SECTION 1: DISTRIBUTION AND STATUS

Population trends of the Mute Swan *Cygnus olor* in the Palearctic

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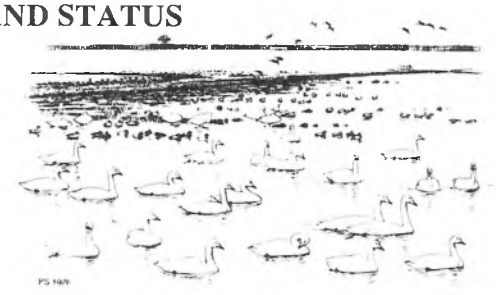

The Mute Swan is widely distributed in the Palearctic. The west and central European populations are still increasing both in numbers and in range. Their ranges are now almost continuous. There are about 28,400 breeding pairs in Europe and about 152,500 birds wintering. Because not all wintering areas are censused, the number of wintering swans may be under-estimated by 15%, so the total may be closer to ±175,000.

The increase in numbers and the extension of the range are coupled with changes in behaviour and choice of nesting sites.

Some birds from the eastern part of the range have ceased to migrate to wintering grounds and remain in their breeding areas.

In south eastern Europe and Asia, where the distribution of swans is continuous, their increases in numbers and range extension have been even more marked. The total number of birds in the USSR population (without swans from Baltic republics) was about 325,000 in 1987 (Krivonosov in press, recalculated). The ranges of eastern and western populations overlap in south eastern Europe.

The total number of Mute Swans in the Palearctic is estimated to be about 500,000 individuals.

The main reasons for changes in swan numbers are discussed.

The Mute Swan *Cygnus olor* is widely distributed in the Palearctic. The European population occurs mainly in Western and Central Europe where it has an almost continuous distribution. The south-eastern European and Asiatic population occurs in south-western parts of Soviet Union (Black Sea and Azov Sea region, Caspian Sea and Kazakhstan (Kishchinski 1979, Krivonosov 1991) and according to Ogilvie (1972) it also should be in Iran, Afghanistan and Mongolia.

Many years ago, the western and central European population was divided into seven subpopulations as follows: 1) Scandinavian-Baltic. This group was the most abundant and covered the largest area, 2) Netherlands, 3) Central Europe, 4) England and Wales, 5) Scotland (with Orkney), 6) Scotland (Outer Hebrides) and 7) Ireland (Figure 1, Atkinson-Willes 1981). Recently, the three British subgroups have been combined into one (Monval & Pirot 1989).

As a result of the eastward and southward spread of swans from the Scandinavian-Baltic and Central European groups, new breeding areas have been created. They cover Western Ukraine, Hungary and Yugoslavia. For this group I propose the name south-east European or west Ukrainean-Hungarian (Figure 1, Horvath & Karpati 1985, Gorban in press, Koshelev *et al.* in press, Serebryakov *et al.* in press, F. Bracko & J. Mikuska pers. comm.). This sub-population is continuing to grow (Rüger *et al.* 1987, Monval & Pirot 1989 and others) and to extend its range in all directions.

Breeding population

The breeding population of swans has been increasing since the early 1970s (Wieloch 1984, Rüger *et al.* 1987, Monval & Pirot 1989 and others). Changes in numbers are monitored in different countries to a different extent, but so far no global estimate of the size of the breeding population exists.

In the second half of the 1980s, the breeding population of the Mute Swan in Western and Central Europe is estimated to have been about 28,400 pairs (Table 1, Figure 2). The increase in numbers is accompanied by range expansion in various directions. The growth rate of the breeding population has been particularly high in newly occupied areas (Figure 3). A very rapid growth occurred in the south-east European and

Fig. 1. Division the Western and Central European population of the Mute Swan into groups. 1. Scandinavian-Baltic group, 2. The Netherlands group, 3. Central European group, 4. The British group, 5. Ireland group, 6. West Ukranian-Hungarian group.

