

Maria WIELOCH

## Numbers and distribution of the mute swan *Cygnus olor* in Poland against the situation of this species in Europe

WIELOCH M. 1984. Numbers and distribution of the mute swan *Cygnus olor* in Poland against the situation of this species in Europe. Acta orn. 20: 187-240.

The paper follows the course of changes in numbers and area of the mute swan in territories now incorporated into Poland, from the beginning of the 20th century to the turn of the seventies, discusses the expansions — territorial and of habitat that still continue in Poland, the wintering of swans in Poland, and the moulting flocks of non-breeding swans in this country. The nesting sites of swans and their productivity are described.

The demographic explosion of the swan, that took place this century, and particularly in its last decades, has been explained as being the result of the overcoming of two barriers limiting the numbers of this species, viz. the predatory pressure from man and the severe-winter barrier. Species-protection by law and the winter feeding of swans by people have resulted in a lowering of the swan's shyness and have caused their synanthropization which in turn has become the cause of habitat expansion.

In the years 1976-79, about 3800 mute swan pairs nested in Poland; in summer not more than 6500 non-breeding swans stayed here, and about 6000 swans wintered in this country.

M. Wieloch. Ornithological Station, Institute of Zoology, Polish Academy of Sciences, 80-680 Gdańsk 40, Poland.

Размещение и численность лебедя-шипунa *Cygnus olor* в Польше на фоне ситуации этого вида в Европе

В работе прослежены изменения численности и ареала лебедя-шипунa на землях принадлежащих в настоящее время к Польше за период с начала XX века до конца 70-тых — начала 80-тых годов; обсуждена экспансия этого вида — территориальная и освоение новых биотопов, что постоянно имеет место на территории Польши; зимовка лебедей в Польше и линька на территории страны негнездящихся стай. Описаны гнездовые биотопы лебедей и их продуктивность.

„Демографический взрыв” лебедя в текущем столетии, а особенно на протяжении последних десятилетий объясняется преодолением двух преград, ограничивающих численность этого вида: хищнического пресса со стороны человека и преграды суровых зим. Видовая охрана и докармливание лебедей зимой людьми повлияли на уменьшение плохливости лебедей и на их синантропизацию, которая в свою очередь способствовала освоению новых биотопов.

В 1976-79 годах в Польше гнездились около 3800 пар лебедя-шипунa, негнездящихся пребывало летом не более 6500 особей, а зимовало около 6000 лебедей.

Introduction . . . . .	188
Methods and material . . . . .	189
Numbers of breeding swans in Poland in the years 1976-79 . . . . .	194
Numbers of non-breeding swans in Poland . . . . .	196
Breeding pair density in Poland . . . . .	198
Number of breeding pairs at a site and its variations in different years . . . . .	200
Variations in numbers of the swans in Poland . . . . .	203
Variations in numbers of the swans in Europe . . . . .	206
Changes in the range of swan breeding areas in Poland . . . . .	208
Distribution of swan breeding areas in Poland in the years 1976-79 . . . . .	214
Changes in the range of the breeding areas of swans of the Scandinavian-Baltic group . . . . .	215
Wintering of swans in Poland . . . . .	216
The swans' nesting habitat in Poland . . . . .	218
The swans' nesting habitat in Europe . . . . .	220
Production of young in Poland . . . . .	221
Production of young in Europe . . . . .	222
Causes of breeding site abandonment in Poland . . . . .	223
Factors affecting the numbers of swans . . . . .	225
Summing up . . . . .	227
Acknowledgments . . . . .	229
References . . . . .	229
Streszczenie . . . . .	238

## INTRODUCTION

The mute swan is one of those waterfowl species which not only do not decrease their numbers due to changes occurring in the wetland habitats, but, on the contrary, show a considerable increase in abundance and a territorial expansion throughout the area of their occurrence.

The area of occurrence of the mute swan is divided into two main parts, at present still completely separated — the northern part including populations inhabiting the basins of the Baltic and the North Sea, the British Isles, and the southern part including populations occurring in the Euro-Asiatic zones of steppes and semideserts, from the Black Sea in the west to Kazakhstan in the east (KISTCHINSKY 1979).

The swans inhabiting the northern part of the area have been divided into geographical populations differing in numbers, degree of residence, distance of migration (KISTCHINSKY 1979, SCHMIDT *et al.* 1979, ATKINSON-WILLES 1981), as well as origin. Some of them stem from wild birds, others from those domesticated in the Middle Ages (BAUER and GLUTZ 1968, SCOTT and Wildfowl Trust 1972, CRAMP 1977) which then returned to the wild state or interbred with wild birds.

ATKINSON-WILLES (1981) includes the swans inhabiting Poland in the Scandinavian-Baltic group. This name is more correct than that proposed by KISTCHINSKY (1979): the „Baltic-North-Sea population”, because the latter

includes also swans of the Dutch group (ATKINSON-WILLES 1981), the separation of which from the Scandinavian-Baltic swans is for many reasons justified.

On the basis of ringing data KISTCHINSKY (1979) and SCHMIDT *et al.* (1979) divided the swans of the Baltic basin into a number of small groups, but as their areas of occurrence to a large extent overlap and there occurs a considerable interchange of individuals among them, such a detailed classification does not seem to be justified.

The occurrence and numbers of swans in Poland have been dealt with in several papers covering the whole area of the country (SOKOŁOWSKI 1960, LESSER 1968, WAŚKIEWICZ 1978) or large regions of it (ZAJĄC 1963, BERESZYŃSKI and WIŃSKA 1980, DOHNAL 1981) and in many local papers (PANFIL 1966, KAŹMIERSKI 1972, KUTZNER 1976, ORŁOWSKI 1977, PAWLIK 1977, PIETKIEWICZ 1978, TROJNIAK 1978, MRÓWCZYŃSKA 1979, SŁAWIŃSKA 1979, MACKOWICZ 1981, RÖSLER 1981, MANDZIOU 1982). In spite of this, the course of changes in numbers of the swans in Poland has not been well-documented. In the different periods the data gathering methods varied and the data were presented in different ways in the various publications, whereas the documentation of the above-mentioned three studies covering the whole of Poland has been destroyed.

The aim of the present paper is to describe the distribution and numbers of the mute swan in Poland towards the end of the seventies, and in some cases at the turn of the seventies of this century, and to follow changes in the range and numbers of this species during the 20th century in territories belonging at present to Poland, against the all-European trends which the species is subject to.

#### METHODS AND MATERIAL

The material used in the paper comes primarily from the questionnaire studies carried out in the years 1978 and 1979. The questionnaire distributed in 1978 had been worked out in cooperation with the Department of Zoology and Ecology of the University of Warsaw. In the questionnaire correspondents were requested to give information on: detailed location of the swan's breeding sites, type of water bodies inhabited by it, number of pairs incubating eggs or leading young, number of adult swans not leading young in July and August, history of a breeding place (since when swans have nested there and whether they nest there every year) and their observations on changes in numbers of the swans in recent years. The first year of information gathering was considered tentative, so questionnaires were sent to a small number of receivers. A total of 400 questionnaires had been sent that year and 256 positive replies were received (Table 1).

In 1979, copies of the questionnaire were sent to hunters via the regional branches of the PZŁ (Polish Hunters Association) or were enclosed with current



issues of the monthly *Wiadomości Wędkarskie* (to Fishermen) and printed in the weekly *Świat Młodych* (to Youth) (Table 1). On the basis of the experience acquired from the use of the questionnaire the previous year, it was decided that if it was to be sent to a larger number of receivers, the questionnaire had to be simplified, so the number of questions was restricted to those concerning the current state.

Data on over 700 breeding sites of the mute swan, relating to the periods analysed in the paper come from the literature and from unpublished data of different data-suppliers.

Table 1. Number of questionnaire sent and received till the end of 1979

Year	Replies	Number of questionnaires sent	Number of positive replies received	Number of negative replies received	Percentage of received replies
1978	Ringers, Participants of previous questionnaire studies, Bird-watchers	400	256	128	96
	Hunters	2442	435	707	47
1979	Fishermen	80 000 (Circulation)	856	365	1.5
	Youth	50 0000 (Circulation)	207	93	0.06
	Total		1498*	1165*	
Total 1978 and 1979			1754	1393	
			3047		

\*Several correspondents returned the questionnaires as late as 1980 and 1981 with data relating to these two years, so these questionnaires have not been taken into account in the calculation of the percentage of received replies.

Information on the summer non-breeding flocks of swans comes from published papers (SŁAWIŃSKA 1979, MACKOWICZ 1981) unpublished data of different authors (A. CZAPULAK, M. GOC, L. JASIK, J. JESIONOWSKI, M. KUPCZYK, P. MAJEWSKI, T. MIZERA, P. PROFUS)\* and my own observation.

Information on the wintering of swans has been made available to me by A. CZAPULAK, J. FLESZAR, W. JANKOWSKI, A. KARDAŚ, T. KROTOSKI, P. MIELCZAREK, A. OWCZAREK, J. PINOWSKI, P. PROFUS, J. PRZYBYSZ, T. RZĄDKOWSKI, T. STAWARCZYK and K. WOŁK. I have also used unpublished reports on places where ringed swans were encountered in winter, accumulated at the Ornitho-

\* A name quoted in the text but not followed by the specification of a year denotes unpublished data.



logical Station of the Institute of Zoology, Polish Academy of Sciences, and data from papers by MAJEWSKI and WIATR (1981), and by BESZTERDA *et al.* (1983).

Data on the breeding success are derived from the questionnaire of 1978 (on 214 pairs) and from that of 1979 (on 272 pairs).

Information on the occurrence of the mute swans in Europe have been taken from the literature or from unpublished materials of several informants (see Tables 5 and 6).

In Poland, the questionnaire method has many a time been used in ornithological studies (DOBROWOLSKI *et al.* 1962, ZAJĄC 1963, DOBROWOLSKI and NOWAK 1965, DYRCZ 1966, BOGUCKI 1967, LUNIAK 1972, OLECH 1973, JÓZEFIK 1976, WAŚKIEWICZ 1978, GROMADZKI and WIELOCH 1983 and others), and its disadvantages have been well known (RYDZEWSKI *et al.* 1972). However, in the case of the swan, a species easy to notice, well known not only to ornithologists, and generally liked by society, some basic errors of the questionnaire methods such as the likelihood of erroneous species identification, erroneous estimation of numbers at a site, failure to discover a considerable number of sites due to cryptic habits of the species under study can have arisen only in exceptional situations. By carefully checking all sites on the map, care was taken to eliminate the error consisting in an overestimation of the number of sites because of different names used by different informants for the same site. The main disadvantage of the material gathered is its incompleteness due to the lack of observations from many water bodies in Poland.

The use of data from some published sources was rather difficult. For instance, in the case of SOKOŁOWSKI's (1960) paper variations in the range of the mute swan in Poland were analysed on the basis of the location of sites presented by the author on a map that was little accurate, and this may have caused a doubling of certain sites. Data contained in LESSER's (1968) paper had to be recalculated because the author specified the abundance of the swan by giving the number of birds without breaking it down into breeders and non-breeders. The calculation method has been described in the appropriate section of the paper.

In the elaboration of the results swans nesting in parks have been omitted. An inventory has been made of all mute swan breeding sites in Poland. The site file is at the Ornithological Station of the Institute of Zoology, Polish Academy of Sciences in Gdańsk.

Any one water body with swans nesting on it was considered to be a breeding site; in the case of fish ponds the unit considered to be a breeding site was a pond complex if the informants specified the total number of pairs occurring on the ponds of the given complex.

The numbers of a site were in essence determined on the figures given by the informants, although the fact was not ignored that inherent in them might be a certain error. Where several different correspondents, acting inde-

Table. 2. Number of mute swan's breeding sites and pairs in Poland in different periods in 20th cent

Voivodship	Number of sites						Number of breeding pairs in 1976-79
	Years to 1939		Years 1945-75		Years 1976-79		
	Sites known before 1939 and partially 1945-75	Sites known before 1939 and in 1976-79	Sites known only in 1945-75	Sites known in 1945-75 and 1976-79	Sites discovered in 1976-79	All sites known in 1976-79	
Biała Podlaska					7	7	18
Białystok			2		12	12	17
Bielsko Biala				1	13	14	30
Bydgoszcz	15	7	52	20	125	152	259
Chelm			1	2	11	13	27
Ciechanów			6	2	7	9	14
Częstochowa				1	25	26	29
Elbląg	10	6	1		41	47	82
Gdańsk		4	31	4	102	110	151
Gorzów Wielkopolski	2	2	18	5	143	150	268
Jelenia Góra					11	11	15
Kalisz					28	28	44
Katowice					27	27	53
Kielce			1		6	6	6
Konin			1	4	24	28	50
Koszalin	5	7	15	10	54	71	128
Kraków						—	—
Krosno						—	—
Legnica					16	16	35
Leszno				6	25	31	41
Lublin			1	3	15	18	30
Łomża			3	1	15	16	54
Łódź					8	8	8
Nowy Sącz						—	—
Olsztyn	30	50	26	51	129	230	356

Opole			1	1	25	26	35
Ostrołęka			1		7	7	13
Piła	4	2	10	4	67	73	102
Piotrków Trybu- nalski					10	10	22
Płock					14	14	21
Poznań			4	5	121	126	187
Przemyśl					2	2	2
Radom				1	6	7	12
Rzeszów						—	—
Siedlce			1		12	12	14
Sieradz					12	12	19
Skierniewice			2		6	6	9
Słupsk	4	7	11	7	62	76	172
Suwałki	38	27	9	17	64	108	243
Szczecin	6	6	24	11	82	99	234
Tarnobrzeg					2	2	3
Tarnów					2	2	2
Toruń			2		56	56	76
Wałbrzych					3	3	3
Warszawa			1		7	7	22
Włocławek			3	1	22	23	34
Wrocław			1	1	33	34	73
Zamość					1	1	1
Zielona Góra		1	3	2	73	75	113
Total	115	119	233	159	1533	1811	3130
	234		392				

Mute swan in Poland



pendently reported different figures specifying the numbers of a site, the number chosen was that given by that observer who was subjectively considered to be most reliable. Sometimes the number of pairs was perhaps overestimated, first of all by including non-breeders in the breeding proportion of the population.

A comparison of the data from the questionnaire and the results of detailed studies carried out in Śląsk and in Wielkopolska has shown that about 20% (19% and 22%) of the sites found during these studies were not listed in the questionnaire (DOHNAL 1981, T. STAWARCZYK). Also some of the data obtained from the questionnaire (about 10%) failed to be confirmed in the detailed studies. In Mazury (voivodship of Olsztyn) the percentage of sites not listed in the questionnaire, but found during detailed studies\* was much higher (32%), however, this was due to a deliberate failure to transfer some questionnaire answers. On the basis of the above data the number of breeding pairs indicated in the questionnaires was augmented by 20%, considering the resultant value to be the approximate number of swan breeding pairs in Poland. MATHIASSEN (1976) found an estimation error of similar magnitude in questionnaire studies of swans in Sweden.

Data on the water surface area have been obtained from the Department of Inland Fishery Economics, the Institute of Inland Fishery, Olsztyn, and from the National Association of State Fish Farms, Warsaw.

#### NUMBERS OF BREEDING SWANS IN POLAND IN THE YEARS 1976-79

In the years 1976-79 a total of 1811 sites of the mute swan with 3130 pairs nesting at them were found in Poland (Table 2). 84% of all the sites known at present were discovered in the years 1976-79, 9% — in the years 1945-75, and 7% were known still before World War II.

Within the present surface area of Poland 234 mute swan breeding sites were known before 1939; of this number of sites 119 are known at present, from which follows that 50% of the prewar sites have disappeared. Between the periods 1945-75 and 1976-79 60% of the sites of that time disappeared; likewise, between the period before 1939 and 1945-75 58% of breeding sites disappeared (Table 2).

Two problems are related to the above figures illustrating the rate of site disappearance between the periods in which the numbers of breeding swans are analysed. One of them is the real abandonment of some of the existing breeding sites by the swans. This phenomenon, the causes of which are complex (see pages 223), occurs in spite of the general tendency towards an increase in numbers (see pages 203-206) and occupation of more and more new water bodies by breeding

---

\* (ORŁOWSKI 1977, PAWLIK 1977, PIETKIEWICZ 1978, MRÓWCZYŃSKA 1979)

pairs. The other problem is the error of method, because of which a number of sites considered to have disappeared are simply those existing site, the persistence of which has not been found a new, although swans most likely continue to nest at them. Our data do not, however, make it possible to assess the percentage of sites really abandoned and of those not discovered relative to the total number of sites declared to have disappeared.

Table 3. Number of mute swan breeding pairs in Scandinavian-Baltic Group in the 1970s

Country	Number of breeding pairs
Denmark	4000
Poland	3800
Sweden	2500
GDR, West Berlin	2400
FRG (Schleswig-Holsstein, Niedersachsen)	800
Finland	400
Lithuania	200
Latvia	350
Estonia	110
Norway	120
Total	14 680

— Source of data: FEILER 1974, PAAKSPUU 1974, SCHERNER 1974, JOGI *et al.* 1976, MATHIASSEN 1976, TENOVUO 1976, LIPSBERG 1979, 1983, ANDERSON-HARILD 1981a, SCHERNER 1981, MALCHEVSKY and PUKINSKY 1983, RUTSHKE 1983, HERREDSVELA *in litt.*, the author's own data.

Table 4. Number of mute swan breeding pairs in northern, central and western Europe in the 1970s, broken down into groups according to ATKINSON-WILLES (1981)

Group	Number of breeding pairs
Scandinavian-Baltic Group	14680*
Netherlands Group	3500**
Central European Group	1650***
England and Wales	} 3140****
Scotland: mainland and Orkney	
Scotland: Hebrides	
Ireland	1000*****
Total	23 970

Source of data: \*see Table 3, \*\*SCHERNER 1974, 1981, RENSSSEN and TEIXEIRA 1980, TOMBEUR *in litt.*, \*\*\*MAYER 1969, HOLZINGER 1973, CRAMP and SIMMONS 1977, BROŽ 1980 (in SCHILFERELLI *et al.*) SALATHE 1983, HORA *in press*, JANDA *in litt.*, SCHMIDT *in litt.*, \*\*\*\*\*OGILVIE 1981, \*\*\*\*\*FORSYTH 1981.

The number of mute swans nesting in Poland in the years 1976–79 was estimated at 3800 pairs. By accepting this estimate it is assumed that about 1/4 of the swan pairs belonging to the Scandinavian-Baltic group (Table 3) and over 15% of the northern- and central-European population of the species (Table 4) nest in Poland.

When analysing the number of swans nesting in Poland, it must be noted that the questionnaire study of 1979, representing the basic source of the information used in the present investigation, was carried out after the severe winter of 1978/79. During that winter many swans died in Europe, and after it at least in some regions of Poland fewer pairs started breeding than in previous years (M. GROMADZKI). Thus the analysis done by me of the numbers of swans in Poland covers the time of a demographic decline of the species, and it was to be expected that there would be a growth in its numbers\*.

#### NUMBERS OF NON-BREEDING SWANS IN POLAND

In Poland areas are known where large concentrations of non-breeding\*\* swans occur in summer (Fig. 1). On the water bodies listed in Fig. 1 about 5000 non-breeding swans are found in summer, 35% of which occur in Mazury.

Assuming that on many lakes there are smaller groups of non-breeding birds (ORŁOWSKI 1977, PAWLIK 1977, PIETKIEWICZ 1978, MRÓWCZYŃSKA 1979, TROJNAR 1978, BEDNORZ 1983, A. DOMBROWSKI, W. JANKOWSKI) and that some larger aggregations of non-breeding swans may have remained undiscovered, the number of non-breeding birds occurring in Poland can fairly arbitrarily be estimated at about 6500 individuals; the accuracy of this method can be disputed, it does not seem, however, possible that the real number of non-breeding swans found at present in Poland in summer could exceed this value.

If accepted, the above figure, as well as the estimate of breeding pairs presented earlier make it possible to calculate the ratio of breeders to non-breeders, whose value for the whole of Poland amounts to 1 : 0.9. This ratio almost equals that given by SOKOŁOWSKI (1960) — 1 : 0.8 — for the whole Polish swan area of that time, and is much lower than that calculated by me for Mazury — 1 : 1.7 (the years 1976–78) on the basis of the data contained in the papers by ORŁOWSKI (1977), PAWLIK (1977), PIETKIEWICZ (1978), TROJNAR (1978), MRÓWCZYŃSKA (1979) and SŁAWIŃSKA (1979). It is also much lower than the value adopted by SCHERNER (1974) for Europe — 1 : 2.2.

If the real ratio of breeders to non-breeders in the Scandinavian-Baltic

\* Such a growth occurred indeed, as confirmed by numerous, mostly still unpublished data (DOHNAL 1981, J. BEDNORZ, M. GROMADZKI, T. KROTOSKI, T. MIZERA, J. MŁYNAREK, T. STAWARCZYK, J. WITKOWSKI, PZW Nowy Sącz).

