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Department of Zoology and Entomology, Colorado State University, Fort Collins, Colorado 80523. Present address of first and third authors: Department of Biology, Division of Natural and Physical Sciences, University of Colorado at Denver, 1100 Fourteenth Street, Denver, Colorado 80202. Received 4 December 1981. Final acceptance 8 October 1982.

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DIURNAL ACTIVITY AND SOCIAL DISPLAYS OF RHINOCEROS AUKLETS ON TEURI ISLAND, JAPAN

ASA C. THORESEN

The distribution of the Rhinoceros Auklet or Horn-billed Puffin (*Cerorhinca monocerata*) arches the north Pacific Basin, with large populations on the coast of North America, Japan, and the adjacent coasts of the Okhotsk Sea (Udvardy 1963). Sows et al. (1978) and Vermeer (1979), summarized the nesting requirements and distributions of known colonies on the west coast of North America and reported that the largest of them ranged from 50,000 to 100,000 breeding pairs. Worldwide, the largest known breeding colony of Rhinoceros Auklets is in northern Japan, located off the coast of Hokkaido on Teuri Island, where there are nearly 400,000 pairs (Environmental Agency Report 1973).

The breeding biology of Rhinoceros Auklets has been studied (Richardson 1961, Leschner 1976, Wilson 1978, Vermeer 1979, 1980, Vermeer and Cullen 1979). Wehle (1980) enhanced and summarized our knowledge of the sexual and social behavioral displays of other species of puffins but little comparative information was available to him for the Rhinoceros Auklet, perhaps because of its usually nocturnal habits. The sexual behavior of this species remains unknown.

Since the species is crepuscular as well as nocturnal on Teuri Island, I was able to observe some social displays and report them here for their comparative value. The auklets' crepuscular habits and their relationship to predation are also discussed.

STUDY AREA AND METHODS

Teuri Island, a Japanese National Monument for Seabirds, is about 38 km west of Haboro, Hokkaido, Japan (44°4'N, 141°3'E). The avifauna of the island has been described in the Japanese literature (Kuroda 1963, Environmental Agency Report 1973). Approximately 3 km of a total of 12 km of coastline is comprised of rocky cliffs up to 100 m in height. On the shoulders, slopes and more level terrain at the crest of the island, dense stands of fescue (*Festuca rubra*), dock (*Rumex longifolius*), meadow grass (*Poa macrocalyx*), and bell flower (*Adenophora triphylla*), reach heights of more than 1 m. These areas are heavily undermined by burrows of Rhinoceros Auklets.

I made observations daily between 4 June and 1 August 1981. Binoculars were used to watch undisturbed birds in

the evening and early morning hours from a campsite at the base of the cliffs, where 15 to 30 individuals could usually be seen near their burrow entrances. Occasionally observations were also made from the cliff-tops.

OBSERVATIONS AND DISCUSSION

Chronological and daily activity patterns. Rhinoceros Auklets come to Teuri in late February, lay eggs in mid-April, begin hatching eggs during the last week of May, and fledge young in July. Most have left by mid-August (Kuroda 1963). When I arrived on Teuri on 4 June, the birds were feeding young and by 15 July their numbers had waned considerably.

Thousands of adult auklets gathered on the sea beginning as early as 2 h before sunset. During June the birds came to land in large numbers, flying at cliff-top height, an hour or more before sunset; they streamed in and out, continuing into the night. The auklets began leaving the island at dawn, although every day I saw individuals departing in mid-afternoon; on dull, foggy days many birds came and went until mid-morning. On Protection Island, Washington, Rhinoceros Auklets arrive at the colony 1 h after sunset (Richardson 1961).

The usual nocturnal habits of the Rhinoceros Auklet are generally thought to be a way of avoiding predators (Cody 1973, Scott et al. 1974, Vermeer 1979). Diurnal land activity has been reported for the species at several places along the North American coast (Thoresen 1980) and has usually been explained by the lack of predation by gulls (Scott et al. 1974). Wehle (1980) suggested that their nesting habitat may partially account for their diurnal activity in the Sea Lion Caves in Oregon, where darkness of the caves excludes gulls. This does not explain, however, their diurnal and crepuscular habits on Teuri, where 20,000 pairs of Black-tailed Gulls (*Larus crassirostris*) aggressively preyed upon the auklets carrying fish to their nests at dusk. Often 10 or more gulls would dive after each arriving auklet that carried fish. The gulls skillfully snatched fish from flying auklets, especially if the auklet slowed down or turned to leave again.

