

BREEDING BEHAVIOR AND TAXONOMIC RELATIONSHIPS OF THE CURLEW SANDPIPER

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IN 1962, a small population of Curlew Sandpipers (*Calidris ferruginea*) appeared near Barrow, Alaska, in early June and nesting occurred. This afforded a most unexpected opportunity for us to gather comparative data as part of our earlier and continuing studies of congeners of this species breeding commonly in northern Alaska. These include the Pectoral Sandpiper, *C. melanotos* (Pitelka, 1959), the White-rumped Sandpiper, *C. fuscicollis* (Holmes and Pitelka, 1962), and others on which studies are progressing, such as the Dunlin, *C. alpina* (Holmes, MS). Portenko (1959), in presenting his observations on Curlew Sandpipers in Siberia and in reviewing the Russian and other European literature, has shown that little is known concerning the breeding behavior of this species, particularly its displays. Accordingly, it is our objective here to report our observations of *C. ferruginea*, including all details useful for later comparisons with other species. Our taxonomy follows that of the B.O.U. Check-list (1952) and Kozlova (1962); for additional comments, see pp. 377-378.

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EARLIER NORTH AMERICAN RECORDS

The breeding range of the Curlew Sandpiper in northern Siberia extends from the mouth of the Yenisei River east to the delta of the Kolyma and Cape Bolshaja Baranov. There is a gap of about 750 miles (1,200 km) between the latter locality and the nearest Alaskan mainland, Point Hope. For eastern North America, there are scattered records of vagrant birds from Canada, the northeastern states, the gulf coast, and several Caribbean islands (A.O.U. Check-list, 1957). For western North America, there are two published records: A male in mixed plumage was obtained on the Queen Charlotte Islands on 31 July 1936 (Brooks, 1937), and a male in breeding plumage was taken at Barrow, Alaska, on 6 June 1883 (Murdoch, 1885).

A second Alaskan specimen (Museum of Vertebrate Zoology no. 134728) was obtained on 25 June 1956, 4 miles (6.4 km) east of Barrow. It was an adult female with heavy fat (weight 82.7 g) and ova up to 4 mm in diameter, and was alone when taken.

The avifauna of the Barrow area has been under continuing study since 1951, and except for vagrant individuals such as that obtained in 1956, it appears well established that the Curlew Sandpiper did not occur as a member of the local avifauna in the 11 years before 1962. Moreover, from 1897 into the 1940's, a considerable amount of collecting stressing rarities has occurred in the Barrow region (Bailey, 1948) and at no time in that interval were any Curlew Sandpipers collected. Barrow is over 900 miles

(1,440 km) east of the easternmost breeding locality previously reported. No explanation for its appearance near Barrow in 1962 can be adduced, except for the possibility that in the Bering Strait a large flock may have become misrouted from the west shores to the east shores by inclement weather or by association with other shorebird flocks moving along their normal routes toward northern Alaska.

CHRONOLOGY OF EVENTS NEAR BARROW, ALASKA, 1962

On 8 June, two Curlew Sandpipers were observed with a group of Pectoral Sandpipers five miles east of Barrow. An adult male (M.V.Z. 148974) in breeding plumage was obtained (left testis 9 mm; little fat; weight 61.7 g). The following day a third individual was observed two miles east of Barrow. Then, from 12 through 24 June, at least 10 and possibly 12 individuals were present in an area of 10 square miles to the east of Barrow and extending to the shore of Elson Lagoon. Individuals were distinguished in the field on the basis of variation in sex and age characters such as plumage pattern, color, and size along with circumstances of local occurrence. Five males were defending territories; three were associated with and soliciting females, indicating preparation for breeding; and the nests of two pairs were located. Two lone individuals, light in color and presumed to be first-year individuals, were each observed on just one date and apparently were not members of the locally settled population.

Territorial and courtship behavior was observed between 11 and 26 June. On 26 June, the nest of one pair which had been under observation was found and contained three eggs. On the following day, the clutch was completed. A second nest with a completed clutch of four eggs was found on 28 June, 2½ miles east of the first. On 30 June, the eggs at the first nest disappeared, and on 8 July, those at the second. After the nests were destroyed, neither the owners nor any other individuals were observed again. The last observation of a male was recorded on 26 June, of a female (that at nest 2) on 6 July. Nest loss was attributed to an increase in numbers of wandering, non-breeding jaegers, both Parasitic (*Stercorarius parasiticus*) and Long-tailed (*S. longicaudus*), which took eggs from a large number of shorebird nests in 1962 (Holmes, MS).

HABITAT

The flat coastal tundra near Barrow consists of a mosaic of wet marshy lowlands dotted by small lakes and ponds, relatively well-drained polygonized ground, and low ridges (Figure 1). The Curlew Sandpipers were found in all of these habitats but were usually located where ridges and polygons predominated. The birds fed on grass- and sedge-covered ridge slopes, in moister troughs among polygons and occasionally in the marshes (Figure 2). The species was characteristically found associated with



Figure 1. Three views of coastal tundra near Barrow, Alaska, where Curlew Sandpipers occurred in 1962. **Upper:** scene of active courtship activity 12 June; two to five individuals present in the area 10–16 June; Elson Lagoon in background. **Center:** area of nest 2, located on low polygon beyond stake at left center; Elson Lagoon and Wohlschlag Slough (to right) in background. **Lower:** area of nest 1, located on near polygon in left center; view westward toward outer (Chukchi) coast in distant background and Middle Salt Lagoon at right center, southwest of Arctic Research Laboratory.

