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BREEDING SEASON TIME BUDGETS OF THE SOUTHERN BLACK-BACKED GULL IN ANTARCTICA

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ABSTRACT.—We studied Southern Black-backed, or Kelp, Gulls (*Larus dominicanus*) at Palmer Station, Antarctica during two breeding seasons to document the role of each sex in the reproductive effort and to determine how these gulls have adapted their behavior to the Antarctic environment. The breeding colony was small (19 pairs) and gulls defended a shoreline feeding territory adjacent to their nest site. During all stages of the breeding cycle, both sexes were inactive (up to 70% of the total time budget) during most of the time they were on territory. Little time (0–6.9%) was spent flying, walking, swimming, nest building, courting, or in agonistic behaviors by either sex. While producing eggs, females spent more time inactive and less time foraging, gathering nest materials, flying, and off territory than their mates. At this time, females received much of their food via courtship feeding by males. Females spent more time incubating (59.3% vs. 40%) than males. As chicks demanded more food, parents spent more time (up to 69%) foraging off territory. Males played a more active role than their mates in territory defense. Agonistic behaviors were more frequent in the "high" density area of the colony where intruders onto territories were more numerous. Both sexes spent a high proportion of time (up to 86%) near (within 5 m) the nest during laying and incubation periods. This proportion dropped steadily through the chick rearing period to a low of 13% as chicks neared fledging. The time budget patterns we observed, in combination with defense of feeding territories, apparently allowed the gulls to reduce energy expenditures in the harsh environment while simultaneously spending much time near the nest during periods when it was most vulnerable to predation.

The Southern Black-backed Gull or Kelp Gull (*Larus dominicanus*) is widely distributed in the Southern Hemisphere (Watson 1975) and is the only gull that breeds in the Antarctic. Various aspects of this species' breeding biology have been studied in New Zealand (Fordham 1963, 1964a, b) and southern Africa (Burger and Gochfeld 1981a, b; Crawford et al. 1982). However, no detailed reports of this bird's breeding ecology in Antarctica have been published although Fraser (unpubl. data) studied these gulls at Palmer Station, Antarctica during 1974–1976.

Antarctica remains relatively pristine and has a comparatively simple ecosystem. By increasing our knowledge of an animal's behavior in this environment, we may be able to better understand its behavior in areas having more complex ecosystems and where man has had a greater impact on the environment. Time budgets are useful for quantifying such aspects as the role of the sexes in the reproductive effort and in evaluating how animals adapt to environmental variables (e.g., food distribution and abundance, predation pressures, climate). Several factors make the use of time budgets appropriate for studies of the Southern Black-backed Gull in Antarctica. First, Antarctica is at the edge of the species' breeding range and has a severe climate in which local conditions vary markedly within and among years. This should exert selection pressures for gulls to adapt their reproductive behaviors accordingly. Second, during much of the breeding season, day length is sufficient to allow behavioral observations throughout the 24-h cycle. Third, in this area, the gulls typically breed in small colonies (<50 pairs) with most pairs defending a shoreline feeding territory adjacent to the nest site. This allows an observer to document most foraging activity while simultaneously monitoring activities at the nest. Fourth, few garbage dumps exist (in contrast to most sites farther north), forcing many of the gulls to rely on "natural" foods.

Our objectives were to: 1) document time spent in various activities by each sex during all stages of the breeding cycle, 2) determine the frequency of agonistic behaviors by each sex relative to density of the nesting colony, 3) document the time the nest was guarded/unguarded by each parent relative to stage of

breeding cycle, and 4) determine to what extent the above time budgets allow these gulls to adapt to the Antarctic environment.

STUDY AREA

The study was conducted at Palmer Station, Anvers Island (64°46'S, 64°03'W) off the Antarctic Peninsula (see map in Maxson and Bernstein 1982). Climate and geology of the region have been described by Watson (1975). Daylight is nearly continuous from early December through late January. Ambient temperatures recorded daily at 08:30, 14:30, and 20:30 averaged 1.4°C from November 1979 through February 1980 (range = −9 to 7°C). Most days were overcast and periods of light rain or snow were common. During austral summer, this area is subject to concentrations of pack ice varying from 0–100% cover depending upon wind and tidal currents.

Various seabirds nest on exposed peninsulas projecting from glacier-covered Anvers Island and on the smaller ice-free islands nearby (Parmelee et al. 1977). Small colonies (<50 pairs) of Southern Black-backed Gulls were present at 10 locations within 4 km of the station. We chose Bonaparte Point, a rocky peninsula described by Parmelee and Maxson (1974), as our study site because it was accessible from the station regardless of pack ice conditions and had been the site of previous gull observations (Parmelee and Maxson 1974; Fraser, unpubl. data).

METHODS

We observed breeding gulls from 13 December 1978–7 February 1979 and 27 October 1979–11 March 1980. Nests were selected for time budget sampling based on the following criteria: 1) at least one member of the pair was color-banded, 2) birds could be seen from a vantage point affording excellent visibility of the territory, and 3) the vantage point could be approached without causing major disruptions in the colony. Several gulls at Bonaparte Point had been marked during Fraser's study. We used a rocket net to capture and color-band additional gulls. Time budgets were recorded by instantaneous sampling of 13 activities. During sample periods, both members of a pair were observed simultaneously and their behavior recorded every 30 s at the tone of a metronome (Wiens et al. 1970).