\*\* In the moulting period they are joined by swans which have last their broods (MINTON 1971).



swan group is more similar to the values calculated for Mazury, or those given by SCHERNER (1974) than the value found by me for the whole of Poland, it means that a considerable proportion of the swans that will eventually nest in Poland spend their juvenile years outside Poland. In this case an exception would be the Masurian swans which spend the immature period on native

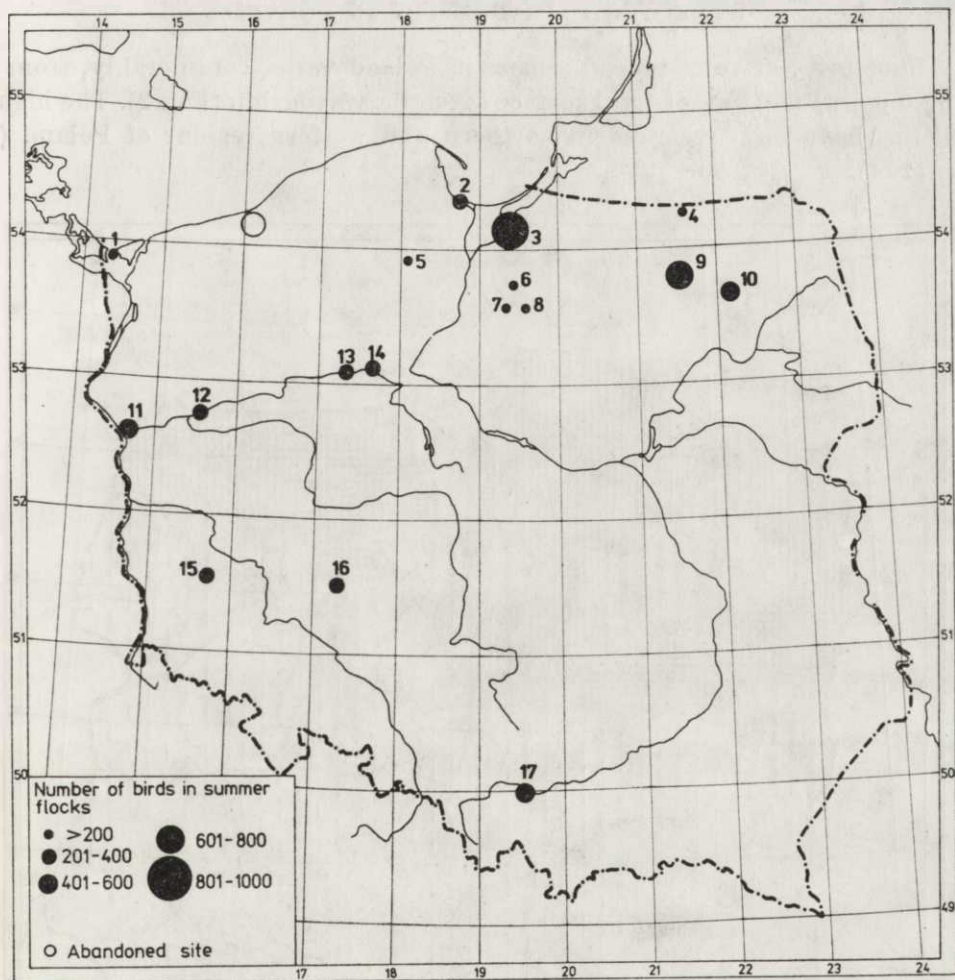


Fig. 1. Major flocks of non-breeding mute swans in Poland at the turn of the 1970s

1 - near Świnoujście - P. ZYSKA, 2 - L. Ptasi Raj - M. WIELOCH, 3 - Vistula Lagoon - (near Nowakowo) - M. GOC, W. GRABOWSKI, 4 - L. Oswin - MACKOWICZ 1981, 5 - L. Krag - W. GÓRSKI, 6 - L. Gaudy - PAWLIK 1977, 7 - L. Popówko - ORŁOWSKI 1977, 8 - L. Karaś - MACKOWICZ 1981, 9 - L. Łuknajno - SŁAWIŃSKA 1979, 10 - L. Pogubie - SŁAWIŃSKA 1979, 11 - Słońsk Reserve - P. MAJEWSKI, 12 - Noteć valley - near Santok - T. MIZERA, 13 - Noteć valley - near Osiek and Wyrzysk - M. KUPCZYK, 14 - Noteć valley - near Ślesin - L. JASIK, J. JESIONOWSKI, 15 - Przemków fish pond complex - A. CZAJULAK, 16 - Milicz fish pond complex - T. STAWARCZYK, 17 - Zator fish pond complex - P. MIELCZAREK, P. PROFUS.

lakes. The excess of non-breeders relative to nesting birds found at the coasts of GDR (RUTSCHKE 1982), as well as an analysis of recoveries (M. WIELOCH unpubl. data) confirm this supposition.

However, the fact must be stressed here that until not long ago aggregations of non-breeding swans were known in Poland only from Mazury and the seaside belt.

#### BREEDING PAIR DENSITY IN POLAND

The density of swan breeding pairs in Poland varies considerably, from 0.1 to 30.0 pairs/1000 km<sup>2</sup> of total surface area of a voivodship (Fig. 2). The highest densities have been recorded in northern and western regions of Poland (see page 214).

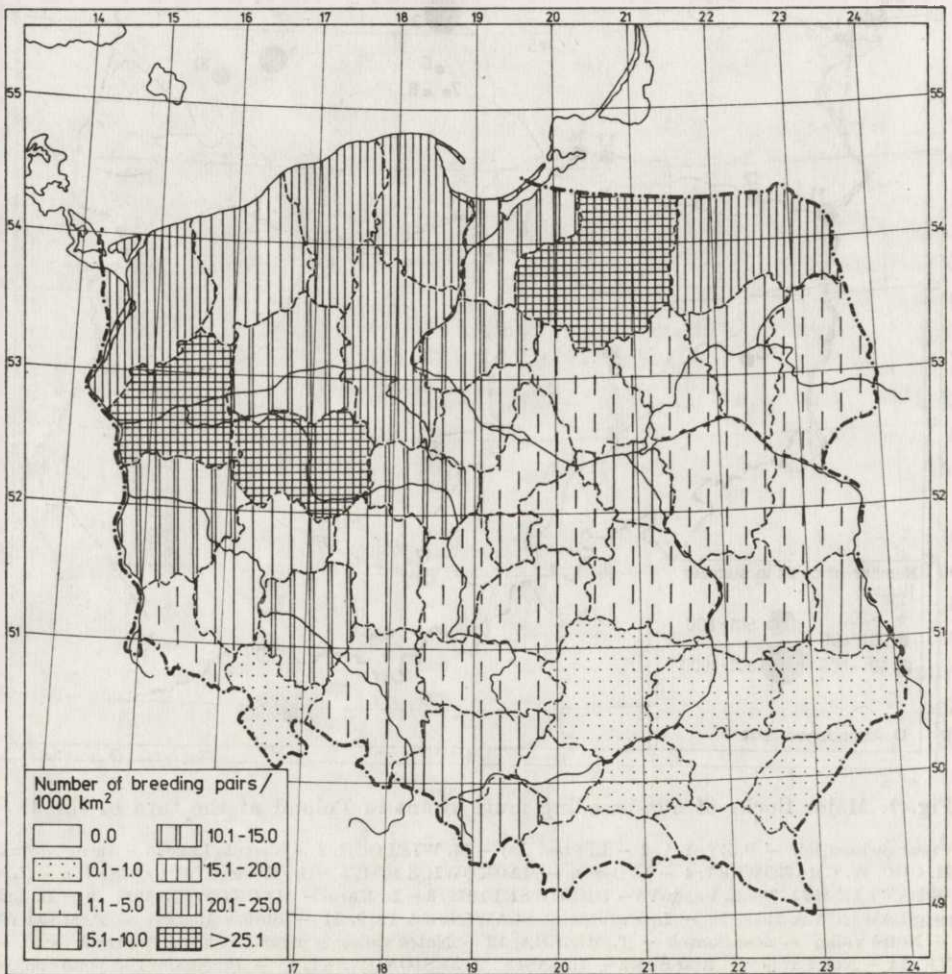


Fig. 2. Density of mute swans in Poland in the years 1976-79. Presented in relationship to total surface area of the particular voivodships.

A slightly different picture is obtained if the density of swans is presented by specifying the number of pairs per unit area of the water bodies (Fig. 3). It appears that only a few regions of the country (the voivodships of Szczecin, Gorzów, Poznań and Bydgoszcz) are characterized by both high total numbers of swans and a considerable saturation of water bodies with them. The majority of the areas where water bodies are to a high degree occupied by swans are terrains with low average total numbers of these birds.

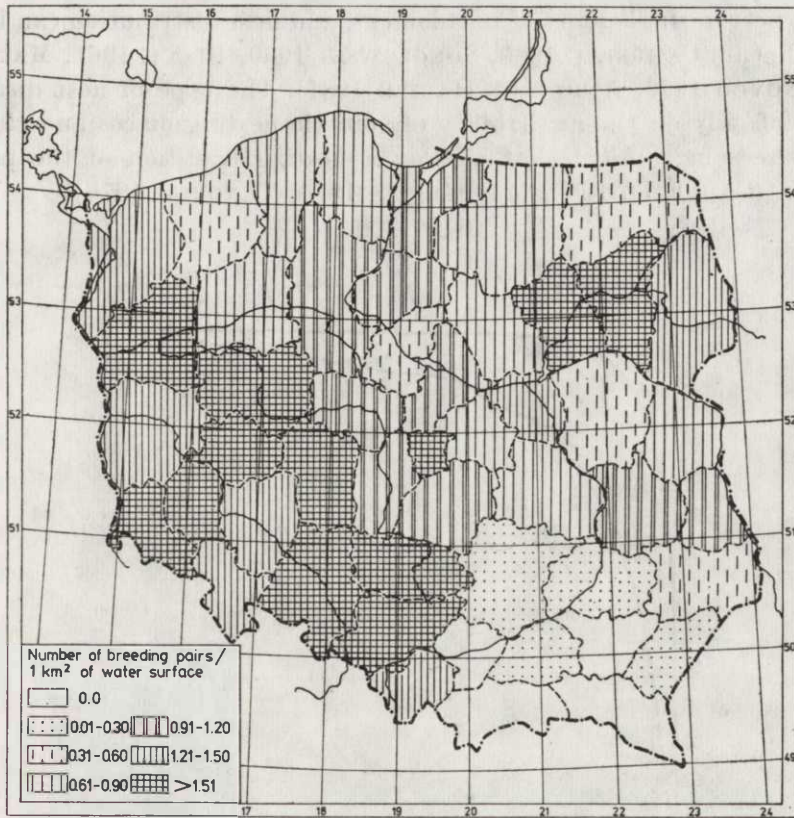


Fig. 3. Density of mute swans per 1 km<sup>2</sup> water surface area in Poland in the years 1976-79. Presented in relationship to the open water surface area of the particular voivodships.

This relationship is connected with the number, and primarily with the kind of water bodies found in the given area, because the number of swans nesting on a water body directly depends on the surface area occupied by emergent and submerged aquatic vegetation, and only indirectly on the size of a water body. This relationship varies between large and small water bodies. On large and medium-sized Masurian lakes there is one swan pair per about 10-12 ha of helophyte area (PIETKIEWICZ 1978, MRÓWCZYŃSKA 1979) and about 1 ha of submerged aquatics (MACKOWICZ 1981) at a depth not greater than 1-1.5 m,



while on small water bodies the total area per 1 pair is no more than several ha, and in extreme cases even 0.5 ha (DYRCZ *et al.* 1972, M. WIELOCH).

One cannot expect the highest value of the pairs per water area index to occur in lakeland areas, but in regions where small and shallow water bodies prevail.

#### NUMBER OF BREEDING PAIRS AT A SITE AND ITS VARIATION IN DIFFERENT YEARS

Swans nest in single pairs or in colonies\*, and nest distribution can be aggregated or linear (CAMPBELL 1960, SOKOŁOWSKI 1960, BLOCH 1961, MATHIASSEN 1976, TENOVUO 1976, ANDERSON-HARILD 1981). The type of nest distribution depends not only on the availability of suitable nesting places and richness of food resources in summer, but also on a nesting tradition of the particular population (CAMPBELL 1960, MATHIASSEN 1976, TENOVUO 1976).

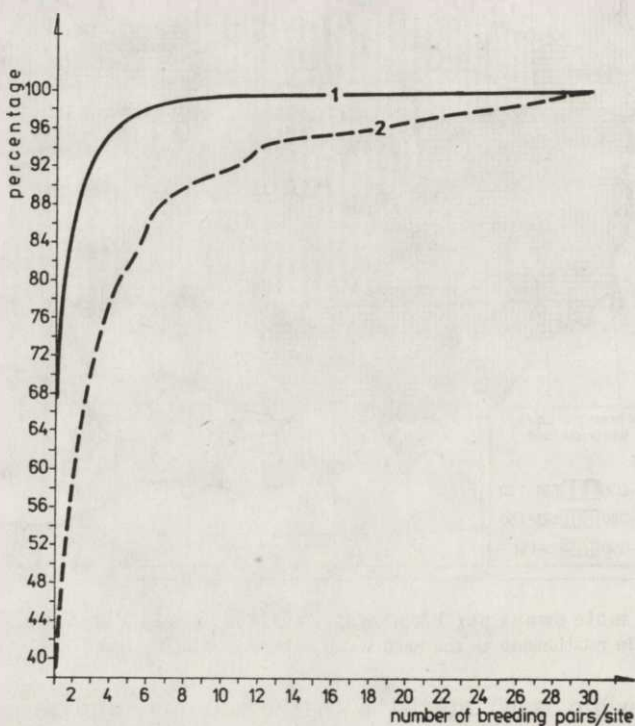


Fig. 4. Number of mute swan's breeding pairs per site in Poland in the years 1976-79.  
1 - Cumulative percentage of sites, 2 - cumulative percentage of pairs.

\* I have assumed that a breeding colony consists of a group of nests occurring close to each other - several to about a dozen metres in the case of an aggregated colony, or several dozen metres in a linear colony (the shore of a lake, river, lagoon, sea).

At the end of the seventies in Poland at each of most of the breeding sites (67%) only one swan pair nested (39% pairs), but almost a half of all pairs (49%) nested at sites holding 2–6 pairs; sites with 10 pairs represented about 1% of all sites, and 8% of all pairs nested at them (Fig. 4).

The largest sites — with 18–30 pairs were found on the lakes Gardno, Łebsko (BEDNORZ 1983), Łuknajno, Pogubie (SŁAWIŃSKA 1979) and Oświn. Some lakes formerly known for large numbers of breeding swans (Gaudy, Liwia Łuża, Lubiатовskie, Somińskie) have now lost their rank (TISCHLER 1941, MIERZWIŃSKI 1955, GÓRSKI 1956, 1970, PUCHALSKI 1956, SOKOŁOWSKI 1960, BARTKOWIAK 1961, ZŁOTORZYCKA 1961, LESSER 1964, PANFIL 1966, 1971, KORSĄK 1968, WOLK 1979).

In the years 1976–79 no sites were found in Poland with above 50 breeding pairs, and such sites still existed at the end of the sixties (SOKOŁOWSKI 1960). At some sites, however, larger and larger numbers of nesting pairs are found. For instance, in 1980 in the Słońsk Reserve the number of breeding pairs rose from about a dozen to 25 pairs (P. MAJEWSKI). However, the area of this reserve is so large that no clearly aggregated nesting can be seen there. On the Lagoon of Szczecin and on the Vistula Lagoon an increase in the number of breeding pairs has been seen, the pairs beginning to aggregate into colonies (Koło Łowieckie 35, 85, W. GRABOWSKI, W. KANIA). In 1981, the number of breeding pairs on ponds at Przemkowo increased from over a dozen to 28, and in the Barycz valley, pond complexes near Milicz were occupied by 11–19 breeding pairs each (earlier by several pairs) (T. STAWARCZYK).

In the seventies, the percentage of places occupied by one or two pairs was similar to that recorded for the fifties, but there was a slight increase in the percentage of sites occupied by 3 or more pairs (Table 5).

On lakes known for large numbers of breeding swans very wide variations in the number of breeding pairs have been observed for several dozen years. On Lake Łuknajno, for example, before World War II the number of swans ranged from several to over 100 pairs (TISCHLER 1941); in 1955 and 1956 SOKOŁOWSKI

Table 5. Distribution of mute swan breeding site numbers in Poland towards the end of the 1950s and in the second half of the 1970s (%)

Number of pairs per site	Years	
	1958,1959*	1976–79
1	71	67
2	21	20
3–10	7	12
11–50	1	1
51–100	1	0
N	565	1811

\*SOKOŁOWSKI 1960.

(1960) found over 70 nests on the whole lake, whereas PUCHALSKI (1956) found 56 nests on an island, and in the sixties 36 pairs at the most nested there (PANFIL 1965). In 1977, 22 pairs were found there (SŁAWIŃSKA 1979), and in 1979 only 5 pairs (MACKOWICZ 1984)\*.

On L. Pogubie the number of breeding pairs decreased in the last two decades from 60 (SOKOŁOWSKI 1960, PANFIL 1965) to 25 pairs (SŁAWIŃSKA 1979)\*\*.

Variations from several to about 100 pairs were also recorded for L. Oświn, where a clear decrease in numbers was seen after the severe winters of 1927/1928 and 1939/1940 (SANDEN 1931, 1938, TISCHLER 1941). Since the fifties the number of pairs on this lake has been decreasing. In 1982, only 8 pairs nested there (SOKOŁOWSKI 1960, Z. LEWARTOWSKI, E. PUGACEWICZ, K. WOŁK).

In other European countries, as in Poland, places with only one swan pair nesting prevail. Sites holding several to over a dozen pairs represent only several per cent, and those holding several dozen pairs are exceptional (FEILER 1964, JENKINS *et al.* 1976, KRAGENOV 1979, LIPSBERG 1979). Among the European sites holding large numbers, except the Polish one, are: L. Galenbäcker (GDR) — up to 15 pairs (RUTSCHKE 1982), L. Engure (Latvian SSR) — up to 85 pairs (LIPSBERG 1983), L. Žuvintas (Lithuanian SSR) — up to 50 pairs and Käina Lagoon (Estonian SSR) — up to 25 pairs (JÕGI *et al.* 1976). However, the largest European site holding over 600 pairs (ANDERSON-HARILD 1981) is on Jutland, Denmark. In Denmark also there are many other large sites with up to 90 pairs (BLOCH 1971).

By contrast to the remainder of Europe, in Scandinavia and in Great Britain a large proportion of swans nest in colonies (CAMPBELL 1960, BLOCH 1970, 1971, MATHIASSEN 1976, TENOVUO 1976). In Denmark and in Finland there are mainly colonies with aggregated nests, while in England and Sweden nests have a linear distribution (CAMPBELL 1960, JENSEN 1967, MATHIASSEN 1976).

An increase in the number of breeding pairs nesting at the particular sites, and under certain situations leading to the formation of new colonies, may be the result of the breeding of the local population, or of immigrations of swans from other areas (CAMPBELL 1960, BLOCH 1970, WICHT 1972,<sup>1</sup> MATHIASSEN 1976, REICHHOLF 1978, ANDERSON-HARILD 1981). It seems that a tendency to nest in colonies is a phenomenon which appears to grow in intensity in places of a high concentration of swans which have already saturated the area that they inhabit. It leads on to a decreased population productivity (ANDERSON-HARILD 1981). Applying this point of view to the swans occurring in Poland, it can be stated that they are a group that is still far from area saturation,

---

\*In many publications the number of breeding swans on L. Łuknajno has been considerably overestimated by regarding all swans staying there to be breeders (LEŃKOWA 1958, BERGLUND *et al.* 1963, FERENS 1963, RICHLING 1973).

\*\* In 1982 there were only a few breeding pairs there (B. PRYZSTUPA).



or that the food conditions prevailing in Poland do not favour colonial nesting (in western and northern Europe most colonies occur near shallow sea regions which provide a rich food-basis for the swans).

#### VARIATIONS IN NUMBERS OF THE SWANS IN POLAND

In the second half of the 19th century there occurred a considerable decrease in the number of nesting swans in Pomorze and Mazury due to an intensive shooting of these birds (HOLLAND 1871, DROSTE-HÜLSKOFF 1872 after ZAJĄC 1963). Up to several hundred swans were shot down every year in Pomorze and Mazury (NAUMAN 1905 after MURASHKA and VALYUS 1961, GI 1937). At the turn of the 19-th century the swan population still remained at a low numerical level, not exceeding a dozen or so pairs in areas west of the Vistula (DETMERS 1912, DOBRICK 1912), and several dozen pairs in about dozen places in areas east of the Vistula (TISCHLER 1941).

