Population Composition and Perching Habitat of Wintering Bald Eagles, *Haliaeetus leucocephalus*, in Northcentral Michigan

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From 15 November 1989 to 15 February 1990, biweekly aerial surveys of the Au Sable, Manistee, and Muskegon rivers, Michigan, detected 54 adult and 33 immature Bald Eagles (*Haliaeetus leucocephalus*) with a high of 19 between 1-15 January. Adults peaked prior to immatures and appeared to leave earlier. Thirteen deciduous and four coniferous species were identifed among 55 perch trees. Adults perched nearly equally in coniferous (43%) and deciduous trees (57%), whereas immatures used mostly deciduous perches (85%, $P = 0.034$). Coniferous perches were taller (23.2 m vs. 18.9 m, $P = 0.029$), in denser stands (577.6 stems/ha vs. 408.9, $P = 0.017$) and on terrain that had a greater mean slope (40.6% vs. 19.9%, $P = 0.008$) than deciduous trees. Perch DBH was greater than both nearest-tallest DBH ($P = 0.003$) and surrounding stand DBH ($P < 0.001$). Distance from perch trees to potential human disturbance varied with tree type, between structures and roadways, and was greatest on the more densely populated Muskegon River.

Key Words: Bald Eagle, *Haliaeetus leucocephalus*, winter, habitat, perching, population, Michigan.

Bald Eagle, *Haliaeetus leucocephalus*, numbers on wintering grounds are governed by food availability, habitat suitability, and proximity of human disturbance (Vian and Bliese 1974; Stalmaster and Newman 1978). Although wintering eagles have been recorded along the Au Sable, Manistee, and Muskegon rivers in the northern lower peninsula of Michigan (National Wildlife Federation 1984, 1988; Figure 1), details of population size and factors influencing it were unknown. The purpose of this study was to determine the numbers and age composition of Bald Eagles wintering on these rivers and describe the associated perching habitat.

Study Area

Within the study area defined by the three rivers (Figure 1), terrain was flat to rolling with occasional hills and an elevational range of 200 to 400 m. Vegetation was predominantly continuous mixed-forest, consisting of White (*Pinus strobus*), Red (*P. resinosa*), and Jack Pine (*P. banksiana*), aspens (*Populus grandidentata* and *P. tremuloides*), oaks (*Quercus rubra* and *Q. nigra*), maples (*Acer rubrum* and *A. saccharum*), and White Birch (*Betula papyrifera*). The area was rural and sparsely populated but supported year-round recreational activity.

Methods

A pilot and two observers conducted surveys every two weeks from 15 November 1989 through 15 February 1990, with a Cessna 172* fixed-wing aircraft flown 60-150 m above ground level at 130-190 km/hr. Each river was flown once during a survey period, and the east-west direction of travel was reversed every survey. The three rivers were flown on as nearly consecutive days as weather and scheduling would permit. We flew directly over the rivers to permit simultaneous viewing of both shorelines, and just offshore along the perimeter of the 11 included hydroelectric reservoirs. During aerial surveys, eagles were classified as adults (≥ 4 years old) or immatures (< 4 years) by plumage characteristics (McCollough 1989). Eagle perch locations were plotted on United States Geological Service 7.5 minute quadrangle maps. Each perch area was also photographed to facilitate relocation on the ground.

Within three weeks of the flights we measured perch trees to determine species, crown class (dominance or codominance in relation to surrounding trees), diameter at breast height (DBH, cm), and height (m). Tree height was measured with clinometer or altimeter. Percent slope of the perch substrate was also determined with clinometer when slope exceeded

*Use of trade names does not imply endorsement by the USDA Forest Service or Michigan State University to the exclusion of other potentially suitable products or services.

