A review of Soviet research on the Lesser Snow Goose on Wrangel Island, U.S.S.R.

M. A. BOUSFIELD and YE. V. SYROECHKOVSKIY

Introduction

This paper reviews the Russian literature on Soviet research on the Snow Geese of Wrangel Island, U.S.S.R., and suggests critical future research of this population. In the early part of the present century, the Lesser Snow Goose *Anser (Chen) caerulescens caerulescens* was abundant along the shores of the Arctic Ocean and nearby islands eastward of the Lena River (Alpheraky 1905). Today, Wrangel Island, an island of 7000 square kilometres located about 140 km off the north-eastern coast of Siberia, in the coldest region of the U.S.S.R., has the only known Snow Goose nesting ground in the Soviet Union. Because of a marked reduction in the island's goose population, Soviet investigators began studying the Lesser Snow Goose in 1969. Before research on the geese began, information on their numbers and distribution was anecdotal and largely obtained from elderly inhabitants of the island. One of us (Ye.V.S.) has been the chief researcher for the past decade and much of the synthesis that follows is contained in publications in Russian by this author and co-workers.

Historical perspective

The recent history of Wrangel Island has played an important role in the population dynamics of the Lesser Snow Geese nesting there. In the first quarter of the present century, nearly all valleys in the central part of the island were full of nesting geese (Uspenskiy *et al.* 1963). This began to change after 1926, when the small settlement of Ushakovskoye was established on the south-western coast of the island to provide a base for the exploitation of marine mammals (Figure 1). The waste from this exploitation came to provide a relatively stable source of food for the arctic fox *Alopex lagopus*. The fox formerly depended on fluctuating populations of lemmings *(Lemmus sibiricus* and *Dictrostonyx torquatus)*. Chernyavskiy and Dorogoy (1981) noted relatively small oscillations in the number of Wrangel foxes compared to those of the mainland Chukchi Peninsula during the 1970's. The phenomenon of reduced fluctuations in population numbers is common to islands, but could be influenced by increased stability of food source. The increase in the fox population led to increased encounters with nesting geese and hence to increased predation on both eggs and young. Syroechkovskiy and Kretchmar (1981) estimated that in any given year, 40–80% of Snow Goose production (eggs and goslings) is consumed by the foxes.

Snow Goose eggs were also gathered in great quantities (up to hundreds of thousands yearly) by the human population, both resident and from scientific expeditions. During the 1930's, the geese stopped nesting on the southern part of the island, where the settlement was located. By the beginning of the following decade only three or four large nesting grounds remained on Wrangel Island (Uspenskiy *et al.* 1963).

In 1948 and 1954, a total of about 150 domestic reindeer *Rangifer tarandus* was introduced to the island (Syroechkovskiy & Kretchmar 1981). The lichen-covered landscape and lack of wolves enabled this population to explode. By 1978, more than 7000 head were recorded. Waste from the annual autumn harvesting of reindeer for processing at the settlement provided yet another anthropogenic food source for the arctic foxes at an otherwise lean time of year. During springtime, the reindeer move from the central mountainous region through the Snow Goose inhabited valleys to the Tundra of the Academy in the northern part of the island (Figure 1), where they graze through the summer and autumn (Syroechkovskiy & Kretchmar 1981). A small herd of caribou traversing a goose colony can result in the wholesale destruction of nests, either by trampling or through grazing (*i.e.* actual consumption of eggs).

The reindeer also affect gosling survival. Broods travel 12–13 km to the Tundra of the Academy to feed around the lakes there.

