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ECOLOGY OF BALD EAGLES WINTERING IN SOUTHERN ILLINOIS

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ABSTRACT

The population size, food habits, distribution and habitat of wintering bald eagles (*Haliaeetus leucocephalus*) were investigated at Union County and Horseshoe Lake Conservation areas during 1979-1981 and Crab Orchard National Wildlife Refuge during 1980-1981. Eagles arrived in southern Illinois late October with estimated peak populations of 180-200 occurring, dependent on weather conditions, in January or February; eagles departed by early March. Immatures predominated wintering populations; but adult and immature subpopulations displayed similar fluctuations in numbers. Morning and evening roost counts provided reliable estimates of total population size while motor counts yielded data on eagle distribution, activities and habitat utilization.

Diurnal perch sites near shallow water areas were utilized most during early winter; with ice cover on waters, eagles shifted to sites of open water where waterfowl were concentrated. Carcasses of Canada geese appeared the principal food at this time. Though eagle attacks were witnessed on injured or dying waterfowl, none were successful. During late winter, eagles appeared less reliant on refuges as feeding areas; this may have been associated with spring migration. Food availability was considered a major influence on selection of diurnal perch sites; protection from winds and insulation from human disturbance seemed secondary. Communal roost areas offered shelter from prevailing winds by surrounding vegetation and were associated with standing water. Most eagles left roosts by sunrise; the peak of return was 10 minutes after sunset.

The bald eagle population wintering in the southern Illinois region has increased significantly since the 1950's. Areas used for roosting and feeding are largely associated with refuges and concentrations of waterfowl. Management should ensure feeding and roosting areas are closed to public access during periods of eagle use; and emphasis should be on protection of trees affording roosting and feeding needs

and those adjacent that served as windbreaks. Further, because of the potential for lead poisoning, hunter use of lead shot should be banned.

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INTRODUCTION

Approximately one-third of the bald eagle population wintering in the United States utilizes the upper Mississippi Valley (Snow 1973). Dams on the Mississippi River and its tributaries north of St. Louis regularly provide open water and feeding sites. The large numbers that congregate along the river have been studied extensively during the last 20 years (Southern 1963, 1964; Grewe 1966, Jonen 1973, Steenhof 1976, Griffin 1978, Dunstan 1979). In southern Illinois, the Mississippi River may be of less importance where Crab Orchard National Wildlife Refuge and the Union County and Horseshoe Lake Conservation areas support large populations of wintering bald eagles and waterfowl. Although bald eagles are principally piscivorous (Bent 1937, Broley 1947), use of waterfowl as a food resource has been reported by Midwest researchers (Steenhof 1976, Griffin et al. 1980 and 1982) and is presumed important in eagle use of refuges. Casual observations (Southern 1963, 1964) provide the only information for wintering eagles in the southern Illinois region prior to this study. The objectives of this research attempt to characterize winter bald eagle populations, their food habits and their habitat use.

METHODS

Research was conducted on three wildlife refuges in southern Illinois. Union County Conservation Area (UCCA) and Horseshoe Lake Conservation Area (HLCA) were investigated November 1979-March 1980 and September 1980-March 1981. Observations at Crab Orchard National Wildlife Refuge (CONWR) were restricted to November 1980-March 1981.

Union County (2,480 ha) and Horseshoe Lake (3,160 ha) are managed as refuges and are located in the Mississippi River Floodplain. The former site has numerous shallow lakes and ponds (320 ha), while the latter (960 ha) is the only permanent body of water on that area; about half of the available acreage on both sites provides winter forage for Canada geese (*Branta canadensis*). Crab Orchard National Wildlife Refuge includes Crab Orchard Lake (17,200 ha) with the remaining acreage a mosaic of croplands, old fields, forests, and flooded timber. Dominant trees include cottonwood (*Populus deltoides*) and ash (*Fraxinus* spp.) at Union County; Bald Cypress (*Taxodium distichum*) and tupelo gum (*Nyssa aquatica*) at Horseshoe Lake; and mixed oats (*Quercus* spp.) and hickories (*Carya* spp.) at Crab Orchard.

