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BREEDING PHENOLOGY AND MID-SEASONAL SOCIAL BEHAVIOR OF THE SOOTY GUILLEMOT ON TEURI ISLAND, JAPAN

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The breeding biology of the genus *Cepphus* (Alcidae) is represented in literature for two of the three species: *Cepphus grylle*, the Black Guillemot and *Cepphus columba*, the Pigeon Guillemot (Asbirk 1978, 1979a and b; Cairns 1978, 1979, 1980, 1981; Drent 1965; Hyde 1936, 1937; Preston 1968; Storer 1952; Thoresen and Booth 1958; Winn 1950). Notations within larger compilations (Dement'ev and Gladkov 1951, Kozlova 1957) and a short paper by Nazarov and Labzyuk (1972) have been the only reports published on the habits of *Cepphus carbo*, the Sooty (or Spectacled) Guillemot. Austin and Kuroda (1953) recorded a population of at least 7000 Sooty Guillemots on Teuri Island, Japan, in 1949, which was at that time the largest known aggregation of the genus anywhere in the world. Unfortunately, this figure is difficult to substantiate and the present number on Teuri Island does not exceed 400 birds, including non-breeders (Environmental Agency 1973). Colonies twice the size inhabit Soviet islands to the north (Nazarov and Labzyuk 1972). I camped on Teuri Island in June and July 1981, to observe the breeding habits of this little studied species.

All three species of *Cepphus* nest as individual pairs, in small groups, or in larger groups — up to 10,000 pairs for the Black Guillemot (Nettleship 1974) — according to the availability of nesting cavities and abundance of food supply. The Sooty Guillemot ranges from the coasts of northern Japan, Korea, and southern Kuriles to the shores of the Okhotsk Sea (Dement'ev and Gladkov 1951). The bird differs from the other two species in being slightly larger, lacking white wing patches, and possessing white eyelids which merge with white facial plumage. As in the other two species, the Sooty has conspicuously red feet and legs. The interior lining of the mouth is flesh pink as opposed to the bright coral red of the Black and Pigeon guillemots.

STUDY AREA AND METHODS

Teuri Island (lat. 44°4'N, long. 141°3'E), is one of two islands located approximately 38 km off the northwest coast of Haboro, Hokkaido, Japan. Teuri is famous in Japan as a National Monument for seabirds and is a well-known tourist attraction (Environmental Agency 1973).

Teuri Island is approximately 5.5 km² and has almost 12 km of coastline, one third of which is suitable for breeding seabirds. The island rises gently at the north end from east to west and more abruptly at the south end to high points of approximately 100 m. The rock is composed of volcanic breccia overlain with ash conglomerates. Several rocky stacks along the western shoreline also provide nesting places for birds. A village of just over 1000 persons is located at the sheltered northeastern end of the island.

The sea was remarkably calm during June and July although a few wet, foggy and windy days impeded observations. Air temperatures varied between 16 and 20° C, and the sea temperatures at shore were just a degree or two below air temperature. Tidal effect was practically nil, with a difference of less than 1 m between high and low tides throughout June and July.

Teuri Island is the site of the largest known colony of Rhinoceros Auklets (*Cerorhinca monocerata*) where a minimum of 500,000 and a maximum estimation of 785,000 individuals breed (Environmental Agency 1973). Other breeding species include Black-tailed Gull, *Larus crassirostris*, 40,000; Slaty-backed Gull, *Larus schistisagus*, 400; Common Murre, *Uria aalge*, 700 to 800; Sooty Guillemot, *Cepphus carbo*, 380 to 400; and a few scattered Ancient Murrelets, *Synthliboramphus antiquus*. (All figures represent individuals.)

I camped on Teuri from 3 June to 31 July 1981, observing for more than 700 hours. From within 25 to 50 m of the campsite 20 or more Sooty Guillemots could be observed. An additional group of birds could be seen

Figure 1. Part of the study area on Teuri Island, Japan.

easily with binoculars to the south. To the north, beyond rock piles, the remaining 300 plus birds were counted each day shortly after dawn and at intervals throughout the day. Attendance counts were made by counting every hour all birds within view of the campsite area on the sea and on land near nesting sites. Locations of nest cavities were determined by observing the movements of the birds to and from the cliffs. Sightings of birds carrying fish were used to determine locations of nest sites in which chicks were present.

A rock blind was constructed from which the entrance to eight nests known to contain chicks could be seen. Among the boulder piles at the base of the cliff 20 nests were located but only 7 of these were shallow enough to permit access to their contents.

