed 35% of the transect area but accounted for 62% of the American bittern and 98% of the least bittern sightings. American bitterns selected burned emergent vegetation in May, and were sighted most frequently in pools that were reflooded after 1-3 years in drawdown. Density estimates for American and least bitterns were 68.0 $\pm$ 95% CI 12.4 and 119.2 $\pm$ 95% CI 33.2 birds/mi^2 emergent marsh respectively. June population estimates were 384 $\pm$ 95% CI 72 American bitterns and 310 $\pm$ 95% CI 86 least bitterns.

Because bitterns are secretive and difficult to see in emergent vegetation, information on population abundance is rarely obtained. American and least bitterns are among 30 nongame bird species in North America that have experienced population declines during the 1980's (Hands et. al. 1989). American bitterns are listed as a species of concern in Minnesota (Minn. DNR 1984). The status of both species on a state or regional level is unknown. In addition, little information exists on habitat preferences of bitterns in northern wetlands or the response of these species to wetland management practices (Hands et.al. 1989).

In this study, I estimated the population density of American and least bitterns and examined habitat variables that might influence their density and spatial distribution in a complex of wetlands managed for waterfowl production.

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STUDY AREA

Agassiz National Wildlife Refuge, 62,000 acres, is located 25 miles northeast of Thief River Falls, Minnesota. The refuge lies in the transition zone between northern coniferous-deciduous forest to the east, and tall grass prairie to the west. The topography is flat with a gradient of 1.5 feet/mile. The Thief and Mud Rivers traverse the refuge.

Approximately 40,000 acres of the refuge is classified as wetland. However, during May-July 1990 only 16,181 (40%) acres were flooded. The dominant emergent marsh vegetation is hybrid cattail (Typha glauca). Other marsh vegetation includes cane (Phragmites communis), hard and softstem bulrush (Scirpus spp.), and reed canary grass (Phalaris arundinacea). Expanses of willow (Salix spp.), dogwood (Cornus stolonifera), and blue-joint grass (Calamagrostis canadensis) occur on drier sites. The balance of the refuge is comprised of grasslands, deciduous forest, and bog swamp.

The primary management objective of the refuge is waterfowl production and maintenance. Eighteen impoundments ranging from 160 to 10,000 acres are independently managed to achieve optimum conditions for nesting, brood rearing, and migration. Techniques used to manipulate marsh vegetation include drawdowns, prescribed fire, and mechanical shearing. On April 21-23 1990, a wildfire burned 20,000 acres on the southeast portion of the refuge. This fire burned portions of the bittern survey routes in Pool 21 and Agassiz Pool.

METHODS

Thirty miles of survey transect was established in 11 pools (Figure 1). Among pools, transect length was relatively proportionate to the surface area of emergent marsh habitat. Within pools, transects were situated to sample