A modified car strip census (Craighead and Craighead 1956) was driven by one observer at speeds between 24 and 32 km/hr on all-weather roads at state refuges. The large size of Crab Orchard Lake coupled with limited shoreline visibility made a car strip census impractical so observations were restricted to shoreline vantage points. Censuses were between 0800-1000 hrs and 1400-1600 hrs CST under vari-

ous weather conditions, excluding days of limited visibility. Duration for each census was 1 hr at UCCA and HLCA and 1.5 hrs at CONWR.

Information on behavior and location of all eagles seen was recorded on forms and maps. A 15-60x spotting scope and 7 × 35 binoculars facilitated observations and minimized eagle disturbance. Birds displaying a white head and tail were considered adults; immatures were discriminated from golden eagles by plumage. Activities were divided into flying, soaring, and perching; flights from previously-censused areas were not recorded to minimize duplication. Perches were classified by height and snags were noted when used. Prevailing weather conditions (cloud cover, ice cover, wind speed and direction) were documented for each census period.

Diurnal habitat use was assessed from motor count observations. As eagles were generally associated with open water, those perched along lake and pond shorelines were used to determine areas of use and temporal changes in distribution. It was not possible to monitor the Mississippi River; hence, its believed importance was not accounted for.

Roost counts were conducted from blinds constructed 50-150 m from roost sites. Location of roosts resulted from observing flight patterns at sunrise and sunset (Lish and Lewis 1975). Confirmation was based on the presence of fecal materials, pellets, and feathers beneath roost trees. Observations were made either 1 hr before sunset until dark or 1 hr before sunrise until most eagles had left the roost. Counts at roost were made within 24 hrs of car censuses.

Species composition and community structure of dominant woody vegetation were analyzed for each roost. Species density, basal area, frequency and canopy height were determined using .03 ha circular plots. Understory vegetation was not considered if the diameter at breast height (DBH) was under 10 cm; 15 random plots were sampled at UCCA and CONWR, and 10 at HLCA. Data gathered for roost trees included species, height, DBH, and condition which was subjectively categorized as living, dead, and dying.

Foods utilized were determined by analyzing pellets collected beneath roost trees (Errington 1932) and examining carcasses fed upon by eagles. Castings were force-air dried at 65°C for 6-36 hours (depending on pellet size and moisture content) in a Fischer Isotemp Model 340. Mammalian and avian remains were identified by guard hair and contour feather characteristics in conjunction with other pellet materials (bones, claws, skin, etc.). Data were supplemented by observations of foraging and feeding eagles. Unfortunately, the almost complete digestion of fish permitted little evaluation of this important food.

RESULTS AND DISCUSSION

Population Fluctuations

Interpretation of eagle counts was dependent on census technique; motor counts reflected numbers along a limited area bordering the route. Peak numbers recorded often reflected large concentrations of eagles around waterfowl or fish carcasses and rarely represented an adequate index to population levels for a given time. Roost counts were the most reliable estimates, especially after mid-November (Figure 1) even though early fall migrants often roosted singly in trees outside the censused roost sites.

Because data for 1979-80 were not obtained prior to November (Figure 1), emphasis on population levels is placed on the 1980-81 roost censuses. During 1980-81