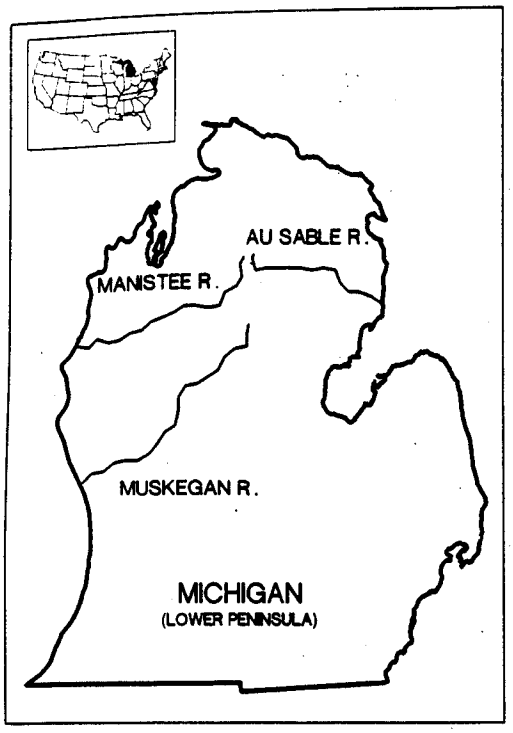

FIGURE 1. Location of the Au Sable, Manistee, and Muskegon rivers in the northern lower peninsula of Michigan.

10%. DBH was measured with a standard DBH tape. Distances from perches to potential disturbance by humans, defined as roadways (primary roads, secondary roads, snowmobile trails) or structures (buildings, power plants, transmission lines) were measured with a 33 m tape or calculated from maps.

We characterized perch surroundings through measurements of two additional habitat features. We recorded DBH and height of the nearest-tallest tree to compare perch trees with potential alternate perches (Chester et al. 1990). To characterize the perch stand, a 132-m^2 area was centered on each perch tree with the point-centered quarter method (Cottam and Curtis 1956) and the DBH's of trees $\geq$ 10.16 cm within this area were recorded for calculating mean DBH and stand density.

Statistical analyses were performed using SPSS/PC+ Version 4.0 (Norusis/SPSS Inc. 1990a-b). We tested quantitative data (DBHs, heights, distances, and densities) for normality with the Kolmogorov-Smirnov one sample test, and then used either parametric t-test's and ANOVA, or nonparametric binomial, Mann-Whitney *U* and Kruskall-Wallis' tests for further analyses, as appropriate. We also used crosstabulation summaries with Chi-square tests among variables to evaluate patterns or non-random distributions.

Results

Numbers and Age Composition

Between 15 November and 15 February we recorded 87 Bald Eagles (54 adults and 33 immatures, Figure 2): 28 on the Au Sable River (19,9), 31 on the Manistee (21,10), and 28 on the Muskegon (14,14). The overall ratio of adults to immatures was 1.6:1, but varied among rivers with the two northern rivers, Au Sable and Manistee, being 2.1:1 and the Muskegon, 1:1. Adults equalled or outnumbered immatures in all but the final survey period. The greatest number of eagles (19) was observed between 1-15 January. Adult peaks (11) were during 1-15 December and 16-31 January and preceded the peaks for immatures (9) during 1-15 January and 1-15 February. On the Au Sable River, adults were present throughout the study period, while immatures were absent during two survey periods. Adults outnumbered immatures on the Manistee River on all but the last survey; whereas on the Muskegon, immatures equalled or outnumbered adults on all but the second survey.

Perching Habitat

In measuring the 55 perch trees recorded during our surveys (Table 1), we identified 13 deciduous and four coniferous species (Table 2). Deciduous trees were used twice as frequently as coniferous trees ($P = 0.015$). However, coniferous perch trees were taller (23.2 m vs. 18.9 m, $P = 0.029$), in denser stands (577.6 stems/ha vs. 408.9, $P = 0.017$) and on terrain that had a greater mean slope (40.6% vs. 19.9%, $P = 0.008$) than deciduous trees. Coniferous perches were also less variable in height with a coefficient of variation (s.d./mean X 100%) of 27.4% versus 35.7%. The proportion of coniferous and deciduous perches was similar between crown classes: dominant (37% and 63% respectively); codominant (31% and 69%, $P = 0.639$). Although the frequencies of coniferous perches and dominant crowns were nearly identical, only about a third of the conifers were dominant.

