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BREEDING ACTIVITIES OF LONG-TAILED JAEGER, HERRING GULL AND ARCTIC TERN ON BYLOT ISLAND, NORTHWEST TERRITORIES, CANADA*

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INTRODUCTION

The 1954 Bylot Island Expedition spent from June 12 to July 29 at the mouth of the Aktineq River on southern Bylot Island—approximately 73° North Latitude and 79° West Longitude—District of Franklin, Northwest Territories, Canada (map in Miller, 1955).

A short description of the trip has been published in *The Bulletin* of the Massachusetts Audubon Society (1955), and descriptions of the area and faunal lists will be published (Van Tyne and Drury, 1959).

This paper reports on observations of breeding Arctic Terns and of early stages of the breeding cycle of Long-tailed Jaeger and Herring Gull.

The accompanying map (Figure 1) shows details of the topography of the area and the location of the nests of Arctic Terns.

LONG-TAILED JAEGER

Stercorarius longicaudus Vieillot. (Eskimo: Ishunga).

Migration and Arrival

On our arrival we found Long-tailed Jaegers both at Pond Inlet (June 11) and on Bylot (June 12). Between June 12 and 25, flocks of six to 15 birds flew in steadily, and usually silently, from over the ice on Eclipse Sound; they continued inland, flying out of sight to the north. In our study area during June and July, we saw groups of ten to 15 birds flying over the uplands, the mouth of the Aktineq River, and the lead in the sea ice. They often uttered a *cooo-eeeeeep* cry.

Habitat

Jaegers had territorial perches on exposed hummocks, mounds, or rocks, from which there were wide views of the uplands. We found three territories in the study area: on the east slope of West Ridge, near Kungo Hill; on the highest point of West Ridge; and on a knob west of Iceberg Lake. There was a fourth on a ridge west of the study area. These perch sites are shown on the plate of nests in a paper on Bylot passerines (Drury, 1960), to be published in this journal.

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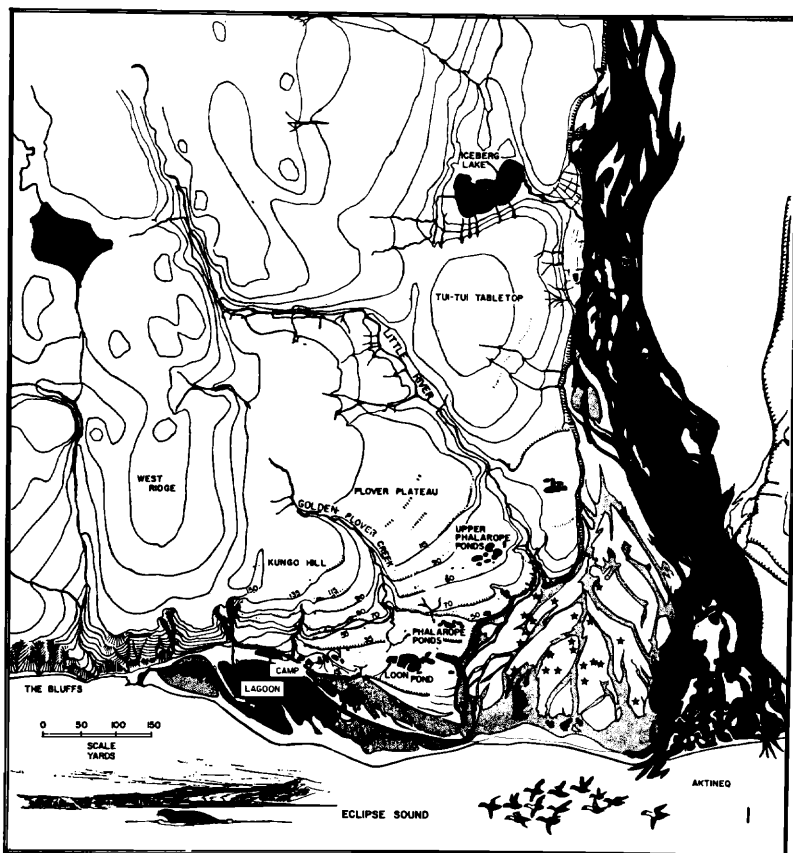


Figure 1. FIELD MAP OF THE STUDY AREA AT THE MOUTH OF THE AKTINEQ RIVER—SOUTHERN BYLOT ISLAND. Topography is indicated approximately by contours which tend to follow raised beach levels. The contour lines were not accurately established or followed. They are used to indicate topography. The nests of Arctic Terns are shown.

We saw five pairs established on territories on July 21 during a walk north from our study area to the tongue of the Aktineq Glacier.

D. V. Ellis says that in 1955 (June 15-16), a Long-tailed Jaeger seemed to have a nest on a spot which, by his description, we judge to be on the 70-foot beach about 100 yards directly north of our camp.

Territory

We first saw territorial behavior June 30, when the snow had left the upland slopes. Jaegers took up perches morning and evening between 0600 and 0900, and between 1700 and 2100.