During the 1978–1979 season we divided the day into four 6-h periods (00:00–06:00, 06:00–12:00, 12:00–18:00, 18:00–24:00) and conducted 2-h samples within these time blocks. We varied the time of observation from day to day so that birds were sampled during all hours of the day over the course of the study. During the 1979–1980 season, observations conducted between 8 December–19 January were 24 h in duration beginning at midnight. Early and late in the season, observations were shortened owing to periods of darkness but covered the entire daylight period.

The 13 activities we used to construct time budgets are defined below:

Foraging—searching for, capturing, or eating food items, plus courtship feeding; *Feeding Chicks*—offering food items to chicks; *Preening*—manipulating feathers with the bill, bathing; *Inactive*—standing, sitting, sleeping; *Flying*—normal flapping flight, gliding, aerial chases; *Walking*—walking about without pecking at food items; *Swimming*—swimming without pecking at food items; *Nest Building*—gathering nest materials and incorporating these into the nest; *Incubation*—sitting on the nest when at least one egg was present; *Brooding*—sheltering one or more chicks under the parent's body; *Courtship*—attempted copulations, copulations, displays leading to copulation; *Agonistic*—fights, chases, long calls, face-offs at territory border; and, *Off Territory*—away from the territory and out of view.

At hourly intervals we recorded ambient temperature, wind direction and velocity, cloud cover, precipitation, tide level, and pack ice conditions. We also recorded the amount of time each sample bird spent near (here defined as within 5 m) the nest and the number of fights, chases, long calls, face-offs, courtship feedings, chick feedings, and intrusions onto the territory by other gulls.

We subdivided the colony into "high" and "low" density areas to compare frequency of agonistic behaviors between areas. Nests in the high density area were within 50 m of their nearest neighbor and had shoreline feeding territories less than 100 m in length. Nests in the low density area had inter-nest distances and feeding territory lengths exceeding these values. We used Chi-square goodness-of-fit tests to determine whether frequencies of agonistic behaviors were equal in the two areas.

Since gull nests were subject to predation by South Polar Skuas (*Catharacta maccormicki*) when the colony was disturbed by humans, we restricted entry into the colony area. This gave us a more realistic picture of gull production during the two seasons but it precluded our obtaining exact dates of laying, hatching, or nest loss, in some instances.

RESULTS

When we arrived at the study site in mid-December 1978, most gull nests contained hatch-

ing eggs or small chicks. We found nine active nests on Bonaparte Point and selected three for time budget observations. The single chick from one of these nests disappeared after seven days so we ceased monitoring that pair. The other two pairs each fledged two chicks in late January and were the only gulls on Bonaparte Point to breed successfully that season.

The following season the majority of gulls had returned to the area in September (Bernstein 1983). When time budget observations began on 27 October, most gulls were occupying breeding territories and many were constructing nests. Egg-laying began in mid-November. Of 19 pairs that laid eggs, nine pairs fledged a total of 11 chicks. We watched five pairs during the prelaying period but later observations were limited to two pairs, only one of which fledged a chick.

Instantaneous samples totaled 880 bird-h (105,600 data points) and data were categorized by sex and stage of breeding cycle. During prelaying through incubation (Fig. 1) when gulls were on their territories and not involved in incubation, they were inactive most of the time although they seldom actually slept. Little time was spent flying, walking, swimming, building nests, courting, or engaging in agonistic behavior by either sex.

Females spent less time foraging and more time inactive than their mates during prelaying and laying stages (Fig. 1a, b). When foraging, females appeared to do so less intensively than males. During these periods females frequently begged food from their mate using head-tossing displays as described by Fordham (1963) and probably received a substantial portion of their food in this manner. For example, during the egg-laying stage, we observed one pair (BABB and GGRA) during an 18 h daylight period. The male captured 14 limpets (*Nacella concinna*), the principle food obtained from feeding territories, whereas the female obtained only one but was fed three times by the male. These courtship feedings probably constituted most of her food that day. We did not see courtship feeding once clutches were complete and thereafter females typically spent as much time foraging as males.

The substantial proportion of time spent off territory during prelaying (Fig. 1a) was likely associated with foraging flights out to sea. Early in the season (October), ice sometimes covered shoreline areas making foraging for limpets impossible. At these times, pairs often flew off for extended periods. When open water was present, flights off territory tended to be associated with periods when limpets were difficult to obtain (e.g., high tide). As the laying stage approached, females typically spent more

