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FEEDING COMPETITION BETWEEN LAUGHING GULLS AND HERRING GULLS AT A SANITARY LANDFILL

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ABSTRACT.—Feeding behavior of Laughing Gulls was examined and compared to that of Herring Gulls on a dump in New Jersey. Laughing Gulls ate food at the dump or carried away items to eat elsewhere. Whenever Herring Gulls were present, Laughing Gulls could not land on the dump, were forced to move from good feeding areas once they did land, and lost food to Herring Gull pirates both on the dump and while carrying food away. I suggest that direct competition from Herring Gulls has prevented Laughing Gulls from greater exploitation of dumps in New Jersey in the past. Recent changes in the operations of dumps have reduced interspecific competition by providing a situation in which Laughing Gulls can effectively dip for food and Herring Gulls are prevented from feeding. As a result of this change, the use of dumps by Laughing Gulls has increased in New Jersey.

Early in the present century, the large, white-headed gulls began using refuse dumps for food in Europe and North America, and the small gulls have recently begun to do so. The increase in numbers and expansion in breeding range of Herring Gulls (*Larus argentatus*) in Europe (Andersson 1970, Davis and Dunn 1976) and in North America (Kadlec and Drury 1968, Drury and Kadlec 1974, Burger 1977) has been attributed to garbage dumps, which provide a dependable food supply throughout the year (Drury 1965, Harris 1970, Kihlman and Larsson 1974, Monaghan 1978). The availability of food increases the survival of chicks during the breeding season (Hunt 1972), of juveniles after the breeding season, and of all ages during the winter (Drury and Smith 1968).

Some of the small, hooded gulls such as the Laughing Gull (*L. atricilla*) have not undergone a population increase and may be decreasing (see Harris 1970, Nisbet 1971). These birds use dumps less than 0.1% of their foraging time after the breeding season, and they rarely use dumps in the summer (Hunt and Hunt 1973). Since the 1960's, Hunt (pers. comm.) has found Laughing Gulls feeding at dumps in Florida, and Forsythe (1976, pers. comm.) observed them at dumps in South Carolina during the winter. Laughing Gulls have foraged on dumps in New Jersey only since about 1975 (R. Kane, pers. comm.), and their numbers on dumps have been increasing steadily. One reason Laughing Gulls may avoid dumps is that they are much smaller than Herring Gulls (*L. argentatus*), which frequent garbage dumps on the Atlantic coast. Owing to their smaller size, Laughing Gulls may lose conflicts with Herring Gulls, and they may be unable to dig through the garbage to find food.

In 1978 I studied the feeding behavior of Laughing Gulls at a sanitary landfill in East Brunswick, New Jersey. Competition with Herring Gulls might result in Laughing Gulls being less successful, being forced to feed at the edge of the dump, or losing food to Herring Gull pirates. My study was designed to examine how Laughing Gulls feed at a dump in the presence of Herring Gulls, and to compare feeding behavior between the species. If Laughing Gulls are less successful or have more difficulties feeding at dumps than Herring Gulls, this might partially explain why they are not increasing while Herring Gulls are. New Jersey has 75 colonies with approximately 54,000 pairs of nesting Laughing Gulls (J. Galli, pers. comm.). During the year of this study, I individually marked (with wing-tags) 601 young and 36 adults at the nearest breeding colony (Clam Island). I found that 26 young (4%) and 6 adult (17%) Laughing Gulls used the dump some of the time; wing-tagged birds usually accounted for less than 5% of the Laughing Gulls present. Since more than two hundred garbage dumps are available to gulls in New Jersey, these figures suggest that dumps are an important feeding location.

STUDY AREA AND GENERAL METHODS

My three assistants and I observed feeding behavior for four days a week (4–6 h/day) during September and October 1978, at the Edgeboro Sanitary Landfill in East Brunswick, New Jersey. Garbage trucks emptied from 07:00 to 16:30 on weekdays. Large bulldozers roamed the dump, crushing and redistributing garbage.

