

moult, and migrates, information concerning the protection of the species should be disseminated, as hunters are currently rather unaware of the need.

A research programme to study this species on both a national and international scale is needed, the main priority of which should be to determine the migratory routes and wintering grounds of the populations by means of ringing and individual colour-marking schemes.

## BEAN GOOSE

### *Anser fabalis* L.

#### GUMÉNNIK

The Bean Goose is a northern Palearctic species of both tundra and taiga regions. The systematics of the species here follow the latest review by Stepanyan which is widely accepted throughout the former USSR. In his view, two principal subspecies occur in Central Siberia: the Western Tundra Bean Goose (*A. f. fabalis*) and the Taiga Bean Goose (*A. f. middendorffii*). A third, the East Siberian Tundra Bean Goose (*A. f. sibiricus*), occurs in the basins of the Khatanga and Kotuy Rivers and on the western shore of Khatanga Bay. Central Siberia is the region where these three subspecies intergrade, but the limits of their respective distributions are not quite clear. In many cases the subspecies intergrade, sometimes all three or, more often, the two western, the tundra and taiga subspecies. The following example serves to illuminate the degree of hybridization between the subspecies. Upon analysis of over 200 birds from the Pyasina River near Ust'-Tareya in the northern part of the typical tundra subzone, deep within the range of the Western Tundra Bean Goose and far from the ranges of the other subspecies as given by Pushenko (1952) and Stepanyan (1990), A. A. Vinokurov found the following proportions: Western Tundra Bean Goose, 65-72%; Taiga Bean Goose, ca. 10%; East Siberian Tundra Bean Goose, 3-5%, and birds with transitional features, 15-20% (Vinokurov 1971).

Tundra Bean Geese do not nest in the polar desert zone nor in most of the arctic tundras of Taymyr. The breeding grounds seem to be limited to the northern shore of the peninsula north of Lake Taymyr along the Nizhnyaya Taymyra River (Sdobnikov 1959).

For the taiga region of Central Siberia, the distribution pattern given by Pushenko (1952) has become obsolete. The Taiga Bean Goose breeds throughout the Podkamennaya Tunguska River basin, in the adjacent Yenisey mid taiga, and even along the northern tributaries of the lower Angara River (Syroechkovski 1959; Rogacheva *et al.* 1978; Syroechkovski *et al.* 1978).

The northern breeding range limit of the taiga subspecies follows the northern boundary of forest-tundra but extends north along the valleys of large

ivers. The southern boundary of its present distribution passes approximately along the watershed separating the Angara and the Podkamennaya Tunguska Rivers, and west of the Yenisey along the Sym and Kas Rivers. To the east, the birds breed along the upper reaches of the Nizhnyaya Tunguska River in the Katanga District of the Irkutsk Region (Melnikova *et al.* 1984). Small numbers of Bean Geese do breed in remote areas in mid and sometimes southern taiga. It is possible that they bred south to the southern limit of this subzone in former times. The southernmost currently occupied breeding grounds known to us are located in the basins of the Yeloguy, Dubches, Sym, and probably the Kas Rivers. Near Mimoye (62°15' N), the geese breed in pairs or in small groups on remote taiga lakes and bogs along the Verkhnyaya Sarchikha, the Bolshaya Varlamovka, and the Malaya Varlamovka River where broods two and five days old were found on June 13 and 16 in 1985, respectively. Before autumn migration, the taiga geese feed intensively in horsetail thickets on the sand banks of the Yenisey. From 1970 to 1975 in the area around Mimoye—which received protected status in 1970—only individual flocks of 2-5 birds appeared from deep within the taiga on a 10 km stretch of sand shores on the western side of the Yenisey. Between 1982 and 1986, however, 150-200 Bean Geese could be seen in the same area at one time. During the same period, though, the number of migratory geese observed on the Yenisey in mid taiga decreased drastically to levels one-half to one-third those observed for the past 30 years.

In the past, the species also nested regularly in the West and East Sayan as well as the Kuznetsky Alatau Mountains in the south of Central Siberia. In the Sayan Mountains, considerable numbers occurred along the Kandat and the Tyukhet Rivers, tributaries of the Amyl River (Tugarinov 1915). Small numbers also bred on the Sisim and Kazyr Rivers and possibly on the Mozharskiye Lakes (Sushkin 1914). The basins of the Mana and Tuba Rivers are also listed as belonging to its distribution range (Pushenko 1952). As in Mongolia, the Bean Goose inhabited high montane bodies of water sometimes near tree line and occasionally within the forest belt.

Today, the Bean Goose has virtually disappeared from the mountains of the Central Siberian south. Only a few records of their occurrence there are currently available. In the West Sayan Mountains, a breeding site was found along a forest lake which has been since submerged under a large reservoir at the mouth of the Antropka River in the Sayano-Shushensky Reserve (Sokolov *et al.* 1983). From 1970 to 1972, small numbers of geese bred on high montane lakes near the village of Verkhniy Zub in the Kuznetsky Alatau Mountains. This region subsequently received heavy use both by tourists and by people fishing, and the geese disappeared (Prokofyev pers. comm.). These

montane Bean Goose populations in the south of the Krasnoyarsk Territory and throughout South Siberia are disappearing rapidly and urgently require the strictest protection.

