Parental and brood behaviour of Emperor Geese in Alaska

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Introduction

The Emperor Goose *Anser canagicus*, a maritime species, is restricted in its breeding range to western Alaska and eastern Siberia. Until recently little work has been done on the ecology or behaviour of this species. Kistchinski (1971) made observations of the Emperor in its Asiatic range. Bailey (1925, 1943, 1948), Conover (1926), and Gabrielson and Lincoln (1959), reported their notes on the Emperor in North American range; but behaviour records have been fragmentary, with no report of parental behaviour. Accordingly, when a 3-year study of Emperor Goose nesting ecology and productivity was begun in Alaska, (Eisenhauer & Kirkpatrick 1977), this behaviour study was undertaken in the second summer.

The study region

This study took place in the region of Kokechik Bay within the Clarence Rhode National Wildlife Range on the ancient Yukon-Kuskokwim Delta of Alaska (Figure 1). The two areas used were on tidal reaches of the Kwecharak and Kokechik Rivers (Figure 2). Brood habitat on the Kokechik River study area resembled that described by Eisenhauer and Kirkpatrick (1977) for tidal sedge flats on their study area, characterised by extensive patches of *Carex rariflora* on mud flats. This plant appears to be maintained at a maximum of about 13 mm height primarily through occasional flooding by tidal water. Immediately inland from *C. rariflora* are areas characterised by other *Carex, Potentilla* and *Elymus* species. The Kwecharak River study area showed the

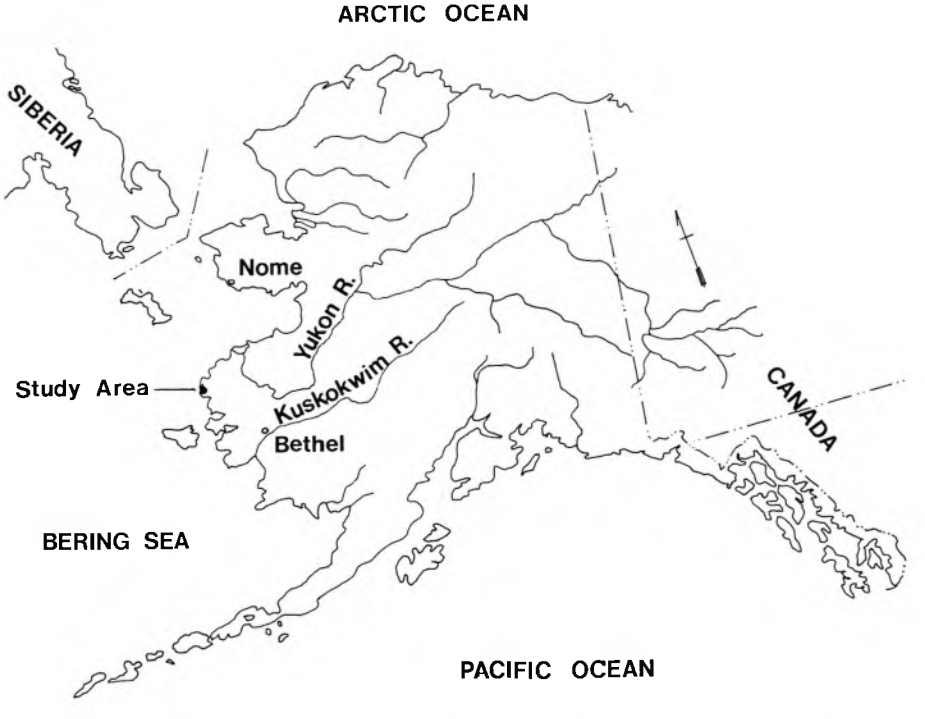

Figure 1. Outline of Alaska showing location of Emperor Goose study area in region of Kokechik Bay.

