Intraspecific Kleptoparasitism in Lesser Black-backed Gulls Wintering Inland in Spain

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Abstract.—Attempts at intraspecific kleptoparasitism by Lesser Black-backed Gulls (*Larus fuscus*) feeding at a rubbish dump in southwest Spain during the winter 2001-2002 were studied to measure differences in the frequency of attacks between the age classes, the success of the attacks and the existence of possible density-dependent kleptoparasitism. Significant age differences in the frequency of attacks initiated were not found, although first year birds received a higher number of attacks. The success of the attacks increased with the age of the kleptoparasite and decreased with the age of the victim. The gulls selected victims of an equal or younger age to their own. A correlation was found between density and number of attacks on most dates. The possibility exists that kleptoparasitism could influence the success of the recent expansion of the species in the Iberian Peninsula. *Received 19 February 2003, accepted 30 May 2003.*

Key words.—Bird density, Iberian Peninsula, intraspecific kleptoparasitism, *Larus fuscus*, Lesser Black-backed Gull, rubbish dump, social dominance.

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Kleptoparasitism is an example of a competition between species exploiting common resources (McNaughton and Wolf 1984). In birds, this interaction has been detected in gulls, terns, skuas, waders, the Cattle Egret (*Bubulcus ibis*) and cormorants (Lekuona and Campos 2001 and cited references; Shealer and Spendelow 2002). It also represents a clear example of an overlap of the trophic niche, which is frequent in many gull species in many circumstances (Brockmann and Barnard 1979; Burger 1979; Furness 1987; González-Solís *et al.* 1997). However, most studies have centered on inter-specific, rather than on intra-specific kleptoparasitism. In gulls, kleptoparasitism has been observed mainly on rubbish dumps where there are high densities of birds (Monaghan 1980; Nelson 1980; Götmark 1984; Greig *et al.* 1983, 1986; Coulson *et al.* 1987; Noordhuis and Spaans 1992; Pons 1992; Gómez-Tejedor and de Lope 1993, 1994, 1995; Sol *et al.* 1993).

The success rate of kleptoparasitic attacks is low in many species (26% on average for gull and tern species; Furness 1987), though some studies suggest the existence of differences in the frequency and success rate of kleptoparasitism among age classes (Bertellotti and Yorio 2001 and cited references). This is a consequence of the differences in foraging skills and efficiency among age classes (Orians 1969; Davies and Green 1976), and the learning of the feeding techniques that some species require to become fully proficient (Norton-Griffiths 1967; Hesp and Barnard 1989). In some gull species, these age-related differences are the only factor affecting the robbing success (Bertellotti and Yorio 2001).

In the Lesser Black-backed Gull (*Larus fuscus*), studies of intraspecific kleptoparasitism and competition have been carried out mainly in breeding colonies (Harris 1964; Brown 1967; Davis and Dunn 1976), but there are some data from rubbish dumps in the wintering areas (Gómez-Tejedor and de Lope 1995).

In other species, kleptoparasitism is defined as the most efficient strategy by which some individuals avoid carrying out the complex task of prey pursuit (Hesp and Barnard 1989; Lekuona and Campos 2001). In the case of the Lesser Black-backed Gull feeding on rubbish dumps, the only explanation for kleptoparasitism is as a strategy that avoids the search for and the selection process in exploiting a food source (Greig *et al.* 1983; Gómez-Tejedor and de Lope 1995).

In this study, an analysis is presented of the differences in the kleptoparasitic behav-

ior between the different age classes in the Lesser Black-backed Gull at a rubbish dump in southwest Spain, and the effect of the density of gulls on the number of kleptoparasitic attacks. The possible role of kleptoparasitism in the recent expansion of the species into new wintering areas inland in the Iberian Peninsula is also considered.

Some studies have found that immature gulls are less efficient kleptoparasites than adults (Burger and Gochfeld 1979; Greig *et al.* 1983; Amat and Aguilera 1988; Hesp and Barnard 1989; Carroll and Cramer 1985; Wunderle 1991; Gómez-Tejedor and de Lope 1995; Bertellotti and Yorio 2001), and this lower efficiency of the immature birds could result in longer periods of feeding and more attacks to gain the same amount of food (Greig *et al.* 1983; Gómez-Tejedor and de Lope 1995). Hence, it would be expected that the immature gulls made a higher number of attacks than adults and the adults achieved a greater success in their attacks than immature individuals.