Generally speaking, the Bean Goose is currently the most numerous goose of Central Siberia. However, its numbers have been decreasing steadily, while those of the White-fronted Goose are stable or even slightly increasing, and thus, the White-fronted Goose may soon rank first. According to A. S. Martynov's estimates, there was a mean of 510,000 Bean Geese in the Krasnoyarsk Territory between 1978 and 1981 (Martynov 1983). Further, he suggests that of these, 4% (20,400 geese) occur in arctic habitats, 69% (351,000) in tundra, 24% (121,400) in forest-tundra, and 3% (15,300) in taiga. The greatest numbers of Bean Geese are found in the central and southern parts of the typical tundra subzone as well as the shrub tundra subzone, which area coincides closely with the North Siberian Lowland (excluding its northern section) in Taymyr. This area accounts for no less than 60% of all the Bean Geese within the territory.

It should be emphasized that in A. Ya. Tugarinov's day the Bean Goose was undoubtedly the most numerous goose in the region. Today, the proportion is changing in favour of the White-fronted Goose. This can be attributed to the hunting to which the Bean Goose is subjected on its wintering grounds in East Asia, while the population of the White-fronted Goose, which winters in Western Europe, receives effective protection.

In the 1960's, approximately equal numbers of Bean and White-fronted Geese were recorded in western Taymyr; only in some areas were the White-fronted Geese more numerous (Krechmar 1965 and 1966). In 1978 and 1979, the White-fronted Goose predominated in western Taymyr, accounting for between 65 and 70% of the geese. In the central part of the peninsula (on the Verkhnyaya Taymyra, Lukta, and Aya-Tari Rivers), the Bean Goose was predominant, and in eastern Taymyr the species constituted the overwhelming majority (Krivenko *et al.* 1984). Other authors state that the ratio of moulting Bean to White-fronted Geese in western Taymyr (Pura River) was 1:1 in 1980, 1:2 in 1982, 1:3 in 1983, and 1:2.4 in 1984 (Kokorev 1985). Ya. I. Kokorev further suggests that the stable predominance of the White-fronted Goose in the western part of Taymyr (up to the Gorbata River) implies that the population of the White-fronted Goose is in relatively good condition and that it indirectly confirms the negative trend in the numbers of the Bean Goose. Interestingly though, the line of separation through Taymyr between the respective populations of the two most numerous goose species in the north of the central Palearctic remains practically unchanged, in accordance with the existence of the Yenisey zoogeographical boundary. A certain expansion of

the White-fronted Goose population wintering in Western Europe eastwards to central Taymyr may be assumed, but there has been no evidence supporting this so far.

There are not many numbers available concerning the breeding densities of the Bean Goose. Three to five nests/km<sup>2</sup> were recorded on favourable sites on the middle reaches of the Pyasina River within the area showing the highest breeding densities in the typical tundras of western Taymyr (Krechmar 1966). In the Agapa River basin in shrub tundra, 60,000 Bean Geese were recorded on an area of 30,000 km<sup>2</sup> (Pavlov and Kuksov 1965). B. M. Pavlov registered 2.5 pairs/km<sup>2</sup> on the middle reaches and 1.7 pairs/km<sup>2</sup> on the lower reaches of the Pura River in 1969. Such high numbers occur only in individual years particularly favourable for reproduction. Furthermore, these are most probably no longer current figures. In the season preceding Pavlov's observations, the geese almost failed to reproduce entirely because of abnormal spring weather conditions, while in 1969, the majority of the adults found were nesting. For the Bean Geese in Taymyr, alternating years of reproductive success and failure are typical (Kokorev 1985). Poor weather conditions in spring affect primarily the Bean Geese, as these are the first geese to arrive and to begin nesting (Zyryanov and Kokorev 1983). Breeding densities of the species vary by a factor of eight and mean clutch size by a factor of two, depending on the weather conditions in spring (Borzhonov 1974).

The samples taken by A. V. Krechmar and B. M. Pavlov may not have been taken randomly; rather, they may have sampled selectively in areas with the highest goose concentrations. Regular samples taken by zoologists from Norilsk between 1978 and 1982 in the basins of the Pura and Verkhnyaya Taymyra Rivers gave figures ranging from 0 to 0.32 pairs/km<sup>2</sup> (Kokorev 1985). Densities of 0.32 pairs/km<sup>2</sup> were found only in 1978; during the subsequent 5 years, the density did not exceed 0.15 pairs/km<sup>2</sup>. Data from the Pura River were taken on specially selected permanent sampling plots and may be considered quite representative of large territories. In 1980, transect surveys were carried out during the breeding season on the Pura River resulting in values of 0.1 birds/km<sup>2</sup> (Kokorev 1983). Even if the samples taken by Ya. I. Kokorev and B. M. Pavlov in the 1960's were from areas with exceptionally high goose concentrations, we may still conclude, based on the range of current figures available, that the population on the Pura River decreased dramatically over the 15-20 years prior to 1980.