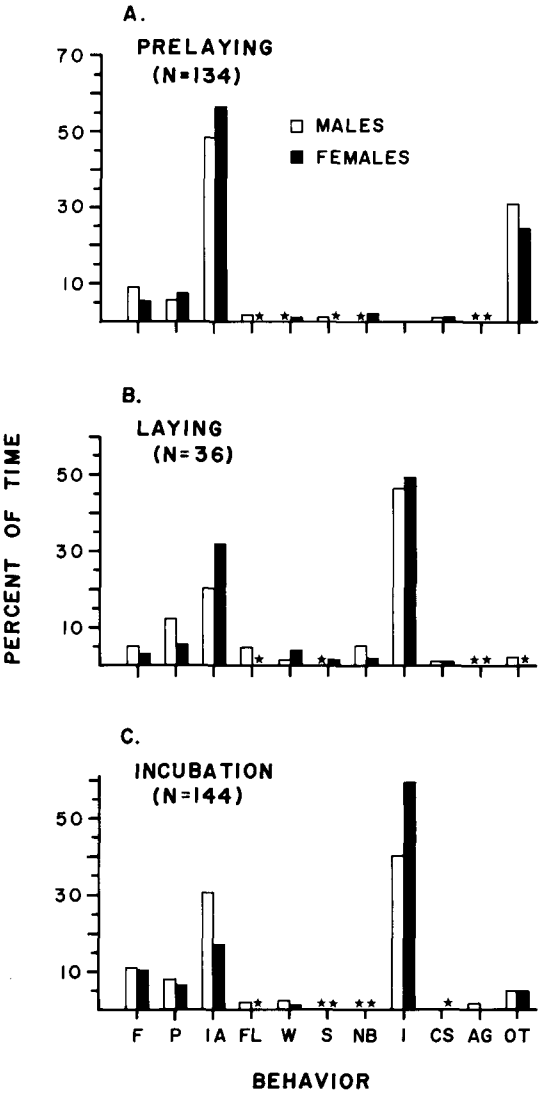

FIGURE 1. Time budgets of Southern Black-backed Gulls during Prelaying, Laying, and Incubation periods. (N = bird-h of observation; * = values less than 1%; F = foraging; P = preening; IA = inactive; FL = flying; W = walking; S = swimming; NB = nest building; I = incubation; CS = courtship; AG = agonistic; OT = off territory.)

time on territory than their mates and both sexes spent less time off territory.

Though nest building often began several weeks before egg-laying, building activities peaked during the laying period and diminished rapidly once the clutch was complete. Males spent more time in active nest construction than females—a pattern also noted by Fordham (1964a) and Fraser (pers. comm.). As an example, during 30 h of observation of BABB and GGRA during prelaying and laying periods, the male made 21 flights to gather nest materials (moss and grass) while the female made only one flight. Data suggesting that females spent more time nest building than males

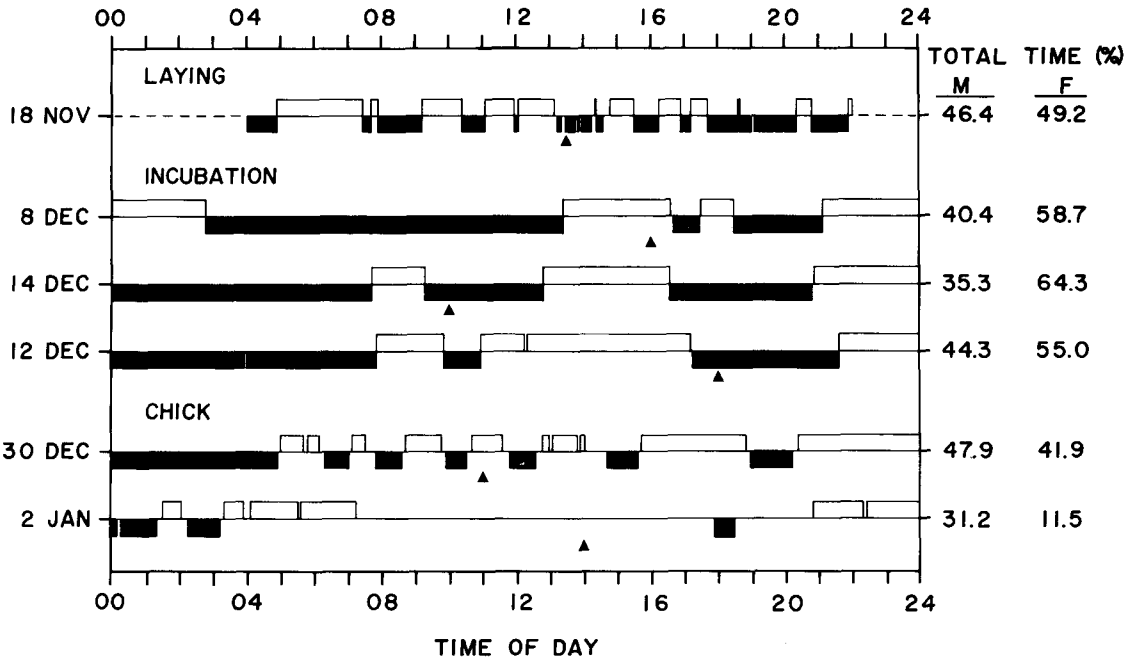

FIGURE 2. Male-female patterns of incubation and brooding during Laying, Incubation, and early Chick-Rearing periods. (Horizontal line = total time of observation; dashed line = no data; open rectangles = time male incubated/brooded; solid rectangles = time female incubated/brooded; triangles = time of low tide; 18 November, 8, 14 December = data from BABB pair; 12, 30 December, 2 January = data from RORA pair.)

during prelaying (Fig. 1a) are misleading since, of the 2.1% of time females were recorded as engaged in nest building, 87% was spent sitting quietly in the empty nest as though incubating.