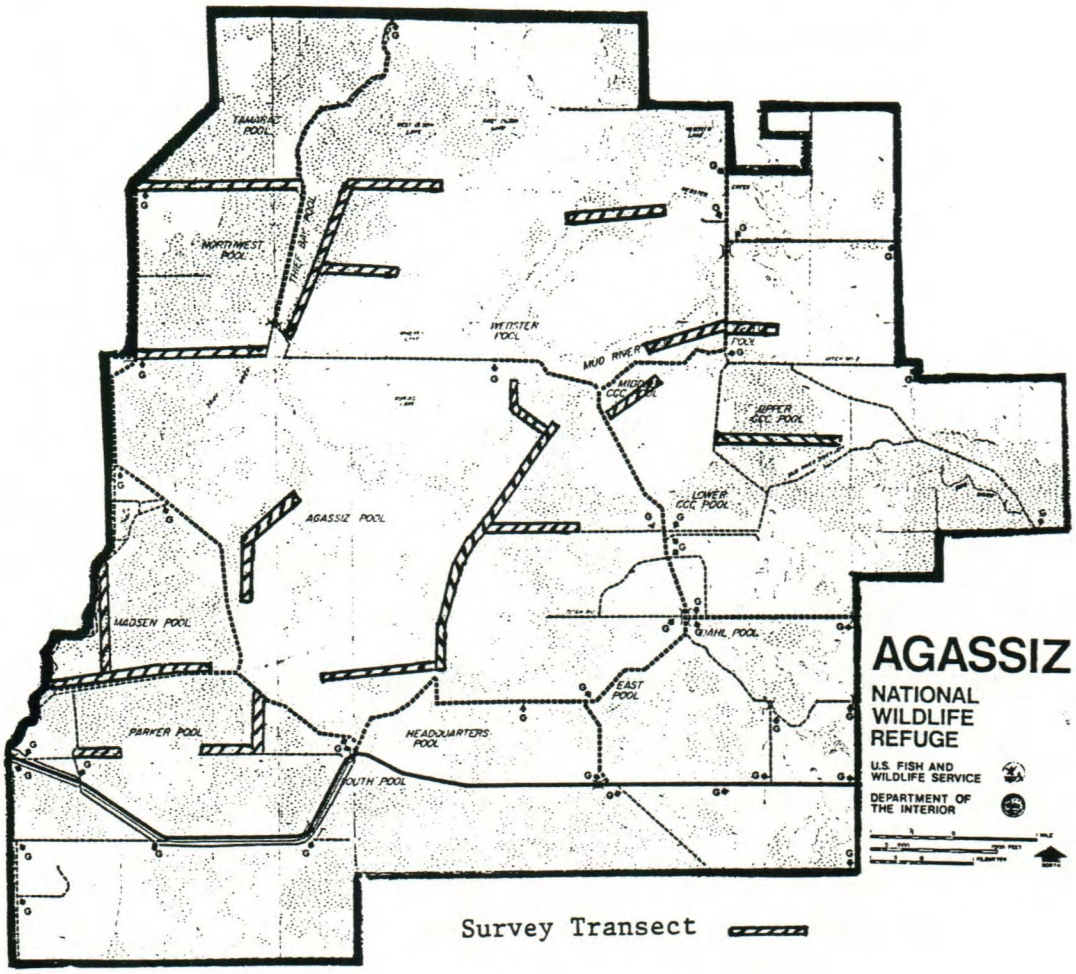


Figure 1. Location of bittern survey transects, Agassiz NWR, 1990.

representative emergent habitat. Unusable habitat, such as expanses of open water, occupied ≤ 10% of the area along transects. Seventy-eight percent of the emergent cover along transects was untreated, 19% burned, and 3% sheared (cut at ground level with a dozer). In Agassiz Pool we avoided placing transects near colonial gull, tern, and grebe colonies.

Transects were surveyed during daylight hours at 10-15 day intervals from 1 May to 31 July 1990. Two observers conducted the surveys using an airboat as described by Manci and Rusch (1989). Airboat speed was kept at 10 mph. Days with strong wind (>15 mph), rain, or fog were avoided. When a bittern was flushed, one observer recorded the species and perpendicular distance (in 1 foot increments) from the flush site to the center of the transect. The second observer marked the flush site with a wooden pole and plotted the flush site on a 1:10,000 scale aerial photograph.

On the return trip, a stop was made at each flush site to collect habitat information including water depth, emergent stem density, and plant species composition. Reference photographs were taken at a representative sample of the flush sites. Volume of emergent wetland vegetation was estimated from color aerial photographs taken in August 1990. Water levels in each pool were collected bi-monthly by refuge personnel and entered into an R-base program that computes surface acres and depth distribution in 1 foot gradients.

I used the computer program "TRANSECT" (Laake et. al. 1979) to analyze data and estimate density. Density estimates were based on surveys conducted while birds were territorial or nesting (15 May - 30 June). To increase sample sizes, results were pooled for all transects during the nesting season. If the same transect was surveyed more than once during this period, the highest estimate was used. Population estimates were based on bittern density

and available wetland habitat. Suitable water depth for American and least bitterns was based on means and ranges obtained during this study, and the literature on bittern ecology.

