GENERAL NOTES

Limits to Egg Size in Gulls: Another Point of View.—Gulls (*Larus*) typically lay 3 eggs, and within the clutch the first egg laid (the *a* egg) is usually the largest, and the last egg laid (the *c* egg) is usually the smallest (Mills 1979 and references therein). Parsons (1970, 1972, 1975), Mills (1979) and Schreiber et al. (1979) have shown that chicks that hatch from small eggs have a statistically smaller chance of surviving than siblings hatching from larger eggs. Nearly all Herring Gull (*Larus argentatus*) chicks from eggs smaller than 65 cm³ died soon after hatching, only 8% of all eggs laid were below this size, and 89% of these were *c* eggs (Parsons 1970). Parsons (1972, 1975) showed that small *a* eggs had a significantly shorter incubation period than large *a* eggs, and he suggested that because the *c* egg is the smallest egg in the clutch, it hatches a little earlier and therefore more synchronously with the *b* egg than it would if it were of the same size as the *b* egg. We can deduce from these findings that a *c* egg should be big enough to give the chick hatched from it a reasonable chance to survive and at the same time small enough to ensure its hatching as synchronously as possible with the hatching of the *b* egg. The size of the *c* egg is thus a compromise between opposing selecting forces.

Coulter (1980) reported that Western Gulls (*L. occidentalis*) conform with other gulls in laying 3 eggs, that the *c* egg is usually the smallest egg, and that chicks with lower hatching weight suffer higher mortality during the first few days of life than all chicks combined. He argues that because chicks hatched from eggs below a "minimum" size show poor survival, "one would expect the distribution of egg sizes of *c* eggs to be skewed toward small eggs. That is, if few small eggs are laid, the tail on the small side of the statistical distribution would be lacking, and hence the distribution would be skewed" (Coulter 1980) to the right. His data (n = 32) *appear* to support his hypothesis. The distribution of *a* eggs was skewed to the left, of *b* eggs was normally distributed, and of *c* eggs was skewed to the right. In the case of *a* eggs, he suggested an "upper limit" to egg size imposed by female body size.

We agree with the suggestion that the upper limit to egg size is influenced by female body size, but we disagree with Coulter's (1980) logic about the skewedness of *a* and *c* eggs and support it with our data on Glaucous-winged Gulls (*L. glaucescens*) on Mandarte Island, British Columbia. This gull conforms with other large gulls with respect to decreasing egg size in the clutch, differences in the hatching success as related to egg size, and so on, as found by Parsons (1975), Davis (1975), Schreiber et al. (1979), Coulter (1980), and others.

Egg size in gulls is related to age of the female (Davis 1975, Mills 1979) and season (Paludan 1952, Coulson 1963, Spaans and Spaans 1975). Additionally, it is safe to assume that body size of gulls in the colony is normally distributed, and that larger females lay on average larger eggs than smaller females. On these various grounds we would expect that each female lays as large an *a*, *b*, and *c* egg as she physically can with special restrictions placed on the size of the *c* egg as discussed above. As each female does this independently from other females in the colony, we would expect a normal frequency distribution of volumes of *a*, *b*, and *c* eggs in the population, which is indeed what we found (Fig. 1). To determine egg volume we used the formula: length of egg × width² × k. For the constant *k* we used the value .476 as determined by Harris (1964). All three curves are skewed slightly to the right; however, the degree of skewedness is not significantly different from a normal distribution (z = .230, P = .409 for *a* eggs; z = 1.020, P = .156 for *b* eggs; and z = .887, P > .187 for *c* eggs).

Apart from any theoretical arguments, Coulter's (1980) own data do not support his predictions. It is inappropriate to use the χ^2 test if more than 20% of the expected frequencies have a value less than 5 (Siegel 1956). It appears that in the calculation of goodness of fit to his observed curves for both *a* and *c* eggs, as many as 50% of the expected values were below 5.

