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CORRELATES OF THE DISTRIBUTION AND ABUNDANCE OF WINTERING GULLS IN MAINE

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Abstract.—Gull aggregation sites in Maine were surveyed by volunteers 22 Feb.–19 Mar. 1985–1987 to study differences in foraging site preferences between Herring Gulls (*Larus argentatus*) and Great Black-backed Gulls (*L. marinus*). Proportionately more Great Black-backed Gulls occurred at human-made versus natural food sources and at sites with small total gull populations. The proportion of Great Black-backed Gulls at sites decreased as distance from coast increased. Numbers of Herring Gulls were positively correlated with an index of the size of the human-made food supply at foraging sites but numbers of Great Black-backed Gulls were not. These results suggest that Herring Gull populations may have increased more rapidly than Great Black-backed Gull populations in the eastern U.S. over the last 60 yr because Herring Gulls have exploited human-produced food sources more readily than Great Black-backed Gulls. Results corroborate other evidence showing that Great Black-backed Gulls are more strongly restricted to a coastal distribution than are Herring Gulls, though the reasons why this might be so are unknown.

CORRELACIONES DE LA DISTRIBUCIÓN Y ABUNDANCIA DE GAVIOTAS INVERNALES EN MAINE

Sinopsis.—Un grupo de voluntarios efectuó una evaluación de lugares en donde se agregan gaviotas, para determinar la diferencia entre lugares preferentes de forrajeo entre *Larus argentatus* y *L. marinus*. El estudio se llevó a cabo del 22 de febrero al 19 de marzo de 1985–1987. Proporcionalmente un número mayor de individuos de *L. marinus* se encontraron en lugares en donde hubo intervención por parte de humanos en relación a la cantidad de comida provista vs. áreas con comida natural, y en localidades con números poblacionales bajos de gaviotas. La proporción de *L. marinus* en diferentes localidades se redujo en armonía con un incremento en la distancia a la costa. El número de individuos de *L. argentatus* se correlacionó positivamente con un índice sobre la cantidad de comida provista por los humanos; no hubo la misma correlación para *L. marinus*. Estos resultados sugieren que en los últimos 60 años, las poblaciones de *L. argentatus* han incrementado mas rápidamente que las de *L. marinus* en la parte este de los Estados Unidos, debido a que la primera ha explotado de forma más aceptable los recursos alimentarios producidos por los humanos. Los resultados corroboran otra evidencia que muestra que *L. marinus* está más restringida a la costa que *L. argentatus*, aunque se desconoce la razón por lo cual esto ocurre.

Herring Gulls (*Larus argentatus*) and Great Black-backed Gulls (*L. marinus*) occur together at feeding sites throughout their area of sympatry. We would therefore expect the two species to differ in certain aspects of

their foraging ecology in order to coexist (Schoener 1974, Slobodkin 1961). Knowledge of these differences might explain why Herring Gull populations in the eastern U.S. have increased more rapidly than Great Black-backed Gull populations (Korschgen 1979) and may help predict the relative effect of dump closures on populations of the two species.

I compared the relative proportions of Herring and Great Black-backed Gulls at different types of aggregations to demonstrate differences in foraging ecology of the two species and to answer the following questions: (1) Do Herring and Great Black-backed Gulls differ in their preferential use of natural and human-made food sources? (2) Do Herring and Great Black-backed Gulls differ in their preferential use of inland and coastal sites? (3) Do Herring and Great Black-backed Gulls differ in their respective representation in different size-class aggregations? (4) Are the relative proportions of Herring and Great Black-backed Gulls found in this study similar to proportions reported in other studies of Maine gulls?

