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Brief reports

The odd colour of the last laid egg in Herring Gull *Larus argentatus* clutches: does it reflect egg quality?

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Introduction

Birds seldom lay clutches of entirely similar eggs, especially the last laid egg is often the one that can be singled out as the odd egg (Slagsvold et al.1984). The third and last egg in clutches of most *Larus*-gulls is often odd in that it is smaller than the other two eggs, thereby, producing a smaller chick (Parsons 1970, Reid 1987). Besides being smaller, the third young has a further disadvantage in hatching later than the other two chicks. Both factors may contribute to the lower survival of the third chick which is sometimes observed (Parsons 1970, 1975). Verbeek (1988) used these arguments to hypothesize that egg predation on Glaucous-winged Gulls *Larus glaucescens* might be somehow directed towards the least valuable egg. Verbeek (1988) argued that the light colouring of the third egg is adaptive if there is egg predation, since it helps to focus the predators' attention on this egg.

Baerends & Hogan-Warburg (1982) described the wide variation in the colouring of Herring Gull *L. argentatus* eggs. Although the last (c-) egg tended to be the oddest in a clutch (smallest, often the lightest with respect to ground colour, with smeared spots) no single character significantly singled out the third egg in their sample of 100 nests. As Herring Gulls seem to have lower survival of the third chick (Parsons 1970,1975), this result contrasts with Verbeek´s (1988) results.

We analysed a sample of Herring Gull clutches for oddity of the third egg in an environment where the third chick survives as well as the others (Kilpi *et al.* 1995), and very few eggs are taken by predators (Kilpi 1990). We therefore predict that the third egg should not differ from the others.

Study site and methods

This study was done at Storsundsharun, a colony of about 130 pairs in the western part of the Gulf of Finland, near Hanko (60°N, 23°E). In 1994, we scored the colour of 101 clutches over the entire laying season (see Fig. 1). We used a subjective scale to score an egg as obviously darker or lighter than other eggs in the clutch, and also checked whether it had a similar ground colour as the other eggs. Thus an egg which was obviously odd, could differ only in different shades of the same colour (dark olive versus pale olive for instance), or it could have a different ground colour (olive versus cream-coloured, see also Baerends & Hogan-Warburg (1982) for photographs of clutches with odd c–eggs). Our scale is conservative, and an odd egg was entered as odd only if it stood out clearly. Spot colour or spot density was not scored.

All clutches were of known laying date, known laying sequence, and their fate was sub-

Fig. 1. A clutch with a paler, cream-coloured c-egg.

sequently checked on until hatching. We checked all nests every afternoon during the entire laying period. All scored eggs were measured with calipers to the nearest 0.1 mm. The volume of eggs was calculated as (length × width^2) × 0.000476 (see Bolton 1991).

Results

Most cluthes (59.4%, Table 1) of the 101 examined, contained three similar eggs. In almost 25% of the clutches, one egg stood out as odd and pale, in 13% of the clutches the odd egg was darker than the other two. In a few clutches (3%), all eggs were dissimilar. When there was an odd egg in the clutch (38 clutches), the palest egg was mostly the c-egg (in 80% of all cases when the oddity was paleness, Table 2). This frequency is significantly higher than an even frequency among the three eggs ($\chi^2 = 11.2$, df = 2, P = 0.004). In clutches with an obviously dark egg, this egg was mostly the a-egg (54 % of 13 clutches), but the total material is too small for a meaningful test.

The third eggs scored as odd did not differ in absolute volume compared with those equally coloured (mean for odds 82.7 cc ± 8.0 (n = 18), for equally coloured 80.0 ± 6.5 cc (n = 57) t = –1.48, df = 73, P = 0.14), and they did not differ in relative size within the clutch (odds = 94. 2 ± 7.9 % of a-egg size (n = 18) , equally coloured = 94.4 ± 6.7 % of a-egg size (n = 57), t = 0.09, df = 73, P = 0.92).

Further, the laying interval between the first and the last egg in the clutch was similar for pale third eggs and for similarily coloured third eggs (odds = 4.2 ± 0.7 days, n = 17), equally coloured 4.1 ± 0.7, n = 48, t = –0.37, df = 63, P = 0.72).

Finally, only a single egg (0.3%) from these clutches was lost to predators before hatching, if both parents survived (98 clutches). In three cases, the entire clutch was lost due to one parent disappearing.

