in this and other species of birds, especially in the light of recent suggestive evidence of sex-ratio distortions in relation to laying sequence in Ring-billed Gulls (*Larus delawarensis*) (Ryder 1979) and in Red-winged Blackbirds (*Agelaius phoeniceus*) (Fiala 1981). It is, however, going to be absolutely necessary to work with large sample sizes and to use sampling techniques that exclude possible biases.

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## Effects of Intraspecific Piracy on Breeding Ring-billed Gulls

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Interspecific food stealing among members of the family Laridae has received considerable attention in recent years (e.g. Hatch 1970, Hopkins and Wiley 1972, Dunn 1973). Piracy also may occur intraspecifically, as was first reported by Hays (1970) for Common Terns (*Sterna hirundo*) attempting to feed their young. Recently, we published a preliminary description of intraspecific piracy in breeding Ring-billed Gulls (*Larus delawarensis*; Elston et al. 1977). In such instances, adult or young Ring-billed Gulls steal from conspecifics during attempts by adults to feed their young.

During the 1978 and 1979 breeding seasons, we monitored feeding attempts at a Ring-billed Gull colony, situated near Rogers City (Presque Isle County), Michigan, to determine how intraspecific piracy affected adult gulls supplying food to their young (see Southern and Southern 1981 for a colony description). The incidence of food stealing was low for about 10 days following the onset of hatching. Before the onset of piracy, adults efficiently fed their young and showed little hesitation before regurgitating food.

After piracy started, however, feeding behavior changed noticeably. Adults paced near their begging chicks and alternated between regurgitating food and reswallowing it. Frequently, adults interrupted feeding attempts to chase or threaten neighboring adults or chicks that showed an interest in the feeding attempt (Southern and Southern in press). These behavioral changes resulted in prolonged feeding attempts, which often were not completed. In this paper, we examine these behavioral changes and their effects on the efficiency of parental care.

This study was conducted between 21 May and 20 July in both 1978 and 1979. Mean nest density at this colony was 1.85 m²/nest in 1978 and 1.32 m²/nest in 1979 (Southern and Southern 1981). Observations were made for 2-h periods at each of three study plots from the first through the eighth week posthatching. In 1978, 534 feeding attempts were monitored during 136 h of observation, and, in 1979, 1,000 feeding attempts were observed during 147 h. Observations were made between 0800 and 1600 h each day, weather permitting. A feeding was considered to start when one or more chicks initiated begging, i.e. assumed a hunched posture and pecked at the adult's bill. Once a feeding started, it was monitored

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to completion or to an abortion of the attempt. Because only one feeding could be observed at a time, all feedings that occurred during an observation period were not recorded. Data presented in this paper are arranged by weeks post-hatching (i.e. Week 2 = the second week following the onset of hatching).

Terms having specific meaning in this paper are as follows: An *interruption* occurred when an adult reswallowed food that had been regurgitated to the point of causing the neck to swell in preparation for feeding young; a *completed feeding* attempt was one in which food was given up by a parent regardless of who received it; *aborted attempts* were those in which either the parents ceased regurgitation efforts and left without feeding their chicks or the chicks ceased begging without being fed; *pirated feeding attempts* were those in which a pirate attempted to steal food, regardless of the success or failure of the attempt; and an *aggressive interaction* was when an adult either long called, open-wing charged, or made physical contact with a neighboring adult or chick. Neither piracy itself nor reactions to the actual act of piracy was recorded as an aggressive interaction.

The incidence of aggressive acts by a parent during chick feeding generally increased between Weeks 1 and 7 (Table 1). Incidence of piracy and occurrence of aggression during feeding attempts were related in both 1978 and 1979 (1978: $\chi^2 = 37.4$, df = 1, $P < 0.001$; 1979: $\chi^2 = 125.8$, df = 1, $P < 0.001$). The number of aggressive interactions per feeding also increased as the season progressed in both years (1978: $F = 16.9$, df = 7,526, $P < 0.001$; 1979: $F = 26.7$, df = 7,992, $P < 0.001$).

