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FORAGING ECOLOGY OF PALE-FACED SHEATHBILLS IN COLONIES OF SOUTHERN ELEPHANT SEALS AT KING GEORGE ISLAND, ANTARCTICA

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Abstract.—The Pale-faced Sheathbill (*Chionis alba*) is an opportunistic predator-scavenger. During spring in Antarctica it foraged in colonies of southern elephant seals, obtaining placentas, pup carcasses, milk from nursing cows, blood, and feces. Afterbirths and pup carcasses constituted the bulk of the food consumed. Daily consumption estimates averaged 67 g/bird for placenta and 11 g/bird for pup carcasses, which are 54% and 26% of daily energy requirements, respectively. Sheathbills spent 86% of the day foraging or displaying and 14% resting or preening. Actively feeding birds spent 38% of the time searching for food, 20% feeding, 23% resting, 14% on comfort activities, and 3% in agonistic behaviors.

LA ECOLOGÍA DE LA ALIMENTACIÓN DE LA *CHIONIS ALBA* EN LOS HARENES DE ELEFANTES MARINOS EN LA ISLA KING GEORGE, ANTARCTICA

Sinopsis.—La Paloma Antártica (*Chionis alba*) es una especie oportunista depredadora y carroñera. Durante la primavera antártica se alimenta frecuentemente en los harenes de elefante marino obteniendo placentas, carcasas de crías muertas, leche de hembras, sangre y deyecclones. Las placentas y crías muertas constituyeron lo mas importante en la dieta de la especie. Las estimaclones diarias de consumo por ave promediaron 67 g de placenta y 11 g de tejido extraído de carcasas, lo que representó un 54 y un 26% respectivamente de los requerimientos energéticos diarios de la especie. Las palomas antárticas utilizaron el 86% del día alimentándose o interactuando con otros individuos y el 14% de día reposando o acicalándose. Los individuos que se encontraron activamente alimentándose emplearon un 38% del tiempo en la búsqueda de alimento, 20% tomando alimento, 23% reposando, 14% en actividades de confort y un 3% en comportamientos de agresión.

Sheathbills (*Chionis* spp.) are opportunistic predators and scavengers breeding on the Antarctic Peninsula and subantarctic islands (Watson 1975). This species breeds in association with penguin colonies where high-quality food is abundant during summer (Burger 1981a, 1981b). However, their foraging behavior is sufficiently flexible to take advantage of other food sources (Verheyden and Jouventin 1991). For example, placentas and carcasses of elephant seals *Mirounga leonina* (Burger 1981a, Ulrich-Peter 1988) and Weddell seals *Leptonychotes weddelli* (Jones 1963) are available between early September and mid-November, when the birds forage intensively amongst the seals.

As reported by Jones (1963) and Ulrich-Peter (1988) for other localities in Antarctica, and by Favero (1993) for Stranger Point, during spring the number of Pale-faced Sheathbills increases as a result of the presence of elephant seals. Sheathbills concentrate their activity among seals until the beginning of the pygoscelid penguin breeding season that corresponds with the end of seal pupping (end of November for South Shetland Islands). Then sheathbills disperse to their breeding places, which are usu-

ally located within penguin colonies. With the end of the penguin breeding season (early March), sheathbills disperse and residual populations that remain in Antarctica are found in association with permanent human habitation. Due to their small population size in relation to penguins, Imperial Cormorants offer a less important food source, although it is possible to find isolated sheathbills foraging in cormorant colonies (Favero 1996). This paper reports a preliminary study of the food and foraging behavior of Pale-faced Sheathbills (*Chionis alba*), associated with southern elephant seals in Antarctica.

METHODS

From 24 Sep.–22 Oct. 1992, information on Pale-faced Sheathbills associated with reproductive groups of southern elephant seal was collected at Potter Peninsula (62°14′S, 58°38′W), King George Island, South Shetland Islands, Antarctica. The study area comprised 8 km of shoreline between Potter Cove and Stranger Point.

