from the Penrose Fund of the American Philosophical Society. I would like to thank Alfred L. Gardner for critically reading an earlier draft of this manuscript and providing helpful comments and suggestions.—MARSHALL A. HOWE, *National Fish and Wildlife Laboratory, National Museum of Natural History, Washington, D.C. 20560.* *Accepted 1 March 1974.*

Breeding success relative to nest location and density in Ring-billed Gull colonies.—The role of nest location and density in determining breeding success in Ring-billed Gulls (*Larus delawarensis*), to our knowledge, has not been studied previously. In breeding colonies some nests will be located centrally while others are peripheral. Two factors that could affect breeding success of individual pairs within a colony are nest density and the relative location of each nest. Several workers have investigated nest location and its influence on breeding success of colonial breeding birds. Studies of the Black-headed Gull, *L. ridibundus* (Patterson, Ibis, 107:433–459, 1965), Adelie Penguin, *Pygoscellis adeliae* (Tenaza, Condor, 73:81–91, 1971), and the Black-legged Kittiwake, *Rissa tridactyla* (Coulson, Nature, 217:478–479, 1968), have shown that birds nesting solitarily, or on the edge of colonies, tend to have lower reproductive success than those nesting in the colony center.

We studied two Ring-billed Gull colonies in Lake Huron from 16 May to 4 July 1972. The Calcite Colony is located on a man-made peninsula near Roger City, Presque Isle County, Michigan. The other colony is on Bird Island in Thunder Bay near Ossineke, Alpena County, Michigan. The Calcite Colony contained about 3,000 pairs of nesting Ring-billed Gulls and is situated along the south shore of the proximal portion of the peninsula, about 2 m above water level. The ground is generally level and in summer it is partially covered with low-growing (1 m high) herbaceous vegetation, mostly grasses and a few burdock (*Arctium* sp.).

During highs in the Great Lake water cycle, such as when our study was conducted (see monthly and yearly mean water levels, Chart No. 207, Department of the Environment, Ottawa, Ontario), Bird Island is actually three small low-lying islands. We conducted our observations on the middle islet, which had approximately 500 nesting pairs of Ring-billed Gulls. Dense brush (1 to 7 m high) covered the islet except for portions of the south and east sides, which were essentially without vegetation and had the most gull nests. The most abundant plant species were red-osier dogwood (*Cornus stolonifera*), green ash (*Fraxinus pennsylvanica*), arbor vitae (*Thuja occidentalis*), and 2 m high nettle (*Urtica gracilis*).

For our study we used 184 nests in the Calcite Colony and 315 nests in the Bird Island Colony. Only those nests that formed the interface between the colony and its surrounding environment were considered as constituting the fringe sample. Nests proximate to the geometric center of each colony were selected as representative of the center. Nest density was measured by counting all contemporary nests within a radius of 1 m of each nest cup.

We visited the study sites at least every other day and recorded the number of eggs and young present, any mortality in each nest, and weather conditions. Data were collected on chicks from the time of hatching until they were 21-days-old or dead, whichever might have come first. The term "breeding success" is used here as a combination of hatching success and chick survival through 21 days.

Two statistical tests were applied to the data. For examining the effects of nest loca-

TABLE 1

BREEDING SUCCESS IN CENTRAL AND FRINGE AREAS OF RING-BILLED GULL COLONIES

Nest location	No. of nests	No. of eggs	No. eggs hatched	No. chicks surviving	No. "successful" chicks
Calcite Colony					
Fringe	42	115	63	51	51
Center	38	111	79	72	72
χ^2_c			5.150[2]	2.321	8.753[2]
Bird Island Colony					
Fringe	65	173	77	44	44
Center	42	119	97	77	77
χ^2_c			42.463[3]	8.651[2]	43.205[3]

[1] Survival to 21 days.
[2] Significance at five percent level.
[3] Significance at one percent level.

tion on breeding success, we used 2 × 2 contingency table analysis with the Yate's correction for continuity (χ^2_c). To determine if breeding success was correlated with nest density, we used the Kendal rank correlation analysis (Siegel, Nonparametric statistic for the behavioral sciences, McGraw-Hill Book Co., Inc., 1956). The five percent significant level was employed in both cases.

Table 1 shows the results of the statistical analysis of breeding success depending on nest location. Both colonies showed a significantly higher hatching rate for pairs nesting in the center of the colony than those on the fringe. Chick survival in the Calcite Colony did not differ significantly between the center and the fringe; however, on Bird Island there was a significant difference, favoring survival at the center. As these results were based on one season's work, they can not be considered conclusive. It appears, however, that nest location in perspective with topographical features does affect Ring-billed Gull breeding success. Lower hatching rates at the fringe are primarily responsible for the difference.