Binoculars, notebook, tape recorder, a 16 mm motion picture camera and a 35 mm motor-driven camera were used for recording behavior. The early mating behavior was entirely missed, nevertheless social activities continued throughout June and July. Figure 1 pictures the campsite and part of the observation area on Teuri. Figure 2 shows four adult birds.

RESULTS AND DISCUSSION

Breeding Chronology and Development of Young

Storer (1952) indicated that the prenuptial (prealternate) molt of the Sooty Guillemot appeared to occur in January and February in northern Japan. This observation fits in well with the early onset of breeding activities which take place on Teuri Island.

Eggs were already hatching on 2 June 1981. On 5 June, five of seven accessible nests contained eggs: three contained two eggs and two only one. Matutoshi Aotsuka, warden of birds on Teuri Island, informed me that the

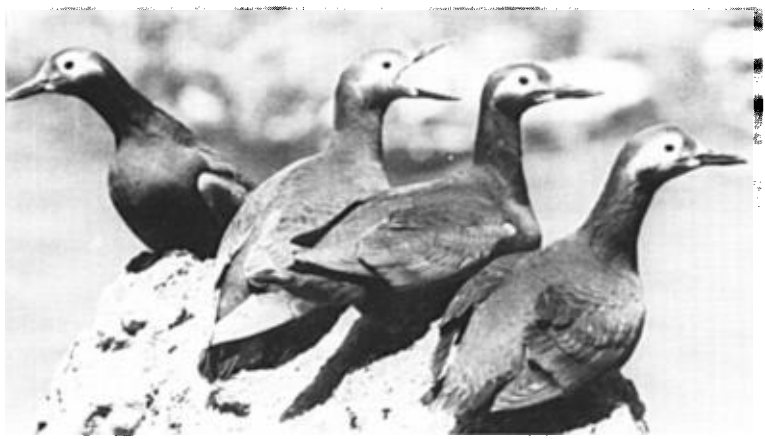

Figure 2. Adult Sooty Guillemots perched near a nesting area. One bird utters the alarm Scream from a resting position.

eggs usually hatched at about the same time every year and that, in 17 years of banding birds on Teuri, he had never found more than one Sooty Guillemot chick being fledged from a nest. Nazarov and Labzyuk (1972) also could find only one chick in each nest they examined. My observations showed that although two chicks may hatch, only one fledges. In one nest the second chick to hatch was found dead on the second day with its head severely pecked.

On 4 July 1981 the first fledgling was seen on the bay, where it was observed daily until 20 July. Allowing 40 plus days for the nestling stage (based on records from three nests) and assuming that the incubation period averaged 30 days, the first eggs of the Sooty Guillemot on Teuri probably were laid about 26 April and hatched 26 May. To the north Nazarov and Labzyuk (1972) found the earliest eggs on 8 May with the greatest number being laid after 20 May.

Of a maximum population of about 400 individuals, no more than 200 were breeders in 1981. In other words, there may have been a maximum of 100 nests with a lesser number of pairs rearing young. Nests were located under rock piles, in crevices, and under rocks higher on the slopes. Sixty percent of the nest sites, as determined by observing birds flying to them, were more than 20 m above sea level (see Figure 3). Nest sites were often defended late in the season by adults without eggs or young being raised in them. Preston (1968) noted this behavior also in the Black Guillemot on Kent Island in all five years of his study.

Throughout June and July, I observed daily 5 to 10 non-breeders which were still in mottled-grey belly plumage. These immature birds displayed with the other members of the colony. Kozlova (1957) and Nazarov and Labzyuk (1972) have also noted that young birds frequently retain white feathers late into June.

The eggs of the Sooty Guillemots resemble in appearance those of the other two species. The two eggs of a single clutch are not always marked alike, a feature also noted in the Pigeon Guillemot (Thoresen and Booth 1958). However, Asbirk (1979b) commented that the two eggs from the same clutch of Danish Black Guillemots always have the same ground color and the same pattern of spots. Ten eggs on Teuri averaged 60.37 x 41.70 mm with a range of 57.60 - 63.80 x 40.3 - 43.8 mm. These were smaller than 14 eggs measured by Nazarov and Labzyuk (1972) who on more northerly islands found a range of 61.1 - 66.8 x 41.1 - 45.2 mm. Nine eggs at late stages of incubation had an average weight of 55.57 g with a range of 50.0 - 60.1 g.

