The distribution and status of Bewick's Swans *Cygnus bewickii*, Tundra Swans *C. columbianus* and Whooper Swans *C. cygnus* in the 'Extreme Northeast' of the USSR

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The distribution, numbers and status of three swan species: Bewick's, Tundra and Whooper swans, in the 'Extreme Northeast of Asia' are described. The breeding grounds of Bewick's Swans cover the maritime tundra of the Arctic basin eastwards as far as Kolyuchin Bay in the Chukotka Sea. A total of 1,200 Bewick's Swans live in the region of which at least 90% are concentrated in the Kolyma Lowlands (over 700 birds) and Chaun Lowlands (over 300 birds). Breeding birds comprise about 23% of the total number of Bewick's Swans in the breeding grounds each year.

It has been established that some pairs of Tundra Swans are breeding in a number of low-lying sections of the sea-coast of eastern Chukotka. The region of supposed sporadic breeding extends from the Vankarem Lowland to Krest Bay. There are no data concerning the status of the Tundra Swan but intensive economic development of the breeding sites causes concern for the fate of this species.

The Whooper Swan is widely distributed in the taiga zone of the Extreme Northeast, but data on its breeding status and population size are very limited. According to preliminary estimates about 2,200 Whooper Swans are in the region. Two main migration routes have been monitored. Birds which settle in the Anadyr-Penzhina Lowland fly across Kamchatka and the Kurile Islands. The remaining birds follow the western Sea of Okhotsk.

The term 'Extreme Northeast of Asia' is used to denote the Asian mainland stretching westwards as far as the valley of the River Kolyma

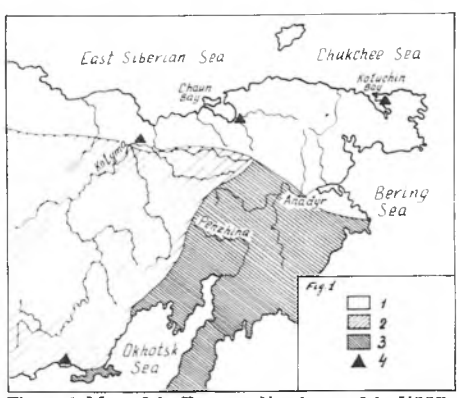

Figure 1. Map of the Extreme Northeast of the USSR. 1. Tundra Zone, 2. North Taiga, 3. Bering forest-tundra, 4. Field stations

and the Shelekhovsk coast in the Sea of Okhotsk (Biske 1975)(Fig.1). Almost three quarters of this huge country, with an area of about 1,200,000 sq km, is occupied by tracts of mountains with an absolute height of 2000 m. The lowlands in the Extreme Northeast consist of three extensive, geographically separate regions - Kolyma, Chaun and Anadyr-Penzhina. Lowland belts are also found outside these extensive depressions, along the sea-coast and in the intermontane depressions. As a result of its geographical position, this region has a severe climate with a prolonged winter of 6 to 7.5 months and a short frost-free period of less than two months. Snow cover lasts from 7 to 9.5 months.

The central and southwestern parts of the Extreme Northeast lie in the northern taiga zone where the predominant forest-forming species is Larch, *Larix dahurica* Turcz. Larch woodlands extend northwards as far as the mouth of the Kolyma, 69 degrees North. Vast areas in the north of the Extreme Northeast are occupied by arctic and zonal tundras, while the east of the region is occupied by the distinctive Beringian tundra with wide areas of alas marshland, bordered by ribbons of Mountain Pine, *Pinus pumila* Rgl and Alder, *Alnus fructicosa* Rupr.

