Wildfowl (1973) 24:88–102

Waterfowl in north-east Asia

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By 'north-east Asia' is meant the territory northwards and eastwards of the middle reaches of the Lena river and of the lower reaches of Amur, including Sakhalin, Kamtchatka, and the Kurile Islands. Most of this huge area is mountainous. Wetlands suitable for breeding waterfowl occupy comparatively small areas in the river valleys and coastal lowlands. In these places waterfowl were abundant, and in some cases still are. Large numbers of water birds moult, migrate and winter in the coastal waters of the East Arctic and Pacific seas.

For several reasons, in the last 20–25 years, waterfowl populations in north-east Asia have greatly decreased. We have almost no quantitative information concerning their status in the past, and some valuable faunistic studies made in previous years can only be used now with essential corrections. Data on the absolute numbers of waterfowl have appeared only recently. The country is poorly studied as yet, and this essay is the first attempt to discuss data obtained to date.

Breeding distribution of waterfowl populations

The general pattern as it is now known is presented in Figure 1. In the arctic tundras of Yakutia and along the northern coasts of the Chukchi Peninsula, waterfowl numbers are still rather high. Long-tailed Duck*, White-fronted Geese and eiders (in some places Pacific Eider and Spectacled Eider) predominate. Attempts have been made to determine waterfowl numbers—generally from aircraft (Table 1). Data on geese are the most reliable. We estimate the total numbers of geese in the Yakutian and Chukchi arctic tundras (excluding Wrangel Island) as 250–300,000. Different species of geese (except Snow Geese) cannot be distinguished from the air, as a rule; however, the White-fronted Goose strongly predominates everywhere in the arctic tundra westwards of Koliuchinskaya Bay. Only in shrub tundras does the Bean Goose replace it. On Wrangel Island, up to 60,000 pairs of Snow Geese breed in normal years (Syroetchkovski, 1972), as well as several thousand Brent Geese. Along the shores of the Chukchi Peninsula westwards to the Amguema lagoon and Anadyr Gulf, the rare Emperor Goose breeds (Kistchinski, 1971; Portenko, 1972).

Breeding populations of Long-tailed Duck in the arctic tundra of East Asia (Table 1) probably number hundreds of thousands; the breeding stock of King Eider is perhaps up to 100,000. The Pacific Eider is very common along the coasts of Chukchi Peninsula westwards to the Tchaunskaya Bay. The Spectacled Eider is most abundant in the delta of the Indigirka river (Table 1; Kistchinski & Flint, in preparation) and in tundra westwards of the Kolyma mouth (Vorobyev, 1963).

In the southern tundra, eiders disappear, and Pintail, Green-winged Teal and Baikal Teal (the teal species are hardly distinguishable from the air), and Scaup appear as common species. Aerial counts at the end of summer of Pintail and teal made by Yegorov (1965; *in litt.*) in 1964–1966 in the southern parts of the Yana-Kolyma tundra (Table 1) were incomplete. Even in the tundra quantitative data are poor, and many areas are not studied yet.

In the forest-tundra and northern thinly-forested areas Pintail, Green-winged Teal, Baikal Teal, Wigeon, White-winged Scoter, Black Scoter, Scaup, Long-tailed Duck and Bean Geese predominate (Figure 1). Table 2 summarizes some data on the population density of ducks. One should realize that dabbling ducks (especially teal) are decidedly underestimated from aircraft (see figures for 1966–1970). In 1972, our total results are probably too high, because most of the counts were made in favourable habitats; however, data on Baikal Teal are too low. The results are thus not too accurate, but they show the general pattern. We can see that the productivity of lowlands between Yana and Kolyma rivers is somewhere still high enough. However, numbers of Bean Geese have strongly decreased here.

Unfortunately, we have no quantitative data on the breeding waterfowl populations of Anadyr and Koryak lowlands, nor on the lowlands of Central Yakutia where waterfowl numbers have recently greatly diminished. Waterfowl are abundant on the Parapolski Dol (V. D. Yakhontov, personal communication). In the mountains of the Kolyma Highlands there are few water birds; Green-winged Teal, Harlequin Duck,

*Scientific names are listed in Appendix A.