Every evening the exposed garbage was covered with a layer of dirt. The dumping surface (about 10 × 6 m) was almost level, and the bulldozers pushed the garbage over the edge of a 10 × 14 m high sloping face. I designated the dumping surface as the top, and divided the sloping surface into two equal sections: the middle, from the edge of the dumping surface halfway down the slope, and the bottom, the remaining lower section. The level area at the bottom of the exposed slope of garbage was designated the foot of the dump. Scattered food items were present in this area. All four areas were approximately equal in size.

We distinguished three age classes of Laughing Gulls: *young* (hatched in June of the study year), *subadults* (15 to 16 months old), and *adults* (27 months and older). Herring Gulls take four years to reach adult plumage (see Dwight 1925) but we distinguished three age classes: *young* (hatched the past summer), *subadults* (15 to 39 months old) and *adults* (older than 51 months).

At the beginning of each observation period we recorded the species composition by age. Three types of data were collected: feeding behavior of individuals, how individual gulls handled food once it was obtained (eat immediately, carry from the dump), and aggressive interactions of gulls competing for food (or feeding space). These data were gathered for both Laughing and Herring gulls in order to compare feeding behavior and success. Specific methods used to study each of these aspects will be described in the appropriate section.

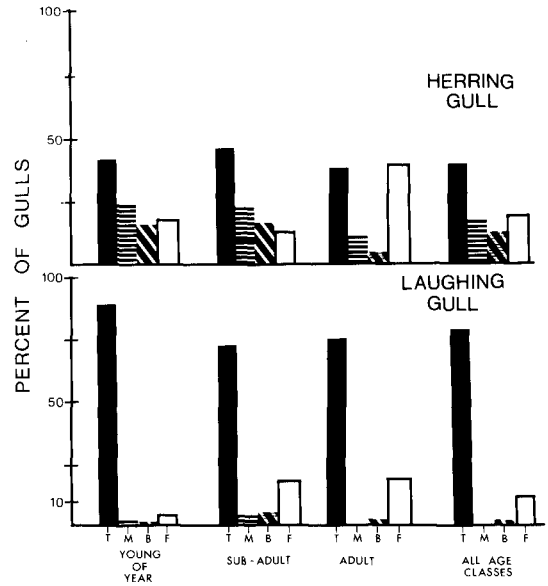

FIGURE 1. Location of foraging Herring and Laughing gulls according to age and dump location. T = top third, M = middle third, B = bottom third of the dump and F = the flat area with little exposed garbage at the base of the dump.

RESULTS

SPATIAL AND TEMPORAL USE OF THE DUMP

In general, gulls fed on the dump wherever garbage was being freshly dumped or was being pushed around by bulldozers. Gulls searched for food either by hovering over the dump (Laughing Gulls) or by walking over the surface and pecking at items (both species), or turning over garbage (Herring Gulls). Gulls of both species fed in a dense group, resulting in aggressive interactions between individuals over food items or feeding space (see aggressive interactions below). Up to 55 Laughing Gulls ($\bar{x} = 61$, SD = 18.3) fed on the dump. The age distribution of Laughing Gulls present was: adult, 53%; subadult, 8%; young, 39%; for Herring Gulls: adult, 23%; subadult, 10%; young, 67%. Overall, a higher proportion of Herring Gull young than Laughing Gull young fed on the dump ($\chi^2 = 36.5$, df = 1, $P < 0.001$). Of the four census areas, over 75% of Laughing Gulls fed at the top ($\chi^2 = 354.2$, df = 2, $P < 0.001$, Fig. 1). There were no age differences in how Laughing Gulls used the dump. Adult Herring Gulls fed at the foot of the dump more often than younger gulls. Nonetheless, Herring Gulls primarily fed at the top of the dump, although over half of them fed elsewhere ($\chi^2 = 450.3$, df = 2, $P < 0.001$). Although Herring Gulls often outnumbered Laughing Gulls on the dump, Laughing Gulls frequently outnumbered Herring Gulls on the top of the dump. More food was available at the top where it was freshly dumped, but Herring Gulls often avoided this area when trucks and bulldozers were moving rapidly. Laughing Gulls could keep out of the way of bulldozers by hovering above the dump and dipping down to pick up freshly exposed food items.

