

WINTER MICROCLIMATE OF BALD EAGLE ROOSTS ON THE NORTHERN CHESAPEAKE BAY

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ABSTRACT.—From 11 November 1988 to 1 April 1989, we studied the microclimate and nightly energy budgets at three separate Bald Eagle (*Haliaeetus leucocephalus*) communal roost sites; one used in winter, one used in summer, and another used year-round. We compared the roost sites with the microclimate and nightly energy budgets at randomly selected inland forested sites and eagle shoreline perch sites on the northern Chesapeake Bay. Mean and minimum air temperatures were similar among all sites. Mean and maximum wind speeds were greater at the shore than at other sites. Wind speed did not differ between roosts and inland sites. Among roost sites, mean and maximum wind speeds were lowest at the winter roost. The year-round roost and summer-roost winds did not differ. Mean net radiation was greater at inland sites than at the shore sites, whereas mean net radiation of roost and inland and of roost and shore sites did not differ. Minimum net radiation was greatest at inland sites, whereas roost and shore minimum net radiation did not differ. We calculated that roosting eagles would have expended 205.9 kcal per night at traditional roost sites, 206.6 kcal per night at shoreline perches, and 203.7 kcal per night at inland sites. Calculated energy expended on the 10 coldest nights was similar among roost, shoreline, and inland sites. Adding the estimated cost of transport from shoreline perches to roosts (\bar{x} = 5.3 kcal/round trip) did not produce significant differences in nightly energy expenditure between eagles roosting in communal roosts vs. those roosting on the shore. Received 7 June 1990, accepted 10 January 1991.

PASSERINE birds may experience thermal stress during cold winter nights (King 1972), which sometimes results in significant mortality (Odum and Pitelka 1939). Consequently, specific patterns of habitat use may reduce thermoregulatory costs (Walsberg 1983, 1985, 1986). In contrast, cold stress may be less important in the survival of larger-bodied birds, including raptors such as the Bald Eagle (*Haliaeetus leucocephalus*; Newton 1979: 212). Hayes and Gessaman (1980) were unable to induce cold stress in Red-tailed Hawks (*Buteo jamaicensis*) and Golden Eagles (*Aquila chrysaetos*) with microclimatic conditions that exceeded average conditions at many Bald Eagle wintering areas in the coterminous United States (-17°C , 13.47 m/s wind, and 0.0 W/m² net radiation). Reports of cold-induced mortality in Bald Eagles are anecdotal and come from the northernmost extremes of the eagle's range (Sherrod et al. 1976). Moreover, two previous studies differed on the im-

portance of roost-site selection to energy budgets in eagles. Stalmaster and Gessaman (1984) reported that eagles in Washington State saved energy by roosting in protected inland conifers rather than in deciduous trees adjacent to foraging areas. In contrast, Keister et al. (1985) concluded that energy savings at communal roost sites in the Klamath Basin, Oregon, did not offset the cost of flying > 10 km between roost sites and foraging areas. In both cases, eagles in coniferous roost sites had lower nightly heat budgets than if they roosted at more exposed foraging areas. The distance from the foraging area to the roost determined whether eagles moving to the roosts incurred a net energy gain or loss.

On the northern Chesapeake Bay, eagles roosted only in deciduous trees and roosted close (\bar{x} = 0.18 km) to foraging areas (Buehler et al. 1991). Moreover, we suspected that thermal differences between northern Chesapeake roosts and western roosts exist because the northern Chesapeake lacks conifers and substantial topographic relief. We tested the hypothesis that Bald Eagles on the northern Chesapeake Bay selected roost sites that resulted in reduced en-

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ergy expenditures by comparing the microclimate and energy expended at roosts with the microclimate and energy expended at shoreline perch sites and randomly selected inland forested sites.

STUDY AREA AND METHODS

Study area.—We studied Bald Eagle roosts on the U.S. Army Aberdeen Proving Ground, a 350-km² military installation on the northern Chesapeake Bay, north of Baltimore, Maryland. Study-area vegetation consisted of mature coastal lowland oak-gum (*Quercus* spp.–*Liquidambar styraciflua*) forests bordering the Chesapeake Bay.