Three swan species are found in the Extreme

Northeast: Bewick's Swan, *Cygnus bewickii* Yarr, Whooper Swan, *Cygnus cygnus* L, and Tundra Swan *Cygnus columbianus* Ord. Most of the region is unsuitable for these large waterfowl. Their breeding sites are found mainly in the maritime depressions and flat sections along the valleys of the largest rivers. This paper is based on the author's research in the tundras of the Kolyma basin in Chukotka from 1972-1985 and on the coast of the Sea of Okhotsk from 1986-1989. These data are supplemented by data available in ornithological literature (Lebedyev & Filin 1959, Portenko 1972, Kishchinski 1973, 1976, Kishchinski *et al.* 1975, Krechmar 1982, Krechmar *et al.* 1978, Tomkovich & Sorokin 1983, Gusakov 1987 etc). A number of unpublished observations by professional zoologists, amateurs and colleagues actively employed in nature work were also used.

The main aim of this paper is to summarise all available data concerning numbers, geographical distribution and status of the swan populations breeding in the Extreme Northeast. Such an analysis is necessary as a basis for presenting well argued and scientifically based recommendations for the conservation of these birds. It is hoped that this will help future researchers to concentrate on the most important aspects of swan research.

Methods

Field work was concentrated on long-term observations from fixed points at field bases. Such research is indispensible for analysing the most important demographic characteristics and population structure of the birds. Of great help in the work was the use of individual colour-marking of swans carried out according to the Soviet-Japanese Convention on the Conservation of Migrating Birds and their Habitats. It should be emphasised that the high success of the colour marking of swans was possible only thanks to the excellent work and enthusiasm of our Japanese colleagues who study these birds in their wintering sites. Counts and mapping of breeding sites and moult gatherings of the swans were carried out on foot and from boats. Aerial counts were also extensively carried out using aeroplanes and helicopters. Questioning of the local inhabitants in the region produced extensive data for identifying the distribution and status of the birds' breeding sites. The information on the distribution of Whooper Swans and Tundra Swans was especially interesting.

Results.

1. Bewick's Swans

Distribution

The Bewick's Swan is widely distributed in the zonal tundras of Eurasia and is a common breeder in the northern part of the Extreme Northeast. The eastern limit of its range is the Vankarem Lowland and the coast of Kolyuchin Bay in the Chukotka Sea (Fig.2). The western limit of stable and relatively extensive breeding is almost 1000 km to the west, along the borders of the Chaun Lowland. East of the Chaun Lowland occasional breeding pairs are recorded and in unfavourable years there are almost no nests here. The Bewick's Swan is a bird of open areas, ecologically linked with the extensive maritime lowlands. The breeding area of the species in the Extreme Northeast includes two optimum regions where it is not a rarity: the Lower Kolyma and the Chaun Lowland. It appears that at least 90% of Bewick's Swans in the region are concentrated in these extensive depressions. Colour marking has shown in particular that almost all spend the winter in Japan (Kondratiev 1984). The Bewick's Swans found in the tundras of the Kolyma Lowland and in Chukotka appear not to have separate wintering territories but winter together.

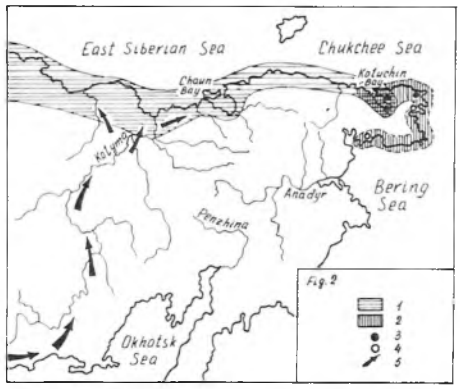

Figure 2. Map of distribution of Bewick's and Tundra swans. 1. Bewick's Swans breeding grounds, 2. Suggested region of Tundra Swan nesting, 3. Observation points of Tundra Swans nesting, 4. Observation points of Tundra Swans nesting which require confirmation, 5. Spring migration routes of Bewick's Swans.

Migration

The Bewick's Swan migration routes in the Extreme Northeast are shown in Fig.2. Groups leave the wintering sites in spring and initially fly along the coast of the Sea of Okhotsk, but

near the southern limits of the Extreme Northeast they cross the watershed mountain ranges to reach the Kolyma Valley. A further route lies along the channel of this river, the largest in the region. Only in the Lower Kolyma do the migrating swans fan out over the breeding grounds, including the most easterly limits of the range. Autumn migration tends to repeat the routes of spring migration.