field studies were initiated 28 September; the first sightings were 2 adult eagles on 28 October at UCCA and 1 adult on 4 November at HLCA. The dates of arrival in southern Illinois are similar to those of other wintering areas in the Midwest (Hallaron 1960; Johnson 1961; Southern 1963, 1964; Jonen 1973; Vian and Bliese 1974) as well as those at more northern latitudes (Hancock 1964, Servheen 1975, Nye and Suring 1978). This similarity in arrival times suggests weather has a minor influence on the movement of early fall migrants. Also, availability of suitable habitat did not appear an important factor as early arrivals in transit to southern Illinois passed many northern wintering grounds (Fawks 1961; Southern 1963; Ingram 1965; Grewe 1966; Dunstan 1970, 1979; Jonen 1973; Vian and Bliese 1974). Gerrard et al. (1978) suggested bald eagles tend to return to the same wintering areas year after year; first-year birds may then follow older eagles to traditional wintering grounds. It has also been postulated that in the Midwest subadults migrate south earlier than adults (Southern 1963, Sprunt and Ligas 1966). Although the first fall arrivals at both UCCA and HLCA refuges were adults, no significant difference in arrival times was evident between age classes.

Eagle numbers gradually increased November through late January to early February (Figure 1); in 1979-80, population peaks were 71 at UCCA on 19 February and 78 at HLCA on 8 February. Comparison of population trends suggested that some eagles may have shifted from HLCA to UCCA in mid-February (Figure 1). In 1980-81, populations peaked at 79 at UCCA and 77 at HLCA on 23 January. At these peak levels; 24% were adults at UCCA and 35% at HLCA.

In contrast to populations at UCCA and HLCA, the population levels were lower at CONWR (Figure 1); the peak (29) was mid December followed by a general decline through March. Ice cover (50-90%) on Crab Orchard Lake during December and January probably influenced the decline in numbers by reducing foraging areas. The Mississippi River, which provided open water near UCCA and HLCA was believed used for feeding when refuge impoundments were frozen. High numbers of eagles have also been noted on wintering areas with open water on more northern segments of the Mississippi River (Southern 1963, 1964; Jonen 1973).

The number of eagles dropped rapidly at UCCA and HLCA during late January (Figure 1); these declines continued through February and few were seen after early March. Increases to peak numbers were considerably slower (3 months) than subsequent declines (1 month). A heightened sensitivity of mature birds to spring changes in photoperiod (Servheen 1975) could have contributed. But, rapid declines might also reflect a low influx of spring migrants from southern wintering areas.

Habitat Utilization

Eagles selected tall trees with large horizontal branches for feeding and loafing. Perch sites above 7 m were consistently used (85%, N = 944); most adults perched above 15 m (47%, N = 419), while immatures usually selected sites between 7 and 15 m (51%, N = 525). Generally, perches provided an unobstructed view in at least one direction and allowed easy routes for takeoff and landing. Eagles preferred snags (49%, N = 903), especially those near large bodies of water.

Food availability was considered the major influence on distribution of eagles at each refuge. Newton (1979) believed that raptors dependent on poikilotherms for prey moved farthest south because seasonal temperature variations had the greatest impact on food availability. Hence, piscivorous birds generally winter near

areas offering open water (i.e., reliable food sources) through most of the winter. During early winter, eagles consistently used perches near ponds and borrow pits; apparently, fish were more easily captured here than in deeper waters. Subadults, which may be less efficient at capturing fish, comprised 73% of the observations (52% of population) at these sites. Large bodies of water were more often used by adults. During midwinter, increases in numbers along lake shorelines seemed most associated with the availability of open water and waterfowl carcasses. Presence of Canada geese was associated with 48% of sightings of perched eagles; such flocks of geese usually numbered 1500 or more. This relationship may have been coincidental as both eagles and waterfowl congregated near open bodies of water during mid-winter. Few eagles used refuge foraging areas during late winter; the initiation of the spring migration of geese may have diminished their importance to eagles.

The impact of human activities has been well documented (Servheen 1975; Stalmaster and Newman 1978; Steenhof 1976; Vian and Bliese 1974) and reviewed by Steenhof (1978). The use of diurnal perch sites at HLCA was impacted by human activity during 1980-81. There was a marked decrease in eagle use of perch sites adjacent to a road open to vehicular traffic throughout most of the winter. This was in sharp contrast to 1979-80 when the road was closed and perch sites were consistently used. Moving traffic was often tolerated; but, eagles flushed when vehicles stopped or people approached on foot. Most of the diurnal perch sites at UCCA and CONWR were in areas of restricted access.