Wildfowl 36 (1985): 13–20

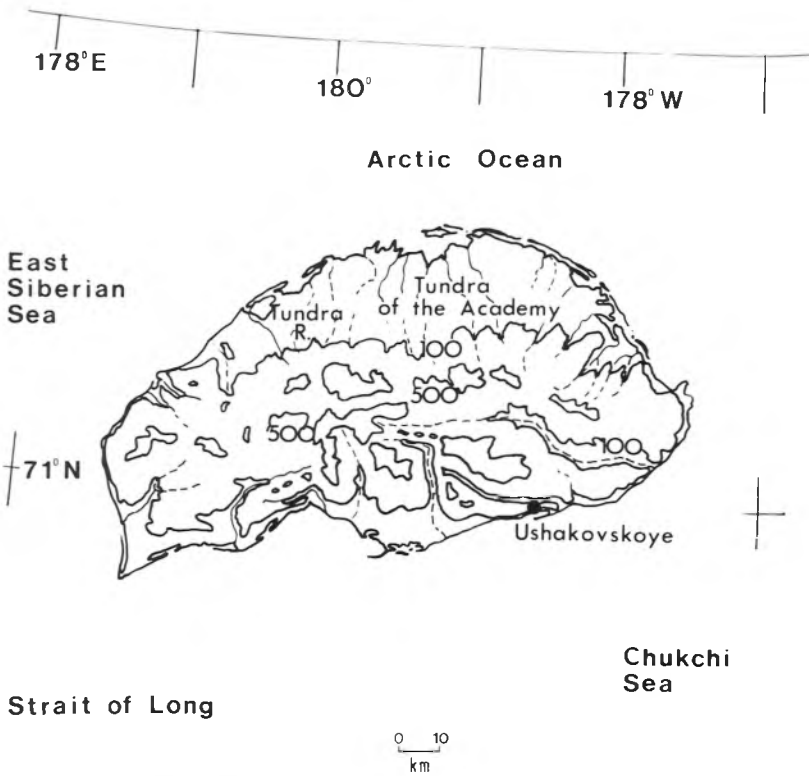

Figure 1. Map of Wrangel Island, U.S.S.R. General relief and major rivers are shown.

When a flock of geese and a herd of reindeer vie for the same lake, the herd inevitably wins. The flock must then walk to a neighbouring lake, which may be two or three kilometres away (Syroechkovskiy & Kretchmar 1981). Goslings are particularly vulnerable to predation by foxes during such overland treks. They do not gain relative immunity to such predation until they can fly, when they are five to six weeks old. The adults are also flightless during this period, as the result of the annual moult of flight feathers.

By the late 1950's, only one large colony of Snow Geese remained on Wrangel Island, at the upper reaches of the Tundra River. The seriousness of the situation led to the first attempts to census the colony by S. M. Uspenskiy and, in 1961, the designation of the area as a *zakaznik*, or emergency nature preserve. The aim was specifically to save the Snow Goose population, by limiting spring (but not summer and fall) hunting and by stopping the gathering of eggs (Syroechkovskiy & Kretchmar 1981). Unfortunately, poaching of eggs continued to be a major factor contributing to the population decline. Nonetheless, Uspenskiy (1969) concluded that as many as half a million Snow Goose eggs could be collected annually without injuring the population. However, the more intensive investigations into the biology and ecology of the Snow Goose which began in 1969 revealed the precarious position of this species. Workers found the *total* number of eggs to be less than one-quarter of a million.

The number of adult geese declined markedly on Wrangel Island until the mid-1970's (Figure 2). There were suggestions that hunting pressures during spring and fall migration along the North American Pacific coast, as well as on the wintering grounds, were the source of this decline (Syroechkovskiy & Kretchmar 1981). However, adult mortality between breeding seasons remained around 20% throughout the period of population decrease and the absolute numbers of those not surviving that period actually declined (Figure 2). Thus, North American hunting could be held responsible for the Wrangel Island Snow Goose population decline only in that bag limits and timing of hunting seasons did not