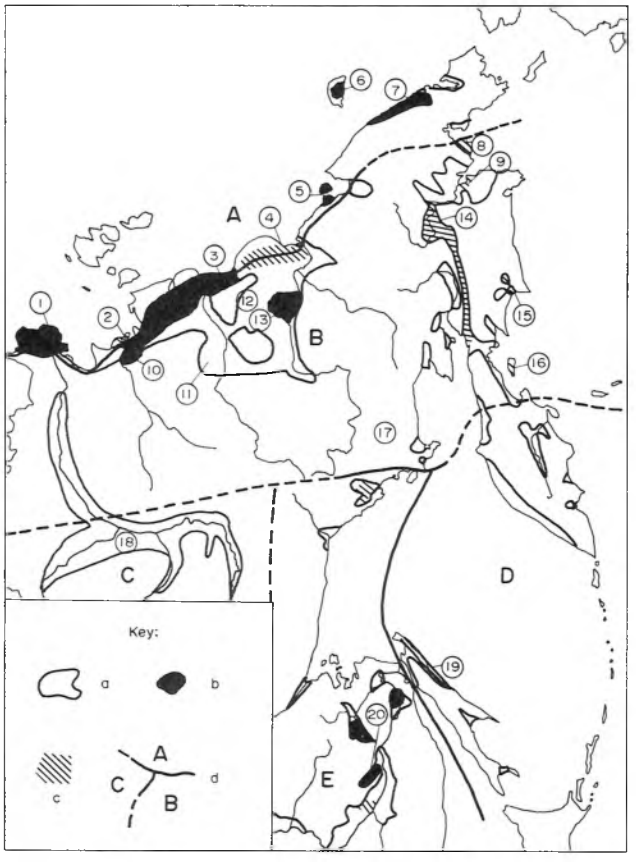

Figure 1. Waterfowl breeding distribution in north-east Asia. Key: a—lowlands and flats rather rich in wetlands; these areas are potentially productive in waterfowl; b—known areas of high concentration of waterfowl; for most of them quantitative data are available; c—known areas of relative abundance of waterfowl; usually, quantitative data are absent; d—boundaries between the provisional zones with the different waterfowl situations. Localities, time of survey, main species, and source: 1—delta of the Lena (see Table 1:1); 2—tundras of the Yana delta (see Table 1:2); 3—lowlands between Yana and Sundrun rivers (see Table 1:3–4); 4—tundras between Alazeya and Kolyma rivers, 1966 (see Table 1:5); 5—northwestern shores of Tchaunskaya Bay and Ayon Island, 1958; White-fronted Goose, Long-tailed Duck, Pacific Eider, King Eider (Lebedev & Filin, 1959); 6—Wrangel Island, Snow Goose (120,000—Syroetchkovski, 1972), Pacific Eider, Brent Goose; 7—northern coasts of the Chukotski Peninsula (see Table 1:6); 8—Uelkal area, 1961; Pintail, Long-tailed Duck, Common Eider (Portenko, 1972); 9—Anadyr mouth area, 1957; Pintail (Kuzyakin, 1965); 10—forest-tundras of the Yana delta (see Table 2, left column); 11—middle reaches of the Indigirka, old data, White-winged Scoter, Pintail, Baikal Teal, Bean Goose (Mikhel, 1935); 12—southern tundra and forest-tundra along the Alazeya river, 1963; Long-tailed Duck, Pintail, Scaup, Lesser White-fronted Goose, White-fronted Goose, Bean Goose, Baikal Teal, White-winged Scoter (Vorobyev, 1967); 13—middle reaches of Kolyma river (see Table 2, three right columns); 14—middle reaches of the Anadyr river, old data; Wigeon, Pintail, Green-winged Teal, Bean Goose, Scaup, Black Scoter, White-winged Scoter, Long-tailed Duck (Portenko, 1939); 15—valleys of the Koryak Highlands, 1959–1961; Pintail, Green-winged Teal, Black Scoter, White-winged Scoter, Scaup, Bean Goose (our observations); 16—Karaginski Island; Harlequin Duck (up to 4,000), Pacific Eider (hundreds) (Gerasimov, 1972a); 17—Kolyma Highlands sea slope, 1963–1964; Green-winged Teal, Harlequin Duck, Goosander (Kistchinski, 1968); 18—central Yakutia, 1950s; Pintail, Green-winged Teal, Tufted Duck (Vorobyev, 1963); 19—lagoons of north-east Sakhalin; Green-winged Teal, Baikal Teal, Garganey, Mallard, Wigeon, Gadwall, Long-tailed Duck, Harlequin Duck, mergansers (Vshivtsev & Tchernyshev, 1965); 20—large lakes of the lower Amur region; Mallard, Falcated Duck, Green-winged Teal, Garganey (see Table 3).

Table 1. Results of waterfowl censuses in the tundras of Yakutia and Chukotski Peninsula: (a) birds per 10 sq. km; (b) total numbers, in thousands

No. Territory	Bewick's Swan		Geese (mostly White-fronted)		Long-tailed Duck		King Eider		Spectacled Eider		Pintail		Teal (Green-winged and Baikal)	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
1. Delta of the Lena, arctic tundras, aerial counts, 1963, estimated (Yegorov, 1965)	1·7	4·2	27·2*	68*	No count		2·4	6	No count		1·2	3	1·6	4
2. Eastern parts of the delta of the Yana, shrub- and moss-lichen tundras, ground counts (original, 1972)	Very rare		Very rare		15·2	No estimate	Very rare		Not observed		Common (no count)		Rare (no count)	
3. Lowlands between Yana and Indigirka, all subzones of the tundra, aerial counts, 1964, estimated (Yegorov, 1965)	1·5	10·5	15·5	108·5	No count		1·6	11·2	No count		7·5	52·5	10·3	72
4. Tundras (all subzones) between Khroma and Sundrun rivers, 1971 (Kistchinski & Flint, 1972)**	?	1–2	20–25	40–70	1–19	40–60	Very rare in 1971 (usually common)		2–100	30–40	0–6	No estimate	Very rare	
5. Tundras between Kolyma and Alazeya rivers, all subzones, aerial census, 1966 (Yegorov, in litt.)			16·6	No count			6·2		No count		26·5			36
6. Northern shores of the Chukotscki Peninsula (Vankaremskaya lowland) arctic tundras, ground counts, 1970 (Kistchinski, 1972 and unpublished.)	Not observed		10–15	30–50	65	200	10	30	Accidental		Only moulting flocks		Accidental	

*Since the census year geese numbers have essentially diminished here (Nagretski 1972).

**This territory partly intergrades with the foregoing one. Total numbers of swans, geese and Long-tailed Duck are estimated by means of aerial counts; all the other data—by means of ground counts.

Table 2. Results of waterfowl counts in the forest-tundra and northern taiga of north-east Asia (birds per 10 sq. km)

Species	Forest tundra, southern parts of the delta of Yana river, ground census, June 1972 (total studied area 1,500 ha.; our data)*	Northern taiga, middle reaches of Kolyma river (near Sredne-Kolymsk), aerial counts, total area censused 10,000 ha.** (Yegorov & Perfilyev, 1970; Perfilyev, 1972)		
		August 1966	August 1967	August 1970
White-winged Scoter	16·0	52·8	10·4	
Scaup and Tufted Duck	5·4	52·8	23·1	28·0
Long-tailed Duck	5·4	22·5	5·6	
Pintail	45·4	16·1	25·7	
Wigeon	10·6	12·1	15·0	32·0
Green-winged and Baikal Teal	18·6	2·6	1·0	
Total	101·4	161·3	81·8	60·0

*Counts were made in optimum habitats, and cannot be extrapolated to the total area of the delta.
**Counts were made in the lowlands rich in lakes, and can hardly be extrapolated to the whole Yana—Indigirka forested lowlands; these are probably optimum figures.

and mergansers are more common (Kistchinski, 1968).