STUDY AREA AND METHODS

The study was carried out between October 2001 and March 2002 at a rubbish dump at Badajoz (SW Spain, 38°53'N, 6°58'W) during the period when the greatest numbers of Lesser Black-backed Gulls visit the site (Gómez-Tejedor and de Lope 1993). The study area was approximately 150 × 50 m^2 (7500 m^2), with an almost even distribution of gulls. All the rubbish was of household origin and the edible items were not clumped, but spread over the whole area. Though the rubbish was compacted by a bulldozer, it was not covered with earth until later, so a high proportion of the potential food was always available for the gulls.

Data collection took place during the 2-3 hours after dawn which was the period of maximum activity (Sol *et al.* 1993). Days on which the bulldozers were not working were chosen in order to consider a consistent level of food exploited by the gulls, rather than varying amounts when work was in operation. This undisturbed food attracted a greater number of birds, as feeding was easier than when the garbage was being disturbed and buried by the bulldozers (Monaghan 1980; Greig *et al.* 1985; Greig *et al.* 1986; Sol *et al.* 1993).

The birds were divided in four age classes. Adult birds were defined as four years or older, while immature birds were identified as first, second and third winter individuals. The different age classes were identified by the plumage characteristics (Dwight 1925; Cramp and Simmons 1983; Harrison 1996; Garner and Quinn 1997). The winter period was defined as 1 October to 28 February.

There are few data on the time spent feeding at rubbish dumps by some species of gulls (Coulson *et al.* 1987), and focal sampling was carried out by recording all the occasions in which kleptoparasitic behavior was observed. The shortest sampling period to obtain acceptable records was five minutes. The observations were carried 5-10 m from where the gulls were feeding. Each individual was chosen at random except that, to avoid bias, the same number of observations was carried out for all the age classes. For each one of these observation periods, the following information was collected: (1) the ages of the kleptoparasitising gulls and their victims; (2) the number of kleptoparasitic attacks; and (3) the result of the different interactions. It was considered that an attack was successful when the victim was robbed, even if the victim then recovered the food. An attack was not successful if the attacker did not obtain the food (Lekuona and Campos 2001). Attacks where the purpose was not to rob a conspecific individual (for example, those which attempted to displace a rival from a given area) were excluded.

In order to determine the density of birds, the number of gulls at the rubbish dump was counted twice; once at the beginning of the census, and again at the end. The larger count was used (Tellería 1986; Bibby *et al.* 1992). The density of individuals in the study area was obtained by dividing the number of gulls counted by the area used for feeding (7,500 m^2).

Data were normal distributed and parametric statistics were used (Sokal and Rohlf 1995). To test the different frequencies, G-tests based on the number of kleptoparasitic attacks were used. ANOVA was used to compare the means of the total number of attacks (considered as the sum of the total number of attacks accomplished plus the total number of attacks received) in the study period, having previously applied the Levene test for homoscedasticity. Pearson correlation was used to examine possible relationship between the mean number of attacks and bird density (Zar 1999).

RESULTS

The time that the gulls were not feed was not considered. A total of 253 sample periods, corresponding to 1,265 minutes of observations, was carried out. Kleptoparasitic action was observed in 162 (64%) of the samples, with a success rate of 68%. The number of gulls present varied between 2,350 and 5,350.

Description of Attacks

All kleptoparasitic attacks were made by individuals, never by groups, and the victims of the attacks were always individuals. The attacker adopted the typical hunched, aggressive attitude of the species when approaching a conspecific individual, with the body almost horizontal, open bill, back feathers raised and head down, sometimes shaking the head vigorously but adopting an apparently less aggressive position immediately before attacking. The attacks were pro-

duced when the kleptoparasite and the victim were less than five m apart. When a potential victim was further away, no attack took place. Physical contact between the kleptoparasite and the victim did not always occur, and frequently the food was taken without a physical attack on the victim.