Roosts were located on relatively level terrain where adjacent trees provided protection from prevailing northwesterly winds. Tree species used were not consistent between refuges (Table 1). Cottonwood (*Populus deltoides*) snags dominated the UCCA roost sites; this species is commonly used by eagles in the Midwest (Southern 1963, Lish and Lewis 1975, Steenhof 1976, Griffin et al. 1980 and 1982). Snags bordered by live trees were most used. Sycamore (*Platanus occidentalis*), frequently used on more upland sites (Jonen 1973, Lish and Lewis 1975), was the favored roost tree at CONWR. The bald cypress-tupelo gum association was unique to the HLCA roost; but, tupelo was not used probably because it was seldom over 10 m tall. Most roost trees at all areas were large, easily recognized from the air, possessed stout horizontal branches, and offered good visibility over the surrounding terrain.

Southern (1963) reported that eagles roosted singly or in small groups in northern Illinois; but, only early migrants roosted singly in southern Illinois. Edwards (1969) proposed that communal roosting occurred when roosting trees were scarce. Although availability of suitable trees was not believed limiting in southern Illinois, possible competition for favored perch sites may have limited the number of birds within a roost. All roosts in southern Illinois were associated with water, had prominent trees, were bordered by open areas, and usually were insulated from human disturbance.

Lish and Lewis (1975) reported that in Oklahoma most eagles returned to roosts 40 minutes before sunset; in this study they arrived in greatest numbers 5-25 minutes after sunset (Figure 2). Upon entering roost trees, immatures perched in peripheral trees and later shifted to more central roost positions. In the morning, most immatures flew once again to peripheral perches before leaving roosting sites. Adults selected central perches upon entering the roost and left directly in the morning. The major exodus from roosts was between 5 to 35 minutes before sunrise (Figure 2).

Foods and Feeding Habits

In 1979-80, 89 pellets were collected beneath the UCCA roost and 867 pellets were gathered in 1980-81 at UCCA, HLCA, and CONWR. All pellets from 1979-80 were analyzed and a stratified random sample of 150 pellets (50 per roost) was analyzed from 1980-81. Avian remains were most common in eagle castings and typically contained feathers and bone fragments; tarsal skin, claws, dertrum, and gizzard plates were also found. The most common species was Canada goose (234 pellets); mallard (*Anas platyrhynchos*) (27 pellets) represented the only other species of significance (Table 2). Hair and bone of rabbit (*Sylvilagus* spp.), white-tailed deer (*Odocoileus virginianus*), and muskrat (*Ondatra zibethicus*) occurred in a few pellets. Four pellets contained fish scales but fish were generally completely digested (Lish and Lewis 1975). Many studies of bald eagle diets suggest not only great variability in food habits but also great difference as to that recorded in stomachs as compared to cast pellets (Imler and Kalmach 1955).

Because of concern for secondary lead poioning, eagle pellets were fluroscoped. Lead and/or steel shot was exclusively associated with pellets containing waterfowl remains; Canada goosc was the principal species (84% of pellets). Of the shot recorded, 89% was lead. There was no correlation between incidence of shot and gizzard plates; hence, most shot was probably initially imbedded in body tissues of waterfowl. Approximately 6% of the pellcts yielded lead/steel shot which contrasted markedly with the 50-60% rate for lead reported by Dunstan (1974) in northern Illinois and 71% recorded in Utah (Platt 1976).

Waterfowl carcass feeding, (largely Canada geese) evident November through mid-Febrnary, was most frequently observed when there was partial ice cover of impoundments. Immature eagles, less adept at capturing live prey (Sherrod et al. 1967), seemed to rely more heavily on carcasses as a food source. Subadults, which comprised 72% of the individuals seen at carcass sites, made up but 52% of winter populations.