There are almost no quantitative data on the breeding waterfowl of Sakhalin and Kamtchatka. In Sakhalin, most of the birds breed on the coastal lowlands in the north-east of the island (Figure 1); in Kamtchatka—on coastal lowlands, river valleys, and near thermal lakes in volcanic areas. In general, we do not know any great concentrations of breeding waterfowl here. On Karaginski Island, up to 4,000 Harlequins and hundreds of Pacific Eiders breed (Gerasimov, 1972a); on the Commander Islands, several hundreds of pairs of Pacific Eiders as well as few other ducks—in total not more than 2,000 pairs (Marakov, 1965).

The number of breeding waterfowl in the lower Amur region has recently greatly decreased. Most of the ducks rear young in the lowlands near large lakes—Bolon', Udyl', and in the Evoron-Tugur depression. No large-scale counts were made there; ground censuses carried out on some of these optimal wetlands (Table 3) show that their productivity is still rather high. In the Evoron Game Management area, before the hunting season it can reach 12,000–

Table 3 Waterfowl productivity of the optimum wetlands in the Amur basin

Territory	Birds per 1,000 ha. of wetlands	Birds per 10 km of census route	Source
Game management area "Utinoye" near Khabarovsk	84 broods (1963)	—	Yakhontov, 1965
Game management area "Utinoye" near Khabarovsk	—	3–47 (1965–1967)	Stcherbakov, 1968
Game management area "Utinoye" near Khabarovsk	73–100 broods (1963–1969)	—	Sapaev, 1971
Lake Bolon'	—	6–48·5 (1965–1967)	Stcherbakov, 1968
Lake Bolon'	70 broods	—	Sapaev, 1971
Lake Udyl' and adjacent area	152 broods	—	Yakhontov, 1965
Lake Evoron	100–2,500 birds	—	Roslyakov & Koltchin, 1972
Lake Tchukchagirskoye and adjacent area	—	113–116	Stcherbakov, 1965
Valleys of Nai, Ulike and Amir rivers which are not flooded in summer	—	27–63	Stcherbakov, 1965
Valleys of Amur, Amgun' river, and their tributaries which are flooded in summer	—	3–15	Stcherbakov, 1965

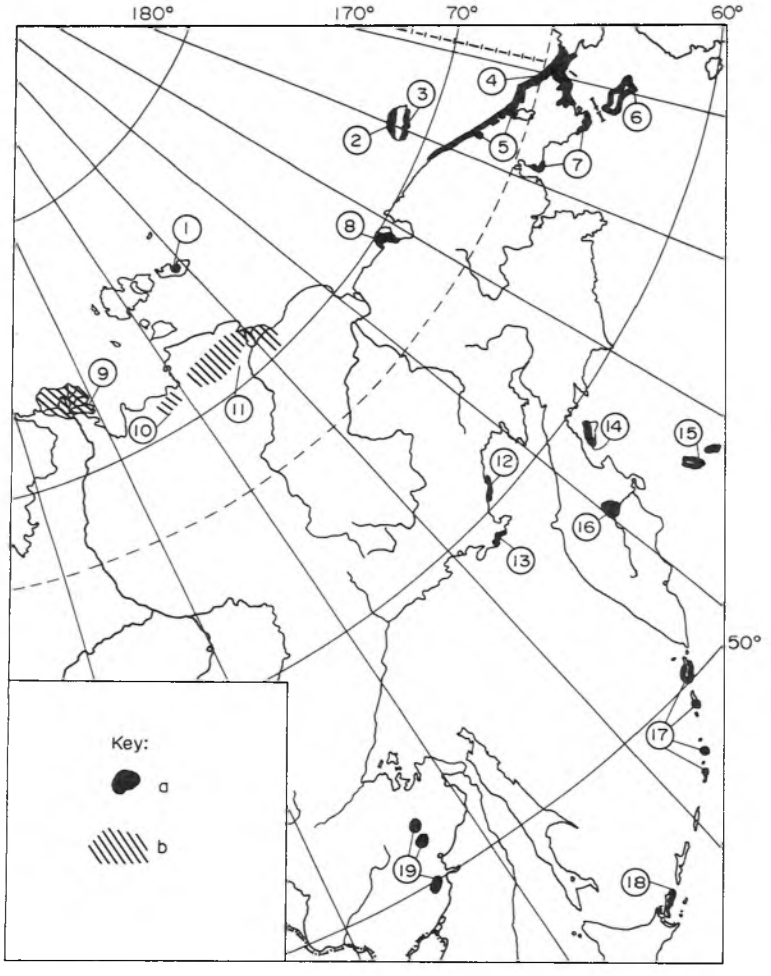

Figure 2. Moulting areas of waterfowl in north-east Asia. Key: a—known moulting concentrations; b—moulting areas where birds are more scattered. Localities, time of survey, main species, and source: 1—Novaya Sibir Island, 1950s, Brent Goose, thousands (Shevareva, 1959; our enquiry); 2—Wrangel Island, Snow Goose (hundreds of thousands), Brent Goose; 3—southern coast of Wrangel Island, Long-tailed Duck (Portenko, 1972); 4—northern coasts of the Chukotski Peninsula and Bering Strait area; Long-tailed Duck, Pacific Eider, King Eider, Steller's Eider, Spectacled Eider, very large amount (Portenko, 1972; our data); 5—Ukouge lagoon and Koliuchinskaya Bay, Emperor Geese, 2,000 and more (Kistchinski, 1971; M. E. Shumakov, personal communication); 6—St. Lawrence Island; Long-tailed Duck, Harlequin Duck, King Eider, Pacific Eider, Steller's Eider (Fay, 1961); 7—southern coasts of the Chukotski Peninsula, old data, Steller's Eider, Harlequin Duck, Pacific Eider (Portenko, 1972); 8—shores of Tchaunskaya Bay and Ayon Island, 1958; Long-tailed Duck, King Eider, Pacific Eider (Lebedev & Filin, 1959); 9—delta of the Lena, geese; 10—eastern part of the Yana delta; Pintail, Baikal Teal (Kistchinski & Uspenski, unpublished); 11—tundras between the Yana and Sundrun rivers; White-fronted Goose, Bean Goose, Long-tailed Duck, Pintail (Uspenski *et al.*, 1962; Kistchinski & Flint, unpublished) 12—coasts of the Shelikhov Gulf, 1963; mergansers, Pacific Eider (Kistchinski, 1968); 13—Babushkin Bay, 1964; Harlequin Duck, thousands (Kistchinski, 1968); 14—Karaginski Island and Litke Strait; Harlequin Duck, mergansers (2,500–3,000), White-winged Scoter (4,000–4,500), Steller's Eider (5,000), Pacific Eider (2,500–3,000) (Gerasimov, 1972a); 15—coastal waters of the Commander Islands; Harlequin Duck (10,000—Marakov, 1965); 16—middle parts of the valley of the Kamtchatka river, old data; Tufted Duck, Scaup, Pochard (Vershinin, 1965); 17—northern and middle Kuriles, 1963; Harlequin Duck (11,000—Velizhanin, 1965); 18—Kunashir Island, sea coasts, 1963; White-winged Scoter (1,200—Velizhanin, 1965); 19—Lake systems in the lower Amur basin, dabbling ducks (Sapaev, 1971, etc.).