Breeding grounds.

In Chukotka the overwhelming majority of Bewick's Swans breed in a narrow coastal belt 10-15 km wide. Only occasional pairs of swans penetrate along the river valleys into the interior. The swans in the Lower Kolyma are distributed more evenly in the flat tundras and are not uncommon even 100-150 km from the coast. The character of the birds' distribution in the breeding site undoubtedly depends mainly on the appearance of the tundra lakes and the composition of the semi-aquatic vegetation. The preferred breeding habitat of Bewick's Swan is the shores of thermokarste lakes. They prefer water bodies with a sharply indented shore-line and an abundance of shallow inlets overgrown with *Potamogeton, Hippurus vulgaris L* and *Arctophilia fulva* And. In the deltas of the large rivers of the Chaun Lowland the breeding density of Bewick's Swan in suitable habitats reached 0.2 pairs per sq km. In the Kolyma tundras the maximum breeding density recorded did not exceed 0.05 pairs per sq km. It should be noted that the average breeding density of Bewick's Swans in both depressions will be approximately 20 times lower than the figures given. Thus in various years in the Chaun Lowland from 25 to 50 breeding pairs of Bewick's Swans have been counted in about 5000 sq km of maritime plains (Fig. 3).

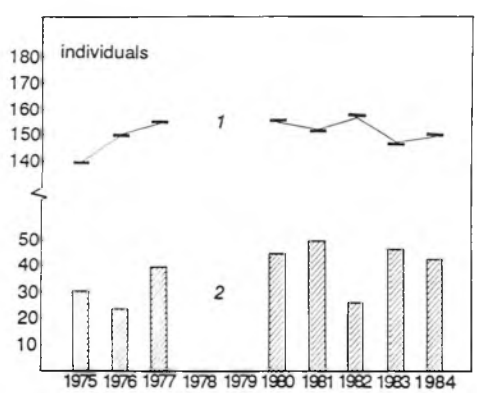

Figure 3. Number of Bewick's Swans on 200 km² in the delta tundras of the Chaun Lowland in late June-early July. 1. Total number of swans, 2. Nesting birds.

Non-breeders keep to the immediate vicinity of the breeding sites on the coastal saltmarshes in the delta lowlands. In the moulting period they concentrate on the largest lakes or low islands in the river deltas. From Fig.3 it is obvious that the ratio of breeding and non-breeding swans in the breeding grounds can change considerably (as much as two-fold) from year to year. These fluctuations are probably determined by the variable environmental conditions in the breeding sites. The total number arriving at the breeding grounds in spring is more stable; annual fluctuations do not exceed 10%. In different years the proportion of breeders in the Chaun Lowland varied from 18.3% to 36.8% and averaged about 23% of the total number.

According to approximate estimates the total number of Bewick's Swans which inhabit the Extreme Northeast is about 1,200 birds. Just over 300 are found in the Chaun Lowland and almost 700 birds in the Lower Kolyma. Details of Bewick's Swan breeding biology in the Chaun Lowlands are presented in Kondratiev (1991). The average clutch size is 3.84 and brood size before fledging is 2.96. Losses during incubation and cygnet-rearing average 17.9% of the number of eggs laid. Thus, the annual increase in the Bewick's Swan population in the Chaun Lowland, calculated for the fledging period, is between 16.6% and 61.4%, with an average of about 32%. The true increase in the population will be lower, since these figures do not take into consideration loss of young between fledging and the beginning of autumn migration. The extent of this loss is unknown, but it is considered to be appreciable in some years.

The main predators are Arctic Foxes, *Alopex lagopus* L, large gulls, *Larus argentatus* Pont and *Larus hyperboreus* Gunn and skuas, *Stercorarius spp.* In normal conditions they may have no noticeable effect on the breeding success of the swans. However, sometimes a period of low numbers of lemmings, *Muridae*, coincides with high numbers of birds of prey and Arctic Foxes. In this situation the predators can reduce the breeding success of the Bewick's Swans. During the last 15 years such a coincidence of unfavourable factors has only occurred once, in 1984, when predators destroyed up to 30% of the swans' nests in the delta tundras of the Chaun-Palyavaam.