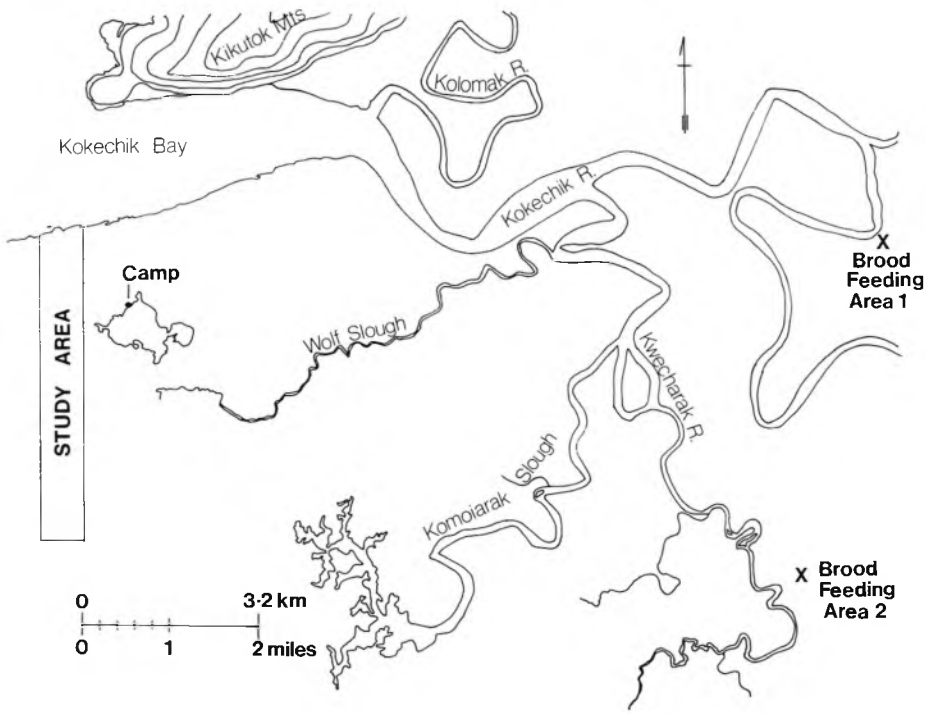

Figure 2. Location of study sites in relation to major waterways at Kokechik Bay. Blank areas south of Kokechik Bay and River are occupied by tidal sedge and grass flats, pingo tundra, and tall sedge marsh. See Eisenhauer and Kirkpatrick (1977).

same tidal zone vegetation, but pingos and high ground predominated much closer to that river.

Large brooding areas were usually found along the inside of river bends where deposition of silt made a slight incline on which *C. rariflora* grew. Narrower beds of the sedge around edges of tidal ponds were generally only 15–90 cm wide.

Methods

Observations on nestling period behaviour were made from a 0·9 × 1·5 × 2·1 m tent of green tarpaulin. Windows on each side fitted with mosquito netting and suitable apertures permitted observations in all directions. Equipment used included a portable tape recorder, a zoom telescope, and a single lens reflex camera with telephoto lenses.

All 104 Emperor goslings found in 39 nests were individually marked with fingerling fish-tags attached to an interdigital web of the gosling. Web-tagged goslings were intended to be recovered during late trapping drives for appraisal of movements; but since trapping could not be done, only a few such marked goslings came to hand incidentally.

After broods left their nest sites for brood-rearing habitat, we noted their normal behaviour, as well as response to human disturbance, when we made brood counts.

Age determination of goslings was based on plumage development for known-age Canada Goose goslings (Yocum & Harris 1965).

Certain activities were better studied by watching captive birds. Three goslings were enclosed in a 0·9 m wire netting pen approximately 9 × 22 m in area including a small pond and natural food and cover. A box provided shelter, and commercial rabbit food supplemented natural food.

Results and discussion

Nestling period

The nestling period covers the time from first

pipping until the family group leaves the nest site. The first Emperor eggs hatched on 26 June and the modal hatching date for 1972 was 2 July. Pair behaviour prior to the nestling period is described by Eisenhauer and Kirkpatrick (1977). D.A.F. observed Nest A intensively from 17–19 July during a period of intermittent rain and chilling winds, from first pipping until the family group left the nest. He observed Nest B as two goslings hatched while pipping eggs were still present.

The female at Nest B assumed the 'hiding posture' (Figure 3) while the blind was installed but returned to the 'brooding posture' (Figure 4) immediately after the observer entered. The female of Nest A was absent during installation of the blind. Unless camera and telescope lens were moved suddenly, the incubating females took little notice of the blinds. However, the Nest B female was disturbed by activity at our camp 75 m away, lowering into hiding position whenever someone appeared there. The female at Nest A, located 365 m from camp, showed no reaction.