The most obvious field signs associated with eagle scavenged waterfowl carcasses were the large tracks which could not be confused with any other wintering raptor. Feathers from the breast, abdomen, neck, or back were first removed from fresh carcasses; often goose carcasses were decapitated. Once the body cavity was opened, visceral organs were consumed before muscle. Remains from heavily scavenged carcasses consisted of bones and primary feathers; skeletal remains were principally the wing, pectoral girdle, and vertebral column.

Feeding by eagles on carcasses of bowfin (*Amia calva*), big-mouth buffalo (*Ictiobus cyprinellus*), and shortnose gar (*Lepisosteus platostomus*) was also recorded. Excluding the head, buffalo and bowfin were completely consumed while shortnose gar were only eviscerated.

Six attacks on live waterfowl, made predominantly by immatures, were witnesssed with three instances involving apparently healthy waterfowl. A male mallard and a female hooded merganser (*Lophodytes cucculatus*) on water were attacked by an immature eagle on separate occasions; both escaped by diving. Another incident involved an aerial pursuit in which a Canada goose easily outdistanced an immature eagle. The remaining observations were on crippled waterfowl incapable of flight. An immature made a single pass about 3 m above a Canada goose nearly frozen in ice. On another occasion, a female mallard with a broken wing escaped an immature's attack by running across the water. An adult and two immature eagles participated in the only incident in which a waterfowl was struck from an aerial

attack by an adult eagle. The impact knocked the duck onto it's back, after which the eagle landed upon it's breast and plucked a number of breast feathers. Within a minute, the adult stepped off and two immatures standing nearby immediately took to the air and twice lifted the mallard roughly 7 m and dropped it onto the ice. The duck eventually returned to an upright position but was unable to walk; no further attempts were made to pursue feeding on it.

Researchers in northern Illinois (Southern 1963, 1964; Jonen 1973), Nebraska (Vian and Bliese 1974), and South Dakota (Grewe 1966) believed the association between wintering eagles and waterfowl to be coincidental as both relied on open water. However, studies in Oklahoma (Griffin 1978) and South Dakota (Steenhof 1976) indicated that eagles were active predators on waterfowl. In southern Illinois, eagles fed principally on waterfowl carrion; most attacks observed on healthy waterfowl were by immatures and were unsuccessful. It was not presumed that injured or diseased ducks, especially those incapable of flying or diving, were not vulnerable to predation. However geese, even in weakened condition, were apparently too large to be readily taken.

Observations of eagles capturing fish were similar to those reported by Southern (1963); the most prevalent and successful method was to swoop from a low perch and secure a fish with one or both feet. Eagles were also noted to soar in tight circles 10-15 m over open water and drop to capture fish. Adult eagles, believed to be fishing, were occassionally observed gliding 1-3 m over open water; however, no successful captures during passes were recorded. Eagles were consistently observed fishing at shallow water impoundments and Mississippi River backwaters; gizzard shad (*Dorosoma cepedianum*), 15-25 cm in length, was the only fish observed taken. Additional species were probably caught but were not identified.

SOME SUMMARY GENERALIZATIONS

The numbers of eagles now appearing each fall and winter in the southern Illinois region are many times that noted during 1949-1970. The bald eagle is probably re-establishing a population distribution in the Mississippi River Valley similar to its historic pattern. However, with man-induced developments as evidenced by dams and impoundments on the River and the created waters of Rend Lake, Crab Orchard, Union County, and Horseshoe Lake refuges, a once probably dispersed population now reflects focal points of concentration due to localized food supplies as provided by open waters below dams and concentrated populations of waterfowl, especially Canada geese. The availability of the latter is further enhanced by concentrated hunting which yields a considerable food source as injured and unretrieved dead birds. The developing security for this eagle population is further attested by the 1-3 nesting pairs each year recorded in southern Illinois since the mid 1970s. This recurrence of the bald eagle is to some degree a consequence of planned events associated with refuge development and management. However, significantly important has been the combined efforts of many who perserved in activities to protect the eagle from a variety of vicissitudes imposed by humans. Although many aspects of this raptor's recovery are now in place and subject of widely-prevalent management practices, continued mortalities are still unanswered by proper constraints. Presumably, man will not repeat the DDT episode; but all chemical use in our environment must be viewed with caution. However, the con-