RESULTS

Distribution/Habitat Relationships- Forty-four American and 28 least bitterns were sighted on survey transects. All sightings were of individuals with the exception of one "group" of two least bitterns. Bitterns normally flushed in front of or perpendicular to the airboat and flew a short distance (<300 feet) before landing. Mean flush distances for American and least bitterns were 22 feet (r= 3-75 feet) and 12 feet (r= 0-45 feet) respectively. There was no difference ($P < 0.05$) in mean flush distance between burned, sheared, and untreated emergent habitat.

American bitterns were sighted in 6 of 11 pools surveyed (Table 1.). Least bitterns were only sighted in Agassiz Pool with the exception of one sighting in Madsen Pool. Agassiz Pool comprised 35% of the transect area but accounted for 62% of the American bittern and 97% of the least bittern

Table 1. Distribution of American and least bittern flushes among pools, Agassiz NWR, 1990.

Pool	Transect length (mi)	No. surveys	Mean number of bitterns flushed/mi transect	
			American	least
Middle CCC	0.5	3	0.90	0.00
Madsen	3.1	5	0.40	0.06
Northwest	1.5	5	0.33	0.00
Agassiz	10.5	8	0.27	0.34
Pool 21	3.0	5	0.16	0.00
Parker	3.0	4	0.08	0.00
Tamarack	2.5	4	0.00	0.00
Webster	1.1	3	0.00	0.00
Thief Bay	2.5	3	0.00	0.00
Upper Mud	1.0	4	0.00	0.00
Kelly	1.6	4	0.00	0.00
Totals	30.3	48	0.21	0.14

sightings. The fewest bitterns were sighted during the early May surveys. Sighting of both species increased during the third week of May and remained relatively constant through 31 July (Figure 2). In Agassiz Pool, bittern sightings peaked on 5 July.

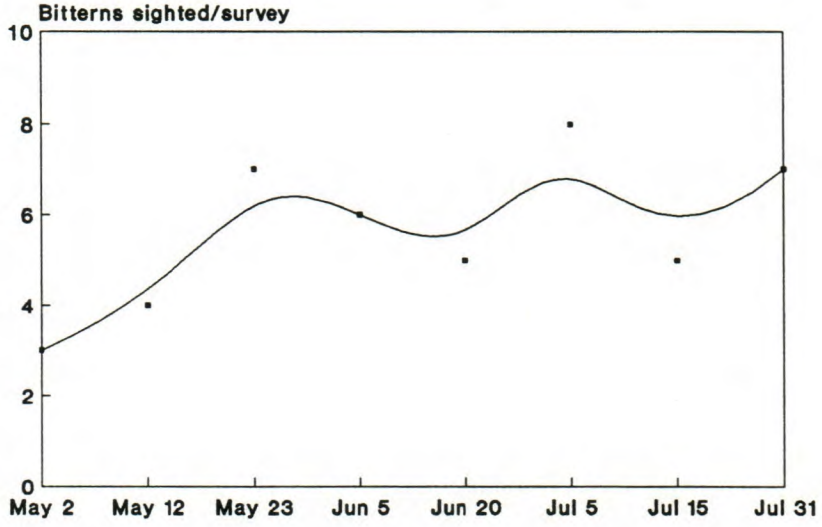


Figure 2. Monthly distribution of American and least bittern sightings, Agassiz Pool, 1990.

American bitterns were almost exclusively associated with emergent cover flooded with $\leq$ 12 inches of water, whereas least bitterns occurred primarily in emergent cover $\geq$ 24 inches deep (Table 2.). Vegetation density at least bittern flush sites was nearly twice that at American bittern flush sites. Both species occurred primarily in cattail, although this species was dominant throughout the study area. Basal stem density at flush sites in burned vs untreated emergent did not differ ($P < 0.05$). In most of the burned emergent, only the upper canopy of vegetation was removed by fire.

Table 2. Comparison of habitat parameters at American and least bittern flush sites, Agassiz NWR, 1990.

	Water depth (in.)		Vegetation density (stems/ft^2)		Composition of Vegetation (%)	
	mean	range	mean	range	cattail	other[1]
American (n=31)	5.9	0-14.0	10.2	0-21.0	90.3	9.7
least (n=20)	26.4	8.0-37.0	18.9	6.0-38.0	95.0	5.0

[1] Included Phragmites sp., bulrush, and Burreed.