25,000 ducks (Roslyakov & Kolchin, 1972). But their total area is comparatively very small. Mallard, Falcated Duck, teal and Garganey are the most common (Figure 1).

Population distribution during moulting, migration and wintering

The most important moulting areas known to date are shown on Figure 2. Hundreds of thousands of Long-tailed Duck and eiders (all four species) moult along the northern and eastern coasts of the Chukchi Peninsula and in the Bering Strait area. Snow Geese moult on the northern lowlands of the Wrangel Island; Brents moult on the same area, as well as on the northern shores of the Chukchi Peninsula and on the Novaya Sibir Island (the most recent information from this island was in 1960).

Geese, Pintail, Baikal Teal and diving ducks moult on almost inaccessible lakes and rivers in the tundra and forest-tundra. Many goose-moulting areas between the Yana and Kolyma rivers where, in former times, thousands of geese could be taken in one catch, are now of no importance. Many thousands of diving ducks moulted on the Sen-Koel lake near Sredne-Kolymsk; it was recently drained, and the ducks have disappeared (Perfilyev, 1972). In the 1940s, many diving ducks moulted in the system of shallow lakes in the valley of Kamtchatka river near the mouth of Yelovka river (Figure 2:16), but the present situation is unknown. Many Harlequins, mergansers, and Pacific Eiders spend the moulting period along the northern coasts of the Okhotsk Sea (Kistchinski, 1968). The same species as well as White-winged Scoter and Steller's Eider, moult in thousands near Karaginski Island (Gerasimov, 1972a). Harlequins also moult near the North Kuriles and the Commander Islands (see Figure 2). Many dabbling ducks moult on the large lakes in the lower Amur basin (Sapaev, 1971).

Large numbers of waterfowl migrate along the sea coasts, and along the valleys of the Lena, Kolyma, and Anadyr, through interior valleys of Sakhalin and along the Evoron-Tugur depression, the Ussuri and Amur rivers. Important 'ecological routes' of migration are sketched on Figure 3. However, detailed patterns of migrations of different species and populations vary and in most cases are not well known because of the scarcity of ringing data. Therefore, these 'ecological routes' cannot be treated as real flyways; sometimes they are probably only resting grounds on flyways of unknown direction. Routes along the arctic coast (Snow Goose, eiders, Brent), Lena, Kolyma, Kuriles, east Sakhalin, Amur, Anadyr seem to be true 'flyways'. Much study is needed to solve the problem. Some birds (Bean Goose, White-fronted Goose, dabbling ducks) move in a dispersed way across the mountains as well.

In recent years (especially in 1970–1971) winter waterfowl counts were made in north-east Asia. Professional zoologists have participated in this work as well as game, forestry and fishery officers, and hunters. Data for the U.S.S.R. are presented in Table 4 and Figure 4 (Figure includes also St. Lawrence Island as a geographical unit close to Chukchi Peninsula). Figures in Table 4 regarding marine wintering grounds are certainly not complete nor accurate, due to the difficulties of census techniques (especially in the waters adjacent to the Kuriles and Sakhalin). Besides, areas of waterfowl winter concentrations are not constant from year to year.

From January 1970, regular winter counts are being carried out in Japan—at more than 1,000 points. Professor Y. Yamashina has kindly informed us that the numbers of waterfowl counted in January were approximately:

Whooper Swan (1970–1972)	9,800–11,400
Bewick's Swan (1970–1972)	540– 930
White-fronted Goose (1970–1972)	3,400– 3,700
Bean Goose (1970–1972)	1,500– 1,900
Brent Goose (1970–1972)	2– 340

Ducks (1970–1971)—about 1,000,000, among them:

Mallard	200,000
Green-winged Teal	160,000–220,000
Spotbill	140,000–160,000
Tufted Duck	130,000
Scaup	16,000– 50,000
Pochard	37,000– 43,000
Pintail	37,000– 44,000
Wigeon	38,000– 43,000
Baikal Teal	11,000– 37,000
Shoveler	10,000– 12,000
Falcated Duck	12,000– 15,000
White-winged Scoter	5,700– 12,000
Mandarin	9,500– 10,000
Long-tailed Duck	2,600– 8,600
Goldeneye	1,600– 2,300
Red-breasted Merganser	2,400– 3,200
Goosander	1,200– 1,600

The number of birds varied little between the years. Geese and swan counts are highly accurate; counts of dabbling ducks fairly accurate; numbers of sea-wintering diving ducks are certainly underestimated.