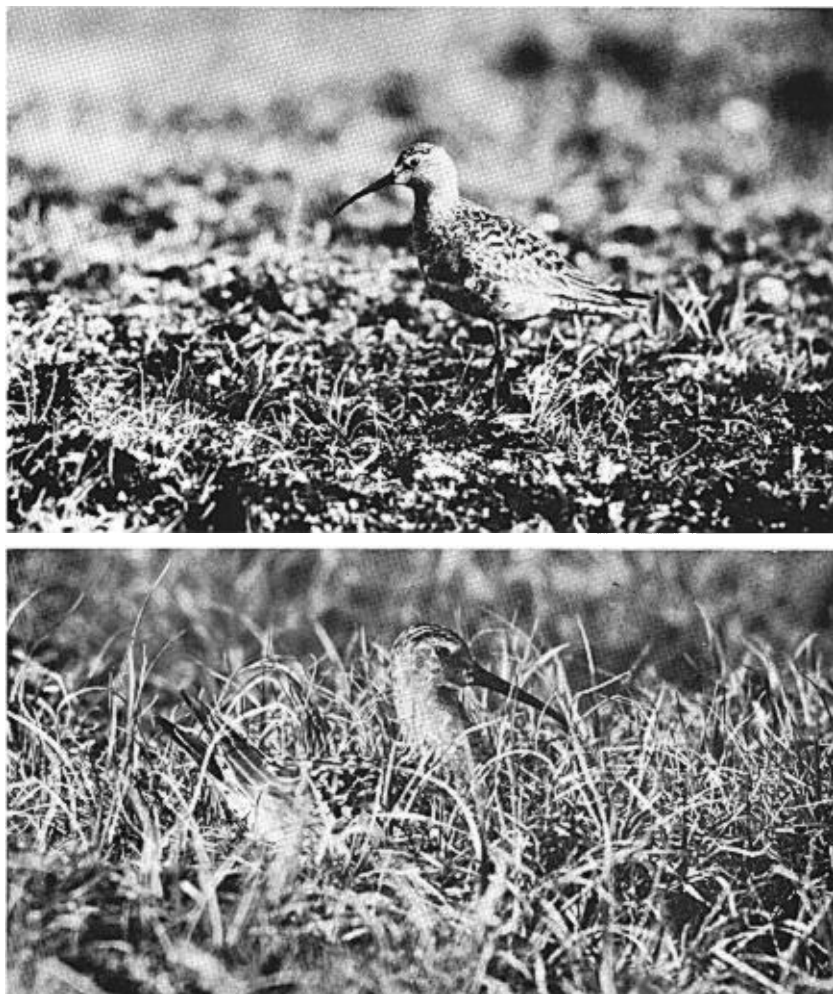


Figure 2. Female Curlew Sandpiper near nest 2 (above) and on eggs (below), photographed 29 June 1962.

Ruddy Turnstones (*Arenaria interpres*), which occupy the same type of habitat. This association was also noted in the Siberian arctic by Birula (quoted in Pleske, 1928).

Nests were located on low mounds among well developed polygons. The vegetation surrounding the cup was quite sparse so that when the incubating bird was not on the nest, the eggs were exposed and quite conspicuous (Figure 3), despite their light olive-green background color and dark brown and reddish-brown blotchings. (In coloration the eggs are similar to those of the Semipalmated Sandpiper, *Calidris pusilla*, and *C. maritima*.)

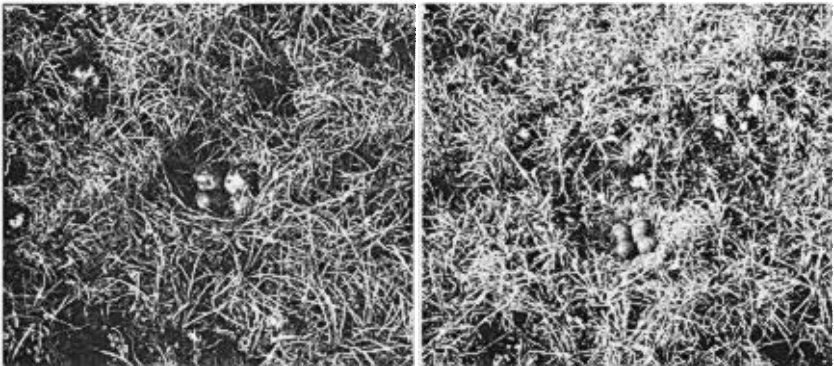


Figure 3. Nests 1 and 2 (left and right) of the Curlew Sandpiper near Barrow, Alaska; photographed in late June, 1962.

