

## SHORT COMMUNICATIONS

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### SEX DIFFERENCES IN NESTING SITE ATTENDANCE BY PEREGRINE FALCONS (*Falco peregrinus brookei*)

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The Peregrine Falcon (*Falco peregrinus*) usually shows a strong fidelity to its nesting site. Nonmigratory peregrines may be observed near the nest at any time of the year. According to the sex of the bird and the developmental period of its young, there are variations in the time a site is attended (Nelson 1970, Carlier and Gallo 1989). The purpose of this paper is to report sex differences in parental attendance in the nesting areas throughout the breeding period.

#### METHODS

Five peregrine pairs (*F. p. brookei*) were studied from courtship until fledging of their young in the region of Quercy, southwest of Massif Central, France. Observations totaled 525 hr, during 113 half days from 11 February to 28 June 1989. Observation bouts lasted either from daybreak until midday or from midday until dark, with each nesting area being studied at different times.

Sites where the nests were easily visible from at least 100 m away were chosen for observation. Most of the eyries were located on cliffs, three were in holes and two on ledges. All parents were adults at least 2 yr old, as indicated by their plumage.

Observations were made with a 20–60× telescope and 8× binoculars, using a continuous sampling method (Tacha et al. 1985). Behavior, movement and time notations were recorded on audio cassettes. Two areas were distinguished for each site: 1) the nest site, defined by the eyrie and its immediate surroundings, and 2) the nesting area, including the nest and the area around the nest that the pairs occupied.

Twelve developmental periods were distinguished during the breeding cycle: 1) courtship, 2) incubation, 3) pipped eggs, 4) early nestling period with young ≤10 d old, or 5) young between 10–20 d old, 6) late nestling period with young between 20–30 d old, or 7) young between 30–40 d old, 8) fledging period with young between 40–50 d old, or 9) young between 50–60 d old, or 10) young between 60–70 d old, or 11) young between 70–80 d old, or 12) young between 80–90 d old. If several observation segments occurred for the same site within a same period, they were pooled. A total of 55 observation segments were spent during the entire period.

#### RESULTS

**Attendance in the Nesting Area by Females.** There was a significant difference between periods in the proportion of time the females attended the nesting areas (Kruskal-Wallis  $H = 39.44$ ,  $df = 11$ ,  $P < 0.001$ ,  $N = 55$ ; Fig. 1). Attendance was negatively correlated with developmental periods (Kendall Rank Correlation Coefficient  $\text{Tau} = -0.641$ ,  $Z = -6.911$ ,  $P < 0.001$ ,  $N = 55$ ). The only increase in attendance occurred between incubation and pipped eggs, followed by a progressive decrease in attendance.

**Attendance in the Nesting Area by Males.** There was a significant difference in the proportion of time males spent in the nesting areas over the different periods (Kruskal-Wallis  $H = 29.1$ ,  $df = 11$ ,  $P < 0.002$ ,  $N = 55$ ; Fig. 1). As with females, attendance was negatively correlated with developmental periods (Kendall Rank Correlation Coefficient  $\text{Tau} = -0.498$ ,  $Z = -5.365$ ,  $P < 0.001$ ,  $N = 55$ ). In contrast to females, males spent little time in the nesting area between incubation and pipped eggs, but equal or more time than the females thereafter.

Female attendance overall in 55 nesting areas was higher than that of the males (Mann-Whitney  $U = 1145.5$ ,  $Z = -2.198$ ,  $P < 0.028$ ). Despite some differences, female and male attendance overall was positively correlated (Kendall Rank Correlation Coefficient  $\text{Tau} = 0.37$ ,  $Z = 3.986$ ,  $P < 0.001$ ,  $N = 55$ ).

**Simultaneous Attendance in the Nesting Area by Males and Females.** There was a significant difference in the proportion of time males and females spent at the nesting area together (Kruskal-Wallis test  $H = 35.75$ ,  $df = 11$ ,  $P < 0.001$ ,  $N = 55$ ; Fig. 1). Moreover, attendance was negatively correlated with developmental periods (Kendall Rank Correlation Coefficient  $\text{Tau} = -0.611$ ,  $Z = -6.585$ ,  $P < 0.001$ ,  $N = 55$ ).

Simultaneous attendance by males and females decreased sharply before hatching, remained rather stable until the young were 40 d old, and then decreased gradually.