Chicks were fed at varying periods during the day. Early morning and late evening feedings were more frequent than midday feedings in 20 nests observed. Three to eight feedings per day, with an average of five, were observed on four different days, from dawn until sunset. Small chicks were usually fed fish 4-6 cm long. Occasionally a fish, too large for a chick to swallow, was either left at the nest site or carried away again by the parent. The most common fish seen being brought to the nest were sand lance (*Ammodytes* sp.), rock blennies (*Pholis* sp.) and small sculpins. Three 20 cm sand lance weighing between 28 and 29 were dropped at one nest. (A single 4.0 cm sand lance weighed only 2.0 g). As is well known, *Cepphus* feed

upon practically any small fish they are capable of catching. For example, Follett and Ainley (1976), in a study of the Pigeon Guillemot in central California found representatives of 10 families of fish including 19 genera and 24 species to form the prey of that species. The Sooty Guillemot is probably just as adaptable in its diet.

The chicks of Sooty Guillemots, upon hatching, look just like the young chicks of the other two species. They have a full covering of sooty-black down. The legs and feet are pink, turning black in a day or two. The bill is also black with a prominent white egg-tooth on the top mandible, while at the tip of the lower mandible a smaller egg tooth is also present. These features match those of the other species of *Cepphus* (Sealy 1970). Both egg teeth gradually wear off, but in the three chicks observed to fledging, a remnant of the upper one remained up to the 40th day. A single chick hatched with a body weight of less than 40.0 g, reached a peak of 605 g by Day 38, and declined to 545 g the day before fledging.

Body feathers and remiges began to show on Days 12 and 15 after which the belly feathers developed a mixture of white and sooty black. The head, neck and dorsum including the wings and tail were a uniform sooty-black by fledging time. The eyelids were white and an area around the eyes, destined in maturity to become white, remained naked until close to fledging when it filled in thinly with fine grey feathers. The feet and legs upon fledging were black or dark grey. Figure 4 pictures a juvenile in the nest cavity the day before it fledged.

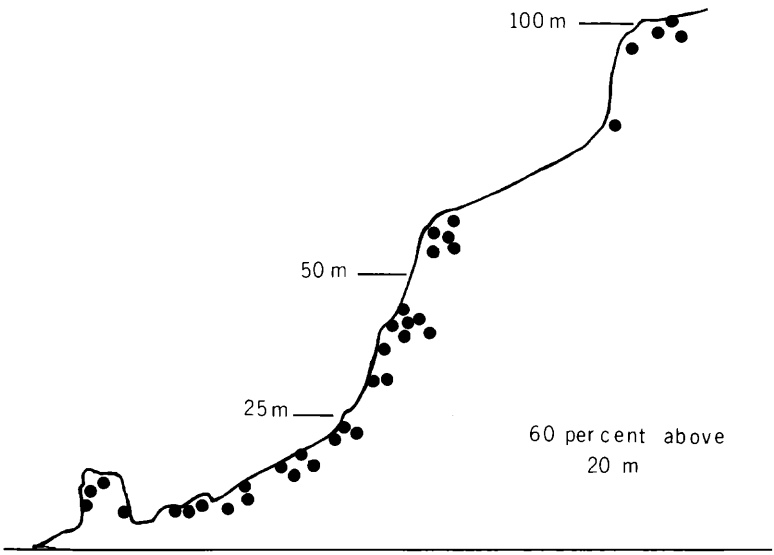

Figure 3. Profile of Teuri Island cliffs showing distribution of Sooty Guillemot nests above sea level.

One fledgling was observed for 16 days from 4 July through 19 July, feeding alone very close to shore. It was a remarkably tame bird often allowing my approach to within a few meters. When first sighted it was midway out in the bay among adult-plumaged birds which kept threatening it and driving it away from the group. One adult dived repeatedly after the young one until both were out of sight behind rocks at the bay entrance. At that time the feet and legs of the fledgling were noticeably as dark in color as a nestling's. After 12 days its plumage had changed from slaty to brown. Dement'ev and Gladkov (1951) also described the brownish color of the juvenal plumage in *Cepphus carbo*. Nazarov and Labzyuk (1972) noted that in August the juveniles become brown. Also by 12 days the feet and legs had become a brownish-red and by 19 July they were almost as bright red as an adult's. The bird never attempted to fly in the 16 days it was observed. The fledgling, unlike the mature birds, always swam with its neck withdrawn. It also boldly defended itself. On one occasion I saw the fledgling attack a bathing Black-tailed Gull so vigorously that it ploughed up onto the gull's back, causing the gull to fly away. Fledging of three birds in observed nests occurred on 20 July (Day 45), 21 July (Day 44) and 29 July (Day 40).