Asia population. Data on the size of the breeding population in 1978 and 1987 are compared in the Table 2. Over this period, the number of breeding pairs increased three-fold and the number of non breeding birds increased five-fold (Krivonosov in press). These increases, especially the latter one, seem to be a little high and this may be partly due to an increased number of observers in 1987. The Mute Swans from south-east Europe and Asia population have not yet reached the carrying capacity of the area (Krivonosov in press, Rusanov & Krivonosov in press).

Swans are considered to be territorial birds, but in some areas, rich in food, they nest in colonies. Such colonies are known from Sweden, Great Britain, Denmark and West Germany (Campbell 1960, Bloch 1970, 1971, Mathiasson 1976, Tenovuo 1976, Andersen-Harild 1981, Reichholf 1987). Rusanov & Krivonosov (in press) observed a colony of Mute Swans at the mouth of the Volga and recently swans have attempted to establish a small colony on the coast of Rügen, GDR. (Köppen pers. comm.). There was a breeding colony in Poland in the mid-1950s (Luknajno Lake, Mazury Lakeland, 56 nests, Puchalski 1956, Sokolowski 1960). Colonial breeding is advantageous to many

Table 1. Size of West and Central European Mute Swan population in second part of 1980s.

Country	Number of breeding pairs	Number of wintering birds	Information source
Poland	± 4000	12000-14000	Kot & Kuc 1989, Wieloch unpubl. data
USSR			
Lithuania	± 500	1270	Anonymous 1988, recalc., Raudonikis *et al.* 1989
Latvia	350-360	±500	Lipsberg in press.
Estonia	500	500-700	Renno in press
RSFSR /Leningrad/	5-8		Khrabryj pers. comm.
Byelorussia	>40	200	Samusenko pers. comm.
West Ukraine	100	up to 2000	Gorban in press.
GDR	2250	24500	Rutschke pers. comm.
FRG	2000-2700	6000	Scherner pers. comm.
Czechoslovakia	530	4500	Hora 1987, Pykal pers. comm.
Austria	150	1700	Aubrecht & Bock 1985, Steiner pers. comm. Aubrecht pers. comm.
Switzerland	500	4000-5000	Salathe 1983, pers. comm., Suter & Schifferli 1988
Denmark		37000	Laursen *et al.* 1987
	4000	40000-70000	Andersen-Harild pers. comm.
Netherlands	2500-3500	7000-13000	Beekman pers. comm., Lensink *et al.* 1987
Belgium	170	400	P. Devillers & C. Kerwyn pers. comm.
France	400	2100	Boutet *et al.* 1987, Voisin 1984, 1985
Luxembourg	+	+	Crowther & Melchior 1988
Sweden	3500	10100	Karlsson & Kjellen 1984, Nielsson 1988
Norway	200-250	1000	Frostrup 1982, Haga & Hanssen 1983, Nygard *et al.* 1988
Finland	1000	250	Solonen 1983, Hilden & Koskimies 1989, Monval & Pirot 1989
Great Britain	3150	18000	Birkhead & Perrins 1986, Monval & Pirot 1989
Ireland	±1000	7000	Monval & Pirot 1989, R. Collins pers. comm.
Hungary	15	150	Horvath & Karpati 1985
Yugoslavia	10-15	120	Geister 1988, F. Bracko pers. comm., J. Mikuska pers. comm.
Italy	45	150	Parodi & Perco in press
Romania	?	2800	Rüger *et al.* 1985
Bulgaria	20	270	Nankinov 1982, pers. comm., Monval & Pirot 1989
Greece	+	300	Cramp & Simmons 1978, Monval & Pirot 1989
Turkey	?	200	Cramp & Simmons 1978, Monval & Pirot 1989
Total	±28400	±152500	