METHODS

Volunteers censused gull aggregations in Maine from 22 Feb. to 19 Mar. 1985, 1986 and 1987. One-hundred five samples from 50 sites were collected (Fig. 1). Fifteen samples were excluded from further analysis, however, because no gulls were found, no specific location was designated, or significant numbers of gulls were unidentified to species. Sample sites were chosen by observers and were usually in or near the community where the observer resided. Each observer spent ½–2 h at a site, often visiting it several times within a 1–2-wk period. Observers recorded the exact location of the site, the site type, the number of individuals of each gull species present, and were asked to document reports of rare gull species. Sites were categorized as coastal (<30 km from coast) or inland, human-made (dumpsites, sewer outlets, waste treatment plants, fish processing plants) or natural (mudflats, mussel beds, rocky shores, beaches). Sites were classes by total gull population size into five categories: 1–99 individuals (A), 100–499 individuals (B), 500–999 individuals (C), 1000–1999 individuals (D), and >2000 individuals (E). Comparisons of species composition between various site-types and size-classes were made using contingency table analysis.

Eleven dumpsites were censused two or more times (Fig. 1). Mean numbers of Herring Gulls, Great Black-backed Gulls, and mean Great Black-backed/Herring Gull ratios were calculated for each of these sites. Distance from coast was measured for each site and compared to the site mean using Spearman rank correlation. The human population size of the town served by each dumpsite (as a crude gauge of size of food source) was compared to the mean number of gulls at the site using Spearman rank correlation.

RESULTS

Eight species of gull were recorded (Table 1). Forty-nine samples (54%) were designated as coastal, 41 (46%) as inland, 56 (62%) as human-made,

