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Received 21 December 1994; accepted 30 May 1995

*J. Raptor Res.* 29(3):210–213


## COOPERATIVE NESTING BY A TRIO OF BALD EAGLES

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KEY WORDS: *bald eagle*; *breeding*; *California*; Haliaeetus leucocephalus; *nest helpers*.

Helpers at the nest have been reported in at least 222 bird species and are widespread taxonomically (Skutch 1961, Grimes 1976, Rowley 1976, Zahavi 1976). Although rare among raptors, helping occurs regularly at nests of the cooperatively breeding Harris' hawk (*Parabuteo unicinctus*; Mader 1975) and Galápagos hawk (*Buteo galapagoensis*; Faaborg 1986). Helpers at the nests of raptors not considered to be cooperative breeders have been reported for the peregrine falcon (*Falco peregrinus*; Spofford 1969), red-tailed hawk (*Buteo jamaicensis*; Wiley 1975), merlin (*Falco columbarius*; James and Oliphant 1986), Mississippi kite (*Ictinia mississippiensis*; Parker and Ports 1982), American kestrel (*Falco sparverius*; Wegner 1976), and Eurasian sparrowhawk (*Accipiter nisus*; Newton 1973)

Bald eagles (*Haliaeetus leucocephalus*) are monogamous and highly territorial (Stalmaster 1987). Sherrod et al. (1977) observed three adult bald eagles at two nests on Amchitka Island, Alaska, and Fraser et al. (1983) did so for a nest in Minnesota. Neither, however, presented details on the involvement of the third adult. In this paper we describe a trio of bald eagles that cooperated in territory defense, incubation and the provisioning of nestlings through fledging.

### STUDY AREA AND METHODS

In 1980 a program was initiated to reestablish breeding bald eagles onto Santa Catalina Island, where the species was extirpated by the early 1960s (Garcelon 1988). The island is approximately 194 km$^2$ and is located 34 km southwest of Long Beach, California. Because residual DDE compounds remained in the environment (Garcelon et al. 1989), nesting attempts early in the program failed,

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Table 1. Participation by adults in nesting activities at three bald eagle nests in 1992 on Santa Catalina Island, California. One territory consisted of a trio of adults and the other two each consisted of a pair. $N$ = total number of times each activity was observed at each nest.

| | Trio Nest | | | | Pair A | | | Pair B | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Activity | % Male | % Female | % Helper | ($N$) | % Male | % Female | ($N$) | % Male | % Female | ($N$) |
| Prey delivery | 67 | 16 | 17 | (77) | 68 | 32 | (74) | 58 | 42 | (33) |
| Feeding eaglet | 22 | 45 | 33 | (117) | 26 | 74 | (94) | 6 | 94 | (69) |
| Nest material delivery | 17 | 34 | 46 | (67) | 45 | 55 | (38) | 20 | 80 | (20) |

and the manipulation of eggs and the fostering of nestlings were initiated.

In 1991, two eggs were removed from a nest at the northwest end of the island and replaced with a viable egg. During the incubation period a third adult attempted to enter the territory on several occasions, but was driven off by a member of the nesting pair. The intruder was seldom seen in the territory after the egg hatched. In January 1992, a video camera was placed near the nest to document egg-laying times and identify prey items.

The three adults were identified by the following characteristics: (1) one eyelid of the paired female was closed because of an injury suffered during the 1992 breeding season, (2) the third eagle was smaller than the paired female, and (3) the paired male was the smallest of the three birds, and was banded on the opposite leg from the other birds. Although sex was known for all eagles released on the island, the third eagle was not color-marked and we were unable to determine its sex or age. On 24 March the clutch was taken for captive incubation and replaced with dummy eggs.

## Observations

Three adult eagles were seen simultaneously in the area prior to egg laying, and on 15 March 1992, the mated pair laid the first of two eggs. On 20 April, the third eagle was confirmed to be participating in incubation. Problems with the video-monitoring system prevented determining the percentage of time the helper incubated.