Every 15 min throughout the study we recorded the number of gulls of each species present. Since these data were taken over several weeks all stages in the tide cycle were represented at each time of day. Few Laughing Gulls fed before 09:00 or after 16:00, although Herring Gulls fed from 06:00 to 18:00. The highest percentage of Laughing Gulls used the dump from 11:00 to 13:00.

FEEDING BEHAVIOR

Gulls either ate the food where they found it, or they flew off and ate it elsewhere. To compare the behavior of Laughing and Herring gulls, we collected data only when both species were feeding at the top of the dump. For 100 five-min sample periods two observers recorded the following data for birds within a randomly-selected circular area with 2.5 m diameter: time, number of each species by age, time since a truck had dumped or the bulldozer had operated, number of items eaten by each species, and number of items carried away according to

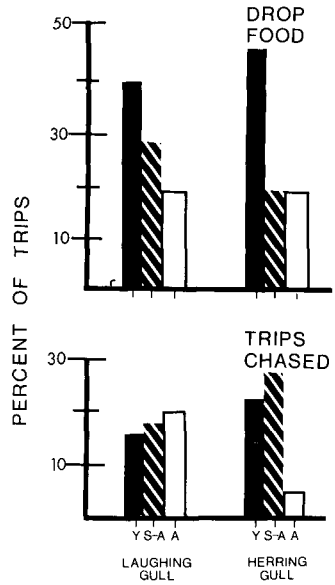

FIGURE 2. Behavior of gulls being chased by pirates. The top graph indicates the percentage of food dropped as a function of species and age. The bottom graph shows the percentage of gulls chased as a function of species and age. Y = young, S-A = subadult and A = adult.

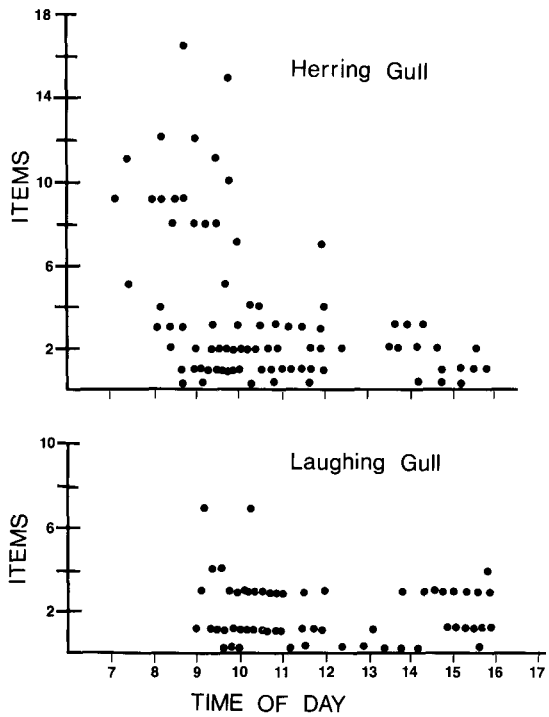

FIGURE 3. Food items located by Herring Gulls (HG) and Laughing Gulls (LG) as a function of time of day. Multiple dots for each time period equals samples taken on different days.

species and age. Normally only six to ten birds fed in this area and it was possible for two observers to follow all the birds (each observer followed one species). For items removed, a third observer recorded if the item was eaten or dropped, the number of each species and age of gulls pursuing the gull with food, and the outcome of the pursuit. I used stepwise multiple regression techniques to determine the factors contributing to the variance in the number of food items carried away and eaten on the dump. This procedure gives an R^2 (percent of total variance explained by the regression model). For each model given below I present the R^2 with associated F values and probability levels.

