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Dynamics of a year-round communal roost of Bald Eagles.—Communal roosts of Bald Eagles (*Haliaeetus leucocephalus*) occur regularly outside of breeding season and have been described in detail (Fitzner and Hanson 1979, Keister and Anthony 1983, Crenshaw and McClelland 1989). However, year-round Bald Eagle roosts have been studied only recently (Chester et al. 1990, Buehler et al. 1991). I describe here the results of 188 h of observation at a year-round communal roost of Bald Eagles in southern Florida.

Everglades National Park (ENP), located at the southern tip of the Florida peninsula, is home to a large, stable breeding population of Bald Eagles (ca 50 breeding pairs/year, Curnutt and W. B. Robertson, Jr., unpubl. data). The climate is sub-tropical with mean temperatures of 26.8°C in August and 18.9°C in January. Eagles nest in two major areas: Florida Bay, a shallow 1600 km^2 estuary, and the extensive mangrove forests of the park's Gulf coast. Nesting activity (nest building) begins in late November and ends (young fledged) in late March (Curnutt 1991). Bald Eagles have been known to use the southern end of the Miami Rock Ridge pinelands as a roosting site since they were discovered there in the early 1960s by A. Sprunt, IV, and W. B. Robertson, Jr. The southern terminus of the pinelands is nearly 20 km north of Florida Bay, the nearest Bald Eagle nesting and foraging habitat, and is dominated by mature slash pine (*Pinus eliottii*) with an understory kept open by natural and planned fires. During aerial surveys of the pinelands, I determined that roosting activity was concentrated in an area of ca 20 ha where the southern tip of the pine forest intersected the Main Park Road (MPR). The vegetation between the roost area and Florida Bay is dominated by dry *Muhlenbergia* prairie, red mangrove (*Rhizophora mangle*), and coastal prairie (Craighead 1971).

I observed the roost from atop a van on the MPR. I alternately parked and drove within 0.5 km of the road-pines intersection in order to count eagles. This allowed me to observe and count eagles perched at the edges and within the stands of pines. I observed the roost three consecutive evenings and the following mornings near the middle of each month from March 1990 through February 1991. The March 1990 observations were used to test and refine methods and are not included in analyses. I conducted evening observations from at least 1 h before sunset to 0.5 h after sunset and morning observations from 0.5 h before sunrise to 4 h after sunrise or until the last known eagle departed the area, whichever was later. I noted the direction of flight (bearing) and estimated altitude of each eagle seen flying. Times (to the nearest minute) were recorded for eagles entering or leaving the roost area. Trees in which I saw eagles perched were identified to species, noted as living or dead, and assigned to one of the following categories of relative height: above canopy, canopy height,

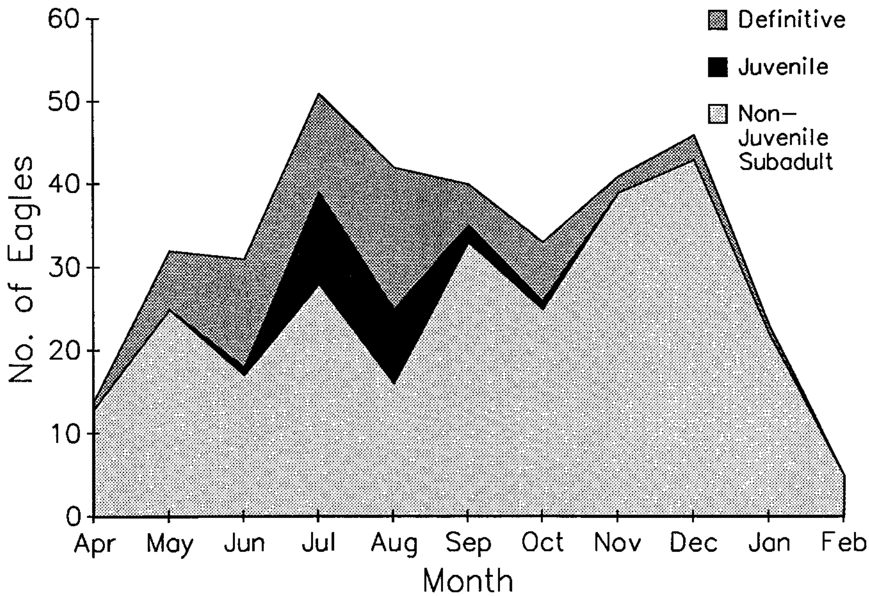

FIG. 1. Cumulative numbers of Bald Eagles observed each month at the Everglades National Park roost.

below canopy. When conditions of light and time allowed, I assigned each eagle to one of the six age classes described in McCollough (1989). This helped in identifying individuals during each observation period and avoiding double-counting. For analyses, eagles were considered either adult (definitive plumage) or subadult (all other plumages). Every 15 min I noted the temperature, wind speed and direction, percent cloud cover (to nearest 10%), and presence of precipitation. Days were considered cloudy if the average cloud cover was ≥75% and clear if the average was ≤25%. Effects of environmental conditions on eagles were analyzed using multiple linear regression. I used AbStat (copyright, Anderson-Bell Co. 1984) statistical package to analyze data. A probability level of 0.05 was considered significant.

