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OBSERVATIONS OF AGGRESSIVE INTERACTIONS BY BALD EAGLES OF KNOWN AGE AND SEX[1]

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Key words: Bald Eagle; Haliaeetus leucocephalus; *interactions; supplanting; dominance.*

Bald Eagles (*Haliaeetus leucocephalus*) are widely known to compete with conspecifics for food both by pirating small prey items and by supplanting other individuals at large prey items (McClelland 1973, Stalmaster 1976, Sherrod et al. 1977, Knight and Knight 1983). The effect of plumage (adult, subadult, immature) and relative size on the outcome of these interactions has been described by others (Griffin 1981, Stalmaster and Gessaman 1984, Hansen 1986, Knight and Skagen 1988), however, the actual sex of the eagles was unknown in these studies.

As part of a reintroduction attempt on Santa Catalina Island, California, Bald Eagles that were reared and released from artificial nest (hacking) platforms from 1980 through 1984 were observed to determine their time and activity budgets. Here I report on the outcome of supplanting attempts between 11 individuals of known age and sex.

METHODS

Eagles were sexed by morphometrics or karyotyping (Garcelon et al. 1985), or by observing a bird's behavior during nesting (e.g., egg laying). Weights were obtained on eight of the 11 eagles that we observed in

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this study. An eagle's weight was taken either just prior to fledging, or when the eagle was trapped 1–2 years later. Mean weight for females was 4,745 g (n = 4), and for males was 3,375 g (n = 4). While the fledging weights of raptors may be higher than older birds, the magnitude of the differences between the sexes should be similar. Prior to release on the island each eagle was fitted with wrap-around patagial wing markers and backpack-mounted telemetry transmitters (Garcelon 1988) for individual identification. Observations of eagle supplanting attempts were recorded for sex and age of the birds involved, and whether the supplanting attempt was successful. A successful supplanting was defined as one where the aggressor replaced or removed the recipient from a perch, or moved the recipient more than 1 m from a carcass or position on the ground near a carcass. In order to better examine relationships between different age classes, same-aged individuals were pooled disregarding sex. A chi-square contingency or Fisher's exact test was used to test for differences of age and sex on outcomes of interactions.

RESULTS

Individual eagles initiated interactions with one to four other individuals. In supplanting attempts by birds of the same age but different sex, there was a significant difference in the proportion of successful female-initiated attempts compared to those attempts initiated by males ($P < 0.001$). Female eagles initiated 46 supplanting attempts and were always successful. Only four of the 46 attempts (8.6%) initiated by females included physical contact (use of talons or wing slapping). Male eagles initiated fewer intersexual supplanting attempts (n = 12) and were successful in five (42%). Of the attempts made by males, six included physical contact with the defending female.

I observed 28 supplanting attempts involving two birds of different age and sex (Table 1). Pooling birds by age (disregarding sex) showed no significant difference in successful supplantings by older birds over younger birds (P = 0.21). When pooled by sex, regardless of age, there was a significant difference between females and males (P = 0.04), with females being more successful at supplanting males.

When supplanting attempts by eagles of different age and the same sex were examined no significant difference in the success of attempts could be attributed to age (P = 0.36). When older birds initiated supplanting attempts against younger birds of the same sex, they were successful in four of five attempts. Younger birds initiating supplanting attempts against older birds of the same sex were successful in all nine attempts. Supplanting attempts between eagles of the same age and sex did not elucidate any pattern of hierarchy among the birds; the number of attempts initiated by males was similar to that of females, six and nine, respectively.

TABLE 1. Outcomes of supplanting attempts by Bald Eagles of different sex and different age, from 1981 through 1984. Older and younger refer to at least 1 year difference in age between the Bald Eagles involved in the supplanting attempts.