VOCALIZATIONS

The Curlew Sandpiper exhibited a more varied repertoire of sounds than any of eight other sandpipers of the genus *Calidris* which we have studied on breeding grounds. Word descriptions, even though conveying the qualities of these calls inadequately, are presented here as background for the ensuing discussion of displays and nesting behavior.

Call notes.—The male or female in flight or on the ground gave a loud *cheedle*, *chee-dle-lee* . . . , suggesting in quality the flocking note of the Western Sandpiper, *C. mauri*. This is apparently the *chirrip* or *chirripip* reported by Witherby *et al.* (1940). It was not heard frequently at Barrow. A second note, *chit*, given five or six times by one member of a pair in flight, resembled notes common to small sandpipers of several species.

Alarm note.—When the male or female Curlew Sandpiper was disturbed by birds of other species or by humans, it gave a rapidly repeated and sharp *whik*, *whik*, *whik* . . . or *wik-ki-ki*- This same note was described from birds observed in the Siberian arctic by Haviland (1915) and Birula (*in Pleske*, 1928).

Chase note.—This call, given by the male and apparently the female during courtship flights and by the male in aerial territorial chases, consisted of a high-pitched musical twittering, resembling the flight notes of the Vaux Swift (*Chaetura vauxi*). It is also mentioned by Grote (1937) in quoting Russian sources.

Whine note.—A strong whine note, delivered singly or slowly in series, was frequently given by the male on the ground or, less frequently, in flight. It was a clear, melodic, ascending *whaay*, *whaay* . . . , plaintive and rather plover-like in quality. This note could be heard for hundreds of yards and therefore seemed to serve as a location note and an announce-

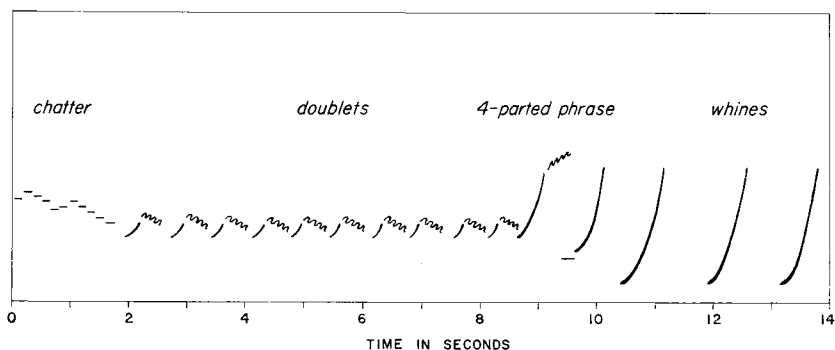


Figure 4. Song of the Curlew Sandpiper diagrammed to show its approximate structure.

ment of occupied habitat (see "ground announcement" below for additional comment). The same note was also given to close the complete song performance (see below).

Song.—The song given by the male is composed of several parts, any one of which may be omitted. In its complete and most elaborate form, it was about 10 to 15 seconds in length and consisted of several introductory notes, a series of trilled doublets, a complex four-parted phrase, and finally one to several drawn-out whining calls (Figure 4). Each of these parts is now described in more detail.

The opening notes, if given, vary in number. Some songs started with two definite notes *chick, chick*, followed by the rolled doublets; most songs began with a brief chatter of 5 to 10 staccato *chit-chit . . .* sounds, varying in pitch slightly and trending downward.

The main part of the song was a series of rolled or trilled doublets of moderate loudness given at the rate of eight per five seconds, or about one every $\frac{2}{3}$ second. Usually the series consisted of 5 to 10 doublets, but one courting and excited male gave several long series in sequence; the longest single series consisted of 38 doublets. If these doublets were slurred together, as was heard once from a singing male, the result would be very similar in pattern and quality to the aerial "motorboat" song of *Calidris pusilla*, although neither so loud nor so low-pitched.

One male actively courting a female, while fending off a lone male's persistent displays on a neighboring territory, introduced his series of doublets with long series of twittered notes (see "chase note" above) leading directly into doublets, or first into a series of anxiously repeated *kree* notes, which, in the more relaxed tempo of the doublets series, became the longer of the two notes comprising each doublet. Another male in sexual

chases on wing also followed series of twitter notes with more slurred *dreer-dreer* notes, stopping with these or continuing with a series of doublets, also slurred and more vibrato than those of other males heard.

Often following the doublets was a complex phrase of four notes which were weak and wiry. The first note was short and sharply upswing, the second an insect-like shrill buzz, the third a low short note, and the last an upswing wheeze note during which the male held his bill wide open as does *Calidris fuscicollis* during part of its song (Holmes and Pitelka, MS). The four-parted phrase was given in 1½ seconds. The quality of the notes is similar to that of the display song of *C. mauri*, as well as *C. fuscicollis*.

Finally, as a terminal part, the song included a series of ascending whine notes, uttered slowly, about one every 1½ seconds. This note is not matched by any we have heard from any member of the genus *Calidris*, *sensu lato*.

The song of *ferruginea* differs markedly from that of most sandpipers of the genus *Calidris*. Songs of the latter consist of a series of generally monotonic trills given in the air or on the ground and seem generally to be used more in territorial announcement than was true in *C. ferruginea* at Barrow in 1962. However, in denser populations of the latter, use of the song in announcement may be more common than was noted at Barrow.