I recorded 398 Bald Eagle sightings at the roost area during the study. I was able to assign 72% of the individuals to the age classes described by McCollough (1989). Aging in morning (AM) counts was more successful (78.8%) than in evening (PM) counts (63.6%) (t = 2.53, df = 57, P = 0.01) because of the better light conditions and longer observation time available in AM. The number of Bald Eagles observed in each observation period ranged from 0 to 18. There was no attempt to avoid double counting of individuals between observation periods. Comparisons between months are based on the cumulative number of eagles sighted during all PM and AM counts each month. Most (77%) of the eagle sightings were of subadults. There were two peaks in cumulative monthly eagle sightings at the roost (Fig. 1). The highest count, 54 in July, was brought about by the presence of adults and young of the year augmenting the subadult population. The second peak (47) occurred at the height of the breeding season in December and was composed primarily of subadults. The number of eagle sightings was lowest in February (5 subadults). The number of eagles arriving at the roost in the evening was negatively correlated with wind speed (r = −0.68, df = 30, P

= 0.004) and positively correlated with mean observation-period temperature (r = 0.44, df = 30, P = 0.006). There was no difference between the number of eagles arriving at the roost on evenings with south vs north winds (ANOVA, F = 0.519, df = 9, P = 0.499). The number of eagles observed during AM counts was directly related to the number observed arriving the night before (r = 0.77, df = 31, P = 0.001), suggesting that there was not a significant number of arrivals after 0.5 h past sunset.

The time that Bald Eagles arrived at the roost was strongly correlated with sunset (r = 0.88, df = 167, P = 0.001) and was not affected by cloud cover (clear vs cloudy evenings; ANOVA, F = 0.63, df = 86, P = 0.533). Arrival time was not significantly different for adults and subadults (ANOVA, F = 1.83, df = 159, P = 0.178). Adults tended to leave the roost later than subadults but the difference was not significant (subadult mean = 169.8 min after sunrise, adult mean = 191.2 min after sunrise, ANOVA, F = 3.42, df = 155, P = 0.066). Morning departure time was positively correlated with higher temperature (r = 0.54, df = 17, P = 0.001). Crenshaw and McClelland (1989) reported that eagles arrived later on clear evenings than on cloudy evenings at a roost in Montana, as did Lish (in Crenshaw and McClelland 1989) in Oklahoma. Crenshaw and McClelland (1989) also reported subadults leaving the roost earlier than adults and attributed this to poorer hunting skills of subadults and consequent lower food availability. Neither of these phenomena occurred at a significant level at the ENP roost. This may be attributed to the longer winter daylength in southern Florida resulting in greater foraging time. Unlike eagles in Montana (Crenshaw and McClelland 1989), ENP eagles rarely left the roost before sunrise and most returned before sunset.

Nearly all (95.8%) eagles arrived at the roost area from the south or southwest, regardless of the concurrent wind direction. Bearings of eagles leaving the roost in the morning showed more variability. Most (54.5%) flew south, with southwest and west accounting for another 20.1%. Departure bearings appeared to be influenced by wind direction as eagles soaring in thermals often drifted with the wind. The predominance of arrivals from and departures to the south and southwest indicate that most roosting eagles frequented northwestern Florida Bay. This area has the highest concentration of active Bald Eagle nesting territories in Florida Bay (Curnutt 1991) and is where a majority of subadults has been observed during annual aerial surveys of eagle nesting activity (W. B. Robertson, Jr., unpubl. data). Although Bald Eagle nesting in ENP occurs along the park's Gulf coast and among the brackish interior bays of the extreme southwestern peninsula, as well as in Florida Bay, eagles that visited the roost apparently frequented only Florida Bay.

Of the 393 Bald Eagle sightings, 216 involved birds perched in trees, all but one in slash pines. Both adults and subadults used super-canopy and canopy-level trees independently (χ^2 = 0.20, df = 1, P = 0.654). There were two instances (<1%) of eagles perching in subcanopy trees. Dead trees were used as perches 30.2% of the time.

Seasonal changes in the proportion of adult and subadult Bald Eagles as observed at the communal roost in ENP have not been reported for other areas. In Florida Bay, over 95% of 31 historical breeding territories have been occupied each breeding season (N = 31 seasons), although many of these (from 2–12/season) consisted of single (unpaired) adults (Curnutt 1991). Because Bald Eagles are highly territorial against conspecifics during the breeding season (Palmer 1988), adults would tend to stay at their territories during this time and perhaps drive subadults from the area. This would account for both the low incidence of adults and the higher numbers of subadults at the roost during the breeding season. Conversely, during the nonbreeding season subadults are free to spend more time at the undefended territories of Florida Bay, and adults (perhaps unpaired) are able to leave there and visit the roost. The low number of adults at the roost, even in the summer (maximum single observation period count = 6, July 1990) is a small proportion of the Florida Bay adult population (ca 53). However, this would account for most of the unpaired adults (8) that defended territories during the 1989/1990 breeding season in Florida Bay (Curnutt 1991). Some of the variation in the numbers of eagles at the roost each month may be due to the presence of alternative roost sites (as in Buehler et al. 1991) of which I was unaware.