The first time the Nest A male flew to the natal lake after the blind was installed he swam back and forth 8 times, watching the blind but not vocalising. For the next 15 minutes he stood erectly on shore about 18 m away, staring at the blind, after which he settled to rest. At each subsequent visit to the natal lake, he swam once past the blind before settling down. The male of Nest B was not seen.

Attentiveness

Kendeigh (1952) defined attentiveness as 'those intervals of time when a bird of either sex is actually engaged in nesting activities, whether these activities be singing, nest building, incubating, brooding, feeding the young, or scolding at enemies.' In Emperors only females incubate and brood goslings at the nest (Eisenhauer 1976; Eisenhauer & Kirkpatrick 1977). Thus, while our criteria for female attentiveness were the same as Kendeigh's, we judged male attentiveness by the way he responded to potential danger, especially Glaucus Gulls *Larus hyperboreus*, flying overhead.

Eisenhauer and Kirkpatrick (1977) reported that females in early stages of incubation left their nests daily for feed and water, and Eisenhauer (1976) detailed female incubation behaviour. Except as noted below, neither female in this study left the immediate nest vicinity during the nestling period, but periodically readjusted body position, rising from and settling on the nest. During readjustment, the female occasionally worked in the nest with her bill, or stretched before resettling. The Nest B female, watched in two 1½-hour observation periods during one afternoon, readjusted on average every 18 minutes (n = 9) with a range of 5–33 minutes. Observations began on Nest A at 1400 on 17 July for a total of 29 hours. This female readjusted on average of every 68 minutes (n = 19) with a range of 18–143 minutes. Rain and chilling weather related to the longer periods between readjustments of the female on Nest A.

When dismounting from the nest the females braced their feet along the inside of the nest, drew back the breast until the body was balanced over the legs, and then stood up. When resettling, the order was reversed, their wings drawn along the body until the tip of the longest primary was about 75 mm off the back. Part of the female's weight may

Figure 3. Incubating Emperor Goose in 'hiding posture'. (*David I. Eisenhauer*)

Figure 4. Incubating Emperor Goose in 'brooding posture'. (*David I. Eisenhauer*)

thus be placed on the wrist joint of the wings, minimising possible injury to eggs and goslings while she rocked side to side. When the rocking motion ceased, the female spent about 5 minutes rearranging nest rim material, though one worked on the rim for 11 minutes.

Twenty-three hours after the gosling hatched, the Nest A female started to call while on the nest. The calls resembled the mooing of a domestic cow, only much higher pitched and somewhat nasal sounding. 'aauuhhh ... aauuhhh ... aauuhhh'. While calling she scanned in all directions. The male responded by swimming to the nest and keeping an alert posture for several minutes. Upon standing, her call changed to the 'leading' call, 'aauh aauhn ... aauh aauuhn', first on an ascending and then on a more even pitch. The gosling left the nest and stood beside her while she covered the remaining egg. Kistchinski (1971) noted a call on the last day of incubation, which he described as 'a low recurring "Kyur ... Kyur ... Kyur ..."' Eisenhauer (1976) heard similar calls from females he disturbed during hatching, but D.A.F. did not.

The female grasped vegetation and down from the rim and pulled it over the nest, completely obscuring the egg from view. She then led the gosling to water 2·5 m away, where she alone drank, and led the gosling back to the nest and brooded again. To open the nest she lowered and rocked forward and backward and side to side.

Both females infrequently reached from the nest while brooding and fed on green plant material, but little was consumed, since the vegetation within reach already was cropped close to the soil during earlier incubation (Eisenhauer 1976).

The male from Nest A exhibited definite site-activity preference (Figure 5). The term 'guard' means that he maintained primarily alert postures within the area. The term 'rest' is used to indicate that he sat and rested or slept within the area. When at the natal lake he spent the most time in Areas 2 and 3. When arriving at the lake he landed in Area 2, swam in front of the blind once and then returned to Area 2. Area 5 was a small pingo, which he used only at night.

The duration of the male's visits to the lake increased as the nestling period progressed. The three visits, in order of occurence lasted 4, 5 and 9 hours. On the last visit he stayed until the family group left the nest.