Aerial records from different tundra areas of Taymyr from July and early August 1978 and 1979 gave average figures ranging from 92 to 1580 in 1978 and from 319 to 2265 birds per 100 km of rivercourse in 1979 for both the

Bean and the White-fronted Goose together (Krivenko *et al.* 1984). The highest numbers of geese were found in the basins of the Mokoritto and the Gorbata Rivers (1353 and 1590 in 1978, and 2227 and 2265 in 1979, respectively). Again, Bean Geese constituted the majority of the birds in eastern Taymyr, while the White-fronted Goose prevailed in central and western Taymyr.

In forest-tundra, the Bean Goose is no longer a numerous, rather only a common species. It breeds in small numbers in open woodlands near Lake Khamtayskoye. Even if many suitable breeding sites are available, pairs nest at distances of several kilometers from one another. In boggy open woodlands with many small lakes, an average of 1 pair for every 2.3 km<sup>2</sup> (0.33-0.50 pairs/km<sup>2</sup>) was found, but areas with such a great goose abundance were not numerous (Syroechkovski 1961). Numbers on the remaining, greater part of the area were one-half to one-third as high.

In northern taiga, the Bean Goose is rare but breeds regularly, though more rarely than in the belt of extreme northern taiga with its numerous open tundra-like areas and lakes. In the remote parts of northern taiga, the Bean Goose numbers remained unchanged until the end of the 1970's, but thereafter, with increased use of helicopters, the population level dropped to one-half to one-third previous levels. The most dramatic reductions were observed in the Yenisey valley (Rogacheva and Vakhrushev 1983). The distribution of the species in forest-tundra is relatively clumped and very irregular, while in northern taiga, the pairs occur only individually but also irregularly in suitable areas.

In mid taiga the Bean Goose is rare. Breeding sites are widely scattered, located only in individual remote areas, mainly on taiga lakes, large bogs, and on small taiga rivers, but it avoids large rivers. The individual pairs nest separately or in small groups of up to 10 pairs and rarely in larger groups. Numbers in protected areas are recovering. Further south, in the mountains of southern Central Siberia, the pairs breed only individually.

The habitats characteristically occupied by Bean Geese in Central Siberia are as follows: in tundra on Taymyr, Bean Geese most frequently select breeding sites in tussock moss-cottongrass or moss-sedge tundra at a distance of no more than 500-600 m from a body of water; in forest-tundra, they select sites in mixed stunted forests on the shores of small, infrequently forested lakes (Krechmar 1966; Syroechkovski 1961). The Bean Geese of the taiga nest on large mossy bogs often located on watersheds, near lakes in taiga, and near small forest rivers with patches of herbaceous vegetation on the banks. In the mountains up to 2400 m above sea level, they nest on subalpine plateaux

with bogs and lakes, in river valleys, and even near forest lakes (Sushkin 1938; Syroechkovski 1959 and 1961; Rogacheva *et al.* 1978).

The wintering grounds of the Central Siberian Bean Geese have not been adequately studied since the ringing efforts have been ineffective and since only single recoveries from this region have been procured. Most of the Bean Geese breeding in Central Siberia winter in China or in adjacent countries and cross over Mongolia. The evidence on which this is based comes from the flight direction of flocks and on the frequent recovery of small iron shot of Chinese origin embedded in the bodies of geese collected in western Taymyr (Krechmar 1966). This is true for both the taiga and tundra populations. That the geese also frequent wintering grounds in India, Burma, or Japan cannot be ruled out, particularly for the taiga population and the population in the eastern part of the territory, although no supporting evidence is available.

Autumn migration is typically directed to the southeast or the south in the majority of the Bean Geese of Taymyr. This is based on numerous visual observations and on ringing data. Of 69 Bean Geese ringed in the summer in western Taymyr, 6 birds were shot and the rings recovered (Lebedeva 1979). Two birds, one and two years after ringing, were killed in the spring near Lake Baikal; another was shot in the spring the year after ringing in the western part of the Chita Region on the border to Mongolia (Kyra District). Two further birds were shot in the same year they were ringed 300 km to the south of the ringing location; one was killed not far from Norilsk on September 17 and the other on the Yenisey near Dudinka on July 6. This latter fact is of particular interest: this bird left the tundra shortly after ringing and moved south along the Yenisey a considerable distance, into the forest-tundra. Perhaps this goose and other similar birds are those that appear further south in August—in the Yenisey mid taiga. This would explain the numerous findings of Tundra Bean Geese deep inside the taiga along the Yenisey, south to the Podkamennaya Tunguska River. The other ringed goose recovered was shot late in the autumn (November 25) of the year it was ringed far to the southwest, in the Urals. The orientation of Bean Goose migration from eastern Taymyr is further evidenced by a bird ringed in August 1968 on the Boshaya Balakhnya River and shot in April of 1974 in Priargun' District, Chita Region.