Discussion

As found by Baerends & Hogan-Warburg (1982), within-clutch variation in egg colour is wide in the Herring Gull. However, most Herring Gull females lay a uniform clutch in the sense that the eggs are very similar with respect to ground colour. Therefore, it seems that oddity in one egg is not prevalent in the Herring Gull. When an odd-

Table 1. The distribution of different types of within-clutch egg colouration in nests of Herring Gulls at the Storsundsharun colony in 1994.

Type of egg colouration	Number of nests (n = 101, %)	
All eggs similar	60	(59.4)
One egg paler	25	(24.7)
One egg darker	13	(12.9)
All eggs dissimilar	3	(3.0)

Table 2. Frequency of colouration type for individual eggs in clutches containing one egg of odd colouration, either a pale or a dark egg.

Type of colouration (n)	Frequency (n) for a-egg	b-egg	c-egg
One egg paler (25)	12.0 (3)	8.0 (2)	80.0 (20)
One egg darker	53.8 (7)	30.8 (4)	15.4 (2)
Total	(10)	(6)	(22)

ity occurs, it mostly seems to concern the c-egg, though the a-egg is also odd sometimes. This result is similar to the result of Baerends & Hogan-Warburg (1982), but the frequencies cannot be directly compared since they used a very detailed colour-scale. However, they also found most differences to be very small, and clearly odd eggs were not frequent.

Verbeek (1988) suggested that oddity is adaptive, since it may help to focus the attention of the predator on the egg with the lowest chance of survival. In our study colony, there is no third chick disadvantage in terms of survival (Kilpi *et al.* 1995) and egg predation rates in colonies in the study area are low, ranging from nil to 8% per annum (Kilpi 1990). Predation rates in the Glaucous-winged Gulls studied by Verbeek (1988) were 10% in two years, which is well within the range of figures reported for different populations of Herring Gulls (Kilpi 1990). We find it puzzling that Herring Gulls would not have evolved a way of focussing attention on the low quality c-egg, since Glaucous-winged Gulls apparently have done so. As Verbeek (1988) also reported, the main predation pressure is on the a-egg, and egg losses after the clutch is completed are low. In our study colony, c-eggs were only slightly smaller than a-eggs and mostly of similar colour. There were thus no eggs of clearly inferior value in the clutch. To underline an egg of lesser value would require an ability of the female to actively control the pigmentation of the eggs, if one egg is always automatically of lesser value. There are some indications of an ability to control egg colour in Herring Gulls (Baerends & Hogan-Warburg 1982). Perhaps the most parsimonious explanation of odd colour of the third egg is that it recieves less pigment "showers" in the uterus (Baerends & Hogan-Warburg1982). This is likely due to the fact that c-eggs should be laid as fast as possible to reduce asynchrony (Parsons 1975, Verbeek 1988), but it may be that a one-day checking interval is too crude to detect a difference in laying interval between odd and normal c-eggs. Also, the darker colour of the a-egg might stem from the fact that this egg sometimes is retained for longer in the uterus, giving it extra time to receive pigmentation (see also Verbeek 1988).

It would be of interest to compare the ocurrence of odd c-eggs in Herring Gulls from areas where predation rates are high, and where the size-difference between a- and c-eggs is larger, to evaluate Verbeeks (1988) hypothesis. In our study colony, where predation was low, and the quality of the c-egg was high, Herring Gulls did not lay oddly coloured last eggs as a rule, nor were odd c-eggs of inferior reproductive value.

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Sammandrag: Lägger gråtrutar avvikande sista ägg: och i så fall varför?

Sommaren 1994 bedömde vi ifall något av de tre äggen i gråtrutsbon på Storsundsharun, Tvärminne, var avvikande till färgen jämfört med de två andra. I de fölesta bon var alla ägg lika (60 %), i 25 % av alla kullar fanns ett ljust ägg, och i 13 % ett avvikande mörkt ägg. I tre bon var all ägg olika (101 bon sammanlagt). Då ägget var ljust, tenderade det att vara det sist lagda c-ägget, medan de mörka avvikande äggen oftast verkade vara förstlagda ägg. Verbeek (1988) har hävdat att predation på trutägg tenderar att missgynna det sista ägget som är ljust. Eftersom det sista ägget också antas vara av sämre kvalitet än de två första äggen, anser han att avvikande ägg läggs därför att predatorerna i första hand skall ta det ägg som är minst värdefullt. I vår koloni fanns knappast någon predation alls, och c-ägg som var avvikande var lika stora som c-ägg som var lika färgade som de övriga äggen i kullen. Därför tror vi inte att gråtrutarna lade avvikande sista ägg för att rikta möjlig predation. Den enklaste förklaringen är att c-ägg ligger en kortare tid i äggledaren och får en mindre dos pigment än det först lagda ägget.

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