Aggressive Behavior and Pair Formation

In Flight

Territorial advertisement was a slow flight in circuits, with very deep, slow wingbeats (Figure 2), accompanied by cries of *weep*, *reeu*, or by a long, rattling mew—*kkrrreeeeuu*. The short cries were less common and seemed to be of lower intensity. We heard the long, rattling mew also when two or three birds were flying together in normal flight. The cry was directed at human as well as jaeger intruders and is presumably aggressive. Another cry, uttered during aerial displays and pursuit flights, and never heard from solitary birds, was a short and sharp, rolling *rio-rik* or *rig-rig-rig*. These calls are similar to calls described for hostile situations in Skua (*Catharacta skua*) and Parasitic Jaeger (*Stercorarius parasiticus*) by Selous (1901), Perry (1948), Williamson (1950-53), and Stonehouse (1956).

A pursuit flight was the most common display. Two or three jaegers flew together slowly over the uplands; then one suddenly started vigorously pursuing another, rapidly and erratically zigzagging, swooping, towering, and darting. The chases ended as abruptly as they began, the two birds suddenly swooping apart, and then flying along parallel to each other.

The display flights and flights accompanied by the long, rattling mew call were correlated with warm sunshine and absence of strong breeze. Displays were most frequent in mid-morning, 0900-1100, and mid-afternoon, 1400-1700.

On the Ground

Behavior was of two types: (a) head-wagging; and (b) movements simulating take-off. Head-wagging consisted of one bird or two together, standing very straight with the tail horizontal, stretching the neck upward as far as possible and wagging the head from side to side (see Figure 2—*anxiety posture*). One bird often stood facing the other, with its head over the other's back; or as often, the two birds stood parallel. In simulated flight movements, one bird extended its neck forward and upward and stretched its partly opened wings and tail stiffly upward. Then it lowered its head stiffly and beat its wings strongly two or three times, sometimes rising a few feet, sometimes remaining on the ground. After several "false starts" of this sort, the bird often flew off with slow, deep wingbeats. Sometimes the other birds followed, but if not, the flying bird usually returned after a short flight and settled again, stretching its neck, jerking its head from side to side, and calling *weeou* or *rig-rig-rig*. The other birds of the group usually stood very straight with neck stretched, and wagged the head. Head-wagging also often preceded the deep-wingstroke flight.

Solitary jaegers were often seen standing or sitting quietly on the ground and usually uttered a short, yelping mew cry when approached by a flying jaeger or by one of our party. When a single bird settled near another bird or a pair, stretching and head-wagging took place. If one or more jaegers entered another's territory, the holder of the territory pursued the trespassers briefly, giving the long, rattling mew cry. Jaegers on neighboring perches, apparently stimulated by the

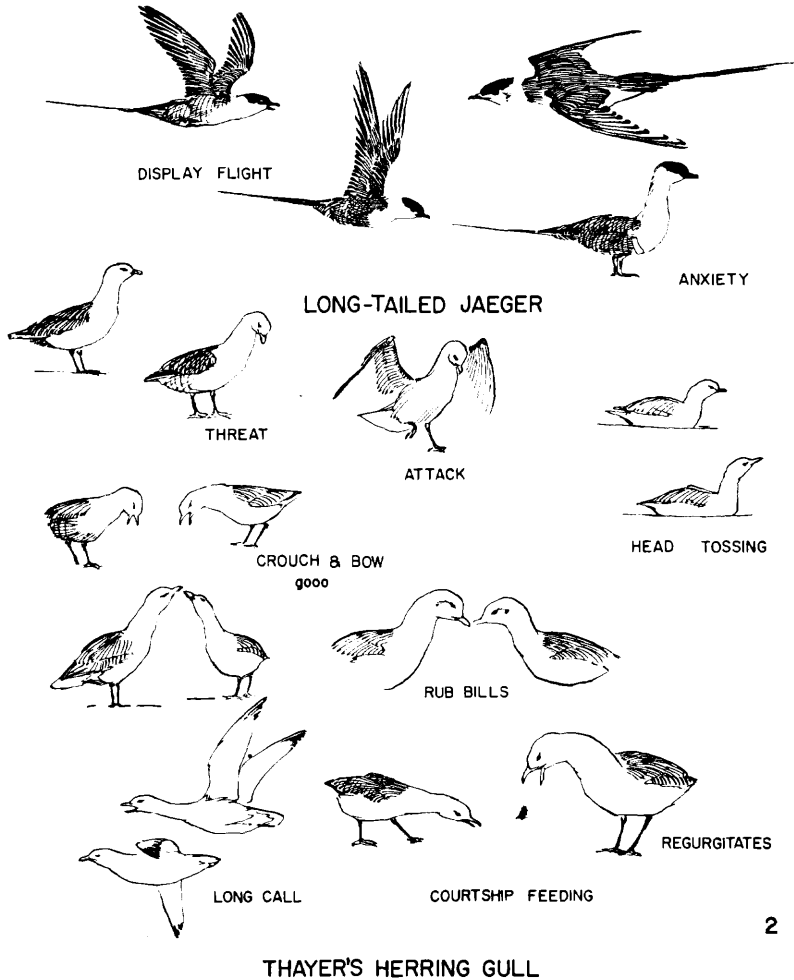


Figure 2. LONG-TAILED JAEGER AND HERRING GULL DISPLAYS.

disturbance, also started the cry. As Sutton (1932) pointed out, groups of these jaegers spent much of their time standing or sitting silently on the ground. On several occasions our approach seemed to incite them to start a ground display.