As evidenced by missing wing feathers in five adults, and the greying of the back of the head and neck plumage in four birds, the annual prebasic molt began at the beginning of July. All four birds seen to be in molt were still feeding young.

Colony Attendance

Toward the end of the first week of July a noticeable switch in the pattern of attendance occurred. Figure 5 shows a gradual shift in attendance to later in the day. This unexplained change of pattern in colony attendance by the

Figure 4. A 44-day-old Sooty Guillemot nestling in its nest cavity the day before it fledged.

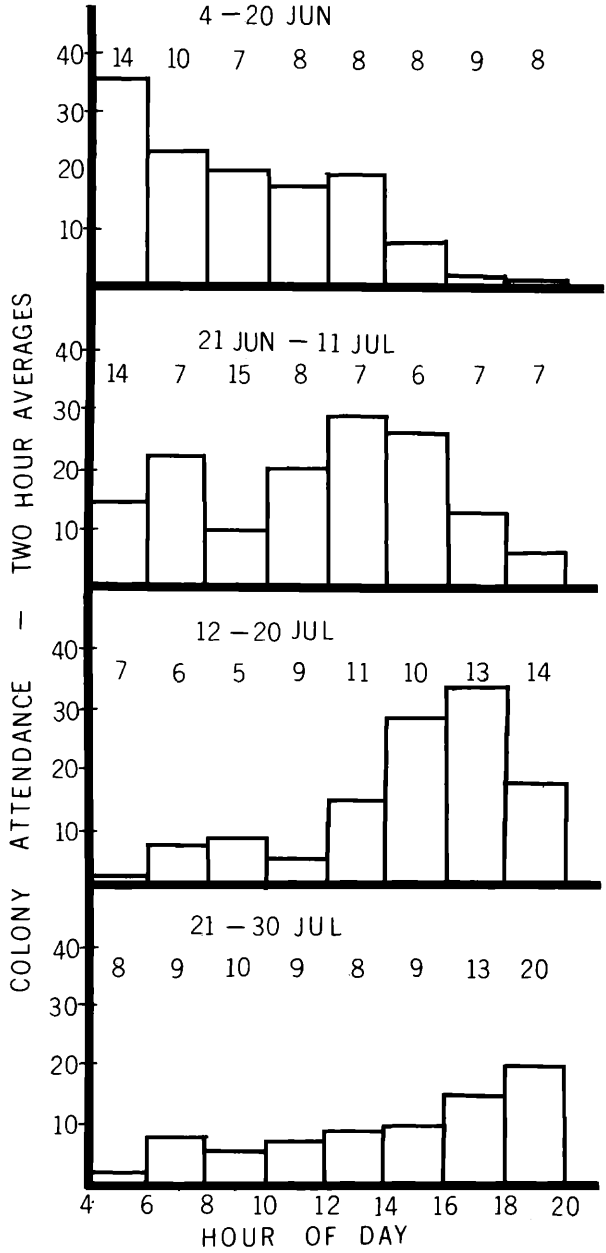

Figure 5. Colony attendance of Sooty Guillemots at intervals during June, July and August 1981. Figures at the top of each graph represent number of counts averaged for each 2-hour period. Colony attendance includes birds on land and on the water close to shore.

Sooty Guillemots was unlike the uniform attendance patterns throughout the breeding season demonstrated by the Pigeon Guillemot (Drent 1965), and the data presented by Asbirk (1976b) and Cairns (1979) for the Black Guillemot. In June, birds arrived in large numbers at dawn and were active on the sea and at the breeding sites until 1500 to 1600 after which time only a few scattered individuals were observable within 0.5 km of shore. By 20 June, a detectable lowering of numbers occurred between 0900 and 1100 each day. By noon a large percentage of the population returned to the rocks and cavity entrances to defend either empty or occupied nest cavities. By 12 July, only the few birds feeding young were ever close to land before 1000. Most other birds returned at about 1300 and stayed until 1900. Sunset at this period was between 1915 and 1930. A few were still at their perches near their nests until 2000. Slight variations occurred with the weather but in general the weather appeared to have little effect on activity. The low numbers of birds carrying fish during the latter half of July indicated that the change in colony attendance had nothing to do with growing demands for food by young.