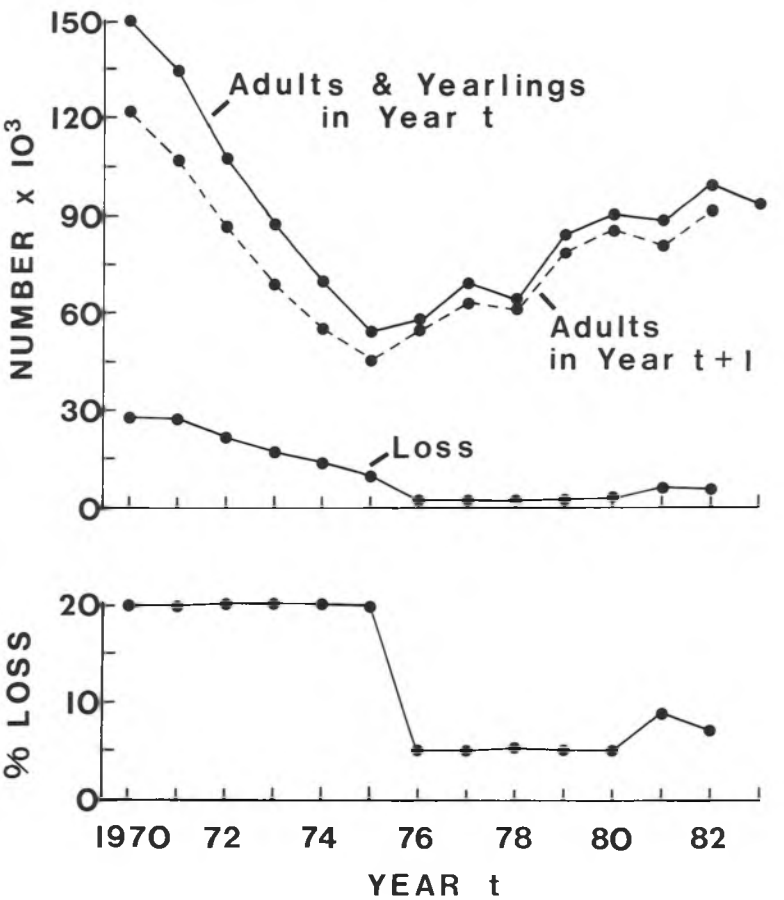

Figure 2. Survival of adult Snow Geese between nesting seasons on Wrangel Island. Loss is defined as: No. of adults + No. of yearlings in year t – No. of adults in year t + 1. (Based on data in Syroechkovskiy 1981; Syroechkovskiy & Kretchmar 1981; and on unpublished data.)

take into account the drastic drop in goose numbers which occurred on Wrangel Island itself. As Figure 3 illustrates, the greatest production loss generally occurs prior to the fledging of the goslings. In years when many geese nest and many goslings fledge, however, there is a severe problem during the fledging to yearling period, hinting at the operation of some density-dependent factor. Most of this period is spent in North America. Studies of the geese during migration and on the wintering grounds there need to be undertaken to determine what this factor may be.

In 1976, when Wrangel Island became a full-fledged *zapovyednik*, or wildlife preserve, winter trapping of foxes became restricted. In the 1960's and 1970's, 200–600 fox pelts had been obtained annually (Chernyavskiy & Dorogoy 1981). Fox numbers were so great that Syroechkovskiy and Kretchmar (1981) advocated the annual shooting of 30–40 foxes in the area of the goose colony alone, and a further 50–60 on the Tundra of the Academy. Chernyavskiy and Dorogoy (1981) recommended that winter trapping be reinstated, and that 500 foxes be harvested annually. However, in 1981 trapping of the foxes was discontinued altogether (N. G. Ovsyanikov, pers. com.).

Since 1976, too, egg collecting has ceased to be a factor in goose mortality, and hunting of the geese has been completely stopped in the entire Magadan Province, which comprises the whole Chukchi Peninsula, along which the geese migrate, as well as Wrangel Island. Owing to co-operation between biologists from the Soviet Union and the United States, hunting of Snow Geese in Washington, Oregon, and