Brooding adaptations to weather

In the usual brooding position the female sat level on the nest, wings appressed so that the primaries met just anterior to the tail feathers, and neck curved off the back, with the bill off the neck (Figure 4).

The brooding female on Nest A, when readjusting during a period without rain, stood along the nest rim, body oriented in any direction, the front of her body held slightly above horizontal with her neck curved downward into the nest (Figure 6). In rain, however, she adopted a 'droop-wing posture' shielding the nest (Figure 7). In this posture she always faced away from the rain and wind direction, her body held toward vertical, with spread and drooped wings touching the ground just outside the nest rim. In periods without rain or with light drizzle, the female remained in the brooding posture; but in periods of heavier rain, she spread her

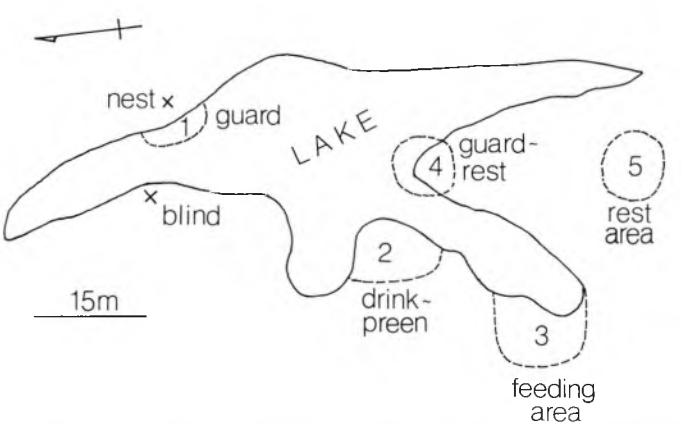

Figure 5. Activity sites of male Emperor Goose paired with incubating female.

wings slightly, resting them on the nest rim causing runoff to flow outside of the nest.

In rain the brooding female often attempted to dry her wings and upper back. The head was first laid on the fore part of the wings, cheek down, and rubbed posteriorly. After several repetitions, the head was returned to the normal position and shaken violently from side to side, with feathers slightly ruffled. This appeared to be somewhat effective as drops of water flew from her head.

Gosling behaviour

Goslings first ventured out approximately 6 hours after hatching, emerging from under the mother's wing or to one side of her tail feathers and returning the same way. The female raised her wing when the goslings pecked at it or tried to nudge in underneath. The goslings always left and entered the nest from the same side. For example, the female of Nest B brooded in an east west axis. Irrespective of which direction she faced the goslings moved only on the north side. Nest A's lone gosling entered on a side at right angles to the direction of the wind and rain. Goslings emerging the first few times generally sat next to the female. They stayed within 1 meter, sometimes wandering for as much as 30 minutes but usually returning in less than 10 (Figure 8). They indulged in nibbling at vegetation or comfort movements until they gradually gained strength and spent more and more time walking around the female. Six hours after hatching goslings pecked and pulled indiscriminately at vegetation. No ingestion of food matter was seen while at the nest, although intensity of feeding motions increased. Eisenhauer (1976) reports that when web-tagging goslings at their nests, they pecked at and ingested mosquitos and flies, even under that degree of disturbance.

Figure 8. Emperor Goose with recently hatched goslings. (*David I. Eisenhauer*)

Figure 6. Female Emperor Goose readjusting nest and eggs.

Figure 7. 'Droop-wing posture' of female Emperor Goose in rain.

Preening motions on the breast, flanks and posterior regions were seen 8 hours after hatching, and the wings were raised vertically over the back and waggled side to side several times. However goslings often fell over, especially while preening the breast and posterior regions. Leg stretches from the prone position were noted immediately after goslings first ventured from the female.

Interspecific relations

When a Glaucous Gull flew past the nest, the female watched intently until it was again about 100 m away. When gulls came closer than 50 m she sat in an 'alert posture' (Figure 9) and stretched her neck vertically, giving it a long, narrow appearance. When

Figure 9. Neck-stretched 'alert posture' of incubating Emperor Goose. (*David I. Eisenhauer*).

'mooing' calls were given by the female in this posture, the male swam into Area 1 (Figure 5) and remained alert until the gull retreated. No gull approached closer than 35 m to the nest and neither goose showed a threat posture.