The World War I period caused a further decline of the swan population in Poland, as a result of intensified hunting and egg removing from nests (TISCHLER 1941). It was only thanks to the introduction of the swan protection law in Prusy Wschodnie and Pomorze in 1920 that this process (PAX 1925) was impeded. In the next years in Pomorze and Mazury swans began to steadily grow in numbers, and single nesting sites appeared also in Ziemia Lubuska and in Wielkopolska (ROBIEN 1928, 1931, WODZICZKO 1929, FRASE 1936, LENSKI 1936, WODZICZKO *et al.* 1938, SANDEN 1939, TISCHLER 1941).

At the beginning of the thirties, in the eastern part of Pomorze about 60 nesting swan pairs were found, and in the middle thirties in the area between the Vistula and the Odra rivers about 115 pairs nested at about 60 sites. At the beginning of the thirties, the number of breeding swans in Mazury was estimated at 300 (SANDEN 1939) and only several years later (the years 1935-37) at 500 pairs inhabiting 160 lakes. Apart from these, there were about 1000 non-breeders there. Swans then occupied 10% of Masurian lakes (TISCHLER 1941). It can therefore be estimated that before World War II there were over 600 nesting swan pairs at about 220 sites in the areas within the present state borders of Poland (Table 6).

Little is known about the fate of swans during World War II. Ornithologists' opinions on this subject vary. According to ZAJĄC (1963), World War II did not have so negative an impact on the numbers of swans in Poland as World War I. At many breeding sites in Pomorze, known from the prewar time, swans continued to breed still in the fifties. SOKOŁOWSKI (1960) holds the view that World War II caused another reduction in the swan population to the level of 20% of the prewar numbers. One of the guards of the nature reserve in Mazury has mentioned about swans being killed and flushed during the war (PUCHAŁSKI 1956). The swans in other regions of the country were still harassed in the post-war period (SZCZEPSKI 1948).

Table 6. Number of mute swan breeding sites and pairs in Poland in different periods

Years	Areas west of the Vistula		Areas east of the Vistula		Total	
	Number of sites	Number of breeding pairs	Number of sites	Number of breeding pairs	Number of sites	Number of breeding pairs
1935-1937*	59	115	160	500	219	615
1958, 1959**	208	353	357	1500	565	1853
1965***	?	ca 850	?	ca 1200	?	2050
1976-1979	1235	2112	576	1018	1811	3130
1976-1979****		2534		1222		3756

Source of data: \*LENSKI 1936, SANDEN 1939, TISCHLER 1941, \*\*SOKOŁOWSKI 1960, ZAJĄC 1963, \*\*\*LESSER 1963 (recalculated data), \*\*\*\*estimates (see page 195)

Swan numbers in Poland in 1956 were estimated at 1000 pairs, data incompleteness admitted, and only, two years later — at as many as about 1800 pairs (SOKOŁOWSKI 1960), which indicates a considerable growth relative to the prewar level. The number of non-breeders in those years was estimated at 1500 and 3000 birds, respectively. In 1958, swans nested on 565 water bodies (SOKOŁOWSKI 1960). This considerable increase in the number of swans in the fifties was to a large extent the result of the introduction of the law of specific animal protection in Poland (1949 and 1952).

In 1959, 353 swan pairs nested in north-western Poland, and about 500 non-breeders stayed there (ZAJĄC 1963), this representing a three-fold growth in numbers relative to the prewar time (Table 6).

In 1965, LESSER (1968) estimated the number of swans found in Poland at 7420 individuals, without distinguishing breeders and non-breeders. The authors who quote him (BAUER and GLUTZ 1968, SCOTT and Wildfowl Trust 1972, MATHIASSEN 1975, OWEN 1977) groundlessly assumed that it was the number of breeders, and they reported that in 1965 3700 breeding pairs nested in Poland.

Even if we assume that the breeders to non-breeders ratio was in 1965 the same as in the fifties (1 : 0.8) (SOKOŁOWSKI 1960), we shall find that the breeding population present in Poland in 1965 can have numbered 2050 pairs at the most (Table 6).

The growth in numbers of the swans was not uniform throughout the country. A comparison of the numbers of breeding swans in Wielkopolska in the years 1959 and 1976–79 shows that within 20 years there occurred a fifteen-fold growth in their numbers in that region (ZAJĄC 1963, BERESZYŃSKI and WIŃSKA 1981, DOHNAL 1981). A similar situation is found in the Nizina Śląska and in the Wyżyna Śląska where towards the end of the seventies the level of numbers of the swans exceeded 200 pairs, while in the sixties over a dozen pairs nested there (T. KROTOSKI, J. WITKOWSKI).

It is hard to assess changes in the numbers of swans nesting in Mazury. Available data indicate that the number of breeding pairs has decreased slightly, and there has been a simultaneous increase in the number of occupied sites. Changes in numbers of the swans in the Lakeland of Olsztyn in the sixties and seventies were noticed by PANFIL (1966), OKULEWICZ (1971) and PIETKIEWICZ (1978) among others. PANFIL (1966) pointed out an unusual growth in the number of swans within several years, which in my estimation was to a large extent the result of an intensified counting of swans in the Olsztyn voivodship. OKULEWICZ (1971) pointed out that there was a real increase relative to the prewar time in the environs of Olsztyn, whereas PIETKIEWICZ (1978) mentioned that the number of swans on some lakes of the Lakeland of Olsztyn decreased. In the Lakeland of Mrągowo MRÓWCZYŃSKA (1979) found, a slight increase in number of the swans. The appearance of swans on hitherto unoccupied Mazury lakes and ponds is accompanied by a reduction in their numbers on other lakes,



or abandonment of the latter (SOKOŁOWSKI 1960, PANFIL 1968, ORŁOWSKI 1977, PAWLIK 1977, PIETKIEWICZ 1978, TROJNIAK 1978, MRÓWCZYŃSKA 1979, SŁAWIŃSKA 1979).

A comparison of the numbers of breeding swans found 20 years ago (SOKOŁOWSKI 1960, ZAJĄC 1963) with their abundance at the end of the seventies shows that the total number of swans nesting in Poland increased by over 50%, the course of changes in numbers in the eastern part of Poland differing from that in western Poland (Table 6). In areas west of the Vistula there was a six-fold growth in numbers and in those east of the Vistula, according to SOKOŁOWSKI'S (1960) data, there was a decrease in numbers of the swans, or their abundance there remained at the same level. In comparison to the prewar period the number of swans appeared to have increased over twenty-fold in areas west of the Vistula, and only slightly over two-fold in areas east of the Vistula (Table 6).

#### VARIATIONS IN NUMBERS OF THE SWANS IN EUROPE

The rapid growth of the number of swans observed in Poland over the recent several decades is not an isolated phenomenon in Europe. A particularly intensive growth in almost all the countries where swans occur began in the fifties of this century, and in many cases it still goes on.

This statement is illustrated with the curves representing the course of abundance dynamics of the swans in the particular European countries (Fig. 5). The figure shows in two separate representations the course of the dynamics in countries in which swan numbers are low — not exceeding 500 breeding pairs (Fig. 5A), and the dynamics of large country-populations presently numbering thousands of pairs (Fig. 5B). This division is naturally independent of the real population boundaries. Countries with a large stock of the swan are in the middle of its area, whereas countries with small swan populations are countries on the periphery of the swan's range, or, as in the case of Sweden, provinces distinguished because the course of changes in numbers of the swans in them was known better than in the remainder of a country.

When analysing the course of the curves presented in Figure 5, it must be remembered that it depends not only on the real changes in the number of swans in the particular countries, but also, and perhaps first of all, on the number of censuses and the time-intervals at which they were done. There is particularly detailed information on the course of changes in numbers in those countries where the number of swans is low and where they began to nest relatively recently (Fig. 5A). It is impossible to make a detailed reconstruction of the course of other curves based on less detailed data; it cannot be ruled out that in the initial phases it was equally vertical (Fig. 5B).

Thus without investigating into the details of the course of the particular curves one may state that in all western, northern and central-European countries the swans grew in numbers. An exception to this statement is two popu-

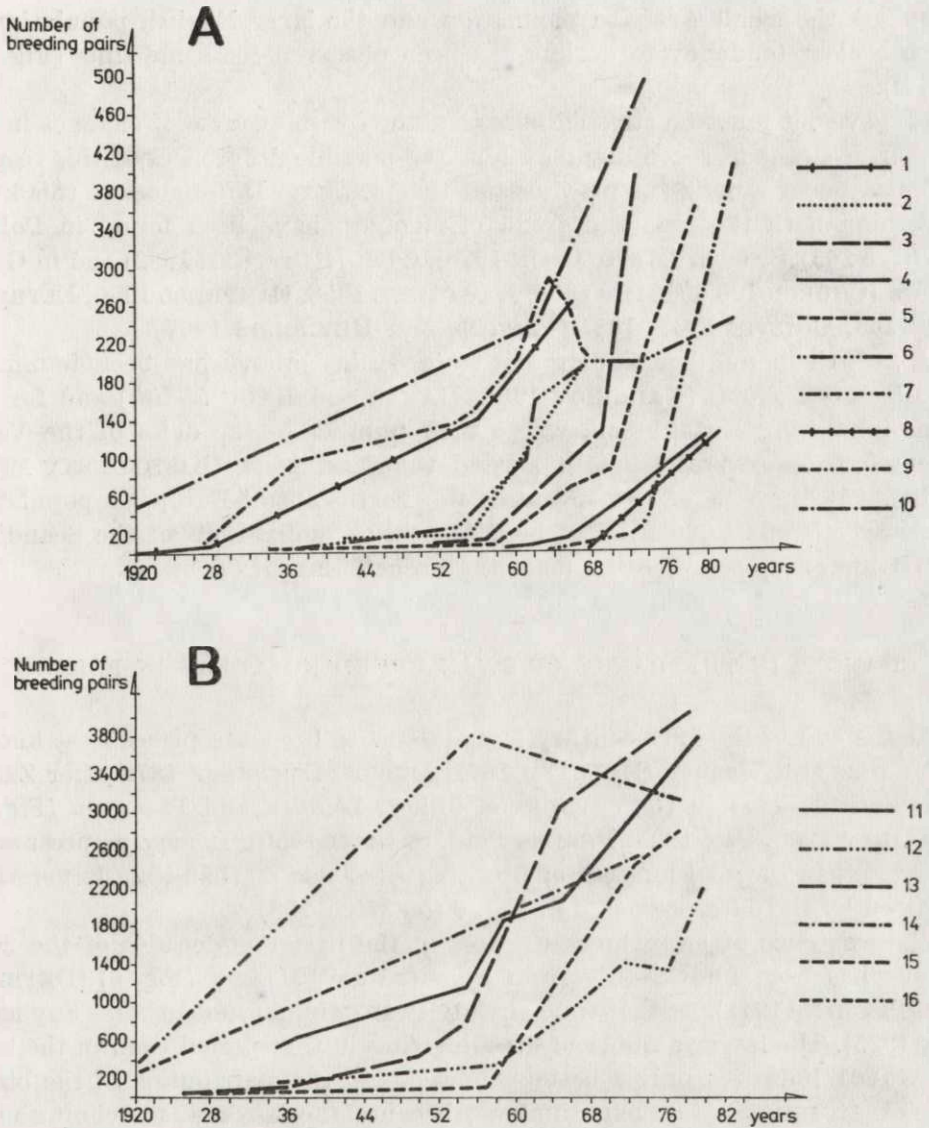


Fig. 5. Abundance dynamics of mute swans nesting in some European countries.

1 - Sweden-Scania, MATHIASSEN 1973, 2 - Sweden - west coast, MATHIASSEN 1973, 3 - Finland, MERIKALLIO 1958, TENOVUO 1975, 1976, HAPPAANEN 1976, 4 - Estonia, LING 1961, JÖGI 1968, ONNO 1970, PAAKSPUU 1974, MALCHEVSKY and PUKINSKY 1983, 5 - Latvia VIKSNE 1968, JÖGI *et al.* 1976, LIPSBURG 1979, 1983, 6 - Lithuania, IVANAUSKAS 1957, MURASHKA and VALIUS 1961, JÖGI *et al.* 1976, MALCHEVSKY and PUKINSKY 1983, 7 - Austria, MAYER 1969, 8 - Norway, FRØSTRUP 1979, HAFTORN 1971, HERREDSVELA *in litt.*, 9 - CSSR, HUDEC and ČERNÝ 1962, PYKAL 1972, HORA *in press.*, JANDA *in litt.*, 10 - Switzerland, SZIJJ 1965, BROŽ 1980, SALATHE 1983, 11 - Poland, LENSKI 1936, SANDEN 1939, TISCHLER 1941, SOKOŁOWSKI 1960, ZAJĄC 1963, LESSER 1968, M. WIELOCH, 12 - GDR, HILPRECHT 1968, SCHIEMENZ 1972, FEILER 1974, RUTSCHKE 1982, 1983, 13 - Denmark, JESPERSEN 1951, PALUDAN and FOG 1956, BLOCH 1970, 1971, ANDERSON-HARILD 1981a, 14 - Sweden, MATHIASSEN 1976, 15 - Holland, RENSSSEN and TEIXEIRA 1980, RENSSSEN *in litt.*, 16 - Great Britain, CAMPBELL 1960, ELTRINGHAM 1963, OGILVIE 1967, 1981.

lations — the small Austrian population and the large English population in which a clear tendency to decline has been observed for some time (Fig. 5A and B).

However, it must be stressed here that the overall course of changes in the number of swans in a country may blur the possible differences in this respect that may occur among the provinces of that country. Differences of this kind, concerning both the rate and trend of changes, have been found in Poland (see page 203), Sweden (MATHIASSEN 1976), GDR (RUTSCHKE 1982) and in Great Britain (CHURCH 1956, CRAMP 1957, RAWCLIFFE 1958, CAMPBELL 1960, ELTRINGHAM 1963, OGILVIE 1967, 1981, PERRINS and REYNOLDS 1967).

A growth in number similar to that described above has been found for the Black Sea group (NANKINOV 1982, HAMAR and RADU *in litt.*) and for the swans inhabiting Kazakhstan, where their number in the delta of the Volga increased from several pairs to several thousand pairs (KISTCHINSKY 1979).

Towards the end of the seventies the north-central-European population numbered about 24 000 pairs of breeding swans, individuals of the Scandinavian-Baltic group representing more than a half thereof (Table 4).

#### CHANGES IN THE RANGE OF SWAN BREEDING AREAS IN POLAND

At the end of the 19th century few mute swan breeding places were known in Pomorze and Mazury (HOLLAND 1871, DROSTE-HÜLSKOFF 1872 after ZAJĄC 1963) and Śląsk — in the environs of Milicz, Legnica and Pszczyna (Fig. 6) (KOLLIBAY 1906, PAX 1925, FERENS 1948, SZARSKI 1950). It may be presumed, however, that the real number of breeding sites was at that time larger than indicated by the data presented in Fig. 6 (see page 203).

The existence of swan breeding sites in the first two-decades of the 20th century has been known only from Pomorze and Mazury (Fig. 6) (DETMERS 1912, TISCHLER 1941). At that time already swans did not nest in Śląsk any more (PAX 1925). The larger number of breeding sites in that period than in the time before 1901 indicates only a better knowledge of the distribution of the birds, and not an increase in their numbers, because the latter was declining until the beginning of the twenties (see page 203).

In the second two-decades of the 20th century there occurred a real growth in numbers of the swans (see pages 203) and, associated with it, an increase in the number of breeding sites in Pomorze and Mazury, that is, areas to which the occurrence of swans in the range discussed is restricted (Fig. 7). The beginning of a territorial expansion is indicated by the appearance of the first sites in Wielkopolska and Ziemia Lubuska (Fig. 7). These two decades are thus first of all the period in which the breeding population of the swan increased in density in their refuge territories.

In the third two decades of the 20th century (strictly speaking in the fifties,



for there are hardly any data for the forties) the growth of the number of breeding refuges in Pomorze and Mazury continued to be intensive, and although the close occurrence of the swan in Poland was still restricted to these regions, there was a conspicuous territorial expansion (Fig. 8). More and more breeding places appeared in Wielkopolska, Ziemia Lubuska and Kujawy. Swans began to nest in Śląsk, in central Poland, and single breeding places appeared even in environs east of the middle course of the Vistula (SZARSKI 1950, ANONIMUS

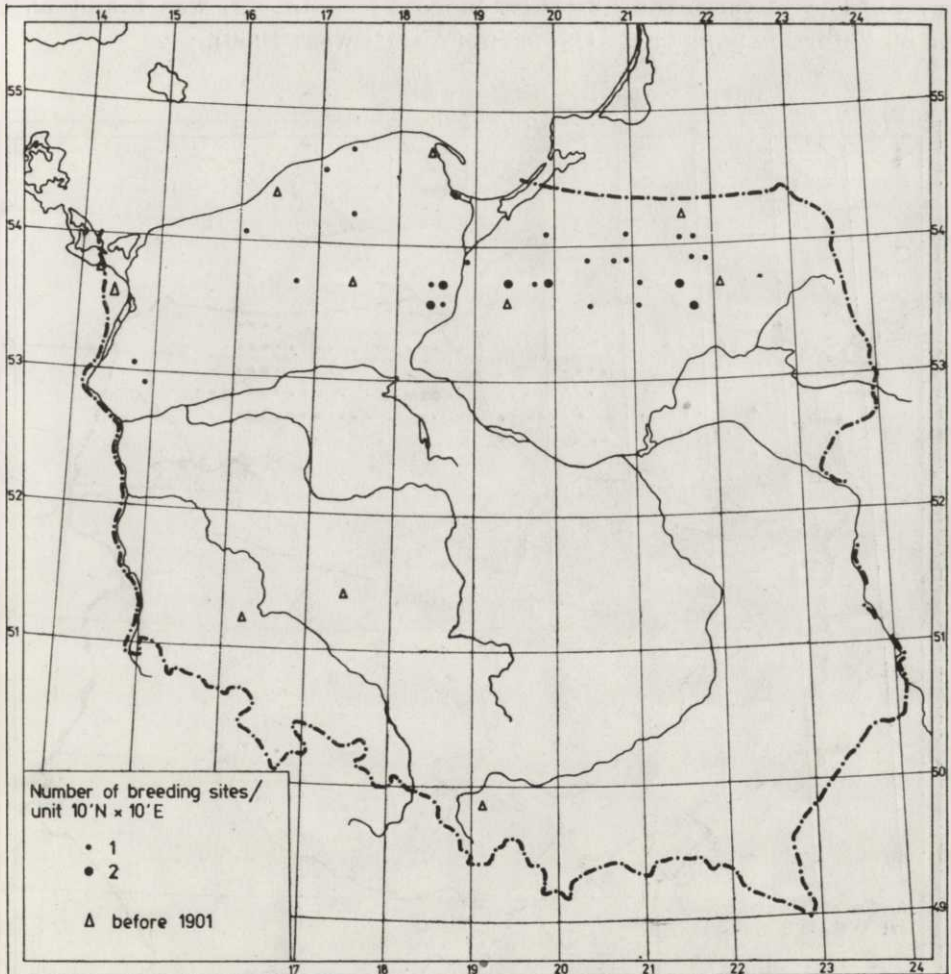


Fig. 6. Distribution of mute swan's breeding sites known before 1901 and in the years 1901-1920.

TISCHLER (1941) lists another 7 sites from the former East Prussia (Prusy Wschodnie), but these sites could not be located on the map.

1951, JANASZEK 1957, MIELEWCZYK 1960, ZAJĄC 1963). Among the farthest-southward-extended breeding sites of the swan were ponds at Modrzejowice in the Radom voivodship (POMARNACKI 1952, 1957), Nowokuźnicki pond in the voivodship of Opole (MICHALAK 1961, 1962) and Lake Brody near Stopnica in the voivodship of Kielce (ZAJĄC 1963).

The sixties witnessed a continuation of the territorial expansion began in the fifties, which resulted in a shifting of the southern boundary of the area of the close occurrence of the swan to areas south of the Noteć river, thus including, in addition to Pomorze and Mazury, also the Lakeland of Wielkopolska (Fig. 9). The farthest southward-extended breeding site was found at that time on Zatorskie ponds near Oświęcim (WASILEWSKI 1966).