The number of sheathbills associated with elephant seal harems was estimated on the basis of transects carried out every 4–6 d throughout the study area. A total of 47 focal animal observations (Altmann 1974) was made on randomly selected sheathbills that were foraging actively within elephant seal harems. The activities recorded were: feeding, searching (for food), agonistic, resting (mainly standing), and comfort behavior. Agonistic behaviors were divided into three classes: postures, displacements, and stretch threats. Among others, "postures" include the forward and hunched display (Burger 1980), "displacements" include displacements and chases without contact between birds, "stretch threats" (Shaw 1984) include the aggressive upright posture and fighting (Burger 1980). Birds were observed for at least 10 min with a monocular telescope (12–36×). Observations were made throughout the day (0600–2000 h local time) and narrated into a tape recorder. Additional information was extracted from three film records carried out between 25 September and 15 October on birds scavenging afterbirths. Records started the moment of the expulsion of the placenta by the seal, and finished when it was totally consumed. To estimate the time spent resting and foraging from dawn to dusk, 84 instantaneous scan samples (Altmann 1974) were made at elephant seal harems covering different times of the day.

The mass of the meals obtained from carcasses and placentas during focal animal observations was estimated based on trials performed around harems. Trials consisted of offering to Sheathbills known amounts of flesh and viscera (as carcasses) and different parts of an afterbirth, filming the birds feeding, and later counting the number of pecks used to consume the food. The consumption rates estimated were 13.4 g/100 pecks for afterbirths (SD = 4.5, 95% CI = 8.7–18.2, n = 6), and 5.1 g/100 pecks for carcasses (SD = 4.0, 95% CI = 0.9–9.3, n = 6). It was impossible to apply this methodology to milk because of difficulties in manipulation of this material.

TABLE 1. Percentage occurrence in field observations, energy content, consumption, and energy contribution of different food items in the diet of Pale-faced Sheathbills.

Item	% occurrence in field[a]	Energy content (kcal/g fresh mass)	Consumption rate (g/bird day)	% energy contribution[e]
Placentas	19	1.13[b]	67	54
Pup carcasses	26	3.30[c]	11	26
Milk	3	4.30[d]	—	—
Seal excreta	52	<0.5	—	—

[a] Based on scan samples.
[b] From Lavigne and Stewart (1979).
[c] Estimations based on meat composition from Hamilton (1949), blubber energy content excluded.
[d] From Carlini et al. (1994).
[e] Using existence metabolic rate at 0°C (Kendeigh et al. 1977), EM (kcal/day) = $W^{0.54}$ (where W is mass in grams).

RESULTS

Diet and consumption rates.—Elephant seal colonies are an attractive feeding area for Pale-faced Sheathbills during spring. Of a mean of 80 birds (n = 6 censuses) observed along an 8-km shoreline, at least 90% were observed around seal colonies. The number of sheathbills associated with seal harems was significantly correlated with the number of females (r_s = 0.87, $P < 0.001$, n = 25) and the number of pups per harem (r_s = 0.85, $P < 0.001$, n = 25). In 52% of scan samples sheathbills were feeding on feces, 26% on pup carcasses, 19% on afterbirths, and 3% on milk obtained from nursing cows (Table 1).

During 10-min focal sampling, consumption estimates averaged 12.8 g of placenta (SD = 3.1, 95% CI = 9.7–20.3, n = 8) and 6.2 g of flesh from pup carcasses (SD = 4.4, 95% CI = 1.1–11.42, n = 6). Between September and November, a total of 594 elephant seals were born (G. Daneri, pers. comm.), representing 2,376 kg of afterbirth available. An average of 35 Pale-faced Sheathbills were associated with the biggest harem found on Potter Peninsula (about 70 females); in three film records done on birds foraging on placentas, a mean of 8 sheathbills (and a maximum of 24 at the same time, n = 46) were seen. Birds spent between 25–45 min consuming an afterbirth, depending not only on the number of sheathbills foraging but on the presence of other species. Estimated total placenta intake over the whole season was 214 kg (95% CI = 162–339 kg), which was 9% (95% CI = 7–14%) of the total available. The mean total intake per bird for the whole seal breeding season (ca. 40 days) was 2.7 kg (2.0–4.2 kg), which represents a daily intake of 67 g (50–105 g) (Table 1).

Because sheathbills (and other bird species) required several days to consume pup carcasses, it was impossible to estimate the consumption rate on the basis of field trials. However, considering the minimal profitable mass of a small elephant seal pup to be 36 kg (excluding skin,

TABLE 2. Activity budget (as percentage of the day) of Pale-faced Sheathbills foraging for different foods. FE = feces, PL = placentas, MK = milk, Unknown = undetermined item.