**Attendance at the Nest Site by Females and Males.** There was a significant difference between developmental periods in the proportion of time that females spent at the nest sites (Kruskal-Wallis  $H = 43.9$ ,  $df = 11$ ,  $P < 0.001$ ,  $N = 55$ ; Fig. 2). Males exhibited a similar trend (Kruskal-

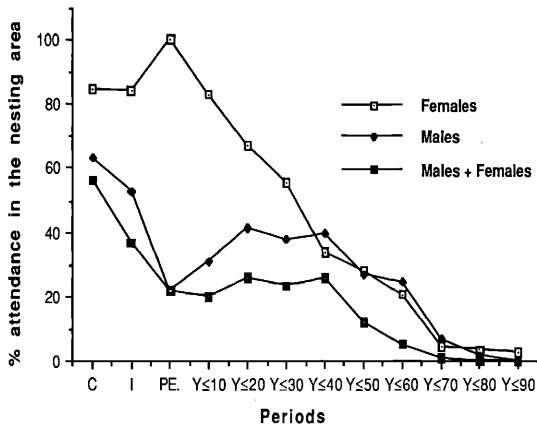


Figure 1. Proportion of observation time during which the nesting areas were attended by females, males, and males and females simultaneously. C represents courtship, I incubation, PE eggs pipping and  $Y < N$  the age of the young in days.

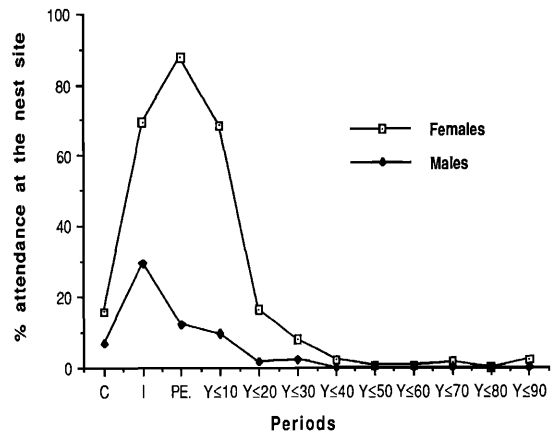


Figure 2. Proportion of observation time during which the nest sites were attended by females and males.

Wallis  $H = 35.3$ ,  $df = 11$ ,  $P < 0.002$ ,  $N = 55$ ; Fig. 2). As might be expected, attendance at the nest decreased as young grew and more presumably able to thermoregulate on their own (females, Kendall Rank Correlation Coefficient Tau =  $-0.614$ ,  $Z = -6.622$ ,  $P < 0.001$ ,  $N = 55$ ; males, Kendall Rank Correlation Coefficient Tau =  $-0.621$ ,  $Z = -6.696$ ,  $P < 0.001$ ,  $N = 55$ ). Attendance at the nest site sharply increased between courtship and incubation (for females Mann-Whitney  $U = 1$ ,  $P < 0.016$ ,  $N_1 = 4$ ,  $N_2 = 5$ ; for males Mann-Whitney  $U = 2$ ,  $P < 0.032$ ,  $N_1 = 4$ ,  $N_2 = 5$ ). However, when comparing the males to the females, it is worth noting the decrease in attendance time by the males between incubation and pipped eggs, while there was an increase in attendance time by the females over this period.

Overall female attendance at the eyrie was higher than that of the males (Mann-Whitney  $U = 1063.5$ ,  $Z = -2.788$ ,  $P < 0.005$ ,  $N_1 = N_2 = 55$ ). However, female and male attendances were positively correlated (Kendall Rank Correlation Coefficient Tau =  $0.577$ ,  $Z = 6.22$ ,  $P < 0.001$ ,  $N = 55$ ).

## DISCUSSION

The results suggest that both sexes spent much of their time at the nesting area during courtship. The maximum attendance of the males at the nesting areas occurred at this time. In contrast, attendance at actual nest sites varied among individuals and was significantly lower during courtship for both sexes than the attendance at the nest site during incubation. No quantitative results were available in the literature regarding the courtship period.