An upright posture is associated with wing-spreading in the Skua (Selous, 1901; Stonehouse, 1956; etc.) which gives a short, sharp call at the same time. It is classified as an aggressive posture or, in the old terminology, a greeting ceremony (Armstrong, 1947). The long call of gulls, which is also aggressive, is presumably represented here by the long, rattling mew.

The head-wagging suggests similar actions described in the hooded gulls (*Larus ridibundus, atricilla*) by Tinbergen and Moynihan (1952) and Moynihan (1955). If it is an appeasement action, it may be a

part of sex recognition or contribute to the more general function of pair formation.

Stonehouse (1956) comments on the absence of a social alarm call in the Skua, and suggests it may reflect social rather than colonial nesting. The yelping call [similar to the call of a Bar-tailed Godwit (*Limosa lapponica*)] given in the presence of a human intruder, is also given in the presence of jaeger and Peregrine (*Falco peregrinus*) intruders (see below).

Nests and Eggs

Mewing and pursuit flights centered around the knobs, but we found no nests on Bylot. Our rounds to check nests may have displaced two of the jaeger pairs. We saw no jaegers in immature plumage. Idlounk and his daughter Leah, two of our Eskimo companions (Drurys, 1955), said that nest sites are on open tundra slopes with a wide view of the surroundings. The Rosins (Drurys, 1955) found a Long-tailed Jaeger nest with two eggs at Pond Inlet, about June 28. They described it as well built, unlike most Long-tailed Jaeger nests reported in the literature and the ones I have seen in Finnish Lapland. The adults showed great concern, flying and mewing overhead, but did not attack.

Reaction to Intruders

One Long-tailed Jaeger, engaged with two others in an aerial display, left them and pursued and attacked a Peregrine that flew past. The jaeger dove vigorously at the Peregrine four times, calling a yelping *kirooa* again and again, sometimes adding *keeeow-keeeow*. The Peregrine flew steadily on, but rolled on its side, showing its "fists" at the last moment, each time the jaeger dove, and the jaeger swerved off without striking. The Peregrine did not alter course or speed, and the jaeger finally gave up the pursuit.

Feeding

The 1954 season on southern Bylot was one of minimum lemming numbers. The jaegers, like other predators, were forced to find other food. (On June 24, an emaciated jaeger, bearing no sign of having been injured, was found dead in the slush at the edge of the lagoon.) From six to ten jaegers could usually be seen over the leads in the ice, or over the open water at the river mouth, feeding on the debris at the ice edge. They flew slowly or hovered low over the water, dipping and picking at the floating trash as do Laughing Gulls (*Larus atricilla*) and Bonaparte's Gulls (*Larus philadelphia*), and taking advantage of the strong and steady wind which made flight relatively effortless.

Once we saw a jaeger pursue an immature Glaucous Gull (*Larus hyperboreus*) until the gull regurgitated a large black mass which the jaeger seized and devoured on the ice. On only two occasions did we see jaegers chasing Arctic Terns (*Sterna paradisica*).

On June 30, during a trip from Pond Inlet to Bylot, the Rosins saw Long-tailed Jaegers diving from a height and going under water for crackers thrown to them. One jaeger was seized and pulled under by

a Ringed Seal (*Phoca hispida*), but soon afterward the bird bobbed to the surface and flew off, apparently unharmed.

On June 25 a Long-tailed Jaeger chased a Lapland Longspur (*Calcarius lapponicus*). The jaeger floated and hovered in the strong wind, gliding down at the longspur in seemingly idle pursuit. For twelve minutes, buffeted by the wind, the longspur flew back and forth across the then dry bed of Little River and up a small creek, its flights becoming shorter and shorter while the jaeger swooped closer and closer, only to rise, hover, and dive again. Finally the longspur dove into the rocks in the dry bed of the river. During the final five minutes another jaeger, which had floated down the valley of the Little River, hovered about thirty yards from the scene but did not join the pursuit. When the longspur disappeared into the rocks, the jaeger fluttered and hovered over the spot for four minutes; then it flew west up Little River, by which time the second jaeger had also drifted westward over Plover Plateau.

From the way the eggs in two Oldsquaw (*Clangula hyemalis*) nests (July 10 and 29) were punctured with a nearly square hole, and the dead young left trampled into the down, Idlouk judged that jaegers, which constantly worked back and forth across these slopes, were responsible for the destruction of both. Perhaps our regular visits exposed these nests to hazards greater than usual.

HERRING GULL

Larus argentatus thayeri W. S. Brooks. (Eskimo: Kooksee or Nowyah Kooksee).

We saw "Thayer's" Gulls on our arrival and regularly in small numbers (all adults) throughout our stay; six (on June 18) were the maximum seen. They scavenged in small patches of melt-water, but ignored the scraps thrown out for them.