	Feces	Pups	Placenta	Milk	Unknown	Significance[a]
Resting	33.1	14.8	17.1	20.9	5.6	ns[b]
Comfort	2.9	0.3	6.2	0.0	84.4	ns
Searching	43.3	48.6	40.6	36.7	8.8	ns
Foraging	17.6	31.5	31.0	31.6	0.0	FE < PL ($P < 0.05$)
Agonistic	2.4	4.8	4.9	10.4	0.1	FE < PL ($P < 0.05$) FE < MK ($P < 0.05$)
Other	0.7	0.0	0.2	0.4	1.1	ns

[a] Mann-Whitney U-test (undetermined items not tested).
[b] No significant differences.

bones, and flippers from a total of 50 kg; Hamilton 1949), nine dead pups during the season represented 324 kg of food. Taking into account the interactions with other species and the fact that sheathbills in Antarctica play the role of "bone-picking" (see discussion), it was roughly estimated that sheathbills took 10% of the total profitable mass which means a daily intake of 11 g/bird (Table 1).

Time-activity budget.—Instantaneous scan samples revealed that sheathbills spent 86% of the day foraging or displaying, and 14% resting or preening. Sheathbills associated with harems averaged 38% of the day searching for food, 20% feeding, 23% resting, 14% on comfort activities (mainly preening and bathing), and 3% on intraspecific agonistic behaviors (postures, displacements, chases, and stretch threats). No significant differences were found in time activity budget through the day (Mann-Whitney *U*-test, $P > 0.05$). From focal observations there were, however, differences in activity budgets in relation to the food source used, especially for foraging and agonistic activities (Table 2). The mean time spent in foraging activities when birds were feeding on feces (18%) was less than when feeding on afterbirths (31%) (Mann-Whitney *U*-test, $P < 0.05$).

The mean number of agonistic interactions between sheathbills was significantly greater when birds were feeding on placentas or milk than when foraging on dead pups or feces (Mann-Whitney *U*-test, $P < 0.05$) (Fig. 1). When sheathbills were resting, agonistic behaviors were much less frequent (Mann-Whitney *U*-test, $P < 0.01$) than when foraging actively. Resting birds were included in the analysis because, as observed for Black-faced Sheathbill (*Chionis minor*) (Burger 1981b), some of the time spent in resting and comfort activities constituted sedentary food searching time. The large number of stretch threats observed in birds feeding on placentae ($\bar{x} = 2.6/10$ min, $n = 28$) could have been due to the high concentration of sheathbills present in a small area (18 birds in 100 m^2) generating high rates of encounters. In birds foraging on dead pups or

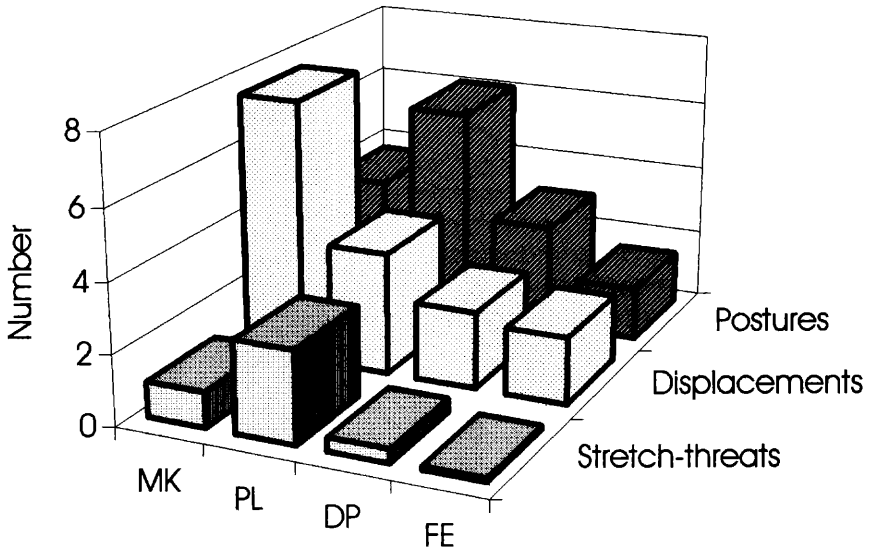

FIGURE 1. Number of postures, displacements, and stretch-threats observed per 10 min of observation in Greater Sheathbills foraging on different items (MK = milk, PL = placentas, DP = dead pups, FE = feces).

on milk, no more than 10 or 3 birds, respectively, were observed actively feeding.