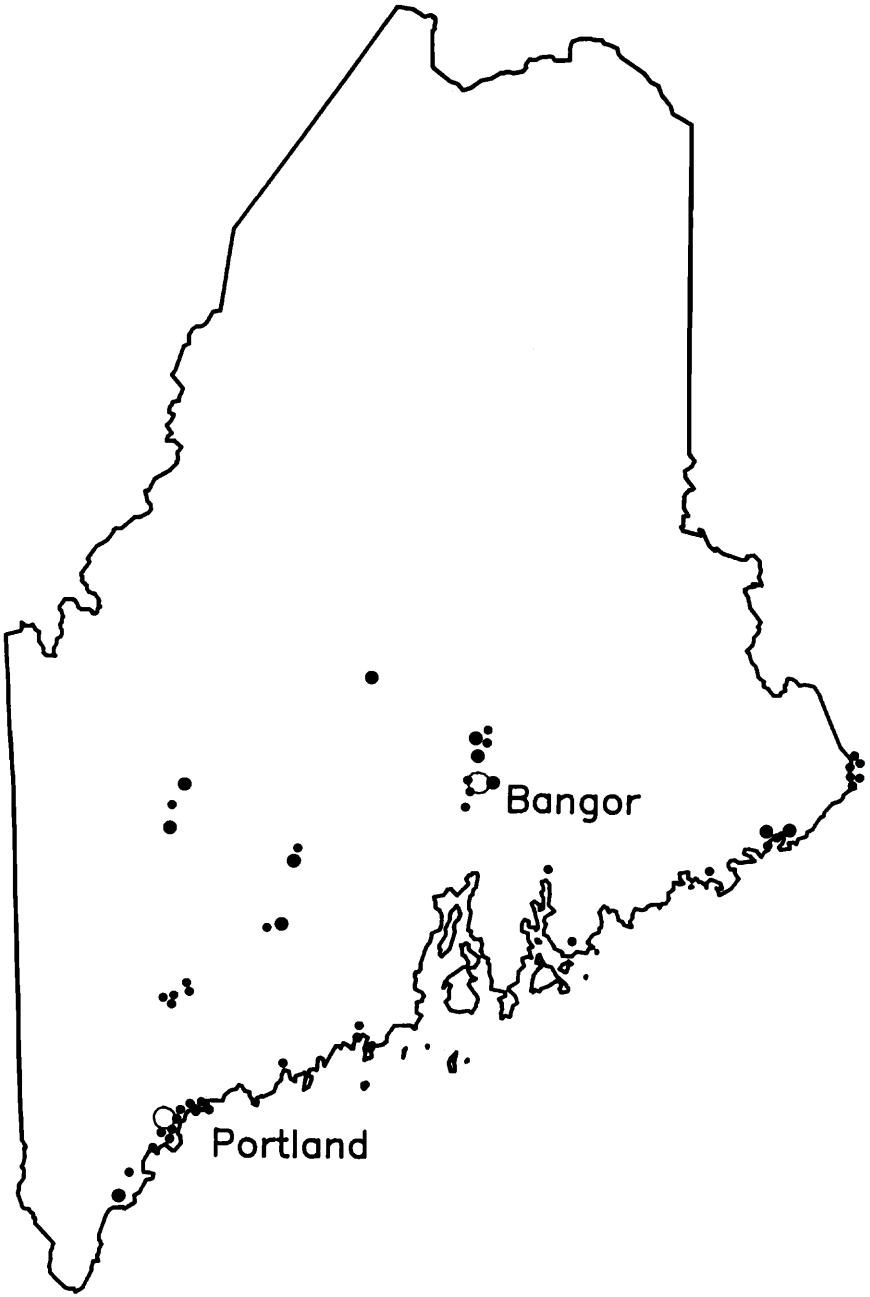

FIGURE 1. Map of Maine showing locations of 50 sites where gulls were counted. The two large open circles represent the locations of the cities of Bangor and Portland for reference. The 11 large solid circles represent the locations of sites associated with human-made food sources that were censused two or more times. The small solid circles represent the locations of the other 39 sites.

TABLE 1. Percent of total number of individuals of each gull species found at each site type in Maine, 22 Feb.–19 Mar. 1985–1987.

Species	% coastal	% inland	% human-made	% natural	Total (% of all gull species)
L. argentatus	70	30	70	30	32,167 (88.4)
L. marinus	68	32	85	15	3682 (10.1)
L. delawarensis	99	1	14	86	521 (1.4)
L. glaucoides	75	25	25	75	12 (<0.1)
L. hyperboreus	50	50	80	20	10 (<0.1)
L. ridibundus	100	0	0	100	3 (<0.1)
L. fuscus	100	0	100	0	1 (<0.1)
L. thayeri	100	0	100	0	1 (<0.1)

and 34 (38%) as natural. All inland samples were associated with human-made food sources (i.e., birds were not observed feeding away from human-made food sources), 15 (31%) coastal samples were human-made (natural inland food sources for gulls do not exist during the winter in Maine). All species, except Glaucous Gulls (*L. hyperboreus*), occurred at coastal locations in higher percentages (Table 1). Ring-billed Gulls (*L. delawarensis*) were restricted almost completely to coastal locations. Greater percentages of both Herring and Great Black-backed Gulls occurred at human-made sites than at natural sites. Ring-billed Gulls occurred more commonly at natural sites (Table 1). Most Iceland Gulls (*L. glaucoides*) and all Black-headed Gulls (*L. ridibundus*) were found at natural sites. Glaucous Gulls were recorded in higher percentages at human-made sites and the single Thayer's (*L. thayeri*) and Lesser Black-backed Gulls (*L. fuscus*) occurred at human-made sites (Table 1).

The aggregations of all gulls found at human-made sites were made up of 88% Herring and 12% Great Black-backed Gulls. As all natural sites were coastal and many human-made sites were inland, however, a more accurate comparison can be made if inland sites are excluded from the human-made sample. At coastal human-made sites Herring Gulls made up 87% of the sample, and Great Black-backed Gulls 13%, a highly significant difference ($\chi^2 = 394.25$, df = 1, $P < 0.0001$) from aggregations at natural sites which were comprised of 95% Herring and 5% Great Black-backed Gulls. The inland human-made sample had 11% Great Black-backed Gulls compared to 13% in the coastal human-made sample ($\chi^2 = 35.46$, df = 1, $P < 0.001$).