In listening to a brief sample of the vocalizations of the Stilt Sandpiper (*Micropalama himantopus*) on a commercial record (*A field guide to western bird songs*, Houghton Mifflin Co.), we were surprised to hear a whine note virtually identical with that of the Curlew Sandpiper in both quality and pattern. On obtaining the available tapes for the Stilt Sandpiper from the Laboratory of Ornithology, Cornell University, we found additional similarities in the vocalizations of the two species. Thus, one monotonous series of rapidly given, harsh, two-noted phrases could be matched to what we have termed doublets above, and moreover this series was followed by a complex phrase which could be compared to the four-parted phrase of *ferruginea*. Finally, the whine note, in *Micropalama* as in *C. ferruginea*, terminated the sequence of monotonous series and complex phrases, though on the tapes we have, the whine note was never given in series by *Micropalama*. In general, the vocalizations of the Stilt Sandpiper, if we judge correctly from the tapes, are louder, more grating, and generally harsher than those of the Curlew Sandpiper, but the basic resemblances in phrasing and other features are striking.

Incidentally, the vocal repertoire of the Stilt Sandpiper includes a harsh, protracted trill note given monotonously and slowly in series, resembling most the song-note of the Sanderling (*Calidris alba*) but more or less similar in quality and pattern to equivalent notes in the repertoires of *C. alpina* (Dunlin), *C. bairdii* (Baird's Sandpiper), and *C. ruficollis* (Rufous-

necked Sandpiper). This type of note we did not hear from *C. ferruginea* near Barrow in 1962.

TERRITORIAL BEHAVIOR

Territorial announcement and disputes were not observed frequently. Singly or in pairs, Curlew Sandpipers flew long distances, on occasion as much as a mile (1.6 km), apparently without regard to any discrete "home" area or boundaries. These long flights may have been made by recently arrived or as yet unsettled individuals; or long flights and low intensity of territorial announcements of apparently settled pairs may be explained by the absence of neighboring Curlew Sandpipers against which to defend. In one situation, however, where two males occupied neighboring territories, displays were frequent, and the types of defensive behavior common to territorial birds were observed. Male Curlew Sandpipers also chased other shorebird species, notably Dunlins, Baird's, Semipalmated, and Pectoral sandpipers, and Red Phalaropes (*Phalaropus fulicarius*). No action was directed toward Ruddy Turnstones, a species with which Curlew Sandpipers were frequently associated, but only in the sense that they occurred locally on the same areas of tundra.

In reacting territorially to its own kind or to other species just mentioned, the male Curlew Sandpiper showed all components of routine territorial behavior seen in other, better known species. These include (1) localization of activity on a circumscribed area (see further comment below); (2) announcement and advertisement, in use of the whine note and in unprovoked aerial displays over the territory; (3) aggressive chasing of intruders; (4) turnback from chase, suggesting awareness of a territorial periphery or edge; (5) offensive flight and aggressive displacement of an intruder at or within a territorial boundary; (6) flight-song display in return from a territorial chase; and (7) repeated orientation of display activity with reference to a neighbor's territory, indicating awareness of a boundary and avoidance of encroachment on the neighbor's territory. In territorial chases, typically rapid and erratic, the twitter note was given continuously. In interspecific conflicts, the male Curlew Sandpiper was always the aggressor.

Defended area.—On a given day, the area defended was 4 to 10 acres (1.6–4.0 hectares) for actively courting pairs; 3 acres (1.2 hectares) for a lone male displaying next to a courting pair. One pair, whose nest was subsequently found, was present on a given area over three days, 22 to 24 June, and possibly over seven days (18–24 June). But members of courting pairs remained mobile, in the sense that they could move long distances, or that the focal area of courting and territorial activity could shift. Possibly the extent of local movements and shifting is a function of

sparseness of population. But another possibility is that in this species, areal attachment in the social organization of the breeding population may be loose. Such a characteristic would go along with the feature of short-term pair bond and desertion of nesting females by males mentioned elsewhere in this paper.

Aggressive display.—Aggressive posturing of a male on the ground toward a territorial neighbor was observed only once. In this instance, male 1, actively courting a female, suddenly took flight and landed 10 feet away from an unmated male of an adjacent territory who had just finished a boundary patrol flight (with flight-song display) and had landed near or in the boundary zone. Male 1 assumed a posture with the head parallel to the ground and pulled back toward the body, wings folded normally, back feathers slightly ruffled, tail lowered and spread. He then ran toward male 2; there was a momentary contact, and male 2 immediately took flight, moving along a ridge toward his main area. Male 1 returned to his area at once and resumed his courtship activities. This aggressive posturing resembles that found in *C. bairdii* (Drury, 1961) and *alpina* (Holmes, MS).