Interactions with other scavenger species.—As mentioned previously, the time spent consuming an afterbirth depended on the number of birds and species foraging. In one film record done in mid-September, Pale-faced Sheathbill was the main species, peaking at 18 individuals foraging, with Kelp Gull (*Larus dominicanus*) as the only additional species present (maximum 14 birds). In a record done in mid-October, Kelp Gulls were the most abundant species reaching 33 foraging birds, followed by Pale-faced Sheathbills (maximum 14 birds), 2 Antarctic Skuas (*Catharacta antarctica*), and 2 Southern Giant Petrels (*Macronectes giganteus*) (Fig. 2). Table 3 shows the interactions between species while consuming an afterbirth, illustrating the strong relationship between dominance and body mass of the species. Despite the large numbers of sheathbills present around the placentas, in general they were displaced by larger species. However, sheathbills rarely flew when chased, and usually immediately recovered their former position.

DISCUSSION

The number of sheathbills associated with elephant seals was highly correlated with the size of harems (expressed as the total number of females or as pups born). As in previous reports (Burger 1981a, Favero 1993, Jones 1963), these data, combined with observation of sheathbills foraging at other sites during the censuses, indicate the importance of

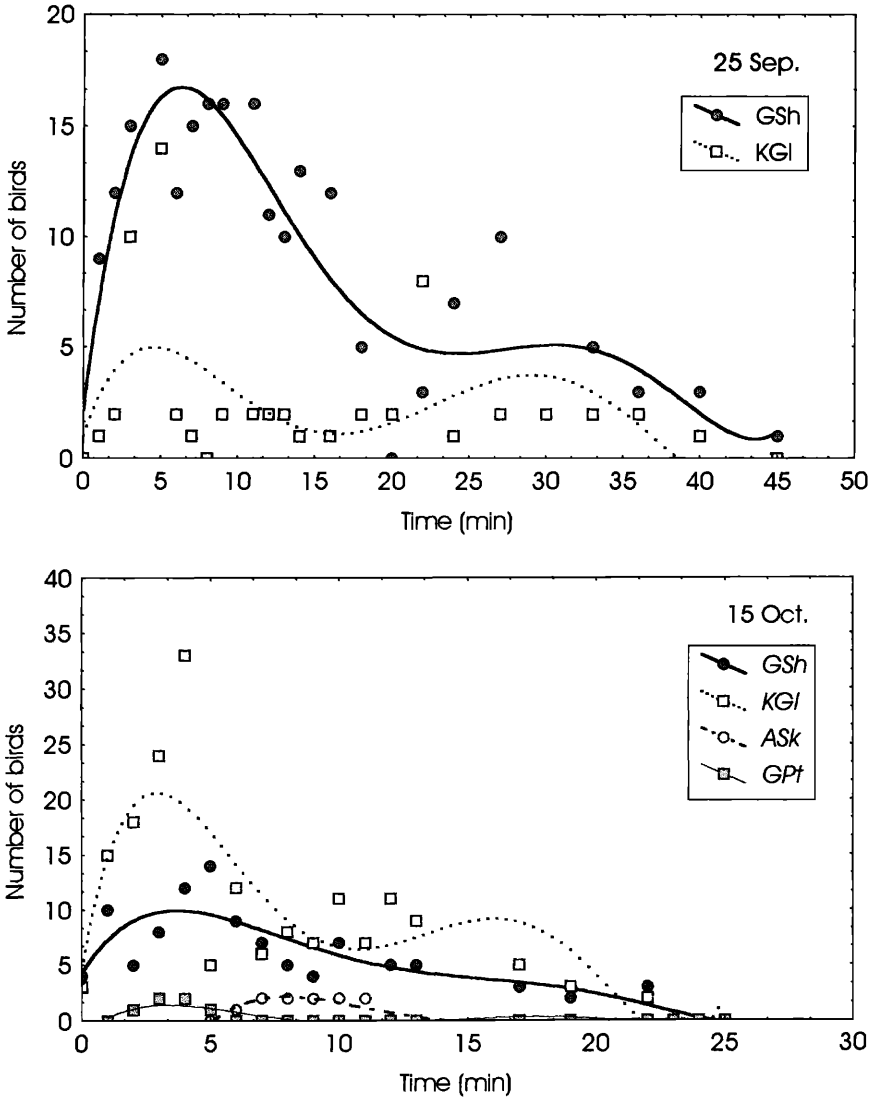

FIGURE 2. Species involved in consumption of placentas on different dates during elephant seal breeding season (GSh = Greather Sheathbill, KGl = Kelp Gull, ASk = Antarctic Skua, GPt = Southern Giant Petrel). Polynomial five-order method used for fit lines.

elephant seal colonies as a source of food during spring. This diet is very different from that of Black-faced Sheathbills at the same time of the year, because this species feed mainly in the intertidal zone, and excreta, placentas, or carcasses from elephant seals are only rarely taken (Burger 1981a).

TABLE 3. Number of Intra- and interspecific interactions (displacements, chases, fightings) observed while birds foraging on placenta during a birth on 15 October. (+) = "won," (−) = "lost." GSh = Greather Sheathbill, KGl = Kelp Gull, ASk = Antarctic Skua, GPt = Southern Giant Petrel.

	GSh (−)	KGl (−)	ASk (−)	GPt (−)	Birds displaced per attack[a]				% won (interspecific)
					GSh	KGl	ASk	GPt	
GSh (+)	31	1	0	0	1.0	1.0	0.0	0.0	4
KGl (+)	20	36	3	0	1.4	1.3	1.0	0.0	64
ASk (+)	3	7	0	0	5.3	4.4	0.0	0.0	77
GPt (+)	4	5	0	0	7.5	8.4	0.0	0.0	100

[a] Mean number of birds displaced by one bird of another species using one attack.

