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First Observation of a Four-egg Clutch of Long-tailed Jaeger (*Stercorarius longicaudus*)

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ABSTRACT.—Long-tailed Jaegers (*Stercorarius longicaudus*) normally lay one or two eggs (rarely three), with a maximum of two eggs set by the existence of only two brood patches. Here, however, we present the first documentation of a clutch of four eggs in a Long-tailed Jaeger nest found at Zackenberg in northeastern Greenland. *Received 13 May 2014. Accepted 5 October 2014.*

Key words: clutch size, Greenland, lemmings, *Stercorarius longicaudus*, Zackenberg.

While in some avian species clutch size varies considerably between breeding seasons, others have more or less fixed clutch sizes (Campbell and Lack 1985). It has been suggested that birds in stable environments, such as deciduous forests, produce clutches with little variation in clutch size, while species living in variable environments – such as the arctic tundra – adjust their clutch size to the environmental conditions (Temple 2001), for instance, the abundance of lemmings.

Long-tailed Jaegers (*Stercorarius longicaudus*) usually lay one or two eggs, with a replacement clutch sometimes being laid if the first clutch falls victim to predation (Wiley and Lee 1998). Unlike the closely related gulls, a clutch size this small is typical for most jaegers. As a consequence, Andersson (1976) suggested that two eggs is the optimal and maximal clutch size for jaegers, as explained by the inability of the parents to incubate more than two eggs effectively. In Andersson's study, experimentally enhanced clutches were also less successful than control nests. When food supply was high, Andersson (1976) showed, however that a third, experimentally added chick could be raised. In years with high rodent densities, three egg clutches should then occur more often. Haftorn (1971), Andersson (1981) and Il'icev and Zubakin (1990) mention that three egg clutches are sometimes, though rarely, observed among jaegers. Il'icev and Zubakin (1990) state that for three-egg clutches, ''successful incubation is impossible,'' without giving any further reference or explanation. One factor contributing to setting the upper limit to clutch size may be the lack of lining in the nest cup. Even more important may be the fact that jaegers only have two brood patches, whereas most gull species that often incubate three eggs, have three brood patches (cf. Andersson 1976, Reid 1987). Andersson (1976) showed that experimentally adding a third egg during incubation resulted in fewer hatched chicks. Consequently, the limitation of two brood patches and two feet is a stronger force on the evolution of clutch size in this species than are the ability to raise more young under plentiful food regimes.

At Zackenberg (Northeast Greenland: 74.5° N, 21° W), the number of breeding Long-tailed Jaegers and their clutch sizes have been recorded since 1996 in a 15.8 km^2 census area (Hansen et al. 2012a). During the same time period, densities of lemmings have been recorded in a 1.06 km^2 census area (Schmidt et al. 2012a).

At Zackenberg, the clutch size of Long-tailed Jaegers shows a type 3 numerical response (sigmoid curve) to the densities of lemmings (Fig. 1), a pattern that has also been found elsewhere in Greenland (Gilg et al. 2006) and in Sweden (Andersson 1981). Lemmings are the most important food for this species in most of its breeding range (Løppenthin 1943; de Korte and

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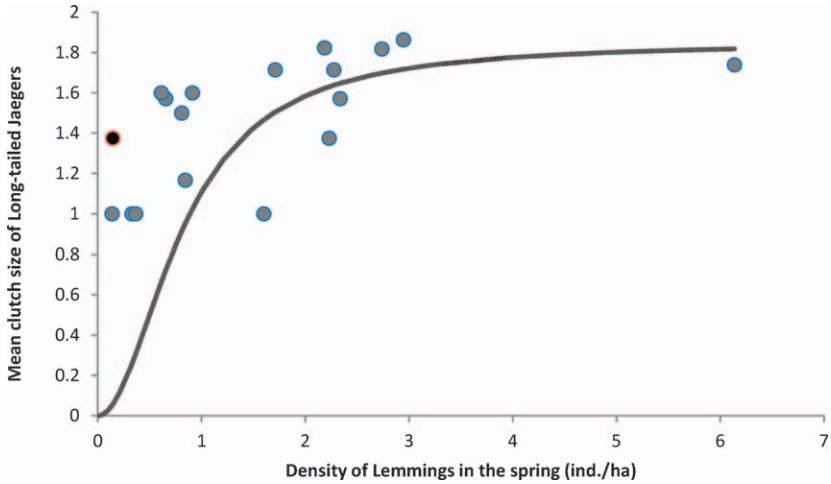

FIG. 1. Clutch size of Long-tailed Jaegers against density of lemming winter nests (individuals/ha) at Zackenberg, 1996–2013, showing a type 3 numerical response ($r^2 = 0.440$).

Wattel 1988; Gilg et al. 2003, 2006; Schmidt et al. 2008, 2012b). Hence, the plastic breeding response of this species can be regarded as an adaptive response to the changing availability of their main prey species in the arctic tundra. Several other studies in birds suggest that food supply can influence clutch size (Campbell and Lack 1985).