Amount of food. The amount of food eaten by Laughing Gulls was related to age of the bird, garbage truck activity, and the number of Herring Gulls present within 1.2 m of the foraging bird ($R^2 = .52$, $F = 54.3$, df = 3, 596, $P < 0.001$). Laughing Gulls obtained more food when few Herring Gulls were present and when garbage trucks were unloading. Almost half of the variance in the number of food items carried from the dump by Laughing Gulls related to the age of the gulls, bulldozer and truck activity, the number of Laughing Gulls, and the density of birds ($R^2 = .47$, $F = 37.3$, df = 4, 595, $P < 0.001$). Laughing Gulls carried away more food when gull density was high, when there were relatively high numbers of Laughing Gulls, when the trucks had just dumped, and when the bulldozers were operating. Twice as much food was carried from the dump when the bulldozer operated compared to when it was not in the area. Laughing Gulls carried away a higher percentage of their food than did Herring Gulls. Adult Laughing Gulls carried away more food than younger Laughing Gulls, and young Herring Gulls carried away more food than older Herring Gulls (Table 1). Although Laughing Gulls carried away smaller food items than Herring Gulls, both species removed the same items. If an item was too large, a gull bit off a piece to carry.

TABLE 1. Percentage of food obtained by each age class that was carried from the dump by Laughing and Herring gulls.

	Laughing Gull	Herring Gull
Number[a]	600	750
Young	15	8
Subadult	14	4
Adult	28	4
Overall[b]	20	6
χ^{2c}	12.84	8.14
P	<0.005	<0.05

[a] Number of gulls finding food, which they either ate there or carried away. Percentages are based on equal numbers of each age class.
[b] χ^2 comparing Herring and Laughing gulls = 6.92, $P < 0.05$.
[c] χ^2 contingency test assuming mean percent for each species.

Dropping food. Birds that carried food from the dump landed on a loafing area to eat it. A gull carrying food might eat it, drop it, or be pursued by other gulls trying to steal it. For unpursued flights with food, the percentage of items dropped varied by age but not by species (Fig. 2). Among Laughing Gulls, adults dropped significantly fewer food items than did younger Laughing Gulls ($\chi^2 = 6.57$, df = 2, $P < 0.005$): among Herring Gulls adults and subadults dropped fewer items than did young ($\chi^2 = 12.65$, df = 2, $P < 0.005$).

Piracy. In 186 piracy attempts that we watched, Laughing Gulls of all ages were chased equally, although adult Herring Gulls were chased less often than younger Herring Gulls ($\chi^2 = 5.99$, df = 2, $P < 0.05$, Fig. 2) and all Laughing Gulls. Overall, Laughing Gulls were chased less often than Herring Gulls ($\chi^2 = 4.14$, df = 1, $P < 0.05$), and they did less chasing than Herring Gulls ($\chi^2 = 4.85$, df = 1, $P < 0.05$). Laughing Gulls never chased Herring Gulls although Herring Gulls chased Laughing Gulls. Pirates of both species obtained food from 35% of their attempts.

Feeding rates. To examine individual feeding behavior and success we observed randomly selected individuals for a 1-min period. One observer recorded the number of pecks directed at garbage (attempts), and the number of items picked up (using a telescope). A second observer recorded the number of displacements, chases, and fights among the birds (including the study bird) within a radius of 1.2 m from the feeding bird. Birds not visible for the whole minute were eliminated from the sample. Other data recorded for the 255 samples included: species and age class of the foraging bird, number of each species by age class within a 1.2 m radius, time of day, truck activity, and location on the dump. Truck activity was the time since fresh garbage had been dumped. I used step-wise multiple regression techniques to determine the best model explaining the variance in feeding rates (Barr et al. 1976). Factors were considered to add to the variability when they entered at a probability level of less than 0.05%.

