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Brood Reduction by Infanticide in Peregrine Falcons

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ABSTRACT. This note describes an observation of infanticide in the Peregrine Falcon (*Falco peregrinus tundrius*). During the summer of 2011, a marked adult female and an unmarked adult male produced and hatched two eggs at a known and regularly monitored nest site. Motion-sensitive camera images indicated that the adults attended to the two nestlings and fed them in a manner that resulted in growth and development typical for the nestlings produced in the study population. During a period of intense rainfall, the two nestlings were left unattended for several hours; both nestlings were clearly distressed, and one was close to death. When the visibly wet marked adult female returned to the nest ledge, she killed and partially consumed the smaller and weaker of the two nestlings. The female flew from the nest ledge without feeding the remaining nestling and returned shortly afterward to kill and partially consume the second nestling. This is the first documentation of infanticide in wild Peregrine Falcons.

Key words: infanticide, avian, brood reduction, asynchronous hatch, cannibalism, Peregrine Falcon, Arctic, core brood, marginal brood

RÉSUMÉ. Cet article décrit une observation d'infanticide chez le faucon pèlerin (*Falco peregrinus tundrius*). À l'été 2011, une femelle adulte baguée et un mâle adulte non bagué ont produit et couvé deux œufs à un site de nidification connu qui fait l'objet d'une surveillance régulière. Les images de caméras à détection de mouvement ont permis de constater que les deux adultes se sont occupés des deux oisillons et les ont nourris au point où ils ont pu grossir et se développer de manière typique aux autres oisillons visés par la population à l'étude. Pendant une période de pluie intense, les deux oisillons ont été laissés à eux-mêmes pendant plusieurs heures. De toute évidence, les deux oisillons étaient en détresse, et l'un d'entre eux se mourait. Lorsque la femelle adulte baguée visiblement trempée a regagné la corniche, elle a tué et consommé partiellement l'oisillon le plus petit et le plus faible. Ensuite, la femelle s'est envolée de la corniche sans nourrir l'autre oisillon, puis elle est revenue peu après pour tuer et consommer partiellement le deuxième oisillon. Il s'agit de la première fois qu'un cas d'infanticide est répertorié chez le faucon pèlerin en liberté.

Mots clés : infanticide, avien, réduction de la couvée, éclosion asynchrone, cannibalisme, faucon pèlerin, Arctique, couvée principale, couvée marginale

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INTRODUCTION

In an examination of the significance of clutch size in birds, Lack (1947) proposed that asynchronous hatch within broods was an evolutionary adaptation to accommodate unpredictable seasonal food supply. The youngest (and usually the smallest) nestlings were predicted to thrive in years when food was plentiful, but were expected to die under environmental conditions associated with low food supply. Mock and Forbes (1995) pointed out that if we assume that the death of offspring within a brood represents an overall decrease in parental fitness, we also presume that the initial number of offspring was optimal. As a result, the authors proposed the existence of a "core brood" plus one or more offspring that were associated with "overproduction," which belonged to a "marginal brood." The value of marginal siblings within broods is clear when food is abundant and survival of the marginal brood results in an overall increase to parental fitness. However, Mock and Forbes (1995) also present other, perhaps less obvious hypotheses to explain how the value of marginal siblings can enhance the survival of the core brood and lead ultimately to increased overall fitness for adult pairs. For example, under poor conditions, marginal offspring may be consumed by or fed to core offspring. In addition, marginal offspring may serve as replacements when core siblings die as a result of

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either extrinsic (e.g., predation) or intrinsic (e.g., congenital disease) causes. In extreme cases, when environmental conditions severely restrict food, parents may kill and consume their young (Forbes, 1991). This note reports an observation of total brood loss by infanticide and cannibalism in wild Peregrine Falcons.

From 2008 to 2012, we routinely used from 2 to 17 motion-sensitive cameras (RECONYX models PM35T25, PC85, and PC800, Hyperfire) installed at a distance of 1–4 m from nests to determine breeding phenology (e.g., lay date, hatch date), breeding behavior (e.g., feeding rate), and causes of mortality (e.g., rain, starvation, predation). Cameras were programmed to capture from one to three images immediately when triggered by motion, after which the camera remained insensitive to movement for 5 to 15 seconds. In addition, cameras were programmed to collect a single time-lapse image every 15 minutes. Memory cards and batteries were replaced every 5 to 10 days for the duration of the breeding season or until the site failed. All observations described here were made from images captured by the RECONYX camera placed on the nest ledge.

The study population of Peregrine Falcons is encompassed within a study area approximately 350 km^2 near the hamlet of Rankin Inlet, Nunavut, Canada. Though the location (62˚49′ N 92˚05′ W) is relatively southern for Peregrine Falcons in the Canadian Arctic, its environmental conditions are as severe as any encountered in the range of the species, and more severe than those at many other locations.

DESCRIPTION OF OBSERVATIONS

A marked adult female Peregrine Falcon (67 B) and an unmarked adult male were observed at a known nest site on 28 May 2011. The pair subsequently produced and hatched two eggs. The nestlings were weighed on two occasions, at ages of approximately 7 days (198 g and 136 g) and 12 days (348 g and 231 g). Development of both nestlings was consistent with normal growth curves reported for this population (Court et al., 1988).

