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The predation of Tern chicks by sheep

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Between 1973 and 1980, sheep ate parts of at least 680 live Arctic Tern chicks and at least 10 Arctic Skua chicks on Foula. This predation was almost completely confined to the dry heath habitat in the southeast corner of Foula. Characteristically, the sheep bit off one or both legs or wings, or more rarely the head. Three different sheep were observed eating chicks, but the habit is probably widespread among sheep on that part of the island. It seems probable that sheep make up nutrient deficiencies by eating chicks. Although up to 8% of chicks were eaten by sheep, losses were low compared with egg desertion and chick starvation, but predation by sheep may have contributed to terns deserting this colony in favour of areas away from sheep.

The suborder Ruminantia contains antelope, deer, cattle, sheep etc., and these animals are usually considered to be exclusively vegetarian, feeding by grazing herbs and grasses, or by browsing shrubs and lower parts of trees.[1] The only record of which I am aware of a member of the suborder Ruminantia deliberately eating live animals is of Red Deer *Cervis elaphus* eating Manx Shearwater *Puffinus puffinus* chicks on Rhum.[2] In this note, I outline the regular and common occurrence of sheep deliberately and selectively eating parts of live chicks of ground-nesting seabirds at colonies on Foula, Shetland.

LOCALITY AND METHODS

Foula (60° 08'N 2° 05'W) is a small island some 30 km west of mainland Shetland. Arctic Skuas *Stercorarius parasiticus* and Great Skuas *Catharacta skua* nest over most of the inland areas of Foula, generally on grassy ground; but Arctic Skuas also nest in the southeast corner of the island, an area predominantly covered with thin *Calluna* and lichen, gravel heath habitat. There has been a colony of Arctic Terns *Sterna paradisaea* nesting in small groups scattered over this southeast area.[3, 4] Arctic Terns also nest at a number of other sites on Foula, but these are either rocky coastal habitats or hay meadows; such sites are not used by sheep.

Each summer about half of the skua chicks on Foula are ringed, the numbers and breeding success of terns is monitored, and tern chicks are ringed if breeding success has been good. Expeditions from Brathay Exploration Group have visited Foula each year from 1956 and ringed seabirds, but it was not until 1970 that ringers noticed tern chicks which had been attacked by a predator in a particularly characteristic manner. In subsequent summers I, or my assistants, made careful searches of the tern colony during incubation, around hatching, and when chicks were well grown (often during chick ringing operations), and recorded all cases of live or dead chicks showing these mutilations. I estimated the number of breeding pairs of terns by counting incubating birds and making an allowance for the proportion of nest scrapes where breeding attempts had failed. I estimated or counted the number of dead chicks that were emaciated and had apparently starved (though death through disease could not be ruled out), and the number of nearly fledged chicks at the colony, assuming that these would fledge successfully.

RESULTS

Damage to chicks

Chicks that had been attacked showed the following conditions; one or both wings, or one or two legs had been cleanly severed. In most cases the chicks had survived this attack and the wound had healed over. In a few cases the chick's head had been cleanly severed.

The chicks attacked were of a wide variety of ages, and there appeared to be no tendency for attacks to be related to chick age or condition. Chicks from which the head had been severed showed no further damage to the body, except in a few cases where skuas had found the corpse and removed internal organs and pectoral muscle. Headless chicks were much less frequently recorded than live chicks with amputated limbs. In more than half of the amputees, one or both legs had been removed, while missing wings were less common. Almost invariably, the cut had been made between the ends of the femur and the tibiotarsal bone in the leg or between the coracoid and the humerus in the wing.

The explanation for these injuries was thought most likely to be attacks by Otters *Lutra lutra* or Hedgehogs *Erinaceus europaeus*, although none was ever seen molesting chicks, but in 1975 one of the crofters on Foula observed the true cause. She watched a grazing ewe in the tern colony which came across a tern chick, apparently fortuitously, took the chick's head into its mouth, lifted it up and shook it while biting through the vertebral column so that the severed body fell to the ground. The ewe then proceeded to chew the head thoroughly and swallow it. It then resumed grazing on the heather. Having been alerted to this, I subsequently saw sheep eating tern chicks on two occasions. Both times I watched sheep push the chick until it rolled over onto its back and then bite off the leg or legs, swallow these, and continue grazing without further attention to the chick. All three sheep seen eating tern chicks could be recognized as different individuals owing to the highly variable colour and patterning of the Shetland sheep on Foula. Perhaps surprisingly, the tern chicks made little or no attempt to evade the sheep. Their response to being pushed gently by the sheep's mouth was to lie still rather than to attempt to run away.

Extent of predation by sheep

These injuries were observed among tern and Arctic Skua chicks in most years between 1970 and 1987. The incidence among Arctic Skua chicks has always been extremely low; in no year did ringers find more than three chicks with amputated limbs out of totals of 50 to 230 chicks handled. Furthermore, the chicks so damaged were almost always to be found in the vicinity of the tern colonies in the southeast corner of Foula. No similar damage to Great Skua chicks on the other parts of Foula has ever been recorded, although from 1000 to 2800 chicks have been handled each year.