When all data were combined, the variance in the number of food items obtained was explained by species, age, time and the number of Herring Gulls ($R^2 = .32$, $F = 5.16$, df = 1, 4,251, $P < 0.001$). For Laughing Gulls, the time, number of conspecifics, and the number of displacements, fights and pecks contributed to the variability in the number of attempts (pecks at potential food items) per min ($R^2 = .30$, $F = 2.12$, df = 5, 130, $P < 0.01$). Laughing Gulls made fewer attempts later in the day, fewer attempts when there were more conspecifics, and fewer attempts when they engaged in more conflicts. For Herring Gulls, however, feeding attempts were affected by time and the number of Herring Gulls ($R^2 = .38$, $F = 10.6$, df = 2,118, $P < 0.001$). Herring Gulls also made fewer attempts later in the day, and they made more attempts when more Herring Gulls were present. Thus, aggressive interactions entered the models for Laughing Gulls only; the density of Herring Gulls reduced attempts by Laughing Gulls and increased attempts by Herring Gulls.

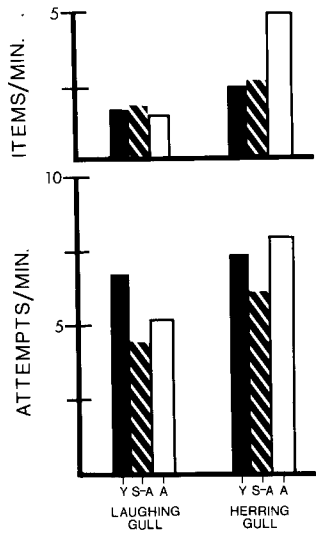

FIGURE 4. Feeding attempts and food items located as a function of species and age. Y = young, S-A = subadult, A = adult.

For both species the number of items located was affected by the number of Herring Gulls present. In Laughing Gulls the number of items found was correlated negatively with Herring Gull density ($r = -.63$); whereas for Herring Gulls the relationship was positive ($r = +.71$). For Herring Gulls, adults found more food items than did young ($\chi^2 = 21.96$, df = 2, $P < 0.001$), and all gulls found more items early in the day (Fig. 3). Several differences between species emerge from this analysis: 1) time of day affected the number of items found only for Herring Gulls, 2) the number of Herring Gulls influenced the number of items found for both species, and 3) adult Herring Gulls found more food items than did younger birds. Herring Gulls found as many as 16 items per minute, whereas Laughing Gulls never found more than 7 (Fig. 4).

TABLE 2. Winning index and losing aggression index for each age class of each species. The index equals the mean number of encounters per individual per minute (see text).[a]

Losing species		Winning species: Laughing Gull Yearling	Laughing Gull Subadult	Laughing Gull Adult	Herring Gull Yearling	Herring Gull Subadult	Herring Gull Adult	Total losing index
Laughing Gull	Yearling	.03	.08	.32	.48	.12	.23	1.26
	Subadult	.05	.04	0	.09	.07	.08	.33
	Adult	.04	0	.06	.49	.04	.15	.78
Herring Gull	Yearling	0	0	0	.66	.19	.21	1.06
	Subadult	0	0	0	.13	.27	.06	.46
	Adult	0	0	0	.08	0	.13	.21
Total winning index		.12	.12	.38	1.93	.69	.86	

[a] Based on 190 5-min sample periods when both species were present.

Attempts (pecks at any object) seemed to be a measure of effort, while the number of items was a measure of food acquired. I computed foraging efficiency by dividing the number of items located by the number of attempts, and multiplying this by 100 to give a percentage. Laughing Gulls had a mean efficiency of 28% and there were no age differences. Herring Gulls had a mean efficiency of 38% and showed significant age differences ($\chi^2 = 13.4$, df = 2, $P < 0.005$); where the efficiency rate of young equalled 35%, subadults equalled 28%, and adults equalled 58%. Thus, adult Herring Gulls seemed to expend the same effort as younger birds, but acquired significantly more food items. We noted no obvious difference according to age in the size of food items taken by Herring Gulls.