Both males and females incubated during the day, with an average female/male attendance ratio of 70 to 30, respectively. Males of different pairs ranged from about 15

to 50% in the proportion of time spent incubating. Females alone seemed to incubate during the night. These results are similar to those of other studies where males spent 12–33% of the daytime in incubation (Cade 1960, Herbert and Herbert 1965, Formon 1969, Nelson 1970, Enderson et al. 1972, Cramp and Simmons 1980, Ratcliffe 1980, Hustler 1983, Monneret 1987). Nelson (1970) stated that both sexes shared the incubation of the eggs in Langara Island, with only the female incubating during the night. According to Nelson, the proportion of the incubation done by each sex during daylight hours depended on the pair concerned and on the stage of incubation. He estimated that at mid-incubation, the male's share was probably between 30 and 50% of daytime incubation.

Concerning the attendance time during the pipped eggs period, there was an average female/male ratio of about 90 to 10 in this study. No comparable quantitative data are available in the literature. This phase is often quoted as the "end of incubation." Nelson (1970) pointed out that toward the end of incubation, the female tended to perform a higher proportion of the incubating. Monneret (1987) observed that males almost never came to the nest site after hatching. In the present study, there was an increase in the attendance in this period by the females at the nest site and a decrease by the males. The analysis of male-female relationships within pairs (Carlier and Gallo submitted for publication) underlies a possible explanation. It is suggested that from the moment of hatching the adults are motivated (need) both to feed and to brood the young. Therefore, it is the female, dominant over her mate, who does not "accept" the male at the nest site any longer and performs all brooding. The male hunts and brings prey to the nesting area, where the female most often takes the prey from him before he can attempt to perform feeding. In the same way, Nelson (1970) wrote, "Because, during the incubation and nestling phases, the female appears to be the dominant member of the pair at the nest ledge, the male's parental shifts are determined by the female's allowing of his take-over of incubation duties."

Further, Treleaven (1977) suggested that the male was not 'tolerated' at the eyrie by the female from hatching until the young were 10 d old. From a cognitive approach, immediately after egg pipping the brooding status changes from the point of view of the parents (Carlier and Gallo 1989). It results in a stronger investment from each of the parents, leading then to a "competition" for the care for the young.

After the "pipped egg phase," female attendance at the nest site decreased. This decrease become especially steep when young were >10 d old. These results are consistent with those of Nelson (1970) and those of Enderson et al. (1972). Such a significant decrease in attendance among the males was not observed between eggs pipping and young under 10 d (about 10% for both periods). These results may be explained by the female's dominance over the male. The 10% attendance by males may reflect what the females "allowed" them to do. Therefore, the males might have spent more time at the nest site if they were permitted to do so. The comparison between the males' attendance at the nesting area and the simultaneous male and female attendance in the nesting area suggests that the males may take advantage of the absence of the females in order to stay in the nesting area. The males' trend does not decrease during the nestling stage. Brown (1976) noted that males occasionally brooded older young during adverse weather. Moreover, it is worth noting that when the young were more than 20 d old, the attendance by the adults at the nest site was limited to prey transfer and feeding.

Cade (1960) estimated the fledgling dependence to be 70 d in length. This is consistent with our study where the attendance of at least one adult in the nesting area revealed a sharp decrease when young were 60-70 d old.

As a way of explanation of the sharing duties, Nelson (1970) pointed out that the female, by virtue of her larger size, is more efficient at incubating than is the male, and that the male peregrine is too small to brood or cover the nestlings properly or comfortably. However, it is worth noting that in no case could a motivation be directly inferred from an assumption about an ultimate function. Therefore, even if we cannot definitely assert that males and females have about the same parental motivation, whatever the breeding stage, male-female interactions should be taken into account when attempting to explain the attendance differences between sexes.

Although attendance by males and females varied between pairs, there was always at least one adult in the nesting area from incubation to egg pipping. Therefore, no matter how different the sharing duties within pairs may be, they did not result in any lack of protection for the brood.

**RESUMEN.**—La atención al sitio del nido de cinco pares de halcones silvestres de la especie *Falco peregrinus brookei*, fue estudiada durante el período de reproducción, en Querry, al sudoeste de Massif Central, Francia. Las observaciones fueron realizadas durante las mañanas o las tardes de 113 días, para un total de 525 horas de observaciones. 12 períodos de desarrollo fueron distinguidos según la presencia, la ausencia, o la conducta de las crías. En gen-

eral, la atención de las hembras en el área del nido y en el sitio mismo del nido fue significativamente mayor que la de los machos; la atención dada por ambos miembros de la pareja, sin embargo, fue positivamente correlacionada. Entre períodos de desarrollo hubieron significativas diferencias en la proporción de tiempo en que los nidos fueron atendidos; y en el total, con el transcurrir del tiempo, hubo una tendencia decreciente en la atención. Sin embargo, la atención al nido por parte de las hembras aumentó entre la incubación y el nacer de los pollos, mientras que decreció la que fue dada por el macho. Se sugiere que las hembras, por su dominación a los machos, limitaron en éstos la atención al sitio del nido. Por tanto, el nivel de la tendencia paternal de los halcones machos no puede asumirse solamente en base a la conducta paternal observada, sin tener en cuenta, en su totalidad, las relaciones macho-hembra en el sitio del nido.