Aggressive Behavior and Pair Formation

We observed displays on June 16-19 among the group of gulls that loitered at the outlet of the lagoon. We watched the birds daily, and I believe this flock was a "club" (Tinbergen, 1953) and that we saw the events leading to pair formation. It was clear that some pairs had already formed. We frequently heard the "call note" which is a low-intensity "long call" (Tinbergen, 1953; Moynihan, 1955).

On June 28, two gulls flew eastward over the outer beach. The leading bird was in normal flight, but the pursuer held its neck stretched far forward, screamed *keeyou keeyou* continually, and beat its wings slowly and more deeply than ordinarily (Figure 2). This was presumably the "trumpeting call" or "long call" given in flight (Deusing, 1939; Tinbergen, 1953). Moynihan (1956) suggests that the aerial long call expresses especially high hostility in the "call note-long call-aerial long call" series.

In a mutual display (Figure 2), first one and then the other of a pair frequently uttered either a wheezy *ngoo* (Tinbergen's food-begging cry) rapidly repeated four to six times, or a slow *koo-luk* (Tinbergen's mew call) slowly repeated about three times. While uttering the calls, the pair bowed slightly, bending their legs, the head pointed straight

downward, the throat distended, and the bill wide open. Then one called *an-oh*, and both straightened up and looked around with necks stretched and heads horizontal. This "choking" (Tinbergen, 1953) is a mutual display usually associated either with nest site or pair formation. Following this, while one continued to give the food-begging call, the other of the pair fluffed out its neck feathers and stretched the neck upward while pointing the head straight downward, as if resting the chin on the breast. Once, after such a preliminary, the gull raised its "wrists" over its back, half spread its wings, and ran at a Glaucous Gull that was about five yards away. This display has been called "upright threat" by Tinbergen (1953). The Glaucous Gull ignored the whole procedure, and the Thayer's Gull merely stopped and looked around. The wings of the threatening and attacking gull seem to have been unusually widely spread for this posture.

On June 17, a mutual food-begging ceremony (Figure 2) took place between two birds while they were sitting on the water. First one gull, then the other, raised its head from the normal position until the bill was pointing upward to an angle of about 45°. An hour later, at the same place, a pair stretched their necks up and forward, heads and bills extended in line. Their bills crossed but did not touch. Then both lowered and wagged their heads, pointing their bills down, then rubbed their bills together. This cocking of the bill, looking downward and touching the other's bill, has been described by Tinbergen as another part of "food-begging." The action lasted for seven minutes; then one bird, with distended neck, regurgitated onto the ice after four attempts, and the other at once ate the food. The displaying bird stopped for 15 minutes, then started again, at the neck-stretching stage, and carried through to another regurgitation. This behavior is like that described by Tinbergen as (a) involved in pair formation in the clubs, and (b) as preliminary to copulation.

Two days later, June 19, the gulls left the lagoon, which is what we would expect according to Tinbergen's sequence. The paired gulls left to select a nesting territory. The actions described above include all the various ones Tinbergen says occur in the clubs during pair formation: (1) food-begging and head-tossing by the female; (2) threat and redirected aggression by the male; (3) mew call and choking (4) food regurgitation; and (5) mutual food-begging (Moynihan, 1955 summary).

We found no differences in the actions of these birds when compared with the actions already described for other populations of Herring Gulls.

ARCTIC TERN

Sterna paradisaea Pontoppidan. (Eskimo: Emokotáilok).

Sterna macrura Naum. of European authors.

Migration and Arrival

We saw the first Arctic Terns (20) at 0200 on July 3, over the gravel wash at the mouth of the Aktineq, where nests were later found. This date is so late that it seemed like a second nesting, but it is un-