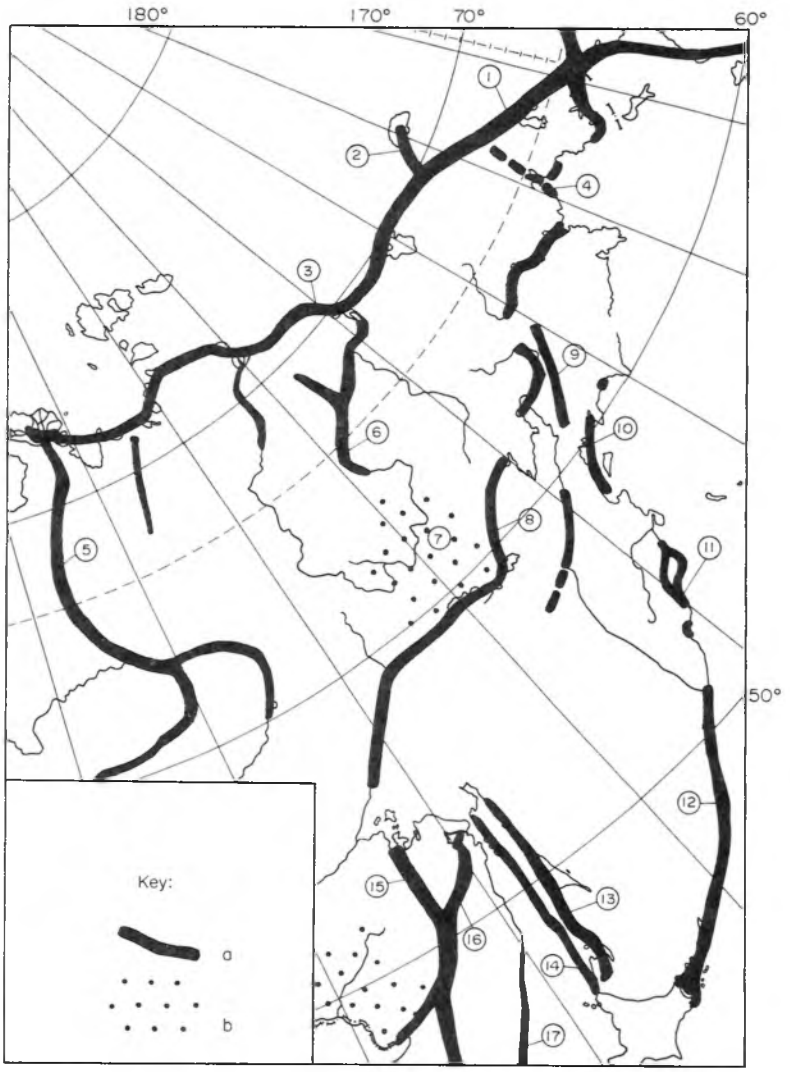

Figure 3. Important 'ecological routes' of waterfowl migration in north-east Asia. Key: a—important ecological routes; b—some areas where migration goes by a dispersed pattern. Localities, and main species: 1—arctic coasts of Chukchi Peninsula: Snow Goose, Brent, Eiders, Long-tailed Duck; 2—across the De-Long Strait: Snow Goose, Brent; 3—arctic coasts of the Yakutia: eiders, Long-tailed Duck; 4—Uelkal: Long-tailed Duck; 5—Lena river: Long-tailed Duck, Bean Goose, White-fronted Goose, White-winged Scoter, Pintail; 6—Kolyma river; Pintail, Baikal Teal, White-winged Scoter, Long-tailed Duck, Scaup, Tufted Duck, White-fronted Goose, Bean Goose; 7—Kolyma Highlands: Green-winged Teal, White-fronted Goose, Bean Goose, Pintail; 8—northern coast of the Okhotsk Sea: Long-tailed Duck, Harlequin Duck, Black Scoter, White-winged Scoter, Scaup, Tufted Duck, geese; 9—Parapolski Dol; geese; 10—shores of the Litke Strait: Long-tailed Duck, Scoters, Harlequin Duck, Scaup, Tufted; 11—Kronotski State reserve, sea coasts and inland thermal lakes; Scaup, Pintail, Wigeon, Green-winged Teal, Long-tailed Duck; 12—Kuriles; all the diving ducks, Mallard, Pintail, Green-winged Teal, mergansers; 13—east Sakhalin ways; many diving and dabbling ducks, geese, swans; 14—west coast of the Sakhalin; Goldeneye, mergansers, Scaup, Harlequin Duck, Mallard, Wigeon, Green-winged Teal, swans; 15—Evoron-Tugur depression; Pintail, Gadwall, Mallard, Falcated Duck, Tufted Duck, Goosander; 16—Amur valley; Pintail, Green-winged Teal, Falcated Duck, geese; 17—coasts of the Primorye Territory; Goldeneye, mergansers, Harlequin Duck, Scaup, Tufted Duck, Mallard, Wigeon, teal, swans.

Table 4. Results of waterfowl winter counts and estimated numbers of wintering waterfowl in north-east Asia

No. Territory	Year of count	Number of counted birds	Total number of birds estimated (thousands)	Main species and their estimated numbers (thousands)
1. Korf Bay (Yakhontov, 1972)	1971	500	12–15	Long-tailed Duck (12–15), Pacific Eider
2. Coastal waters of the Commander Islands (Marakov, 1965 etc.)	Many years		25–30	Steller's Eider (10), Harlequin Duck (3), Long-tailed Duck (3), Mallard (3), Black Scoter, White-winged Scoter, Goldeneye, mergansers, Pacific Eider (hundreds), Emperor Goose (0·2)
3. Coastal waters of eastern Kamtchatka, Kronotski State Reserve (Markov, 1963)	1960–61		Several thousands	Black Scoter, White-winged Scoter, Harlequin Duck, Long-tailed Duck
4. Rivers and lakes of Kamtchatka (Gerasimov, 1972b)	1966–68		24·5–25	Mallard (14·5), mergansers (2·5), Goldeneye (2·5), Whooper Swan (5–5·5)
5. First and Second Kurile Straits (Marakov, 1968; Voronov, 1972; and *in litt.*)	Different years		200–400	Pacific Eider, Steller's Eider, Long-tailed Duck, Harlequin Duck, White-winged Scoter, Black Scoter
6. Coastal waters of the Kuriles southwards of the Second Kurile Strait (Voronov, 1972; and *in litt.*); mainly Pacific side	Different years		Many thousands	Long-tailed Duck, Harlequin Duck (numerous), Black Scoter, White-winged Scoter, Scaup (common)
7. Non-frozen rivers and thermal lakes of Southern Kuriles (Marakov, 1968, new counts 1971)	Different years		2–3	Mallard, mergansers (more than 1), Whooper Swan (hundreds)
8. Waters near Cape Terpenyia and Tiulenyi Island (Voronov, 1972 and *in litt.*)	1970		400–500	Long-tailed Duck
9. Waters near Moneron Island (Voronov 1972 and *in litt.*)	1970	150–200	0·15–0·2	Harlequin Duck
10. Waters near Cape Krilyon (Vshivtsev & Skurtchayev, 1972).	1966–67		8	Long-tailed Duck, Harlequin Duck, Scaup