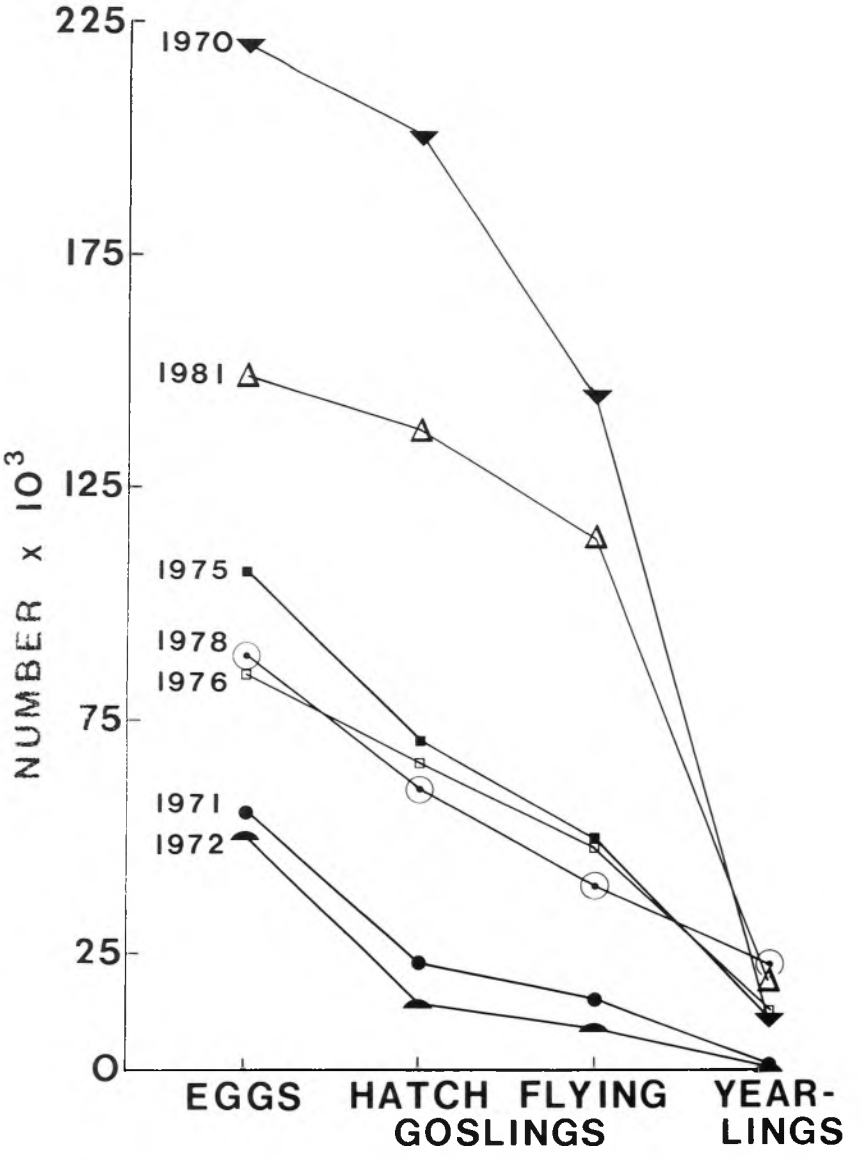

Figure 3. Survival between the egg and yearling stages. (Based on data in Syroechkovskiy 1979, 1981; Syroechkovskiy & Kretchmar 1981; and on unpublished data.)

California became restricted in 1978–9, and indeed there was an increase in the number of geese nesting on Wrangel Island in 1979 (Syroechkovskiy & Kretchmar 1981). The Soviet researchers, however, stated that it was impossible to determine whether this increase resulted from reduced American hunting pressure, or from recruitment from the 1975 and 1976 year-classes, which were the largest for the decade to that time (Figure 3).

Biological research

Reliable censusing of the Snow Geese has been carried out on Wrangel Island since 1969. Transects are covered in the spring, as well as immediately following hatch in early July. During the latter time, 3–8% of the area of the colony is crossed by 250-m transect lines 100–250 m apart, the exact extent and lengths depending upon the area of the colony (Syroechkovskiy & Kretch-

mar 1981). All transect lines are mapped, and the percentage of failed nests, as well as the absolute number of nests, within 4 m of the transects are noted.