Behavior

The habits of the Sooty Guillemot closely resemble those of the other two species of the genus. Sooty Guillemots on Teuri were very sensitive and suspicious birds. Kozlova (1957) also noted their shyness. I partially attributed their caution to the alarm calls and frequent panic flights of the Black-tailed Gulls. Incubating birds would flush at the slightest sound such as a falling rock within 10 m. However, in an area immediately below a tourist observation platform near the top of the cliffs on Teuri, one pair showed little concern for the presence of man. There they seemed to be conditioned to people.

Sooty Guillemots when not disturbed almost always made a direct flight into the nest when carrying fish to their young. If a fish-carrying bird did hesitate it was chased by a gull (six out of seven observations) attempting to snatch the fish.

Discussion of Behaviors

The sounds produced by the Sooty Guillemot were found to be less intense than those of the Pigeon Guillemot. For example, the strong "seeeooo" of the alarm or warning scream of the Pigeon Guillemot is reduced to a thinner sounding "seeee" in the Sooty Guillemot (Figure 6c). The "tsit" or "chip" sound (Figure 6d) is similar in all three species of *Cepphus* and is given at varying intervals, even in flight. The contexts and interpretations of behaviors observed are summarized in Table 1.

The trilled call (Figure 6a and b) lacked the "seeeooo" addition in the middle of the call usually heard in Pigeon Guillemots and in this respect more closely resembled the descriptions given for the Black Guillemot (Preston 1968, Storer 1952, Thoresen and Booth 1958, Drent 1965). Asbirk (1979a) refers to this call in the Black Guillemot as the "Nest song," which I believe rightly identifies it with nest territory ownership.

Squat-peeping or Hunch-whistle is one of the most common social displays seen in all three species of guillemots (Figure 7a). Some observers

have interpreted it as an aggressive display (Asbirk 1979b, Drent 1965, Preston 1968). However, my observations on the Sooty Guillemot did not always reveal an aggressive action. Squat-peeping was sometimes demonstrated by a single bird in a group or at the nest site when an intruder landed nearby. In all of my hundreds of observations of Squat-peeping, Strut-circling by a second bird accompanied it. Strut-circling was characterized by frequent Head-dipping while swimming around the squat-peeper. Squat-peeping may be a sign of being mated both in the Sooty and the Pigeon Guillemot. Numerous observations on both species indicated that when a mated bird, sitting near its nest entrance or on the water below the nest site, was approached by an intruder the former began to Squat-peep. This attracted the mate if it was within calling distance. When the mate arrived it responded by circling the squat-peeping bird. This demonstration usually encouraged the intruder to leave without attack. Otherwise the arriving mated bird displaced the intruder by Strutting, Hunching or attack.

Twitter-waggle (see Figure 7b) is an aggressive display common to all three species of the genus although Drent (1965) interpreted Twitter-waggle in the Pigeon Guillemot to be an appeasement action. In the Sooty Guillemot, the action was strongly aggressive and frequently performed by individuals among groups on the water or on land. Birds jostling for the highest position on the rocks displayed Twitter-waggle constantly. It was also a major part of aquatic displays and was always a mechanism for increasing distance between birds. On one occasion I watched, for 15 minutes, a single Sooty Guillemot continuously Twitter-waggle towards a group of communally

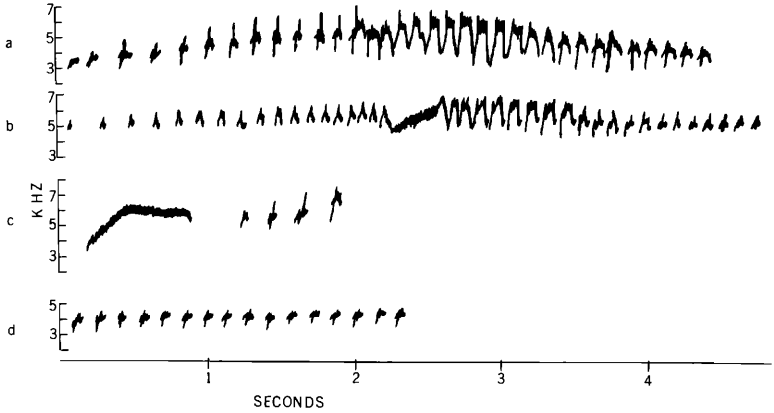

Figure 6. Sonographs of (a) the Trilled song of *Cepphus carbo* (song varies from 4 to 5 seconds in duration and always lacks the central upslur most often included by *C. columba*). (b) the Trilled song of *C. columba*. (c) the Scream ("seeeee") of *C. carbo*, followed by four "tsits" or "chips," and (d) the "tsit" or "chip," the most frequent call heard in *C. carbo*. These "chips" are portrayed here as a series lasting more than 2 seconds. Most often "chips" are given well spaced and are heard in varying situations — even in flight.

bathing Black-tailed Gulls. This bird was obviously attempting to drive the gulls away, although the gulls appeared to ignore it.