Roost, shoreline, and inland sites.—We located roost sites during 1984–1989 by tracking radio-tagged eagles until they roosted in the evening (Buehler et al. 1991). We studied the microclimate at a communal roost used year-round (peak use = 30 eagles/night), a communal-summer site (peak use = 35 eagles/night), and a communal-winter site (peak use = 32 eagles/night). All 3 roosts were used by eagles that foraged on the Chesapeake Bay and Romney Creek, a shallow tidal creek that flows into the bay. Year-round, summer, and winter roost sites were 2.89 km, 2.24 km, and 1.00 km, respectively, from the Chesapeake Bay, and 1.76 km, 0.82 km, and 1.59 km from their closest access to Romney Creek. At each roost site, we monitored 4 regularly used trees that were dispersed throughout the site, to ensure sampling a representative array of microclimatic conditions. We identified shoreline perch trees in the foraging areas by tracking 94 radio-tagged eagles from fixed-wing aircraft during 1985–1988. We randomly selected 2 of 8 Chesapeake Bay shoreline perch trees and 2 of 12 Romney Creek shoreline perch trees identified within 3 km of all 3 roosts for microclimate monitoring. We monitored the microclimate at 4 randomly selected, continuous-canopy inland forested sites within 3 km of the foraging areas. These areas had trees within the range of roost-tree heights (15.5–46.6 m).

Microclimate monitoring.—We monitored wind speed, temperature, and net long-wave radiation with 3-cup anemometers ($\pm 1.5\%$ accuracy, minimum wind speed detection = 0.22 m/s, Campbell Scientific, Inc., Logan, Utah), thermistor probes housed in 8- × 12-cm thermal shields ($\pm 0.4^\circ\text{C}$ accuracy, Campbell Scientific, Inc., Logan, Utah), and net radiometers ($\pm 10\%$ accuracy, Radiation Energy Measurement Systems, Seattle, Washington). We mounted all sensors on a custom pvc-pipe frame and suspended the frame from a tree limb 20–25 m above the ground, within the range of Bald Eagle roosting heights on the northern Chesapeake (Buehler et al. 1991). We used Campbell Scientific CR10 modules to record sensor output every 6 s, to compute averages for input variables every 2 min, and to transfer the average values to a storage module. We analyzed data collected between sunset and sunrise.

Eagle nightly energy requirements.—We used a Bald Eagle heat budget model (Keister et al. 1985) to estimate the metabolic heat production rate and total energy expended by a roosting eagle for each sampling night in each site.

We calculated the mean metabolic heat production rate (M) in kcal/h over every 2-min period of each night. Energy expended per 2-min period was calculated by multiplying M by the time period (2/60 of an hour). We calculated the total energy expended per night by summing all 2-min energy increments.

Statistical analyses.—We used the Chi-square approximation to the Kruskal-Wallis test (Hollander and Wolfe 1973) to test for differences in microclimate and heat budget parameters among roost, shoreline, and inland sites, because most of the variables were nonnormally distributed (Kolmogorov-Smirnov test, $P < 0.05$). If the Kruskal-Wallis test was significant ($P < 0.05$), we used Wilcoxon rank-sum tests for pairwise comparisons, with $\alpha = 0.05$. We tested the nightly means (average of all 2-min means per night) for temperature, wind speed, net radiation, metabolic rate, and the total nightly energy expended. To determine if sites differed in nightly microclimate extremes, we compared the nightly minimum 2-min mean temperature, the nightly maximum 2-min mean wind speed, the nightly minimum 2-min mean net radiation, and the nightly maximum 2-min mean metabolic production rate among sites. To determine if variation among nights obscured differences among sites, we compared the microclimate at the roost, shoreline, and inland sites that were monitored simultaneously ($n = 42$ nights). To examine the similarity among roosts, we compared the 3 roost sites. Because roosts were not monitored simultaneously, we also compared shoreline and inland sites as controls for these sample periods. To test for effects of extreme nights, we compared roost, shoreline, and inland sites on the 10 nights with the lowest mean shoreline temperature, the 10 nights with the greatest mean shoreline wind speeds, the 10 nights with the lowest mean net radiations, and the 10 nights with the greatest mean metabolic rates along the shoreline.

To estimate the energy cost of flying to and from roosts from the foraging areas, we used assumptions identical to Stalmaster and Gessaman (1984); flight speed = 45 km/h, energy for flapping flight = $12.5 \times$ basal metabolic rate (BMR), energy for soaring flight = $3.5 \times$ BMR, BMR = 12.47 kcal/h, and flight to and from roosts = 50% flapping and 50% soaring. We added flight costs into the total nightly energy budgets to compare energy expended at roosts vs. shoreline perch sites.