Both sexes incubated but females consistently spent more time on the nest than males (Fig. 1b, c). For the single day monitored during laying (Fig. 1b), nest attentiveness totaled 95.6% of the daylight hours. Attentiveness increased to 99.3% for three 24-h observations during incubation (Fig. 1c).

The male-female pattern of incubation/brooding changed from laying through the young chick period (Fig. 2) though some aspects remained consistent. Change-overs in nest attendance were more frequent during laying and chick stages than during incubation. Males were on the nest for several hours before midnight, while females typically incubated during early morning hours. The longest parental shifts were those of females during the morning hours, with the longest observed shift being 10.7 h. Shorter shifts occurred during the middle portion of the day when most foraging took place. Gulls usually did most of their foraging at low tides (Maxson and Bernstein, unpubl. data), though some foraging occurred at other times. Based on change-over frequencies, Drent (1970) concluded that usually only one member of a pair of Herring Gulls (*Larus argentatus*) was able to forage during a low-water period. In contrast, we found that both members were able to forage during low-water, since a change-over occurred less than 1 h before or after low tide (Fig. 2). These change-overs were facilitated by having the primary foraging site near the nest.

Once chicks hatched, brooding time for all samples combined was nearly equal between sexes (Fig. 3a), although chicks were brooded more by the male during the two 24-h observations (Fig. 2). Very young chicks were brooded almost continuously (e.g., 89.8% for 2-day-old chicks, Fig. 2). By five days of age, brooding time had dropped to 42.7% (Fig. 2). On this day chicks were left continuously unbrooded for 10.6 h during the middle part of the day despite low ambient temperatures (0–3°C), heavy overcast, and 3 h of mist (08:00–11:00). We saw no brooding of chicks older than 11 days.

We divided the chick-rearing period into three stages based on chick age (0–11, 12–30, 31–fledging). During this period gulls were again inactive most of the time they spent on territory (Fig. 3). Time spent foraging on territory by birds with small chicks (Fig. 3a) was similar to that noted in incubating gulls (Fig. 1c) and relatively little time was spent off territory.

As chicks grew, requiring more food, foraging time on territory increased little but time off territory increased markedly (Fig. 3b). This pattern was complicated by apparent fluctua-

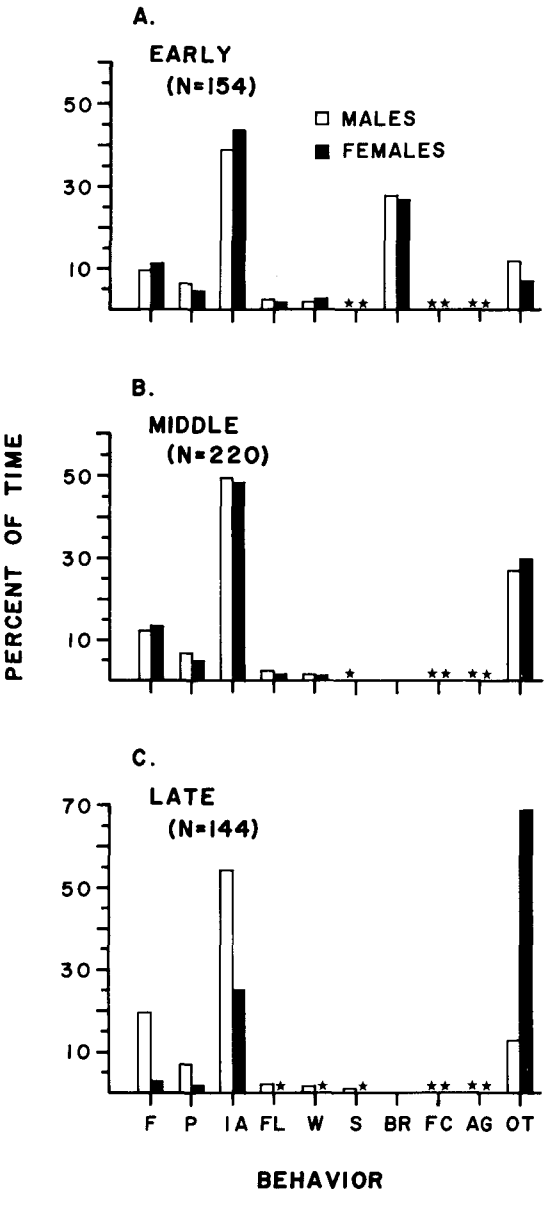

FIGURE 3. Time budgets of Southern Black-backed Gulls during the Early, Middle, and Late Chick-Rearing periods. (BR = brooding; other symbols as in Fig. 1.)

tions in food availability on territory. As an example, on 19 January 1980 (chicks 22 days old) few limpets were visible to us along the shorelines of RORA's territory as they had temporarily moved into deeper water. During our 24-h observation the birds appeared to have difficulty (even at low tide) obtaining limpets. In total, the pair spent 3.7 h foraging on territory but 21.7 h off territory. Chicks were fed 11 times that day (three times by the female after flights off territory). In contrast, on 27 January 1980 limpets were abundant along the shorelines of RORA's territory. During the 20-h light period, the pair captured many limpets in the 7.3 h they spent foraging on territory. Only 5.8 h were spent off territory and neither parent fed chicks upon returning. That day chicks were fed 26 times.