Adults perched nearly equally in coniferous (43%) and deciduous trees (57%), whereas immatures used mostly deciduous perches (85%, $P = 0.034$). We found no difference in crown class ($P = 0.958$) or stand density ($P = 0.860$) among perches used by adult and immature eagles. However, adult perch trees were taller (21.8 m vs. 17.7 m, $P = 0.036$) and on greater slopes (31.6% vs. 17.9%, $P = 0.046$) than immatures. There was no overall age class preference for perch species ($P = 0.467$), but of the 14 observations of *Pinus strobus* only one was of an immature.

The distribution of perch use among recorded species was not random ($P < 0.001$). The two most

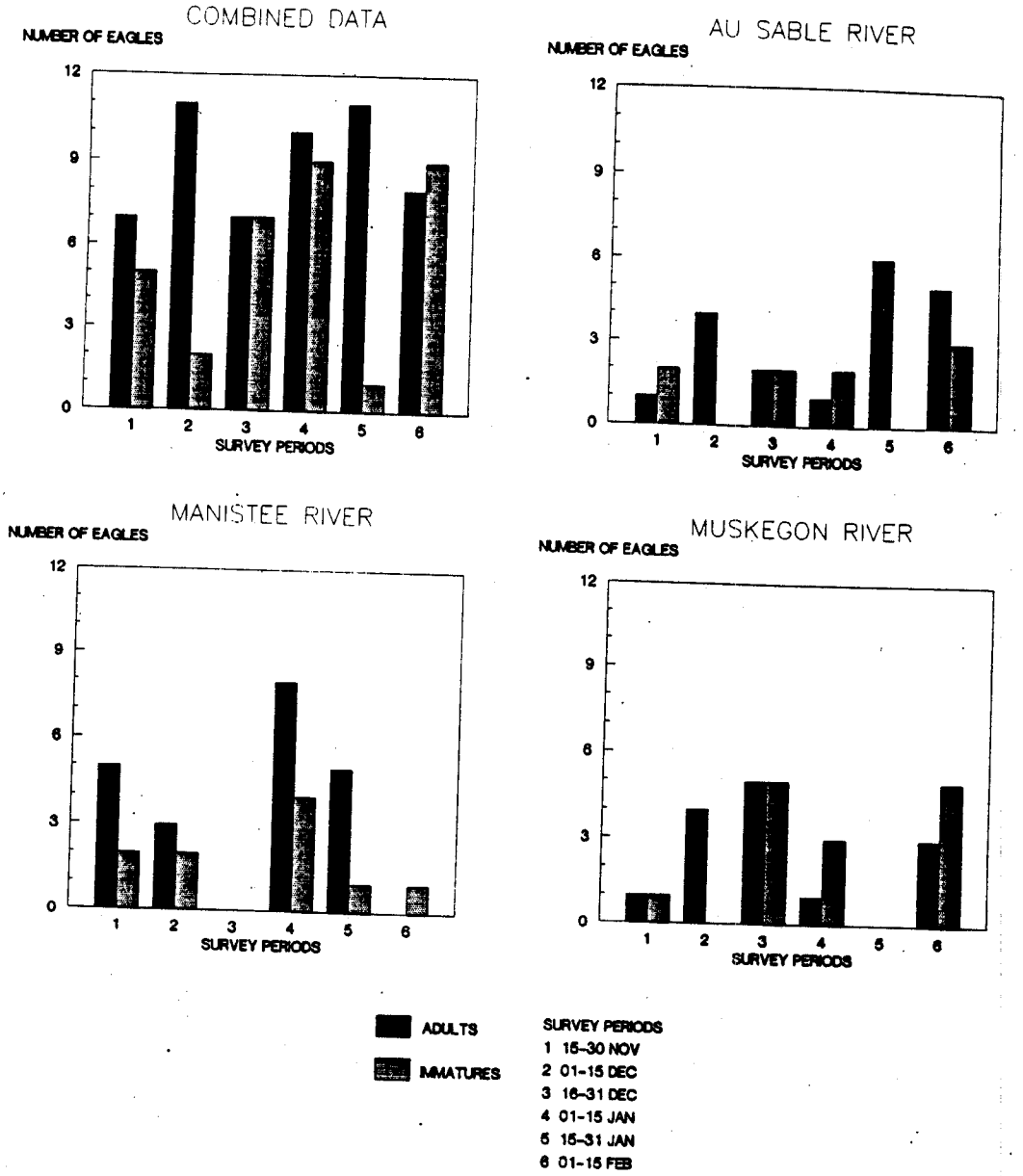

Figure 2. Summary of Bald Eagle numbers and age composition along the Au Sable, Manistee, and Muskegon rivers in northern Michigan, 15 November 1989 to 15 February 1990.

frequently used species were *Pinus strobus* and *Acer rubrum* (Table 2), which collectively were taller ($P = 0.043$) and had greater DBH ($P = 0.021$) than the remaining perch species; crown class ($P = 0.730$) and stand density did not vary ($P = 0.077$). Heights of the nearest-tallest trees, which averaged 5.5 m (s.d. = 3.5) from perches, were comparable to perch tree heights ($P = 0.815$). However, perch DBH was greater than both nearest-tallest DBH ($P = 0.003$) and surrounding stand DBH ($P < 0.001$). Nearest-tallest DBH was also greater than surrounding stand DBH ($P < 0.001$). Only tree type and crown class varied among rivers. The percent of deciduous perch tree use

TABLE 1. Habitat features of perch trees used by wintering Bald Eagles along the Au Sable, Manistee, and Muskegon rivers in northcentral Michigan, 15 November 1989 to 15 February 1990. (Data are presented as number of trees or mean measurements with standard deviations in parentheses.)