Bar-tailed Godwits *Limosa lapponica* are very noisy birds, which call loudly at the first hint of disturbance. Whenever Godwits called, both geese assumed full 'alert postures', extended their necks and scanned the horizon and sky. The calls of Arctic Terms *Sterna paradisaea* brought alert positions occasionally, but those of Black Turnstones *Arenaria melanocephala,* Lesser Sandhill Cranes *Grus canadensis,* and Sabine's Gulls *Xema sabini* rarely elicited alert positions.

Eisenhauer (1976) described the reaction of nesting Emperor females to human disturbance during incubation. Brooding females pressed lower into the nest with the neck flat against the ground (Figure 3). When they were forced to flush from the nest in early incubation, the female left the nest without covering it, skulked for a short distance, then straightened up, called, and took wing. In late incubation and during the nestling period, the female rose, fully extended her wings momentarily, called, and then walked, ran or flew away (Figure 10). Occasionally momentary wing displays were given after leaving the nest. Often when 15–30 m away from the nest the geese began pecking at vegetation in a manner similar to feeding, probably a displacement activity. Two levels of wing display were noted, the first a distraction display, the second a threat posture. None of our data show definitely which display was used under exactly what conditions; however, the threat display generally resulted under greater intensities of alarm to the goose. Tinbergen (1952) attributed distraction to 'the simultaneous activation of the aggressive and escape drives'. Just what stimulus was needed to evoke threat posture in Emperor Geese is unknown. However, it seems that the speed of observer's approach played a major role. If approached slowly, the incubating or brooding goose often gave no wing display before fleeing. Her reaction to a hurried approach was the distraction wing display (Figure 10). If rushed, the female stood on the nest rim, faced the intruder with wings spread, hissed, and left the nest only when approached very closely.

Length of nestling period

The maximum nestling period for Nest B, from hatching of the first gosling to departure, was 27 hours, that for Nest A, 39 hours. This variation could be dependent on: (1) individual behaviour of the parents; (2) weather conditions; (3) proximity to human disturbance; (4) the unhatched, infertile egg in Nest A; (5) intensity of gosling movements at the nest, especially feeding motions; and (6) vocal stimuli between gosling and parent. The female from Nest A

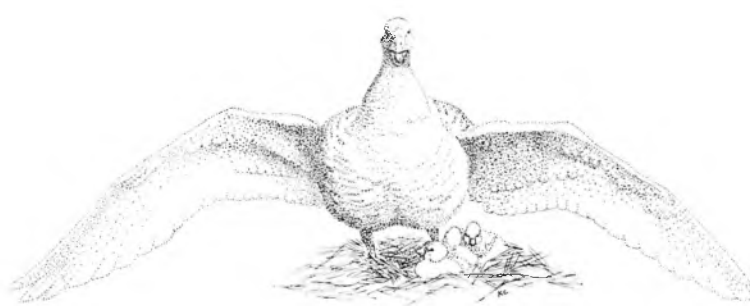

Figure 10. 'Wing-display threat' of Emperor Goose.

showed more frequent small adjustments as the period progressed, perhaps caused by increasingly vigorous gosling activity. Possibly an irritation threshold in the female is reached which elicits departure from the nest.

Leaving the nest

Fifteen minutes before the departure from Nest A the female started the 'mooing' call, which brought the male into Area 1 (Figure 5). She then rose and covered the nest with dried vegetation. The gosling stood beside her until the nest covering was completed. Both adults, uttering the 'leading' call, slowly walked down the shoreline, the male leading, the female following and the gosling trailing her. When the family group stopped, the gosling remained between the adults. The 'leading' call was given at 4–5-second intervals for approximately 10 minutes during which time the family group moved about 110 m from the nest. They then became silent and continued moving slowly, the parents nibbling at vegetation. The gosling pecked and pulled vigorously at vegetation but was not seen to break any of the taller stalks.

Post-nestling period

Brood movement

After the nestling period the family groups moved to feeding areas along the Bay, rivers, and larger sloughs (tidal creeks). Movement was slow but continuous, and eventually most Emperors congregated in small flocks on the larger feeding areas. Flocks comprised 2–20 family groups, but single family groups were using very small feeding areas a month after hatching. Family groups decreased on Wolf Slough (Table 1), an important travel lane to the large river feeding areas (Figure 2), indicating movement off the slough to the Kwecharak River as the season progressed.