From sunrise (~0426) to sunset (~2200) on 1 August 2011, both nestlings (aged 15 and 16 days) were fed on six occasions (four passerines, one large eider duckling, and the remains of one previously cached ground squirrel). Both nestlings were observed with fully distended crops throughout the day. In addition, except for a 15-minute period between 0337 and 0352, the adult female had brooded both young throughout the night from 2030 on 1 August until just after sunrise at 0438 the following morning, when she left the nest ledge. She returned approximately 13 minutes later (0451) and fed a single fully intact passerine to both nestlings. She then brooded both young until 0631, when she retrieved a second fully intact passerine and fed it to the nestlings. At 0637, she again left the next ledge. Images indicate that it began raining at approximately 0717, and both chicks were clearly wet by 0730. The chicks remained alone and huddled together on the nest ledge until 0846 when the rain-soaked female returned to the ledge for a few seconds. The wet nestlings then remained alone and huddled together for almost three hours until the still wet female returned to the ledge briefly (for less than two minutes) at 1141. During this brief visit, the female attempted to feed what appeared to be the desiccated and previously discarded remnants of a ground squirrel to the nestlings. After the failed feeding, the rain-soaked nestlings remained alone on the ledge until 1643 when the female arrived on the nest ledge. Although both nestlings were alive, they had remained unattended for approximately nine hours. Images clearly indicate that both were distressed (wet, huddled, eyes closed, motionless) and show that the smaller of the two was near death. The female (still wet) almost immediately seized the younger of the two, killed it, and began to consume it, but did not appear to feed the remaining nestling, even though the images clearly show that it was begging vigorously. Within minutes (1647), the adult female carried the carcass of the now dead younger nestling away from the cliff and presumably cached the carcass remains. The adult female returned to the nest ledge within two minutes. Using her beak, she seized the second nestling by the neck and simultaneously restrained its body with her talons. The images show clearly that the nestling was alive, likely vocalizing and struggling to free itself, as the adult female held it down and tore a wound into the back of its neck that is consistent with the method that falcons use to kill their prey (Fig. 1). Within one minute of attacking and mortally injuring her nestling, the adult female flew from the nest ledge, carrying the nestling in her talons.

DISCUSSION

Several authors have investigated brood reduction and siblicide in raptors (Bechard, 1983; Edwards and Collopy, 1983; Bortolotti, 1986; Simmons, 1988) and other birds (Mock, 1984). Mock (1984) argued that rapid growth of nestlings and the practice of most avian species to swallow food whole was associated with low incidence of cannibalism in birds, but pointed out that Falconiformes are able to tear their food apart and are therefore not limited by gape size. Although brood reduction has been observed in birds of prey (Reese, 1972; Meyburg, 1974; Newton, 1978; Bortolotti et al., 1991), the fate of the carcass often remains unknown, and it is not clear how often cannibalism occurs. Parental infanticide per se has been confirmed more rarely. An example is the report by Korňan and Macek (2011), who observed a case of infanticide in the Golden Eagle (*Aquila chrysaetos*) in which one chick was killed and then fed to the other.

Asynchronous hatch has been documented in the Rankin Inlet Peregrine Falcon population (Court et al., 1988), and the authors argued that age and size differences among nestlings within broods introduced a competitive disadvantage to the youngest brood members. Starvation was cited as the most likely cause of death in 7% (6/85) of nestlings in 45%

FIG. 1. RECONYX motion-sensitive camera image shows resident adult female Peregrine Falcon (color marked "67 B") killing her nestling near Rankin Inlet, Nunavut, on 2 August 2011.

(5/11) of broods. In peregrines, however, neither starvation of nestlings nor outright infanticide has yet been cited as a mechanism associated with active brood reduction.

In the population of Peregrine Falcons breeding at Rankin Inlet, high levels of annual nestling mortality and a long-term decline in productivity are well documented; they are known to have occurred even though organochlorine residues in blood plasma of this population have declined to concentrations below those known to cause reproductive failure (Franke et al., 2010). The authors of that study discussed the possibility that a change in the precipitation regime and the direct effects of rain were the most likely cause of the observed decline in reproductive success. Anctil et al. (in press) subsequently found that the direct effects of rainfall caused 44% of the recorded nestling mortalities and used an experimental approach to show that nestlings protected in a nest box from the direct effects of rain survived at higher rates than those raised on natural ledges. The authors also found that starvation was responsible for a further 17% of deaths; they reported that within a given brood, fourth-hatched nestlings experienced much lower survival than their siblings regardless of treatment (i.e., nest box vs. natural ledge).

These results indicate that nestlings apparently starved in recent years at twice the rate they did in the early 1980s. They could suggest that the indirect effects of rain are an important component that may have contributed to the observed long-term decline in productivity in the Peregrine Falcon population at Rankin Inlet. In this case, it appears that local environmental conditions (cool and wet weather), in association with acute food restriction, may have provided the catalyst for the adult female to quite suddenly switch from activities typically associated with parental care (brooding and feeding) to killing and consuming her offspring. It would seem that the notion of marginal offspring can, in some instances, extend to an entire brood.

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