JEWETT, S. G., W. P. TAYLOR, W. T. SHAW, & J. W. ALDRICH. 1953. Birds of Washington State. Seattle, Washington, Univ. Washington Press.

KOZLOFF, E. N. 1973. Seashore life of Puget Sound, the Strait of Georgia, and the San Juan Archipelago. Seattle, Washington, Univ. Washington Press.

———. 1974. Keys to the marine invertebrates of Puget Sound, the San Juan Archipelago, and adjacent regions. Seattle, Washington, Univ. Washington Press.

MCATEE, W. L. 1906. Birds that eat scale insects. U.S. Dept. Agr. Yearbook, 1906: 189–198.

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Age Differences in Ring-billed Gull Kleptoparasitism on Starlings

JOANNA BURGER[1] AND MICHAEL GOCHFELD[2]
[1]*Department of Biology, Livingston College, Center for Coastal and Environmental Studies, Rutgers University, New Brunswick, New Jersey 08903 USA and* [2]*Environmental Health, School of Public Health, Columbia University, New York, New York 10032 USA*

Kleptoparasitism is well known among gulls, terns, and skuas (Trillmich 1978, Grant 1971). Intraspecific parasitism has been reported for Common Terns (*Sterna hirundo*, Hays 1970) and Ring-billed Gulls (*Larus delawarensis*, Elston et al. 1977). Interspecific kleptoparasitism has been reported for Common Terns, Roseate Terns (*S. dougallii*; Hays 1970, Hopkins and Wiley 1972, Hulsman 1976), Laughing Gulls (*L. atricilla*, Hatch 1970), and Silver Gulls (*L. novaehollandiae*, Hulsman 1976). These reports are from breeding colonies, but interspecific kleptoparasitism occurs at other times of the year (Bartlett 1957, Siegfried 1972).

Age differences in foraging efficiency have been found for several species (Recher and Recher 1969; Orians 1969; Dunn 1972; Barash et al. 1975; Verbeek 1977b, 1977c; Searcy 1978; Morrison et al. 1978; Ingolfsson and Estrella 1978). In general, efficiency increases with age, although Buckley and Buckley (1974) found that juvenile Royal Terns (*Sterna maxima*) were just as successful in fishing as adults. Although age differences in foraging have been noted, no age differences in kleptoparasitism have been found. Where this factor has been examined specifically (Verbeek 1977a), it has been found not to exist. In this paper we report on age differences in kleptoparasitism of Ring-billed Gulls on Starlings (*Sturnus vulgaris*) observed at the Edgeboro Sanitary Landfill in East Brunswick, New Jersey, and consider if young or subadults compensate for lower success rates. In this study we classified gulls as young (birds of the year), subadults (birds with a dark tailband), and adults (birds with white tail, see Dwight 1925). Observations were made during October and November 1978, when gulls regularly foraged with the Starlings.

Gulls watched the Starlings and when a Starling picked up a food item, the gull flew or walked rapidly at the Starling, forcing it to drop the food. Starlings flew with the food or dropped it before flying. When Starlings flew with food, gulls either looked for another Starling or pursued the Starling aerially. We recorded the interval between attempts (when a gull moved toward a Starling with food) and the success of attempts in terms of foraging method and age.

The interval between robbing attempts varied with age, as the interval was significantly longer for young than for adults and subadults (Table 1). When the data were combined for the 4 days, there was no significant difference due to date, although age differences remained significant ($F = 22.87$, df = 4,168).

We recorded other parameters of foraging behavior on 20 November, when the Starlings and gulls fed in one location for over 5 h. A census showed 136 gulls (50% young, 20% subadult, 30% adult) feeding on the dump, whereas 45 gulls fed among the Starlings (24% young, 44% subadult, 32% adult). Thus, proportionately more subadults and fewer young engaged in kleptoparasitism.

The flock of Starlings was dense but not evenly distributed (ranging from 60–275 birds, $\bar{x} = 116 \pm 32$, for eight 64-m^2 quadrats). The mean nearest neighbor distance between Ring-billed Gulls was 5.35 ± 1.76 m, compared with 4.54 ± 4.58 m for an equivalent number of randomly placed gulls (random number table used to generate coordinates). The gulls were thus regularly rather than randomly distributed ($P < 0.001$) among the Starlings. Presumably, spacing themselves regularly among the clumped Starlings increased the potential for finding Starlings with food by reducing intraspecific competition.