We reanalyzed Coulter's data, using the mean egg volume of each size class of the three curves he presented to calculate values of g_1, a measure of skewedness (Sokol and Rohlf 1969). None of the curves deviates significantly from a normal distribution (z =
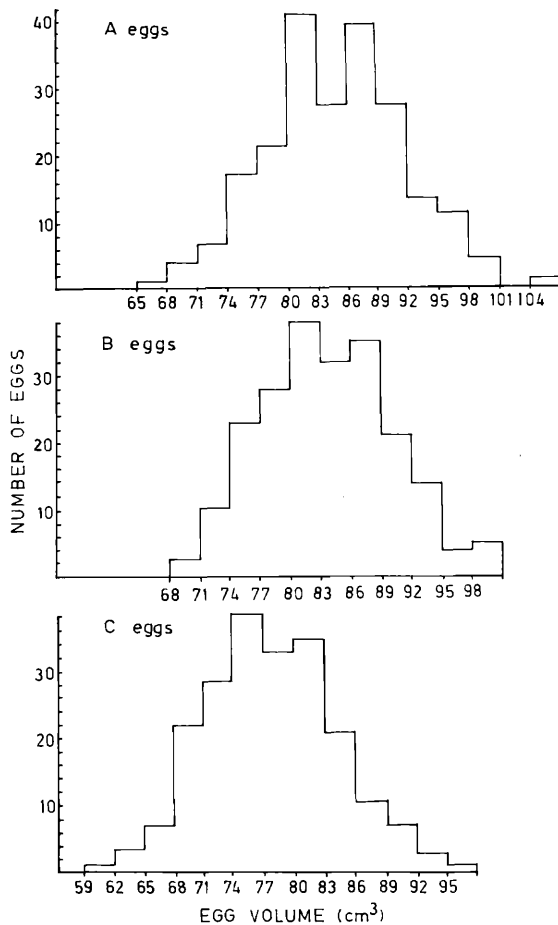
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FIGURE 1.   Volumes of 213 *a, b,* and *c* eggs of Glaucous-winged Gulls on Mandarte Island in 1980, graphed in size classes of 3 cm³.

.576, $P > .281$ for the *a* eggs; $z = 292, P > .386$ for the *b* eggs; and $z = 1.090, P = .138$ for the *c* eggs).

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Mate Fidelity in Ring-billed Gulls.—Long-lived seabirds often retain the same mate from one breeding season to the next (e.g., Richdale 1951, *Megadyptes antipodes;* Coulson 1972, *Rissa tridactyla;* Nelson 1978, *Sula bassana).* Among gulls (*Larus* spp.), mate fidelity has been investigated in several species, notably the Herring Gull (*L. argentatus,* Drost et al. 1961), Glaucous-winged Gull (*L. glaucescens,* Vermeer 1963), and Red-billed Gull (*L. novaehollandiae scopulinus,* Mills 1973). Kovacs and Ryder (1981) demonstrated that female-female pairs of Ring-billed Gulls (*L. delawarensis*) sometimes show mate fidelity. The extent of this tendency among male-female pairs of Ring-billed Gulls, however, has remained undocumented.

From 1978 to 1981 we observed wing-tagged Ring-billed Gulls (Southern 1971) at the Calcite colony near Rogers City, Michigan (Presque Isle County, 45°N, 83°W). In 65 instances, we were able to determine: (1) whether or not a particular bird retained its mate of the previous year, and (2) the colony subdivision in which the tagged bird nested (mapped in Southern and Southern 1981). In some cases, we could not specifically identify a new or old mate, but were able to assess whether or not a change had occurred (e.g., old mate unmarked, new mate tagged).

Table 1 shows the frequency of mate change and mate fidelity we observed. Of the 10 females and 15 males known to have changed mates, at least 7 females and 6 males did so although their partner of the previous year was present. In all instances of mate change where the new mate was identifiable, both males (7) and females (4) paired with birds that had been their neighbors in the previous year. This is not surprising, considering the high degree of nest site tenacity shown by Ring-bills (Southern and Southern 1979, Blokpoel and Courtney 1980).

We have little information on the effect, if any, of reproductive success on the pair bond. Four pairs were known to stay together despite reproductive failure the prior year, while 3 pair bonds were broken following reproductive failure. One pair fledged one chick in 1980 but each member had a new mate in 1981. In all of these cases, mates of the previous year were recorded in the colony, i.e. birds apparently had a choice between their old mate or a new one.

Advantages associated with mate fidelity, or mate switching, in seabirds have been discussed by Coulson (1972) and Mills (1973). Further long-term studies of Ring-billed