Plant cover on Teuri protected an auklet from predators only if a bird carrying fish flew directly to its hole under the vegetation. Wehle (1980) hypothesized that Rhinoceros Auklets can use heavily vegetated terrain because of their nocturnal avoidance of predators. He suggested that darkness allows them to land in an open area and walk to their burrows under the vegetation. On Teuri, however, it was the vegetation that enabled the auklets to avoid the gulls in daylight. The adaptive value of the nocturnal/diurnal habits of these birds remains unsettled.

Social displays. At dawn thousands of Rhinoceros Auklets departed by rocketing down from the cliffs with their wings swept backward, creating a sound of roaring wind.

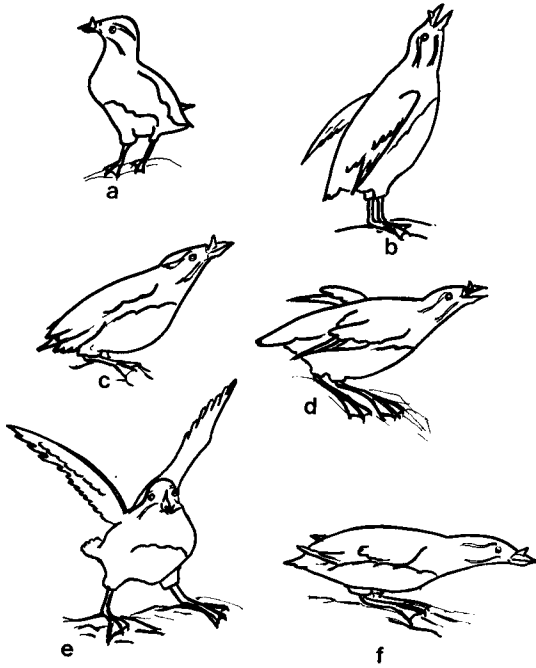


FIGURE 1. Postures of Rhinoceros Auklets drawn from field sketches and photographs. a. Normal upright stance. b. Upright-huff posture. c. Staring into space or "freeze posture." d. Defensive wing-raise with bill agape. e. Ready defensive position in preparation for a fight. f. Low neck-forward profile is a typical walking position, as assumed if a bird is intending to walk into a burrow.

Others left with more normal flapping flight, tilting from side to side as they gradually lost altitude. In a third type of flight, the tips of wings were fluttered gently through a small arc, behavior that has been termed in murres (*Uria*) the "butterfly flight" (Tuck 1960). After observing it many times in the auklets, I believe that "butterfly flight" has no social significance for them but is merely an aerodynamic control of speed as they descend to the sea.

Rhinoceros Auklets occasionally visited offshore rocks during the day where they associated and occasionally interacted with Spectacled Guillemots (*Cepphus carbo*). I once watched nine auklets spend more than an hour on an offshore rock, constantly jostling one another for the highest point. The auklets also chased and churned, just below the surface of the water, in a manner similar to that of *Cepphus* although less aggressively. Once, I witnessed several auklets water-sporting with the guillemots.

Billing between mated pairs undoubtedly assists in maintaining the pair bond in Rhinoceros Auklets as in most other alcids. Billing auklets were observed on the sea and at their burrows. On land, the birds usually faced each other in a semi-hunched position and with slow, deliberate movements passed and repassed each other's bill. The bills did not appear to actually touch.

The birds defended the area immediately in front of their own burrow in various ways. Ownership of the burrow was apparently declared by the "upright-huff" stance in which a bird stood erect with the body almost vertical, often with the wings partly spread and the bill open and pointed skyward. At the same time, air was blown through the throat in distinctive "huffs" (Fig. 1b; Fig. 1a illustrates a normal inactive stance). On five mornings I saw a bird sit partially erect for 5 min or more as if staring into space (freeze posture, Fig. 1c). This occurred at the burrow entrance when no other birds were near. I did not understand

the meaning of this posture, but assumed it to be a lesser signal than the upright-huff for declaring territory.

A typical sequence for a bird arriving from the sea is recorded in my field notes as follows: "One bird arrives from the sea. A bird near a burrow entrance hunch-walks toward it. The arriving bird hunch-walks until the two touch bills, then the incoming bird rises to the upright-huff position whereupon the other hunch-walks into the burrow." This sequence led me to assume that the two birds involved were mates engaging in a greeting display.