Using the existence metabolic rate from Kendeigh et al. (1977) for nonpasserines at 0°C, $M(kcal/d) = 4.142\ W^{0.54}$ (where W is mass in g), the daily energy requirement of a Pale-faced Sheathbill is 140.8 kcal/d. Consumption rates averaged 75.7 and 36.3 kcal/d for placentas and pup carcasses respectively, which means that these items can supply up to 80% of the daily energy requirements (Table 1). During spring it is also possible to find in the study area isolated carcasses of adult elephant seal, Weddell seal, and Antarctic fur seal (*Arctocephalus gazella*), which usually are scavenged by the same species that forage among pupping areas.

The activity budget observed for Pale-faced Sheathbill in this study is similar to that reported by Burger (1984) for Black-faced Sheathbills during winter (69% foraging [search included], 21% resting and 9% preening). No differences were found in activity budgets through the day, and some nocturnal inspections revealed that sheathbills were still active during the night, as has been observed in other shorebirds (Robert and McNeil 1989, Robert et al. 1989).

The presence of other bird species foraging on placentas together with sheathbills depends both on the site and time of births. Sheathbills were dominant when births occurred in the center of harems. When foraging areas were on the borders of harems, Kelp Gulls and Southern Giant Petrels were more abundant. Skuas arrived at the study area on 6 October, but they were not abundant until 22 October when a large increase in the numbers along the coast was observed (D. Montalti, pers. comm.). This is important because both skua species (*Catharacta antarctica* and *C. maccormicki*) are dominant over sheathbills and gulls, and displace these species from placentas and pup carcasses (Table 3). On 20 October, 366 births (62% of the total) were registered; these placentas were consumed mainly by sheathbills, gulls, and giant petrels.

Although the presence of other species results in interspecific competition, sheathbills could benefit when Giant Petrels, skuas, and gulls open the skin of the carcasses of pups and adult seals. Furthermore, much of the food eaten by sheathbills, such as pieces of flesh picked from skeletons, was too small to be eaten profitably by larger birds. In this case Pale-

faced Sheathbills could play the role of "bone-picking" as reported for Black-faced Sheathbills, and high levels of interspecific competition at placentas and pup carcasses was probably mediated by size differences between members of the predator-scavenger guild (Burger 1981a).

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