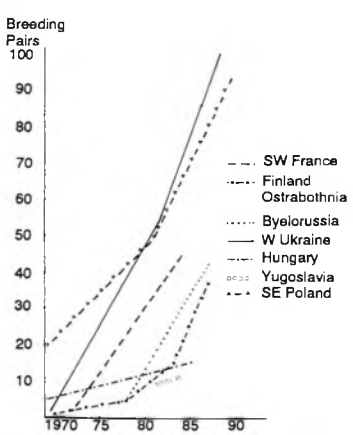

Fig. 2. Changes in numbers of the Mute Swan in areas of their recent expansion. 1. Boutet *et al.* 1987, 2. I. Gorban in press, 3. E. Samusenko pers. comm., 4. Hilden & Koskimies 1989, 5. Horvath & Karpati 1985, 6. J. Bracko & J. Mikuska pers. comm., 7. A. Buczek & T. Buczek pers. comm.

bird species, but swans seem to be more successful when breeding territorially.

Changes in numbers on the wintering grounds

Changes in numbers of swans wintering in various parts of Europe have been observed for many years. Counts made in winter are more reliable than those made during the breeding season because it is easier to count the birds in the places where they aggregate. Over the last two decades, the numbers of wintering swans have increased over almost all areas of Europe (Table 3, Figure 4), although in recent years a decline has been observed, in the Netherlands group and also in Switzerland (Lensink *et al.* 1987, Suter & Schifferli 1988, Monval & Pirot 1989). Even in Great Britain the number seem to be increasing recently in some places. This

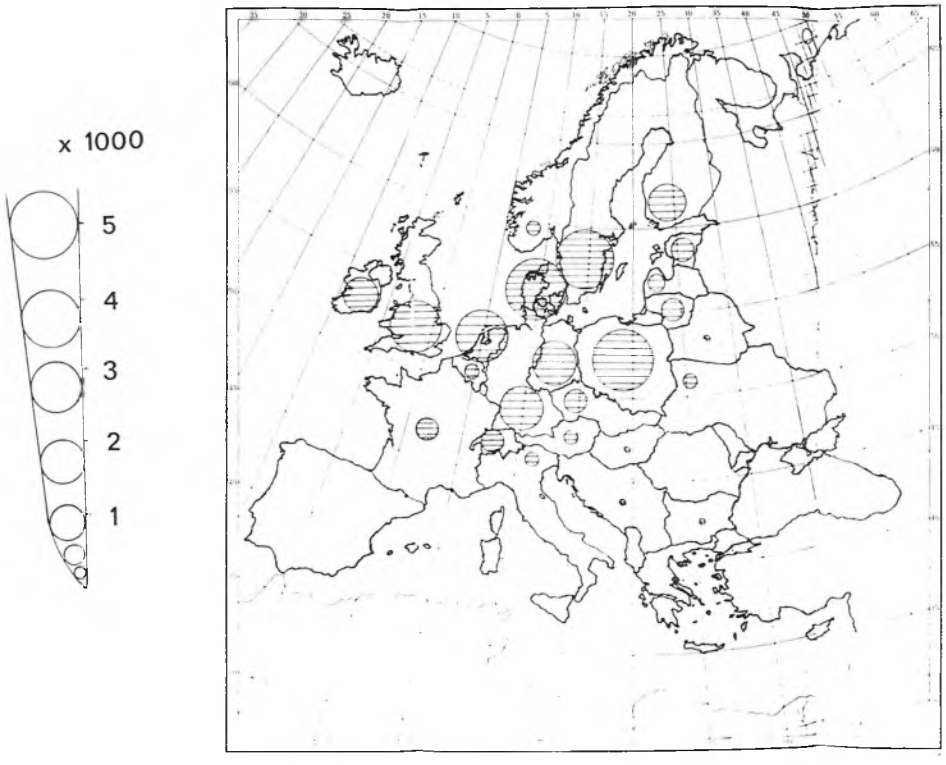

Fig. 3. Number of breeding pairs of the Mute Swan in different European countries

may be due to the fact that anglers stopped using lead sinkers that poisoned about 3,500 swans a year (Brown & Brown 1985, Brown & Brown pers. comm., Salmon *et al.* 1986, Sears & Hunt 1991).