METHODS

During the annual bird monitoring at Zackenberg, M. E. and T. R. discovered a Long-tailed Jaeger nest with four eggs on 30 June 2011. A photo (Fig. 2) was taken, and the precise position recorded. The nest was revisited the following day, when only three eggs remained in the nest cup. All three eggs were floated to check for incubational stage (cf. Hansen et al. 2011), and both adults were captured for metric measurements and for blood sampling. The birds were caught on the nest, using a bow net trap, replacing the eggs with dummy eggs during capture. Both adults were fitted with Danish Ringing Centre metal rings and engraved, coded orange color rings, making it possible to recognise the birds individually.

The nest was followed during the season according to the BioBasis programme protocol (Schmidt et al. 2012a); the nest would normally be visited 3 days before expected hatching (calculated from the incubational stage). In this case we also visited the nest on 5 July, as we caught and ringed both adults (see below) for another research project. In connection with other work, the territory was passed on 9 July, and since no adults were seen in the area, the nest was visited and was found to have suffered full predation. There were no clear signs of which predator had emptied the nest. No previous cases of partial predation are known for Long-tailed Jaegers at Zackenberg. None of the six nests found at Zackenberg in 2011 hatched. Hatching success has been variable over the years of the monitoring programme (Hansen et al. 2012a, b). For partial predation of bird nests at Zackenberg, stoat (*Mustela erminea*) is suspected, while most predation is thought to be by Arctic fox (*Vulpes lagopus*), and to some degree Long-tailed Jaeger (skua) and Common Raven (*Corvus corax*) (Meltofte and Høye 2007).

Genomic DNA was extracted from blood samples according to a standard phenol-chloroform method (Sambrook et al 1989). Molecular sexing was made by PCR with 2550F/2718R primer pair as described by Fridolfsson and Ellegren (1999).

RESULTS AND DISCUSSION

Using DNA sex determination, we demonstrated that the pair of Long-tailed Jaegers was composed of one male and one female. No other jaegers were observed in the vicinity of the nest during incubation.

Since we did not take blood samples from the embryos in the eggs, we could not test whether all the eggs were sired by the same parents. Nonetheless, the floatation measurements taken on three of the four eggs suggest that they had been incubated for a length of time comparable to

FIG. 2. Long-tailed Jaegers' nest with four eggs at Zackenberg, Northeast Greenland, 30 June 2011. (Photo: M. Ek).

eggs laid in succession. They floated at 85°, 90° (at the bottom) and in the middle of the water, respectively, indicating that they had been incubated for 10–11 days (cf. Schmidt et al. 2012a). In Long-tailed Jaegers, incubation starts after the laying of the first egg (Wiley and Lee 1998). While this does not necessarily indicate that the eggs were sired by the same parents, large differences in floating measurements would have pointed strongly towards the possibility of egg dumping or nest sharing. Color can vary a great deal within Long-tailed Jaeger clutches (JH, unpubl. data), yet it was noteworthy that the size and pigmentation of all four eggs were very similar (Fig. 2). In hindsight, measurements of the egg would have strengthened this assumption had they had similar dimensions. Egg dumping is well known among many avian species, including members of the Family Laridae (Yom-Tov 2001). For Long-tailed Jaeger, however, we have found no reports of egg dumping or brood parasitism (cf. Wiley and Lee 1998). Although egg dumping would appear unlikely in the present case, it cannot be ruled out entirely.

Among other jaeger and skua species, it is known that three egg clutches occur rarely, and according to reports, eggs in these clutches do not hatch (Andersson 1976, Philips 2001). Ideally, we would have floated the eggs at every visit thereby having a chance to see indications of whether the development of the embryos would have continued through incubation, but that was not done. Four egg clutches have been reported in very few cases in Arctic Jaeger (*Stercorarius parasiticus*) and Makatsch (1974) suggested that two females might be sharing the nest in these very few cases. Several gull, tern, and sheathbill species have also been known to have such shared nests with supernormal clutch sizes (e.g., Kovacs and Ryder 1981, Conover 1983, Bried et al. 1999). This is an unlikely explanation in our case since we never observed more than two adults, a male and a female, attending this nest. Long-tailed Jaegers are known to produce a second clutch, if the first nest suffers predation early on (Wiley and Lee 1998), which might suggest they are able to produce four eggs for a nest. On the other hand, it is reported that Long-tailed Jaegers only produce one egg in replacement clutches, and it takes up to 8 days from the loss of the first clutch (Wiley and Lee 1998), suggesting that it is less likely to be from the same female.

As mentioned above, there are clear indications from Greenland and Scandinavia that Long-tailed Jaegers respond numerically to densities of rodent populations. However, the particular year, 2011, where the single nest with four eggs was found, was a year with quite low lemming densities. All other seven nests found contained only a single egg (Hansen et al. 2014).

To our knowledge, this is the first documented case of a four-egg Long-tailed Jaeger clutch, which suggests that two eggs is not the absolute maximal clutch size in this species. However, further research will be needed in order to shed light on such rare events. We suggest that for any jaeger clutch larger than two, egg measurements, floatation characteristics, and especially DNA samples of adults and young should be collected. Such information would allow us to explore the factors giving rise to such unusually large clutches among jaegers and skuas.

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