Mean Great Black-backed/Herring Gull ratios were negatively correlated with distance from coast (Table 2); Great Black-backed Gulls made up an increasingly smaller percentage of aggregations as distance from the coast increased. This could be because there were fewer Great Black-backed Gulls or more Herring Gulls as the distance from the coast increased. The mean number of Herring Gulls at each site showed no significant correlation with distance from coast. The mean number of Great

TABLE 2. Spearman rank correlation coefficients and *P*-values for various comparisons between mean number of *L. argentatus*, mean number of *L. marinus*, mean ratio of *L. marinus* to *L. argentatus* (Ratio), mean total number gulls, human population size of town serviced by site, and distance from coast for 11 sites associated with human-made food sources surveyed two or more times. Distance from coast ranged from 0 to 120 km (see Fig. 1 for locations).

	Distance	*P*	Human population	*P*	Total gulls	*P*
L. argentatus	0.133	NS	0.688	<0.025	—	—
L. marinus	−0.537	<0.05	0.360	NS	—	—
Ratio	−0.856	<0.001	−0.309	NS	−0.345	NS
Total gulls	0.133	NS	0.682	<0.025	—	—
Human population	0.178	NS	—	—	—	—

Black-backed Gulls at each site was negatively correlated with distance, however (Table 2). Neither human population size nor gull aggregation size was significantly correlated with distance from coast.

Most gull aggregations were in the smallest group size-classes (A and B), whereas very few samples contained greater than 1000 individuals (Fig. 2). Further, samples within most classes were distributed fairly evenly between coastal and inland locations, except in the highest class (Fig. 3). When the species composition between classes was compared, A and B combined were significantly different from C, and from D and E combined. Therefore A and B were combined, C was left separate, and D and E were combined, forming three group size-classes (small, medium and large). Herring Gulls made up significantly higher proportions of large class samples than either medium or small classes. Great Black-backed Gulls made up a significantly greater percentage of small class samples than medium or large class samples (Fig. 4).

Gull aggregation size was positively correlated with human population size (Table 2). A similar relationship was shown between mean number of Herring Gulls at each site and human population size (Table 2). Mean number of Great Black-backed Gulls at each site showed no significant correlation with human population size. Correlation of Great Black-backed/Herring Gull ratios against each site's mean gull population size and human population size was not significant.

DISCUSSION

Great Black-backed Gulls made up a greater percentage of gulls at human-made sites than at natural sites. Great Black-backed Gulls in Maine and northwestern Europe were found to comprise a greater percentage of gulls occurring on human-made substrates (dumps, effluent) than on natural substrates during the breeding season (Hunt and Hunt 1973). Studies of food brought to nestlings, however, indicated that breeding adult Great Black-backed Gulls usually do not forage at dumpsites (Verbeek 1979; R. Butler, pers. comm.). Verbeek (1979) noted that only one