Arctic Terns first nested on the heath area of southeast Foula in the 1960s; before then only rocky coast colonies existed further north on the island. From 1969 to 1975 tern numbers increased rapidly, and most of the increase was in the colony on the heath. Small numbers of tern chicks showing the characteristic damage described above were found each year after 1970 (Table 1), but in 1975 over 200 tern chicks were found with the head severed or limbs amputated. The Arctic Tern colony on the heath in southeast Foula suffered a high mortality of chicks late in the chick-rearing period in 1972, but otherwise chick production and survival were good until 1976. Although sheep ate very small numbers of tern chicks in 1970–72, the habit seems to have increased greatly between 1972 and 1975. In part this can be attributed to an increase in the number of tern chicks produced since the colony grew considerably and breeding success was high. However, it is possible that many sheep discovered tern chicks as a food item in 1972 when large numbers of corpses were lying around on the heath. In 1975, over 200 tern chicks partly eaten by sheep were counted in the colony, but because the colony produced over 4000 fledglings the impact of this predation was small compared with the effects of food availability or weather in some seasons; breeding success in 1975 was high despite predation by sheep. Since 1977, breeding success has been very low in most years, and numbers have declined. The breeding failures of terns can be attributed to food shortage since those birds that do lay generally abandon their breeding attempt before hatching, or desert starving chicks at a young age. This cannot be affected by sheep predation, since breeding performance of terns on other

Table 1. Numbers of pairs of Arctic Terns nesting at the colony on heathland in southeast Foula, estimates of chick production, hatching success, chick starvation and predation of chicks by sheep

Year	*Pairs*	*Chicks fledged*	*Number chewed by sheep*	*Hatching success*	*Chicks starved*
1969	220	> 100	0	high	v. few
1970	300	> 150	2	high	v. few
1971	850	> 400	4	high	v. few
1972	900	300	1	high	> 250
1973	650	330	10	low	4
1974	1700	1900	50	high	v. few
1975	5800	4000	> 200	high	v. few
1976	5000	3500	200	high	v. few
1977	2800	550	80	low	> 100
1978	1500	150	20	v. low	*c.* 50
1979	2000	1400	100	high	*c.* 50
1980	500	250	20	low	*c.* 20
1981	0	—	—	—	—
1982	10	9	0	high	*c.* 2
1983	100	40	2	low	*c.* 10
1984	50	0	—	v. low	*c.* 10
1985	13	0	—	nil	—
1986	0	—	—	—	—
1987	20	0	0	v. low	*c.* 6

parts of Foula, and elsewhere in Shetland, has been equally poor in recent years. Since 1983 I have found only two chicks, both Arctic Skuas, with legs amputated by sheep. Thus, the impact of sheep on the production of young by terns and Arctic Skuas on Foula has been small compared with losses due to desertion of eggs or starvation of chicks.

In 1978 nearly half the terns that nested moved to a hay meadow instead of nesting on the heath. By 1980 the meadow colony had increased to 3300 pairs and the heath colony had declined to 500. The heath colony was abandoned in 1981, although small numbers returned to nest there in subsequent years (Table 1). The desertion of the heath colony may have been partly due to the activities of sheep in 1975–79, when they chewed up to 8% of the chicks in the colony, but is more likely to have been a response to considerable levels of human disturbance, since the island's airstrip runs across the heath and through the areas used by terns in 1971–79.

DISCUSSION

Most mammalogists and ornithologists respond with incredulity to the idea that sheep deliberately and carefully bite off parts of live seabird chicks. Having seen this happen twice, and been told of an identical observation involving a third sheep, I have no doubt it occurs. With over 200 chicks being chewed in a relatively short period in some years, it is most unlikely to be the result of aberrant behaviour by one or two individual ewes. Since all injuries are closely similar in appearance, it is improbable that any are due to other predators. It seems to be an activity that is widespread among sheep on the southeast part of Foula. Furthermore, the behaviour of the sheep on Foula is almost indentical to that of Red Deer eating shearwater chicks on Rhum.[2]

A possible reason for the behaviour is that the sheep (and deer) alleviate mineral deficiencies by supplementing their diet with seabird heads, legs and wings. The element they seek is probably calcium. On Rhum, Red Deer regularly chew on cast antlers to obtain calcium.[2] Eating skeletal parts of seabird chicks would be an extension of this. Well-managed flocks of sheep are usually given winter dietary supplements to maintain their mineral levels, but sheep on Foula are almost feral. Those on the southeast part of the island probably receive less attention than others. Almost the

whole of Foula is covered with blanket bog, and soils are generally lacking in earthworms and are low in calcium.[5] The high rainfall on Foula will also tend to leach minerals from the thin soil. However, I do not know why sheep on other parts of Foula do not seem to chew seabirds in the same way.

While the numbers of tern and Arctic Skua chicks killed as a result of attacks by sheep are small in relation to the other losses of eggs and chicks, it is possible that predation by sheep influenced the choice of nesting habitat by terns on Foula. The scarcity of mutilated chicks since 1981 suggests that the behaviour of the sheep may be influenced by chick density; sheep may attack more chicks when it is high, rather than seeking out chicks more assiduously when they are scarce. Despite attempts to observe sheep finding and eating chicks, I have been unable to form an opinion concerning the way in which sheep locate chicks and decide to eat them. Clearly, they must become aware that the head, legs and wings of chicks contain calcium and so are good to eat, while the body seems to be too large to eat or perhaps not sufficiently rich in calcium in relation to the amounts of indigestible feather present.

It remains to be determined whether sheep on Foula are calcium-deficient, whether they can smell calcium, seek it out, or learn to eat parts of seabird chicks as a result of an accidental ingestion. It is possible that this behaviour occurs elsewhere in areas where poorly tended sheep have an opportunity to feed on the young of ground-nesting birds, but has gone unrecorded because the damage has been attributed to predatory mammals rather than to sheep.

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