Habitat Feature	Au Sable River	Manistee River	Muskegon River	Totals
Total Perch Trees	14	22	19	55
Eagle Use				
Adults only	10	13	11	34
Immatures only	4	9	6	19
Both adults and immatures	0	0	2	2
General Features				
Tree species (number)	8	9	8	17
Coniferous trees	8	8	2	18
Deciduous trees	6	14	17	37
Dominant crowns	8	8	3	19
Codominant crowns	6	14	16	36
Perch Tree Measures				
DBH (cm)	48.8 (20.2)	39.2 (13.1)	54.1 (29.3)	46.8 (22.2)
Height (m)	21.4 (7.9)	18.4 (5.8)	21.8 (7.0)	20.3 (6.9)
Nearest-Tallest Tree				
DBH (cm)	36.1 (10.2)	33.4 (8.8)	43.7 (21.9)	37.6 (15.4)
Height (m)	18.2 (4.9)	19.9 (4.1)	22.9 (8.1)	20.5 (6.1)
Stand				
DBH (cm)	25.1 (7.2)	22.1 (7.0)	29.5 (11.7)	25.4 (9.4)
Density (stems/ha)	527.6 (310.2)	460.4 (269.4)	421.6 (224.2)	464.1 (264.2)
% Slope				
Mean	45	56	38	50
S.D.	(9.6)	(16.7)	(18.7)	(16.7)
N > 10%	9	19	4	32

increased across the Au Sable (42.9), Manistee (63.6), and Muskegon rivers (89.5, $P = 0.013$). The percent of codominant perch trees followed a similar pattern (42.9, 63.6, and 84.2, respectively; $P = 0.052$).

Distance from perch trees to potential human disturbance varied between structures and roadways, and with tree type. Deciduous perch trees were farther from human activity than conifers (655.0 m vs. 353.5 m, $P = 0.042$). Perches in the vicinity of structures were farther away (752.9 m vs. 455.2 m, $P = 0.026$) and in taller trees (22.4 m vs. 19.5 m, $P = 0.029$) than perches near roadways. Perches on the Muskegon River, a river more densely populated by humans, were almost twice as far from potential human disturbances than those along the Manistee (912.7 vs. 508.3 m, $P < 0.001$), and almost seven times farther than those on the sparsely populated Au Sable (132.4 m, $P < 0.001$). Roadways were the predominant human activity along the Au Sable and Manistee rivers, while along the Muskegon structures were the most frequent activity ($P < 0.001$).