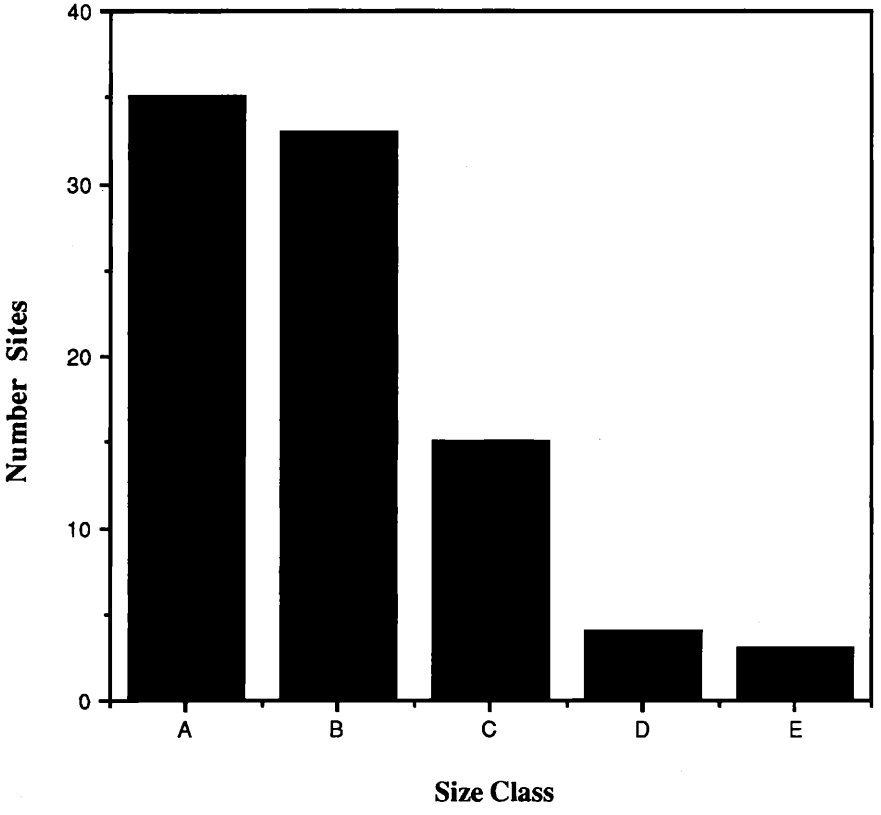

FIGURE 2. Number of sites in each of five size-classes based on gull aggregation size. Classes are: 1–99 individuals (A), 100–499 individuals (B), 500–999 individuals (C), 1000–1999 individuals (D), ≥2000 individuals (E).

of 133 gullet samples from chicks at a colony in England contained refuse, whereas 77 had fish or bird remains. It seems likely that many dump feeding Great Black-backed Gulls are non-breeders and immatures, and that in winter, adults and migrants may augment the population at human-made sites.

The increase in human production of waste has been implicated in the tremendous increase in Herring and Great Black-backed Gulls in New England since the 1930s (Drury 1973). Herring Gulls nesting closer to sources of edible refuse were found to have higher chick survival rates than those nesting further away (Hunt 1972). I found a positive correlation between Herring Gull abundance and the human population size of the town serviced by the site (as a measure of food supply). Great Black-backed Gulls did not show a similar relationship suggesting that they are less dependent on human refuse. Herring Gull populations may have increased more rapidly than Great Black-backed Gull populations in the

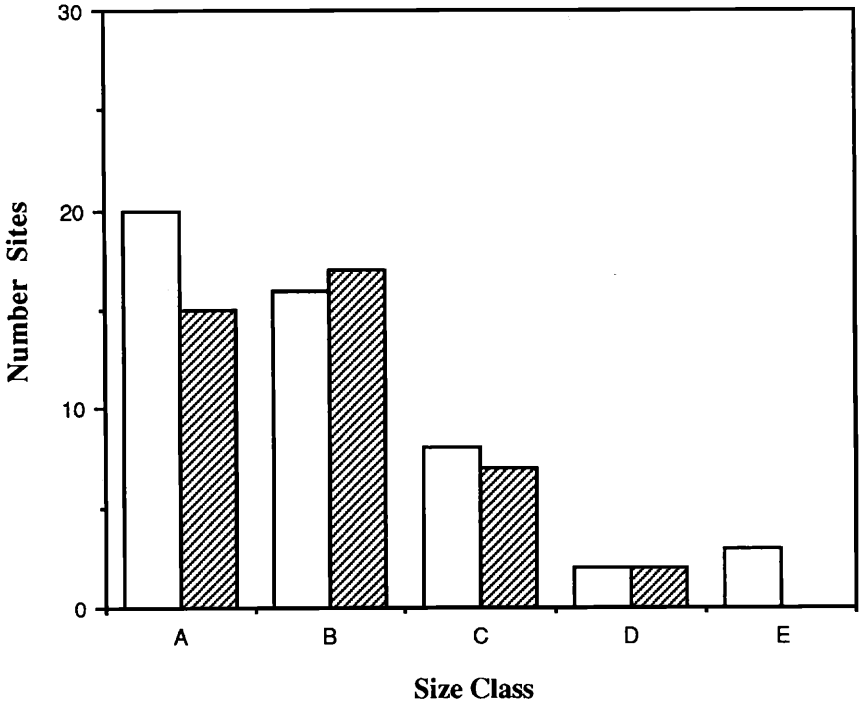

FIGURE 3. Number of coastal sites (open bars) and inland sites (cross-hatched bars) in each of five size-classes based on gull aggregation size.