The three gull pairs we observed during the late chick-rearing stage behaved differently as chicks approached fledging age. BBYA and his mate continued to forage on territory and the chicks remained near the nest. BBYA spent more time off territory than his mate and frequently flew to the station. When we moved in order to watch these trips, we found that he spent most of his time perched on buildings rather than actively foraging.

When the chicks of GGRA and her mate were 25 days old they moved 30 m from the nest and remained there until nearly fledged. GGRA spent more time off territory than her mate, although both continued to forage on their territory. When chicks were 37 days old and on several occasions thereafter, we observed as many as nine adult gulls loafing within several meters of the chicks. We saw no adult-chick aggression and the parents made few attempts to evict the intruders, in contrast to their behavior earlier in the season. A few days later, the chicks had moved about 100 m to the base of a glacier where non-breeding gulls often congregated. They remained at this location until fledged.

The chicks of RORA and his mate remained near the nest, usually returning to it in the evening hours. Intruders were evicted by the parents and both birds foraged on territory until 8 February 1980 (chicks 42 days old). Thereafter, when the female attempted to forage on territory she was chased off by RORA, thus forced to forage elsewhere. Consequently, she spent 81–95% of the daylight hours off territory during this period.

Since 104 bird-h (72% of total) of observation during the late chick-rearing period were conducted on the RORA pair, their behavior is strongly reflected in Figure 3c. Given the variation noted during this phase of our study, additional observations are required before conclusions can be drawn regarding late season behavior patterns in this population.

Some parental care extended beyond fledging of the chicks. On 25 February 1980 the 59-day-old chick of RORA could fly well and followed RORA around the territory begging for food. RORA fed the chick twice early in the morning but not thereafter although the chick continued to beg. The chick picked at filamentous algae on the rocks several times during the day but did not forage for limpets. Parents were seen feeding limpets to chicks nine days after fledging. Shortly before we left the study area in March, we observed chicks as old as 29 days post-fledging still begging from

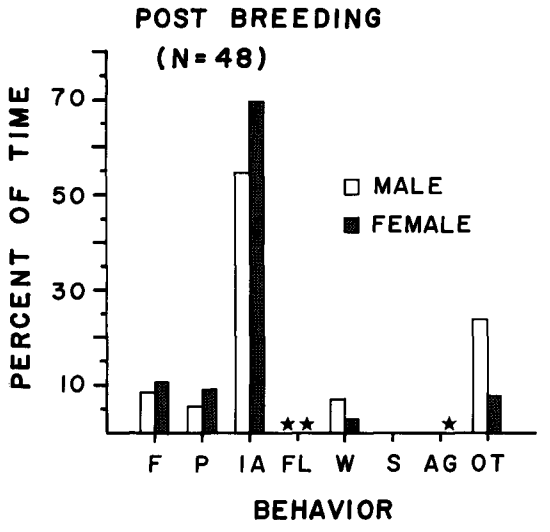

FIGURE 4. Post-breeding time budget for one pair of Southern Black-backed Gulls. (Symbols as in Fig. 1.)

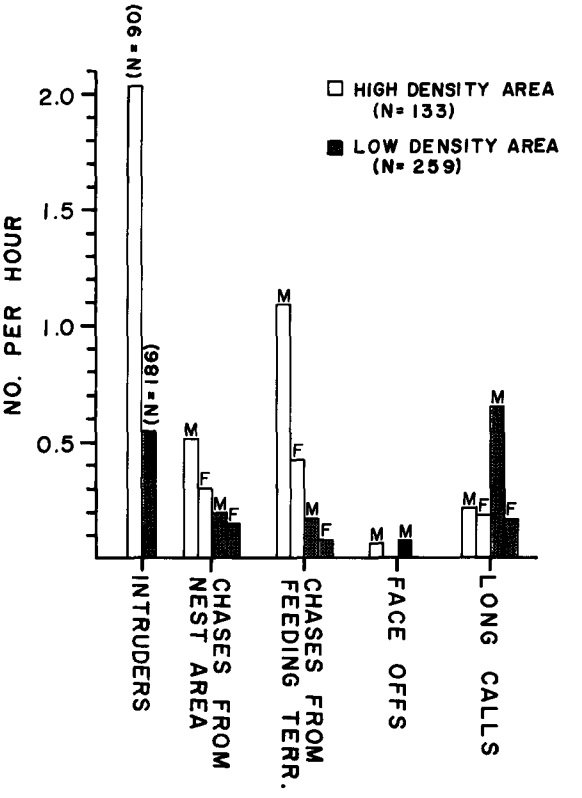

FIGURE 5. Frequency of intrusion and various agonistic behaviors by Southern Black-backed Gulls in the high density vs. low density areas of the Bonaparte Point colony. (N = h of observation; M = males; F = females.) Data were obtained from two nests in each area.

their parents. We commonly saw South Polar Skuas harassing gull fledglings in late February. If the gulls proved strong fliers, skuas eventually gave up pursuit. These observations suggest that extension of parental care beyond fledging may be important for chick survival in this population.