Age-related Behavior

There were no significant differences in the number of attacks produced by the age classes ($G_3 = 6.90$, n.s., Table 1), but the first year birds received a higher number of attacks ($G_3 = 174$, $P < 0.0001$, Table 1). The success of the attacks increased significantly with the age of the kleptoparasite ($G_3 = 22.9$, $P < 0.001$, Table 1) and decreased with the age of the victim ($G_3 = 180$, $P < 0.001$, Table 1).

Analyzing simultaneously the age of the kleptoparasites and the age of the victims, there were differences in the proportion of attacks that some age classes carried out on others ($G_9 = 26.5$, $P < 0.005$, Table 1) and in the number of successful attacks ($G_9 = 24.4$, $P < 0.005$, Table 1). This suggested that the gulls may have been selecting victims of an equal or younger age to their own to achieve greater success.

Phenology and Density-related Behavior

The variation in the mean number of attacks per individual produced and received by the gulls in each sample of five minutes is shown in Figure 1. There were no differences in the pattern of attacks between each month of study period ($F_{5,6} = 2.49$, n.s.; Fig. 1).

No correlation was found between bird density and the mean number of attacks ($r_9 = 0.37$, n.s., Fig. 2). However, when one outlying point, which corresponded to the last day of the study (19 March), was excluded (see Fig. 2), the correlation became significant ($r_8 = 0.77$, $P < 0.01$).

DISCUSSION

The success rate of kleptoparasitic attacks was much higher than in other studies on the Lesser Black-backed Gull (Verbeek 1977; Amat and Aguilera 1988; Gómez-Tejedor and de Lope 1995), but lower than the success found by Greig *et al.* (1983) in the Herring Gull (*Larus argentatus*). The rate was similar to that observed by Domínguez (2002) for the Black-headed Gull (*Larus ridibundus*) kleptoparasiting Black-tailed Godwits (*Limosa limosa*). These suggest that the habitat or the geographical location could influence on the success of this behavior, an interpretation also suggested by Bertellotti and Yorio (2001).

Immature Lesser Black-backed Gulls are less aggressive (Cramp and Simmons 1983 and cited references) and less efficient in kleptoparasitism than adults (Amat and Aguilera 1988; Gómez-Tejedor and de Lope 1995), as in other species (Burger and Gochfeld 1979; Greig *et al.* 1983; Hesp and Barnard 1989; Carroll and Cramer 1985; Wunderle 1991; Bertellotti and Yorio 2001). This lower efficiency of the immature birds could increase the number of attacks by these birds (Greig *et al.* 1983; Gómez-Tejedor and de Lope 1995). However, and contrary to expectations, there were no differences in

Table 1. Number of kleptoparasitic attacks by Lesser Black-backed Gulls (*Larus fuscus*) of different ages and corresponding success rate.

	Kleptoparasite									
	First year		Second year		Third year		Adult		Total	
Victim	No.	% success	No.	% success	No.	% success	No.	% success	No.	% success
First year	20	55	18	78	11	82	25	100	74	80
Second year	2	—	6	50	12	92	9	100	29	79
Third year	0	—	2	—	9	67	7	86	18	67
Adult	15	27	3	—	13	39	10	70	41	39
Total	37	40	29	59	45	69	51	92	162	68

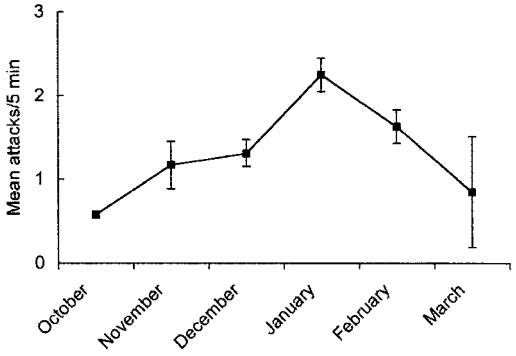

Figure 1. Mean attacking rates (± SD) per individual of the Lesser Black-backed Gull feeding at the rubbish dump in each month of study period.

the frequency of attacks produced by the different age classes in this study. When the food resources decrease, wintering gulls feed at rubbish dumps with a greater frequency and are probably obliged to increase the number of attacks. Greig *et al.* (1986) and Hebert (1998) found that the behavior of adult gulls was more affected by low temperature, and increased the aggressiveness, possibly explaining the overall similar frequency of attacks on both adult and immature birds.

