

VIERAEA	Vol. 39	105-110	Santa Cruz de Tenerife, octubre 2011	ISSN 0210-945X
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Observations on alloparental care of fledglings in Osprey *Pandion haliaetus* (Aves, Pandionidae)

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SIVERIO, M., F. SIVERIO & B. RODRÍGUEZ (2011). Observaciones de atención aloparental de pollos volanderos en el águila pescadora *Pandion haliaetus* (Aves, Pandionidae). *VIERAEA* 39: 105-110.

RESUMEN: Describimos la adopción y la atención aloparental de pollos volanderos por una pareja de águila pescadora, durante dos temporadas de cría consecutivas (2008-09), en la pequeña población semicolonial y rupícola de Tenerife (islas Canarias). Las polladas intrusas (dos pollos volanderos cada año) cambiaron de nido pocos días después de volar (≤ 10 días en 2008 y ≤ 6 en 2009). Usaron el nido receptor y los posaderos junto con las polladas genéticas, y fueron alimentadas por la pareja adoptiva. La corta distancia entre nidos vecinos y unas características orográficas ventajosas del territorio receptor parecen ser las causas principales que motivaron estos comportamientos.

Palabras clave: águila pescadora, *Pandion haliaetus*, adopción, atención aloparental, nidificación semicolonial, Tenerife, islas Canarias.

ABSTRACT: We describe the adoption and alloparental care of fledglings by an Osprey pair during two consecutive breeding seasons (2008-09) in the small and semi-colonial cliff nesting population of Tenerife (Canary Islands). The intruding broods (two fledglings each year) switched nest a few days after fledging (≤ 10 days in 2008 and ≤ 6 in 2009). They used the recipient nest and perches together with the genetic broods, and received alloparental feeding. The short distance between neighbouring nests and advantageous terrain characteristics of the recipient territory seem to be the main reasons that led to these behaviours.

Key words: Osprey, *Pandion haliaetus*, adoption, alloparental care, semi-colonial nesting, Tenerife, Canary Islands.

INTRODUCTION

Adoption and alloparental care is a phenomenon present in many animal species (Riedman, 1982). In birds, several hypotheses have been raised to explain facultative nest switching in fledglings, among others these include: distance between nests (Bustamante & Hiraldo, 1990; Ferrer, 1993), inter-generational conflict (Pierotti & Murphy, 1987; Redondo *et al.*, 1995; Berggren, 2006), kin selection (Poole, 1982), reciprocal altruism (Pierotti, 1980), and reducing the ectoparasite exposure through redistribution among adoptive family members (Bize *et al.*, 2003).

Records of natural adoption and alloparental care in raptors include both diurnal (Donázar & Ceballos, 1990; Arroyo & García, 2002) and nocturnal species (Roulin, 1999; Penteriani & Delgado, 2008). This behaviour occurs not only in colonial or semi-colonial birds of prey (Donázar *et al.*, 1991; Arroyo & García, 2002), but also in species whose nests are usually widely isolated (Donázar & Ceballos, 1990; Ferrer, 1993). In general, the altricial state of most raptor nestlings restricts this behaviour, although in dense colonies, such as those of the Lesser Kestrel (*Falco naumanni*; nesting on tiled roofs), nestlings are able to walk to neighbouring nests before fledging (Tella *et al.*, 1997).

The few studies that have addressed this behaviour in Osprey (*Pandion haliaetus*) generally suggest that the younger fledgling (the subordinates) of large broods are the ones that move to a neighbouring nest (with a younger brood) where they can become dominant (Poole, 1982; Gilson & Marzluff, 2000). In this paper we describe the natural adoption of intruding fledglings by an Osprey pair in a neighbouring territory during two consecutive years. We also discussed the possible scenarios involved, and warn of the errors that could result if population monitoring failed to detect these events.