In most years, the colony consists of a central, densely populated region and a more sparsely populated periphery. Syroechkovskiy (1979) estimated that conditions are such that nesting in the central nucleus can occur in 8–10 of every 10 years, whereas on the periphery it occurs only 2–4 times, and in an even more peripheral 'reserve' zone only once in 10 years. This annual variation is caused by weather conditions and their effects on predation, which are outlined below.

Weather, particularly as it affects snow melt, is the major determinant not only of the timing, pattern, and density of nesting, but of the course of events for the entire nesting season. The adults arrive in mid- to late May and lay eggs in early June. The goslings hatch in early July, after about 23 days incubation. There is a poor relationship between the number of adults arriving in the spring and the number that actually nest (Figure 4). The main reason for this discrepancy is the great variation in timing of snow melt and the extent of bare ground available for nesting. There is a positive correlation between total area used by nesting geese and number of nests (Figure 5a), as well as between colony area and percentage of adults nesting (Figure 5b).

When there is a shortage of nesting space, intra-specific nest parasitism, that is, the laying of an egg by one goose in the nest of another, apparently reaches astounding proportions. In 1973, for example, when snow cover lasted well into the spring, 81.9% of all nests were calculated to contain at least one such egg and many others were found simply lying scattered over the tundra (Syroechkovskiy 1976)! In that year, 87,000 adults were estimated to have arrived on the island, whereas only 6000 nests were estimated in the census. The clutch size was considerably higher (5.9) than the 3.7 that is assumed to represent the average number of eggs laid by one female; the increase was attributed entirely to intra-specific nest parasitism (Syroechkovskiy 1979). This conclusion was based on egg shape and size. According to Syroechkovskiy (1979, and unpubl. obs.), in first-time breeders the oviduct has not been stretched previously, so is less elastic than in experienced breeders. Thus, eggs of the former tend to be more elongate than those of the latter. An elongate egg in a clutch of rounder eggs was assumed to have been laid by a female other than the one on the nest. Data on intra-specific nest parasitism were also obtained through information on egg-laying sequence, which was recorded for approximately 50 nests in each of 1971, 1972, and 1973, when 200 nests were checked every day (except during extremely cold or stormy

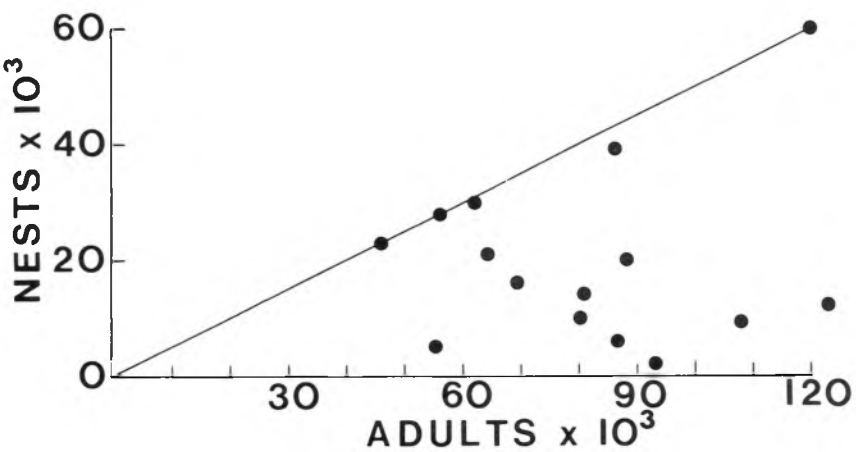

Figure 4. Relationship between number of adult Snow Geese arriving at the Wrangel Island colony and the number of nests found in the colony. (Based on data in Syroechkovskiy & Kretchmar 1981; and on unpublished data.)