The incidence of piratical attempts was found to be associated with the number of aggressive interactions per feeding (1978: $\chi^2 = 14.6$, df = 6, $0.01 < P < 0.025$; 1979: $\chi^2 = 13.1$, df = 6, $0.025 < P < 0.05$). If a feeding attempt involved no aggression, the observed incidence of piracy was lower than the expected value. We are unable to determine from the data, however, whether piracy was the stimulus and aggression the response, or vice versa. Based on our observations, we believe a type of feedback mechanism is operating here. It appears that, as adults experience piratical attempts, they respond by acting aggressively toward neighbors during feedings, thereby increasing the probability that potential pirates will notice the feeding attempt. Thus, as a consequence of threatening neighbors and in an attempt to thwart potential pirates, a feeding parent actually increases the likelihood that its pending feeding attempt will be pirated.

Adults also responded to increasing piracy by interrupting their chick feeding attempts. The proportion of feedings involving one or more interruptions increased from 2.2 to 55.8% between Weeks 1 and 7 in 1978, and from 4.7 to 67.6% between Weeks 1 and 6 in 1979 (Table 1). The incidence of interruptions

TABLE 1. Frequency of aggression, interruption, and pacing during feeding attempts in 1978 and 1979. $n$ = total number of feedings observed each week.

| Week | Percentage of feedings with | | | |
|---|---|---|---|---|
| | Aggression | Interruptions | Pacing | $n$ |
| | 1978 | | | |
| 1 | 6.5 | 2.2 | 0.0 | 141 |
| 2 | 42.5 | 16.2 | 1.2 | 80 |
| 3 | 41.3 | 43.1 | 0.0 | 73 |
| 4 | 47.4 | 35.1 | 8.7 | 56 |
| 5 | 60.3 | 34.4 | 8.6 | 58 |
| 6 | 91.9 | 31.1 | 22.2 | 45 |
| 7 | 79.4 | 55.8 | 52.9 | 34 |
| 8 | 74.4 | 40.0 | 31.9 | 47 |
| | 1979 | | | |
| 1 | 8.3 | 4.7 | 1.2 | 85 |
| 2 | 41.3 | 31.3 | 12.6 | 151 |
| 3 | 51.9 | 53.3 | 30.7 | 179 |
| 4 | 69.4 | 67.3 | 38.0 | 134 |
| 5 | 81.5 | 65.7 | 73.2 | 146 |
| 6 | 87.5 | 67.6 | 76.2 | 139 |
| 7 | 86.2 | 56.0 | 83.6 | 116 |
| 8 | 42.0 | 36.0 | 80.0 | 50 |

and piratical attempts were significantly related in both 1978 and 1979 (1978: $\chi^2 = 26.0$, df = 1, $P < 0.001$; 1979: $\chi^2 = 51.9$, df = 1, $P < 0.001$).

The number of interruptions per feeding attempt also increased as the season progressed in both years (1978: $F = 5.95$, df = 7,526, $P < 0.001$; 1979: $F = 12.5$, df = 7,992, $P < 0.001$). The increasing hesitancy of parents to regurgitate food for chicks apparently was in response to the threat of piracy. Although adults frequently interrupted chick feeding in an attempt to avoid piracy, such interruptions probably made feeding efforts more obvious, thereby increasing the likelihood of potential pirates being alerted.

Beginning in the second week post-hatching, adult Ring-bills preparing to feed their chicks often walked rapidly in one direction, then changed direction and resumed walking in another. Often this pacing behavior became rather frenzied, as aggressive interactions and interruptions often accompanied it. The percentage of feedings involving pacing increased as the season progressed (Table 1). Piracy and the occurrence of pacing during a feeding attempt were related in both 1978 and 1979 (1978: $\chi^2 = 32.9$, df = 1, $P < 0.001$; 1979: $\chi^2 = 26.0$, df = 1, $P < 0.001$). As with aggression and interruption, pacing also made a feeding attempt more obvious and probably alerted potential pirates.