11. Coasts of Sakhalin (new counts)	1970	2,000	10–15	Long-tailed Duck (4–5), White-winged Scoter (1·5–3), Eiders (1), Scaup (1)
12. Interior waters of Sakhalin (new counts)	1970	47	8–10	mergansers
13. Rivers of the 'sea slope' of the Primorye Territory (new counts)	1970	117	1·5–3	Mallard (0·5–1), mergansers (0·4–0·7), Green-winged Teal, Goldeneye
14. Coasts of the Primorye Territory, from Cape Povorotny to Adimi river (new counts)	1970	168	Several thousands	mergansers (3–3·5), Goldeneye (2), White-winged Scoter (1), Pochard (1)
15. Gulf of the Peter the Great and adjacent waters (Nechayev, 1972 etc.)	1970	Up to 13,000	20	Long-tailed Duck (more than 11) White-winged Scoter (1), Scaup, Harlequin Duck
Total, approximately			700–1,050	

Table 5. The waterfowl productivity of the tundra, forest-tundra and northern taiga (1963–1972)

Territory	Time of census	Birds per 10 sq. km.	Main species	Source
Northern coasts of the Chukotski Peninsula, arctic tundras, ground counts	June 1970	96·7	Long-tailed Duck, King Eider, White-fronted Goose	Kistchinski, unpublished
Delta of the Lena river, arctic tundras, aerial counts	August 1963	34·1	White-fronted Goose	Yegorov, 1965
Tundra (all subzones) between Yana and Indigirka rivers, aerial counts	August 1964	36·4	Geese, teal	Yegorov, 1965
Delta of the Indigirka river, arctic tundras, ground counts	June–July 1971	111·0	Spectacled Eider, White-fronted Goose	Kistchinski, unpublished
Delta of the Indigirka river, hilly dwarf-shrub-moss-sedge tundras, ground counts	June 1971	56·8	Long-tailed Duck, Bean Goose, White-fronted Goose, Pintail	Kistchinski, unpublished
Lower reaches of the Yana river, forest-tundra, ground counts*	June 1972	101·4	Pintail, White-winged Scoter, Wigeon, Green-winged Teal, Baikal Teal, Scaup, Long-tailed Duck	Kistchinski, unpublished
Northern thin-forested taiga, lake-land near Sredne-Kolymsk, aerial counts*	August 1966 August 1967 August 1970	161·3 81·8 60·0	White-winged Scoter, Scaup, Tufted Duck, Long-tailed Duck, Pintail, Wigeon	Yegorov & Perfilyev, 1970

*Counts were made in good waterfowl habitats; so the data cannot be extrapolated on the whole subzone.

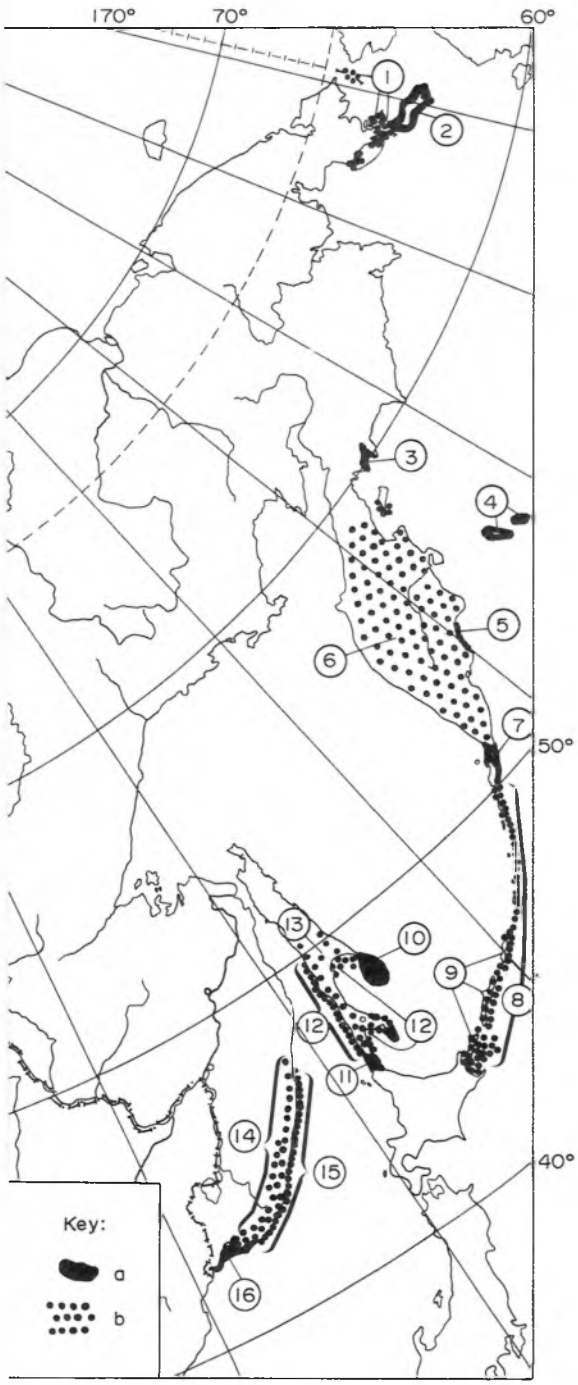

Figure 4. Main wintering grounds of waterfowl in north-east Asia (U.S.S.R.). Key: a—dense winter waterfowl concentrations; b—areas where wintering waterfowl are more scattered. Localities: 1—eastern and southern coasts of the Chukotsk Peninsula; Long-tailed Duck, Pacific Eider, King Eider (Portenko, 1972); 2—coastal waters of the St. Lawrence Island; Long-tailed Duck (up to 500,000), Pacific Eider, King Eider (dozens of thousands) (Fay, 1961); 3—Korf Bay (see Table 4:1); 4—coasts of the Commander Islands (see Table 4:2); 5—coasts of eastern Kamtchatka (see Table 4:3); 6—inland waters of Kamtchatka (see Table 4:4); 7—First and Second Kurile Straits (see Table 4:5); 8—coastal waters of the Kuriles (see Table 4:6); 9—inland waters of Southern Kuriles (see Table 4:7); 10—waters near Cape Terpenya and Tiulenyi Island; (see Table 4:8); 11—waters near Cape Krilyon (see Table 4:10); 12—coasts of Sakhalin (see Table 4:11); 13—interior waters of Sakhalin (see Table 4:12); 14—mountain rivers of the 'sea slope' of the Primorye Territory (see Table 4:13); 15—coasts of the Primorye Territory (see Table 4:14); 16—Gulf of the Peter the Great and adjacent waters (see Table 4:15).