Initiator	Defender	Outcome	
		No. successful	No. unsuccessful
Older female	Younger male	3	0
Older male	Younger female	4	2
Younger female	Older male	15	0
Younger male	Older female	3	1

DISCUSSION

Factors affecting the outcome of pirating and supplanting attempts by Bald Eagles have been discussed by others (Griffin 1981, Stalmaster and Gessaman 1984, Hansen 1986, Knight and Skagen 1988). These factors included age, size, hunger level, mode of attack, displays, and availability of food. Hansen (1986) suggested that eagles assessed the relative fighting ability or expected payoffs of opponents and then acted accordingly.

In interspecific assemblages of scavenging birds, larger birds were generally shown to be dominant in both inter- and intraspecific interactions (Petrides 1959, Andersen and Horwitz 1979, Wallace and Temple 1987). With Bald Eagles, size also appeared to be a major factor in determining the success of an interaction. In this study, female eagles were 29% heavier than male eagles. In 40 outcomes ranked by size, Hansen (1986) found larger Bald Eagles won 85% of the time. Knight and Skagen (1988) found that larger eagles, regardless of age, were successful in pirating from eagles of all sizes. My results were consistent with these data; female (i.e., large) eagles were always successful in supplanting male (i.e., small) eagles of the same age.

The effect of age on the success of an interaction appeared to be more variable and less important than size. Hansen (1986) found that adult eagles won 92 contests against younger birds (subadult and immature classes) and lost 94, while juveniles attacking adults won contests much more frequently than adults pirating from juveniles. However, Stalmaster and Gessaman (1984) found that older eagles were significantly more successful in supplanting and stealing food from younger birds, although relative sizes were not reported. Griffin (1981) found that both adults and immature eagles were highly successful in supplanting each other.

In this study, the relative importance of size vs. age was further exemplified by the lack of a significant difference in the success of interactions between birds of the same sex, but of different age. For Andean Condors (*Vultur gryphus*), males were generally larger than females, and young male condors were generally subordinate to females more than 1 year older, even though males may have weighed as much as one-third more (Wallace and Temple 1987).

While male Bald Eagles made significantly fewer supplanting attempts against females of the same sex, they escalated the interactions to include contact more often than females. However, because males almost always gave way to an approaching female, there may have been no need for females to escalate an interaction.

Knight and Skagen (1988) observed significantly more instances of physical contact during pirating attempts

when food was scarce. Hansen (1986) also equated instances of talon-to-body contact with relative scarcity of food. He found 4.5% of the interactions included contact during food scarcity, while only 0.6% included contact when food was abundant. Hunger was likely the driving factor causing the increased aggression exhibited by eagles during food scarcity. In this study, one male used contact in an interaction against a female of the same age after the male had been away from the hacking platform for 16 days; the male had been followed closely by telemetry and was not known to have fed during that period.

In this study, size appears to be the most important factor in determining the outcome of an interaction. While age (as displayed by plumage) may be used by eagles to evaluate the potential fighting ability of opponents, it may not be as important as size. Knight and Skagen (1988) found that the probability of a small eagle supplanting any other eagle was low unless a small adult was attempting to pirate from a small immature. Other factors, such as hunger level (Hansen 1986), may act as modifiers which alter the risk/benefit associated with challenging a potentially more dangerous (i.e., larger and/or older) opponent.

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CLUTCH SIZE, OFFSPRING QUALITY, AND FEMALE SURVIVAL IN TREE SWALLOWS—AN EXPERIMENT[1]

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Key words: Tree Swallow; Tachycineta bicolor; *clutch size; adult survival; offspring size.*

Many proximate factors, such as time of season, geographical location, and the age of the female are known to affect clutch size in birds (Klomp 1970, Murphy and Haukioja 1986). From an ultimate perspective, Lack's (1947, 1966, 1968) viewpoint, that individuals set their clutch size to the level that produces the maximal number of offspring contributed to the next generation, has recently been modified to account for annual fluctuations in environmental conditions (Van Noordwijk et al. 1981, Boyce and Perrins 1987). While some authors have argued that a cost of reproduction, via adult survival, has acted as the major constraint on clutch size (Williams 1966, Charnov and Krebs 1974), several recent studies have provided no evidence of such costs (De Steven 1980, Smith 1981, Boyce and Perrins 1987,

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