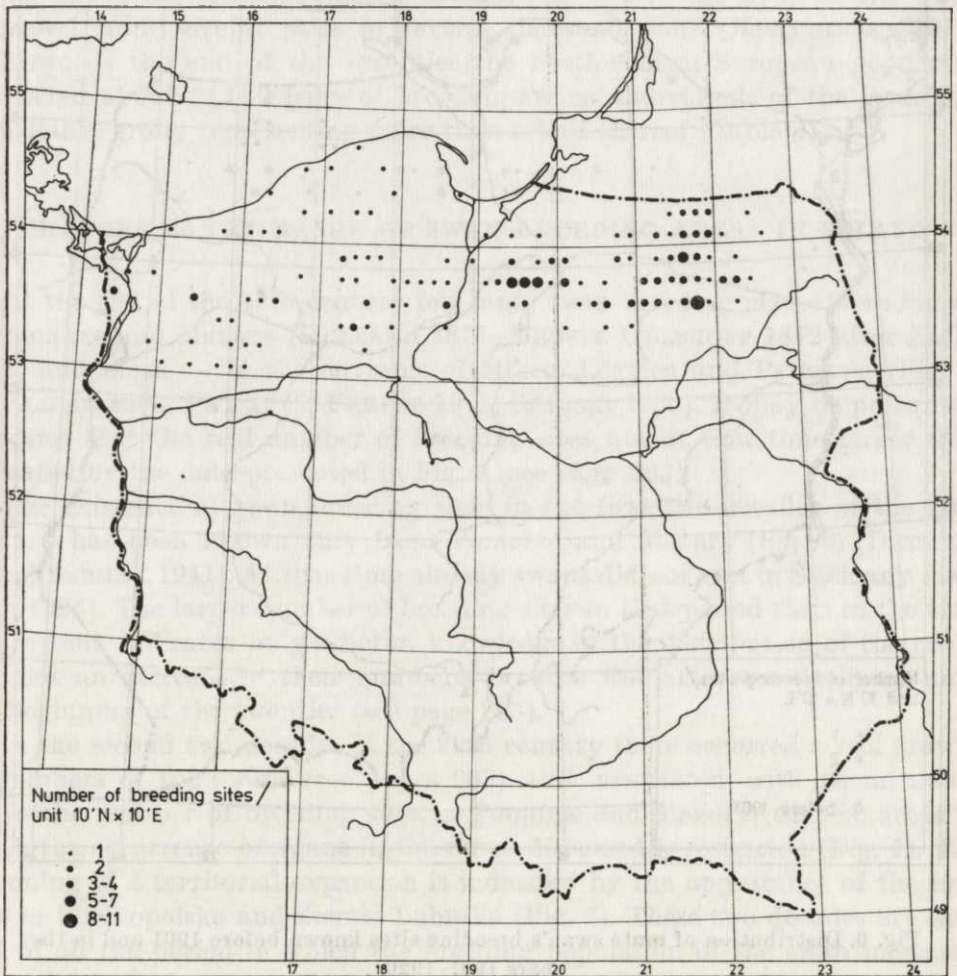


Fig. 7. Distribution of mute swan's breeding sites in the years 1921-40.

Noteworthy in that period is the larger number of newly discovered sites in Mazury than in Pomorze, which probably does not reflect the real differences in the growth of the swan population in the two regions considered, but is the result of the fact that the interest of investigators in the species under study varied. For while no major studies of the swan in Pomorze were carried out in the sixties, in Mazury an inventory of swans was made in that period by PANFIL (1966).

In contrast to the fairly poor interest in the swan in the regions of its traditional breeding refuges, *i. e.*, Pomorze and Mazury, the appearance of new sites in the newly occupied terrains was often signalled in the literature (SOKOŁOWSKI

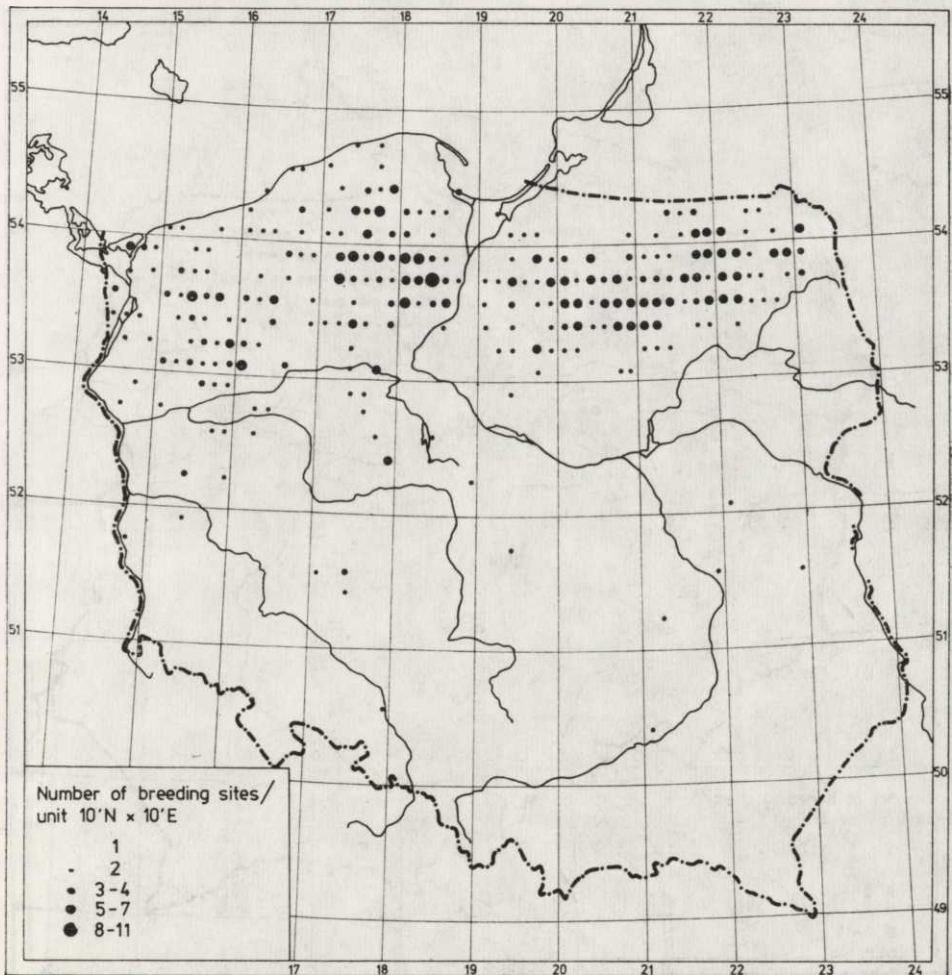


Fig. 8. Distribution of mute swan's breeding sites in the years 1941-60.



1962, CZARNECKI 1963, MAJEWSKI 1963, TOMIAŁOJĆ 1963, KUŹNIAK 1967, ZUBRZYCKI 1973, and others), it may, therefore, be presumed that the course of the expansion that took place there has been documented relatively well.

In the seventies the southward and south-eastward expansion continued. As a result, the range of the breeding territory of the swan included almost the whole surface area of Poland (Fig. 10).

In addition to the occupation of new areas, there was an extremely intensive increase in density in both the areas that had already been within the swan's close-occurrence range in the preceding decades and territories newly occupied by the species. As a result, the density attained by the swans in newly or recently

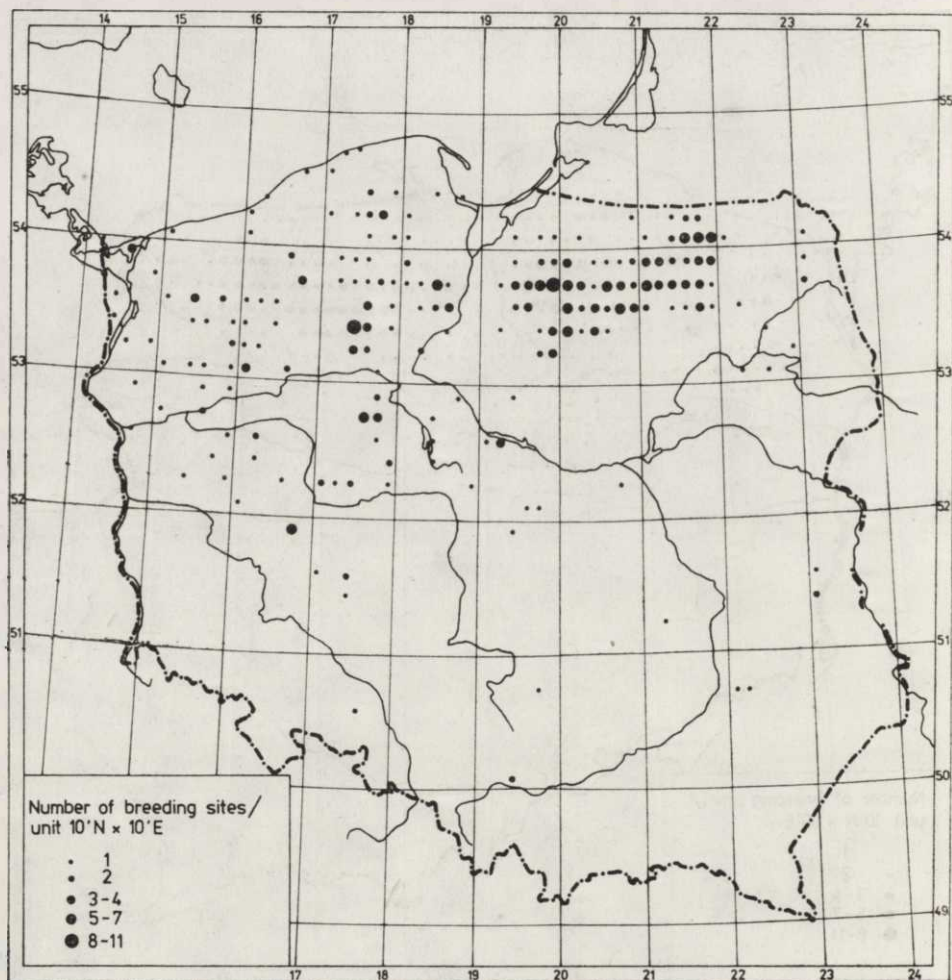


Fig. 9. Distribution of mute swan's breeding sites in the years 1961-70.

occupied territories was equal to, and sometimes greater than that found in their traditional refuges.

An analysis of the course and directions of the widening of the mute swan's range in Poland suggests that in the first period, in which there occurred in fact a recolonization by swans of territories formerly occupied by them (Pomorze, Mazury), the Mazury swans which were more numerous could also colonize some of the Pomeranian lakes. In the second period, in which there was an expansion to new terrains, the swans living in Pomorze played a decisive role, the role of individuals from Mazury being much less important. However, proof for this hypothesis must be sought for in studies of marked birds.



Fig. 10. Distribution of mute swan's breeding sites discovered in the years 1971-79.

## DISTRIBUTION OF SWAN BREEDING AREAS IN POLAND IN THE YEARS 1976-79

Towards the end of the seventies the mute swan nested throughout Poland except the south-eastern-piedmont and the mountain parts of the country (Fig. 11)\*. At that time its close occurrence covered most of the surface area of Poland.



Fig. 11. Distribution of all mute swan's breeding sites known in the years 1971-79.

\* In 1980, mute swan's breeding was already found on the Czchów and Rożnów retention reservoirs (PZW Nowy Sącz, S. MATHIASSEN *in litt*).



### CHANGES IN THE RANGE OF THE BREEDING AREAS OF SWANS OF THE SCANDINAVIAN-BALTIC GROUP

At the beginning of the 20th century the breeding territories of the mute swans of the Scandinavian-Baltic group were limited to a small number of areas, most of them not large in size (Fig. 12); at that time, the largest breeding territory was the Pomeranian-Masurian region.

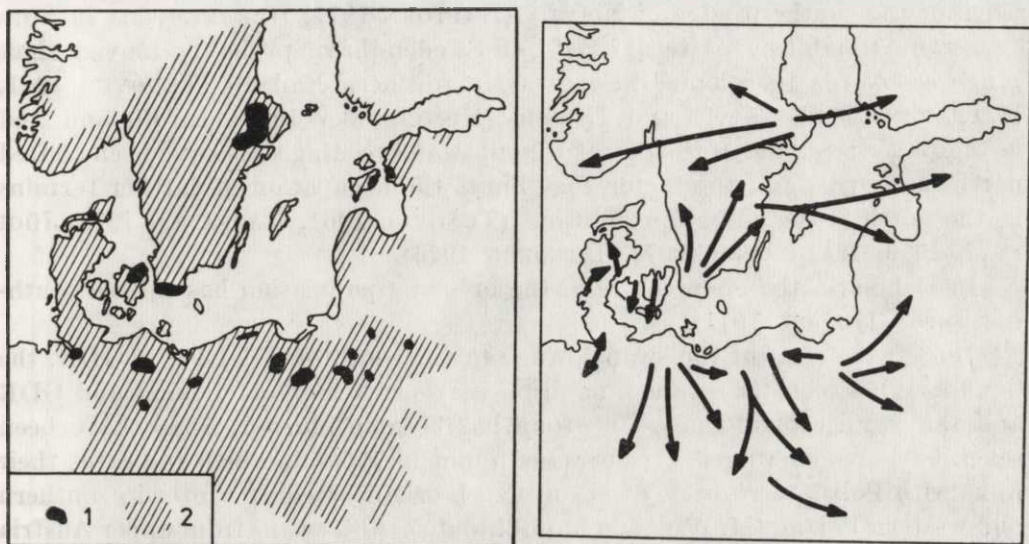


Fig. 12. The area of mute swan of the Scandinavian-Baltic group at the beginning of 20th cent. and in the 1970 s.

1 - beginning of 20th cent., 2 - the 1970s.

Fig. 13. Hypothetical directions of the expansion of mute swans of the Scandinavian-Baltic group in 20th cent.

The rapid growth of the number of swans that took place in Europe in the 20th century (see pages 206–208) was accompanied by a considerable enlargement of the breeding area of this species (Fig. 12). The particular initial groups expanded in different directions (Fig. 13) and at different rates.

Swans inhabiting the region of Meklenburg and Pomorze shifted their range southwards and south-eastwards, colonizing a considerable part of Poland (see pages 203–206) and GDR.

For swans inhabiting Mazury it was easier to move their range to the east, where there are more habitats suitable for settling, than to the south, almost devoid of lakes. It was probably in the thirties that several Masurian swan pairs settled in Lithuania, giving rise to a group of swans at present joined with the Mazury ones into one Masurian-Lithuanian group (LING 1961, MURASHKA and VALYUS 1961, KISTCHINSKY 1979). It is most likely from Mazury also

that the swans which recently appeared in Byelorussia derive (FEDUSHIN and DOLBIK 1967, KISTCHINSKY 1979).

In Sweden the extension of the range went in two directions. Swans from Skane have moved northwards and north-eastwards, and those from the eastern coast have moved westwards. As a result, the areas of the two, originally isolated groups, have joined (MATHIASSEN 1976, 1981).

A further westward shift of the range of the swans inhabiting central Sweden (originally living on the central-eastern coast) has led to the colonization by them of the southern edge of Norway (HAFTORN 1971, HERREDSVELA *in litt.*).

Swans inhabiting eastern coasts of Sweden have probably moved their range eastwards to colonize new areas in southern Finland (TENOVUO 1961, HAPPAANEN 1976), Latvia and Estonia (KISTCHINSKY 1979). In Finland and in the Baltic republics of the Soviet Union, swan breeding sites have been shifted north-eastwards, and the factor that limits the occupation of further terrains in the north is the climatic conditions (TENOVUO 1961, HAPPAANEN 1976, JÖGI *et al.* 1976, MATHIASSEN 1976, LIPSBURG 1976).

In Denmark, the main centre of the breeding population has shifted south-eastwards (BLOCH 1971).

Due to the shift of the swans' range to the south of Poland and GDR, the boundary between the swans inhabiting northern regions of Poland and GDR and the small central-European group has become blurred. There have been several reports on ringed Czech swans found in Poland, which indicates their links with Polish territories. Swans of Czech origin breed or winter in southern and western Poland (M. WIELOCH unpubl. data). Also swans from upper Austria (MAYER 1969) may have moved their range to the north and reinforced groups breeding on fish ponds in Czechoslovakia (KLŮZ 1977).

#### WINTERING OF SWANS IN POLAND

The widening of the range of the swans in Poland and the growth in their numbers have been accompanied by an increase in the number of individuals wintering in this country. In the sixties the numbers of mute swans wintering in areas along the Baltic coast came up to several hundred individuals. Sometimes a small number of swans wintered also in the western part of the country (TOMIAŁOJĆ 1972). In the winters of 1976/1977 and 1977/1978 the number of swans wintering in Poland was estimated at about 1400–1600 individuals (KRZYŚKOWIAK and DOBROWOLSKI 1981), but these values are no doubt underestimated.

In flood areas near the mouth of the Warta river up to 510 mute swans winter (BESZTERDA *et al.* 1983). This is one of the largest inland wintering grounds of the swans in Poland. Swans which decided to spend the winter of 1981/1982 in the south (Wrocław, Nikolin, Opole, Kędzierzyn, Kraków) also formed flocks

of up to several hundred individuals (Fig. 14). In previous years small numbers of swans wintered in those areas.

From the reports on ringed swans spotted in Poland in winter and from other information follows that they winter not only at the Baltic coasts, in the Odra valley and in the upper Vistula valley, but nearly throughout the country (Fig. 14).

Apart from the Słońsk Reserve (BESZTERDA *et al.* 1983, MAJEWSKI 1983), mentioned earlier, the Gulf of Gdańsk (where over 2000 swans are found dispersed — S. STRAWIŃSKI) and the Lagoon of Szczecin (200), the largest aggregations of swans in Poland are found in the following areas: the Odra — almost along the whole of its course (about 2000) (A. CZAPULAK, A. KARDAŚ, T. STA-



Fig. 14. Wintering flocks of mute swans in Poland at the turn of the 1970s.



WARCZYK), the valleys of the Noteć and Gwda rivers (250), the Warta (300) (MAJEWSKI and WIATR 1981), the Rybnik reservoir (up to 120) (T. KROTOSKI) and the Vistula with areas near the mouths of its tributaries (about 500). Swans are found to winter also of the Masurian lakes, but they do not form larger aggregations there. In Pomorze, in addition to numerous small flocks (several individuals), larger flocks of swans are also found in, *e.g.* the overflow area of Rosnowskie Lake (A. OWCZAREK), Lake Tleń (W. JANKOWSKI), the Wda river (J. PRZYBYSZ), and in the environs of Bydgoszcz, Choszczno and Wągrowiec.

The increased number of swans wintering in Poland to some extent indicates a growth of their total numbers, but the conditions man creates to enable them to survive winter seem to be a very important factor. Feeding swans by people late in the autumn and in winter is a common phenomenon in whole Poland. Apart from this, these birds find suitable conditions for wintering on all the water bodies that are not covered with ice. These include natural and man-made water bodies situated near power-stations and other industrial plants discharging heated water and effluent (PINOWSKI and WESOŁOWSKI 1983).

The number of swans staying in Poland (including the coast) during the 1981/1982 winter can be estimated at up to 6000 individuals. This figure is much higher than that given by ATKINSON-WILLES (1981) for the year 1976. According to this latter author a total of up to 2000 swans were staying in Finland, the Baltic republics of the Soviet Union and Poland during the winter (January).

#### THE SWAN'S NESTING HABITAT IN POLAND

In the years 1976–79 over a half of all the swan's breeding sites in Poland (56%) were lakes; the second frequently inhabited type of habitat was fish ponds (25%), other types of wetland habitats representing 19% of the sites (Table 7). In the latter group most breeding sites were located on small, sometimes 0.5 ha of the water surface area or less, natural and man-made water bodies. The nesting of swans on small water bodies, where the water surface was at the most several metres wide due to draining or overgrowth with plants, was found in Poland already in the sixties (DYRCZ *et al.* 1972), but this phenomenon has intensified recently.

A colonization by the swan of new habitat types, as a result of a growth in its numbers, was found in north-western Poland, detailed data for which, relating to the end of the fifties, have been given by ZAJĄC (1963). During about 20 years, between the end of the fifties and the second half of the seventies, the number of swan breeding places in this area increased by 400 (Table 8), which means an increase of over 70%. Lakes represented only 21% of the new

sites, whereas the remaining 79% included other types of wetland habitats, some of which, such as rivers and oxbow lakes, were not inhabited by the swans in the fifties.

There are no data permitting a similar comparison to be made for other lakeland regions in Poland. It seems, however, that the process of habitat expansion has taken place also in them. After the original nesting habitat, the lakes, had been saturated, further growth in numbers was effected via the occupation of nesting territories in other types of habitat.

Table 7. Mute swan's habitat use in Poland

Type of habitat	Percentage of occupied sites		
	North-western Poland		Whole country
	1959*	1976-79	1976-79
lake	90	62	56
pond	1	17	25
swamp, gravel-pit pond, <i>etc.</i>	5	11	9
canal, ditch	2	1	1
retention reservoir	0.4	3	3
river, oxbow lake	—	6	6
lagoon	1	0.3	0.2
Total number of sites	565	965	1811

\* ZAJĄC 1963.

Table 8. Mute swan's habitat expansion in north-western Poland between the end of the 1950s and second half of the 1970s

Type of habitat	Number of sites				Percentage of total growth
	1959	1976-79	Absolute growth	%	
lake	512	596	84	16	21
pond	6	163	157	2617	39
swamp, gravel-pit pond, <i>etc.</i>	28	106	78	278	19
canal, ditch	11	10	-1	—	—
retention reservoir	2	29	27	1350	7
river, oxbow lake	—	58	58	—	14
lagoon	6	3	-3	—	—
Total	565	965	400	—	100

It is an indisputable fact that in the south of Poland where man-made water bodies prevail it is on them that most of the swan's breeding places are located. The territorial expansion into these areas coincided with the habitat expansion that took place in the refuges — the lakeland districts.