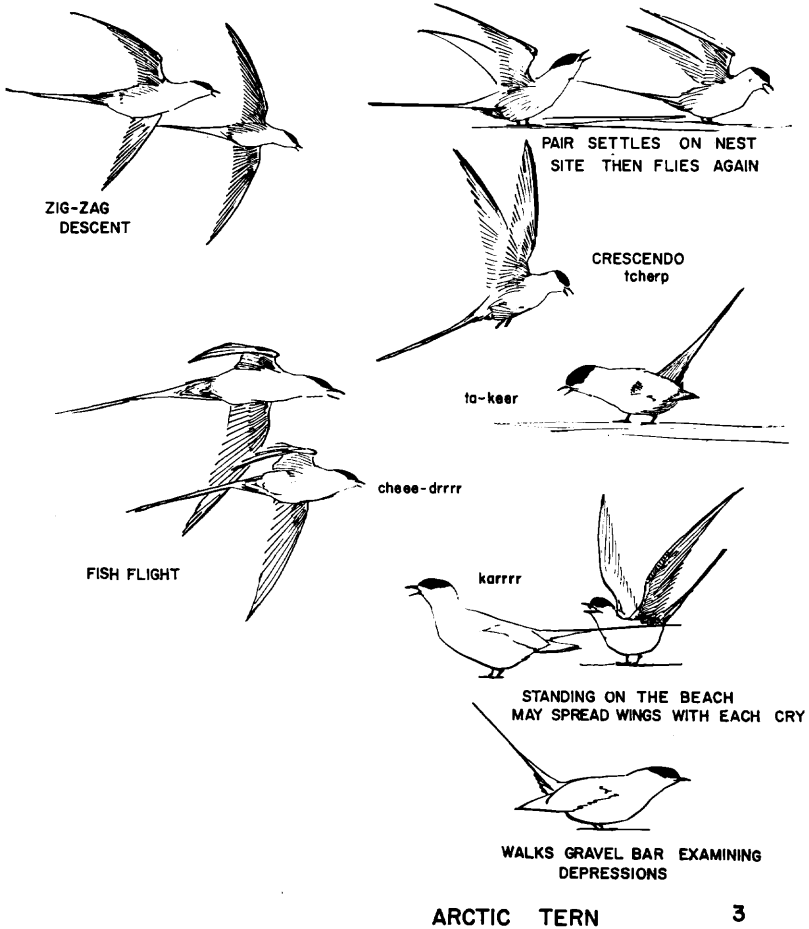


Figure 3. ARCTIC TERN DISPLAYS.

likely that a colony in its second laying would show the conspicuous expression of the early courtship displays we recorded (see Discussion).

We saw no terns on the nesting area when we visited it at least four times between June 14 and June 28. The party returning from Pond Inlet on June 28 saw three or four terns over the leads in the sea ice. We saw a flock of 32 birds roosting on the ice off the Aktineq on July 8.

Our observations agree with those of others for Common Tern (*Sterna hirundo*), Tinbergen (1931), and Dirksen (1932) for Arctic Tern, that after arrival in the colony area the birds spend several night roosting away from the colony. They visit the site very early in the morning but do not alight and soon "forget" their sexual intentions and return in a cloud to feed at sea (Tinbergen, 1931).

Aggressive Behavior and Pair Formation

In Flight

When we first saw the flock on July 3, the birds were flying singly and in pairs, many in the slow-willow flight that precedes the "fish flight" (Figure 3). They were crying *peéé drér*, the second note lower and hoarser. During this flight there was an exaggerated rise and fall of the body between wingbeats. Repeatedly during these flights, some birds gave a *psip* call, singly or rapidly repeated. We could not see whether these birds were the ones in the flight or the others milling around over the same area. The flights took place over the gravel wash, where nests were later found, and also over the gravel ridge of one of the outer beaches in front of our camp. The notes are distinctly higher and more musical than the equivalent notes of Common Terns. Other notes given at this time were a *tcherp* (like the Roseate Tern, *Sterna dougallii*), given very frequently, and a rapid *chrr-chrr-chrr* (compare Tinbergen, 1931—*Korr-korrkorr-krrkrr* given in the fish flight when the head is pointed down—*Beugestellung*).

It must be remembered that most of the authors cited, such as Tinbergen and Palmer, were working with Common Terns, while our studies were of Arctic Terns. Differences are to be expected, but the similarities are conspicuous.

On July 4 there was a marked increase in the tendency for the willow flights to be carried out by pairs, and the cries of the terns were slightly different. The two birds cried *tchik tchik* but did so slightly "out of phase," so that the effect was *ta-chik ta-chik ta-chik* or *ta-kéer ta-kéer ta-kéer*. A *tip tip tip* call in rapid succession was also common. The birds were most active over the lower part of the gravel near the sea and at the mouth of the river, rather than over the nesting area proper. A total of 32 terns took part. None was recorded as actually carrying a fish in the symbolic "fish flight." Tinbergen (1931) suggested that the fish was indeed subsidiary in this flight display, and the action "self-exhausting"—functioning to develop a bond between the pair. Communal displays were last seen July 11.

On the Ground

When a flying bird approached one that was perched on the ground, the latter cocked its tail, pointed its head down and spread its wings slightly (Figure 3), *Beugestellung* (bent posture) of Tinbergen (1931).

Sex Recognition

Occasionally the terns were seen to return to the ground and take part in the phase of courtship that is said to precede sex recognition in Common Terns (Tinbergen, 1938; Palmer, 1941). That is, after the course of a "fish flight" they set wings in "V" and glided to the ground, crying *tcherp* in crescendo and diminuendo, then sat with their wings held over their backs, still calling *ta-kéer*. The bird held its head either with bill raised (*Reckstellung*, stretch posture), or with bill pointed straight down in the bent posture. They cocked the tail up in both postures (Figure 3). Moynihan (1955) suggests tentatively that the *ta-kéer* given in this and other aggressive situations is related to the long call of gulls.

At the end of such a performance, the birds held their wings high over their backs and stood for a short time, often flying off and repeating the procedure. Tinbergen suggested that in the later stages of the communal fish-flight display in Common Terns, a territorial male will only fly in the bent posture (head down), and try to lead each partner to land at his territorial site where he continues the threatening bent posture. Palmer points out that in Common Terns the male is carrying a fish in this posture on the ground and the female approaches and tries to slip past him and steal the fish. The male threatens and pecks her and she assumes the stretch posture at once. He follows suit. A male leaves the site in response to the threats. The female's begging increases and eventually she takes the fish. The male then begs to the female, but still threatens. Numerous repetitions of such visits by a female lead to pair formation.