Table 1. Brood counts of Emperor Geese along Wolf Slough.

Date (July)	Number of broods
2	16
5	9
7	12
9	10
12	9
15	6
20	4

Three web-tagged broods had separately travelled from their nests 0·8 km the same day of marking, 0·8 km in 2 days, and 1·6 km in 38 days. Eisenhauer and Kirkpatrick (1977) reported a brood that travelled 11·2 km in 3 days or less.

Feeding areas

Areas of grasslike *Carex rariflora* tend to be larger along the rivers, and support more Emperors than those along the Bay. Almost the entire diet of very young goslings comprises this small plant and any insects they can catch; however, they soon begin to feed on other vegetation while still relying on the sedge. Adults also feed on it but appear to rely more on coarse vegetation.

Interspecific competitors for food differ between the Bay and major waterways. Black Brant *Branta bernicla orientalis* nest and brood within the tidal areas of Kokechik Bay while Cackling Geese *Branta canadensis minima* brood their young almost exclusively along the interior waterways. Our study emphasized the high Emperor concentrations along those waterways.

Aggressive behaviour and defence of young

Interspecific conflict with Cackling Geese was most intense while the geese were on the feeding areas. Flocks of Emperors and Cacklers generally maintained separate positions and interspecific conflicts between family groups were rare. However, conflicts between Emperor family groups and non-breeding Cackling Geese were relatively frequent. The latter tended to comprise the periphery of the Cackler flock and thus came into contact with Emperor family groups more often. Conflict was confined to threat postures by both species and the Cackler non-breeders always retreated.

As a general rule, Glaucous Gulls above 25 m elicited no threat postures. Otherwise, an 'upward threat posture' was assumed with the body directed upward at a 45–60° angle with the ground (Figure 11). The wings were close to the body, the neck outstretched and slightly curved in direction of the potential threat, and neck feathers sleeked. In such situations goslings responded immediately to a grouping ('mooing') call by huddling together beside the female, remaining motionless until the female quit threatening.

The 'forward threat posture' (Johnsgard

Figure 11. 'Upward threat posture' of Emperor Goose.

1965) was assumed when the threat was on the ground. The posture was seen in intraspecific conflict and against geese of other species, but was rarely directed toward gulls on the ground. The body was horizontal to the ground, the wings were against the body, the neck outstretched and held slightly downward, the bill pointed slightly upwards, and neck feathers sleeked (Figure 12). This posture indicated an imminent rush that usually stopped short of the intruder.

Emperor parents readily abandoned their broods if we broke up family groups by our presence. The adults flew from the water, but if on land they generally ran, often so fast that the goslings could not keep up. Glaucous Gulls captured some goslings thus separated from their parents. Occasionally, one goose, presumably the female, turned toward the attacking gull. She then assumed the 'wing-display threat' seen at the nest, and gave the grouping call. The goslings followed and huddled under her wings, and the gulls gave up the chase.

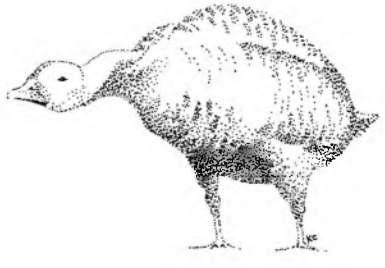

Figure 12. 'Forward threat posture' of Emperor Goose.

As the rearing season progressed the parents remained longer with the broods before flushing at our approach. When moult started, swimming adults often lay low in the water with necks submerged (Figure 13). This position so reduced the visible portion of the goose that it was difficult to distinguish adults from goslings beyond 27 m.

On water goslings 8–15 days old dived repeatedly when Glaucous Gulls came closer than 3 m. Small goslings on land stood little chance of escape. One gosling (41–46 days) charged by a flying gull, returned the attack by swimming toward the gull with neck outstretched in a typical threat posture. The gull fled when the gosling was 1·5 m away.

Emperor goslings usually ran toward the nearest water when we pursued them. Once in the water, they dived repeatedly. A gosling (21–23 days) cornered on a mud flat assumed the adult hiding posture when D.A.F. was 6 m away.

A Golden Eagle *Aquila chrysaetos* dived on 3 Emperor family groups along the Kwecharak River. The Emperors ran into the water and swam away. They usually stood their ground against gulls, or ran away from the water.