Discussion

Numbers and Age Composition

The high proportion of adults, along with the timing of changes in population composition, are consistent with other studies in the Midwest which indicate immatures migrate earlier and travel further south than adults (Southern 1963, 1964; Sprunt and Ligas 1966). At wintering areas along the Mississippi River adults peak between mid-December and early-February, prior to leaving by mid-February; immatures typically peak after the adults and migrate later (Southern 1964; Vian and Bliese 1974). Immatures also exploit readily available food and often rely on different food sources than adults (Servheen 1975; Stalmaster and Newman 1978; Griffin and Baskett 1985). This would explain the greater proportion of immatures on the Muskegon River where eagles feed on mer-

TABLE 2. Perch tree species used by wintering Bald Eagles along the Au Sable, Manistee, and Muskegon rivers in north-central Michigan, 15 November 1989 to 15 February 1990. (Data are presented as number of trees or mean measurements with standard deviations in parentheses.)

Species	DBH (cm)	Height (m)	N	AuS R.	Man R.	Mus R.
Pinus strobus	50.6 (13.7)	25.3 (5.8)	14	5	7	2
Acer rubrum	52.5 (23.7)	18.0 (6.6)	8	0	1	7
Quercus alba	31.7 (9.9)	15.8 (6.2)	5	0	3	2
Acer saccharinum	54.8 (21.0)	23.2 (1.8)	4	0	0	4
Betula papyrifera	35.5 (8.0)	12.3 (2.6)	4	1	3	0
Populus spp.	30.2 (13.2)	17.3 (6.0)	4	0	4	0
Quercus rubra	46.5 (3.3)	18.2 (1.7)	3	2	1	0
Acer saccharum	27.2 (17.1)	16.8 (0.5)	2	1	1	0
Pinus resinosa	41.5 (0.0)	17.0 (0.9)	2	2	0	0
Populus deltoides	39.7 (0.1)	17.7 (3.0)	2	1	0	1
Acer negundo	50.8	19.9	1	0	0	1
Fraxinus spp.	34.6	22.6	1	0	0	1
Pinus banksiana	32.0	15.2	1	1	0	0
Robinia pseudoacacia	147.0	40.0	1	0	0	1
Tilia americana	49.0	25.2	1	0	1	0
Tsuga canadensis	37.8	15.5	1	0	1	0
Ulmus americana	99.1	32.9	1	1	0	0

gansers, *Mergus spp.*, Gizzard Shad, *Dorosoma cepedianum*, and Herring Gulls, *Larus argentatus*, at Muskegon Lake and on winter concentrations of waterfowl at the Muskegon State Game Area.

Perching Habitat

The patterns of habitat use we recorded may be as much a function of habitat availability as an indication of wintering Bald Eagle perch selection. The scope of this study did not permit an analysis of random sites for a statistical comparison of selected versus available habitat. However, our data are sufficient to characterize typical winter perching habitat along the Au Sable, Manistee, and Muskegon rivers, and in addition, to at least partially differentiate perch characteristics among age classes and the three rivers. Our results are consistent with the well documented tendency for Bald Eagles throughout their range to seek the highest available perches (Stalmaster and Newman 1979; Gerrard et al. 1980, Steenhof et al. 1980). Chester et al. (1990) also observed a higher proportion of daytime winter perching in leafless hardwoods than in pines and concurred with Stalmaster and Gessaman (1984) that this may be related to less obstructed flight paths, greater range of vision, and possible thermoregulatory advantage from solar radiation. The differences in distance to disturbance among rivers appeared inversely related to population density but may also have been influenced by the type of disturbance (structure vs. roadway) with its associated level of human activity (Grubb and King 1991).

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