We gathered post-breeding data on BABB and GGRA during one 24-h period (5 January 1980). This pair had apparently lost their chicks shortly after hatching in mid-December. Time spent foraging on territory (Fig. 4) remained similar to that noted for this pair during incubation (e.g., male = 9.6 vs. 9.8%, female = 7.0 vs. 10.4%). Time spent off territory increased substantially for both birds relative to their behavior during previous observation periods. However, rather than foraging, the birds spent much of this time (e.g., male = 4.2 h, female = 0.9 h) bathing and preening with other gulls at a nearby glacial melt pond.

Although agonistic activities comprised little of the time budget during any stage of the breeding cycle (Figs. 1, 3, 4), these behaviors were nevertheless important for defense of the nest site and feeding territory. Data regarding frequency of agonistic behaviors were categorized by sex and whether sample birds were in the "high" or "low" density portion of the colony (Fig. 5). The number of intruders (mostly non-breeding adults or sub-adults) was markedly higher ($\chi^2 = 130.5$, df = 1, $P < 0.001$) in the high density than low density area. In addition to the breeding pairs in the high density area, groups of 10–30 non-breeders often loafed at a small melt pond nearby, whereas no sizable groups of non-breeders were present in the low density area. As might be expected, chases of intruders from the nest area (males: $\chi^2 = 27.9$, df = 1, $P < 0.001$; females: $\chi^2 = 12.3$, df = 1, $P < 0.001$) as well as the feeding territory (males: $\chi^2 = 158.2$, df = 1, $P < 0.001$; females: $\chi^2 = 51.6$, df = 1, $P < 0.001$) were more frequent in the high density area.

Males chased intruders from the nest more than did females in the high density area ($\chi^2 = 6.6$, df = 1, $P < 0.05$) but not in the low density area ($\chi^2 = 2.5$, df = 1, $P > 0.05$). In both areas, males chased intruders on the feeding territory more than did their mates (high density: $\chi^2 = 39.0$, df = 1, $P < 0.001$; low density: $\chi^2 = 6.8$, df = 1, $P < 0.01$) but females in the high density area chased more often than males in the low density area (chases from nest: $\chi^2 = 4.5$, df = 1, $P < 0.05$; chases from feeding territory: $\chi^2 = 23.7$, df = 1, $P < 0.001$). Intruders were sometimes tolerated near the nest for several minutes but they were rarely tolerated on the feeding territory. Even gulls flying over feeding territories were sometimes chased.

Face-offs by males at territory boundaries were infrequent (Fig. 5) and varied little between the two areas ($\chi^2 = 0.3$, df = 1, $P > 0.05$) since each pair had only one or two adjacent

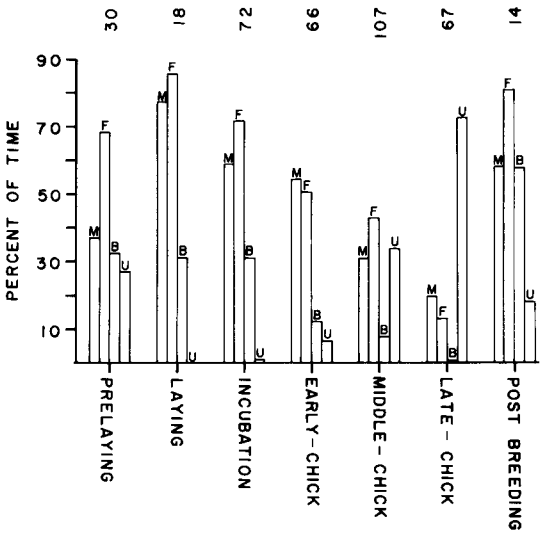

FIGURE 6. Percent of time Southern Black-backed Gulls were near (<5 m) their nest during each stage of the breeding cycle. (M = male; F = female; B = both male and female; U = neither bird within 5 m; numbers above columns = h of observation.)

neighbors. We never saw females engaged in face-offs. No fights were observed involving sample birds and we witnessed only two fights (both during prelaying) during our two seasons of observation.

Long calls were often given as other gulls flew over the territory. Males in the low density area long-called more often than males in the high density area ($\chi^2 = 33.3$, df = 1, $P < 0.001$, Fig. 5). Males long-called more often than their mates in the low density area ($\chi^2 = 74.2$, df = 1, $P < 0.001$) but this was not the case in the high density area ($\chi^2 = 0.2$, df = 1, $P > 0.05$).

The proportion of time gulls spend near (within 5 m) the nest is important in defense of the nest site, eggs, and chicks. When the gulls are within this distance, the parent can quickly confront potential predators. We never saw gulls attempting to prey on eggs or chicks of other gulls. The abundant South Polar Skuas were the major cause of egg loss and probably took some small chicks as well, although we did not witness any successful attempts. Although typically subordinate to skuas on neutral ground, gulls were usually successful in chasing off skuas approaching their nest.