The increases in occurrence of aggression, interruption, and pacing during a feeding attempt resulted in the lengthening of feeding attempts. Feeding attempts increased significantly in length in both

TABLE 2. Comparison of mean length of feeding attempts, percentage of feedings aborted, percentage feedings pirated, and percentage begging chicks fed, by week for 1978 and 1979.

| Week | Mean length of feed-ings (min) | Percentage feedings | | Percent-age chicks fed |
|------|------|------|------|------|
| | | Aborted | Pirated | |
| | | 1978 | | |
| 1 | 0.34 | 0.0 | 13.0 | 100.0 |
| 2 | 1.72 | 13.7 | 23.8 | 85.1 |
| 3 | 1.97 | 12.2 | 13.9 | 84.8 |
| 4 | 3.68 | 43.9 | 7.0 | 49.6 |
| 5 | 3.08 | 41.4 | 10.3 | 55.1 |
| 6 | 5.17 | 44.4 | 17.8 | 60.2 |
| 7 | 4.96 | 35.3 | 41.2 | 57.8 |
| 8 | 5.67 | 41.9 | 34.1 | 58.2 |
| | | 1979 | | |
| 1 | 0.27 | 0.0 | 9.4 | 100.0 |
| 2 | 1.21 | 6.7 | 26.6 | 96.5 |
| 3 | 2.02 | 19.5 | 25.7 | 73.4 |
| 4 | 2.46 | 21.6 | 27.6 | 65.9 |
| 5 | 3.46 | 27.4 | 32.1 | 60.5 |
| 6 | 3.82 | 39.6 | 34.5 | 47.9 |
| 7 | 3.63 | 54.3 | 30.2 | 42.8 |
| 8 | 3.78 | 48.0 | 12.0 | 41.6 |

1978 ($F = 20.1$, df = 7,526, $P < 0.001$) and in 1979 ($F = 22.0$, df = 7,992, $P < 0.001$) (Table 2).

The outcome of a feeding attempt (completed or aborted) was found to be related to the duration of a feeding attempt (1978: $\chi^2 = 154.0$, df = 8, $P < 0.001$; 1979: $\chi^2 = 283.9$, df = 8, $P < 0.001$). In both 1978 and 1979 feeding attempts that lasted 3 min or longer had a higher incidence of abortion than predicted by the expected values. Therefore, as the length of feeding attempts increased, the proportion of feeding attempts aborted also increased (Table 2).

The proportion of begging chicks fed dropped as the season progressed in both 1978 and 1979 (Table 2). A simple linear correlation of the proportion of begging chicks fed per week was highly significant for the 1978 and 1979 data combined ($r = -0.81$, df =6, $0.01 < P < 0.02$). When analyzed separately, however, the 1978 data were not significant. We believe that the significant decrease in the percentage of chicks fed in 1979 was the result of the higher incidence of piracy in 1979.

As the proportion of begging chicks fed dropped, the proportion of pirates that were chicks increased. The first piratical attempts by chicks were observed during Week 3 in both 1978 and 1979. The percentage of pirates that were chicks increased from 5.5 to 73.9% between Weeks 3 and 8 in 1978 and from 1.4 to 85.7% between Weeks 3 and 8 in 1979. We believe that the combination of decreasing chick feeding success and

increasing chick mobility contributed to chicks attempting piracy.

Piracy seems to be the major factor responsible for the described behavioral changes and disruption of feeding attempts. If this is the case, feeding success should have been higher in 1978 than in 1979. Comparison of the entire 8-week periods for 1978 and 1979 shows no significant difference in feeding success between years ($t = 0.13$, df = 14, $P > 0.50$). For Weeks 5 through 8, however, a significant difference was found ($t = 2.5$, df = 6, $0.02 < P < 0.05$). This is probably because the full impact of piracy did not materialize until after Week 4. During Weeks 1 through 3, pirates stole food only occasionally, and parents altered feeding behavior only when a piratical act occurred. Also during the early weeks adults probably had little experience with piracy and consequently did not attempt to prevent its occurrence. After Week 4, however, piracy occurred more frequently, and parents seemed to become increasingly hesitant to feed their chicks. As a result, many feeding attempts were aborted. Thus, besides losing food items to pirates, parents increased the time required to complete a feeding attempt, which may have caused a reduction in the number of times chicks could be fed per day.