RESULTS

MICROCLIMATE

All roost vs. all shoreline vs. all inland sites.—Nightly temperature over the winter ranged

from -8.3°C to 20.0°C . Most nights (118/126, 93.7%) had mean temperatures below the 10.6°C lower limit of the Bald Eagle thermal neutral zone (Stalmaster and Gessaman 1984). Nightly mean and nightly minimum roost, shoreline, and inland-site temperatures did not differ ($P = 0.79, 0.64$, respectively; Table 1). Mean nightly winds ranged from 0.2 m/s to 7.5 m/s and were greatest at shoreline sites, whereas roost and inland-site winds did not differ. Maximum wind speeds also were greatest at shoreline sites, whereas roost and inland-site maximum winds did not differ. Mean nightly net radiation ranged from -69.4 W/m^2 to -4.1 W/m^2 and was greater at inland sites than at shoreline sites. Roost and shoreline minimum net radiation were less than net radiation at inland sites.

Individual roost vs. shoreline vs. inland sites.—Mean and minimum nightly temperatures did not differ among individual roosts and the simultaneously monitored shoreline and inland sites ($P = 0.78, 0.64$, mean and minimum temperature, respectively, year-round roost; $P = 0.95, 0.91$, summer roost; $P = 0.89, 0.82$, winter roost; Table 1).

Shoreline mean and maximum winds were greater than year-round roost and inland-site winds (Table 1). Shoreline mean and maximum winds were greater than inland-site mean and maximum winds, but shoreline winds did not differ from summer-roost mean and maximum winds, and summer-roost mean and maximum winds did not differ from inland-site winds. Shoreline mean and maximum winds were greater than winter-roost and inland-site mean and maximum winds.

Mean nightly net radiation did not differ among any individual roost, shoreline, and inland-site set (Table 1). Minimum nightly net radiation also did not differ among the year-round roost, shoreline, and inland sites. However, during monitoring of the summer roost, the inland-site minimum net radiation was greater (smaller negative value) than summer-roost and shoreline values. During monitoring of the winter roost, the inland-site minimum net radiation was greater than radiation at shoreline sites, but inland and roost-site minimum net radiation did not differ, and shoreline and roost-site minimum net radiation did not differ.

Comparisons among roosts.—Mean and maximum nightly temperatures did not differ among the 3 roosts ($P = 0.29, 0.34$, respectively; Table

1). The summer-roost mean and maximum winds were greater than winter-roost winds, but did not differ from year-round-roost winds. The year-round-roost mean net radiation was greater than the mean net radiation at summer and winter roosts. The year-round-roost minimum net radiation was greater than the summer-roost minimum net radiation, whereas the winter-roost minimum net radiation did not differ from minimum net radiation at either of the other roosts.

Similar separate analyses of shoreline and inland sites showed no differences for the 3 sampling periods for mean and minimum temperature, mean and maximum wind speed, and mean and minimum net radiation variables ($P > 0.05$), except that mean net radiation differed among the inland sites ($P = 0.03$).

EAGLE HEAT BUDGETS

Roost, shoreline, and inland sites.—There were no differences in mean or maximum metabolic heat production rates or total energy among roost, shoreline, and inland sites (Table 2). When individual roosts were compared with shoreline and inland sites monitored simultaneously, mean and maximum metabolic production rates and total energy did not differ. Similarly, when roosts were compared with each other, mean and maximum metabolic production rates and total energy did not differ. We also detected no differences in mean and maximum metabolic rates and total energy expended among all roost, shoreline, and inland sites on the extreme nights of winter, including the coldest, windiest, lowest net radiation, and greatest metabolic rate nights (Table 3).