Figure 13. Response of moulting Emperor Goose to human intruder.

The family group acts as a unit (Jenkins 1944) and, through intraspecific conflict, sets up a moving territory immediately around the group. Little evidence of such a territory was observed in Emperors after the feeding flock had been formed. Family groups often fed very close together. Most threat postures were noticed the moment when geese started to intermingle, or when non-family group members penetrated the 'area' circumscribed by an imaginary line through all the outer members of the family group. Incidence of conflict seemed higher in the Cackler flock. In both flocks conflict appeared to be highest between individual non-breeders, and secondly between family groups and non-breeders. This correlates with findings of Jenkins (1944) with a partially captive flock of Snow Geese *Anser caerulescens*, of Hanson (1953) on *Branta candensis interior*, and Boyd (1953) with European White-fronted

Geese *Anser a. albifrons*: All found singles to be of the lowest rank order. One advantage of higher rank order is that conflicts with subordinates are rare after dominance is established. Rank orders are rarely straight line, a pyramid more closely describes the relationship. Those on the pyramid base, the singles, are more likely to fight among themselves than challenge a family group with a higher rank. It follows that lower rank-ordered geese should be more aggressive than those already established higher up in the rank-order.

Brood integrity

Hanson (1965) and Balham (1954) believed that for Canada Geese each isolated breeding pair establishes family bonds before contact with other families. At first, the mother-young bond appeared to dominate the Emperor family group. By the end of the first week after hatching, however, the father-young bond was nearly comparable. From 1–4 weeks, family groups were rarely seen in which the goslings displayed a decided preference for one parent.

Hostility toward goslings from other broods undoubtedly helps to maintain brood integrity. In two incidents one adult of a family group gave the forward threat (Figure 12) and the strange gosling retreated to its parents. In another case, when the goslings of one family found themselves about equidistant from two sets of adults, one adult from each group displayed. With necks fully extended toward each other, they swung their necks from side to side in an arc. This activity continued for two minutes without an attack while the goslings drifted slowly toward their parents. Collias and Jahn (1959) stated that Canada Geese parents, and goslings over one week old, would attack stray goslings. In the free-roaming Emperor geese this was never observed. Although brood integrity is generally maintained, two apparent adoptions were noted. In each case the family groups comprised 2 very young (1–7 days) goslings and one older (16–25 days) gosling.

Each brood was tended only by the parents, but six non-breeders ran 3 m and surrounded a brood when a Glaucous Gull flew over, non-breeders and parents alike giving the 'upward threat'. When the gull left, the parents redirected their threat postures toward the non-breeders and drove them away.

Feeding Area 1 on the Kokechik River was rarely covered by water at high tide, but the flock of 15–30 Emperor family groups had a cycle whereby they moved on and off the feeding areas approximately every 2 hours. Starting with geese resting in tall vegetation, one or two family groups moved onto the feeding area followed within 2–3 minutes by the majority of the flock including non-breeders. After a variable amount of time feeding, one or two family groups again initiated a move to the river for a drink. At this point the highest frequency of conflicts between family groups occurred. They did not spread out evenly in a single row along the water's edge, but rather bunched in ranks. Nearness to neighbours did not appear to cause threats but rather the contact from pushing and bumping together. Only once was physical combat seen when each of two adults grabbed the other's neck in its bill. With flapping wings they jumped up and down until one and then the other let go. No chase ensued, and they then stood less than 1 m apart drinking.

At Area 2 on the Kwecharak River, which was subject to daily tidal flooding, the 5–6 family groups fed around inland pools. Thus Area 2 geese ranged farther, fed longer per feeding bout and spent more time in tall vegetation than those in Area 1.

In general, goslings remain within 3 m of the parents while feeding. If any strayed more than about 8 m one adult went to the strays while the other adult stayed with the rest of the brood. Stray goslings often noticed their separation from the parents, and ran back to resume feeding near them.