tinued aversion of imposing a ban on use of lead shot is adequately documented a serious, imminent threat (Pattee and Hennes 1983); if not the entire upper Mississippi River Valley, at least several localized settings are suggested by this study as well as others to be potential, if not actual, problems. Further, zealous efforts to impact sites useful for expansion of wintering eagle needs, and the desire of the public to have a close look at feeding and roosting eagles, are locally critical to their best interest. Also, caution in forest harvest practices on state and federal refuges, national forests, and other public holdings must be emphasized as available and acceptable roost sites are unquestionable needs in some areas. Ultimately, even in southern Illinois, availability of suitable nest trees may be a factor to content with.

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Table 1. Tree characteristics of roost sites utilized by eagles at CONWR, UCCA, and HLCA, 1979-81.

Species	Importance Value*		
	CONWR	UCCA	HLCA
Sugar maple (*Acer saccharum*)	104	4	
Red maple (*Acer rubrum*)	16	3	
Box elder (*Acer negundo*)	28	5	
Green Ash (*Fraxinus pennsylvanica*)	3	35	
Sycamore (*Platanus occidentalis*)	29		
Cottonwood (*Populus deltoides*)		41	
Tupelo gum (*Nyssa aquatica*)			105
Bald cypress (*Taxodium distichum*)			95
Snag	6	90	
Total Density	233/ha	400/ha	497/ha
Total Basal Area	39m²/ha	53m²/ha	81m²/ha
Canopy Height	21.38 m	30.56 m	17.94 m
Average Roost Tree Height	31.60 m	30.10 m	21.62 m

*relative density plus relative basal area

Table 2. Food items identified in 239 bald eagle pellets collected beneath roosts at UCCA, HLCA, and CONWR, 1979-81.

Species	Percent Frequency of Occurrence			
	UCCA(89)* 1979-80	UCCA(50) 1980-81	HLCA(50) 1980-81	CONWR(50) 1980-81
BIRDS				
Canada goose (*Branta canadensis*)	82	65	98	80
Mallard (*Anas platyrhynchos*)	6	20	2	6
Widgeon (*Anas americana*)				4
Black duck (*Anas rubripes*)		4		
Unidentified	3	6		4
MAMMALS				
Rabbit (*Syvilagus floridanus*)	6	2		2
Muskrat (*Ondatra zibethicus*)	2	2	6	
White-tailed deer (*Odocoileus virginianus*)				6
Raccoon (*Procyron lotor*)		2		
Grey squirrel (*Sciurus carolinensis*)		2		
Fox squirrel (*Sciurus niger*)	1			
Opposum (*Didelphis marsupialis*)	1			
Unidentified		2	2	4
FISH		2	2	4