An important migratory route for the species follows the Yenisey River. Those geese that do not veer off to the east in the central part of the Yenisey basin and those few that do turn west, continue due south along the Yenisey valley through the Sayan migratory passages in Tuva, then continue on via Mongolia.

A very small number of the Bean Geese breeding in Central Siberia overwinter in Western Europe. This is supported by recoveries of geese ringed in massive ringing programmes on the wintering grounds in the Netherlands. The majority of the Bean Geese wintering there breed in the north of European Russia and of West Siberia. By the end of the 1970's, 395 Bean Geese with Dutch rings had been shot in the USSR. Among these were only approximately one dozen that were shot near the Gydan Peninsula and on the Pur and the Yenisey Rivers, and none that were recovered further east. Only one bird was recovered on the Yenisey in spring; it was shot on May 29 near the village of Vereshchagino at 64°30' N, 2.5 years after it was ringed. Three other birds ringed in the Netherlands were shot on the Yenisey in autumn. Most likely, these birds nested somewhere in the north of Central Siberia, probably Taymyr, migrated south up the Yenisey in autumn and were then shot in mid and late September near Turukhansk, on the Us River in the Sayan Mountains, and on the Bolshoy Yenisey River in Tuva. The latest bird was shot on September 28 in the year it was ringed. However, it is doubtful that this bird—as well as the one shot on the Us River—was returning to its previous wintering grounds in the Netherlands. Both were already near the Mongolian border and evidently moving to their new wintering grounds in East Asia. These birds were probably "intercepted" by their conspecifics; the mass movement of Bean Geese headed for Asian wintering grounds carried with it those birds that had wintered in Western Europe in earlier winters. It cannot be ruled out that a part of the Bean Geese breeding in the north of Central Siberia and especially those breeding along the lower reaches of the Yenisey winter in the Danube basin where the largest European concentrations of wintering Bean Geese (about 100,000 birds) are to be found and where the majority of geese from Yamal and Gydan may winter (Kishchinsky 1979).

A part of the birds using the Yenisey flyway in autumn veers off to the west. Single records of Bean Geese with Dutch rings in Tomsk and Omsk Regions and in northern Kazakhstan in autumn support this. The general pattern seems to be that the farther north, the greater the number of cases of westward migration can be observed. The critical line seems to be somewhere in Yenisey mid taiga and partly in southern taiga but not further south than Yeniseysk. In the far north near Dickson, the Bean Geese head almost immediately due southwest according to V. I. Marunin's visual observations (pers. comm.). It should be remembered that the Bean Geese from the Pyasina delta, only 200 km east of Dickson, head southeast and south directly to Asian wintering grounds. Again, this allows a distinction to be made between the western and eastern Bean Goose populations in Taymyr with the line of separation passing through western Taymyr. M. I. Lebedeva (1979) shares

this view, and again, it is in accordance with the presence of the Yenisey zoogeographical boundary and emphasizes its importance.

No ringing data are available for the Taiga Bean Goose, but the population seems to winter entirely in Asia; a few geese breeding near the Yenisey may form an exception.

The migratory routes followed by the Bean Goose in Central Siberia are poorly known; generally, any information is based on visual observations and not on ringing data. The main difficulties are that in autumn the geese fly mainly at night at considerable heights and that migration progresses rapidly over a very short time period.

In spring, the Bean Geese appear near Krasnoyarsk in late April, and in Yenisey mid taiga at the end of April and early May, as many years' observations show. In the vicinity of the Noril'skiye Lakes in forest-tundra, the geese arrive in the middle of May, and in the typical tundra subzone of western Taymyr during the last third of May (Borzhonov 1968). In the Putorana Mountains, Bean Goose migration covers late May and early June (Borzhonov 1977). Near Minusinsk, migration ends during the second third of May and on the Yenisey in Tuva on May 19 (Sushkin 1914; Savchenko and Chugaev 1986). Mass migration near Krasnoyarsk occurs between May 3 and 10 (Tugarinov and Buturlin 1911); near Mimoye in Yenisey mid taiga it begins between May 21 and 27 and lasts 5-7, occasionally even 10 days (Rogacheva *et al.* 1978). At the latitude of Noril'sk and further north in typical tundra, mass migration proceeds throughout early June. In tundra areas, it usually coincides with the time when the thawed patches rapidly enlarge (Krechmar 1966).