Penned gosling behaviour

Aggression

Two siblings hatched 4 July dominated a newly hatched gosling placed with them a week later. The siblings displayed aggressive behaviour and pecked the non-sibling repeatedly. These attacks continued for 2–3 days. The posture of the dominant goslings resembled the 'forward threat' of adults. Pecks were usually delivered at at the base of the subordinate's wings. Intensity of the blows was apparently not severe as the pecked gosling made no attempt to escape or fight back. With rank-order presumably established, the siblings ceased the aggressive behaviour. Afterwards all three fed, swam, drank and slept together. When resting, the two siblings were often within 30 cm of each other but the non-sibling was usually 1–2 m away. However, under conditions of storm

or cold, and at night, all three huddled together.

One striking behaviour was observed repeatedly in the goslings when the non-sibling returned to the others after 20–30 minute separation, the intensity of its peeping increasing when it was 2 m away. At this point it stopped and all three bobbed their heads up and down, necks slightly extended, and bills directed slightly downward. All three goslings called until completion of the display after 2–10 seconds. A short preening period usually followed, but did not appear to be a continuation of the head-bobbing display. Since the behaviour always started with the non-sibling, the intent seemed essentially aggressive. The partially extended neck resembled postures seen in all Emperor threat displays, and similar to that on the feeding grounds when the two aggressive adults relaxed following their display. This action short of actual combat might serve to reinforce dominance order within the pen.

Comfort behaviour

Stretching

When first hatched, this was as observed in the free-living gosling. When the goslings were 2 weeks old, the wing was stretched along the leg; and by 4 weeks most leg stretching was done as they stood on one leg with the other stretched behind and slightly downward. The wing on the same side was simultaneously stretched along the leg and the neck was stretched forward and slightly to the side opposite the stretched leg. A nearly straight line was described by the neck and stretched leg.

From a few hours after hatching, goslings often raised their wings above their backs and fluttered when the ultimate stretch was reached. At 3–4 weeks, wing flapping was frequent, apparently stimulated by strong wind, into which the goslings ran, calling.

Preening

Goslings made preening movements while still prone in the nest, but as development progressed they preened more often while standing, and time spent per day in preening appeared to increase once feather development started. The preening action of one gosling often determined those of the other two. In general if one gosling initiated a purposeful activity, the others copied. This follow-the-leader behaviour was also frequently noted in free-living goslings.

Feeding

The captive goslings accepted dry rabbit food readily as a supplement to their diet. At approximately 2 weeks of age, when moved to a pen containing *Carex* and *Poa*, they readily broke off *Carex* leaves about 25–50 mm below their tips for their primary diet. While feeding, they frequently gave voice to a soft chattering.

Drinking

Goslings entering the water sometimes opened their bills with the lower mandible below the surface and scooped water into the mouth. Generally, however, they dipped bills into the water while swimming or standing, and raised their heads to a 70–80° angle with the ground. The bill was then opened and shut rapidly and briefly, and the motion repeated.

Vocalisations

The Emperor goslings had a high pitched 'wee-wee' call, given with higher pitch and increased intensity with excitement. The first attempts at adult calls, heard four weeks after hatching, were high pitched and lacked the normal cadence.

Acknowledgements

We are indebted to Dr M. Graham Netting, Carnegie Museum, for providing a grant to support this work from the Allegheny Foundation Fund for Animal Behavior Studies. This research, initiated in 1971 by C.M.K., was supported by a grant from the National Wildlife Federation and the American Petroleum Institute. We are also indebted to Calvin J. Lensink and to Jerry R. Hout for essential logistic support. Special thanks go to John H. Eisenhauer, David I. Eisenhauer, and Peter G. Mickelson for their advice and assistance in the field. The drawings are the work of Kathy Collins to whom we are especially grateful.

This is Journal Paper No. 7165 from Purdue University Agricultural Experiment Station.

Summary

In a study of parental and brood behaviour of the Emperor Goose *Anser canagicus* in the Kokechik Bay region of Alaska, only the females brooded

young. Males generally remained close, but fed several hundred metres from the nest. One or two days after the hatch of the first gosling, the male led the family group from the nest vicinity and moved slowly to the nearest area of stalkless *Carex rariflora*.

On the feeding areas the Emperors formed small flocks, with the family groups in the centre and the non-breeders around the periphery. Intraspecific conflict intensified as the geese crowded to drink, but interspecific conflict was highest on the feeding area. Most conflicts were settled by threat postures. The only predation by gulls on goslings was when broods were broken up by human disturbance. Both adults helped defend the young. No goslings displayed aggressive behaviour in family group encounters.

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