eastern U.S. (Korschgen 1979) because Herring Gulls have exploited human-produced food sources more efficiently than Great Black-backed Gulls. Landfill closures may, therefore, have a greater effect on Herring Gull populations than on Great Black-backed Gull populations.

In Maine, Great Black-backed Gulls, unlike Herring Gulls, are virtually unknown as inland breeders (Adamus 1987; Palmer 1949; P. D. Vickery, pers. comm.). Great Black-backed Gulls are likewise uncommon in the Great Lakes Region where Herring Gulls are numerous (Godfrey 1986, Root 1988, Southern 1980). Vagrant Herring Gulls occur in the midwest United States in much higher frequency than Great Black-backed Gulls (Hobbs and Hobbs 1983, Mumford and Keller 1984). Great Black-backed Gulls seem to have some kind of ecological constraint that ties them to a coastal distribution. This would explain the negative relationship between Great Black-backed Gull abundance and distance from the coast that was observed in the present study.

Most late-winter gull aggregations in Maine contain fewer than 500 individuals. Very few sites have more than 1000 individuals in attendance. The largest gull aggregation noted during this study was estimated at 5000 birds. The same site may have had as many as 10,000 birds at certain

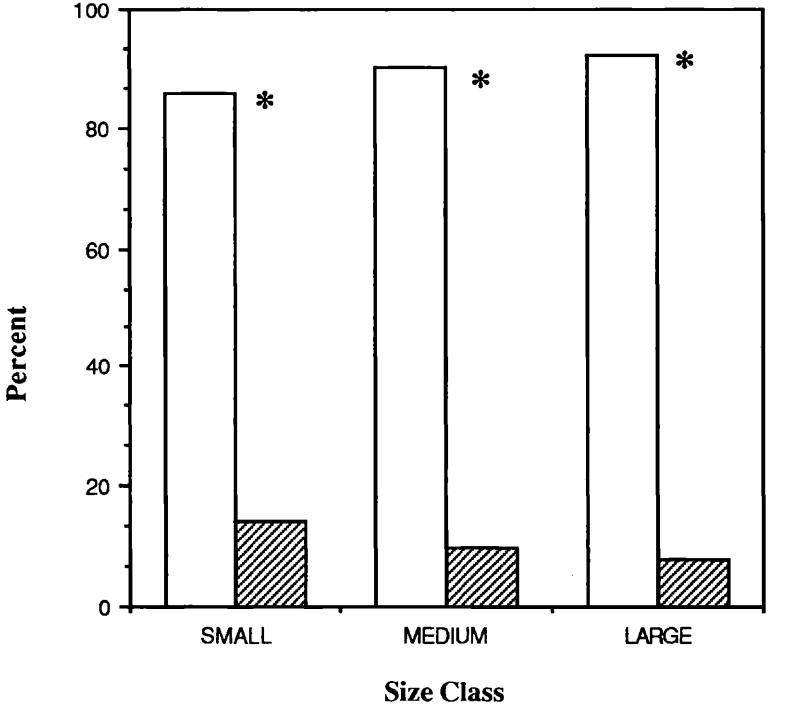

FIGURE 4. Percent of *L. argentatus* (open bars) and *L. marinus* (cross-hatched bars) in winter gull aggregations of three size-classes in Maine. An * indicates $P < 0.01$.