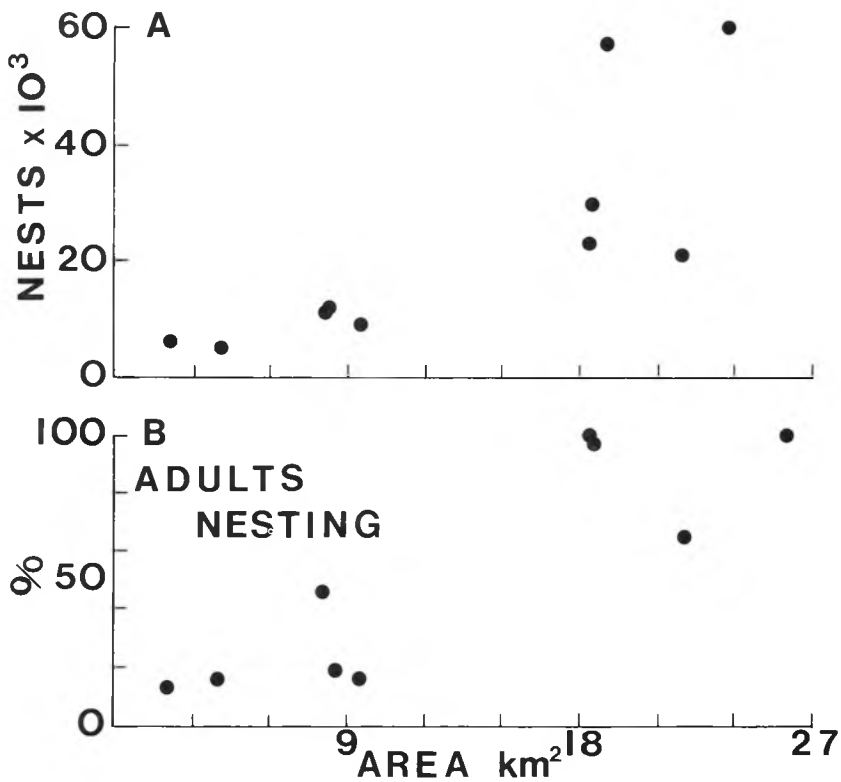

Figure 5. Relationship between area of the Wrangel Island Snow Goose colony, number of nests, and percentage of adults nesting. (Based on data in Syroechkovskiy 1979, 1981; Syroechkovskiy & Kretchmar 1981; and on unpublished data.)

weather). Because a goose needs nearly 24 hours to prepare to lay an egg after laying a previous one, the appearance of more than one fresh egg in a nest during this time period indicates the occurrence of nest parasitism. Syroechkovskiy (1976) noted that intra-specific nest parasitism tends to prevent a completely disastrous drop in the total production of the colony during nesting seasons with harsh weather conditions.

Weather affects nest survival not only directly, but indirectly as well. Areas of high nest density are less susceptible to fox predation than are those with a low density of nests. If nesting density is high, a fox may be threatened and attacked from several sides at once and its success rate in stealing eggs can thus be lowered. However, in areas or years of low nest density, the fox does not encounter this obstacle, because a pair reacts to foxes only when its own nest is threatened (Syroechkovskiy 1972; M. A. Bousfield, pers. obs.). For example, in 1973 the late melting of snow led to very high densities of nests on the few open areas of tundra, and fox predation, despite a low abundance of alternate prey (lemmings), was not severe (Syreochkovskiy & Kretchmar 1981). The total number of nests also affects survival. Figure 6a illustrates the positive correlation between number of nests and the percentage of nests that survive until the hatching period.

Survival after hatching and prior to fledging is not dependent upon total number and density of goslings (Figure 6b), as much as on the number of goslings hatching in a given time period. Snow Geese are synchronous nesters and, even more so, synchronous hatchers. Such synchrony reduces predation by creating an unmanageable surplus of prey, as well as by strengthening goose defences, as family groups flock together when threatened. This is especially important on Wrangel