In our observations later at Aktineq, and July 14 at Ooyarashukjooet, one bird on the ground stood with head down and tail cocked up, calling *ta-kéer*, as another approached in flight also calling it and lit next to "him," holding wings and bill high, then slowly folded wings and lowered bill (Figure 3). We saw birds call on the ground, with head up and wings raised, and with head up and wings folded, as well as head down in these postures. Sometimes after such a flight, or when they had been standing together, one walked past the other, calling *kree-kree* and then *ta-kéer*, sometimes with head bowed, wings slightly strutting, and tail sharply cocked up. We saw no snatching, offering of fish, or exchange of fish, and so have no comment on Dirksen's suggestion that offering of fish leads to begging by the female and is a step toward copulation.

Palmer (1941) brings together information in English on courtship displays of Common Terns. His information of course does not cover studies of the last 18 years, but Michael Cullen has been carrying on an extensive study of the courtship of Arctic Terns in England, and the publication of his thesis will bring the material up to date. I think that the discussion whether the fish-flight is a step toward copulation or is self-exhausting pair formation action, as Tinbergen suggested, is resolved by recent studies in bird behavior such as those by Moynihan (1955). Whether the action "looks forward" to copulation, or to feeding the incubating bird and chicks, seems to me to be an academic question. It seems to me that the discussion in Southern (1938) confuses proximate and ultimate causes.

Nest and Eggs

Nesting Sites

Twenty tern nests were found on the higher ridges of the wash at the mouth of the Aktineq. The closest nests were about 15 to 20 yards apart, but most were no closer than 35 yards apart, and some were as much as 75 yards from the nearest nest. The diameter of the nesting area was more than half a mile (Figure 1—nests black stars). These nests are much farther apart than the "rough circle about six feet in diameter" for Common Terns (O. L. Austin, Jr., 1929).

All the nests were placed in similar situations. They were not in the coarse cobbles, nor in fine sand patches, but in small sandy



Figure 4. ARCTIC TERN NEST. A few pebbles were brought into the scrape which is closely associated with a clump of the perennial Purple Saxifrage (*Saxifraga oppositifolia*).

patches in a generally pebbly area. (Pebbles: one-half to two and one-half inches in diameter.) The sandy patches formed natural depressions in which a "scrape" was made. Usually some pebbles or tiny bits of wood were added to the sides of the nest, and all nests were within six to 12 inches of a clump of plants (Figure 4). The species of plant apparently made no difference; the most common plant (Broad-leaved Fireweed, *Epilobium latifolium* L.) was most frequently used, and the other plants appeared roughly in the order of their frequency of occurrence.

Plants grew in patches of fine-grained sand in the cobbles, so it is hard to say that the patch of plants was selected as such; but the patch of vegetation may be the stimulus given by the environment, while I presume that the feature selected in evolution of this population is the nesting on the highest parts of the gravel—those least subject to flooding by flash floods. Of course the places where clumps of plants persist coincide with those which have remained free of flooding for the longest time, and, presumably, are less likely to be flooded. O. L. Austin, Jr. (1932) has shown that Common and Roseate Terns do take definite regard for patterns of grass in their nest sites, so that the use of vegetation suggested here is not unreasonable.

I am surprised that students of Larid behavior have, even in their comparative studies, almost completely omitted reference to the studies of Common Terns by O. L. Austin, Jr. and R. S. Palmer.

Egg Laying

The first eggs were found July 14. One nest contained one egg, and two nests contained two eggs each. By July 18 we had found

13 nests, of which nine contained two eggs. From this we conclude that most egg-laying took place between July 11 and July 18.

Clutch Size

Of the total of 18 nests for which we have a report of the contents, eight contained one egg, and ten nests contained two. Clutch size averaged 1.55. Pettingill (1939) reported 144 eggs in 100 nests, and Hawksley (1957) reported 308 eggs in 225 nests. Both studies were made on Machias Seal Island, Maine. These gave an average clutch size of 1.4, which indicates that clutches of one egg are not aberrant even in the southern part of the range, and also that there is negligible clutch size variations with latitude between Maine and Bylot Island. In contrast, Lack (1948) reported average clutch size are 2.25 in middle Europe; Bickerton (1909) reported 1.7 in 209 nests in Britain; and Eklund (1944) reported 1.7 in 279 nests from Greenland. Hawksley (1957) could find no significant differences in clutch size between early and late nests, but in the "less severe" weather of 1948, the clutch size was 1.73 in contrast to 1.19 in 1947. Thus annual variation encompasses latitudinal variation.

Activities During Incubation

Our observations agree with Tinbergen's (1931) and Palmer's (1941) that the gliding flight, which they suggest is a continuation of the fish flight (Figure 3), continues into incubation. Such flights were seen at Aktineq and at Ooyarashukjooet. In the course of a gliding flight, two terns dove at each other, alternately calling crescendo and then diminishing *ki-ki-ki-kikikiki-kree-kree-kree-kree*; the dive was usually followed at once by a violent zigzag glide, with wings set in a curve below the body and tails furred and depressed. During the zigzag their call was *keee-yéah*. Sometimes the glide was replaced or followed by the slow-willowy flight and the same call. We saw none carrying fish in this flight.