Table 2. Number changes of the Mute Swans in south eastern European and Asiatic population*

Location of group	Breeding pairs Years 1978	1987
Black Sea area	400	800
Caspian Sea area	3500	13400
N. Caspian Sea area	300	800
Kazakhstan	2400	4000
Others	300	1400
Total	5900	20400

*Krivonosov in press (changed)

I calculate that about 152,000 swans wintered in Europe in the second half of the 1980s (Table 1). Knowing that not all wintering areas are fully covered by censuses, I have increased this number by 15% to give a total number of 175,000 wintering swans. This is similar to the estimate by Monval & Pirot (1989, Table 3). A breakdown of the number of wintering swans by area is shown in Figure 5.

Changes in numbers of wintering swans in different areas reflect not only real changes in population size (during the severe winters of 1984/85, 85/86 and 86/87 a large number of juvenile swans died; up to 3,000 swans per year have been shot in the Netherlands in recent years - Beekman & Esselink pers. comm.), but also changes in the behaviour of birds. For example, swans of the Scandinavian-Baltic group have

Table 3. Number of the Mute Swan wintering in Western and Central Europe.

Location of group	Years 1970s	early 1980s	mid 1980s
Scandinavian-Baltic area	100300	126600	127000
The Netherlands	5900	14500	14500
Central Europe	10100	13500	13500
England and Wales	14700	13900	14000
Mainland Scotland and Orkney	2600	2700	3000
Outer Hebrides	900	1000	1000
Ireland	5000	7000	7000
Total	139500 (a)	179200 (b)	180000 (c)

(a) Atkinson-Willes 1981, (b) Rüger *et al.* 1987, (c) Monval & Pirot 1989.

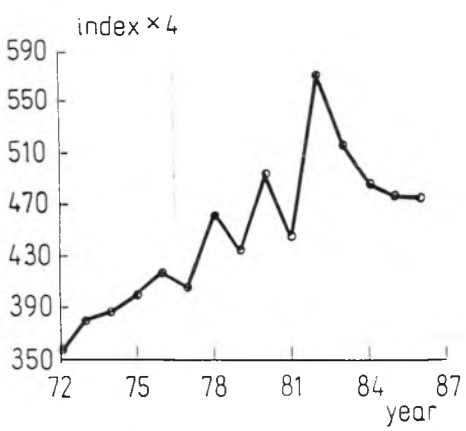

Fig. 4. Changes in numbers of the Mute Swans wintering in Europe between 1972 and 1986 years. Summarising index data for each year from the Scandinavian-Baltic group, The Netherlands group, Central European group and The British populations (Monval & Pirot 1989). N = 10.61 x (years) - 391,23; slope <> 0, $P<0.001$.

largely reduced or even abandoned migrations to wintering grounds in the Danish waters or the eastern coast of the North Sea.

The total number of swans wintering in south-eastern Europe and Asia is about 325,000 birds (Krivonosov in press), so the total number of swans wintering in the Palearctic is estimated to be 500,000 individuals.

Changes in range

The breeding range of Palearctic Mute Swans in the 1970s was compiled by Cramp & Simmons (1978) and Flint (1987). Comparing with data collected by myself (Tables 1 & 2, Figure 2, Krivonosov in press) it can be clearly seen, that swans have extended their range in many different directions. In the 1980s, the Baltic and Black-Sea groups spread towards each other. By the early 1980s, it was obvious to me that these two groups would merge, but at that time I thought it might happen after a dozen or so years. Now it is clear that this is going to happen much earlier since birds of these two groups are already nesting at the same latitude, being separated by only some 150 km (Gorban in press, Koshelev *et al.* in press). Also, although more slowly, the birds of the Central European group are extending their range through Hungary and Yugoslavia towards those birds living in the lower Danube valley (this latter population has remained stable at a low level during the last 20 years, Nankinov 1982, pers. comm.).

In central Europe and Britain, the populations have been almost stable, but with marked fluctuations in small areas (Ogilvie 1981, Brown & Brown 1985, pers. comm., Grül 1988, Leach 1988, Mooij 1988, Prinzinger & Ortlieb 1988, Coleman 1991, and others).