Unfortunately, we know almost nothing about the present-day status of wintering waterfowl in the Chinese People's Republic and South Korea. In the countries southwards, Palaearctic ducks winter in very small numbers.

Main trends in waterfowl populations in north-east Asia

The majority of waterfowl which breed in the arctic tundra (Figure 1, zone A) of eastern Asia, migrate eastwards along the arctic coast and winter either in America (Snow Geese) or in the coastal waters of the north Pacific—mainly on the American side (Emperor Geese, Brent Geese) or on both sides (Long-tailed Duck, eiders). Part of the Long-tailed Ducks probably migrate from the arctic tundra to the Far East wintering grounds overland; their situation is different and will be discussed later (zone B). The Snow Goose is hardly harvested in the U.S.S.R. but it is a popular sporting game species in North America. At present, the Asian population has probably stabilised at a level determined by the carrying capacity of the wintering grounds; numbers fluctuate in accordance with annual breeding success. 'Sea-wintering' species, as a rule, are hardly accessible for hunting during winter; their spring, summer and autumn kill does not seem to be excessive. We have now no information about any essential changes in their year-through habitats. However, prospects for oil drilling on the shelves of Izembek and Bristol Bays—the main wintering or spring resting grounds of Emperor Geese and Brent—are cause for serious alarm. Populations of sea-wintering arctic species also seem to fluctuate according to breeding success in different years but no overall decrease is probable.

Another group consists of arctic birds which migrate across the continent and winter in south-eastern Asia—White-fronted Geese and Brent breeding in Yakutia. In the last 20–25 years, their numbers have sharply decreased over the whole of north-eastern Asia (Vorobyev, 1965; Perfilyev, 1972; our data). Yakutian populations of Brent are evidently close to extinction. In the areas where they were formerly abundant when breeding (e.g. in the deltas of Lena and Indigirka rivers) or on migration, they can hardly be found now. Several hundred Brent winter near the shores of Hondo (Y. Yamashina, personal communication) but we do not know where they come from. The winter status of the species in China is unknown. The breeding habitats of neither of these geese species are seriously disturbed. Hunting has decreased there, and traditional ways of mass harvesting (catching of moulting birds, egg-collecting) have ceased. We believe the main reason for the strong population decrease of these birds to be over-harvesting and degradation of habitats on the migration and wintering grounds.

On the whole, the area of arctic tundra (Figure 1, zone A) is not large, but productivity is rather high (Table 5). However, the main part of this production consists of eiders and Long-tailed Duck which are not very important as game. The most valuable game species—geese—are in a rather unsatisfactory state.

In the southern parts of the tundra zone, in forest-tundra and in northern taiga (Figure 1, zone B), numbers of almost all waterfowl species have strongly diminished in the last 20–25 years. Productivity of the territory, in general, does not exceed that of the arctic tundra (Table 5). This seems to be unnatural and probably indicates a strong decline in the primary (initial) productivity. Breeding habitats have deteriorated locally, but on the vast areas of southern tundra, forest-tundra and northern taiga, disturbance is not serious. However, grazing of domestic reindeer exerts a very unfavourable influence in summer and spring: deer, dogs and men often destroy waterfowl nests. The consequences of unwise wetland 'melioration' play their role too. Nevertheless, the main reasons of waterfowl decline lie, as far as we understand, in the worsening conditions of migration and wintering. The majority of waterfowl breeding in the area winter either in the coastal sea waters (Tufted Duck, Scaup, White-winged Scoter, Black Scoter, Long-tailed Duck, Harlequin Duck, mergansers) or on the fresh-water bodies of south-east Asia (Green-winged Teal, Baikal Teal, Wigeon, Bean Geese and in part Pintail). Only Pintail from the extreme north-east (southwards to central Kamtchatka and westwards up to the lower reaches of Kolyma and Magadan) migrate in part to America (Shevareva, 1968). Diving ducks are essentially safe when wintering on the sea, but they are subjected to a strong hunting pressure during migration, except probably in the case of Harlequin Duck. The numbers of all ducks on migration along the Lena and Kolyma rivers, among them the formerly numerous White-winged Scoter and Long-tailed Duck, have sharply decreased (Yakhontov, 1969; Perfilyev, 1972). We can assume that our 'sea ducks' spend the winter

mainly in the U.S.S.R.'s waters; only our Tufted Duck winter in Japan in considerable numbers. On the contrary, the dabbling ducks (except for part of the Mallard) and geese winter outside the U.S.S.R. The latter undoubtedly go mainly to the Chinese People's Republic; wintering numbers in Japan and in eastern India are negligible. No one country can succeed in stopping the decline of their populations. The numbers of Bean Geese and Baikal Teal have especially diminished; it can be seen both on their breeding grounds in Yakutia and on migration in the lower Amur basin. This process will continue if active measures (including international ones) are not put into force.

The situation in central Yakutia (Figure 1, zone C) has not been studied in detail but waterfowl numbers are decreasing both on breeding and migrations. Habitat deterioration as well as over-hunting and disturbance are involved. Areas of migration and wintering are poorly known, although several ducks ringed in winter in the Ganges basin (India) and in Japan, were recovered from the Central Yakutia and upper reaches of the Lena river.