Flight cost effects.—At 2.2 kcal/km of flight, eagles expended 7.7 kcal to fly round-trip between the closest foraging area (Romney Creek) and the year-round roost, 3.6 kcal to fly round-trip between Romney Creek and the summer roost, and 4.4 kcal to fly round-trip between the bay shoreline and the winter roost. After these values were added into the total nightly energy expended, mean nightly energy expended for the year-round roost still was not different from energy expended at shoreline sites ($\bar{x} = 206.6 \text{ kcal}, 199.9 \text{ kcal}$, respectively, $P = 0.28$). Similarly, when flight costs were included, summer-roost nightly energy increased to 217.1 kcal, but not significantly over the 212.9 kcal expended at the shoreline site ($P = 0.59$). Winter-roost

TABLE 1. Mean and minimum values ($\bar{x} \pm SE$) of temperature and net radiation, and mean and maximum values ($\bar{x} \pm SE$) of wind speed at roost sites ($n = 3$), shoreline perches ($n = 4$), and randomly selected inland forested sites ($n = 4$), northern Chesapeake Bay, Maryland, November 1988 to April 1989. Individual roosts, shoreline, and inland sites were monitored simultaneously on 42 nights. Within-column section comparisons with similar letters were not different, based on pair-wise Wilcoxon rank-sum tests ($P > 0.05$).

	Mean temperature (°C)	Minimum temperature (°C)	Mean wind (m/s)	Maximum wind (m/s)	Mean net radiation (W/m ²)	Minimum net radiation (W/m ²)
Year-round roost ^{st,d}	3.70 ± 0.65A	1.10 ± 0.67A	1.38 ± 0.14A	3.27 ± 0.20A	-25.66 ± 2.05A	-40.77 ± 2.41A
Shoreline ^a	4.12 ± 0.60A	1.88 ± 0.60A	1.98 ± 0.25B	4.51 ± 0.37B	-29.48 ± 2.63A	-43.14 ± 2.72A
Inland ^a	3.87 ± 0.59A	1.62 ± 0.60A	1.34 ± 0.12A	3.07 ± 0.16A	-24.82 ± 1.99A	-36.90 ± 2.23A
Summer roost ^{b,d}	2.36 ± 0.83A	-0.13 ± 0.80A	1.50 ± 0.13AB	3.49 ± 0.21AB	-33.13 ± 2.68A	-47.63 ± 2.84A
Shoreline ^b	2.58 ± 0.82A	0.03 ± 0.78A	1.75 ± 0.15A	4.10 ± 0.26A	-33.22 ± 2.67A	-46.79 ± 2.75A
Inland ^b	2.31 ± 0.82A	-0.25 ± 0.79A	1.15 ± 0.10B	2.87 ± 0.16B	-26.90 ± 2.08A	-38.32 ± 2.26B
Winter roost ^{c,d}	2.86 ± 0.80A	0.24 ± 0.79A	1.11 ± 0.12A	2.83 ± 0.25A	-34.39 ± 2.13A	-46.17 ± 2.34AB
Shoreline ^c	3.10 ± 0.75A	0.69 ± 0.73A	1.62 ± 0.16B	3.84 ± 0.29B	-36.94 ± 2.28A	-49.62 ± 2.47A
Inland ^c	2.93 ± 0.72A	0.43 ± 0.73A	1.20 ± 0.12A	2.72 ± 0.17A	-31.90 ± 1.85A	-42.59 ± 2.04B
All roosts ^c	2.97 ± 0.44A	0.40 ± 0.44A	1.33 ± 0.08A	3.20 ± 0.13A	-31.06 ± 1.36AB	-44.86 ± 1.48A
All shoreline ^e	3.27 ± 0.42A	0.87 ± 0.41A	1.79 ± 0.11B	4.15 ± 0.18B	-33.22 ± 1.48A	-46.51 ± 1.54A
All inland ^e	3.04 ± 0.41A	0.60 ± 0.41A	1.23 ± 0.07A	2.89 ± 0.10A	-27.87 ± 1.16B	-39.27 ± 1.27B

^a Mean and maximum wind speed differed among the year-round roost, shoreline, and inland sites (Kruskal-Wallis tests, $P = 0.03$, 0.001, respectively).
^b Mean and maximum wind speed and minimum radiation differed among the summer roost, shoreline, and inland sites (Kruskal-Wallis tests, $P = 0.01$, 0.001, 0.001, respectively).
^c Mean and maximum wind speed and minimum radiation differed among the winter roost, shoreline, and inland sites (Kruskal-Wallis tests, $P = 0.02$, 0.001, 0.001, respectively).
^d Mean and maximum wind speed and minimum radiation differed among the year-round, summer, and winter-roost sites (Kruskal-Wallis tests, $P = 0.02$, 0.01, 0.01, 0.03, respectively). Winter-roost mean and maximum winds were less than winds at the year-round and summer roosts; year-round-roost mean radiation was greater than radiation at summer and winter roosts; and year-round-roost minimum net radiation was greater than at the summer roost ($P < 0.05$).
^e Mean and maximum wind speed and minimum radiation differed among roost, shoreline, and inland sites (Kruskal-Wallis tests, $P = 0.001$, 0.001, 0.03, 0.001, respectively).