Least bitterns were sighted entirely in untreated emergent vegetation. American bitterns were sighted in burned, sheared, and untreated emergents, but sighting frequencies varied among months. In May, the greatest number of American bittern flushes/mile transect occurred in burned emergent, followed by sheared and untreated emergent (Figure 3.). In June, sightings in untreated emergent increased 34% and declined in both burned and sheared emergent. In July, untreated emergent vegetation accounted for 2.2x as many American bittern sightings/mile transect as burned emergent, and no bitterns were flushed in sheared emergent.

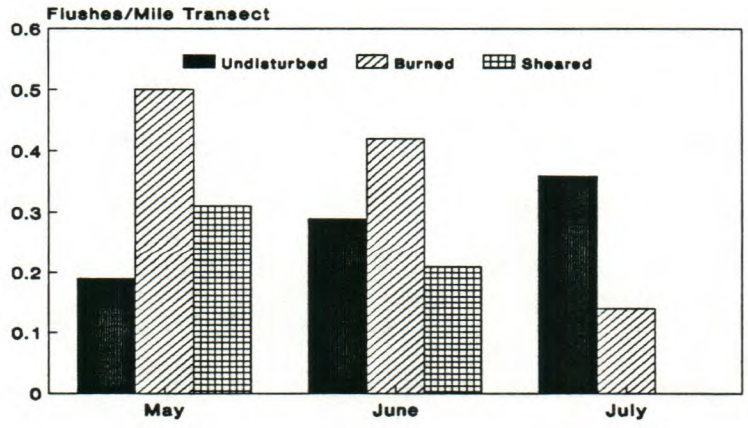


Figure 3. Distribution of American bittern flushes among burned, sheared, and untreated emergent cover, Agassiz NWR, 1990.

Although no deliberate effort was made to search for nests, one least bittern nest was discovered within 30 feet of a survey transect in Agassiz Pool. The nest was constructed in cattail 40 feet from the nearest open water. Water depth at the nest was 23 inches. It contained 6 eggs and all successfully hatched.

Density/Population Estimates- Density estimates for American and least bitterns were 68.0 ± 95% CI 12.4 and 119.2 ± 95% CI 33.2 birds/mi^2 emergent marsh respectively. American bittern density in Agassiz Pool (63.2 ± 95% CI 12.5) was lower than in the smaller pools (84.2 ± 95% CI 16.8). Sample sizes were too small to compare density among the smaller pools.

Available habitat, based on 15 June 1990 water levels and emergent cover (Table 3), for American and least bitterns was estimated at 5.8 and 2.6 mi^2 respectively. American bittern habitat was defined as all flooded surface area <1 foot deep. All pools containing emergent cover in this depth class were included regardless of whether bitterns were sighted during surveys. Due to low water levels in 1990, only Agassiz Pool contained emergent cover in the 2-3 foot depth class. In most of the smaller pools, water depths > 2 feet occurred only in the ditches. Available least bittern habitat included 100% of the 2-3 foot depth class and 50% of the 1-2 foot depth class in Agassiz Pool. The breeding season (June) population estimate was 394 ± 95% CI 72 American bitterns and 310 ± 95% CI 86 least bitterns.

Table 3. Emergent cover, surface acres, and water depth distribution in Agassiz NWR pools, 15 June 1990.

Pool	Surface Acres	Depth (feet) <1	1-2	2-3	3-4	>4
Agassiz	7707	2514	2393	2800	0	0
Headquarters	736	117	619	0	0	0
Kelly	380	171	155	48	5	0
Lower CCC	372	128	142	101	0	0
Madsen	1576	919	540	116	0	0
Middle CCC	62	62	0	0	0	0
Mud River	170	27	75	53	14	0
Northwest	738	738	0	0	0	0
Parker	740	560	120	60	0	0
Pool 21	754	87	666	0	0	0
South	279	179	99	0	0	0
Tamarack	751	397	217	105	32	0
Thief Bay	915	395	310	208	0	0
Webster	550	170	131	124	105	18
Totals	15730	6464	5467	3615	156	18
Percent		40	34	22	1	0
Emergent cover (%)		62	30	8	0	0