Frequently, Twitter-waggle began by a bird distantly removed from a group which would swim quickly toward the group, picking on, it seemed, any individual that would turn and Twitter-waggle back towards it. An attacking lunge and fight often followed with the two birds splashing — "Leap-frogging" (Asbirk 1979a, Preston 1968) — and diving just below the surface. The rest of the group joined the subsurface twisting and turning as individuals, ending with skittering over the surface in all directions. This action dispersed the groups temporarily. The fighters may continue to duel or they may fly from the scene in aerial chase. In the Pigeon Guillemot, Drent (1965) called the water phase of this action the "Water Dance", and the aerial chase the "Duet Flight". However, the terms "Water Duel" and "Duel Flight" are preferred because they describe the activities more accurately. Milling around on and under the water is not a dance, nor is an aggressive aerial chase a duet, since the term "duet" implies song. Duel Flight in guillemots results from an initial flight encounter started with Twitter-waggle. It should not be confused with a pair of birds merely flying together which is a common phenomenon among water birds in general. Duel Flight is an active duel between two birds in which the birds fly high and low frequently crossing each other's flight paths. In the Sooty Guillemot this duel sometimes ended by fighting in the water among groups of other guillemots as much as 0.5 km away from the initial encounter. The fight usually triggered communal subsurface Water Duelling by the new group: a confusion which tended to break up the fight.

While in the air a bird being chased may turn its head and open its beak towards the chaser, but in most encounters observed, Duel Flight was merely a contest to outfly the other. Most frequently the duel ended when considerable space developed between the two birds. In more than 100 sightings of Duel Flight among Sooty Guillemots I never witnessed actual contact in the air, such as tail twigging, or sudden 180° turns with falls into the sea as are commonly displayed by the Pigeon Guillemot.

Erect Display as seen in the Sooty Guillemot is apparently the same as "Neck Stretch," as Nelson (1982) calls it, in *Cepphus columba*. I have also observed a similar stance in Tufted Puffins (*Lunda cirrhata*) and Rhinoceros Auklets, which occasionally stand for a minute or more with their bills pointed upward. According to D. Nelson (pers. comm.) *Lunda, Fratercula, Cerorhinca* and *Cepphus columba* all vocalize during Erect Display. No vocalizations were noted in *Cepphus carbo* although I may have missed the sounds. In the Atlantic Puffin (*Fratercula arctica*) the attitude is accompanied by frequent Head-flicking, but in the Sooty Guillemot Head-flicking is rare and is much less pronounced (Figure 7d).

A strutter waddled on land or when on water swam excitedly, toward the bird to which it displayed. Strutting accompanied by holding the wings stiffly over the body (Wing-flagging) indicated a stronger aggressive action. This posture has also been described in the Black Guillemot which when on land embellishes the action with a distinctive high stepping gait (Preston 1968). Wing-flagging display may be more meaningful in the Black Guillemot which flashes white underwings. The Sooty Guillemot lacks white underwings but

does occasionally flag its wings when strutting and momentarily as a flight-intention signal. In a nonsocial context the Sooty Guillemot may hold its wings over the body for balance when walking over rocks.

Hunching is also an aggressive approach toward an intruder and is demonstrated by all three species of *Cepphus* (Figure 7c). The intruder usually moves away; otherwise a lunging attack occurs.

Headbobbing, a rare display, I interpreted as a threat in the Sooty Guillemot. Headshaking, a side to side motion, as described by Preston (1968) in the Black Guillemot, was not seen in the Sooty Guillemot.