Due to changes in the habitat requirements of the swan that took place in

recent decades, the definition, given by SOKOŁOWSKI (1960) of these requirements\* has lost its validity. It is a pity that this fact has not been taken into account in the planning of the studies of swans carried out at present in some regions of Poland (*e.g.* ORŁOWSKI 1977, PIETKIEWICZ 1978).

#### THE SWAN'S NESTING HABITAT IN EUROPE

In the area of occurrence of the swans of the Scandinavian-Baltic group the prevalent type of breeding place is the lakes (Table 9).

A considerable number of the swans inhabiting Scandinavia nest on salty and brackish waters, building nests on stony sea islets with sheltered bays, shallow water, and on flat shores in fiords (BLOCH 1971, TENOVUO 1971, 1976, MATHIASSEN 1976) (Table 9).

Table 9. Mute swan's habitat use in northern and central Europe

Type of habitat	Country						
	GDR	Denmark	Sweden	Finland	Estonia	Latvia	Lithuania
lake	+	+	+	+	+	+	+
pond	+					+	
swamp, gravel-pit pond, etc.	+				+	+	+
canal, ditch	+						
retention reservoir	+				+		
river, oxbow lake	+						
lagoon, bay, sea shore, archipelago		+	+	+	+	+	+

Source of data: LING 1961, MURASHKA and VALIUS 1961, VIKSNE 1968, BLOCH 1971, PAASIVIRTA and MIKKOLA 1971, FEILER 1974, HAPPANEN 1976, JÖGI *et al.* 1976, MATHIASSEN 1976, TENOVUO 1976, KRAGENOV 1979, LIPSBERG 1979.

In the Scandinavian-Baltic group, about 10% of swans nest by watercourses — GDR (KRAGENOV 1979), FRG (SCHERNER 1981), Poland (Table 7). In England, swan breeding sites by riversides and streams represent over 30% (OGILVIE 1981).

In the lakelands of GDR and the Baltic republics of the Soviet Union, where there are many large lakes, the swans readily occupy those of them whose surface area is over 200 ha (ONNO 1970, KRAGENOV 1979), whereas in Scandi-

\*"A water body on which the swan can nest must have a water surface large enough to enable the bird to run away and take wing. It should not be deep, but should abound in underwater vegetation and have a belt of reed needed as a building material and nest protection".



navia the swans often occupy small water bodies with an average surface area of 1.5 ha (BLOCH 1961). A similar situation is found in FRG (SCHERNER 1974).

In Scandinavia and in the north of the countries situated on the southern Baltic the swans nest primarily on natural water bodies (FEILER 1974, JÖGI *et al.* 1976, MATHIASSEN 1976, TENOVUO 1976, KRAGENOV 1979), whereas in their southern range (RUTSCHKE 1982), as in the central-European group (except Switzerland), a considerable proportion of the breeding places are on man-made water bodies (HUDEC and ČERNÝ 1972, SCHERNER 1974, KLŮZ 1977, SALATHE 1983, HORA *in press*).

A considerable percentage of the swans of the Black Sea group nest in bays and lagoons (DONTCHEV 1973, NANKINOV 1982, HAMAR and RADU *in litt.*).

In recent decades changes have been observed in the occupation of various types of habitats. Some swans change their nesting habitats within fresh-waters, moving from lakes onto ponds, gravel pits, peat pits and the like (BLOCH 1971, SCHERNER 1974, OGLVIE 1976, BERESZCZYŃSKI and WIŃSKA 1980, RUTSCHKE 1982), while others move from fresh-waters onto salty and brackish-waters. In Denmark, during 2 decades there occurred a conspicuous increase in the number of swans nesting on salty or brackish-waters and a decrease in the number of breeding sites on freshwaters (BLOCH 1971), which leads to a growth in the number of swans nesting in colonies.

In Scotland, where their population is known to be stabilized, the degree of fresh- and brackish-water use by the swans does not change (JENKINS *et al.* 1976).

#### PRODUCTION OF YOUNG IN POLAND

In 1978 and 1979 a pair of swans reared on an average 4.3 young\*. This figure is the number of cygnets led by one breeding pair in August, diminished by 5%\*. The numbers of young led in August in the two study years were very similar, and differences between them were statistically insignificant (1978 —  $4.56 \pm 1.71$ ,  $N = 214$ , 1979 —  $4.39 \pm 2.65$ ,  $N = 272$ ,  $\bar{x} 4.46 \pm 1.68$ ,  $N = 486$ ).

The distribution of the number of young led by parents in August in both years has been presented in Figure 15. It is similar to that presented by ZAJĄC (1963) for the autumn of 1959 when there were  $4.42 \pm 1.73$  young per a breeding pair.

Judging from the above, it may be stated that in Poland the average number

\* Only those pairs have been taken into account which led at least one young at the end of the summer.

\* Since young swans become entirely independent four months after their hatching (ANDERSON-HARILD 1981, MANDZIOU 1982), in Poland on an average in September, and the mortality of young between hatching and full independence comes up to 20% (COLEMAN and MINTON 1980, MANDZIOU 1982), it has been assumed that another 5% of juvenile individuals die in the last month preceding their independence.

of young reared by one pair has remained at the same level for quite a long time, but the number of young reared in some microregions and at the particular sites varies from year to year (A. CZAPUŁAK, T. KROTOSKI). At other sites or in other microregions the number of young reared shows a great stability in the successive years, although it may be considerably lower than the mean calculated for the whole country (KAŹMIERSKI 1973, KUTZNER 1976, MRÓWCZYŃSKA 1979, MANDZIOU 1982, A. CZAPUŁAK, T. KROTOSKI).

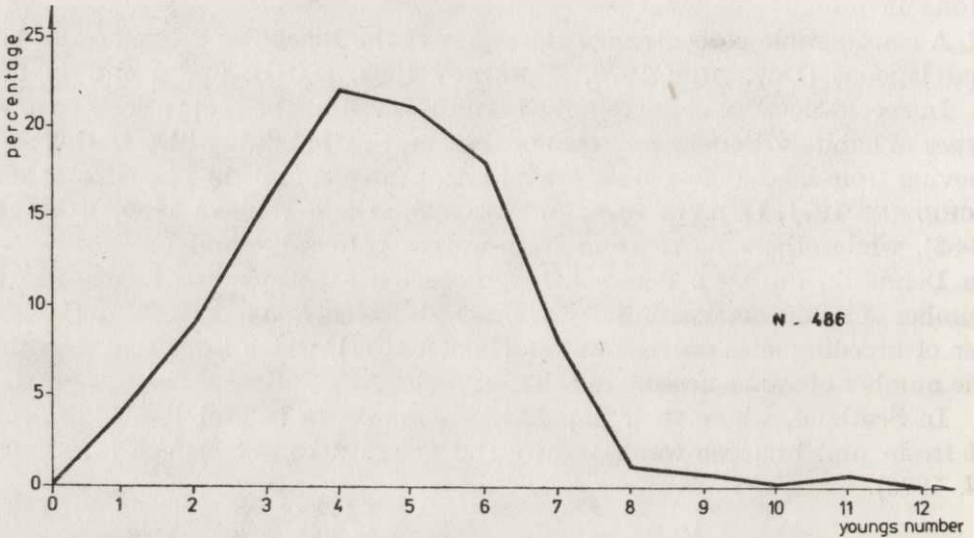


Fig. 15. Distribution of number of young mute swans led by parents in Poland, in August, in 1978 and 1979.

The percentage of pairs which have lost their broods depends to a large extent on local conditions and varies from year to year. In some areas only 50 % of the pairs that start breeding raise young (JENKINS *et al.* 1976, TENOVUO 1976, SPRAY 1981, SALATHE 1983), in others between 65–80 % (ELTRINGHAM 1963, MATHIASSEN 1976). ZAJĄC's (1963) data indicate that at the end of the fifties in northwestern Poland as many as 90 % of the swan pairs that had started breeding reared at least one young. The corresponding values calculated for the swans nesting on Milicz ponds or in the environs of Żnin are much lower, and they do not exceed 60 % (KAŹMIERSKI 1969, MANDZIOU 1982).

The lower the percentage of breeding pairs succeeding in raising young, the lower the average number of young reared by the pairs capable of breeding. However, even if a half of the pairs lost their broods, the average number of young reared would still be higher than the number required to maintain the population balance — 1.5 young per pair (ANDERSON-HARILD 1981).

## PRODUCTION OF YOUNG IN EUROPE

In the Scandinavian-Baltic group Poland is one of the countries where the largest number of young are raised by a swan pair (Table 10).

Table 10. Number of young mute swans reared by a pair\*

Country	$\bar{x}$ young/pair	Source of data
Poland	4.3	the author's own data
GDR	4.0	RUTSCHKE 1982
Denmark	3.9 (single) 3.4 (colony)	ANDERSON-HARILD 1981, <i>in litt.</i>
Sweden	4.1	BERGLUND <i>et al</i> 1963
Finland	1.4	HAPPANEN 1976
Estonia	3.4	PAAKSPUU 1974**

\* A pair with a breeding success.

\*\* Recalculated data.

A low production of young may be the result of the following factors: colonial nesting (ANDERSON-HARILD 1981); lack of the suitable food (REYNOLDS 1965, TENOVUO 1976, REICHHOLF 1978); epidemics (occurring exceptionally) (TISCHLER 1941, RUTSCHKE 1982); reduced clutch sizes (RUTSCHKE 1982); stormy weather immediately after the hatching of cygnets (REYNOLDS 1965, TENOVUO 1967); drastic weather changes during incubation (BERGLUND *et al.* 1963, HAPPANEN 1976, TENOVUO 1976, ANDERSON-HARILD 1981); nest penetration by human beings, boars, foxes, large sea-gulls and birds of the raven group (BERGLUND *et al.* 1963, ELTRINGHAM 1963, REYNOLDS 1965, BLOCH 1970, MATHIASSEN 1973, TENOVUO 1976, FEILER and KÖHLER 1977, COLEMAN and MINTON 1980, ANDERSON-HARILD 1981, RUTSCHKE 1982); pollution (oil pollution) (BERGLUND *et al.* 1963, REYNOLDS 1965, COLEMAN and MINTON 1980).

Cases have been known of an increased production of young in spite of conditions which theoretically should have caused its decrease. In Denmark, for instance, in a colony a lowering of the average clutch size was found, but the percentage of hatched and reared cygnets was higher there than in other colonies (BLOCH 1970).

To keep the stability of the population, a swan pair should rear 1.5 young in the growing season (ANDERSON-HARILD 1981), but such a low level of the production of young is only found in a small proportion of the European territory of the swan (Finland, HAPPANEN 1976, Scotland, SPRAY 1981), while in the remainder of the territory it is much higher (Table 10).

## CAUSES OF BREEDING SITE ABANDONMENT IN POLAND

As has been stated before (see page 194), some swan breeding sites disappear from the records, one of the causes of this state of affairs is the abandonment of sites by breeding pairs.



The questionnaires of 1978 contain data on the abandonment by breeding pairs of 41 breeding sites (Table 11). Most frequently abandoned are sites on lakes and ponds, these sites being abandoned more often than it would followed from a random distribution ( $p < 0.05$ , chi-square test). This may indicate

Table 11. Relationship between breeding site abandonment by mute swans and the type of habitat in Poland

Type of habitat	Number of abandoned sites	%
lake	27	66*
pond	11	27
river	1	2
other	2	5
Total	41	100

\* The difference between lakes and ponds, and other habitats is statistically significant ( $p < 0,05$ , chi-square test).

Table 12. Causes of breeding site abandonment by mute swans in Poland at the end of the 1970s

Cause	Deliberate destroying of nests by man	Driven away due to high activity of man	Man-caused changes in habitat	Overgrowing of water body with vegetation	Destruction by animals	Total
Number	11	15	12	2	1	41
%	27	37	29	5	2	100

that it is in this type of habitat that factors occur exerting a particularly strong pressure on the swans. Since 93 % of all abandoned sites were sites abandoned by the swans due to the activity of man (Table 12), it may be assumed that the main cause is both a deliberate action and its side effects. Among the causes of abandonment most frequently reported by the informants are the following: intensive water sports causing much noise and strong waves which harass the swans mainly during the breeding season; fast growth of tourism and building of rest centres on lakes; cutting of reed along lake shores, where the swans often build their nests; clutch destruction by removing eggs from nests and frequent penetration of the vicinity of nests by people, and drainage work. Similar causes of site abandonment have been found also in other countries (OGILVIE 1979, 1981, HARDMAN 1980). In Poland a new cause, unknown before, of abandonment of some Masurian lakes by the swans is the culture of the grass carp which eats all the underwater vegetation available to them (TROJNAR 1978). As the density of the swan population increases, the destruction of nests by boars becomes intensified (*e.g.* the Milicz ponds — MANDZIOU 1982, A. DYCZ, or the Lakeland of Hawa — ORŁOWSKI 1977).

## FACTORS AFFECTING THE NUMBERS OF SWANS

At the beginning of the 20th century the situation of the mute swan was not very promising. After centuries of intensive hunting and more or less intensive domestication (the oldest records of reared swans date from the 11th century in England; swans were brought there also from Poland, OWEN 1977) its wild stock was reduced to several hundred pairs, at the most, inhabiting few and territorially small refuges (Fig. 14). The next periods brought new losses of the stock, while World War I was the last dramatic period for the swans.

After the war the situation of the swan changed. Its numbers in the refuges began to grow (page 203), and consequently a territorial expansion followed (which can to some extent be considered as a recolonization, but the essence of the process remains the same) (see page 208). Thereafter the growth in numbers became explosive (Fig. 5, Table 4), the nesting territory increased (see page 209), and the biological cycle changed, this being manifested first of all by a higher degree of residence (NEDZINSKAS 1977, KISTCHINSKY 1979, PYRKAL 1982, WEISSNICHT and WAWRZYŃIAK 1982, M. WIELOCH); changes in the behaviour followed (OGILVIE 1981, MANDZIOU 1982). The density within the occupied area increased considerably (MAYER 1969, ANDERSON-HARILD 1981, WEISSNICHT and WAWRZYŃIAK 1982), this being to a large extent connected with habitat expansion (BLOCH 1971, SCHERNER 1974, BERESZYŃSKI and WIŃSKA 1980, KLŪZ 1972, RUTSCHKE 1982). Now the swan population continues to grow over most of its area (Fig. 5), and in the period of slightly over half a century it has changed its status from the position of a species threatened with extinction to the position of a species which, as a result of its excessive numbers, is the cause of specific economic and nature-conservancy problems, and begins, for this reason to be combated locally (BERGLUND *et al.* 1963, MAYER 1963, REICHHOLF 1978, KRÜGER 1982).

What event of the past half-century brought about such a radical change in the situation of this species?

The swan is a large and very strong bird living in a habitat practically inaccessible to large predatory mammals, hence no natural enemies — except man are dangerous to it. This indifference of the swan to predators is further reinforced by its white plumage.

For a bird of this size, the swan is characterized by an exceptionally high fecundity, at present considerably exceeding the requirements of the simple reproduction of this species (ANDERSON-HARILD 1981). It may, therefore, be assumed that in the natural habitat of the swan there existed a factor which considerably reduced its numbers. The effect of predators having been ruled out and epidemics having been stated to occur only exceptionally (RUTSCHKE 1982) it remains to consider the food conditions to be the main number-limiting factor. However, since the swan is a herbivore feeding on a fairly wide



spectrum of plants (BERGLUND *et al.* 1963, KRÜGER 1982), it is hard to presume that it would normally lack food. Food shortage may only occur under conditions preventing normal foraging. The only factors capable of preventing an aquatic herbivore of so large a body size from foraging are the frost and wind. Thus the main cause of a non-physiological mortality of the swans would be severe winter conditions leading to the death of adult individuals. In recent decades a lot of data confirming this conclusion have been gathered (TISCHLER 1941, SOKOŁOWSKI 1960, BERGLUND *et al.* 1963, OGIWIE 1967, MATHIASSEN 1973); in extreme cases there occurred a four-fold reduction in the number of breeding pairs as a result of a severe winter (JÖGI *et al.* 1976, NEDZINSKAS 1973, 1977).

Thus the survival and breeding success of the swan as a species depended on the overcoming of two reducing factors — the predatory pressure of man and the impact of severe winters.

The former factor has been eliminated by nature conservancy law. The law which in 1920 took the swan in the former East Prussia and Pomerania under protection, brought about an almost immediate increase in its stock in the regions of its main refuges *i.e.*, Pomorze and Mazury (Figs 6, 7). However, for a long time after that the swans continued to nest in the least accessible water bodies protected against human interference. On some of them the swans nested in colonies (PUCHALSKI 1966, SOKOŁOWSKI 1960); on Polish territories colonial nesting disappeared only after the barrier of fear of man, developed due to the harassment lasting for centuries, had been overcome. The overcoming of the shyness barrier was slow. This statement is suggested by the opinion of GODYŃ (after STRAWIŃSKI 1971) who still in the forties considered the mute swan to be a species that shuns man and civilization.

Ever since the introduction of the swan protection law the numbers of this species grew steadily, but relatively slowly (see pages 208). A real explosion of numbers and area inhabited by this species occurred only in the sixties and seventies of this century. It was probably only then that the severe-winter barrier was overcome, which additionally contributed to the final overcoming of the shyness barrier.

The first factor which led to the overcoming of the severe-winter barrier was swan feeding. Feeding, which increased the survival rate, favoured the least shy individuals, thus leading (via selection and learning) to an over-all reduction in shyness. This in turn changed the swans' behaviour, and these birds began to nest on small water bodies, often in the immediate vicinity of man. This offered the swan the possibility of a wide habitat expansion.

Another factor contributing to the overcoming of the severe-winter barrier was the creation of conditions for wintering on inland waters free of ice in winter due to the industrial discharge of heated water (RUTSCHKE 1975, DĄBSKA 1976, DOBROWOLSKI *et al.* 1980, WEISSNIGHT and WAWRZYŃIAK 1982, PINOWSKI and WESOŁOWSKI 1983). At present the swans winter, in smaller or larger



groups, in almost the whole of Poland (see page 217). This makes easy their feeding by people and reduces the risk of death of large flocks as a result of local climatic disasters (during the severe 1978/1979 winter about 25 thousand wintering swans died in the environs of Copenhagen — O. PREUSS pers. comm.).

Thus owing to the elimination of the predatory pressure of man, and the overcoming of the shyness barrier and the severe-winter barrier, the swans gained the possibility of a considerable population growth; this growth will not probably be stopped until the carrying capacity of the habitat has been exceeded.

#### SUMMING UP

1. In the years 1976–79 a total of 1811 mute swan breeding places, with 3130 pairs nesting in them, were found in Poland. Assuming a 20 % error of estimation, the number of swans nesting at that time in Poland was estimated at about 3800 pairs.

2. Summer aggregations of non-breeders, numbering between 100 and 1000 individuals, were found not only in the seaside belt and Mazury, from where they had been known for a number of years, but also in the valley of the Noteć river, in Śląsk and in Małopolska. The number of non-breeders spending the summer in this country was estimated at up to 6500 individuals. Part of the swans probably spend their juvenile years abroad.

3. The swan population density in Poland varies considerably, between 0.1 and 30 pairs/1000 km<sup>2</sup> of total surface area; the highest density was found in lakelands, in the northern and western part of Poland.

4. The density of swans per unit of open-water surface area is less varied, ranging from 0.1 to 3.7 pairs/1 km<sup>2</sup> water surface area. The highest values of density so calculated are found (with few exceptions) not for lakeland areas, but for regions where small and shallow water bodies prevail.

5. At most sites (67 %) only one swan pair nested, while sites holding over 10 pairs represented about 1 % of all pairs. At the end of the seventies no sites holding over 50 pairs were found in Poland, and such sites still existed at the end of the fifties.

6. At the beginning of the present century in lands now within the state boundaries of Poland the abundance of the swans decreased as a result of the harassment by man; this decline was impeded in 1920 when a swan-protection law was introduced in Pomerania and in the former East Prussia. Since then the number of swans in these refuge-territories grew steadily, attaining in the period before World War II the level of 115 pairs in areas west of the Vistula, and 500 pairs in areas east of the Vistula.

7. The impact of World War II on the swan stock in Poland is not known. In the post-war time it has continued to increase, more intensively in areas

west of the Vistula and more slowly in those east of this river (at the end of the seventies a twenty-and two-fold, respectively, growth was found relative to the pre-war time, and a six-fold growth and stabilization of the stock relative to the end of the fifties).

8. The growth in numbers of the swans is effected via a density increase in areas already occupied by the species, or by way of expansion in new territories. This expansion started in the second two decades of the 20th century and continued through the third and fourth two-decade periods, and was very intensive in the seventies when the range of the swan's area encompassed almost the whole of Poland.

9. In the seventies, there occurred a very conspicuous growth of the number of swans wintering in Poland. At present their wintering is not restricted to the Baltic coast and the western part of the country, as it was until as late as the sixties, but they winter nearly throughout the country. The number of the swans wintering in Poland at the turn of the seventies was estimated at about 6000.