times during December and January (N. Famous, pers. comm.). Great Black-backed Gulls made up a significantly smaller percentage of large size-class gull aggregations than medium and small size-classes. Sites with smaller gull aggregations had a greater percentage of Great Black-backed Gulls than sites with large gull aggregations. If Great Black-backed Gull numbers did not increase after reaching some threshold but Herring Gull numbers did, the difference would be reflected as a lower percentage of Great Black-backed Gulls at sites with larger gull aggregations. Perhaps Great Black-backed Gulls have an intraspecific competition threshold above which extra incoming individuals cannot successfully compete. Such a threshold would limit the number of individuals at a site. This threshold could be a function of competition for food supply or competition for available victims from which to pirate food. Verbeek (1979) in his study of gulls at Walney Island, England, believed that on the garbage dump Great Black-backed Gulls were exclusively parasitic, especially on Herring Gulls. Burger et al. (1979), however, found that Great Black-backed Gulls infrequently engaged in piracy at a New Jersey dumpsite. Food supply may limit the number of Great Black-backed Gulls at a site

up to a certain point after which the number is limited by an intraspecific competition threshold.

Herring Gulls have nested in Maine since before European arrival (Palmer 1949). As a result of heavy hunting pressure in the late 1800s and early 1900s, the breeding population reached a low of approximately 10,000 pairs (Drury 1973). The nesting islands received protection in the 1930s, and the population showed a marked increase. In 1972, the breeding population was estimated at 29,000 pairs (Drury 1973) and in 1977, 22,390 pairs (Korschgen 1979). Great Black-backed Gulls are not known to have bred in Maine prior to 1930 (Palmer 1949). In 1972, the breeding population was estimated at 7500 pairs (Drury 1973) and in 1977, 9847 pairs (Korschgen 1979).

From the most recent estimates in 1972 and 1977, the breeding species composition can be computed. Drury's (1973) census found that Herring Gulls made up 79%, and Great Black-backed Gulls 21% of the state's large breeding gulls (Laughing Gulls [*L. atricilla*] breed in small numbers but are excluded from this analysis). The 1977 survey by Korschgen found that Herring Gulls made up 63% of Maine's breeding gulls, Great Black-backed Gulls 37%. My study of the late winter gulls showed a marked deviation from the species composition of both the Korschgen (1979) and Drury (1973) estimates. When considering only the two large gull species that made up the bulk of the population, Herring Gulls comprised 90% of the gulls, Great Black-backed Gulls only 10%.

Schreiber (1968) studied gulls at foraging and roosting sites along the Penobscot River in central Maine from December 1964 through February 1966. He found that Great Black-backed Gulls comprised 1–3% of the population. Hunt and Hunt (1973) counted foraging gulls during the breeding seasons of 1967–1969 along a segment of the shoreline of mid-coast Maine. They found that Great Black-backed Gulls made up only 7% of the total gulls. For further comparison I computed the percent Great Black-backed Gulls from the 5-yr means of Maine Christmas Bird Counts (1984–1985 through 1988–1989) and found that they comprised 9% of the large gulls counted (excluding the very small number of individuals of other species).

Great Black-backed Gulls are underrepresented in all of these surveys as compared to the 1972 and 1977 breeding colony surveys. There are at least six possible explanations.

(1) There were more Great Black-backed Gulls in Maine during the 1970s. This is very unlikely. Breeding season foraging site surveys done in the late 1960s (Hunt and Hunt 1973) found only 7% Great Black-backed Gulls. Great Black-backed Gulls made up 9% of the large gull species tallied on Maine Christmas Bird Counts for the season prior to the 1972 breeding colony survey (American Birds 1972).

(2) Great Black-backed Gull and Herring Gull populations differ in age-structure or age-related mortality rates. The two breeding surveys included only adults, whereas all the other surveys I have reviewed (including the present one) included all ages. Great Black-backed Gulls would,

however, have to have significantly higher juvenile/immature mortality than Herring Gulls for the difference in species composition to be attributable to survivorship alone. This seems unlikely.