Territorial flight displays.—The male announced territorial claim by flying low over the ground with full, rapid wing beats. At irregular intervals, the wing strokes became slower and more deliberate in a manner similar to that of *bairdii* in display flight but not as slow as in that species nor with the bounce of the "butterfly" flight of the American Golden Plover, *Pluvialis dominica*. Occasionally the slow flight was followed by a glide on outstretched wings. The slow wing beat or the glide was maintained for only a very few seconds, and then normal beat was resumed. During the gliding intervals, the head was raised above the plane of the body, and a series of doublets or whine notes was given. The song, usually in its entirety, was uttered toward the end of the flight and through the landing.

In one flight display, after completing the song with the high-pitched four-parted note, the male glided, quivered his wings in the manner of *alpina* or *bairdii*, and gave several whine notes; then, repeating the glide and quivering once, it raised its wings and landed. This was the only observation of flight-display behavior which resembled that of *alpina* and *bairdii* to the extent that the male alternately glided and quivered his wings as he gave a single note which, were it harsh and throaty, would fit the pattern of these other members of *Calidris*. However, this analogy cannot be pushed too far, as the clear, plaintive whine note of *ferruginea* is given most frequently from the ground and, both in being given from the ground and in quality, this note is peculiar to *ferruginea*.

A variant of the basic pattern of territorial announcement was observed

when two males were found defending adjacent territories. One male was occupied in courtship activities; the other fed, assumed an alert upright attentive posture with intermittent song or calling, or displayed on wing. In the display, he patrolled a ridge about 150 yards (about 140 m) long, flying with rapid wing beats low (4–8 feet) over the tundra, then rising sharply to a height of 12 to 15 feet (about 4 to 5 m), giving the song and concluding with the four-parted phrase at the peak of the climb, then gliding down gently, uttering several whines before settling to the ground. The abrupt rise of the bird added effectively to its conspicuousness by bringing it above the horizon and making it visible to neighbors during at least part of the vocal performance. Another shorebird in northern Alaska which exhibits a similar flight-display maneuver is *C. melanotos* (Pitelka, 1959). The displays of other *Calidris* species differ to varying degrees but in general all display at considerable heights, usually 50 to 150 feet above the ground, and hover in the air on downcurved, rapidly beating, outstretched wings. This is true of *alpina*, *bairdii*, *fuscicollis*, *minutilla* (Least Sandpiper), *pusilla*, *mauri*, *alba*, and *ruficollis*.

One flight display of *ferruginea* was exceptional in area covered and height. Here the male climbed in a normal, fast-flying manner to an altitude of 150 feet, giving the trilled doublets as he ascended. He then made several wide circles over an area of about 10 acres, flying with slow wing beats and giving the song or parts of it (wind and distance prevented us from hearing him at all times). After two minutes, the bird flew back toward the central portion of his territory, setting his wings horizontally and gliding for the last 200 feet before landing, and giving several whine notes during the terminal glide. This was the only time a male was observed to display high above the ground. At no time was *ferruginea* observed to hover.

Wing-raising display.—When landing after a patrol or chase, the bird folded his wings normally without delay. Once, the wings were held high above the head and were then lowered slowly into position after about one second. No other use of the wings in aggressive display was observed.

The wing-up display in landing and a related pattern, that of wing flashing, are common elements in the display behavior of many *Calidris* sandpipers, especially *bairdii* and *fuscicollis* (Drury, 1961; Holmes and Pitelka, MS), *alpina* (Holmes, MS), and *maritima*, the Purple Sandpiper (Keith, 1938). Thus, the rarity of delayed wing folding and the lack of wing flashing in *ferruginea* contrasts with these calidrine species but does show some similarity to *melanotos*, another species in which these displays are not common (Pitelka, 1959).

Ground announcement.—Another type of announcement given from the ground has not previously been reported for *C. ferruginea*; nor do we know

of a similar display in other species of *Calidris* we have observed. At frequent intervals, the male interrupted his feeding and while standing in an erect posture gave from 1 to 30 whine notes. In doing this, he breathed deeply, expanding observably and thereby puffing out his plumage, and moving his wings out and down slightly to expose the rump. As the bird exhaled, its plumage and wings resumed normal resting position, and at the same time, the whine note was given. The result was an eye-catching, pulsating effect of exposed white rump, simultaneous with and thereby reinforcing the call. A male standing upright on a low ridge or polygon and whining loudly announces his presence by this means as well as by the more formal flight displays previously described.

COURTSHIP BEHAVIOR

The Curlew Sandpipers at Barrow were already paired when first located. Portenko (1959) reviews several European reports that pair formation may take place in the spring even before the birds have left their wintering grounds; in other cases, pairing may occur after the birds reach their breeding areas (Suschkin, *in* Portenko, 1959).

For two weeks in mid-June at Barrow, each pair moved about an area of several acres with the female feeding and quiet, and the male following and attending her at varying distances, usually 10 to 20 feet. Frequently, he vocalized giving partial or complete songs, and exhibited courtship behavior of several sorts to be described below. Since the pair was already formed, these displays may have functioned to maintain the pair bond and perhaps to bring the pair into synchrony for mating. Courtship antics took place in the air and on the ground; those on the ground were the more varied.