The amount of time each parent spent at or near the nest, the time both were near the nest simultaneously, and the time the nest was unguarded (i.e., neither parent within 5 m) were categorized by stage of breeding cycle (Fig. 6). Females typically spent more time near the nest than males during prelaying through incubation periods. Time that nests were unguarded dropped from 27% during prelaying to less than 1% during laying and incubation. During the early chick-rearing period males spent slightly more time near the nest than females, but birds of both sexes were near the nest far more than the amount of time they spent brooding chicks (Fig. 3a). As chicks grew larger and less susceptible to being carried off by skuas, parents spent less time near the nest. Time that nests were unguarded increased correspondingly from 6.8–72.4% during early-late chick-rearing stages. During the single day of post-breeding observations, the nest remained the focal point of BABB and GGRA's territory. Both birds were seen sitting in the nest as though incubating, and intruding gulls and skuas were still chased off. Each time we checked that area of the colony thereafter (20 January and 1, 3, 6, 10 March) these birds were present on their territory and usually near the nest site. Other post-breeding gulls were also seen occupying their territories during these checks.

DISCUSSION

Since time and energy are closely interrelated in breeding activities, energy should be considered when evaluating time budgets. Whereas time constraints on Southern Black-backed Gulls in Antarctica may be reduced during austral summer owing to extended day length, the harsh climate may place energy at a premium. Although one could argue that natural selection should favor efficient energy use in any environment, the selection pressures in Antarctica may be stronger than those in more temperate regions. Several aspects of the time budgets we recorded can be viewed as habits which conserve energy. Foraging and preening were the only active behaviors involving a substantial time investment (Figs. 1, 3, 4) and probably required a certain minimum time expenditure regardless of other factors. Little time was spent flying, although time off territory no doubt included additional flight time. Spending much time inactively can be interpreted as an energy-conserving habit which may simultaneously afford a passive defense of territory and nest. When females required more energy during egg production, they appeared to reduce energy expenditure in several ways. Relative to their mates, they spent more time inactive and less time foraging, gathering nest materials, flying, and off territory (Fig. 1a, b). Females were able to reduce foraging time because much of their food was supplied via courtship feedings during this period. This male-female pattern changed after egg-laying when energy demands became more nearly equal for each sex (Figs. 1c, 3, 4). Females

resumed foraging as much as males. The time that each sex spent inactively varied. However, if one combines inactive time with incubation-brooding time (also "inactive" behaviors of roughly equivalent energy cost), both sexes spent approximately equal time "inactive" through the middle chick-rearing period (Figs. 1c, 2a, b).

Defense of feeding territories adjacent to the nest site is a behavior pattern not reported for Southern Black-backed Gulls in other parts of their range. This behavior was facilitated by several factors. Gull colonies were small and nests were relatively dispersed. Available nest sites were adjacent to the coastline and food (e.g., limpets) was distributed along shorelines in predictable locations and quantities where it could be economically defended. Agonistic activities associated with feeding territory defense typically made up less than 1.4% of the time budget (Figs. 1, 3, 4).

Having the primary foraging site near the nest has several potential benefits. First, less time and energy are spent flying to distant foraging areas or searching for ephemeral food sources. Presumably, this would not only reduce energy expenditure but would also allow more time and energy to be spent on other needs (e.g., care of eggs or chicks). Second, during incubation or the first few days after hatching, change-overs at the nest can be accomplished rapidly allowing both adults to forage at low tide, when limpets are most available (Fig. 2). Third, when foraging nearby, a parent can quickly return to aid its mate in defending the nest from predators. The only predators faced by gulls in our study area were South Polar Skuas and an occasional Brown Skua (*C. lonnbergi*). We saw no attempts at cannibalism by gulls, in contrast to reports by Fordham (1964b) and Burger and Gochfeld (1981a). Each of the gull nest depredations that we observed occurred when one of the parent gulls was off territory.

In view of the apparent time-energy saving and predation-reducing advantages of feeding territories, why did gulls sometimes leave the territory? When ice covered the shoreline during portions of the prelaying period, gulls had to forage at sea. During the laying and incubation periods, territories of sample birds appeared to provide sufficient food since very little time was spent off territory (Fig. 1b, c). However, when chicks hatched, thereby increasing food demands, time spent off territory increased (Fig. 3). Indeed, one male (RORA) forced his mate to forage off territory during the late chick-rearing period as food demands reached their peak. Gulls, being opportunists, might also leave the territory if there was an abundant food source elsewhere. Fraser (pers. comm.) noted that after chicks hatched, the gulls flew out to sea and consistently obtained small fish (mostly *Pleuogramma antarcticum*). These fish were apparently abundant since the gulls achieved high reproductive success (1.9 and 1.8 fledged chicks/pair during 1974–1975 and 1975–1976, respectively). South Polar Skuas which also fed on these fish likewise achieved high reproductive success (Parmelee et al. 1978). Off territory food sources were not abundant during our study because gulls did not consistently return with food from flights out to sea. Reproductive success for gulls at Bonaparte Point dropped to 0.4 and 0.6 fledged chicks/pair during the 1978–1979 and 1979–1980 seasons, respectively. South Polar Skua reproductive success was also reduced (Pietz and Maxson 1980). These data suggest that, while possession of feeding territories had several advantages, these territories themselves did not produce sufficient food for the gulls to achieve high reproductive success during our study. The extent to which food abundance on these territories varies annually remains unknown.