On 2 May, we placed a foster eaglet approximately 2-wk-old in the nest. All three adults participated in brooding, feeding, and procuring food for the eaglet. On a few occasions all three adults were observed either standing or lying in the nest with the eaglet. On five occasions the helper and mated female were observed feeding the eaglet simultaneously, and in one instance the mated female tore food from a prey item, and relinquished it to the helper which then fed the eaglet. During four other feeding bouts the helper appeared to steal food from the beak of the mated female, and then either consumed it or fed it to the eaglet.

Based on comparisons with adult birds at two other active nests on Santa Catalina Island, our observations indicate that the paired female at the trio nest derived a greater energetic benefit from the presence of the helper than did the male (Table 1). For example, although adult males at all three nests made similar percentages of prey deliveries, the mated female at the trio nest procured food only half as often as the females at the other two nests (Table 1).

On 15 June, we visited the trio nest to band and equip the eaglet with a radio-telemetry transmitter. All three adults aggressively defended the nest while researchers were in the area. On 16 or 17 July the nestling fledged, and the three adults were still in the territory on 9 September when observations ended. Although a considerably smaller amount of time was spent observing this nest in 1993 and 1994, a trio of adult eagles was present at this nest each year during the entire breeding season, and they reared a fostered nestling on each occasion.

## Discussion

If the helper bird was a female, as suspected because of its size compared to the adult pair, helping behavior may have been driven by a lack of available mates. Skewed sex ratios have been suggested to lead to cooperative breeding in certain species (Emlen 1978, Faaborg et al. 1980, Reyer 1980) as has habitat saturation (Woolfenden and Fitzpatrick 1984). During the three breeding seasons when a trio of bald eagles nested cooperatively, only 8–11 adult birds were known to be on the island, and four of these were unpaired adult females. In addition, the closest breeding population of bald eagles (more than one pair) was more than 650 km from the island; thus, no alternative breeding areas or mates were readily available.

Trivers (1972) and Maynard-Smith (1977) postulated that for an animal to maximize its inclusive fitness it should regulate its investment in offspring relative to expected costs and benefits. Among other factors, the coefficient of relatedness to the young it rears can determine the benefit a helper will receive in terms of its fitness (Reyer 1984). While helpers are generally related to the breeding pair that they are assisting (Skutch 1987), this is not always the case (Rood 1978, Reyer 1984).

If inclusive fitness is excluded as the potential benefit for the helper at the Catalina Island eagle territory (assuming the helper did not lay one of the two eggs), other possible benefits such as gaining breeding experience or inheriting a breeding territory (Woolfenden and Fitzpatrick 1984) might have been the reward. It is extremely unlikely the helper eagle on Catalina Island gained an inclusive fitness benefit from tending the eggs and eaglet, given that all eagles present on the island were originally

removed as nestlings from different nests located throughout the Pacific Northwest.

If the male eagle of a pair does not have to forage to support the helper, and the helper cares for the egg and nestling, defends the territory, and assists in procuring food, then it is beneficial for the male to allow the presence of the helper. Also, in some species where helpers are common, productivity at nests with helpers is generally higher compared to nests without helpers (Woolfenden 1975, Reyer 1980, Rabenold 1984).

RESUMEN.—En 1992, fue encontrado un territorio de *Haliaeetus leucocephalus* en Santa Catalina Island, California, con tres adultos presentes en un nido. Desde 1992 hasta 1994, la pareja consorte y un ayudante (probable hembra participaron en la incubación de los huevos, empollamiento, alimentación del polluelo y obtención de alimentos. La asistencia de un ayudante en el nido, permite gastar menos tiempo a la pareja en obtener presas y alimentar a los polluelos, en camparación con dos nidos y con una sola pareja de adultos en cada uno.

[Traducción de Ivan Lazo]

ACKNOWLEDGMENTS

We acknowledge the assistance of the following people in obtaining behavioral data at the nest sites: D. Delaney, W. LaHaye, J. Manning, G. Roemer, R. Tanner, and S. Tomassi. The manuscript was improved by comments from J.W. Parker, P.C. James, and G. Roemer. The Santa Catalina Island Conservancy graciously allowed the research to be conducted on their property. Funding was provided by the U.S. Fish and Wildlife Service.

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Received 17 October 1994; accepted 15 May 1995