Nesting Success

Twelve nests were robbed by an Eskimo dog on the night of July 27. The robbed nests were those we had checked most often; perhaps the dog was led to them by our tracks. We have no information to indicate that the Eskimos at Eclipse Sound collect tern eggs for food.

Reactions to Intruders

The terns showed marked concern toward human intruders, typically as the intruder entered the nesting area. A shallow pool inside the gravel beach, across which birds flew to feed in the sea at the mouth of the river and in which they dipped and bathed, was included in the area where birds showed concern. Although 70 yards from the nearest nest, more terns actually flew overhead when we were on the edge of the colony than in the middle of the nests. They were noticeably silent in comparison with Common, Roseate, and Least Terns (*Sterna albigrons*) in similar situations. Both parent birds showed aggressive behavior (more violent than that of Common Terns), but one of the

pair was especially violent and attacked while the other remained apart. Both cried *keh keh keh kak* (a call of anger, Tinbergen, 1931) as they dove, and one of the pair often struck. As others have commented, each pair actively attacked only near its own nest, and withdrew as soon as the intruder moved to a neighboring nest and out of the nest territory.

Feeding

The birds flew out to sea off the mouth of the river to feed at all hours, but most conspicuously in the mid-morning (0800-1100) and late afternoon (1700-1900). Over the open water they fed by hovering, dipping, and diving. They often went far out along the leads to the middle of the Sound. They also hovered and dipped over fresh-water pools behind the gravel bars, where there were tiny fish fry. At sea they were seen to be feeding on shrimp and a red amphipod. The hovering flocks constantly communicated by a soft *tchip*, barely audible at thirty yards. We saw terns bathe in the sea as well as in fresh water.

Our observations agree with those of Sutton (1932) on Southampton Island that terns were essentially unmolested by jaegers. Terns drove Long-tailed Jaegers away from the nesting colony and from the flocks fishing over the slush on the lee shore of the leads. The jaegers fed in the same way as the terns, and we saw jaegers attack or pursue terns only twice.

DISCUSSION

Displays of three subgroups of Laridae

Our observations of the displays of jaeger, gull, and tern illustrate details of "courtship" actions which at first do not suggest similar origin. Moynihan's careful studies, however, single out elements in gull postures which, when recognized, can be traced into the postures of the jaegers and terns. It is strong support for the correctness of the Moynihan study that the elements recognized first in the hooded gulls can be seen in these others.

The three species we watched form an interesting series: Arctic Terns were delayed in their arrival but rapidly went through the early stages of the reproductive cycle and many pairs laid complete clutches. Herring Gulls seem to have been undisturbed in their progress through pair formation, and when the pairs were formed they left to take up territories elsewhere. Long-tailed Jaegers were interrupted during the pair formation stages, presumably because of lack of prey. I will discuss non-breeding below.

The aggressive-upright and anxiety-upright postures (Moynihan, 1955) can be recognized in all three species. Appeasement postures seem various in the three: stretch posture in Arctic Tern, continued food-begging in Herring Gull. I don't think I saw an action in jaegers which clearly functions in this way, but the similarity of the head-wagging to head-flagging in hooded gulls suggests similar function.

Moynihan (1956) assigns aerial displays to the very general category "produced by simultaneous activation of the attack and escape drives." Aerial displays have been described for Skua and Parasitic Jaeger by Selous, Perry, Williamson, etc., as including sailing with wings held over the head (Skua), and involving twisting chases, towering and

stooping, and being accompanied by a long call which Moynihan suggests tentatively is the same as a gull's long call. Tingergren's (1931) description of fish flight must be an aerial display specialization of this sort, and it is associated with the terns' equivalent of the long call. As Moynihan points out, larger gulls in general omit aerial display, as is the case with Herring Gull. Smaller gulls which spend much time flying in search of food "use" display flights conspicuously. It is not surprising that jaegers and skuas, living by their superb flight, should build display of their flight into their courtship.

It is interesting, and further confirmation of Lorenz' idea that the action precedes the structure, that Long-tailed Jaegers seem to "show" their winglinings in an aggressive situation. The meaning of this act is itself obscure, however. Just the same, it must be beyond coincidence that wings were raised regularly in especially hostile situations in all three species discussed here: jaeger when on its perch; gull when attacking a Glaucous Gull; tern when on its territory in the bent and stretch postures. In each case intention movements for flight are suggested, but that is not enough explanation, if for no other reason than that the jaegers have a white patch at the base of the primaries and the gulls a black and white patch at the tip.

The displays of Long-tailed Jaegers are most suggestive of those of terns. They have a willowy and social display in the air, followed by repeated visits to a site for "recognition." This may only be reflection of emphasis of flight displays.

Non-breeding and delayed breeding

The most conspicuous feature of these three species was the non-breeding of Long-tailed Jaegers; but the terns' delay in starting their breeding cycle presents just as interesting a biological problem.