STUDY AREA AND METHODS

We collected data at the sea cliffs of the Teno massif, NW of Tenerife Island (Canarian archipelago, 27°37'-29°25' N and 13°20'-18°19' W), during the post-fledging dependence period in the 2008 and 2009 breeding seasons. We recorded observations as part of a long-term research project monitoring density, laying phenology, hatching success and nesting success of the Osprey population in this area (Siverio, 2006; Siverio, 2008). Over two years of study the population has ranged between four and five pairs, and the average distance between neighbouring nests was 1700 m (range 687-3385, $n = 4$ pairs) and 1098 m (range 388-3000, $n = 5$ pairs), respectively. As in much of the Osprey's range, these nearest-neighbour distances also reveal the trend of this rupicolous population towards semi-colonialism (Poole, 1989).

We conducted three observation sessions during the post-fledging dependence period, one in the first year (16 June 2008; 09:10-13:35 h GMT) and two in the second (18 and 27 June 2009; 10:00-16:00 and 08:30-15:30, respectively), over a total of 17.25 hr. Observations were made using binoculars and telescopes (20x-60x) from the top of the cliff where there is an optimal visibility of the nest (about 200 m distant) and of the commonly used perches of the recipient territory, as well as a large segment of the emitting territory. The

genetic broods of the recipient pair were marked with metal and colour rings with alpha numeric code (intruding broods were not marked), and the recipient territory pair was individually identified by the plumage pattern on the pileus (Bretagnolle *et al.*, 1994). Each observation session was taken as a sampling unit, and the attack rate (AR) was calculated by dividing the number of attacks (aggressive intraspecific interactions) between the hours of observation (see Margalida & Bertran, 2005).

RESULTS

The recipient nest and the intruders' natal nest (687 m apart) were in the same location in 2008 and 2009, and were the only successful nests in the two nesting seasons. In 2008 and in the first observation session of 2009, the intruding broods (two fledglings each year) and the genetic broods of the recipient pair (one in 2008 and two in 2009) were about 70 and 65 days (d) old, i.e. about 10 and 6 d after fledging, respectively. During these two observation periods the intruding fledglings were recorded in the nest of the recipient pair for an average of 50 min (\pm 59 SD; range 3-180, $n = 9$; 43% of the whole observation time). During the rest of the time the intruders remained in the recipient territory, either in flight or on well defined perches. No agonistic behaviours were recorded between intruder and genetic fledglings, neither when they were together in the recipient nest (both broods), nor when they used communal perches.

In general, the recipient pair tolerated the presence of the intruders, with just two incidents recorded (one by the male and another by the female) of agonistic behaviour toward the intruder fledglings (AR = 0.13); this persecution lasted 3.20 min, 0.3% of the total observation time. Alloparental feeding was recorded in both years. In 2008, the two intruders were fed at the same time as the genetic fledgling, and in 2009 (second observation session) an intruder was observed to be fed at the same time as the genetic fledgling. During the three observation periods the recipient pair defended the territory when the genetic parents of the intruders flew into it (AR = 0.4 ± 0.2 SD), investing in this 1.34 min on average (\pm 2.53 SD; range 0.5-8; $n = 7$).

DISCUSSION

Given that the Osprey is generally a semi-colonial bird (Poole, 1989), fledgling nest-switching behaviour observed in Tenerife appears to be related to the proximity of the emitter and recipient nests (687 m apart). Distance between nests was also considered as one of the main motivations for nest-switching by fledglings in North America (Poole, 1982; Gilson & Marzluff, 2000) and on the island of Menorca, Mediterranean Sea (R. Triay, pers. comm.). In studies of other raptors that normally nest in isolation, e.g. Red Kite (*Milvus milvus*), Imperial Eagle (*Aquila adalberti*), Egyptian Vulture (*Neophron percnopterus*), and Eagle Owl (*Bubo bubo*), nest-switching also occurs when population densities are high and distances between neighbouring nests are reduced (Bustamante & Hiraldo, 1990; Donázar & Ceballos, 1990; Ferrer, 1993; Penteriani & Delgado, 2008).