Aerial courtship.—As in many other *Calidris* species, the male pursued the female in long chases, low over the ground. Occasionally, catching up with her, he set his wings horizontally, glided for a brief moment, gave several of the trilled doublets, and then resumed rapid flight. In such courtship chase, the male (and sometimes the female) gave the twittering chase note, as in territorial encounters. In fact, courtship chases are very similar to territorial boundary conflicts; the latter, however, were more erratic, the males performing many sharp turns and gyrations, while in the display chase, the flight was more even and sinuous, the birds swerving back and forth across the tundra. At the end of the courtship flight, after the pair landed, the male usually began one of the ground courtship displays.

Ground courtship attitude.—During the prenesting period, the male frequently alternated a "courtship" stance with normal feeding posture. Since the ground courtship displays to be described below were usually

performed after the male had assumed this stance, it has been termed the "courtship attitude" and probably represents a state of increased sexual excitement. The male lowered his head in line with the body, pulled in the neck, held wings and tail normally, ruffled the scapulars and back feathers, and bent his legs, giving an over-all "hunched" appearance. The aggressive ground display posture described previously was similar to this, but in the former the tail was lowered and fanned, the neck more outstretched.

Ground courtship: nest-cup display.—Often while in the courtship attitude, the male moved across the tundra on short runs; then, stepping into a slight depression, he began to settle down as if he were on a nest, raising his tail and folding his wing tips over the back until they were almost perpendicular to the ground. In this position, he pressed and rotated his breast against the bottom of the cavity, simultaneously wagging his up-turned wing tips and tail from side to side. Occasionally, he crouched in the cup and scratched first with one foot and then the other, kicking pieces of moss and lichen into the air behind him. Next, he stood up and picked bits of vegetation, mostly blades of dead grass or sedge, from the periphery of the cup; then, tossing his head either to right or left, he threw the pieces into the cup at his feet. If he failed to grasp the blade of vegetation or if it fell out of the bill before it was tossed, the bird still went through the stereotyped motion of throwing the item over his shoulder. He often followed this grass-picking sequence by a stamping of the feet or by again pressing his body into the cup.

While in the courtship attitude or in the nest-cup display, the male often gave one to several sequences of the trilled doublets and occasionally a few whine notes.

This activity was not an act of nest building, since individual males were seen performing this nest-cup display several times during one day and on several successive days, each time in a different location. The female was usually within a few yards of the displaying male during this activity but did not seem to direct her attention toward him.

A nest-cup display of one pair observed on 22 June involved both sexes. When first located in the morning, the birds were feeding. The male occasionally assumed the courtship attitude, and two or three times he performed short territorial display flights, each ending with the song. Several minutes later he began a nest-cup display. Immediately the female walked up and stood beside him. After several seconds, the male stepped out of the cup, kept his tail cocked, head forward and slightly up, back feathers raised, wings dropped slightly, and stood only inches away, giving the trilled doublets (Figure 5, a). The female stepped into the mold, turned slowly, making a 360° rotation, and then walked away feeding. The birds took flight, the male performed an aerial courtship display, and both

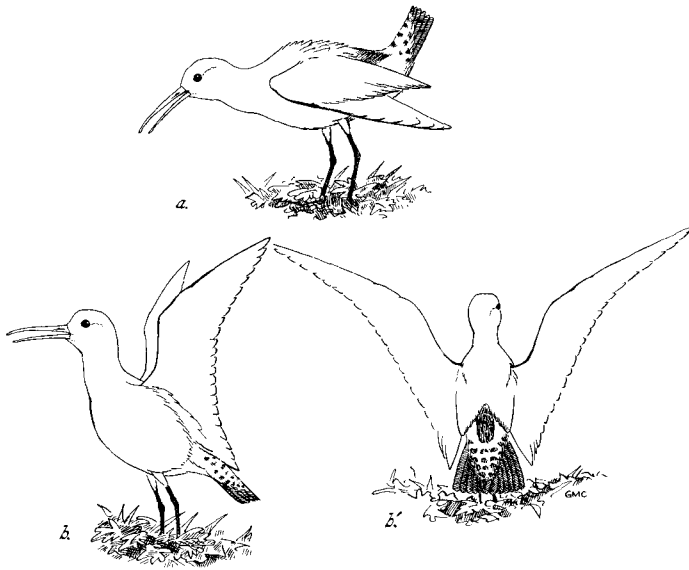


Figure 5. (a) Display of courting male Curlew Sandpiper near sham nest cup following female's entry of it. (b-b') Precopulatory display of male in side and rear views.

landed 100 yards away from this display site. This was followed by an attempt at copulation. Later the same day, the male performed several more nest-cup displays, each at a different site. Suddenly, while the male was feeding nearby, the female settled into a depression which had not, during our observations, been used by the male. The male with his tail elevated, wings slightly drooped, and head forward but not horizontal with the ground, ran toward her giving trilled doublets, stopping only inches away. This posturing and singing by the male was maintained for about 45 seconds; he then ran off in the "hunched" courtship attitude and started to feed. Meanwhile, the female squatted in the cup picking grass or sedge from around the edge, tossed it alternately to the right and then to the left, so that it fell into the cup in which she was standing, a behavior identical to that of the male in his earlier displays. After two minutes in the cup, she stood up and walked away feeding. Four days later the nest of this pair was found in another cup about 150 yards from this site.