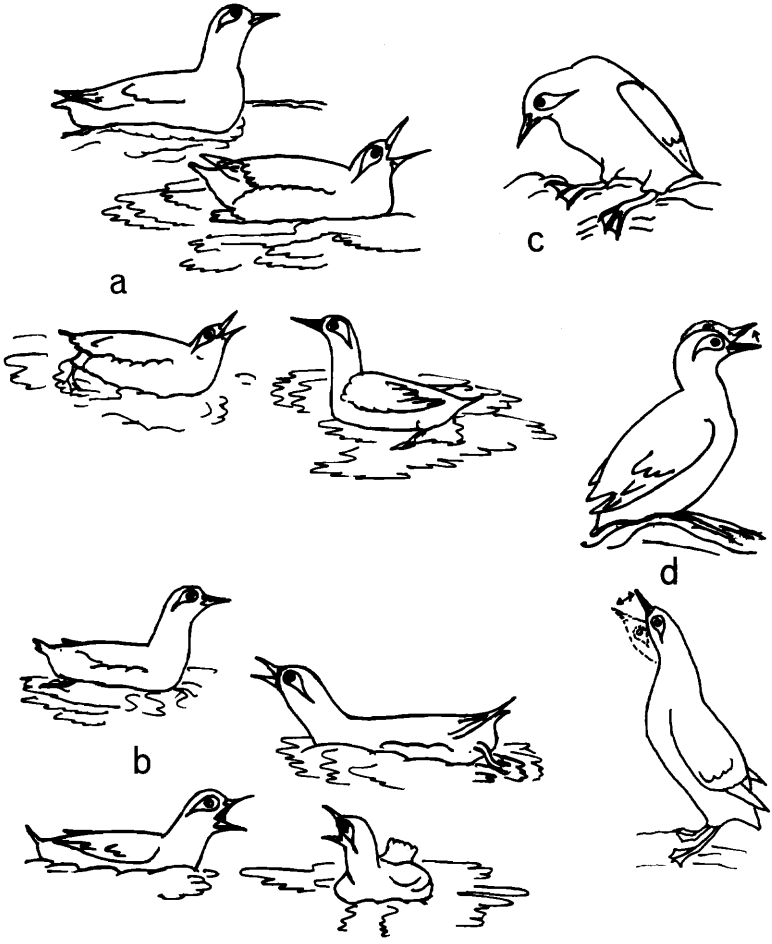

Figure 7. Displays of the Sooty Guillemot: (a) Squat-peeping or Hunch-whistle, (b) Twitter-waggle, (c) Hunching, and (d) Erect Display with Head-flicking.

Table 1. Behaviors of Sooty Guillemot (*Cepphus carbo*).

A. VOCALIZATIONS

Behavior	*Description*	*Context*	*Interpretation of Function*
1. Scream	A long high-pitched "seeeeeeeeee"	Disturbance Alarm	Warning call
2. Chip	A short "tsit" or "whist"	Heard from individual groups, in flight or on the sea or rocks	Mild alarm Sound of contentment Signal to an approaching bird Flight-intention call
3. Trilled Call	A long series of rapid "tsits"	At nest site To mate To young in nest	Stimulates care of young Declares mate and nest territory Maintains pair bond
4. Twitter-billing	Resembles the rapid "tsit" of the trilled song accompanied by headturning, bobbing and flicking.	Face-to-face with mate	Sure sign of being mated (Drent 1965)
5. Squat-peep (Hunch-whistle)	A repeated drawn-out "tsit-tsit-tsit-tsit-seeep-seeep." While sitting or swimming with the neck drawn in, bill up and open displaying the flesh-pink lining. The tail is often cocked.	One of the most common social displays. Usually accompanied by Strut-circling by a second bird.	Sexual readiness Sign of being mated Call to the mate in the presence of an intruder
6. Twitter-waggle	The neck is fully stretched forward, and the head is vigorously waggled from side, accompanied by twittering sounds. The tail is cocked and the wings are slightly drooped.	Constantly displayed in closely associated groups on water or land.	Strongly aggressive, often ends in attack or fight

Table 1 (Cont.)

B. BEHAVIORS WITHOUT VOCALIZATIONS (According to D. Nelson, pers. comm., 1, 2 and 6 are vocal in other species)

Behavior	*Description*	*Context*	*Interpretation*
1. Erect Display	On land the bird stands erect with the bill up. On water the neck is stretched high with bill up. Head is occasionally flicked.	Sometimes precedes Squat-peeping or follows Twitter-waggle	A stance of relaxation after some other action. Possibly associated with territory possession.
2. Strutting	Head held high with the bill pointed down. Tail is often cocked.	Display is towards another bird	Aggressive
3. Wing-flagging	Wings are stiffly held over the body during strut	Walks towards another bird	Strongly aggressive, preliminary to attack. Also a flight intention signal.
4. Hunching	Walk towards another bird with the body hunched and head down. Wings may be drooped.	Display to an intruding bird	Aggressive approach which may end in attack
5. Duel Flight	An aerial chase resulting from a fight, therefore, duel. A contest to outfly the other bird.	Begins with Twitter-waggle and a fight between two birds. Triggers splash-or-scatter-dives in groups of other birds.	Aggressive
6. Headbobbing	Rare. The head and neck are bobbed. Wings held partly open.	Directed towards an intruder or a closely-situated bird	Threat
7. Headturning	Turning of the bill over the back	Associated with preening activity	Preening activity. No social function.
8. Head-dipping	Dipping of the head under water	Increases with disturbance	Search for prey or underwater disturbance
9. Bill-dipping	Dipping of the bill into the water	Increases with disturbance but is a constant habit.	Increases before impending flight. Possibly to rinse salt secretions from the bill.