Southern Black-backed Gulls have adapted successfully to a harsh and variable environment. Our time budget data suggest that the gulls have adopted ways to conserve energy while simultaneously spending much time near the nest during periods when it is most vulnerable to predation. Since our study was conducted during two seasons of relatively poor reproductive success for gulls at Palmer Station, additional studies are desirable during "good" years to further understand how these birds alter their behavior in response to changing environmental factors.

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LITERATURE CITED

BERNSTEIN, N. P. 1983. Influence of pack ice on non-breeding Southern Black-backed Gulls (*Larus dominicanus*) in Antarctica. Notornis 30:1–6.

BURGER, J., AND M. GOCHFELD. 1981a. Colony and habitat selection of six Kelp Gull *Larus dominicanus* colonies in South Africa. Ibis 123:298–310.

BURGER, J., AND M. GOCHFELD. 1981b. Nest site selection in Kelp Gulls in southern Africa. Condor 83: 243–251.

CRAWFORD, R. J. M., J. COOPER, AND P. A. SHELDON. 1982. Distribution, population size, breeding and conservation of the Kelp Gull in Southern Africa. Ostrich 53:164–177.

DRENT, R. H. 1970. Functional aspects of incubation in the Herring Gull. Behaviour Suppl. 17.

FORDHAM, R. A. 1963. Individual and social behaviour of the Southern Black-backed Gull. Notornis 10:206–222.

FORDHAM, R. A. 1964a. Breeding biology of the Southern Black-backed Gull I: pre-egg and egg stage. Notornis 11:3–34.

FORDHAM, R. A. 1964b. Breeding biology of the Southern Black-backed Gull II: incubation and the chick stage. Notornis 11:110–126.

MAXSON, S. J., AND N. P. BERNSTEIN. 1982. Kleptoparasitism by South Polar Skuas on Blue-eyed Shags in Antarctica. Wilson Bull. 94:269–281.

PARMELEE, D. F., AND S. J. MAXSON. 1974. The Antarctic Terns of Anvers Island. Living Bird 13:233–250.

PARMELEE, D. F., W. R. FRASER, AND D. R. NEILSON. 1977. Birds of the Palmer Station area. Antarct. J. U.S. 12:14–21.

PARMELEE, D. F., N. BERNSTEIN, AND D. R. NEILSON. 1978. Impact of unfavorable ice conditions on bird productivity at Palmer Station during the 1977–78 field season. Antarct. J. U.S. 13:146–147.

PIETZ, P. J., AND G. A. D. MAXSON. 1980. Comparative ecology of South Polar and Brown skuas at Palmer Station. Antarct. J. U.S. 15:158.

WATSON, G. E. 1975. Birds of the Antarctic and Sub-Antarctic. American Geophysical Union, Washington, DC.

WIENS, J. A., S. G. MARTIN, W. R. HOLTHAUS, AND F. A. IWEN. 1970. Metronome timing in behavioral ecology studies. Ecology 51:350–352.

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Ornithology books in the library of Trinity College, Hartford/including the library of Ostrom Enders.—Prepared by Viola Breit and Karen B. Clarke. 1983. Trinity College, Hartford, Connecticut. 270 p. $35.00. Source: Trinity College Library Associates, Summit Street, Hartfort, CT 06106. Ostrom Enders, a retired banker, sportsman, and aviculturist recently gave his natural history library to Trinity College, an institution that his family has long supported. Augmented by the College's existing holdings, this puts the Watkinson Library at Trinity among the major collections of ornithological materials in America. The publication of this catalogue marks Mr. Enders' gift and introduces the collection to ornithologists and librarians at large. The volumes range in date from Willughby's *Ornithology* (1678) to the present, and reflect the donor's particular interest in game birds and aviculture (especially waterfowl) as well as general ornithology. Several thousand entries with bibliographic data are listed in this nicely printed book. Since the collection will be maintained and kept up-to-date by an endowment, future supplements are planned.

Bibliography of the Genera *Calidris* and *Limicola* and **Bibliography of the Genus *Phalaropes*.**—Sven Blomqvist. 1983. Special Reports from Ottenby Bird Observatory Nos. 3 and 4. Separately issued in paper covers. No. 3: 104 p., $7.00. No. 4: 28 p., $4.00. Source: Ottenby Bird Observatory, Pl. 1500, S-380 65 Degerhamn, Sweden; prices include surface mail postage. The first of these booklets is a compilation of 1,364 references, the second of 394 references. They list primarily papers and secondarily a few books, with coverage through 1980. Complete though they may be, these bibliographies would be more useful if they had been provided with taxonomic, geographic, and topical indexes.