10. At the end of the seventies over 1/2 of all swan breeding places in Poland were on lakes, 1/4 on fish ponds, and the remainder on various other natural and man-made water bodies, sometimes not larger than 0.5 ha in water-surface area.

11. Between the end of the fifties and the end of the seventies the growth in numbers of the swans accomplished itself mainly due to the colonization by this species of various non-lake wetland habitats, originally much sparsely populated by it or not colonized at all.

12. Among the sites most frequently abandoned by the swans are lake and pond-sites, and the most frequently-encountered cause of the abandonment is the activity of man.

13. At the end of the seventies, in Poland, a swan pair (one with a breeding success) reared on an average 4.3 offspring, which indicates that the average total number of cygnets reared has remained in Poland for a long time at the same level, considerably exceeding the requirements of a simple reproduction of this species.

14. The increase in the abundance of the swan that occurred in Europe during the 20th century is explained by a hypothesis which assumes that the main causes of the natural mortality of this species were the predatory pressure of man and severe winters which led to the death of adult individuals due to a lack of food. The human predatory pressure was eliminated as a result of the introduction of the swan-protecting law, at first in the areas of its refuges, and later in all countries where it occurs. The severe-winter barrier has been overcome owing to the winter feeding of swans, especially efficient on inland wintering grounds and on waters free of ice cover due to an industrial effluent of heated water. Species-protection and the winter feeding have resulted in a lo-

wered shyness of the swans and a clear synanthropization of these birds, which in turn became the cause of a conspicuous habitat expansion of the species which took place in the last decade.

#### ACKNOWLEDGMENTS

I would like to thank cordially all my colleagues, mentioned in the text, these from Poland as well as from abroad, who have kindly accepted their unpublished material to be used in my paper. I am grateful to the many people who answered to the questionnaires. I also wish to thank cordially Maciej GROMADZKI, for advice during the elaboration of the materials, and very valuable critical comments on the previous versions of this paper. My thanks are extended also to Jadwiga GROMADZKA, Elżbieta KRÓL, Wojciech KANIA, and Wojciech KRÓL, for constructive comments and suggestions throughout the preparation of the manuscript. I also owe a debt of gratitude to Franciszek ULCZYCKI, for assistance in the preliminary ordering of the data gathered in 1978.

#### REFERENCES

- AGAPOW L. 1968. Łabędź niemy na torfiankach w Lipkach Wielkich w powiecie gorzowskim. *Chrońmy Przyr.* **24**, 6: 50-51.
- ANDERSON-HARILD P. 1981. Population dynamics of *Cygnus olor* in Denmark. In: G. V. T. MATTHEWS, M. SMART (eds). Proceedings of the Second International Swan Symposium 1980, 176-191, Sapporo.
- ANDERSON-HARILD P. 1981a. Weight changes in *Cygnus olor*. In: G.V.T. MATTHEWS, M. SMART (eds). Proceedings of the Second International Swan Symposium 1980: 359-378, Sapporo.
- \*ANONIMUS. 1947. Ochrona zwierząt. Łabędzie na Łuknianach. *Chrońmy Przyr.* **3**, 1-2: 59-60.
- \*ANONIMUS. 1949. Pojawienie się łabędzi dzikich na Podlasiu. *Chrońmy Przyr.* **5**, 9-10: 49.
- ANONIMUS. 1951. Łęgowe łabędzie w pow. siedleckim. *Łow. pol.* 6-7: 30.
- \*ANONIMUS. 1953. Występowanie dzikich łabędzi na jez. Kolno koło Augustowa. *Chrońmy Przyr.* **9**, 2: 51.
- \*ANONIMUS. 1967. Łabędź niemy na Pałukach. *Przyr. pol.* **11**, 7: 9.
- \*ANONIMUS. 1973. Materiały. *Cygnus olor*. *Not. przyr.* **7**, 10: 93.
- \*ANONIMUS. 1981. Przyroda projektowanego rezerwatu Krutynia im. Melchiora Wańkowi-cza na Mazurach. *Chrońmy Przyr.* **37**, 6: 44-51.
- ATKINSON-WILLES. G. L. 1981. The numerical distribution and conservation requirements of swans in Northwest Europe. In: G. V. T. MATTHEWS, M. SMART (eds). Proceedings of the Second International Swan Symposium 1980: 40-48, Sapporo.
- BARTKOWIAK Z. 1961. Faunistyczny rezerwat przyrody, Jezioro Liwia Łuża w powiecie grafickim województwa szczecińskiego. *Przyr. Pol. zach.* **3**: 307-311.
- BAUER K. M., GLUTZ v. BLOTZHEIM U. N. 1968. *Handbuch der Vögel Mitteleuropas*. Vol. 2: 27-46, Frankfurt am Main.
- BEDNORZ J. 1983. Awifauna Słowińskiego Parku Narodowego z uwzględnieniem stosunków ilościowych. *PTPN, Wdz. Mat. Przyr. Prace Kom. Biol.* **64**: 1-101.

\* Used only for map preparation.



- \*BERESZYŃSKI A., GALIŃSKI T. 1980. Ptaki rezerwatu im. Bolesława PAPI na jeziorze Zgierzynieckim w latach 1967–1978. *Rocz. AR Pozn.* **72**. Orn. stos. **11**: 11–19.
- BERESZYŃSKI A., WIŃSKA M. 1980. Występowanie i liczebność łabędzia niemego, *Cygnus olor* (Gm.) w woj. poznańskim w 1978 roku z uwzględnieniem województw ościennych. *Rocz. AR Pozn.* **72**. Orn. stos. **11**: 113–120.
- BERGLUND B. E., CURRY-LINDHAL K., LUTHER H., OLSSON V., RHODE W., SELLERBERG G. 1963. Ecological studies on the mute swan (*Cygnus olor*) in Southeastern Sweden. *Acta verteb.* **2**: 165–288.
- BESZTERDA P., MAJEWSKI P., PANEK M. 1983. Wintering of the mute swan *Cygnus olor*, and the whooper swan *Cygnus cygnus*, in flooded area of the Warta river mouth. *Acta orn.* **19**: 217–225.
- BLOCH D. 1970. Knopsvanen (*Cygnus olor*) som kolonifugl i Danmark. *Dansk Orn. Foren. Tidsskr.* **64**: 152–162.
- BLOCH D. 1971. Ynglebestanden af Knopsvane (*Cygnus olor*) i Danmark i 1966. *Danske Vildtunersøgelse* **16**: 1–47.
- \*BOCHEŃSKI Z. 1960. Próba analizy populacji ptaków stawów rybnych w Gołyszcu. *Ekol. pol. Ser. B.* **6**: 269–280.
- BOGUCKI Z. 1967. Kilka uwag o ankietowym badaniu ptaków. *Bocian biały. Prz. zool.* **11**: 161–164.
- BROŹ P. 1980. *Cygnus olor*. In: SCHIFFERLI A., GEROUDET P., WINKLER R. (eds.). *Verbreitungsatlas der Brutvögel der Schweiz*, 66–67, Sempach.
- CAMPBELL B. 1960. The Mute swan census in England and Wales 1955–56. *Bird Study* **7**: 208–223.
- CHURCH H. F. 1956. The Mute swan populations of the eastern borders. *Bird Study* **3**: 212–217.
- \*CIEPLIK A. 1971. Koszalińskie rezerwaty przyrody. *Przr. Pol.* **15**, 7: 7.
- COLEMAN A. E., MINTON C. D. T. 1980. Mortality of Mute Swan progeny in an area of South Staffordshire. *Wildfowl* **31**: 22–28.
- CRAMP S. 1957. The census of Mute swans 1955 and 1956. *London Bird Rep.* **21**: 58–62.
- CRAMP S., SIMMONS K. E. L. (eds.). 1977. *Handbook of the birds of Europe, the Middle East, and North Africa. Vol. 1: 372–379*, Oxford.
- \*CZARNECKI Z. 1958. Obecny stan fauny łęgowej jeziora Gopło. *Przr. Pol. zach.* **2**: 299–300.
- CZARNECKI Z. 1963. Stan badań nad ornitofauną Wielkopolski. *Bad. fizjogr. nad Pol. zach.* **12**: 7–38.
- \*CZUBIŃSKI Z. 1951. O racjonalną sieć rezerwatów przyrody Pomorza. *Chrońmy Przr.* **7**, 11–12: 13–40.
- DĄBSKA I. 1976. Zmiany we florze roślin naczyniowych Jeziora Gosławickiego, na przesłrzeni 17 lat w związku z użytkowaniem wód tego jeziora. In: *Badania hydrobotaniczne jezior podgrzanych w okolicy Konina. UAM Poznań, Biologia* **6**: 13–16.
- DETMERS E. 1912. Verbreitung einiger jagdlich wichtiger Brutvögel in Deutschland. *Veröff. Inst. Jagdk. Neudann.* **1**, 5: 65–164.
- DOBBRICK L. 1912. *Ornis der Tucherer Heide. Ber. westpr. bot. – zool. Ver.* **34**: 97–173.
- \*DOBROWOLSKI K. A., KRZEMIŃSKI Z. 1978. Dać miejsce ptakom. *Przr. pol.* **10**, 11: 20–21.
- DOBROWOLSKI K. A., NOWAK E. 1965. Występowanie remiza *Remiz pendulinus* L. w Polsce. *Acta orn.* **9**: 77–114.
- DOBROWOLSKI K. A., PIEŁOWSKI Z., PINOWSKI J., WASILEWSKI A. 1962. Das Vorkommen des Kolkkraben (*Corvus c. corax* L.) in Polen im Zusammenhang mit seinen Areal and Quantitätsveränderungen in Mitteleuropa. *Ecol. Pol. A*, **10**: 377–456.
- DOHNAL M. 1981. Badania występowania i ekologii łabędzia niemego *Cygnus olor* w woj. poznańskim. M. Sc. thesis. ART Poznań, 77pp.
- \*DOMASZEWICZ A., LEWARTOWSKI Z. 1973. Obserwacje awifauny rzeki Narwi i jej doliny. *Not. przr.* **7**, 10: 3–36.

- DONTCHEV S. 1973. Migration, wintering and nesting sites of the Mute swan — *Cygnus olor* (GMELIN) in Bulgaria. Proc. IWRB Symp. Rational Use Waterfowl. Brno 1972: 72–74, Warszawa.
- DYRCZ A. 1966. Rozmieszczenie kolonii gawrona w Polsce. Acta orn. **9**: 227–240.
- \*DYRCZ A. 1981. Ptaki Zbiornika Otmuchowskiego. Acta zool. crac. **25**, 4: 69–102.
- DYRCZ A., OKULEWICZ J., TOMIAŁOJĆ L., WITKOWSKI J. 1972. Ornitofauna łęgowa Bagien Biebrzańskich i terenów przyległych. Acta orn. **13**: 343–424.
- \*DYRCZ A., OKULEWICZ J., WIATR B. 1973. Ptaki Pojezierza Łęczyńsko-Włodawskiego w okresie łęgowym (z uwzględnieniem badań ilościowych na torfowiskach niskich). Acta zool. crac. **18**: 399–473.
- \*DYRCZ A., TOMIAŁOJĆ L. 1969. Ornitologiczne motywy ochrony bagien biebrzańskich. Chrońmy Przyr. **25**, 4: 38–42.
- ELTRINGHAM S. K. 1963. The British population of the Mute Swan in 1961. Bird Study **10**: 10–28.
- FEDUSHIN A. V., DOŁBIK M. S. 1967. Pticy Belorussii. Mińsk, 518 pp.
- FEILER M. 1974. Die Bestandssituation des Höckerschwans (*Cygnus olor*) in der DDR 1971. Beitr. Vogelkd. **20**: 340–368.
- FEILER M., KÖHLER B. 1977. Massensterben von Wasservögeln durch Botulismus auf der Potsmer Havel im Sommer 1975. Falke **24**: 226–239.
- \*FERENS B. 1948. Spotkanie z łabędziem niemym. Chrońmy Przyr. **4**, 9–10: 32–39.
- \*FERENS B. 1949. Zagadnienia ochrony ptaków w pradolinie Baryczy. Chrońmy Przyr. **5**, 7–8: 15–24.
- FERENS B. 1963. Łukniany — jezioro tysiąca łabędzi. Przyr. pol. **7**, 8: 8.
- \*FERENS B. 1964. Milieź raj ptaków. Przyr. pol. **8**, 2: 7, 13.
- \*FIJAŁKOWSKI D. 1976. Kraina jezior i bagien. Przyr. pol. **11**: 9.
- FORSTER R., WAGNER G. 1973. Der Höckerschwan *Cygnus olor* in der Nordostschweiz. Orn. Beob. **70**: 67–80.
- FORSYTH I. 1980. A breeding census of Mute swan in Ireland in 1978. Irish Birds **1**: 492–501.
- \*FRASE R. 1936. Der Höckerschwan (*Cygnus olor* Gm) in der Grenzmark Posen-Westpreussen. Abh. Ber. grenzmärk. Ges. nat. wiss. Abt. Schniedemähl. **11**: 67–70.
- FRØSTRUP J. Ch. 1979. Knoppsvanen *Cygnus olor* i Aust-Agder. Fauna **32**, 4: 161–165.
- \*FRUZIŃSKI B. 1973. Ekologia ptaków kostrzyńskiego zbiornika retencyjnego ze szczególnym uwzględnieniem *Anatidae*. Roczn. AR Pozn. **37**: 1–108.
- Gl[asewald]. 1937. Federwildstrecken in Preussen zu Ende des 19. Jahrhunderts. Naturschutz. Neudamm. **18**: 262.
- \*GÓRCEKA H. 1965. Fauna Wolińskiego Parku Wolińskiego. Przyr. pol. **9**, 5: 13.
- GÓRSKI S. 1956. Piękne jezioro. Łow. pol. **7**: 8–9.
- GÓRSKI W. 1970. Ptaki rezerwatu „Jezioro Lubiatowskie” pod Koszalinem. Not. przyr. **4**, 5: 1–9.
- \*GÓRSKI W. 1976. Ptaki łęgowe pobraża Bałtyku między Mielnem a Ustką w latach 1965–1975. Not. orn. **17**: 1–34.
- GROMADZKI M., WIELOCH M. 1983. Distribution and number of the grey-lag goose *Anser anser* in Poland in the years 1977–1979. Acta orn. **19**: 155–178.
- HAFTORN S. 1971. Norges Fugler. Oslo, 150 pp.
- HAPPANEN A. 1976. [Breeding range and migration of swans in Finland]. In: E. KUMARI (ed.). Bird migration: 184–190, Tallin.
- HARDMAN J. 1980. Mute swan investigation. Swan populations. BTO News **110**: 2.
- HILPRECHT A. 1968. Der Bestand des Höckerschwans in der Deutschen Demokratischen Republik im Jahre 1966. Falke **15**: 148–151.
- HORA J. in press. Bestandssituation des Höckerschwans in der ČSSR.

- HÖLZINGER J. 1973. Brutverbreitung, Brut- und Sommerbestand des Höckerschwan (*Cygnus olor*) 1969 in Süddeutschland. Anz. orn. Ges. Bayern. **12**: 10-14.
- HÜBNER E. 1913. Geschichtliche Entwicklung des Vogelschutzes an der Pommerschen Ostseeküste. Orn. Mschr. **38**: 304-323.
- HUDEC K., ČERNÝ W. 1972. Fauna CSSR. Ptaci. Vol. **1**. Praha, 536 pp.
- IVANAUSKAS T. 1957. Issledovania po faune ptic v Litve. Trudy II Prib. orn. konf.: 117-120, Vilnius.
- \*JAKUBOWSKI B. 1953. Nowe stanowisko dzikich łabędzi na Mazurach. Chrońmy Przyr. **9**, 3: 40.
- \*JAKUCZUN U., JAKUCZUN B. 1973. Projektowany rezerwat ścisły Łuniewo na Wyspie Wolin. Chrońmy Przyr. **29**, 1: 68-74.
- JANASZEK S. 1957. Łabędzie gniazdowe w województwie lubelskim. Łow. pol. 9-10: 23.
- JANOWSKI K. 1967. Niektóre ptaki obserwowane w powiecie niemodlińskim w latach 1964, 1965. Acta orn. **10**: 243-253.
- JENKINS D., NEWTON J., BROWN C. 1976. Structure and dynamics of a Mute Swan population. Wildfowl **27**: 77-82.
- JENSEN F. 1967. Knopsvanen som ynglefugl påBognaes. Dansk Orn. Foren. Tidsskr. **61**: 143-151.
- JESPERSEN P. 1951. Knopsvanen som ynglefugl i Danmark. Dansk Orn. Foren. Tidsskr. **45**: 174-191.
- JÕGI A. 1968. [The present distribution of the Mute swan in the Estonian SSR]. Com. of the Baltic Comm. for the Study of Bird Migration **5**: 68-75, Tartu.
- JÕGI A., LIPSBERG J., NEDZINSKAS V. 1976. Numbers and seasonal distribution of the east Baltic population of the Mute swan. In: E. KUMARI (ed.). Bird migration. 175-184, Tallin.
- JÓZEFIK M. 1976. Występowanie gawrona, *Corvus frugilegus* L. w Polsce. Część I. Struktura przestrzenna i mechanizmy samoregulacji populacji. Acta orn. **15**: 339-482.
- \*KARCZEWSKI Z. 1953. Awifauna jeziora Drużno. Pr. Kom. Mat. Przyr. PZPN **14**, 2: 1-22.
- \*KARCZEWSKI Z., KOPTON J., TOMIAŁOJĆ L. 1964. Wycieczka ornitologiczna na jezioro Drużno. Acta orn. **7**: 317-323.
- KAŹMIERSKI J. 1967. Gniazdowanie łabędzia niemego, *Cygnus olor* (GM) w powiecie żnińskim. Not. orn. **8**: 62.
- KAŹMIERSKI J. 1972. Lęgowiska łabędzia niemego *Cygnus olor* w powiecie żnińskim. Chrońmy Przyr. **28**, 2: 61-62.
- KISTCHINSKY A.A. 1979. [Migrations of Mute Swan. Conclusions.] In: V. D. ILYCHOV (ed.). [Migrations of Birds of Eastern Europe and Northern Asia]. Vol. **2**: 62-70, Moscow.
- KLŮZ Z. 1977. Pribyva labuti velkych a čapu černych v českých krajích. Živa **25**: 149-150.
- KOLLIBAY P. 1906. Die Vögel der Preussischen Provinz Schlesien, Breslau, 370 pp.
- \*KOŁOSOWSKI K. 1981. Rezerваты ornitologiczne w Puszczy Nadnoteckiej. Chrońmy Przyr. **37**, 5: 48-54.
- KORSAK W. 1968. Notatki ornitologiczne z Ziem Zachodnich. Chrońmy Przyr. **24**, 2: 37-41.
- \*KORSAK W. 1970. Łabędź niemy na jeziorze Lubiato. Chrońmy Przyr. **26**, 1: 42-43.
- \*KOT. H. 1981. Materiały do awifauny Pojezierza Łęczycko-Włodawskiego. Not. orn. **22**: 17-30.
- \*KOWALEWSKI L. 1979. Łabędź niemy *Cygnus olor* w regionie częstochowskim. Chrońmy Przyr. **35**, 2: 72-74.
- \*KOWALEWSKI L. 1981. Łabędź niemy *Cygnus olor* w regionie częstochowskim. Chrońmy Przyr. **37**, 4: 77-78.
- \*KOZŁOWSKI P. 1967. Ptaki rezerwatu Jaru Raduni. Prz. zool. **11**: 62-65.
- \*KOZŁOWSKI P. 1967a. Materiały do awifauny powiatu kartuskiego. Acta orn. **10**: 1-24.
- KRAGENOV P. 1979. Höckerschwan *Cygnus olor*. In: KLAFFS G., J. STÜBS J. (eds). Die Vogelwelt Mecklenburgs, Vol. **1**: 98-99, Jena.