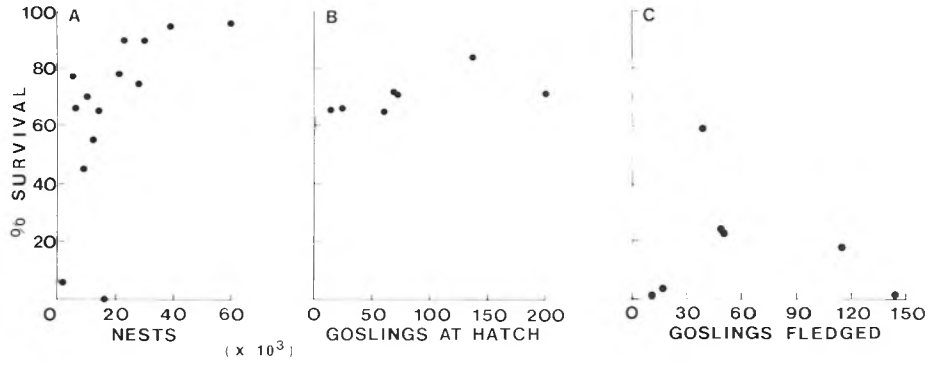

Figure 6. Survival of nests to hatch (a), goslings from hatching to fledging (b), and from fledging to returning to the Wrangel Island colony as yearlings (c). (Based on data in Syroechkovskiy & Kretchmar 1981; and on unpublished data.)

Island, where such groups daily form bands and leave the nesting grounds, where little food exists, to walk to the distant Tundra of the Academy, where the feeding conditions are comparatively lush. However, when different areas of the colony become free of snow at different times, the periods of egg-laying, and hence of hatching, are protracted for the population as a whole. Hatching of the entire colony may then occur throughout a 10–15-day period, rather than the 5–6 days of the usual, more synchronous years, and no sudden, large peak in hatching occurs (Syroechkovskiy & Kretchmar 1981). Fox predation on goslings, especially those hatching late in the period, is then quite high.

In general, there is higher predation of goslings than of eggs when lemming numbers are high, and *vice versa* when lemming numbers are low. In seasons of high lemming abundance, many foxes breed. The vixens do little hunting just prior to (three weeks) and following (two weeks) the birth of their young in June; the males defend their territories, on which live sufficient numbers of lemmings to sustain the pair and their very small offspring (N. G. Ovsyanikov, pers. com.). However, once the young foxes grow and need meat, and once they move out of the den onto the parental territory, predation on goslings increases markedly. On the other hand, when lemming numbers are low, few foxes breed, so few have territories. Therefore, many roam far and wide and thus encounter goose nests. Unless countered by the effect of high nest density, fox predation on eggs is high in such years.

The high losses of eggs and young goslings have resulted in the age structure of the goose population on Wrangel Island being weighted toward older birds. Based on their censuses and upon an assumed adult mortality rate of 20% between 1969 and 1976, Syroechkovskiy and Kretchmar (1981) calculated that in 1978 about 50% of the population was older than 8 years. This situation appears unlikely to change in the near future. Since the study began, young-of-the-year have represented at least 72% of Snow Goose losses between breeding seasons each year except in the period 1971 to 1974, and in 1983, when gosling production was low. Except for 1978–9, when approximately 43% of the estimated number of fledged goslings returned as yearlings, 72.5–98% of the fledged goslings have failed to return the following year (Figure 6c). These losses have been offset by good nesting seasons in 1975, 1976, 1978, 1979, and 1981. Should such seasons prevail in the second half of the 1980's, the age structure of the goose population should be shifted toward younger birds.

In any case, studies of the population during migration and on the wintering grounds appear necessary to determine the causes of such high mortality amongst young fledged birds. Such research could be vital to the continued recovery of this last remaining population of Snow Geese in the Soviet Union.

Acknowledgements

Thanks are extended to the participants of the 5th North American Snow Goose Conference and Workshop, held in Quebec City, Canada, 4–7 October 1984, who encouraged MAB to publish

this paper, and to J. Grant, J. R. Kirkham, and I. A. McLaren, who improved earlier versions of the manuscript.