Preston (1968) described Headturning display in the Black Guillemot as a turning of the bill over or into the scapulars. Pigeon Guillemots also Headturn (Nelson in press). This display occasionally occurred in the Sooty Guillemot. However, in over 300 observations I was uncertain only a few times that turning the head toward the rear and tucking the bill in the scapulars was not associated with preening. Otherwise, Head-turning may be a signal for appeasement toward a Twitter-waggler.

Bill and Head-dipping are habits common to all alcids, as well as to some other waterbirds, and are no less frequent in the Sooty Guillemot. I observed a single bird actively feeding close to shore, and obviously Head-dipping to locate prey before diving to catch it. From about 2 m above, I could also see the fish in the clear water, which left me with no doubts as to the function of Head-dipping in that instance, for the bird peered under water to the right and left until it spied a fish then dashed after it. However, disturbances above or below water also increased the frequency and length of Head-dipping among Sooty Guillemots. For example, a cormorant swimming under a group of Sooty Guillemots precipitated bouts of Head-dipping. Increased Bill-dipping frequency, a lesser but more rapid response with only the bill involved often indicated impending flight.

SUMMARY

A maximum of 400 birds made up the Teuri Island colony of Sooty Guillemots in 1981. No more than half the population defended nests and some of these did not rear young. Although two chicks were often hatched, no pairs were found to rear more than one chick. Three chicks hatched at about 40 g and reached as much as 605 g at 40 to 45 days of age before fledging. One fledgling was seen daily for 16 days feeding alone close to shore. During this time its plumage changed from sooty to mottled brown, and its legs and feet from dark grey to red.

Although behavior patterns were similar to those of other species of *Cepphus*, some displays were less energetic than those demonstrated by related species at the same phase of the breeding season. Behaviors accompanied by vocalizations and other displays were identified.

Colony attendance gradually changed to later in the day as the season progressed. No explanation was discovered for this change.

ACKNOWLEDGMENTS

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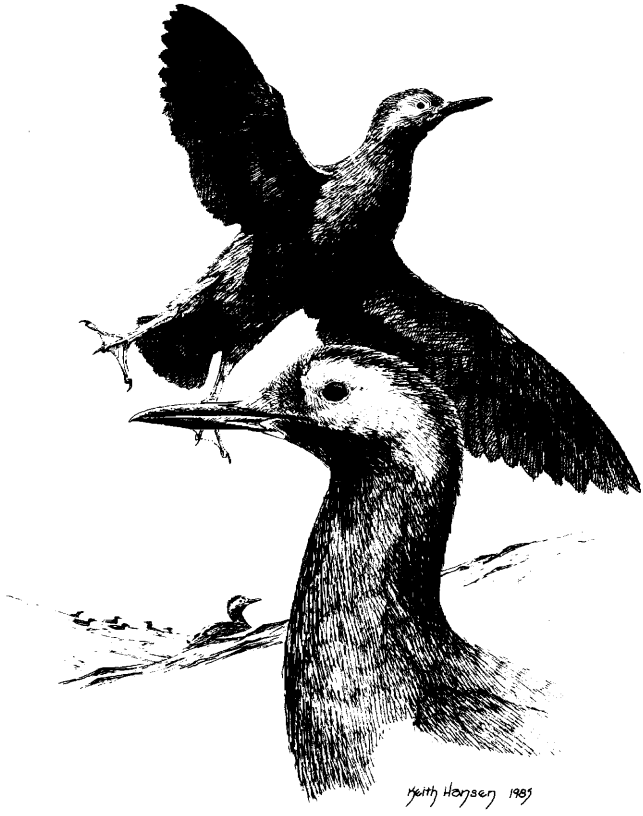

Sooty Guillemot *Sketch by Keith Hansen*