(3) There are proportionately more non-breeding adult or immature Herring Gulls that remain in Maine than Great Black-backed Gulls. This seems very unlikely. Data from band returns (Gross 1945, Southern 1980) indicate that Great Black-backed Gulls travel shorter distances than Herring Gulls. If this is the case, there should be proportionately more non-breeding or immature Great Black-backed Gulls, not less.

(4) There are proportionately more wintering immigrant Herring Gulls in Maine than wintering immigrant Great Black-backed Gulls. Herring Gulls have a larger breeding range north of Maine (American Ornithologists' Union 1983, Southern 1980) and are undoubtedly more numerous than Great Black-backed Gulls. It therefore seems likely that proportionately more Herring Gulls would winter in Maine. This does not explain, however, the disproportionate number of Great Black-backed Gulls found in breeding season foraging surveys (Hunt and Hunt 1973).

(5) There are proportionately more Great Black-backed Gulls that emigrate out of Maine during winter than Herring Gulls. As Great Black-backed Gulls tend to travel shorter distances than Herring Gulls (Gross 1945) it seems unlikely that proportionately more of them would leave Maine.

(6) A higher proportion of Great Black-backed Gulls were not counted in foraging site surveys. The only types of areas not surveyed in this study or in the studies I have cited were open ocean, offshore locations and outer islands. Both Herring and Great Black-backed Gulls regularly winter offshore (Brown et al. 1975). A study of seabirds observed from commercial trawlers in the Irish Sea (Watson 1981) found that Herring Gulls comprised 65.9% of the six regularly occurring species and Great Black-backed Gulls 2.9%. In a study of the pelagic distribution of marine birds off the northeastern U.S., Power (1983) noted that the ratio of Herring Gulls to Great Black-backed Gulls never exceeded 2:1. Using the 5-yr mean number of Herring and Great Black-backed Gulls from Christmas Bird Counts for the period 1984–1985 through 1988–1989, I compared the percent Great Black-backed Gulls on Monhegan Island (16 km offshore) to that on the nearby mainland (Thomaston-Rockland CBC). The percent Great Black-backed Gulls on Monhegan was 31%; on the mainland only 3%. The disproportionate numbers of Great Black-backed Gulls found in breeding season foraging surveys (Hunt and Hunt 1973) is consistent with this explanation and makes it seem the most likely one.

The dynamics of wintering gull guilds are very complex. In order to fully understand what is taking place, future research should document the size of Maine's total wintering gull population, the age structure of the population, the origin of wintering gulls, and should examine more closely the factors that affect gull distribution.

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1994 NORTH AMERICAN BLUEBIRD SOCIETY RESEARCH AWARDS

The North American Bluebird Society is pleased to announce the results of its 10th annual research grant program. The following individuals are recipients of the 1994 research awards.

Bluebird Grants

Rachel F. Holt.—University of British Columbia. Population regulation of Mountain Bluebirds nesting in clear cuts: the changing roles of nest site limitation, predation and vegetation succession.

Daniela S. Monk.—Indiana University. Differential allocation of parental care in Mountain Bluebirds.

Gary L. Slater.—University of Florida. Nest site limitation and competition: effects on Eastern Bluebirds and Brown-headed Nuthatches in southern Florida threatened pineland ecosystem.

Student Grants

Jeffrey F. Kelly.—Colorado State University. The effect of food availability on behavior and reproduction of Belted Kingfishers.

Sheldon J. Cooper.—Utah State University. Physiological, physical, and behavioral adaptations to cold in the Mountain Chickadee and the Plain Titmouse.

Colleen A. Barber.—Queen's University. Determinants of extra-pair paternity in Tree Swallows.

General Grants

Drs. E. Dale Kennedy and Douglas W. White.—Kansas State University. Breeding biology of Bewick's Wren: conservation implications.

Dr. Charles R. Blem.—Virginia Commonwealth University. Clutch size, rate of growth, and reproductive success of Prothonotary Warblers.