AGGRESSIVE INTERACTIONS

Conflicts among individuals feeding on the dump were frequent, usually because two or more gulls tried to eat the same food item, or occupy the same place. Often there were more gulls than could fit on the space where garbage had just been dumped. To examine aggressive behavior we recorded all interactions of all gulls within an area with a 2.5-m diameter for a 5-min period. For each 5-min observation, we recorded the number of each species by age class, and the loser and winner of all displacements, pecks, and fights according to species and age. A displacement occurred when one bird landed on the dump, forcing another bird to move. Usually, only 6 to 12 birds were in the area and interactions could be counted on a tally counter. Summing the total aggressive interactions for each 5-min sample indicated variability in the number of interactions. The variance in the number of interactions was explained by the number of feeding attempts and the number of gulls of all species (or density, $R^2 = .58$, df = 2,188, $P < 0.001$). Aggressive interactions increased as the number of feeding attempts decreased, and as the number of gulls increased. In other words, when there were more gulls pecking at less potential food, aggression increased.

TABLE 3. Aggression rates and percentage of encounters won by age for Herring and Laughing gulls.

	Aggression index	Percent wins in conspecific encounters	Percent wins in all encounters
Laughing Gull			
Adult	.38	75	35
Subadult	.12	66	28
Young	.12	29	11
Herring Gull			
Adult	.86	69	82
Subadult	.69	54	42
Young	1.93	50	66

For each sample period (N = 190) I computed an aggression index for winners of each combination of species and ages by dividing the number of interactions between the two groups by the number of the two interacting groups (see Burger et al. 1979). To get a total winning index for each age class in each species, I added the winning index for its interactions with all other age classes of each species (Table 2). For every interaction, one individual lost (left the area or gave up the food item), and the other individual won.

The aggression indices indicated that Laughing Gulls never won over Herring Gulls (Table 2). Adult Laughing Gulls won more conflicts than younger Laughing Gulls (Fig. 5, $\chi^2 = 17{,}14$, df = 2, $P < 0.001$), and adult Herring Gulls won more than younger Herring Gulls ($\chi^2 = 237.2$, df = 2, $P < 0.001$). Young gulls engaged in more conflicts than adults of their respective species,

although young Herring Gulls were more aggressive than young Laughing Gulls ($\chi^2 = 59.7$, df = 1, $P < 0.001$).

Over 50% of all aggressive behavior by Herring Gulls and 82% of aggressive encounters of Laughing Gulls was interspecific ($\chi^2 = 71.3$, df = 1, $P < 0.001$). Laughing Gulls never won against Herring Gulls. For most interspecific conflicts Herring Gulls were the instigators, trying either to steal food or displace the Laughing Gulls.

For both species, the percentage of wins in conspecific encounters related to age: adults won most encounters although adult Laughing Gulls (75%) won more encounters than adult Herring Gulls (69%). For both species about 80% of conspecific encounters involved displacements, and less than 5% involved fights.

For conspecific encounters the percentage of wins varied by age of the intruder as well as age of the defender. The percentage of wins increased with the age of the defender, and decreased with age of the intruder. That is, young gulls lost the most to intruders, and adults won the most from intruders. As intruders, adults won more often than young.

Thus, while feeding on the dump, Laughing Gulls competed directly with Herring Gulls for food and foraging space, resulting in overt aggression and displacements. Herring Gulls usually started and won aggressive encounters with Laughing Gulls. In conspecific encounters, adults won more than young, both as defenders and intruders. These relationships are summarized in Table 3.