- KRÜGER H. P. 1982. Zur Notwendigkeit und zu Ergebnissen bestandregulierender Massnahmen beim Höckerschwan, *Cygnus olor* an Fischteichen. Beitr. Vogelkd. **28**: 74–78.
- KRZYŚKOWIAK A., DOBROWOLSKI K. A. 1981. Zimowanie ptaków wodnych w Polsce w latach 1976/77 i 1977/78. Not. orn. **22**: 81–84.
- KUTZNER T. 1976. Łabędź niemy (*Cygnus olor*) w okolicach Sępólna Krajeńskiego w latach 1966, 1971–1973. Not. orn. **17**: 93–98.
- KUŹNIAK S. 1967. Remiz, *Remiz pendulinus* (L.) i łabędź niemy *Cygnus olor* (Gm) w powiecie leszczyńskim. Acta orn. **10**: 265–267.
- \*KUŹNIAK S. 1981. Jezioro Trzebidzkie, projektowany rezerwat ornitologiczny w województwie leszczyńskim. Chrońmy Przyr. **37**, 5: 45–47.
- \*KUŹNIAK S. 1983. Przelot i zimowanie ptaków wodno-błotnych na Pojezierzu Krzywińskim (Wielkopolska). Acta orn. **19**: 237–250.
- LENSKI E. 1924. Im Vogelparadies am Lüptow-See. Ein Naturdenkmal in Gefahr. Ostf. Naturwart. Liegnitz, **1**: 190–191.
- LENSKI E. 1936. Zum Vorkommen des wilden Höckerschwans in Hinterpommern. Orn. Mschr. **61**: 178–180.
- \*LENAR L. 1963. Rezerwaty jeziorowe w Polsce. Przyr. pol. **7**, 8: 4.
- LEŃKOWA A. 1958. Wzrosła ilość łabędzi na Jeziorze Łuknianach. Chrońmy Przyr. **13**, 2: 53.
- LESSER H. 1964. Rezerwaty zwierzęce w Polsce. Przyr. pol. **8**, 2: 3.
- LESSER G. 1968. Stan liczbowy łabędzi niemych w Polsce. Chrońmy Przyr. **24**, 2: 50–52.
- \*LEŚNICZAK A. B. 1981. Łabędź niemy *Cygnus olor* na Dolnym Śląsku. Chrońmy Przyr. **37**, 3: 78–80.
- \*LEWANDOWSKI A. A. 1964. Ptaki jeziora Mamry Północne (pow. Węgorzewo). Acta orn. **8**: 139–173.
- LING R. G. 1961. O novom zaselenii lebedem-šipunom Estonskoj SSR. Trudy IV Prib. orn. konf.: 81–83, Riga.
- LIPSBURG J. K. 1979. [Number and distribution of the Mute Swan (*Cygnus olor*) in Latvia]. Ornitologia **14**: 126–132.
- LIPSBURG J. K. 1983. *Cygnus olor* (L.). In: J. VIKSNE (ed.). Birds of Latvia. Territorial distribution and number: 33–34, Riga.
- \*LUNIAK M. 1963. Niektóre gatunki ptaków spotykanych w rezerwacie Czerwone Bagno koło Rajgrodu, woj. Białystok. Acta orn. **7**: 282–283.
- \*LUNIAK M. 1967. Materiały do awifauny województwa lubelskiego. Acta orn. **10**: 267–268.
- LUNIAK M. 1972. Rozmieszczenie kolonii gawrona *Corvus frugilegus* L. w powiecie Siedlce (woj. warszawskie). Acta orn. **13**: 425–449.
- \*ŁASZEK Cz. 1978. Ptasi raj u wrót Warszawy. Przyr. pol. **4**: 12–13.
- \*ŁĄCKI A. 1959. Interesujące stanowiska łęgowe ptaków w Pomiatowie Pырzyckim (woj. szczecińskie). Przyr. Pol. zach. **3**: 158–160.
- \*ŁOWCZY. 1958. Łabędzie w Człuchowie. Łow. pol. **23**: 15.
- MACIEJEWSKI R. 1965. Dzikie łabędzie w ogrodzie. Łow. pol. **18**: 7.
- MACKOWICZ R. 1981. Ökologische Untersuchungen an wilden, nicht brütenden Höckerschwanen (*Cygnus olor* Gm) in Nordost-Polen (Woiwodschaft Olsztyn). Ökol. Vogel **3**: 267–280.
- MACKOWICZ R. 1984. Łabędź niemy *Cygnus olor* na jeziorze Łuknajno. Acta zool. crac. **27**: 187–206.
- MAJEWSKI P. 1983. Evaluation of the role of the Słońsk Reserve (Poland) for waterfowl. Acta orn. **19**: 227–235.
- MAJEWSKI P., WIATR B. 1981. Znaczenie dolnego biegu Warty i Noteci dla ptaków wodno-błotnych. In: Zasoby przyrody województwa gorzowskiego. Ośrodek Badań i Konsultacji TWWP: 189–198, Gorzów Wielkopolski.
- MAJEWSKI Ż. 1963. Obserwacje nad ptakami prowadzone na terenie powiatu Wałcz w 1961 In: Materiały do awifauny Polski. II Spisy faunistyczne. Acta orn. **7**: 271–275.

- MALCHEVSKY A. S., PUKINSKY Y. B. 1983. Lebedi, gusi i kazarki v Leningradskoj oblasti. Soob. prib. kom. po izuč. migr. ptic. **14**: 23-42.
- MANDZIOU J. 1982. Ekologia rozrodu łabędzia niemego (*Cygnus olor*) na stawach milickich, M.Sc. thesis. Uniwersytet Wrocławski. Wrocław, 40 pp.
- \*MANIKOWSKI S. 1966. Ptaki chronione w projektowanym Słowińskim Parku Narodowym. Chrońmy Przyr. **22**, 2-3: 53-65.
- \*MARKOWSKI J., SZMIGIERO L., WOJCIECHOWSKI Z. 1974. O utworzenie rezerwatu ornitologicznego w dolinie Bobrówki (pow. Łowicz). Chrońmy Przyr. **30**, 2: 58-64.
- \*MASTYŃSKI Z. 1964. Inwazja dużych zwierząt na woj. bydgoskie. Wszechświat **12**: 266-267.
- MATHIASSEN S. 1973. Moulting grounds of Mute Swans (*Cygnus olor*) in Sweden, their origin and relation to population dynamics, biology and distribution of Mute Swans in the Baltic area. Viltrevy **8**: 399-452.
- MATHIASSEN S. 1976. Studies on mute swans in Sweden. In: E. KUMARI (ed.). Bird migration: 190-196, Tallin.
- MATHIASSEN S. 1976a. Some aspects on learned behaviour and tradition in the migratory habits of Mute Swan with special reference to Swedish swan population. In: E. KUMARI (ed.). Bird Migration: 197-207, Tallin.
- MATHIASSEN S. 1981. The moult grounds relation to breeding and wintering areas revealed by neck-banded *Cygnus olor*. In: G.V. T. MATTHEWS, M. SMART (eds.). Proceedings of the Second International Swan Symposium 1980: 132-141, Sapporo.
- MAYER G. 1969. Der Höckerschwan (*Cygnus olor*) in Oberösterreich. Monticola **2**: 13-32.
- MERIKALLIO E. 1958. Finish birds. Their distribution and numbers. Fauna Fenn. **5**: 1-181.
- MICHALAK S. 1961. Staw Nowokuźnicki jako rezerwat przyrody. Przyr. pol. **5**, 12: 5.
- MICHALAK S. 1962. Łabędź niemy, *Cygnus olor* (Gm.) na Opolszczyźnie. Pr. zool. **6**: 80.
- MIELEWCZYK S. 1960. Łabędź niemy (*Cygnus olor* Gm) w powiecie gnieźnieńskim. Przyr. Pol. zach. **4**, 3-4: 168-170.
- \*MIERZWIŃSKI W. 1953. Łabędź niemy — perła jezior mazurskich. Łow. pol. **2**: 28.
- MIERZWIŃSKI W. 1955. Jezioro Siedmiu Wysp. Chrońmy Przyr. **11**, 5: 42-43.
- \*MIERZWIŃSKI W. 1958. Łabędzie w dolinie rzeki Guber. Chrońmy Przyr. **14**, 4: 29-31.
- \*MIERZWIŃSKI W. 1959. Łabędzie na Mazurach. Chrońmy Przyr. **15**, 4: 27-31.
- MINTON C. D. T. 1971. Mute Swan flocks. Wildfowl **22**: 71-88.
- MRÓWCZYŃSKA A. 1979. Występowanie łabędzia niemego *Cygnus olor* (GMELIN) na Pojezierzu Mrągowskim. M. Sc. thesis. ART Olsztyn, 34 pp.
- \*MRUGASIEWICZ A., WITKOWSKI J. 1962. An ornithological sketch of Barycz valley in Poland. Brit. Birds **55**: 245-272.
- MURASHKA I. P., VALYUS M. I. 1961. Estestvennaja reakklimatizacija lebedia šipuna v Litve i na blizleżaščich territorijach. Trudy IV Prib. orn. konf. 1961: 71-80, Riga.
- NANKINOV D. N. 1982. Krasnaja kniga NR Bulgarii, Sofia, 250 pp.
- \*NAWROCKI P., JERMACEK A., JESIONOWSKI J., NAWROCKA B. 1983. Ptaki Bagien Kramskich w okresie lęgowym w latach 1976-1979. In: Z. CZARNECKI (ed.). Ekologia ptaków doliny środkowej Warty. Pr. Kom. Biol. Pozn. TPN. **67**: 19-41.
- NEDZINSKAS V. S. 1973. K ekologii litovskoj populacii lebedia sipuna (*Cygnus olor*) Zool. Žur. **52**, 9: 1360-1366.
- NEDZINSKAS V. S. 1977. Rost čislennosti lebedia-sipuna i rossirene gnezdowych stacij na territorii Litvy. Ekol. ptic LSSR: 65-76, Vilnius.
- NEDZINSKAS V. S. 1979. [Seasonal distribution of Mute Swan breeding in the Lithuanian SSR]. In: V. D. ILYICHOV (ed.). [Migrations of Birds of Eastern Europe and Northern Asia]. Vol. **2**: 40-46, Moscow.
- \*NIEWĘGŁOWSKI J. 1958. Łabędź w szczecińskim. Łow. pol. **14**: 13.
- \*NOSAL T. 1948. Łabędź, kormoran i puchacz w Nadleśnictwie Gołębia Góra (Pomorze Zachodnie). Łow. na Pom.: 105-107.

- \*NOWYSZ W. 1974. Ptaki obserwowane na jeziorze Rakutowskim (pow. Włocławek) w okresie przelotów jesiennych. Not. przyr. 7, 10: 49–54.
- \*NOWYSZ W., WESOŁOWSKI T. 1974. Materiały do awifauny doliny Noteci. Not. przyr. 7, 10: 37–48.
- \*OCHOROWICZ S. 1953. Łęgi łabędzi w pow. Garwolin. Łow. pol. 10: 153.
- Ogilvie M. A. 1967. Population changes and mortality of the Mute Swan in Britain. Wildfowl Trust Ann. Rep. 18: 64–73.
- Ogilvie M. A. 1981. The Mute Swan in Britain, 1978. Bird Study 28: 87–106.
- OKULEWICZ J. 1971. Ptaki miasta Olsztyna i okolie. Acta orn. 13: 127–171.
- \*OLACZEK R. 1968. Nowe dla Polski stanowisko łabędzia niemego pod Łowiczem. Chrońmy Przyr. 24, 1: 56–59.
- \*OLDENBURG K. 1942. Kleinere ornithologische Beobachtungen aus Bütow. Dohrniana 21: 75–76.
- OLECH B. 1973. Szkody w uprawach wyrządzane przez ptaki krukowate. Ochr. Roślin 17, 8: 18–20.
- ONNO S. 1970. The numbers and distribution of the Estonian waterfowl during the nesting season. In: E. KUMARI (ed.). Waterfowl in Estonia: 18–46, Tallin.
- ORŁOWSKI J. 1977. Występowanie łabędzia niemego, *Cygnus olor* (GMELIN) w południowo-zachodniej części Pojezierza Iławskiego. M. Sc. thesis. ART Olsztyn, 41 pp.
- OWEN M. 1977. Wildfowl of Europe. London, 256 pp.
- PAAKSPUU V. 1974. On the counts of the nesting Mute swans in Estonia in 1974. Loodusvaatlusi 1: 86–90.
- PAASIVIRTA O., MIKKOLA K. 1971. [On the Mute Swan population in Aland in 1965–1970]. Lintumies 7: 45–48.
- PALUDAN K., FOG J. 1956. [The Danish breeding population of wild living *C. olor* in 1954]. Danske Vildt. 5: 1–46.
- PANFIL J. 1966. Łabędź niemy w woj. olsztyńskim. Chrońmy Przyr. 22, 2–3: 66–82.
- PANFIL J. 1971. O ptakach rezerwatu jeziora Łuknajno i jego nabrzeży. Chrońmy Przyr. 27, 3: 13–28.
- PAWLIK J. 1977. Występowanie łabędzia niemego *Cygnus olor* (GMELIN) w północno-wschodniej części Pojezierza Iławskiego. M. Sc. thesis. ART Olsztyn, 50 pp.
- PAX F. 1925. Wirbeltierfauna von Schlesien. Berlin, 558 pp.
- PERRINS C. M., REYNOLDS C. M. 1967. A preliminary study of the Mute Swan *Cygnus olor*. Wildfowl Trust Ann. Rep. 18: 74–84.
- PIERZCHLEWSKI K. 1977. Nowe stanowisko lęgowe gęsi gegawy. Łow. pol. 16: 14.
- PIETKIEWICZ Z. 1978. Występowanie łabędzia niemego *Cygnus olor* (GMELIN) na Pojezierzu Olsztyńskim. M. Sc. thesis. ART Olsztyn, 38 pp.
- PINOWSKI J., WESOŁOWSKI T. 1983. Wpływ regulacji Wisły na awifaunę. In: Z. KAJAK (ed). Ekologiczne podstawy zagospodarowania Wisły i jej dorzecza: 543–567, Warszawa.
- \*PIOTROWSKA M. 1976. Materiały do awifauny Doliny Wieprza w okolicach Ułęża. Not. orn. 17: 35–39.
- \*POMARNACKI L. 1948. Łabędzie. Łow. na Pom. 94–96.
- POMARNACKI L. 1952. Łabędzie w kieleckim Łow. pol. 4: 16.
- POMARNACKI L. 1957. Łabędzie w radomskim. Chrońmy Przyr. 13, 2: 41–43.
- \*POMARNACKI L. 1969. O łabędziach z dzikich wód. Przyr. pol. 13, 6: 9.
- PUCHAŁSKI W. 1956. W krainie łabędzia. Warszawa, 131 pp.
- PYKAL J. 1982. Zimoviště labutě velké (*Cygnus olor*) ve Strakonících. Sborník příspěvku k ornitologickému výzkumu Jihočeského kraje: 18–20.
- RAWCLIFFE C. P. 1958. The Scottish Mute Swan census, 1955–56. Bird Study 5: 45–55.
- REICHHOLF J. 1973. Die Bestandsentwicklung des Höckerschwans (*Cygnus olor*) und seine Einordnung in das ökosystem der Innstauseen. Anz. orn. Ges. Bayern. 12: 15–46.



- REICHHOLF J. 1978. Der Schwan ist kein Problem. Sielmenns Tierwelt **9**: 28-35.
- RENSEN Th. A., TEIXEIRA R. M. 1980. Taxatie van het aantal knobbelzwanen in Nederland. Watervogels **5**: 18-24.
- REYNOLDS C. M. 1965. The survival of Mute swan cygnets. Bird Study **12**: 128-129.
- \*RIABININ S. 1958. Łabędź w woj. lubelskim. Chrońmy Przyr. **14**, 2: 53.
- RICHLING A. 1973. Kraina wielkich jezior mazurskich. Przyr. pol. **17**, 7: 10-11.
- \*ROBIEN P. 1920. Das Brutgeschäft pommerscher Vögel im Jahre 1919. Abh. Ber. pommer. naturf. Ges. **1**: 57-66.
- ROBIEN P. 1928. Die Vogelwelt Pommerns. Abh. Ber. pommer. naturf. Ges. **9**: 1-94.
- ROBIEN P. 1931. Die Vogelwelt Pommerns. Nachtrag 1929/30. Dohrniana. **11**: 10-33.
- RÖSLER A. 1981. Łabędź niemy *Cygnus olor* na Pojezierzu Sławskim. Chrońmy Przyr. **37**, 5: 68-72.
- \*RUTKIEWICZ I. 1973. Osobliwości suwalszczyzny i ich ochrona. Przyr. pol. **17**, 11: 18-19.
- RUTSCHKE E. 1975. Zur Überwinterung der Stockente und des Höckerschwans in Berlin und im Industriebezirk Halle. Falke **22**: 41-46.
- RUTSCHKE E. 1982. Zur Bestandsentwicklung des Höckerschwans (*Cygnus olor*) in der DDR. Beitr. Vogelkd. **28**: 59-73.
- RUTSCHKE E. 1983. Zur Bestandentwicklung des Höckerschwans in der DDR. Falke **6**: 186-191.
- RYDZEWSKI W., TOMIAŁOJC L., WITKOWSKI J. 1972. W sprawie ankietowego badania ptaków. Prz. zool. **16**: 424-427.
- SALATHE T. 1983. Bestand und Verbreitung des Höckerschwans *Cygnus olor* 1971-1974 in der Schweiz. Orn. Beob. **80**: 105-117.
- SANDEN W. 1931. Zunahme des Höckerschwans auf dem Nordenburger See, Ostpr. Orn. Manatsber. **39**: 53-54.
- SANDEN W. 1939. Der Bestand der Höckerschans Ostpreussens 1936/38 und ihr Leben auf dem Nordenburger See. Schr. phys.-ökon. Ges. Königsberg. **71**: 37-52.
- \*SCHEELE W. 1913. Vom Lüptower See. Mitt. Vogelw. Nürnberg **13**: 207-208.
- SCHERNER E. R. 1974. Biotop, Verbreitung und Bestand brütende Höckerschwäne (*Cygnus olor*) in Bremen, Hamburg, Hessen, Niedersachsen, Schleswig-Holstein und West Berlin 1969. Vogelwelt **95**: 161-169.
- SCHERNER E. R. 1981. Der Höckerschwan (*Cygnus olor*) in Nordwestdeutschland (Übersicht). Drosera **81**: 47-54.
- SCHIEMENZ H. 1972. Die Situation der vom Aussterben bedrohten Vögel in der DDR. Falke **19**: 42-47.
- SCHMIDT R., SIEFKE A., PERNER H. 1979. Mitteleuropäische Subareale des Höckerschwans (*Cygnus olor*) nach Beringungsergebnissen aus dem Gebiet der DDR. Beitr. Vogelkd. **25**: 50-64.
- SCHOENNAGEL. 1938. Zur Verbreitung des Höckerschwans in der Kurmark. Märk. Natursch. Berlin **10**, 38: 132.
- SCOTT P., The Wildfowl Trust. 1972. The Swans. London, 242 pp.
- \*SIENIAWSKI L. 1970. Zimowa oaza łabędzi na Jeziorze Miedwie. Przyr. pol. **14**, 6: 13.
- SŁAWIŃSKA K. 1979. Rytmika zmian liczebności stad łabędzia niemego, *Cygnus olor* (GMELIN) na jeziorach Łukniany i Pogubie w ciągu 1977 roku. M. Sc. thesis. ART Olsztyn, 35 pp.
- \*SOKOŁOWSKI J. 1958. Ptaki Ziem Polskich. Vol. 2. Warszawa, 456 pp.
- \*SOKOŁOWSKI J. 1959. Wpływ opadów atmosferycznych na stan ilościowy ptaków wodnych i błotnych. Przyr. pol. **3**, 5-6: 3.
- SOKOŁOWSKI J. 1960. The mute swan in Poland. State Council for Conserv. of Nature. Warszawa, 28 pp.
- SOKOŁOWSKI J. 1962. Zmiany awifauny na terenie woj. poznańskiego w ostatnich dziesiętkach lat. Przyr. Pol. zach. **6**: 15-30.