DISCUSSION

Line-transect sampling from an airboat was an effective method for surveying bitterns on Agassiz NWR. Because of the short flushing distances, few problems were encountered with species identification or distance estimation. Unlike rails (Smith 1987), American and least bitterns did not run prior to flushing. I was initially concerned that repeated airboat travel on the transects would flatten the emergent vegetation and create an artificial break in the cover that bitterns might either avoid or seek. This was not a problem in cattail flooded with $\geq$ 4 inches of water if the transect was traveled only twice/month and if the return trip was made using an alternate route. The importance of establishing transect routes before the growing season, when surface and subsurface obstacles such as iron posts and rocks can be clearly seen and avoided, cannot be overemphasized.

Distribution- American and least bitterns were distributed unevenly among pools and distribution was directly related to water levels. Bitterns occurred in pools that supported flooded emergent vegetation within the range of preference for each species. Least bitterns, require deeply flooded emergent marsh habitats (Weller 1961, Weller and Spatcher 1965), and were only sighted in Agassiz Pool. During June 1990 pool levels were 29% below the previous 9-year average and 38% below the desired capacity (Figure 4). Pool 21, Parker, Thief Bay, South, and Northwest Pools were ≥ 41% below average and 65% below desired capacity (Agassiz NWR records).

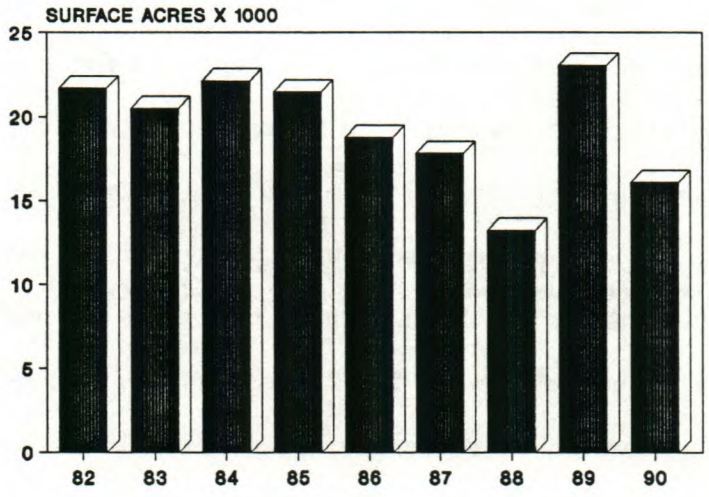


Figure 4. Water levels on Agassiz NWR during mid-June 1982-90.

During normal or high water levels least bitterns probably have a much wider distribution. In 1982, refuge personnel sighted 1 or more least bitterns in Pool 21, Tamarack, Headquarters, and Middle CCC Pools (Agassiz NWR, unpubl. records). Water levels in most pools during June 1982 were at approved capacity and averaged 1.4 feet above June 1990 levels (Agassiz NWR, 1983 Ann. Water Plan). Random observations of bitterns by myself and other researchers during 1990 closely agree with transect survey results. In

conjunction with another research project, airboats were used to systematically search for canvasback (Aythya valisineria) nests in Lower CCC, Headquarters, Mud River, and 10 of the 11 bittern survey pools. During nest searching in May and June, American bitterns were only sighted in Northwest, Madsen, and Middle CCC Pools, and a least bittern was sighted in Madsen Pool.

Small wetland basins, such as Olson Lakes, Webster Lake, and Dahl Pool, are not included in the surface acre total (Table 3.). Although these basins were either dry or filled to <25% capacity in 1990, they probably support American bitterns during higher water levels.

Habitat- The composition and density of vegetation used by least bitterns at Agassiz NWR was similar to that reported for other regions but water depths were slightly greater. In Missouri, Reid (1989) found least bitterns in vegetation averaging 29 stems/ft^2 and water 3-17 inches deep, and in Iowa, Weller (1961) reported a mean water depth of 21 inches at nest sites.