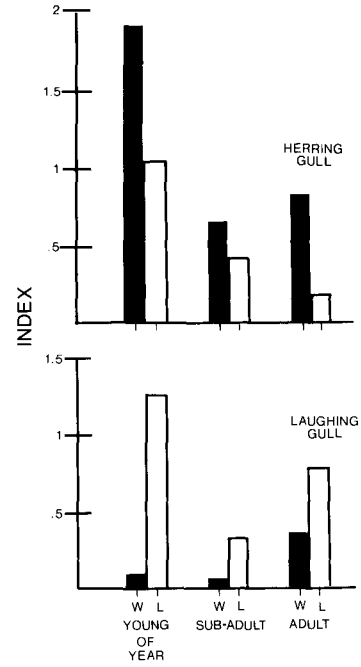

FIGURE 5. Winning (W) and losing (L) aggression index for Herring (HG) and Laughing (LG) gulls as a function of age.

DISCUSSION

In this study the feeding behavior of the two species of gulls differed in several respects; there were no age differences in feeding success on the dump for Laughing Gulls. The infrequent use of dumps by Laughing Gulls in the past, and their present increased use of dumps relate to their interactions with Herring Gulls as well as to changes in how the dumps are managed. These aspects of the study are discussed below.

AGE DIFFERENCES

In this study Laughing Gulls of all ages made similar attempts at finding food, ate the same kinds of food and number of food items, and had similar rates of foraging efficiency while feeding on the dump. This finding differs from previous findings with a variety of gulls feeding on natural situations and at dumps (Verbeek 1977a, b, Ingolfsson and Estrella 1978).

On a refuse tip in England, Verbeek (1977a) found that young Herring Gulls found fewer objects per minute, moved fewer objects in search of food, dug for food less often and tried to steal food more frequently than adults. While feeding on starfish, adults were more successful on the first dive, were chased for food less often, and fed for less time than did young (Verbeek 1977b). Young Herring and Glaucous-winged gulls (*L. glaucescens*) were less successful at opening bay scallops (*Pecten irradians*) and clams, and fishing than adults (Barash et al. 1975, Ingolfsson and Estrella 1978, Searcy 1978).

These studies indicate that gulls feed more successfully as they get older. Such age differences reflect the difficulty of the task and the time required to learn the techniques and locations of feeding areas (Ingolfsson and Estrella 1978). It takes time for gulls to learn to dive for fish or other invertebrates, drop clams over hard rather than soft surfaces, and dig for garbage. Young gulls compensate for these deficiencies by feeding for a longer period of time each day.

In the present study, Herring Gulls behaved as predicted on the basis of the above pattern: adults fed more efficiently and less often than young. However, Laughing Gulls

did not fit the pattern because there were no age differences in foraging efficiency. There are several possible explanations for a lack of age differences: 1) Laughing Gulls are recent exploiters of dumps and adults have not had sufficient experience, 2) their feeding method on the dump is easy and age differences might not be expected, and 3) Herring Gulls interfere directly in feeding or indirectly by being aggressive.

Laughing Gulls have fed at dumps in New Jersey for at least five years; thus, adults have had previous experience with dumps which might have increased their feeding ability over naive young. Age differences might not exist where the task was sufficiently easy to render prior experience unnecessary. However, Laughing Gulls hovering over the dump frequently were unable to land (to search for food) or to dip and pick up food items because space was not available. Laughing Gulls were usually prevented from landing by the mass of feeding Herring Gulls. In sum, their task does not appear easy.

My results indicate that the number of food items Laughing Gulls obtained was directly related to the density of Herring Gulls, but not the density of Laughing Gulls. Laughing Gulls hovering above the dump simply could not displace Herring Gulls already feeding on the dump, whereas an intruding Laughing Gull could displace a conspecific. Furthermore, once on the dump surface, Herring Gulls still could displace a Laughing Gull that was already feeding. I suggest that the lack of age difference in feeding success of Laughing Gulls comes about because interference from Herring Gulls eliminates the advantage of prior experience: Laughing Gulls of all ages move over, depart, or never land in the presence of Herring Gulls. Preliminary observations in Florida indicate that Laughing Gulls exhibit age differences while feeding on a dump in the absence of Herring Gulls (J. Burger, M. Gochfeld, unpubl. data).