Several factors, singly or in combination, may contribute to lower hatching success and chick survival at the fringe. Birds of comparable reproductive experience and capabilities may not be distributed equally throughout the colony, and the fringe territories may be inhabited by a larger proportion of gulls breeding for the first time. Also nests along the colony fringe may be located in areas subject to wave action during high winds. At Bird Island, waves destroyed nests and caused extensive wetting of eggs and chicks. When the chicks were between one and two weeks old, wave action eroded about 2.5 m of shoreline and damaged many nests along the fringe. In contrast, the Calcite Colony was not affected by high water because of its elevation. This is probably a primary reason for the difference between chick survival rates at the two colonies.

There was no correlation between nest density and breeding success for Ring-billed Gulls nesting within either colony (Kendal's rank correlation coefficient, Calcite Colony = 0.29; Bird Island Colony = 0.29). This does not infer that density dependent factors (e.g., social releasers) are unimportant in the successful nesting of this species. Instead, it simply means that nearness of neighbors (i.e., closeness of territories) had no direct bearing on nesting success within the colony.

We would like to express our appreciation to the U. S. Steel Corporation Michigan Limestone Division for permitting us to conduct our studies on their property, Mr. T. Mears of Alpena Community College for use of a motor boat, and Dr. J. Zar of NIU for providing statistical advice. The project was conducted while Dr. Southern was under support from National Science Foundation Contract GB 28856. This paper is contribution number 503 from the NIU Department of Biological Sciences.—MARILYN DEXHEIMER *and* WILLIAM E. SOUTHERN, *Department of Biological Sciences, Northern Illinois University, DeKalb, Illinois 60115.* *Accepted 25 April 1974.*

Use of abandoned cacique nests by nesting Troupials (*Icterus icterus*): precursor to parasitism?—On 16 September 1971, I observed five individual Troupials (*Icterus icterus croconotus*) investigating and entering disused nests of Yellow-rumped Cacique (*Cacicus cela*) along 20 km of the Río Jivino near Limoncocha, Ecuador (0° 24′ S; 76° 38′ W). The cacique nests were clustered together in trees overhanging the river, usually 5 to 15 nests per cluster. By 10 October, each pair of Troupials had obviously selected a nest and was repairing and using it for its own. In no case did I see more than one pair of Troupials using a given cluster of cacique nests. Along a small river at Tumi Chucua, Bolivia (11° 8′ S; 66° 10′ W), I observed the same kind of behavior in October and November 1972. At neither locality did I see evidence that Troupials constructed their own nests. I can find no reference to the nests of the southern race of the Troupial (*I. i. croconotus*). Phelps (Aves Venezolanas, Creole Petroleum Corp., Caracas, 1953) states that individuals of the northern race (*I. i. icterus*) occasionally construct their own nests in the form of a bag, but generally they repair and use old nests of other species.

In taking over abandoned cacique nests, the Troupial could be evolutionarily moving into an ideal set of circumstances for developing brood parasitism, at least in the Limoncocha and Tumi Chucua areas. Both the potential host and the potential parasite species are icterids feeding almost entirely on insects during the breeding season. The Troupial was rare compared to the Yellow-rumped Cacique, the latter being among the 10 most common species while the Troupial was more than 100th in rank of commonness. The potential host is a colonial nester, and its nesting was synchronized within a period of three months at both sites.

By using the old cacique nests, the Troupial saves a considerable investment of time and energy in repairing rather than completely constructing a nest. Furthermore, the cacique nests themselves may be attractive in that: 1, they are frequently located in trees along rivers, the foliage of which is the principal foraging area of the Troupial; 2, the nests are often in the vicinity of wasp nests, which presumably protect the young caciques and orioles from botflies and predators (Smith, Nature 219:690–694, 1968); 3, the nests are at the ends of branches and difficult for many potential predators to approach; and 4, the nests are clustered tightly together, which may act as a maze in deterring predators, i.e., a potential predator has a much greater chance of finding several empty nests in a cluster before discovering the single nest containing Troupial eggs or young.

If behavior were to develop in which the Troupial were to investigate clusters of nests before the caciques were through laying eggs, if the Troupial were to advance its egg-laying cycle to correspond with that of the caciques, and if the Troupial were to develop egg-dumping behavior, then brood parasitism could evolve in the species. On the other hand, few, if any, brood parasites are as gaudily colored as the Troupial (black