When the frequency of piratical attempts by adult Ring-billed Gulls was high, the proportion of begging chicks fed was lower than during times of low piratical activity. This stimulated chicks to participate in piracy, thereby adding to the problem facing adult gulls attempting to feed their young. Intense intraspecific piracy, such as described in this paper, could have one or more of the following effects on Ring-billed Gulls: (1) disruption of provisioning attempts by parents may affect the rate of chick development and possibly fledging success; (2) increased juvenile mortality may be a consequence of energy deficiencies and adult attacks that are associated with adult aggression increasing in response to food stealing; (3) high energetic costs associated with parental care during the later stages of chick development could render continued parental care inefficient; (4) stressed parent-young bonds (as a result of parents being hesitant to feed their young and hungry chicks increasing their demands for food) may stimulate juveniles to disperse within and from the colony and adults to be absent from their territories; (5) expenditure of increasing amounts of time in aggressive interactions as chicks develop may detract from adult time available for chick care and for other behavior (e.g. comfort activities, pair-bond maintenance); and (6) the reproductive potential of asynchronous (i.e. late) nesters may be reduced to near zero, because small chicks fed fish require considerable handling time, which renders them particularly vulnerable to pirates.

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# First Record of the South American Pochard in Central Brazil

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The South American Pochard (*Netta erythrophthalma erythrophthalma*) is a little known pochard, spottily distributed in Venezuela (Caribbean coast), Colombia (Caribbean coast, temperate zone of the Eastern Andes, the southeast, and Cauca Valley), southeastern Ecuador, Peru (west of the Andes), northern Chile, northern Argentina, and sporadically in eastern and northeastern Brazil (Meyer de Schauensee 1966). In Brazil it has been collected in Belmonte (Bahia, 15°51′S, 38°54′W), Lagoa da Ribeira (Rio de Janeiro, 22°08′S, 41°28′W) (Coimbra-Filho 1969), and Baturité (Ceará, 04°20′S, 39°00′W). (Specimens are in the Museu de Zoologia da Universidade de São Paulo). The ecology and biology of the South American Pochard are almost unknown.

On 8 August 1980, while banding waterfowl at Santa Maria reservoir, we saw 100 South American Pochard for the first time in central Brazil. The 825-ha reservoir is in the middle of the Brasília National Park (15°40′S, 47°50′W) at an altitude of 1,100 m. Dammed in 1970, it was formed by the Barriguda, Vargem Grande, and Milho Cozido Rivers. It is surrounded by cerrado vegetation and has swampy vegetation only at the mouths of the rivers. The water level is variable because of the well-marked dry (May–September) and rainy (October–April) seasons. South American Pochards, Brazilian Teal (*Amazonetta brasiliensis*), White-faced Tree-Ducks (*Dendrocygna viduata*), Black-bellied Tree-Ducks (*D. autumnalis*), sandpipers, and other water birds use the reservoir year round or seasonally. Only the Brazilian Teal and the Pied-billed Grebe (*Podilymbus podiceps*) breed there. The reservoir has been regularly mist-netted since July 1979.

The first flock of pochards was seen on 8 August 1980 along the shore of the reservoir at 1400. Most were sleeping or preening; a few were feeding in 20 cm of water near the shore. Between 100 and 150 pochards of both sexes were seen in the same place on 30 August, 3 September, and 13 September 1980. They disappeared after 13 September 1980. On 22 February 1981, between 0430 and 0600, several flocks of pochards were seen at the reservoir, flying west to east close to surface of the water. All flocks numbered between 50 and 100 birds. A male was netted in the Milho Cozido River mouth and banded with CEMAVE band number S-00511. It was in full adult plumage, and its iris was deep red. When released in the water, the male dove instead of taking flight, the normal escape behavior of the other duck species banded. Each dive was about 50 m long and lasted 20 s. The male wasn't damaged by the net, and its remiges were fully grown.

On 4 April 1981, 20 pochards were seen at the reservoir. Eight were molting the remiges and could not fly. On 13 June 1981, at the mouth of the Barriguda River, five males and two females were seen; all were in wing molt. Four of six males, collected on 3 and 6 August 1958 in Baturité, Ceará and housed in the Museu Paulista de História Natural, were molting the remiges (pers. obs.). These data indicate great variation in the timing of wing molt in the South American Pochard.

We suggest that the southern Pochard has colonized the Central Brazilian Plateau by expanding its range from southeastern coastal Brazil. The new reservoirs constructed in the Paraná and São Francisco basins have furnished new habitat suitable for these species, as, for example, that of the Brasília National Park reservoir.

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