TABLE 1. Time intervals (s) between foraging attempts made by Ring-billed Gulls against Starlings.

	12 November	16 November	20 November	26 November
Number of Starlings	860	1,800	1,500	350
Number of gulls	12	36	42	19
Foraging attempts				
Young, n	16	12	20	12
$\bar{x} \pm$ SD	82 ± 43	84 ± 28	73 ± 54	69 ± 29
Subadults, n	16	12	20	12
$\bar{x} \pm$ SD	36 ± 34	33 ± 31	29 ± 34	36 ± 26
Adults, n	16	12	20	12
$\bar{x} \pm$ SD	41 ± 32	39 ± 27	42 ± 52	28 ± 21
F	12.6	39.0	11.61	14.9
df	2, 45	2, 33	2, 57	2, 33
P	<0.001	<0.001	<0.001	<0.001

Foraging success varied by pursuit method and age. Aerial pursuits (n = 41) accounted for 26% of adult, 17% of subadult, and 16% of young foraging attempts. Success ranged from 0% (young) to 28% (adults), but there were no significant age differences. Walk pursuits accounted for 10% of adult, 14% of subadult, and 32% of young foraging methods. Young walked significantly more often than older gulls (χ^2 = 12, df = 2, $P < 0.001$). Percent success varied from 36% (young) to 100% (adults), but these differences were not significant. The most common behavior involved flying at Starlings, causing them to drop food (n = 129). Fly pursuits occurred in 64% of adult, 69% of subadult, and 65% of young approaches. Adults were significantly more successful (78%) than subadults (42%) and young (36%; χ^2 = 8.18, df = 2, $P < 0.005$). Considering all foraging methods (N = 206), adults were significantly more successful (66%) than young (33%) or subadults (36%; χ^2 = 8.64, df = 2, $P < 0.005$).

We computed a mean feeding rate for a 15-min period by multiplying the overall percent success by the mean number of attempts for 15 min. By this method, adults would obtain 14 food items, subadults would obtain 11 items, and young would obtain 4 items during this time interval.

These results indicate age differences in foraging success, adults being more successful than other age classes. Subadults and adults make more attempts than young. Taken together, subadults and adults obtain more items per unit time than do young. Thus, for kleptoparasitism on Starlings, adults wait to make an attempt until they have a high chance of success, and subadults seem to compensate for their somewhat lower success by making more attempts. Young have significantly lower foraging rates, wait longer between attempts, and have a lower success once they try.

The age difference is noteworthy because scaring a Starling is surely easier than plunge-diving or digging in garbage, both of which require a learning period (Verbeek 1977b, Searcy 1978). Verbeek (1977a), however, found that success in kleptoparisitism of Lesser Black-backed Gulls (*Larus fuscus*) did not increase with age. Young Ring-billed Gulls seemed more hesitant about flying toward Starlings, and the Starlings were less startled and failed to drop their food as often. Starlings were more successful in escaping with food from young (67%) than from adult (34%) gulls. In addition, young walk at their victim more often than adults or subadults. As walking takes longer, the victim is not as startled and is more likely to fly with the food.

For all age groups and methods, foraging success varied from 0 to 100% ($\bar{x}$ = 41%). Thus, kleptoparasitism on Starlings was substantially more successful than that reported in other studies of Larids [e.g. 20% for Silver Gulls, Hulsman 1976; 12.5% for Laughing Gulls, Hatch 1975; 10% for several tern species, Hopkins and Wiley 1972; and 6% for Herring (*Larus argentatus*) and 31% for Lesser Black-backed gulls, Verbeek 1977a]. The 41% success we found is the same as the overall rate reported for a specialist kleptoparasite, the Parasitic Jaeger (*Stercorarius parasiticus*, Arnason and Grant 1978).

LITERATURE CITED

ARNASON, E., & P. R. GRANT. 1978. The significance of kleptoparasitism during the breeding season in a colony of Arctic Skuas *Stercorarius parasiticus* in Iceland. Ibis 120: 38–54.

BARASH, D. P., P. DONOVAN, & R. MYRICK. 1975. Clam dropping behavior of the Glaucous-winged Gull (*Larus glaucescens*). Auk 87: 60–64.

BARTLETT, L. M. 1957. Ring-billed Gull steals food from Coot. Wilson Bull. 69: 182.