Defenders responded to intruders, even to other species such as Black-tailed Gulls, with an "aggressive hunch-walk." In this position the body was hunched, at least partially, with the neck stretched forward. The defender walked very slowly and deliberately with high steps (often 15 s between steps) toward the intruder. This action seemed to resemble the appeasement or landing displays described for other puffins (Wehle 1980). The intruder responded by leaving or posturing with a "defensive wing-raise" with the bill agape (Fig. 1d). In a more intense defensive pose, wings were raised higher (Fig. 1e). Wehle (1980) interpreted bill gaping in other puffins as a threat display, usually in response to an intrusion, and this behavior in the auklet appears to be similar. A fight occasionally followed with the two birds locking bills and clawing at each other's belly. One fighting pair fell at least 50 m over the cliff before disengaging. On two occasions I witnessed auklets attacking gulls who had persisted in standing too close to a burrow entrance. The gulls jabbed back at the auklets before moving away. When walking near its burrow an auklet always assumed a "low neck-forward profile," evidently the necessary position for entering a burrow (Fig. 1f). Only rarely did the bird move rapidly.

These few observations of Rhinoceros Auklets support the belief that more comparative studies of puffin behavior may improve our understanding of relationships within the group. Since this species tends to crepuscular and some diurnal activity on Teuri Island, this is an excellent place for both intra- and interspecific observations, and perhaps experimental studies of behavior. Why are the auklets crepuscular here and less so in the eastern part of their range?

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Department of Biology, Andrews University, Berrien Springs, Michigan 49104. Received 10 July 1982. Final acceptance 31 March 1983.

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THE NATAL PTERYLOSIS OF *AMPHISPIZA* SPARROWS

DENNIS MINSKY

AND

CHARLES T. COLLINS

The natal pterylosis of many North American passerines was examined by Wetherbee (1957, 1958). We present here similar data for the genus *Amphispiza* (Emberizinae; Paynter and Storer 1970), a taxon for which quantitative information was not then available.

We examined four nestlings of the Sage Sparrow (*A. belli*) collected by J. M. Sheppard from a single nest 3 km southwest of Maricopa, Kern Co., California on 16 April 1968, and three nestlings of the Black-throated Sparrow (*A. bilineata*) collected by Collins from a single nest on the China Lake Naval Weapons Center, Inyo Co., Cali-

fornia on 19 May 1974. In all seven specimens, the juvenal contour feathers have erupted through the skin but have not ruptured their sheaths (Stage C, Wetherbee 1957:356). The age of these specimens is not a factor in this analysis since the evidence indicates that the pattern and length of downs are fully developed at hatching (Wetherbee 1957:353); no losses of neossophtiles due to abrasion were noted.

Linsdale (1936) noted that the down of young *bilineata* was "white, slightly grayish, and very fluffy"; *belli* and *bilineata* were categorized as having "pale," and the still lighter "pallid" downs, respectively. In our specimens, however, the neossophtiles of *belli* were perceptibly lighter than those of *bilineata*. Neossophtile lengths ranged from 1 to 8 mm but were longer for *bilineata* in 6 of the 11 regions they shared in common (Table 1). The overall pattern of neossophtile distribution in the two species was similar but not identical (Fig. 1). In *bilineata* there were 142-167 neossophtiles in 14 regions while in *belli* there were only 110-145 neossophtiles in 11 regions (Table 1). The average total number of neossophtiles for *bilineata* and *belli* was 152 and 129, respectively. As previously noted in the Red-winged Blackbird (*Agelaius phoeniceus*; Clark

TABLE 1. Distribution and length of neossophtiles of *Amphispiza* sparrows.

Tract (region)	<i>A. bilineata</i> (n = 3)			<i>A. belli</i> (n = 4)		
	Length	Average no.*	Range	Length	Average no.*	Range
Capital						
(Coronal)	6	7	2-9	4.5	10	8-12
(Occipital)	7	4	3-4	8	4	4-5
Spinal						
(Mid-dorsal)	6.5	5	2-6	5.5	5	4-5
(Pelvic) ^b	6	7	5-8	5	5	4-6
Scapular	7	8	7-8	7	6	3-8
Femoral	6	12	11-15	6	8	1-12
Ventral	3	9	8-11	3	11	9-12
Crural	3	5	2-8	1	2	0-5
Caudal	2	4	3-5	2	4	3-5
Alar						
(Primaries)	21	4	0-6	—	0	—
(Secondaries)	4	2	0-8	—	0	—
(Greater secondary coverts)	6.5	10	9-10	4.5	10	7-11
(Middle secondary coverts)	7	8	6-8	1	2	0-5
(Carpal remex)	2	1	0-1	—	0	—
Total		171	(142-167)		125	(110-145)

* Numerical average to nearest whole number.

^b Unpaired row on midline; all others bilaterally paired.