The Mute Swan population on the river Inn in Bavaria or in Switzerland has fluctuated in numbers due to changes in carrying capacity of the habitat, which is affected independently by factors controlling the rate of water discharge and climate (Reichholf 1973, Salathe 1983, Suter & Schifferli 1988).

At the edges of its range, numbers are increasing and the range is expanding in all directions (Norway, Finland, RSFSR - Leningrad

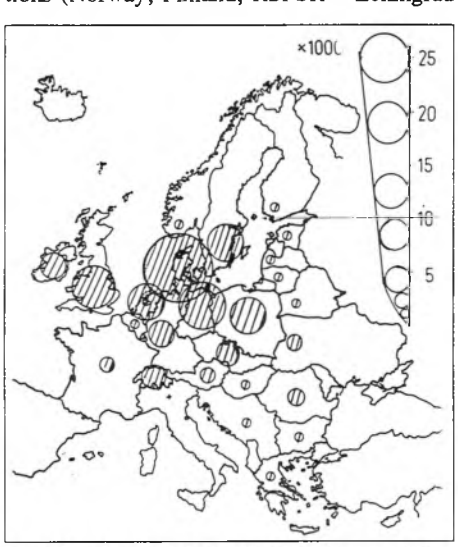

Fig. 5. Number of wintering the Mute Swans in different European countries.

area, Baltic Republics of USSR, Ukraine SSR, Czechoslovakia, Hungary - Horvath & Karpati 1985, Lipsberg *et al.* 1987, Hastbacka & Ulfvens 1987, Tichy 1988, V. Khrabryj pers. comm., H. Herredsvela pers. comm.). On its northern border, the Mute Swan already competes with the Whooper Swan *Cygnus cygnus*, which is expanding its range southward (Karlsson & Kjellen 1984, Renno in press, Mathiasson pers. comm. and others). On the Caspian Sea, Mute Swans are pushed to the south in winter due to competition with the Whooper Swan (Rusanov & Krivinosov in press).

Migration

Swans living in Western Europe tend to be non-migratory (movements of British or Dutch swans typically do not exceed some tens of kilometers (Ogilvie 1967, Renssen 1981). Swans living in eastern Europe are mostly migratory or nomadic, but they are tending to reduce the distance between breeding and wintering grounds or to become resident (Kishchinski 1979).

As a result of range expansion in Europe, different groups of swans often merge. This facilitates contact among individuals of different groups on wintering and moulting areas. This also influences changes in migration routes of some swans and accounts for the formation of pair bonds between individuals from different groups (the Netherlands, van Dijk *et al.* 1986).

Earlier, swans breeding in Poland and Baltic Republics of the USSR wintered mostly on the Danish and Rügen coasts. These areas are still used by some birds from the Scandinavian-Baltic group, but an increasing number of Polish swans are migrating southwestward or southward, spending winter on the water bodies in GDR, Czechoslovakia, Austria and Hungary. (Lipsberg *et al.* 1987, Wieloch 1990). In Sweden, especially on the western coasts and in Skane, many swans now spend the winter on their breeding grounds (Mathiasson 1987). Similar behaviour is observed in Dutch and British swans (Kear 1972, Renssen 1981, Birkhead & Perrins 1986).

Swans from the Baltic Republic of the USSR undertake the longest migrations (Kishchinski 1979). In severe winters some individuals have reached Britain. Currently, however, these birds are also tending to shorten the distance they migrate (Lipsberg *et al.* 1987).

In the severe winter of 1986/87, swans from Poland were recorded on the western coast of France and to the south in Yugoslavia.