*number of pellets analyzed

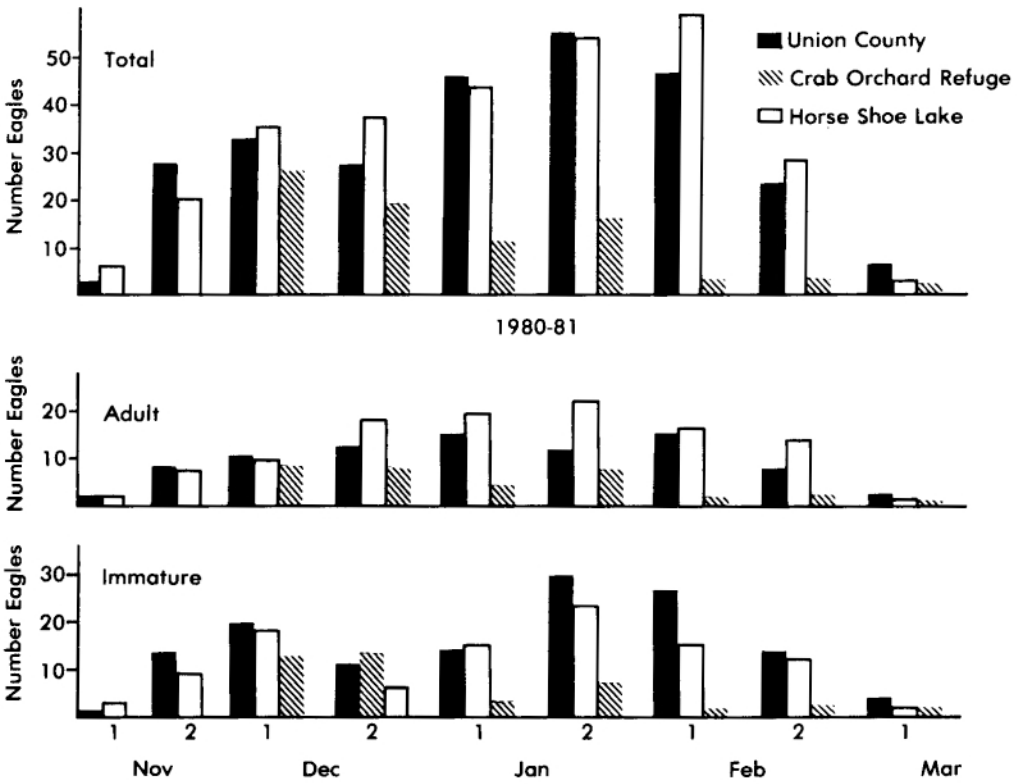

Fig. 1. Eagle populations for November 1980-March 1981, as recorded for UCCA, HLCA and CONWR.

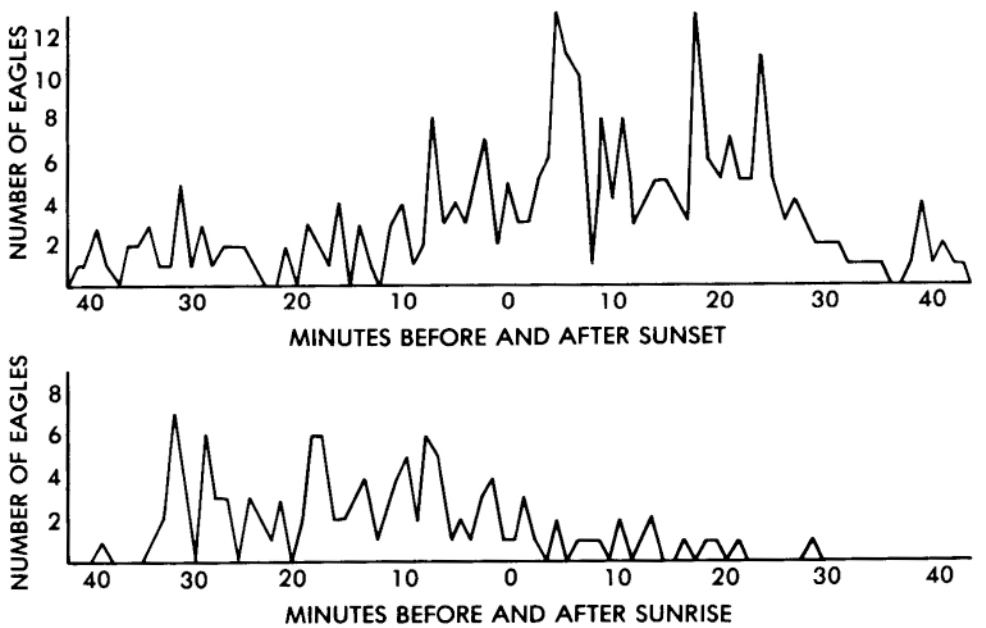

Fig. 2. Arrival and departure times of bald eagles at HLCA, UCCA, and CONWR, relative to sunrise(0) and sunset(0), 1980-1981.