In studies that have addressed adoptions in Osprey, most nests involved (emitters and recipients) were on artificial platforms (Gilson & Marzluff, 2000), usually less than 10 m high and in open habitats where neighbouring nests are in line-of-sight (Poole, 1982). Such situations of proximity would facilitate nest-switching, perhaps due to the stimulus that produces on fledglings food deliveries seeing in neighbouring nests (Poole, 1982). The nests under study on Tenerife are not within sight of each other, but peculiarities of the recipient territory terrain may be more favorable for intrusions to occur. The two territories are in the same bay, facing SW, with a high insolation level after midday. However, the intruders' natal nest is 100 m above sea level (a.s.l.) at one end of the bay on a vertical cliff (with no beach at the base) and more than 300 m in height. In contrast, the recipient nest is situated in the centre of the bay, at 50 m a.s.l., on a cliff (with a beach on the base) which is less vertical and lower in height, and it is dissected by the perpendicular mouth of a ravine. This territory has many more shaded perching areas which appear to have a strong attraction for the broods (intruder and resident) and the foster adults, where they spend long periods of time. In this regard, before the subject nests of this study had been built, in 2006, ringed fledglings from nearby territories used these same shaded perches, including the natural ledge where the recipient nest is now placed. One fledgling came from a nest at about 1200 m away, whereas the other two were from a nest 300 m away (M. Siverio, unpubl. data).

The growth phase of the intruder nestlings before fledging was apparently adequate, so it is unlikely that our examples of nest-switching were related to intergenerational conflict (poor nest provisioning), i.e. when an inadequate amount of food is offered to a nestling by its parents this may induce it to beg for food at a foreign nest (Pierotti & Murphy, 1987). Moreover, the adoptions occurred when intruders had been flying ≤ 10 d in 2008 and ≤ 6 in 2009, suggesting that their parents were still feeding them frequently. The intruders, on the other hand, could not behave as dominants, because fledglings from the recipient nest were of the same age and because dominance behaviour is more likely to occur when they are older than the recipient nest fledglings (Poole, 1982; Bustamante & Hiraldo, 1990; Redondo *et al.*, 1995; Gilson & Marzluff, 2000). The adoption, in our study, of a whole brood by a pair with young of the same age would supposedly diminish the food intake of all fledglings (intruders and genetic). However, this was not reflected in the external appearance or behaviour of the four fledglings during the third observation session in 2009 (nine days after the second), leading to suspicion that the genetic parents of the intruders also may feed both their own and other local fledglings as they were seen carrying prey near the recipient nest.

Generally, Osprey pairs seem to recognize their own descendants, tolerating fledglings that are not their own, but defend their territory from conspecific adults (Poole, 1982). The foster pair of our study showed no abnormal behaviour towards their genetic fledglings, but on two occasions attacked the intruders (e.g. the female chased the two intruders at the same time). However, alloparental feeding, AR and the limited time spent in these chases suggest that a high level of tolerance prevails. Moreover, on one occasion the foster female spent an hour at the nest near an intruder while it was eating, and on another occasion the foster male delivered prey to an intruder fledgling in response to begging when it was perched in the recipient nest. We do not know if this tolerance is associated with the degree of relatedness between the intruders and the recipient pair (kin selection hypothesis),

but it seems conceivable, given the high level of philopatry in this species (Poole, 1989; Dennis, 2007). However, this is potentially a maladaptive reproductive error for the foster pair (Gilson & Marzluff, 2000), and it is more likely that adoption is the result of a “conformity” or instinctive response behaviour by these adults, since the energy cost invested in frequent chases towards the intruders would not be compensated (see Penteriani & Delgado, 2008).

Although Bustamante (1995) found no adoptions or any type of alloparental care over 35 years monitoring an Osprey nest, these behaviours may occur more frequently than thought (Poole, 1982; Gilson & Marzluff, 2000). Therefore, in populations that are poorly monitored, undetected cases of alloparental care could lead to errors in the calculation of nest success. Especially if fledglings are not ringed or nests are not regularly checked before fledging, i.e. casual observation of the number of fledglings at a nest does not necessarily infer that all are at their natal nest.

ACKNOWLEDGMENTS

We would like to thank Terry E. Dennis, Airam Rodríguez and Karen Steenhof for their suggestions which contributed to improve the manuscript. Thanks also to Rubén Barone and Guillermo Delgado for their comments to the final text.

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