Least bitterns can attain high nesting densities (1 nest/2 acres) in pockets of optimal habitat (Kent 1951, Ziebell 1990), but more frequently nests are evenly spaced in suitable habitat (Weller 1961). In Agassiz Pool, most least bittern sightings occurred in several 10-40 acre stands of cattail in the south-central and east-central regions of the pool. These stands were interspersed with openings and surrounded by open water.

Habitat characteristics at American bittern flush sites were very similar to those reported in southern Minnesota by Hanowski and Niemi (1986). They found a mean water depth of 4.0 inches and mean vegetation density of 10.9 stems/ft^2 at American bittern breeding sites. In Missouri, Reid (1989) flushed American bitterns at sites with a mean water depth of 10.2 inches and mean stem density of 14.6 stems/ft^2.

All least bitterns were sighted in untreated emergent habitat. This is

not surprising because all of the burned and sheared emergent habitat was in the ≤ 1 foot depth class. Although I did not directly measure habitat preference, sighting frequencies (flushes/mile transect) suggested that American bitterns were selecting burned and sheared emergent over untreated emergent during May. The absence of residual cover may have enhanced food resources and foraging conditions. In northern wetlands, burning promotes higher spring productivity through the release of nutrients and the tendency for the substrate to warm up quickly (Weller 1981, Mallik and Wein 1986). A decline in the use of burned and sheared emergent in July may have been related to the loss of surface water from these areas. Reid et.al.(1989) found that bitterns used shorter and less dense vegetation in spring than in fall.

Although Verner (1981) warns that line transect data generally does not yield sufficient numbers of observations to assess the effects of management, my results suggest that American bitterns are selecting pools that are actively managed. No bitterns were flushed from dense matted stands of old residual cattail that characterized most of the transects in Kelly, Tamarack, Thief Bay, and Parker Pools. In contrast, American bitterns were most consistently sighted in pools where all or a portion of the pool had received some form of vegetation or water level manipulation during the past 3 years. Middle CCC, Madsen, and Northwest Pools were reflooded in 1990 after 1 or more years in drawdown (Agassiz NWR, 1989 Ann. Water Plan). Cattail in portions of Madsen Pool were sheared and burned during drawdown in 1988 and again during the winter of 1989-90. Northwest Pool was treated with prescribed fire in fall 1989 and Pool 21 was burned by the April 1990 wild fire. The presence of young (< 2 years old) cattail stands was common in each of the pools that had been in recent drawdown. Bitterns prefer pioneering stands of cattail and

other emergents (Weller and Spatcher 1965, Reid 1989). Both burning and shearing create openings in dense cattail and may provide interspersion and "edge" habitat that American bitterns seek.

Agassiz Pool contains a range of water depths and a diversity of emergent cover types that is uncommon in the other pools. Although water depths throughout much of the pool exceed the preference range of American bitterns at elevations above 1139, ridges and islands of peat support broad transition zones of emergent vegetation. Sightings of American and least bitterns were closely associated with these shallow regions.

Weller and Spatcher (1965) found that both species of bitterns avoid floating cattail and seek rooted emergents that offer firm support for nests. In this study, no bitterns were flushed along transects that traversed floating clumps of cattail. This condition was most common on the transect in northern Webster Pool.

Density/Population Estimates- Due to the tendency for American bitterns to use upland habitats (Duebbert and Lokemoen 1977, Hancock and Kushlan 1984), I may have underestimated the population of this species. American bitterns commonly flushed from dry sites (primarily ditch spoil banks) but none of the transects sampled continuous expanses of upland habitat. However, upland habitat use by bittern at Agassiz NWR may be minimal because unlike grasslands used by bitterns in North Dakota (Duebbert and Lokemoen 1977), the drier portions of most wetland basins at Agassiz support dense stands of Phragmites and willow.