[Traducción de Eudoxio Paredes-Ruiz]

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## ARE BALD EAGLES IMPORTANT PREDATORS OF EMPEROR GEESE?

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Bald Eagles (*Haliaeetus leucocephalus*) and geese often occur together, especially at sites used by geese for migrational staging and wintering. Although numerous studies have been directed at these taxa, there are only anecdotal accounts (Parris et al. 1980, Bennett and Klaas 1986, Bartley 1988) of Bald Eagles killing healthy geese at any time of the year (but see Raveling and Zezulak 1991). Most species of geese may be too large, as suggested by Sherrrod et al. (1976) and Palmer (1988), or they may not regularly allow eagles an advantageous attack position (J.M. Gerrard *in litt.*).

Here we report observations of attacks on Emperor Geese (*Chen canagica*) by Bald Eagles on the Alaska Peninsula in autumn. We discuss these and other observations of eagle-geese interactions *vis-a-vis* the role of Bald Eagles as predators of Emperor Geese.

### STUDY AREA AND METHODS

We recorded observations on the occurrence and behavior of Bald Eagles and Emperor Geese during a three-year study (1986-88) of Cackling Canada Geese (*Brantha canadensis minima*) staging at Cinder and Hook lagoons (57°15'N 158°15'W), two large, adjacent estuaries on the northeastern Alaska Peninsula (Gill et al. *in press*). Observations were made daily from blinds and on foot between the last week of September and the last week of October each year. We also interviewed several long-time residents of the Alaska Peninsula and most biologists involved in on-ground studies there during the past 25 yr.

Several hundred Bald Eagles are year-round residents of the Alaska Peninsula, but probably fewer than 40 pairs nest along the north side of the peninsula (Wright *in press*, Dewhurst *in press*). Each year, however, between July and November, many eagles gather among five or six prominent estuaries along the north side of the peninsula. They are presumably attracted to these sites because of the large runs of anadromous fish and the large concen-

trations of staging waterfowl, primarily eiders (*Somateria mollissima* and *Polysticta stelleri*) and geese (Cackling Canada, Emperor, and Brant geese *Brantha bernicla*). Indeed, between September and November each year most of the entire population of Emperor Geese (about 90 000 birds) stages on these estuaries (Petersen and Gill 1982, King and Brackney 1991). About 15 000 of these use Cinder-Hook Lagoon (R. Gill unpubl.).

### OBSERVATIONS

Our first observation of an attack occurred on 12 October 1987, when we saw an adult Bald Eagle in aerial pursuit of a flock of 12 Emperor Geese. The eagle separated a juvenile goose from the flock, grabbed it by the back and neck with its talons, and then flew with it for about 400 m before landing and eating the goose.

Our second observation, on 27 October 1987, involved an attack on a goose by six eagles. One adult eagle flushed a flock of 40 Emperor Geese and attacked an adult, knocking it from the air. The eagle landed about 200 m away but did not try again to kill the goose. Over the next 20 min, five different eagles (two adult, one subadult, and two hatching-year birds) stooped individually on the goose a total of 16 times. The goose was able to evade each attack, and none of the eagles hit the goose again. About 30 minutes after the initial attack, the goose took flight from the mudflats surrounded by seven perched eagles, none of which made any attempt to attack the goose once it was in the air.

### DISCUSSION

From interviews we learned of only seven other successful attacks observed when the two species occur together on the Alaska Peninsula (September-April); five of these entailed juvenile geese (G.V. Byrd, P.J. Kust, P.E. Gundersen, and J.A. Schmutz pers. comm., R. Gill pers. observation). The sole published account, from the Aleutian Islands (Sherrrod et al. 1976), documented a Bald Eagle catching an adult Emperor Goose and carrying it to a sea stack.

Another point of evidence is that Bald Eagles have frequently been seen feeding on carcasses of recently killed

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