The departure of the geese in autumn from the upper reaches of the Pyasina River and from the Noril'sk area typically occurs in the last third of September or early October; occasionally it takes only two or three days (Krechmar 1966). In Yenisey mid taiga migration begins in early September and lasts until the first half of October; the period of the most intensive migration here begins on September 26 or 27 and lasts about a week, but the number of days on which intensive movements are observed does not generally exceed three or four (Rogacheva *et al.* 1978).

The routes taken during spring and autumn migration show significant differences. In spring, the geese keep to large rivers with well-developed valleys such as the Yenisey, Angara, Pyasina, and Khatanga Rivers; they rarely follow the narrow and rocky valleys of the Podkamennaya and Nizhnyaya Tunguska Rivers.

On the upper reaches of the Yenisey in Tuva, the Bean Geese also remain in the Yenisey valley (Savchenko and Chugaev 1986). However, the massive

migratory movements of Bean Geese along the Yenisey mentioned by A. Ya. Tugarinov and generally observed in the early part of this century are no longer noted. The reservoirs built on the Angara River and on the upper Yenisey have had a negative effect on the intensity of migration along these rivers. Previously, the geese remained for a long time around the Kexhma and Motygin Islands on the Angara River and near Vorogovo on the Yenisey. The present break-up pattern of the ice has become unfavourable for geese (Martynov 1983). Today the valleys of the Yenisey and Angara Rivers are also more developed and receive more intensive use by hunters.

Large mountain systems tend to be circumscribed by the migratory routes. In the Putorana Mountains, spring migration is much weaker than in the adjacent areas (Syroechkovski 1961) as there are few suitable areas for feeding and resting, particularly in spring. In the sources of the Ayan River, however, 1776 birds were noted for 10 days, the entire length of the spring migration in that area (Borzhonov 1977). In general, between 10,000 and 15,000 geese cross over the central part of the Putorana Mountains during spring migration (Zyryanov and Pavlov 1984).

Autumn migration through Central Siberia proceeds in a wider front than in spring, but the two main Central Siberian orientations of waterfowl migration, particularly pronounced in spring, can also be traced in autumn: the Yenisey stream and the east Evenkian stream (Syroechkovski 1965). The geese cross Evenkia in a wide front. Near the Noril'skiye Lakes, autumn migration is intensive and spring migration weak. In spring, the geese in western Taymyr mainly follow the Yenisey and Pyasina Rivers (Krechmar 1966). My own observations show that in the vicinity of the Noril'skiye Lakes all the Bean Geese fly strictly to the southeast in autumn. Part of the Pyasina population must also follow the Yenisey during autumn migration since a goose that Krechmar ringed on the Agapa River in the August of 1960 was shot in the same year at the mouth of the Angara River (Krechmar 1966). In Yenisey mid taiga (Mirmoye) the intensity of migration is similar in both seasons, but in autumn the geese move mainly at night flying rather high and short-cutting the Yenisey meanders (Rogacheva *et al.* 1978).

A. S. Martynov believes that the migratory stream crossing over Evenkia in autumn splits into two (Martynov 1983). One branch is directed towards Lake Baikal, the other shifts towards the Yenisey. These birds cross the Sayan Mountains and are known to spend the nights on lakes in the alpine belt.

The Bean Geese cross the mountains, at least partially, along the Yenisey valley; in the foothills near the "entrance" to Tuva, they remain in the valley. Bean Geese and Mergansers constituted 52.3% of all the waterfowl migrating along the valley of the upper Yenisey at the point where it begins to cut into

the mountain system. Over two months of observations of spring migration only 978 geese were recorded there. However, it is possible that a considerable portion of the waterfowl crossing over the Sayan Mountains pass in a wide front at altitudes too high for visual observation (Savchenko and Chugaev 1986).

Before the start of autumn migration, the Bean Geese forage intensively, concentrating their efforts on large sand banks with horsetail thickets, their main diet during this period. The largest concentrations accumulate on the huge beaches on the shores of the Khatanga Bay. Local concentrations are also found on the Yenisey, Kheta, Popigay, Gusikha, and Bolshaya Balakhnya Rivers (Martynov 1983).

Spring and autumn stopover sites for migratory geese are known in Central Siberia from steppe and forest-steppe areas within the forest-meadows of Khakasia, namely in Taseevski and Dzerzhinsky Districts. On the whole, according to A. Ya. Tugarinov's observations, autumn migration occurs much more rapidly than spring migration, sometimes beginning unexpectedly or ending suddenly. Spring migration, according to his earlier data (Tugarinov 1906), may extend over a month and a half, while autumn migration may take place almost during a single night in some localities. In 1908, for example, during the night from September 30 to October 1 an immense migratory movement was observed throughout the area from the Angara River basin up to the latitude of Minusinsk. "The geese passed by in huge flocks every minute, descending on taiga rivers, lakes and salty steppe lakes only to take off again when they were replaced by ever more flocks. In the morning only very small flocks could be seen. A similar situation was observed in 1910" (Tugarinov and Buturlin 1911).