Secondly, the age difference in Herring Gulls is partially attributable to the ability of adults to open bags and dig through the garbage for food (see Verbeek 1977a). Since Laughing Gulls do not dig for food, they do not behave in such a way that experience may improve success. They did, however, fly from the dump with food and adults flew more often and lost less food to pirates than young. Adults thus ate more of the food they found than did young.

COMPARISON OF FEEDING METHODS OF LAUGHING AND HERRING GULLS

Laughing Gulls use the dump differently than Herring Gulls. Laughing Gulls forage at the top where garbage is constantly being dumped and bulldozed, whereas Herring Gulls forage over all areas of the dump. This difference is attributable to differences in feeding behavior and not to competition. Herring Gulls are large enough to turn over objects and break open bags to expose food whereas Laughing Gulls are not. Thus, Herring Gulls have a larger available foraging area, and are not dependent on truck or bulldozer activity.

Secondly, Laughing Gulls frequently hover over the dump dipping for food items (in a manner similar to dipping for insects over water) whereas Herring Gulls always land to feed. This difference in behavior is attributable to direct competition as well as to differences in foraging behavior in natural situations. Since Herring Gulls frequently feed where trucks have just dumped, the Laughing Gulls often hover over this area searching for food *and* a space to land and pick up the food. When Herring Gulls are absent, Laughing Gulls will land and feed the same way that Herring Gulls normally do. Their hovering thus is partially related to the presence of Herring Gulls (but see below).

Thirdly, Laughing Gulls carry more food away from the dump than do Herring Gulls. This difference is related to competition between the species and to the activity of the bulldozers and trucks. Herring Gulls often steal food from Laughing Gulls and displace them from prime feeding areas. Laughing Gulls can consume more food by immediately flying from the dump with the food, to eat it undisturbed. Also, they often fly with food to avoid being run over by bulldozers or trucks.

HOW HERRING GULL COMPETITION AND DUMP OPERATIONS AFFECT DUMP USE BY LAUGHING GULLS

One objective of this study was to determine why Laughing Gulls have not exploited dumps more often in the past, and why their exploitation of dumps has increased in recent years in New Jersey.

I suggest that Laughing Gulls have used dumps infrequently in the past because of direct competition with Herring Gulls. Herring Gulls can prevent Laughing Gulls from landing on the dumping surface, displace

them from prime feeding areas once they have landed, steal food from them while they feed, and pirate food from them when they carry it from the dump. Secondly, since Laughing Gulls cannot (or do not) dig through garbage to find food, they are restricted to the top surface of the dump.

I attribute the recent increase in the use of dumps by Laughing Gulls to changes in how dumps are managed. In the past, trucks dumped garbage all day, and after several days or weeks it was covered with sand. With the recent awareness of the exploitation of dumps by rats and gulls, public officials have demanded that sanitary landfills cover the garbage every day. Rats, of course, pose health problems, while gulls present a hazard to airplane traffic, and since dumps are often located near airports, there has been an effort to decrease gull populations (see Blokpoel 1976). The imperative to cover garbage immediately with dirt causes constant bulldozer activity to distribute and mash down the garbage so that it can be covered that afternoon. This procedure is distinctly advantageous to Laughing Gulls. First, it makes food available all day since the bulldozers break open bags and expose food. More importantly, it decreases the competition between Laughing Gulls and Herring Gulls. Laughing Gulls, being smaller, are more agile than Herring Gulls and can feed in between the moving bulldozers. They simply hover around the bulldozer at the top of the dump, and dip for food items. The bulldozer allows them to employ a feeding method (dipping), which they normally use over the ocean, unobstructed by Herring Gulls. Thus, recent changes in how dumps are managed are disadvantageous to Herring Gulls, and advantageous to Laughing Gulls. Further, these changes lead to the prediction that Laughing Gulls may increase their use of dumps in the future, and may increase their populations as well.

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