This last situation might indicate that the female chooses her own cup and makes the nest herself. If this is the case, she must investigate and perhaps partially prepare more than one cup before the final one is adopted, since she was observed in at least two different cups before one was chosen. Also, the nest cups prepared by the male would be display sites, having no significant part in the location of the nest. This was the interpretation

placed on similar behavior of *C. maritima* by Keith (1938). It is still possible that a nest site chosen by a male and presented to his mate may be adopted by her, as occurs in the Black-tailed Godwit, *Limosa limosa* (Lind, 1961).

Ground courtship: precopulatory behavior.—The most elaborate ground displays were performed by the male prior to copulation (Figure 5, b and b'). In these displays, with the members of the pair standing near each other, the male first raised the wing closer to the female toward her until it reached an angle of about 60° to 70° with the horizontal, the tip of the wing slightly flared; the other wing was then raised to the same elevation. The head was held high; the neck was elongated; the tail was lowered and broadly fanned. The male, giving a sequence of doublets, swayed back and forth around the female in a zigzag fashion so that sometimes he was behind her, then suddenly in front with his back toward her. It appeared that he was always attempting to turn his back to the female, thereby most effectively displaying the fanned tail and white rump before her. Each time this happened the female, who up to this point had ignored the antics of the male, dashed at the conspicuous white rump or at least thrust her head in that direction. In several instances, she overshot and went beyond the rump so that her head was brought alongside the flank of the male. After approximately one minute, the female turned and faced away, the male walked up behind her with wings still held high, and prepared to mount. Copulation or a copulation attempt was observed in every instance when this display was noted; however, copulations were seen in two other cases which were not immediately preceded by this display. In one of these situations, a male, just completing an aerial song display, landed and ran toward the female, giving two whines. She stood still in a normal position. He approached facing her, walked to her left, then completely around her, and finally after a moment's hesitation mounted her. He settled on her back, balancing himself with his wings beating shallowly over his back but not fluttering. He remained there for about 25 seconds before finally settling down; it appeared that no effective contact occurred. It was just 10 minutes later that this female gave the intensive nest-building display described in an earlier section.

BEHAVIOR AT THE NEST

Observations of behavior associated with the nest were limited because of the early nest failures. A few points, however, are worthy of note.

Only one bird of a pair was ever seen at or near each nest, and in both cases the incubating birds, judging by plumage characters and size, were females. Portenko (1959) also reported that only females incubate. Birula (*in* Pieske, 1928) thought incubation was performed by both sexes,

but this appears to be in error. At Barrow, males were not observed after 26 June. It appears that the pair bond is broken after egg laying is completed. Perhaps males of *ferruginea*, like those of *melanotos* (Pitelka, 1959), leave the breeding grounds soon after egg laying.

The female on the nest would sit tightly upon our approach, not flushing until we were within 30 feet and often not until we were just a few feet away. She then dashed off giving a strong distraction display in which the wings were stretched horizontally, the tail depressed and spread. The bird then fluttered off over the ground, giving a high-pitched squeaky call note. When this did not divert us, she returned in a hunched or rodent-run posture (similar to the courtship attitude), running around us and then again performing the distraction display. When all this failed, she ran back to the nest, settled onto the eggs, and resumed incubation, even though we remained close by (see Figure 2).

On 30 June at nest 1 and on 8 July at nest 2, when the nest cups were found empty, the adult females were not present. Most likely, they left immediately upon finding the eggs gone.

COMPARISON OF DISPLAYS WITH OTHER SPECIES

Comparative and evolutionary aspects of displays and courtship behavior in *Calidris* sandpipers, including the Curlew Sandpiper, will be considered in a later report. It may be noted here, however, that while the flight display and nest-cup display have counterparts in most other sandpipers studied in northern Alaska, the precopulatory display of *ferruginea* as described above is significantly different from that found in related species.

There is one aspect of interspecific comparisons that we do wish to discuss here, namely characteristics of the Curlew Sandpiper's displays in relation to the Pectoral Sandpiper (Pitelka, 1959), on the one hand, and to more typical members of the genus *Calidris* on the other. Contrasting with the latter, and resembling *melanotos*, the aerial song display of *ferruginea* is performed low over the ground. It may be ended with a terminal rise and gentle glide and it is performed without any mid-air suspension on quivering wings. Moreover, the deep breathing and related body movements accompanying the whine note are the only action in any *Calidris* sandpiper studied by us suggesting the similar body movements accompanying the hooting of *melanotos*. Only the head rocking in the display of *fuscicollis* even suggests this aspect of the display repertoire of *ferruginea* and *melanotos* but, as mentioned earlier (Holmes and Pitelka, 1962), this characteristic of *fuscicollis* is offset by others placing it closer to other members of *Calidris*. The ground display of the male *ferruginea* near a female in nest-cup exploration, or near a female following one of his own