Bewick's Swan, like other swan species in the USSR, is protected by law. Cases of swans

being killed by poachers in the Extreme Northeast are quite rare. Active nest destruction occurs in regions of extensive reindeer breeding. The recent reduction in breeding density of Bewick's Swan in the northwestern regions of the Chaun Lowland could be attributed to the negative effects of reindeer breeding. In the absence of unnecessary disturbance, Bewick's Swans readily tolerate humans. In the delta tundras of Chaun-Palyavaam, the breeding density of Bewick's Swan around the field stations has not fallen, but even slightly increased. The moulting sites of the birds on the islands in the Chaun Delta, 10 km from a settlement, have been protected for many years.

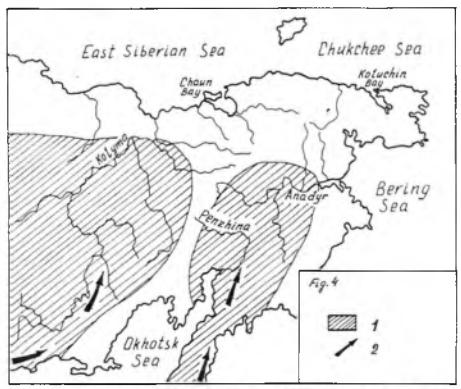

Figure 4. Map of distribution of Whooper Swans in the Extreme Northeast. 1. Breeding grounds, 2. Spring migration routes

2. Tundra Swans

Tundra Swans are only known to have bred in the USSR in 1974 (Kistchinski *et al.* 1975) when a pair of these birds with young were found on the coast of Kolyuchin Bay in the Chukotka Sea. Unfortunately, this recent discovery only indicates the lack of surveys in these regions of Chukotka. Tundra Swan have also been found breeding in a number of other regions in the Extreme Northeast (Tomkovich & Sorokin 1983). From data gathered from questioning the local inhabitants, the area of sporadic breeding of Tundra Swans appears to include the maritime lowlands in the east of the Chukotka Peninsula from Kolyuchin Bay to Krest Bay (Fig.2). A narrow zone of Tundra and Bewick's Swan hybridisation occurs in the region of the Vankarem Lowland. This is indicated both by the presence of mixed pairs (Kishchinski *et al.* 1975) and by observations of birds of supposed hybrid origin (P S Tomkovich pers comm).

3. Whooper Swans

Distribution

The Whooper Swan is widely distributed in the taiga zone of the Extreme Northeast. Over almost the whole region the northern limit of the range coincides with the distribution of coniferous forests and only in the eastern part does it extend beyond the limits of the taiga zone (Fig.4). In the Anadyr-Penzhina Lowlands Whooper Swans settle on comparatively small shallow lakes in alas depressions, often in slightly raised hilly tundra. These lakes are relatively warm and their shores and shallows are abundantly overgrown with *Carex, Equisetum* spp. and *Arctophila fulva.* In the floodland forests of the Yana-Taui depression in the south of the Extreme Northeast and in the Kolyma basin, the Whooper Swans choose to breed on the most remote taiga lakes and lead a very secret life. Non-breeders do not form large gatherings in the breeding period but also concentrate in small groups on lakes or river channels.

Data on breeding density and numbers of Whooper Swans in the Extreme Northeast are fragmentary and insufficient to draw a reliable picture of the whole region. The most interesting data have been published by Krechmar (1982), who studied Whooper Swans in the Middle Anadyr. According to his data there is a small but stable population totalling 100-200 birds on the Anadyr. Gusakov (1987), using aerial counts, determined the number of Whooper Swans in the Penzhina-Parapol Valley (Fig.4) as 1,100 birds. The average population density recorded was 9 birds per 100 sq km during autumn counts and from 4 to 8 birds per 100 sq km in the breeding period. According to counts by S V Tarkhov (pers comm) 184 Whooper Swans were recorded in an area of about 500 sq km in the Magadan State Reserve. Of these about 30% were breeding pairs. Special Whooper Swans counts have not been carried out in other regions of the Extreme Northeast, but questionnaire data indicate that these birds are very rare throughout.