As found by Greig *et al.* (1983), the higher number of attacks received by first year birds is probably caused by the greater success that is achieved by attacking individuals of an inferior age class.

The higher success rate of attacks by adult birds suggests that the adults select younger individuals to procure a greater success, and the other age classes also selected victims belonging to a younger age class. Greig *et al.* (1985) obtained similar results in adult Herring Gulls, observing that females attacked fewer adults and correspondingly more immature individuals than would be expected on the basis of random selection of the individual being attacked. They also found that females are subordinate to males in a competitive feeding situation. In this study, the success of the attacks increased with the age of the kleptoparasite (Greig *et al.* 1983), which indicated that adults are the dominant social class in this species. In particular, adult males are dominant because of their larger size and greater experience (Greig *et al.* 1985). A similar selection of the victims by the kleptoparasites has been found in other species (Paterson 1986; Lekuona and Campos 2001). However, despite this social hierarchy, most immature birds are able to gather sufficient food for survival, albeit less efficiently than adults (Greig *et al.* 1983).

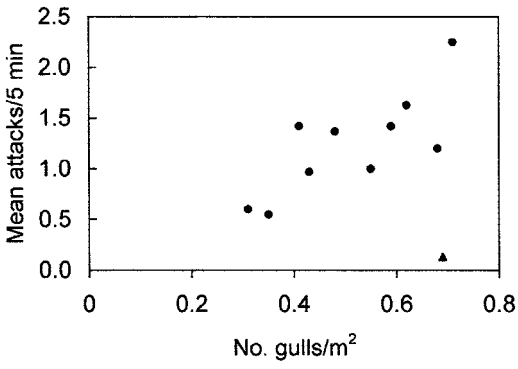

Figure 2. Relationship between the mean number of attacks per individual and the Lesser Black-backed Gull density during the study period. The outlying point is marked with a triangle.

Gull numbers in this study area were dominated by adults (70%; Galván 2000). In another study on kleptoparasitism in Lesser Black-backed Gulls at the same study site, Gómez-Tejedor and de Lope (1995) did not find evidence of age selection of victims, and suggested that social factors were not influencing selection. Moreover, they suggested that the adult dominance is the factor that prevented the immature gulls selecting more profitable victims. In this study, the social dominance found in kleptoparasitic behavior indicated that all the age classes selected their victims without being individually affected by the dominance of adults. Gómez-Tejedor and de Lope (1995) only considered two age groups (adult and immature). This inclusion of first, second and third year birds in one age class may have concealed the age-related hierarchy among these groups.

Contrary to expectations, no density-dependent kleptoparasitism was found in the study area. However, there was a density-dependent effect on most dates, with the exception of the last occasion. This point corresponded to the last day of the study (19 March). In the Herring Gull, Greig *et al.* (1985) found that feeding was less intense

immediately prior to gulls leaving the wintering area. The Lesser Black-backed Gulls leave the study area during March (Gómez-Tejedor and de Lope 1993), which suggests that the pre-migratory changes may have been the cause of the low intensity of kleptoparasitism on this date.

Kleptoparasitism has been suggested to be part of a flexible feeding strategy to decrease the metabolic cost associated with the search of food and maximize feeding efficiency (Lekuona and Campos 2001). Because of this, it could be suggested that the expansion of the Lesser Black-backed Gull in the Iberian Peninsula (Díaz *et al.* 1996) may be favored by the kleptoparasitism in this species. Sol and Lefebvre (2000) have shown that the invasion success of the species is partly related to the rapid adoption of new food sources in changing environments, and their pair-wise comparisons of closely related species indicate that successful invaders show a higher frequency of foraging innovations in their region of origin. Thus, the exploitation of rubbish dumps by the Lesser Black-backed Gull is a strategy that permits it to become established as a regular wintering species in new areas, and the kleptoparasitism is a method of making this exploitation more efficiently.

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