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The second egg in the lesser spotted eagle (*Clanga pomarina*) clutch as a nesting insurance

Druhé vajce v znáške orla krikľavého (*Clanga pomarina*) ako hniezdna poistka

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Abstract: Over an interval of 16 days, two eggs were laid by the same lesser spotted eagle female in her nest in the west-central Slovakia in 2021. The first egg failed to hatch, and the female ate it on the 45th day after she had laid it. Thereafter, the chick hatched from the second egg and later successfully fledged. The case contributes toward explaining why the species lays a second egg, even though the younger hatched chick is almost always prone to siblicide. In this case, the second egg acts as a reserve or an insurance if the first egg should not hatch, enabling the parents to breed successfully.

Abstrakt: V roku 2021 bolo zistené na hniezde orla krikľavého na západe stredného Slovenska znesenie dvoch vajec s odstupom až 16 dní tou istou samicou. Prvé vajce sa nevyliahlo a samica ho na 45. deň po znesení skonzumovala. Mláďa z druhého vajca sa vyliahlo a neskôr z hniezda úspešne vyletelo. Prípad prispieva k vysvetleniu príčiny znášania dvoch vajec u tohto druhu, hoci mladšie mláďa skoro vždy podlieha siblicíde. V tomto prípade druhé vajce poslúžilo ako rezerva alebo poistka, keď po nevyliahnutí mláďaťa z prvého vajca umožnilo páru úspešne vyhniezdiť.

Key words: belated second egg laying, cainism, Abel rearing

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Introduction

The main evolutionary advantage of siblicide in birds of prey is to increase the surviving nestlings' share of food from their parents (Simmons 2002). The lesser spotted eagle is one of the raptor species where obligate siblicide, also known as cainism (Wendland 1958), regularly occurs (Simmons 1988) - e.g. harpy eagle (*Harpia harpyja*), bearded vulture (*Gypaetus barbatus*), crowned eagle (*Stephanoaetus coronatus*), Verreaux's eagle (*Aquila verreauxii*), tawny eagle (*Aquila rapax*), and the African hawk-eagle (*Aquila spilogaster*). Obligate siblicide reduces these species' brood size to one in virtually all (> 90%) cases, and food stress was never found to be the proximate cause of this behaviour in any season (Gerhardt et al. 1997). Although the complete lesser spotted eagle clutch consists mostly (81%) of two eggs, sometimes (16%) of one egg, and, in exceptional cases (2%) of three eggs (n = 178, Meyburg 1969), the percentage of nests found with two fledged young ranged from only 0.1% in Germany (Meyburg et al. 2008, n = 1305) to 3.6% in Slovakia (Maderič et al. 2008, n = 1775). The interval from when the female laid her first to her second egg, calculated from the timing between when they hatched, would reach three to four days (Meyburg 1970, Sládek 1959) and occasionally up to six days (Meyburg 2002). Scheller & Meyburg (1996) estimated the interval between the first and second egg at 5-7 days, and Matsone et al. (1996) measured the difference in captivity as seven days. Väli (2017) calculated the median difference between the laying of the first (n = 21) and the second egg (n = 8) as five days. The incubation period was estimated at 37-41 days (Sládek 1957, Scheller & Meyburg 1996). The young from the egg that hatched later (Ábel, Wendland 1958) would be attacked by its older sibling (Cain), with the smaller chick usually fleeing to the edge of the nest to die of exposure to cold or starvation or falling out of it (Meyburg 1974). The older chick would continue to attack even if there is a sufficient

food reserve in the nest (Sládek 1959). The younger chick sometimes receives no food and dies within a few days after hatching (Sládek 1959). The female could then rip the dead chick and feed the pieces to the older chick or eat it herself (Meyburg 1974).

The amount of food correlates negatively with sibling aggression and brood reduction (Estes et al. 1999) in facultative siblicide species, such as the northern goshawk (*Accipiter gentilis*) and American kestrel (*Falco sparverius*). The young or the parents could subsequently feed upon the dead brood (Boal & Bacorn 1994). Cannibalism is more frequent in years of food scarcity (Bortolotti et al. 1991).

Modern optical recording devices enable the observation of the breeding biology in raptor species in which siblicide has evolved and to learn how either the younger chick dies or, on the contrary, survives with minimal disturbance.

Methods

A KeepGuard 680V camera trap was used to study the lesser spotted eagle's breeding biology (cf. Väli 2017). An external power source, a car battery, was placed at the base of the nesting tree. The camera trap was installed on 29 March 2021, before the eagles' arrival from their wintering grounds, to minimise human disturbance (cf. Dombrovski 2019). It was placed directly over the nest and pointed downwards. The minimum trigger interval was set at 30 seconds. The camera was removed from the nest after the young had fledged on 9 September 2021. The nest is located on a fir (*Abies alba*) tree in the Veľká Fatra Mountains, in the Turiec region in the west-central Slovakia, at 660 m.a.s.l.