Data on numbers during migration are scarce. Around the Noril'skiye Lakes, hardly more than two dozen Bean Geese could be seen at once from one observation point (Krechmar 1966). The situation was the same on Lake Khatayskoye in 1960 (Syroechkovski 1961). According to Krechmar (1966), migration was observed for only two days in the autumn of 1959, but the movements were quite intensive: flocks of 50-70 birds followed one after the other very rapidly, sometimes with intervals of only a few minutes. In other years, there were so few geese that an observer could record no more than 10 birds even at those moments of the most intensive migration. In the north at the Pyasina River on the major spring route, flocks and small groups of Bean Geese flew over a single observation point every 10-15 minutes during most of the day on good days (Krechmar 1966).

During the mass migratory movements observed in 1966 and 1967, between 185 and 1430 geese a day flew over a 2-km observation strip near the

Purinskiye Lakes and on the Verkhnyaya Taymyra River. Of these birds, Bean Geese accounted for 51% (Borzhonov 1968). In the northern forest-tundra between the Yenisey and Pyasino Lakes (a front 60 km long) during massive spring migratory movements, between 14,000 and 22,000 geese passed overhead, of which half were Bean Geese (Zyryanov *et al.* 1968).

In general, it is believed that the number of migrating geese in Taymyr has decreased in the last decade, but concrete figures are unfortunately not available.

An observer recording geese passing through the Yenisey mid taiga near Mimoye between 1971 and 1978 registered between 3000 and 5000 geese during each entire spring migration (Rogacheva *et al.* 1978). By comparison, the migrations in both spring and autumn between 1980 and 1986 were less intensive. Compared to observations made between 1956 and 1958 near Komsa, it appears that the number of geese migrating across the Yenisey mid taiga in both spring and autumn has decreased drastically within the last 30 years, to levels one-half to one-third of what they were. The decrease here over the last 50 years is even more dramatic. The data on the numbers of geese migrating on the Yenisey near Verkhne-Imbatskoye and on the lower Yeluguy River have been taken from the zoologists V. N. Scalon, A. A. Sludsky, and K. A. Yudin who worked in the area in the 1930's. Estimates show that levels of migrating Bean Geese were 4-5 times higher then than they were 50-55 years later. It is possible that the decrease in the actual numbers of Bean Geese is lower, since the calculations here are based on the Yenisey River which the geese simply seem to use less today, especially in spring. There are indications that the migration has dispersed somewhat onto a wider front; many geese fly over the unpopulated depths of the western bank of the Yenisey—along the watershed with numerous bogs and some lakes separating the Yenisey from the Dubches River, for example. In the spring of 1985, a considerable movement of geese was observed west of the Yenisey along the Turukhansk Lowland, particularly along the Nizhnyaya Baikha River. The movement was as massive as that in the adjacent Yenisey valley (Zabelin pers. comm.).

The number of migrating geese decreases more conspicuously at the latitude of Yeniseysk, Krasnoyarsk, and further south. Intensive development of the region, the construction of dams on the Angara River and the upper Yenisey which flooded the sand banks, meadows and other foraging areas of the geese, autumn ploughing which impedes the foraging of the geese in spring—all this affected the migratory conditions in the area negatively. Thus, where previously hunters in Sharypovsky District could shoot 20 geese in a

spring the Bean Goose today is noted only as a very rare visitor in migration (Zhukov and Tertitsky 1984).

The numbers available do not allow an estimate of the total number of geese moulting in Taymyr. Numerous motor boat surveys in western and central Taymyr between 1980 and 1984 showed that between 9.7 and 139, most often between 12 and 20 Bean Geese were present for every 10 km of the survey route (Kokorev 1985). This is not much. In 1961, A. V. Krechmar recorded geese on the Pura River where similar observations were taken in the 1980's (Krechmar 1966). He recorded flocks averaging 150 birds every three or four km. On a survey route with a total length of 350 km, 430 geese were recorded for every 10 km of the survey route, and a majority of these birds were Bean Geese. On nearly all of the small tributaries of the Pura River, or at least in the areas around their mouths, flocks of several to several hundred birds belonging to both Bean and White-fronted Geese were noted.

The moulting grounds of the Bean Goose are on the rivers and lakes in the most inaccessible parts of the tundra. A shift in the Taymyr moulting grounds from the major rivers such as the Verkhnyaya Taymyra and the Lukakh to the most remote and undeveloped bodies of water seems to be occurring (Kokorev 1985). Areas hosting massive moulting goose concentrations, once widespread throughout Taymyr, are now declining in number. In 1984, a huge concentration of moulting geese was discovered in the Pyasina delta. Aerial surveys showed that one-fifth to one-quarter of all of western and central Taymyr's geese, or about 230,000 birds, Bean and White-fronted Geese, were gathered here (Borzhonov and Vinokurov 1984).