Little information exists on the density or relative abundance of bitterns due to their secretive nature and reluctance to flush from heavy cover. In Missouri, Smith (1987) flushed 0.12 American and 2.12 least bitterns mile/transect in emergent marsh during the breeding season. At

Horicon NWR, Wisconsin, Manci and Rusch (1988) used call counts to estimate density of American bitterns (410 birds/mi^2 emergent marsh) and least bitterns (410 birds/mi^2 emergent marsh). Their density estimates were 6.6 and 3.5x greater than those at Agassiz for American and least bitterns respectively. However, density estimates developed by Manci and Rusch (1988:7) are based on small sample sizes (9 American & 7 least bitterns) and may be biased by the observers ability to reliably estimate distances to calling birds.

Because bitterns are strongly influenced by water-cover interactions, consecutive annual surveys are needed to assess local breeding populations. Drought conditions this year may have either concentrated bitterns or displaced them to more favorable habitat off the refuge.

Although detectability (conditions for sighting bitterns) changed monthly as vegetation increased in height and density, flushing rates for both species remained relatively constant. This suggests that line-transect surveys by airboat conducted over short periods can yield representative density estimates for American and least bitterns. In large (> 1,000 acre) wetlands dominated by cattail or other robust emergents, surveys from airboats may be the only practical means to obtain unbiased estimates of density for bitterns or other secretive species.

Literature Cited

Duebbert, H.F., and J.T. Lokemoen. 1977. Upland nesting of American bitterns, marsh hawks, and short-eared owls. Prairie Nat. 9:33-39.

Hancock, J., and J.A. Kushlan. 1984. The herons handbook. Harper and Row, New York, N.Y. 288pp.

Hands, H.M., R.D. Drobney and M.R. Ryan. 1989. Status of the least bittern in the northcentral U.S. Unpubl. Rept. to USFWS, Mi Coop Fish & Wildl Res Unit. Columbia, Mi. 13pp.

Hanowski, J.M. and G.J. Niemi. 1986. Habitat characteristics for bird species of special concern. Unpubl. Rept. to Minnesota Dept. of Nat.

Res., St. Paul. 50pp.

Kent, T. 1951. The least bitterns of Swan Lake. Iowa Bird Life 21:59-61.

Laake, J.L., K.P. Burnham and D.R. Anderson. 1979. Users manual for program TRANSECT. Utah State Univ. Press, Logan. 69pp.

Mallik, A.V., and R.W. Wein. 1986. Response of a Typha marsh community to draining, flooding, and seasonal burning. Can. J. Bot. 64:2136-2143.

Manci, K.M. and D.H. Rusch. 1989. Surveying waterbirds from airboats at Horicon Marsh. Pass. Pigeon 51:145-153.

_____ 1988. Indices to distribution and abundance of some inconspicuous waterbirds on Horicon Marsh. J. Field Ornithol. 59:67-75

Minnesota Department of Natural Resources. 1984. Checklist of endangered & threatened animal & plant species of Minnesota. Minn. DNR, St. Paul. 23pp.

Reid, F.A., M.S. Kaiser and L.H. Fredrickson. 1989 (unpubl.). Differential habitat use of seasonally flooded wetlands by migrant rails and bitterns. 51st Midwest Fish & Wildl. Conf., Springfield, Ill.

Reid, F.A. 1989. Differential habitat use by waterbirds in a managed wetland complex. Ph.D. Thesis, Univ. Missouri, Columbia.

Smith, J.W. 1987. Wetland ecology studies in north Missouri. Federal Aid Project No. W-13-R-40 (1986). Missouri Dept. of Consv.

Verner, J. 1981. Measuring responses of avian communities to habitat manipulation. Stud. Avian Biol. 6:543-547.

Weller, M.W. 1961. Breeding biology of the least bittern. Wilson Bull. 73:11-35.

Weller, M.W. 1981. Freshwater marshes: ecology and wildlife management. University of Minnesota Press, Minneapolis, MN. 146pp.

Weller, M.W. and C.S. Spatcher. 1965. Role of habitat in the distribution and abundance of marsh birds. Agric. and Home Econc. Exp. Stn. Spec. Rep. 43, Iowa State Univ., Ames. 31pp.

Ziebell, T.J. 1990. Nesting least bitterns on Rush Lake, Wisconsin. 52:19-28.