BUCKLEY, F. G., & P. BUCKLEY. 1974. Comparative feeding ecology of wintering adult and juvenile Royal Terns (Aves: Laridae, Sterninae). Ecology 55: 1053–1063.

DUNN, E. K. 1972. Effect of age on the fishing ability of Sandwich Terns, *Sterna sandvicensis*. Ibis 114: 360–366.

DWIGHT, J. 1925. The gulls (Laridae) of the world. Bull. Amer. Mus. Nat. Hist. 52: 63–408.

ELSTON, S. F., C. D. RYMAL, & W. E. SOUTHERN. 1977. Intraspecific kleptoparasitism in breeding Ring-billed Gulls. Pp. 102–109 *in* Proc. Colonial Waterbird Group. De Kalb, Illinois.

GRANT, P. R. 1971. Interactive behavior of Puffins (*Fratercula arctica* L.) and Skuas (*Stercorarius parasiticus* L.). Behavior 40: 263–281.

HATCH, J. J. 1970. Predation and piracy by gulls at a ternery in Maine. Auk 87: 244–254.

———. 1975. Piracy by Laughing Gulls *Larus atricilla*: an example of the selfish group. Ibis 117: 357–365.

HAYS, H. 1970. Common Terns pirating fish on Great Gull Island. Wilson Bull. 12: 99–100.

HOPKINS, C. D., & R. H. WILEY. 1972. Food parasitism and competition in two terns. Auk 89: 583–594.

HULSMAN, K. 1976. The robbing behavior of terns and gulls. Emu 76: 143–149.

INGOLFSSON, A., & B. T. ESTRELLA. 1978. The development of shell-cracking behavior in Herring Gulls. Auk 95: 577–579.

MORRISON, M. L., R. D. SLACK, & E. SHANLEY, JR. 1978. Age and foraging ability relationships of Olivaceous cormorants. Wilson Bull. 90: 414–422.

ORIANS, G. H. 1969. Age and hunting success in the Brown Pelican (*Pelecanus occidentalis*). Anim. Behav. 17: 316–319.

RECHER, H. F., & J. A. RECHER. 1969. Comparative foraging efficiency of adult and immature Little Blue Herons (*Florida caerulea*). Anim. Behav. 17: 320–322.

SEARCY, W. A. 1978. Foraging success in three age classes of Glaucous-winged Gulls. Auk 95: 587–588.

SIEGFRIED, W. R. 1972. Ring-billed Gulls robbing Lesser Scaup of food. Can. Field-Naturalist 86: 86.

TRILLMICH, F. 1978. Feeding territories and breeding success of South Polar Skuas. Auk 95: 23–33.

VERBEEK, N. A. M. 1977a. Interactions between Herring and Lesser Black-backed Gulls feeding on refuse. Auk 94: 726–735.

———. 1977b. Age differences in the digging frequency of Herring Gulls on a dump. Condor 79: 123–125.

———. 1977c. Comparative feeding behavior of immature and adult Herring Gulls. Wilson Bull. 89: 415–421.

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Club-tipped Feathers in Some South American Tanagers

RICHARD C. INNES[1]
Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts 02138 USA

The presence of patches of feathers, "fused into deep orange, club-shaped structures," behind the ear openings in males of the South American tanagers *Chlorochrysa* has been noted by Storer (1969, Living Bird 8: 127). These structures result from the enlargement of several of the barbs near the tip of each feather and the absence of barbules on these barbs. Three basic types of enlargement can be discerned: uniform widening of the entire length of the barb, gradual widening from the base to the tip of the barb, and a sudden widening very near the tip of the barb. These types tend to intergrade somewhat so that no single description of these club tips is possible. In *Chlorochrysa calliparaea fulgentissima* (a subtropical species that occurs east of the Andes in Peru and Bolivia), which exhibits the character most clearly, the enlargement may be 3–4 times the normal diameter of a barb near the tip. The tips appear to be a glossy orange from all angles, and the widened part may start as much as $^3/_{16}$ of an inch from the tip of the barb. Each feather in the patch grows duller from tip to base, graduating from orange through yellow to gray, as the barbs get closer to the base of the rachis; these inner barbs are not normally visible and

[1] Present address: Urban Systems Research & Engineering, Inc., 36 Boylston Street, Cambridge, Massachusetts 02138 USA.