- \*SOKOŁOWSKI A. W. 1978. Projektowany rezerwat Wilkokuk w Puszczy Augustowskiej. *Chrońmy Przyr.* **34**, 1: 60-65.
- SPRAY C. 1981. An isolated population of *Cygnus olor* in Scotland. In: G. V. T. MATTHEWS, M. SMART (eds). *Proceedings of the Second International Swan Symposium: 191-208*, Sapporo.
- \*STĘPCZAK K. 1960. Z przyrody Jeziora Sławskiego i okolicy. *Przyr. Pol. zach.* **4**: 117-124.
- STRAWIŃSKI S. 1971. O ptakach, ludziach i miastach. Warszawa, 156 pp.
- \*SWOBODA M. 1977. Nowe rezerваты przyrody. *Przyr. pol.* **11**: 28.
- \*SZARSKI K. W. 1950. Obserwacje ornitologiczne w pradolinie Baryczy w latach 1946-1949. *Ochr. Przyr.* **19**: 163-178.
- \*SZCZEPKOWSKI J. 1948. Z wizytą u dzikich łabędzi. *Łow. pol.* **11**: 19-22.
- \*SZCZEPKOWSKI J. 1956. Fauna zabytkowa w nadleśnictwie Biały Zdrój. *Łow. pol.* **10**: 11.
- SZCZEPSKI J. B. 1948. Ochrona ptactwa na wybrzeżu Pomorza Wschodniego i Zachodniego. *Ochr. Przyr.* **18**: 104-122.
- \*SZCZEPSKI J. B. 1958. O konieczności ochrony awifauny rezerwatu na wyspie Mętnej pod Szczecinem. *Chrońmy Przyr.* **14**, 2: 26-31.
- SZIJJ J. 1965. Eine Schätzung der Anzahl der Höckerschwan-Brutpaare in der Schweiz. *Orn. Beob.* **62**: 61.
- \*SZYMAŃSKI W. 1967. Zimowe przeloty łabędzi. *Łow. pol.* **3**: 14.
- \*ŚPIEWAKOWSKI E. R. 1977. Słowiński Park Narodowy. *Przyr. Pol.* **1**: 5-8.
- TENOVUO R. 1961. Knölsvanen (*Cygnus olor*) invänderar till sydöstra Finland. *Nordenskiöld-samfundets lidskrift.* **21**: 26-37.
- TENOVUO R. 1975. [The Mute Swan, *Cygnus olor*, population in South-West Finland]. *Suomen Rüsta* **26**: 5-13.
- TENOVUO R. 1976. The Mute Swan (*Cygnus olor*) in Finland. *Ornis Fennica* **53**: 147-149.
- TISCHLER F. 1941. Die Vögel Ostpreussens und seiner Nachbargebiete. Königsberg-Berlin. Vol. **2**: 721-1304.
- TOMIAŁOJĆ L. 1963. Ptaki obserwowane w okolicy jez. Miedzno koło Osia, pow. Świecie. *Acta orn.* **7**: 285-287.
- TOMIAŁOJĆ L. 1963a. Ptaki okolic Dobrego Miasta w powiecie lidzbarskim. *Acta orn.* **7**: 427-463.
- TOMIAŁOJĆ L. 1972. Ptaki Polski — wykaz gatunków i rozmieszczenie. Warszawa, 312 pp.
- TROJNIAK T. 1978. Łabędź niemy, *Cygnus olor* (GMELIN) na wielkich jeziorach mazurskich. M.Sc. thesis. ART Olsztyn, 36 pp.
- \*URBAŃSKI J. 1949. Rezerwat ptasi Mętna koło Szczecina. *Chrońmy Przyr.* **5**, 1-3: 57-62.
- WASILEWSKI J. 1966. Ptaki wodno-blotne stawów zatorskich. *Prz. zool.* **10**: 51-60.
- WAŚKIEWICZ M. 1978. Rozmieszczenie łyśki (*Fulica atra* L.) i łabędzia niemego (*Cygnus olor* GM) na terenie Polski. M.Sc. thesis. Uniwersytet Warszawski, Warszawa, 26 pp.
- WEISSNIGHT S., WAWRZYŃIAK H. 1982. Zur Populationsdynamik des Höckerschwans (*Cygnus olor*) im Kreis Eberswalde, Bezirk Frankfurt (Oder). *Beitr. Vogelkd.* **28**: 79-88.
- \*WESOŁOWSKI T. 1975. Ptaki Jeziora Bytyńskiego (woj. poznańskie). *Acta orn.* **15**: 113-144.
- WICHT U. 1972. Erstmals Kolonieartiges Brüten des Höckerschwans (*Cygnus olor*) am Bodensee. *Anz. orn. Ges. Bayern* **11**: 164-167.
- WISS L. E. 1979. Knölsvan *Cygnus olor* På Gotland 1978. *Bläcku* **2**: 69-72.
- \*WITKOWSKI J. 1965. Ptaki rezerwatu „Staw Nowokuźnicki” w latach 1963-1964. *Acta orn.* **9**: 169-178.
- \*WODZICZKO A. 1929. Zabytki Przyrody na Pomorzu. *Pam. Inst. Balt., Ser. Balticum.* **1**.
- WODZICZKO A., KRAWIEC F., URBAŃSKI J. 1938. Pomniki i zabytki przyrody Wielkopolski. *Wyd. Okr. Kom. Ochr. Przyr. Wlkp.* **8**.
- \*WOJTERSKI T. 1957. Kaszubski Park Narodowy. *Chrońmy Przyr.* **13**, 3: 22-39.
- \*WOLK K. 1956. Bieliki i łabędzie na wyspie Wolin. *Chrońmy Przyr.* **12**, 6: 43-45.

- \*WOŁK K. 1957. Obserwacje ornitologiczne w projektowanym Wolińskim Parku Narodowym. *Chrońmy Przyr.* **13**, 5: 40–42.
- WOŁK K. 1970. Obserwacje ornitologiczne w rezerwacie „Jezioro Liwia Łuża” na Pomorzu. *Acta orn.* **12**: 48–51.
- \*WOŁK K. 1974. Ptaki rezerwatu Krajkowo nad Wartą. *Ochr. Przyr.* **40**: 205–228.
- VIKSNE J. 1968. Rezultaty učetov lebedia-šipuna i orlana-belohvosta v Latvii v 1964 godu. *Soobšč. Prib. kom. po izuč. migaciji ptic. Tartu.* **5**: 76–80.
- \*ZAJĄC R. 1957. Z badań nad łabędziem niemy ( *Cygnus olor* GMEL.) w województwie szczecińskim. *Przyr. Pol. zach.* **1**: 139–146.
- \*ZAJĄC R. 1960. Obserwacje ornitologiczne z Jeziora Resko Przymorskie. *Przyr. Pol. zach.* **4**: 164–167.
- ZAJĄC R. 1963. Łabędź niemy, *Cygnus olor* (GMELIN) w północno-zachodniej Polsce. *Acta orn.* **7**: 221–252.
- \*ZAJĄC R. 1964. Trzy gatunki łabędzi (*Cygnus* BECHST.) na jeziorze rezerwatu „Ptasi Raj” w Górkach Wschodnich koło Gdańska. *Prz. zool.* **8**: 157–161.
- ZŁOTORZYCKA J. 1961. Obserwacja zwyczajów łabędzia niemego, *Cygnus olor* (GM.) *Not. orn.* **2**: 11.
- ZUBRZYCKI W. 1967. Występowanie niektórych gatunków na Jeziorze Bytyńskim w roku 1966. *Not. przyr.* **1**, 1: 10–11.
- \*ŻARCZYŃSKI J. 1959. Dzikie łabędzie w województwie koszalińskim. *Łow. pol.* **14**: 15.

## STRESZCZENIE

[Liczebność i rozmieszczenie łabędzia niemego *Cygnus olor* w Polsce na tle sytuacji tego gatunku w Europie]

Celem pracy jest opisanie rozmieszczenia i liczebności łabędzia niemego w Polsce w końcu lat siedemdziesiątych, a w niektórych przypadkach na przełomie lat siedemdziesiątych i osiemdziesiątych bieżącego stulecia oraz prześledzenie zmian zasięgu i liczebności tego gatunku w ciągu XX wieku na ziemiach należących obecnie do Polski, na tle ogólnoeuropejskich trendów, jakim ten gatunek podlega. Zebrany materiał pochodzi z lat 1976–79. Podstawowy zasób informacji o lęgowych łabędziach uzyskano metodą ankietową w latach 1978 i 1979, a uzupełniono go danymi pochodzącymi z wszelkich innych dostępnych źródeł. Określając liczebność stanowiska posłużono się liczbami podanymi przez informatorów. Za stanowisko lęgowe uznano zbiornik wodny, na którym gnieźdzą się łabędzie, bez względu na jego rozległość i liczbę gnieźdzących się par.

W latach 1976–79 na terenie Polski stwierdzono 1811 stanowisk lęgowych łabędzia niemego, na których gnieździło się 3130 par. Uwzględniając 20% błędu oceny liczebności, liczbę łabędzi gnieźdzących się w tym okresie w Polsce oszacowano na 3800 par.

Łabędzie niełęgowe tworzą latem skupiska liczące powyżej 100 ptaków nie tylko w pasie nadmorskim i na Mazurach, ale również w dolinie Noteci, na Śląsku i w Małopolsce. Oszacowano, że liczba ptaków niełgowych spędza-



jących lato w kraju nie przekracza 6500 osobników. Przymuszczalnie część łabędzi spędza swe młodzieńcze lata poza granicami kraju.

Zagęszczenie łabędzi w Polsce wynosi od 0,1 do 30 par/1000 km<sup>2</sup> powierzchni ogólnej, najwyższe zagęszczenie stwierdzono na pojezierzach i w północno-zachodniej części kraju. Zagęszczenie łabędzi odniesione do powierzchni wód otwartych jest mniej zróżnicowane (0,1–3,7 p/km<sup>2</sup> pow. wody). Najwyższe wartości tak obliczonego zagęszczenia przypadają (z nielicznymi wyjątkami) nie na pojezierza, lecz na obszary, na których przeważają niewielkie i płytkie zbiorniki wodne.

Na większości stanowisk gnieździła się tylko jedna para łabędzi, stanowiska liczące powyżej 10 par stanowiły około 1%\*. W końcu lat siedemdziesiątych nie stwierdzono w Polsce stanowisk liczących powyżej 50 par, jakie istniały jeszcze w końcu lat pięćdziesiątych.

Na początku XX w, na ziemiach należących obecnie do Polski, liczebność łabędzi obniżyła się w wyniku prześladowania ze strony człowieka, proces ten został zahamowany w 1920 r., w wyniku wprowadzenia ustawowej ochrony łabędzia na Pomorzu i w Prusach Wschodnich. Od tego czasu liczebność łabędzi na terenach ostojowych systematycznie wzrastała, osiągając przed II wojną światową stan 615 par lęgowych. W okresie powojennym liczba łabędzi nadal wzrastała, z tym że wzrost ten był bardziej intensywny na terenach leżących na zachód od Wisły. Wzrost liczebności łabędzia odbywał się drogą zwiększenia zagęszczenia na terenach zajętych już przez ten gatunek, jak i drogą ekspansji na tereny nowe. Ekspansja ta zaczęła się w drugim dwudziestolecu XX w, kontynuowana była w trzecim i czwartym, a bardzo intensywnie przebiegała w latach siedemdziesiątych, kiedy to areal łabędzia w Polsce objął swym zasięgiem niemal obszar całego kraju.

W latach siedemdziesiątych bardzo wyraźnie zwiększyła się liczba łabędzi zimujących w Polsce. Łabędzie zimują obecnie na terenie prawie całego kraju. Liczbę łabędzi zimujących w Polsce na przełomie lat siedemdziesiątych i osiemdziesiątych oszacowano na około 6000 osobników.

W końcu lat siedemdziesiątych w Polsce ponad połowa wszystkich stanowisk lęgowych łabędzi przypadała na jeziora, 25% na stawy rybne, a reszta znajdowała się na rozmaitych zbiornikach wodnych, nieraz nie przekraczających 0,5 ha powierzchni lustra wody. Wzrost liczebności łabędzi między końcem lat pięćdziesiątych i siedemdziesiątych w Polsce północno-zachodniej dokonał się głównie w wyniku zajęcia przez ten gatunek rozmaitych niejeziornych siedlisk wodno-błotnych, które pierwotnie były zasiedlone w znacznie niższym stopniu lub nie były zasiedlone wcale.

Do najczęściej opuszczanych przez łabędzie stanowisk należą jeziora i stawy,

---

\* Do najliczniejszych stanowisk w latach 1976–79 należały jeziora: Gardno, Łebsko, Łuknajno, Pogubie i Oświn.

a najczęstszą ze stwierdzonych przyczyn ich opuszczania jest działalność człowieka.

W końcu lat siedemdziesiątych para łabędzi (z sukcesem lęgowym) wychowała średnio 4,3 młodego, co dowodzi, że ogólna średnia liczba wychowywanych młodych utrzymuje się w Polsce od dłuższego czasu na tym samym poziomie, przekraczającym znacznie potrzeby reprodukcji prostej tego gatunku.

Wzrost liczebności łabędzia, jaki dokonał się w Europie w XX w, wyjaśnia hipoteza zakładająca, że głównymi czynnikami naturalnej śmiertelności tego gatunku była drapieżnicza presja człowieka oraz surowe zimy, w czasie których ginęło z braku pokarmu wiele dorosłych osobników. Zlikwidowanie presji drapieżniczej nastąpiło w wyniku wprowadzenia ochrony prawnej łabędzia, początkowo na jego terenach ostojowych, a później we wszystkich państwach, gdzie występuje. Bariera surowych zim została przełamana w wyniku zimowego dokarmiania łabędzi, szczególnie efektywnego na zimowiskach śródlądowych — na wodach niezamarzających w wyniku przemysłowych zrzutów wód podgrzanych. Ochrona gatunkowa i zimowe dokarmianie łabędzi wpłynęły na obniżenie ich płochliwości i na wyraźną synantropizację, co z kolei było powodem wyraźnej ekspansji siedliskowej łabędzia, jaka miała miejsce w ostatnim dziesięcioleciu.

## Instruction for Authors

"Acta Ornithologica" is a scientific series publishing original papers concerned with birds. Papers should preferably be written in English or Polish. They should be concisely but informatively written. If a paper will have to be translated by a translator at the request of the Editors, its author will be obliged to submit a glossary of technical terms and, subsequently, to verify the translated version.

Manuscripts should be submitted in duplicate. They should be double-space typed with wide left margin (3.5cm) on one side of the papers only.

The author should mark in margin (with a pencil) where figures and tables may be inserted. The first page of the manuscript should begin in the middle of the paper.

Papers should be headed with author's first name and surname and the title (below) of the paper.

Paper should in general be divided into the following main sections: Abstract (up to 200 words), Introduction, Material and Methods, Results, Discussion, Conclusions, References, Summary (up to 10% of the text).

The abstract should be an informative digest of significant content and conclusions of the article.

The abstract, summary, tables (together with their titles) figures (maps, drawings and photographs) and explanations to the figures should be prepared on separate sheets. Figures (line drawings) may be submitted in pencil (N.B. diagrams on mm graph paper) or should be made with indian ink on tracing paper. Figures and tables should always be mentioned in the text and should be numbered with arabic numerals (consecutive numbering of tables and a separate one of figure). Tables and figures must be clearly headed and, if possible, self-explanatory. Put as much explanatory matter as possible into the legenda rather than on the figures themselves. Tables larger than the usual typed page should be avoided.

A running headline (not more than 45 typewriter strokes, including spaces) should be suggested.

References should be cited in text by the year of publication giving the surname of the author with the year, e.g. White (1969), (White 1969), more than 2 authors thus: Black et al. (1972). If more than one paper is cited for one year, the letters a, b, etc. follow the date. Titles of papers written in the Latin alphabet must be in original form, while papers written in the Cyrillic alphabet should be transliterated according to the international rules (ISO Recommendation 9). All references cited in the text must be listed in alphabetical order, according to the following pattern:

Folk C., Deklova M. 1971. Die Winterung der Saatkrahe *Corvus frugilegus* L. im Stadtischen Milieu. Zool. Listy 20: 357-363.

Tomiałojć L. 1972. Ptaki Polski - wykaz gatunków i rozmieszczenie. Warszawa, 312 pp.

Uspenski S. M. 1970. Waterfowl of the Soviet arctic and subarctic regions (in Russian with English summary). Finnish Game Res. 30: 1-15.

Abbreviations of periodical titles should be given according to the "World List of Scientific Periodicals", Butterworths, London.

A list of references must not include unpublished papers. References to papers that have been sent to the printers should be followed by "in press" in brackets.

The order in which papers are printed depends on the date of preparation and submission of the work for printing. The Editors reserve the right to alter the order of printing in certain cases where the necessity for preserving the author's right to priority arises.

Proofsheets will be provided to authors once, but the authors will not be allowed to make any alterations in the text as accepted for printing.

The author receives 25 copies free. Additional copies (25, 50 or 75) may be supplied at the author's expense.

Subscription orders should be sent to ORPAN Export, pok. 1611, PKiN, 00-901 Warszawa, Poland. Annual subscription about USA \$ 20. -



## Wskazówki dla autorów

„Acta Ornithologica” są nieperiodycznym wydawnictwem naukowym publikującym oryginalne prace dotyczące ptaków. Wydawane są w zasadzie w językach angielskim i polskim. Jeżeli praca ma być przetłumaczona, autor powinien dostarczyć słowniczek terminów w języku, na jaki praca ma być przetłumaczona. Nie będą publikowane informacje o gatunkach objętych listą ptaków podlegających weryfikacji przez Komisję Faunistyczną, a nadesłanych bez podania numeru weryfikacyjnego.

Prace powinny być nadesłane w dwóch egzemplarzach, na papierze nieprzebitkowym, z podwójnym odstępem między wierszami (do 30 wierszy na stronie), z szerokim marginesem po lewej stronie (3,5 cm), normalną czcionką maszynową (tzn. nie drobną). Pierwsza strona powinna zaczynać się w połowie kartki. W maszynopisie nie należy stosować żadnych wyróżnień oprócz akapitów. Autor jest zobowiązany do zaznaczenia w maszynopisie miejsce umieszczenia tabel i rycin, może także zaznaczyć partie tekstu, które chciałby wyróżnić (petitem, drukiem półgrubym, rozstrzelonym, dużymi literami itd.). Wszystkie adnotacje powinny być robione ołówkiem na lewym marginesie.

W zasadzie praca powinna składać się z następujących części: abstrakt nie dłuższy niż 200 słów, podający zwięzłą i precyzyjną informację o uzyskanych wynikach), wstęp (zawierający cel pracy i wprowadzenie do tematu), metodyka i materiał, wyniki, dyskusja, wnioski lub podsumowanie wyników, piśmiennictwo i streszczenie (nie przekraczające 10% objętości tekstu). Tytuł powinien konkretnie informować o treści pracy i być jak najkrótszy.

Abstrakt (w 3 egzemplarzach, z podanym na końcu adresem autora), streszczenie oraz podpisy do rycin (do wszystkich razem) należy napisać na osobnych kartkach papieru.

Nazwy gatunkowe i wyższych jednostek systematycznych zwierząt i roślin muszą być podawane zgodnie z obowiązującymi kodeksami nomenklatorycznymi, bez podawania autorów nazw. Jeżeli treść pracy nie wymaga innego układu — w odniesieniu do ptaków należy stosować układ systematyczny wg Wetmore (Ch. Vurie. 1959/65. *The Birds of the Palearctic Fauna*, Vol. 1-2, London. W Polsce system ten stosuje L. Tomiałojć w książce „Ptaki Polski”).

Pozycje literatury cytuje się w tekście prac, podając nazwisko autora i rok wydania np. Maciejewski (1969), (Maciejewski 1969), przy więcej niż 2 autorach: Kowalski et al. (1972), (Kowalski et al. 1972). Cytując kilka prac jednego autora wydanych w jednym roku należy oznaczyć je literami a, b, itd., stawianymi za rokiem wydania. Cytując kilku autorów należy ich umieścić w kolejności lat publikacji. Cytuje się wyłącznie prace wydrukowane lub przyjęte do druku, wszystkie inne cytując jako „materiały niepublikowane” i nie umieszczając ich w spisie piśmiennictwa (należy podać w tekście nazwisko ich autora).

Spis piśmiennictwa powinien zawierać tylko pozycje cytowane w pracy, ułożone w porządku alfabetycznym wg nazwisk pierwszych autorów (wzór — patrz wersja angielska Wskazówek). Skróty tytułów czasopism należy podawać wg pracy J. Rożnowskiej-Feliksiańskiej „Wydawnictwa ciągłe w Bibliotece Instytutu Zoologii Polskiej Akademii Nauk” lub wg „World List of Scientific Periodicals, Butterworths, London. Skróty tytułów czasopism polskich podawać wg pracy Borowiec M., Wesolowski T. 1981. *Polska bibliografia ornitologiczna II*. Lata 1961-1970. *Acta orn.* 18: 5-140.

Wszystkie tabele i ryciny (rysunki, wykresy, mapy, fotografie — w skrócie ryc.) muszą być przygotowane osobno (nie w tekście). Tabele i ryciny powinny mieć osobną arabską numerację. Każda tabela powinna być napisana na osobnej stronie, zaopatrzona w numer, tytuł oraz wszelkie niezbędne objaśnienia. Ryciny mogą być wykonane tuszem (na kalce technicznej albo białym kartonie) lub ołówkiem (wówczas wykresy na papierze milimetrym). Wszelkie napisy na rycinach należy wykonywać ołówkiem.

Liczba rycin, zwłaszcza fotografii, należy ograniczyć do niezbędnego minimum. Należy unikać dużych tabel nie mieszczących się na jednej stronie (wymiar strony druku 13,5 × 20 cm). Przygotowując ryciny należy pamiętać, że w czasie kliszowania będą one zmniejszone dwu-, trzykrotnie.

Objaśnienia do tabel i rycin muszą być przejrzyste i w zasadzie umożliwiać ich zrozumienie bez odwoływania się do tekstu. Na samej rycinie należy umieszczać możliwie jak najmniej napisów, starając się umieścić wszelkie objaśnienia do niej w podpisie.

Autor zobowiązany jest do przepisania tekstu lub pokrycia kosztów przepisania po poprawkach redakcyjnych. Obowiązuje go także dokonanie jednej korekty bez prawa wprowadzania zmian w stosunku do tekstu zatwierdzonego do druku. Autor otrzymuje bezpłatnie 25 odbitek. Dodatkowe odbitki (25, 50 lub 75) autor może zamówić na koszt własny przy składaniu maszynopisu.

Pojedyncze numery *Acta Ornithologica* można kupować w księgarniach ORWN PAN w Katowicach, Krakowie, Poznaniu, Warszawie i Wrocławiu. Księgarnie te przyjmują także zamówienia na stałą dostawę *Acta*.