Some of the swans nesting in the western Ukraine winter on the Polish coast. Those nesting in the northern part of the Black Sea often winter there, though some of them move to the warmer bays in the south-western part of the sea (Ardamatskaya 1987, Kostin 1987). Usually, only young birds remain on the northern coast where, surprisingly, the juvenile: adult ratio in winter may be about 20:1. A similar situation occurs on the coast of the Caspian Sea (Tkachenko in press, Korzyukov pers. comm.). For swans wintering in the Gulf of Gdansk, the juvenile:adult ratio ranges between 1:20 (at the beginning of the winter) to 1.5:1 (end of the winter), mean - 1:5 (Ciecierski 1987, Meissner pers. comm., Wieloch unpubl.).

It will be interesting to follow the fates of the breeding birds and their offspring from the Black Sea population, nesting already close to the range of the Scandinavian-Baltic group and to follow their fates when the breeding grounds of the two groups meet and overlap. According to the most recent data (Serebryakov *et al.* 1991) some of the swans from the Baltic and Black sea groups used to meet each other at the end of their migration in central Ukraine, but we do not know what kind of birds they are and how much further they migrate to the east.

Factors determining changes in numbers

The process determining population size involve birth-rates and death-rates. The most important factors leading to reduced mortality and increased reproduction of swans comprise:

1. Legal protection of the species
2. An increased number of nesting sites
3. Creation of new water bodies in places where they did not exist (e.g. retention reservoirs)
4. Rapid eutrophication of waters as a result of agricultural and industrial developments
5. Supplemental feeding of swans in different parts of the year, especially in winter
6. Rapid synanthropization of swans in many regions, making it possible for the swans to use new nesting sites, moulting areas and wintering areas
7. Low mortality during mild winters
8. Reduced numbers of natural enemies
9. Longevity

A common view is that the legal protection of the species is the most important single cause of its expansion. This protection brought to the end (or limited) hunting, egg removal and trapping on moulting areas (Wieloch 1984). However, some hunters, ornithologists, nature con-

servation officers, naturalists or farmers are thinking about population control. Many swans are nowadays killed on fish ponds in GDR because of the alleged damage they cause (U. Köppen pers. comm.). In the same country other methods of swan control are also proposed, such as pricking the eggs in nests, removing part of the clutch, culling of cygnets and juveniles, or hunting in autumn (Krüger 1982). Some new methods for control of feral Mute Swans in the United States are recommended by Allin *et al.* (1987). In Schleswig-Holstein swans are hunted in October (but I do not know how many are killed), whereas the Dutch kill up to 3,000 swans foraging on crops and meadows to protect these (J.Beekman pers. comm., J. van der Ven pers. comm.). In the Groningen area (the Netherlands) up to 30-40% of the clutches are taken to reduce the population (J. Beekman pers. comm.). Also in Poland from time to time it is suggested that swans should be included on the list of game birds; the occurrence of larger groups of non-breeding swans (e.g. 500 individuals) in fish-farms is not popular with the farmers. But in general swans enjoy the approval of society in Poland. Data from Bavaria and Switzerland show that the Mute Swan population seems to be self-regulating in relation to changes in carrying capacity and man's "help" is not necessary (Reichholf 1973, 1984, Salathe 1983).

Over most of the Mute Swan's range, many suitable nesting sites are not currently in use by these birds (Mathiasson 1987 and others). According to Reichholf (1984) only 20% of the potential breeding population are able to obtain breeding territories at Southern Bavaria and Upper Austria. During the last several decades, swans apparently shifted (extended) their nesting sites to water bodies they had not used before. For example, in Poland in the 1950s swans nested almost exclusively on large lakes. By the 1970s, however, they were also nesting on ponds, canals, swamps, gravel-pits, ditches, rivers, retention reservoirs and oxbow lakes (Zajac 1962, Wieloch 1984). Some of these sites have poor food supplies, but when the young hatch the whole family often moves to other water bodies richer in food. Andersen-Harild (1981) found that young from marginal habitats are in poorer condition than those from rich habitats.

Since many water bodies in Europe are not covered, totally or in part, with ice, swans can overwinter near their breeding areas. These areas are often located near human settlements where they may be supplied by man with extra food, enhancing their survival over winter.