Summary

Since 1969, Soviet investigators have been studying the Lesser Snow Goose *Anser (Chen) caerulescens caerulescens* on Wrangel Island, off the north-east Siberian coast. A large decline in goose numbers, which started six decades ago when the first permanent settlement was established on the island, is attributed to a combination of weather conditions, increased predation, and anthropogenic activities, both on Wrangel Island and along the North American Pacific migration route and on the wintering grounds. Weather conditions influence all aspects of the nesting season. A late spring results in high nest density in the few areas available, thereby decreasing the success rate of the major predator, the arctic fox *Alopex lagopus*, which accounts for 40–80% of goose production losses each year. Predation is heavy on eggs when numbers of the major alternate prey, lemmings *Lemmus sibiricus* and *Dicrostonyx torquatus*, are low, and on goslings when lemmings are abundant. A protracted spring leads to a protracted period of hatching and thus a decrease in gosling survival. Reindeer *Rangifer tarandus* are also responsible for losses during the nesting season. Co-operation by the Soviet Union and the United States with regard to changes in egg-collecting and hunting regulations have led to an increase in the Snow Goose population during the past decade. Adult mortality between nesting seasons has dropped from 20% to 5%. However, at least three-quarters of the goslings which fledge still fail to return to the colony as yearlings. Studies of the population on its wintering grounds in North America are advocated as a means to determine the chief causes of mortality of these young geese.

References

Alpheraky, S. 1905. *The geese of Europe and Asia.* Rowland Ward, London.

Chernyavskiy, F. B. & Dorogoy, I. V. 1981. K ekologii pestsa. [Contribution to the ecology of the arctic fox] Pp. 82–98 in: Krivosheyev, V. G. (Ed.) *Ekologiya mlekopitayushchikh i ptits ostrova Vrangelya. [The ecology of mammals and birds of Wrangel Island]* DVNTs Akad. Nauk S.S.S.R., Vladivostok.

Syroechkovskiy, Ye. V. 1972. O nyekotorykh osobennostyakh vzaimootnosheniy byelykh gusyey i pestsov na ostrovye Vrangelya. [Concerning some characteristics of interrelationships between snow geese and arctic foxes on Wrangel Island] *Zool. Zh.* 51 (8): 1208–1213.

Syroechkovskiy, Ye. V. 1976. Osobennosti povedeniya byelykh gusyey *(Anser caerulescens)* v gnyezdovoy period. [Behavioural traits of snow geese *(Anser caerulescens)* in the nesting period] *Zool. Zh.* 55 (10): 1495–1505.

Syroechkovskiy, Ye. V. 1979. Podkladyvaniye byelymi gusyami yaits v chuzhiye gnyezda. [The laying of eggs by snow geese into the nests of others] *Zool. Zh.* 58 (7): 1033–41.

Syroechkovskiy, Ye. V. 1981. Struktura kolonii byelykh gusyey *(Anser caerulescens)* na ostrovye Vrangelya i popytka prognoza izmeneniya ikh chislennosti. [Structure of the colony of snow geese on Wrangel Island and an attempt at a prognosis of the change in their abundance] *Zool. Zh.* 60 (9): 1364–73.

Syroechkovskiy, Ye. V. & Kretchmar, A. V. 1981. Osnovnyye faktory, opredelyayushchiye chislennost' byelogo gusya. [The fundamental factors determining the abundance of the snow goose] Pp. 3–37 in: Krivosheyev, V. G. (Ed.) *Ekologiya mlekopitayushchikh i ptits ostrova Vrangelya. [The ecology of mammals and birds of Wrangel Island]* DVNTs Akad. Nauk S.S.S.R., Vladivostok.

Uspenskiy, S. M. 1969. *Zhizn' v vysokikh shirotakh. [Life at high latitudes]* Mysl', Moskva.

Uspenskiy, S. M., Bemye, R. L. & Velizhanin, A. G. 1963. Avifauna ostrova Vrangelya. [Avifauna of Wrangel Island] *Ornitologiya* 6: 58—67.

M. A. Bousfield[1], 6256 Quinpool Road, Halifax, Nova Scotia, Canada, B3L 1A3.
Ye. V. Syroechkovskiy, Bird-ringing Centre, 1st Kotel'nicheskiy Perelulok 10, Moscow 109240, U.S.S.R.

[1] Present address: Delta Waterfowl and Wetlands Research Station, RR#1 Portage la Prairie, Manitoba, Canada R1N 3A1.