None of the Bald Eagles observed in this study was marked. The consistent movement to and from Florida Bay suggests that most of the eagles were part of the resident ENP population. However, since at least some Bald Eagles from every breeding population migrate (see Palmer 1988 for a review), it is possible that some of the eagles observed at the roost were migrants from other populations. Broley (1947) reported that young Bald Eagles, especially juveniles, dispersed from their natal area of the central Gulf coast of Florida during the summer in a generally northward migration. This was also found to occur with nestlings banded in central Florida (P. Wood, pers. comm.). Although the lower numbers of non-juvenile subadults at the roost in the summer may, in part, be due to migratory movements away from the area, the occurrence of subadult Bald Eagles, including juveniles, at the ENP roost from June to November suggests that some eagles fledged in Florida Bay may remain during the summer.

Unlike most Bald Eagle communal roosts, the ENP roost is not located near feeding areas, nor, with southern Florida's sub-tropical climate, does it seem to offer any obvious advantage in climate. The reason eagles visit the roost may be primarily social. Palmer (1988) suggested that pair formation among Bald Eagles can occur before definitive feathering and may come about through the extended association of pre-breeding individuals. At least one potential breeding pair (an adult male and Basic IV female) was formed at the ENP roost during this study. The high degree of interaction I observed between subadults, e.g., pursuit flights and talon grasping, as well as the increased level of aggression by eagles during the nesting season may facilitate mate selection. Bald Eagle prey in Florida Bay has included over 20 species of birds and over 10 species of fish (Curnutt, unpubl. data) and there is no indication that prey availability is a limiting or even stress-inducing factor for breeding eagles there (Curnutt 1991). The stable climate and food supply of Florida Bay has resulted in a saturated breeding population of Bald Eagles (Curnutt 1991) and, in turn, year-round social interaction at a communal roost.

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Nonbreeding Bald Eagle perch habitat on the northern Chesapeake Bay.—Bald Eagle (*Haliaeetus leucocephalus*) habitat is declining throughout much of the range because of human land uses along shoreline areas (Buehler et al. 1991a), logging (Anthony and Isaacs 1989), and recreation (Chester et al. 1990). Identification of habitat for protection requires knowledge of the characteristics that define habitat suitability. Although nesting and nocturnal roost habitat have been described throughout the eagles' range (e.g., Andrew and Mosher 1982, Keister and Anthony 1983, Anthony and Isaacs 1989, Bohall Wood et al. 1989, Buehler et al. 1991b), few studies have quantified diurnal perch habitat (Stalmaster and Newman 1979, Steenhof et al. 1980, Chester et al. 1990, Caton et al. 1992). Moreover, past studies relied on visual location of perched eagles along shoreline areas, potentially biasing results toward exposed, shoreline perch sites. We used radio telemetry to avoid this potential problem.

Except for Chester et al. (1990), other studies have not examined the effects of time of day or season on eagle habitat selection. Because microclimate variables such as temperature vary by time of day and season, we investigated whether diurnal perch selection differed with respect to these periods. We also tested the hypothesis that perch habitat differed from habitat available at random on the northern Chesapeake Bay.

Study area and methods.—The study area extended along the Chesapeake Bay from the Bay Bridge at Annapolis, Maryland, to the Conowingo Dam on the Susquehanna River, encompassing 3426 km^2. The area included 2472 km of bay, river, and creek shoreline and extended inland to the head of all major tributaries except the Susquehanna and Chester rivers. It also included part of the Baltimore metropolitan area and the U.S. Army Aberdeen Proving Ground, a 350-km^2 military installation. The study area included a largely urban-suburban setting near Baltimore, coastal lowland oak-gum (*Quercus* spp.-*Liquidambar styraciflua*) forests on the Aberdeen Proving Ground, agricultural fields with scattered oak woodlots on the Eastern Shore, and upland and lowland oak-gum-hickory (*Carya* spp.) forests along the Susquehanna River valley (Brown and Brown 1972).

A total of 59 Bald Eagles were radio-tagged. Twenty-nine immatures and two adults were trapped with floating noose-fish (Cain and Hodges 1989) and padded leghold traps (Young 1983) at Aberdeen Proving Ground, Susquehanna River, and Eastern Shore trap sites. Also, we radio-tagged 28 nestlings at 8–10 weeks of age in nests throughout the northern Chesapeake region.