Swans have readily habituated to the close proximity of man in various parts of their range. As recently as the 1940s, they were considered to be very timid in Poland and not likely to get used to human presence, but now this is not the case. In Krakow, southern Poland, swans were a rare attraction in the early 1980s, whereas in the winter of 1988/89, 900 individuals stayed there. At a distance of several 10 kilometers from that place, they established a new moulting area. Both these places are used also by birds from the countries located south of Poland.

Mild winters, which have been more frequent in recent years in Baltic and central parts of Europe, have enhanced the survival of many swans, especially young, which die during severe winters. Moreover, large amounts of extra food supplied by man (although not always beneficial to the condition of the birds) increases the survival of swans, especially in winter.

As swans are large and strong birds, they have few natural enemies. Their nest may be destroyed by wild boars, foxes, raccoon dogs or even wolves (Berglund *et al.* 1976, Tenovuo 1976, Wieloch 1984, Birkhead & Perrins 1986, Mandziou 1987 and others). Losses due to eagles, goshawks or ravens can be of some importance in the incubation period and even shortly after hatching. Natural mortality factors also involve flooding of nests during strong winds or as a result of changes in the water level. Epidemic diseases (*Salmonella, botulism*) (Feiler & Kohler 1977) and parasites (*Trematodes, Hymenolepididae*) can also account for some losses, but these are usually rather small (Sulgostowska 1972, Czapliński 1975, Nielsen *et al.* 1981, Ardamatskaya in press).

Swans can live 25 years (Staav 1983) and they can still reproduce at age of 20 years (Mathiasson 1987). They start breeding for the first time at various ages ranging from two to 10 years. Some individuals do not breed at all (Andersen-Harild 1981, van Dijk *et al.* 1986, Mathiasson 1987).

In expanding populations, the age at the first nesting attempt is, on average, lower than in stable populations, established in an area for a long time.

We have few data on the age when swans start to breed in Poland since the ringing of young birds on a large scale was started only recently. The data we already have, show that some swans start breeding when three years old. One swan near Gdansk started breeding at the age of two years but without success, as is the case with many first attempts.

Swans have a high reproductive rate and in

most breeding areas success is higher than necessary for the population to maintain itself (Andersen-Harild 1981, Reichholf 1984, Wieloch 1984 and others). Breeding success is lower in stable populations, which have reached their carrying capacity than in newly established populations (Reichholf 1984). In colonies, reproduction is needed to maintain the population (Andersen-Harild 1981, Reichholf 1984).

Conclusions

This review shows that the Mute Swan is characterized by a high ecological plasticity. Swans have increased in numbers very rapidly in the last two to three decades over large parts of their range and they have turned from very shy to almost synanthropic birds and also, they have changed their migratory habits. They have high reproduction rates, often higher than is needed for the population to maintain itself. Reproductive rates are lower in swans nesting in colonies.

Outside the major area of expansion, in places such as the British Isles, the Netherlands, Central Europe and even GDR, the Mute Swan populations seem, at present, to be stable with fluctuations of only up to 10-15%. These fluctuations are affected not only by natural factors (severe winters with high snow cover), but also by human activity such as sports and angling or intentional reduction of the swan populations.

The number of swans breeding in Western and Central Europe is estimated as 28,400 pairs and wintering about 175,000. Thus total number of breeding pairs in the whole Palearctic is estimated as about 49,000 (28,400 + 20.400, see Tables 1, 2), and the Palearctic swan population involves about 500,000 individuals.

Much recent information shows that the Mute Swan has filled the habitat in many European areas and if man would not help it by new breeding areas, the increase in numbers will soon stop. The Mute Swan in the south-east Europe and Asia population have not yet filled the habitat to capacity.

The problem of possible population control will be raised with increasing frequency. There is a need for clarifying arguments for and against population control before hunters, fishermen or farmers embarrass ornithologists with their arguments for which the latter will have no clear, objective answers, backed up by the results of scientific investigations.

In my opinion we should not interfere in the swan population either by reducing its size or by providing extra food.

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