Results

Both the male and female first appeared at the nest on 12 April. On 26 April, the female laid her first egg, followed 16 days later, on 12 May, by a second egg. The eggs could easily be distinguished from each other because the earlier-laid egg was lighter, rounder and slightly larger than the latter egg. On May 13-17, rainfall occured, and temperatures were cooler than average on May 13-17. On the evening of 14 May, neither egg was incubated while it was raining for over one hour because the adult eagles were not at the nest, so the eggs got wet. On 10 June, 45 days after the first egg was laid, the female cracked the first egg and consumed its contents. The chick never hatched. Since the egg was already 5-6 days after its estimated hatching date and still contained a lot of yolk, the embryo had probably not been fully developed. On June 18, the camera trap memory card became full, and the hatching of the second chick could not be recorded. Nevertheless, the "Abel" had hatched and was observed from the ground as a fully feathered chick in the nest on 3 August 2021, shortly before it fledged. Subsequently, on 9 September, the young was observed again already flying in the forest around the nest.

Discussion

Contrary to previous knowledge, a 16-day interval between laying two eggs is relatively large. At first, a possible explanation for the late laying of the second egg was that it had been laid by another female. Polygyny was found in a closely related Indian spotted eagle (*Clanga hastata*) (Sant et al. 2017), where one male bred with two females in two different nests. In lesser spotted eagles, females visit foreign nests in the later stages of breeding, and it is assumed that they do not exhibit territorial behaviour towards other females therein (Meybrug et al. 2007). There are, however, no known data on polygyny in lesser spotted eagles. Although in the case described, there were no individual markings on the female (either a ring or a wing marking), it is clear from the individual colour signs on her back, shoulders and upper parts of her wings that both eggs were laid and the first egg also consumed by the same female, and no polygyny was involved in this case. In 2020, a breeding male most likely disappeared at this site during the breeding season and a new male probably nested here a year later. The methods used did not determine whether the female had two partners. There are no data on polyandry in lesser spotted eagles either. The female's laying of a second egg 16 days later probably cannot be considered a replacement clutch, for which longer intervals have been found in other raptors, ranging from 25 days in ospreys (*Pandion haliaetus*) to 60 days in bald eagles (*Haliaeetus leucocephalus*) (Morrison & Walton 1980, cf. Moleón et al. 2009). It is not exactly known why the laying of the second egg was delayed.

The date when the second egg was laid, 12 May, is not exceptional. For instance, one case was found by me in 2019 when a chick fledged as late as 18 August, and in another case, Bergmanis (Latvijas Sabiedriskie Mediji 2022) observed young hatching even as late as around 7 July.

The interruption in the earlier-laid egg's embryonic development may have been caused by exposure to hypothermia on 14 May, the 18th day after the first egg had been laid. The second egg was then at a different stage of development, being laid only two days before. Although the survival of the developing embryo is

significantly influenced by its age (Webb 1987), recent research suggests that many bird species can tolerate egg hypothermia as low as 10 °C (Zhao et al. 2017).

In several respects, the lesser spotted eagle does not fall into the category of cainistic species. These are typically large, have long life spans, are tropical and sedentary, with high sub-adult mortalities, extremely stable territories and low rates of adult turnover within them, thus limiting opportunities to breed (Simmons 1988). Therefore, the reasons why siblicide developed in lesser spotted eagle are probably different from other above-mentioned obligate cainists.

Factors that allow for siblicide in obligate cainists (Edwards & Collopy 1983) include a few days hatching asynchrony, the size difference of the eggs and consequently the chicks' size when they hatch, the sex of the chicks and the order in which they hatch. The age difference gives the earlier-hatching chick a substantial size development advantage. The first egg laid is almost always larger, and so is the chick that hatches from it, although female chicks also happen to be larger overall. In lesser spotted eagles, these factors are complemented by mutual aggression between the chicks (apparently the larger chick usually against the smaller one) and the lesser attention the mother gives to the smaller and less active chick (Meyburg 2002). The second egg laid in species with obligate siblicide serves as insurance (Edwards & Collopy 1983, Meyburg 1974). It is a parental response to the pressure of floaters in the population, where the proportion of two-egg clutches declines as their number increases (Simmons 1988, 1997). Meyburg (2002) supposes that the lesser spotted eagle is in an evolutionary transitional phase, laying one egg instead of two.

This unusual case offers a possible explanation of the two laid eggs where the second egg can be an insurance policy for the lesser spotted eagle, allowing the parents to raise Abel and let him successfully fledge after the earlier-laid egg fails.

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