TABLE 2. Mean and maximum values ($\bar{x} \pm SE$) of metabolic heat production rate and total nightly energy expended for roost sites, shoreline perches, and randomly selected inland forested sites, northern Chesapeake Bay, Maryland, November 1988 to April 1989. Individual roost, shoreline, and inland sites were monitored simultaneously on 42 nights.

	Mean metabolic rate (kcal/h)	Maximum metabolic rate (kcal/h)	Total nightly energy (kcal/night)
Year-round roost ^{a,d}	14.56 \pm 0.31	15.84 \pm 0.33	198.94 \pm 4.53
Shoreline ^a	14.63 \pm 0.30	15.84 \pm 0.31	199.89 \pm 4.37
Inland ^a	14.47 \pm 0.29	15.66 \pm 0.31	197.61 \pm 4.18
Summer roost ^{b,d}	15.39 \pm 0.40	16.69 \pm 0.40	213.46 \pm 6.75
Shoreline ^b	15.36 \pm 0.39	16.68 \pm 0.38	212.94 \pm 6.51
Inland ^b	15.10 \pm 0.38	16.42 \pm 0.38	209.28 \pm 6.42
Winter roost ^{c,d}	15.10 \pm 0.36	16.35 \pm 0.37	205.41 \pm 6.11
Shoreline ^c	15.22 \pm 0.34	16.45 \pm 0.34	206.88 \pm 5.91
Inland ^c	15.02 \pm 0.32	16.20 \pm 0.33	204.28 \pm 5.70
All roosts ^e	15.02 \pm 0.21	16.29 \pm 0.21	205.94 \pm 3.41
All shoreline ^e	15.07 \pm 0.20	16.32 \pm 0.20	206.57 \pm 3.28
All inland ^e	14.86 \pm 0.19	16.09 \pm 0.20	203.72 \pm 3.19

^a Mean and maximum metabolic rates and total energy did not differ among year-round roost, shoreline, and inland sites (Kruskal-Wallis tests, $P = 0.88, 0.82, 0.91$, respectively).

^b Mean and maximum metabolic rates and total energy did not differ among summer roost, shoreline, and inland sites (Kruskal-Wallis tests, $P = 0.79, 0.81, 0.79$, respectively).

^c Mean and maximum metabolic rates and total energy did not differ among winter roost, shoreline, and inland sites (Kruskal-Wallis tests, $P = 0.84, 0.70, 0.87$, respectively).

^d Mean and maximum metabolic rates and total energy did not differ among year-round, summer, and winter roosts (Kruskal-Wallis tests, $P = 0.18, 0.24, 0.18$, respectively).

^e Mean and maximum metabolic rates and total energy did not differ among roost, shoreline, and inland sites (Kruskal-Wallis tests, $P = 0.66, 0.57, 0.69$, respectively).

nightly energy plus flight costs equaled 209.8 kcal, not different from the 206.9 kcal expended at the shoreline site ($P = 0.67$).

DISCUSSION

We do not believe that energy conservation is an important factor in eagle roost-site selection on the Chesapeake Bay. Although Stalmaster and Gessaman (1984) reported significant energy savings in western Washington, Keister et al. (1985) reported energy savings at Oregon roosts were negated by flight costs, and we found no energy savings under any circumstances. There are several possible explanations for these differences.

It is possible that topographic differences between the Chesapeake and the western Washington and Oregon study areas explain the observed differences in energy savings. Greater topographic variability in Washington and Oregon, compared with the relatively flat Chesapeake region, may provide eagles with a greater range of microclimates from which to choose. The presence of suitable stands of conifers for roosting in the western areas contributes to microclimate variability as well. Energy expended at foraging areas and roost sites may differ sig-

nificantly because of this greater range of microclimates.