nest-cup displays, resembles the precopulatory display of *melanotos* near a solicited or receptive female: head held down, body feathers raised, tail raised, wings drooped, along with a characteristic series of notes (doublets in *ferruginea*, a weak vibrato version of the double hoot note in *melanotos*). Finally, there is the evidence from our observations that the female alone incubates, which agrees with Portenko's report, and that the pair bond may break once the clutch is completed. In this respect, *ferruginea* would again resemble *melanotos*, and probably also *fuscicollis*. In other characteristics, *ferruginea* resembles other members of *Calidris*, as in direction of sexual dimorphism in size (male much larger in *melanotos*, smaller in *ferruginea* and other *Calidris* species), in the nest-cup display (lacking in *melanotos*), and in various vocalizations discussed above. Drury (1961: 208) placed *ferruginea* with other species of *Calidris*, inferring similarity among them of displays and vocalizations, but this is not borne out by our observations.

The lesson of all this, for us, has been the realization (1) that the Curlew Sandpiper's repertoire of display behavior is complex to a degree exceeding that of most other species of *Calidris* known to us (*melanotos* being the exception), and (2) that the specifics of this variety fill a gap between *melanotos* and other *Calidris* species. A spectrum of behavioral types will evidently emerge when the behavior of other still little-known members of the genus is studied.

TAXONOMIC COMMENTS

There are differences among species of the inclusive genus *Calidris*, as used in the B.O.U. Check-list (1952), and even among the species of one section of this genus set aside under *Erolia* in the A.O.U. Check-list (1957), that suggest generic separability. Examples of these differences are given in recent papers by Pitelka (1959), Drury (1961), and Holmes and Pitelka (1962). Indeed, Drury considered two species (*E. melanotos* and *E. fuscicollis*) to be sufficiently different from other members of *Erolia* to justify reviving the genus *Heteropygia* to accommodate them. This was done, however, without a comparison of the behavior and ecology of a large enough series of species from the complex now assigned to four genera by the A.O.U. Check-list, but included in two (*Calidris* and *Crocethia*) by the B.O.U. Check-list and in one (*Calidris*) by Kozlova (1962). Basing his judgment regarding breeding behavior of *E. melanotos* on the literature, Drury considered resemblances of that species to *fuscicollis* to be greater than they really are. We know both species from observations on northern Alaskan breeding grounds. In our opinion, the limited facts regarding *melanotos*, *fuscicollis*, and other members of *Erolia* did not, at the time of Drury's writing, justify any more than the suggestion earlier made

by Pitelka (1959), that *melanotos* was sufficiently distinct from other members of *Erolia* to be generically separable. Any formal action in this direction is thwarted by the lack of information on the Asiatic species *E. acuminata*. Now, however, even the separability of *melanotos* from other "erolias" is thrown into doubt by the new information we report for *C. ferruginea*, which shows characters bridging *melanotos* with other "erolias." Earlier we commented on the vocalizations of *Micropalama*, but without knowledge of their behavioral contexts, it is not possible to consider further the resemblance of *Micropalama* to *C. ferruginea* and other members of the genus *Calidris*. Nevertheless, on the basis of these strong resemblances, it is obvious to us that *Micropalama* is more closely related to *Calidris* than was suspected heretofore.

For the time being, the arrangement of species and genera for *Calidris* and close relatives used by the B.O.U. Check-list (1952), or by Peters (1934), or by Kozlova (1962), more correctly reflects relationships as now understood than does the A.O.U. Check-list. Other than the exercise of this kind of preference it seems best to avoid taxonomic changes until poorly known members of the *Calidris* complex are studied. This applies not only to *Calidris*, *sensu lato*, but to the several puzzling and suspect monotypic genera such as *Limicola* and *Tryngites*, in addition to *Micropalama*, all placed close to *Erolia* by Peters (1934).

SUMMARY

A small population of Curlew Sandpipers settled near Barrow, Alaska, in 1962. Two nests were found, and breeding behavior was observed.

It appears that only females incubate, as Portenko recently reported. Males may leave at once after egg laying, or at least the pair bond may be broken after completion of the clutch. These points need further verification. Males are territorial during the period of courtship and egg laying; in this behavior they resemble other *Calidris* species.

The maneuver form of the flight display of the Curlew Sandpiper resembles that of *C. melanotos*; in vocalizations and certain other actions, its displays resemble those of several other species of *Calidris*. An elaborate precopulatory display, differing from that of other *Calidris* species studied to date, emphasizes the back coloration of the male addressed to the female. The nest-cup display has counterparts in other sandpiper species, but not *C. melanotos*. The complete song display is more elaborate than that of any other northern Alaskan *Calidris* species studied to date. A distinctive whine note used in territorial announcement on the wing and especially on the ground is absent in the other eight species of *Calidris* that are reasonably well known to us, but does occur in *Micropalama himantopus*.

The Curlew Sandpiper exhibits a number of behavioral characters intermediate between *C. melanotos* and more typical members of *Calidris* such as *alpina* and *bairdii*. The spectrum of behavioral repertoires now known to us for members of the genus *Calidris*, *sensu lato*, is such that any taxonomic changes should be delayed until critical information on displays and form of social organization for all members of the group is available.

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