Migration

The migration behaviour and population structure of Whooper Swans are still far from clear. Individual colour marking of Whooper Swans carried out in the breeding and wintering sites (28 Whooper Swans ringed on the Anadyr and about 200 young and adult birds ringed in Japan) has so far proved to be of little success. None of

the birds marked in the Extreme Northeast have been sighted among the Whooper Swans wintering on Hokkaido. Whooper Swans from the Extreme Northeast fly to the breeding sites along two different routes. One route runs across the Kurile Islands and Kamchatka Peninsula where migrating Whooper Swans are numerous (Nechayev 1969, Lobkov 1987). It is likely that this route is used by Whooper Swans from the Anadyr-Penzhina Lowland. The second route runs along the western coast of the Sea of Okhotsk (Fig.4). This route is used by Whooper Swans from the Yana-Taui depression and Kolyma basin. During spring migration up to 800 birds pass here. Taking into account the intensity of migration we estimate as a first approximation, that the total number of Whooper Swans in the Extreme Northeast is 2,000-2,200 birds.

Breeding success

The status of Whooper Swans in the Anadyr-Penzhina lowland is stable at present and breeding success is relatively high. The average brood size before autumn migration is 2.25 for Anadyr (Krechmar 1982) and 2.9 for Penzhina (Gusakov 1987). With the establishment of the Magadan State Reserve in 1982 the numbers of Whooper Swans in the Yana-Taui depression have increased. In the remaining part of the Extreme Northeast the status of breeding sites is unknown. Whooper Swans rarely breed in sites regularly visited by humans. Old nests found along the shores of lakes now unused by swans suggest disturbance may cause desertion of sites.

Discussion

Individual colour marking has made it possible to establish that all Bewick's Swans from the Extreme Northeast spend the winter in Japan. Linked by common migration routes and wintering sites they are in essence one population. The question of Whooper Swan wintering sites is very interesting. Whooper Swan migration routes from the Anadyr-Penzhina lowland and other regions in the Extreme Northeast, including the Kolyma basin, are separate from each other. Birds breeding in these regions have almost no contact, or possibly none at all, whilst in the breeding grounds. Whether these birds have contact in the wintering grounds needs to be established. Since Whooper Swans marked in the Anadyr have not been recorded in the wintering grounds in Japan, we assume that they winter in Kamchatka where small winter gatherings of Whooper Swans are known (Lobkov 1987). This also requires careful study. Further active research into the swans of the Extreme Northeast is only possible with the wide use of individual colour marking. Bewick's Swan marking should be continued in the west in the large breeding grounds (Khrom-Indigira watershed, Lena Delta, Taimyr etc).

The breeding of Tundra Swans in Chukotka offers a marvellous opportunity for a comparative ecological analysis of the reproductive period of these birds and for establishing the taxonomic interrelationship of Bewick's Swans and Tundra Swans.

Analysis of the present status of the swan populations in the Extreme Northeast requires the establishing of the effects of limiting factors in each specific region, although there are many common causes which determine the degree of well-being of the birds. The natural loss of young in all species of swan is the result of the activity of predators and early autumn frosts. This loss is usually low and may reach noticeable levels only in some unfavourable years. Bewick's Swan and Tundra Swans nests are also actively destroyed in the regions of intensive reindeer breeding. The well-being of all swan species depends quite definitely on the safe-keeping of their habitat. At the moment the Bewick's Swan and Whooper Swans populations are completely stable and are even experiencing some increase in sites which are rarely visited by humans and are little affected by economic activities. The degree of negative influences on the birds caused by the economic development of the region must be a subject of special research. This question is most acute with regard to Whooper Swans and Tundra Swans because of the reduction in floodland forests and because of human transformation of these birds' habitats. It should also be emphasised that successful work in all aspects mentioned is possible only if international cooperation within the framework of joint international programmes is increased.

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