Alternatively, the heat budget model may be an inaccurate estimate of eagle heat budgets. Some of the parameters estimated in the model have been experimentally measured for other avian species and agree fairly well with model-derived values (Robinson et al. 1976, Mahoney and King 1977, Hayes and Gessaman 1982). We are unaware, however, of any field tests of the entire model for large-bodied avian species. Wind speed and net radiation were 2 microclimate factors that varied between shoreline and roost sites on the northern Chesapeake. Underestimation of the effects of these parameters could produce the observed results that suggest that roost sites were not energetically favorable.

It also is possible that eagles select roosting sites for microclimatic benefits accrued, not on average winter nights but on catastrophically stormy nights. The studies to date, which concentrated on average or "typical" conditions, were unlikely to detect evidence for such behavior. To account for this effect, we examined microclimate differences on the 10 most extreme nights of winter but detected no differences in energy expended. Roost-site selection under the catastrophic scenario may be more

TABLE 3. Mean and maximum values ($\bar{x} \pm SE$) of metabolic heat production rate and total nightly energy expended for roost sites, shoreline perches, and randomly selected inland forested sites on the 10 coldest temperature, 10 windiest, 10 lowest net radiation and 10 greatest metabolic rate nights, northern Chesapeake Bay, Maryland, November 1988 to April 1989.

	Mean metabolic rate (kcal/h)	Maximum metabolic rate (kcal/h)	Total nightly energy (kcal/night)
Coldest temperature ^a			
Roosts	19.48 \pm 0.33	20.84 \pm 0.44	276.03 \pm 6.31
Shoreline	19.25 \pm 0.31	20.52 \pm 0.44	272.72 \pm 5.46
Inland	19.05 \pm 0.30	20.32 \pm 0.45	269.95 \pm 5.84
Windiest ^b			
Roosts	15.17 \pm 1.16	16.93 \pm 1.20	198.59 \pm 18.56
Shoreline	15.41 \pm 1.10	17.17 \pm 1.12	201.55 \pm 17.95
Inland	15.08 \pm 1.01	16.81 \pm 1.06	197.14 \pm 16.85
Lowest net radiation ^c			
Roosts	17.29 \pm 0.53	18.72 \pm 0.59	233.64 \pm 9.58
Shoreline	17.42 \pm 0.53	18.78 \pm 0.58	235.57 \pm 9.84
Inland	17.05 \pm 0.51	18.50 \pm 0.57	230.42 \pm 9.39
Greatest metab. rates ^d			
Roosts	19.42 \pm 0.35	20.75 \pm 0.48	275.10 \pm 6.47
Shoreline	19.25 \pm 0.31	20.49 \pm 0.45	272.60 \pm 5.49
Inland	18.99 \pm 0.32	20.24 \pm 0.47	268.99 \pm 5.99

^a Mean and maximum metabolic rates and total energy did not differ among roost, shoreline, and inland sites on the 10 lowest temperature nights (Kruskal-Wallis tests, $P = 0.59, 0.63, 0.73$, respectively).

^b Mean and maximum metabolic rates and total energy did not differ among roost, shoreline, and inland sites on the 10 windiest nights (Kruskal-Wallis tests, $P = 0.78, 0.87, 0.84$, respectively).

^c Mean and maximum metabolic rates and total energy did not differ among roost, shoreline, and inland sites on the 10 lowest net radiation nights (Kruskal-Wallis tests, $P = 0.59, 0.77, 0.79$, respectively).

^d Mean and maximum metabolic rates and total energy did not differ among roost, shoreline, and inland sites on the 10 greatest metabolic rate nights (Kruskal-Wallis tests, $P = 0.64, 0.61, 0.63$, respectively).

based on the selective advantages of avoiding buffeting by strong winds and may not be thermoregulatory in nature. Our finding that winter roosts afford greater protection from wind than summer or year-round roosts is consistent with this hypothesis. Steenhof et al. (1980) also suggested that roost-site selection in the Midwest may occur to avoid buffeting by winds.

Given the variability of the evidence to date, hypotheses that explain eagle roost-site selection in other than thermoregulatory terms may be more plausible, at least for our study area. A variety of hypotheses are offered to explain why some birds roost communally, including predator avoidance (Lack 1968: 137) or information transfer (Ward and Zahavi 1973). It is possible that Bald Eagles select a communal roosting habitat that facilitates or enhances the benefits obtained under one or more of these hypotheses.

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