On Sakhalin Island (especially in the south) breeding waterfowl habitats have seriously deteriorated due to wetland draining, cutting of coastal vegetation, disturbance, and overharvesting. Ducks are rare as breeders but abundant on migration; no overall decrease of migratory stocks have been proved. On the whole, the status and trends of the Sakhalin and Kamtchatkan (Figure 1, zone D) waterfowl populations are hardly known. Ringing data show that birds moving through these areas winter mainly in Japan.

In the lower Amur region (Figure 1, zone E), numbers of waterfowl (especially dabbling ducks and geese) are decreasing both on the breeding grounds and on migration. Migratory stocks of Baikal Teal have strongly diminished, and Greylag Geese, Swan Geese, Mandarin, and Chinese Merganser are endangered. The number of harvested ducks as well as the success of hunters have decreased. Nevertheless, evident overharvesting and strong human disturbance occur. In the south of the Amur basin, great habitat deterioration is due to cutting and trampling of coastal and meadow vegetation, cattle grazing, meadow fires in spring and early summer, and water pollution. A strongly unfavourable influence is the flooding of nesting and feeding grounds during summer high waters in the Amur basin (Table 3). Many former places of waterfowl concentrations have lost their role. At present, waterfowl reproduction seems to occur mainly in the valleys of the vast, unfrequented mountain areas, where population density of waterfowl is rather low but the total area is large. Conditions on migration have essentially worsened (hunting pressure, loss of good resting grounds, disturbance). Waterfowl which breed and migrate in the Amur basin winter probably in the Chinese People's Republic, and to some extent (ringing data) in Japan. Winter conditions in Japan are satisfactory. The situation on the migration and wintering grounds in China is not studied but we have no reason to believe it to be favourable. In most recent years (from 1969) when spring hunting in the Amur region was not allowed, duck numbers on spring passage and breeding in some areas seem to have increased (Roslyakov & Kolchin, 1972). However, we think that if further measures, including continental-wide ones, are not taken the total population decline will not be arrested.

The situation described above is based on the present level of our knowledge, which leaves much to be desired. In order to improve it, some steps are necessary, among them: (1) To gather more quantitative information on the population distribution of waterfowl, and to make essential progress in waterfowl ringing. In future, we should know the seasonal distribution of the different geographical populations of each species, and we should work out overall schemes of management and conservation for the whole area of each population—with corresponding hunting quotas for various parts of its area. (2) To enforce protection of wildfowl habitats; to create reserves in the important concentration areas and to improve feeding conditions (perhaps through planting food species); to reach effective agreement on land-use practices between game management, agriculture, and forestry.

Populations of migratory birds, among them waterfowl, have continental-wide ranges. Therefore, their management and conservation should also be planned and carried out on a continent-wide basis—not within administrative boundaries. Only international agreement will provide effective conservation and secure an increase of waterfowl populations.

Acknowledgments

I express my gratitude to Mr N. N. Gerasimov, Professor L. A. Portenko, Mr M. E. Shumakov,

Mr V. G. Voronov, Mr V. D. Yakhontov, and Dr O. V. Yegorov who have kindly supplied me with their unpublished data on waterfowl status in areas studied by them. I thank Professor Y. Yamashina for much valuable information on the waterfowl wintering in Japan. I would also like to thank all the persons who participated in the winter waterfowl counts.

Summary

The distribution of waterfowl on breeding, moulting, migration, and wintering grounds in north-east Asia is described and the main areas of concentration indicated. Trends in the waterfowl populations are outlined. The situation in the arctic tundra is quite satisfactory for the 'sea-wintering' Long-tailed Duck *Clangula hyemalis* and eiders which migrate along arctic coasts, as well as probably for the Snow Goose *Anser caerulescens*, Emperor Goose *Anser canagicus* and the eastern populations of Brent *Branta bernicla*. The status of the White-fronted Goose *Anser albifrons* and especially of Yakutian populations of Brent is unfavourable. Waterfowl populations breeding in southern tundras, forest-tundras and northern thin-forest taiga, are still highly productive in places, but their total numbers have strongly decreased in the last 20–25 years. The main cause seems to be overhunting and habitat deterioration on migration and wintering grounds. On Sakhalin and Kamtchatka breeding waterfowl are no longer numerous, but birds are abundant on migration. In the lower Amur basin, waterfowl stocks have strongly diminished due to habitat degradation, overharvesting and disturbance on breeding grounds, migration routes and probably on winter ranges as well. Brent Geese, Baikal Teal *Anas formosa* and some rare species have suffered especially. More studies are necessary, as well as urgent protective measures (including international ones) directed to the protection of habitats and creation of reserves.

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Appendix A. Scientific names of species mentioned in the text, tables and captions.

Whooper Swan	*Cygnus cygnus*
Bewick's Swan	*C. columbianus bewickii* (*jankowskii*)
Swan Goose	*Anser cygnoides*
Bean Goose	*A. fabalis*
White-fronted Goose	*A. albifrons*
Lesser White-fronted Goose	*A. erythropus*
Greylag Goose	*A. anser*
Emperor Goose	*A. canagicus*
Snow Goose	*A. caerulescens*
Brent Goose	*Branta bernicla*
Pintail	*Anas acuta*
Green-winged Teal	*A. crecca*
Baikal Teal	*A. formosa*
Falcated Duck	*A. falcata*
Mallard	*A. platyrhynchos*
Spotbill	*A. poecilorhyncha*
Wigeon	*A. penelope*
Garganey	*A. querquedula*
Shoveler	*A. clypeata*
Pacific Eider	*Somateria mollissima v-nigra*
King Eider	*S. spectabilis*
Spectacled Eider	*S. fischeri*
Steller's Eider	*S. stelleri*
Pochard	*Aythya ferina*
Tufted Duck	*A. fuligula*
Scaup	*A. marila*
Mandarin Duck	*Aix galericulata*
Black Scoter	*Melanitta nigra americana*
White-winged Scoter	*M. fusca deglandi*
Harlequin Duck	*Histrionicus histrionicus pacificus*
Long-tailed Duck	*Clangula hyemalis*
Goldeneye	*Bucephala clangula*
Red-breasted Merganser	*Mergus serrator*
Chinese Merganser	*M. squamatus*
Goosander	*M. merganser*