**Protection and rational use.** There is reason to doubt the Bean Goose population estimates given by Martynov (1983). With a steady decline in numbers, the Central Siberian population is not likely to equal one million birds; the species probably ranks second behind the White-fronted Goose. The goose problem in Taymyr, particularly in the west, is misleading at first glance. Clearly, the total number of geese in the area has declined, but in recent years, there has been a barely noticeable rising tendency in some goose populations. The noted losses are not taking place at the expense of the White-fronted Goose as this species is protected on its wintering grounds in Western Europe. The same is true of the Red-breasted Goose and other species.

The main reason for the decreasing numbers of the Bean Goose is the losses it experiences on its wintering grounds outside the former USSR, in East Asia. The other factors are certainly also important but cannot be playing the decisive role. This is obvious when compared with the White-fronted

Goose. Here, nearly the same local factors, hunting pressure during migration and on the breeding grounds, habitat deterioration, etc., do not have a detrimental effect on the population. The most significant local factors impinging on the population are as follows.

Hunting pressure, according to A. S. Martynov's estimates, cost 63,000 geese their life in the Krasnoyarsk Territory in 1978 (Martynov 1983). Of these, 6600 were killed in Turukhansk and Yeniseysk Districts, 1100 in Evenkia, 600 in the Angara area (Severo-Yeniseysk, Motygino, Boguchany, and Kezhma Districts), 1300 in the south of the territory (42 districts) and 53,000 in Taymyr. In Taymyr, including eastern Taymyr where Bean Geese predominate, Bean Geese accounted for half of the birds shot; the birds shot in the other areas were virtually all Bean Geese. Thus, the number of Bean Geese killed in the Krasnoyarsk Territory was 36,100. The data for the Turukhansk and Yeniseysk Districts, however, seem to be overestimated. Generally speaking, hunting losses made up about 7% of the population. The Bean Geese of Central Siberia are also shot in Tuva, in all regions of the Baikal and Transbaikalian areas, and in Mongolia. In the Pyasina River basin alone, between 6000 and 9000 geese were killed annually during spring hunting (Kostin 1981), of which about half, perhaps more, belonged to the Bean Goose, since hunting began with their arrival (Kokorev 1985).

The continuing development of the tundra is the most significant of the other factors. As a result, the number of destroyed clutches increases as well as the mortality levels of goslings and moulting birds. The disturbances, though, have a negligible effect on the well-being of the birds gathering on the moulting grounds. Zoologists in Norilsk have recently established that one of the reasons goose numbers are decreasing may be the presence of hundreds of thousands of wild reindeer during the breeding season, particularly in western Taymyr. In the southern part of the Krasnoyarsk Territory, the general changes in land-use and the reorientation of the hydrological systems as well as the sharp increase in the population at large and particularly of the hunters has a continuing negative effect on migratory Bean Geese and is particularly detrimental to the remnants of the vanishing montane population.

A system of protection and rational use of the Bean Goose should take into consideration ecological specificities of the species itself and not of geese in general or of waterfowl on the whole as is often done. Furthermore, it requires regional differentiation, even within the Central Siberian population.

The montane populations should be recognized as vanishing if not already extirpated and should be registered under the appropriate heading in the Red Data Book of the Krasnoyarsk Territory. The Sayano-Shushensky Reserve

and the mountain sanctuaries in the Krasnoyarsk Territory should be important in their restoration and protection.

The Taiga Bean Goose, the population of which is not large and has experienced losses in many areas, requires special protection. Its economic importance is negligible. The populations throughout the entire mid taiga region, those that have maintained themselves near the northern border of the southern taiga, those along the Yenisey valley and in northern taiga all deserve special protection. These populations are already listed in the Red Data Book of the Krasnoyarsk Territory.

The Bean Goose within Central Siberia requires protection, but to control hunting here is not an easy task. Complete prohibition of spring waterfowl hunting in the Krasnoyarsk Territory and the Russian far north is a measure that cannot claim widespread support. In Taymyr, prohibiting the hunting of Bean Geese while allowing hunting of the White-fronted Goose is not feasible as it is difficult to distinguish the two species while hunting. Therefore, we propose a more flexible solution based on the migratory geography of the species.

A complete moratorium on the hunting of geese for a period of at least 5 years in the "Bean Goose zone," where the species does not mix with other geese along its main migratory routes, seems reasonable. This would give the species a respite from hunting in the southern and central parts of the Krasnoyarsk Territory including the area along the Angara River and, naturally, along the entire Yenisey River north up to and including Turukhansk and Igarka Districts and to Dudinka. Goose hunting could be permitted in Evenkia with the exception of the mid taiga subzone nearly according to the previous regulations, as there are no large concentrations of migrating geese there. In that region, the Bean Goose is the main migratory goose. Only near Dudinka do the White-fronted Goose as well as the Red-breasted and some Lesser White-fronted Geese join the migrating Bean Goose. In this way, 9000-10,000 Bean Geese can be spared and, what is more important, the disturbance factor on the major part of the migratory route through Central Siberia can be deleted. Similar measures should be taken in Tuva, the Baikal, and the Transbaikalian areas. Thus, several dozens of thousands of Bean Geese would be spared.