Long-tailed Jaeger

Manniche (1910) correlated the bad lemming year of 1907 with non-breeding of jaegers. Many other authors have noticed the closely parallel fluctuations of predators with their lemming prey. Bird and Bird (1940) and Marshall (1952) summarized knowledge to date of non-breeding in the Arctic, and listed the many authors who have commented on it. Pitelka, Tomich, and Treichel (1955) have discussed the mechanisms of the effect of prey density upon the reproduction of Pomarine Jaegers (*Stercorarius pomarinus*) at Point Barrow, Alaska. The population which Pitelka, *et al.*, studied started to breed when lemmings were abundant at the "crash" and subsequently most breeding failed as a result of food lack and vicious competition which led to violent territorial fights and disturbance of neighbors' nests. On Bylot Island the prey crash earlier in the reproductive cycle resulted in halting the cycle at the territory-pair formation stage. Present knowledge of the physiological mechanisms involved in the progress of the reproductive cycle (Marshall, 1952, 1954) suggests that failure of the female to respond to the male's actions early in the chain of reproductive sequence may cause the failure.

F. H. A. Marshall (1936) suggested that lack of one or more of several important environmental stimuli may lead to failure to breed.

As in so many cases in field biology, simple explanations are probably naive. A. J. Marshall (1952) discusses a wide variety of causes which affect a variety of species. In each case, a different factor may be critical, and that factor may have no meaning at all to the immediate species' neighbor on the nesting ground. Marshall's examination of the testis of breeding and non-breeding birds at Jan Mayen strongly supports his comment that it was not possible to forecast the condition of the testis even after collecting. "The time of arrival, within reasonable limits, is apparently not very significant: the important thing is what the bird finds in the environment when it gets there. . . . There is nothing physiologically abnormal with the adult male non-breeder of several species, including passerines, waders, gulls, and auks. . . . All the evidence suggests that each species has evolved a hereditary response to an environmental 'pattern' (including behavioural interactions between the sexes) and that if, in any locality, one or more important external stimuli are not present, the neuro-endocrinal reactions are not carried forward to fruition and so reproduction will not occur."

Arctic Tern

Lack (1933) observed on Bear Island that Arctic Terns nested in different areas on successively later dates, as those places became free of snow and available for nest sites. Marshall (1952) showed in his tests on Jan Mayen that he could not cause second laying by destroying the first clutch. Bertram, Lack, and Roberts (1934) suggested that Arctic Terns delay the advance of ovulation when nesting sites are not suitable. Manniche (1910) and Bird and Bird (1940) suggested that ice conditions affect the breeding of Arctic Terns, and this may be associated with Palmer's (1941) suggestion that lack of fish for "fish flight" has a detrimental effect on the courting behavior in Common Terns.

Seligman and Wilcox (1940) suggest that in an area where Arctic Terns arrived late (Jan. Mayen), the gonads might even have passed the peak of potential breeding activity before they arrived.

It may be argued that in many of our nests (eight with only one egg), the birds had been delayed so long that they were beyond the peak of reproductive potential and showed smaller, late clutches, as many people have found and we have found in Lapland Longspurs (Drury, 1960). The evidence presented above under clutch size, however, shows that frequency of single egg clutches was no higher at Bylot Island than on Machias Seal Island, Maine.

All of these pieces of evidence converge on a general explanation that the Arctic Terns arrived in the general area of Eclipse Sound ready to follow to the next stages of pair formation and nest site occupation, but did not cross wide areas of ice until leads opened up. It has been my experience in Bylot Island, the Canadian Yukon, and Finland that Arctic Terns do cross stretches of ice when there are large cracks in it, and when there is ice-free water near the colony site. Upon arrival, the suitable conditions at the colony site stimulate the birds to start their mutual excitement and to carry through the reproductive cycle.

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PENGUIN FLIPPER-BANDS USED BY THE USARP* BIRD-BANDING PROGRAM 1958-60.

By W. J. L. SLADEN and R. L. PENNEY

Flipper-bands were designed for Adelie, *Pygoscelis adeliae*, and Gentoo, *P. papua*, Penguins in 1948 (color bands) and 1949 (aluminum) (Sladen, 1952: 543) and have since been used extensively on other species, with varying success, by British, French and Australian Antarctic expeditions. These bands have several advantages over bands placed around the tarsus (Richdale, 1951), or around the feathered tibia, but they require very careful fitting. Some of the problems of this technique have been discussed by Gwynn (1955), Austin (1957), and Sladen & Tickell (1958).

The bands described here were designed for the USARP Bird-banding Program**, and are being used by U. S. and New Zealand biologists in studies now being conducted in the Antarctic on population dynamics, behavior, orientation, navigation and physiology of penguins.

Both of us travelled on U.S.S. *Staten Island* during the summer season of Operation Deep Freeze IV, 1958-9. Penney left the ship in February to winter-over at Wilkes Station (66° 15' S., 110° 31' E.), and reports here on the success of the 1958 Adelie flipper-band design.

For Emperor Penguins (*Aptenodytes forsteri*)

As the size of the flipper varies more in Emperor Penguins than in Adelies, bands must be used on Emperor flippers with much care, and fitted exactly. More trials are needed before they are used in large numbers.

In the two designs described, the reference number lies on the outer face of the flipper, so that it can be read without handling the bird. Most of the address is hidden in the axilla.

Footnote:— * = United States Antarctic Research Program

Footnote:— ** This program started in December 1958, is in collaboration with the U. S. Fish & Wildlife Service and supported by the National Science Foundation (N.S.F. G6327 & G9990).