In Taymyr and other localities (after hunting resumes), a geographical network of protected areas should be established based on knowledge of goose ecology and the precise locations of goose concentrations during migration, breeding, and moulting. Of utmost importance is the establishment of a state sanctuary in the Pyasina River delta. This reserve may be seasonal but must



be maintained under strict control. It is necessary in order to hinder people from staying in the area and to prohibit low-flying aircraft and their landing in the area. The Pyasina delta is a unique area for moulting geese not only within Taymyr but also in the entire Asian North. In accordance with the Ramsar Convention criteria, this is a wetland of international significance (Borzhonov and Vinokurov 1984).

However, merely the efforts of Russia cannot solve the problem. Regulation of hunting and the protection of migratory routes and wintering grounds are also necessary in Mongolia and particularly so in China. This requires international efforts and coordination, perhaps by means of a convention on hunting and the rational use of geese. Special research should precede the preparation of such a convention. The study of migration patterns and wintering grounds, a survey of the major moulting concentrations, investigations into the mortality factors of the population, comprehensive surveys of the breeding grounds, and permanent migration monitoring programmes should receive priority. A mass ringing program should be organized in Russia.

#### BAR-HEADED GOOSE

##### *Eulabia indica* Lath.

#### GÓRNY GUS'

The Bar-headed Goose, listed in the Red Data Books of the RSFSR and USSR, is a rare species, endemic to the mountains of Central Asia. In Central Siberia, it is an extremely rare vagrant. The nearest breeding grounds are located in the southeastern Altai, Tuva, and northern Mongolia.

Since the 1960's, light-colored geese resembling Bar-headed Geese were observed in Taymyr. Norilsk zoologists succeeded in substantiating the reports (Borzhonov 1978). In August 1965, B. M. Pavlov observed a Bar-headed Goose in a flock of moulting White-fronted Geese on the Purinskiye Lakes. B. B. Borzhonov observed the species on two occasions among non-breeding, moulting geese also on the Purinskiye Lakes and on the lower reaches of the Agapa River. In June 1972, a Bar-headed Goose—an immature male—was collected from a flock of Pintails moulting on the Agapa River. And on June 11, 1972, V. A. Kuksov saw a Bar-headed Goose in a flock of immature White-fronted Geese on the upper reaches of the Pyasina River. Bar-headed Geese probably stray to Taymyr when young individuals join flocks of other geese on the wintering grounds or during migration.

### *Cynopsis cygnoides* L.

#### SWAN GOOSE

#### SUKHONÓS

The Swan Goose occurs in Russia only on the northern periphery of its range. It is listed in the USSR Red Data Book as a rare species and as an endangered one in the Red Data Book of the RSFSR. The greater part of its range lies in Mongolia and China. P. P. Sushkin noted the species as a rare bird of the Krasnoyarsk Territory that bred in the northwestern part of the Minusinsk depression on Bele, Irengol, and Chernoye Lakes. Breeding in this area was confirmed by A. I. Yanushevich and K. T. Yurlov (Yanushevich and Yurlov 1950). However, according to Prokofyev (1987), it no longer breeds in Khakasia, although it is encountered here very rarely but annually. S. M. Prokofyev observed a Swan Goose in May 1975 on Lake Chernoye in a flock of Greylag Geese. Two birds were collected in autumn 1982 from a flock of eight seen in Beysk District.

### *Cygnus cygnus* L.

#### WHOOPEER SWAN

#### LÉBED'-KLÍKÚN

A rare species of the Central Siberian taiga and forest-tundra, the Whooper Swan east of the Yenisey seems to nest everywhere on suitable bodies of water in the Putorana Mountains and in the area around the Norilskiy Lakes. Here, near the Pyasina River, its range approaches that of the Bewick's Swan (Krechmar 1966). Along the Yenisey, the species occurs north to 70° N, but breeding evidence has been provided only for the area around Ust'-Khanayka at 68°15' N in the southern forest-tundra subzone. Along the Yenisey itself, virtually no breeding areas in southern and mid taiga were found, and breeding is rare in northern taiga. The areas where the highest concentrations of Whooper Swans in Central Siberia occur are located in the depths of the Yenisey northern taiga and forest-tundra on the western side of the river. In mid taiga, especially its northern section such as the upper reaches of the Taz River and the basin of the Yeluguy River, Whooper Swans were once numerous but are rare today, although they still breed regularly. In the area around Mirmoye, which has stood under protection since 1970, the birds breed consistently in small numbers on remote lakes on the western floodplain of the Yenisey near the Desyativerstnye Lakes (Lake Lebedinoe among others) and in the basin of the Razvilki River. The swans appear in Mirmoye during the last third of April, although already in March in some cases. In autumn the last migrants were observed in the middle of October.