The breeding ecology of the Mute Swan *Cygnus olor* in Poland - preliminary report

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Data were collected in three places in Poland: Gdansk area, the reserve "Przemkow Ponds" and Milicz fish ponds. The Mute Swans from northern Poland (Gdansk area) nested later than those in Silesia which is located in south-western part of country. The difference in the occurrence of the peak of first egg laying was about 20 days though after mild winters it was smaller (aprox. 10 days). The mean clutch size was very similar in all three areas and it varied between 5.8 and 6.2. However, swans from the Gdansk area laid larger eggs than those from Silesia. Mean number of fledged cygnets per succesful pair (which raised at least one cygnet) varied betwen 4.1 and 4.3. The production of young per breeding pair was estimated at 2.8 -3.3. Pairs which started to breed before 20 April had larger clutches, laid bigger eggs, and produced more cygnets than those breeding late (after 20 April).

The Mute Swan, *Cygnus olor* is a quite common breeding bird in Poland but to date little research has been done on its breeding biology. Two papers (Fruzinski 1973, Mandziou 1987) provide some data but sample sizes were small in both cases.

This paper is based on data collected during the 1980s in three places: the Gdansk area (northern Poland); the Reserve "Przemkow ponds" (Legnica region) and the Milicz fish-ponds (Wroclaw region, in Silesia) (Fig. 1). These data are not complete but provide preliminary information.

Study areas

The Gdansk area (54° 25' N 18° 57' E).

There are many lakes, ponds, canals and rivers situated within the 225 sq. km of the city of Gdansk (of over 500,000 inhabitants). The smallest pond used by breeding swans was less than one ha. and the largest lake 102 ha. The food resources varied between breeding sites. Most occupied sites were in close proximity to human habitation. Data were collected in 1983 - 1989.

The Reserve "Przemkow ponds" (51° 31' N 15° 48' E).

This consists of a complex of 60 fish-ponds with a total area of about 900 ha. The ponds are separated by narrow dikes, usually without trees. Strips of emergent vegetation, (mainly the reed, *Phragmites communis*) occur along almost all dams. They can be up to 20 m wide but are usually only 2-5 m wide. The ponds are 1.5-2 meters deep. Data were collected in 1981 - 1984.

The Milicz fish-ponds (15° 21' N 17° 06' E).

Observations were carried out at five complexes of fish-ponds in the eastern part of the Barycz Valley. Two of them are part of the Reserve "Milicz fishponds". Only four ponds (538 ha. altogether) are left in a more or less natural state. In the other ponds belonging to the reserve, some management is allowed, though hunting is forbidden. Other complexes have been modernized and their reed-beds destroyed. There are artificial islands covered with grassy vegetation, bushes and sometimes trees. The total area of all five complexes is around 3,000 ha. Data were collected in 1988 - 1989.

Methods

The nests were located from mid-April (in Silesia) and late April (in the Gdansk area). They were visited several times during the incubation period, usually weekly. The number of eggs and age of embryos (using the water test (Nedzinskas 1972)) were noted. Eggs were measured to an

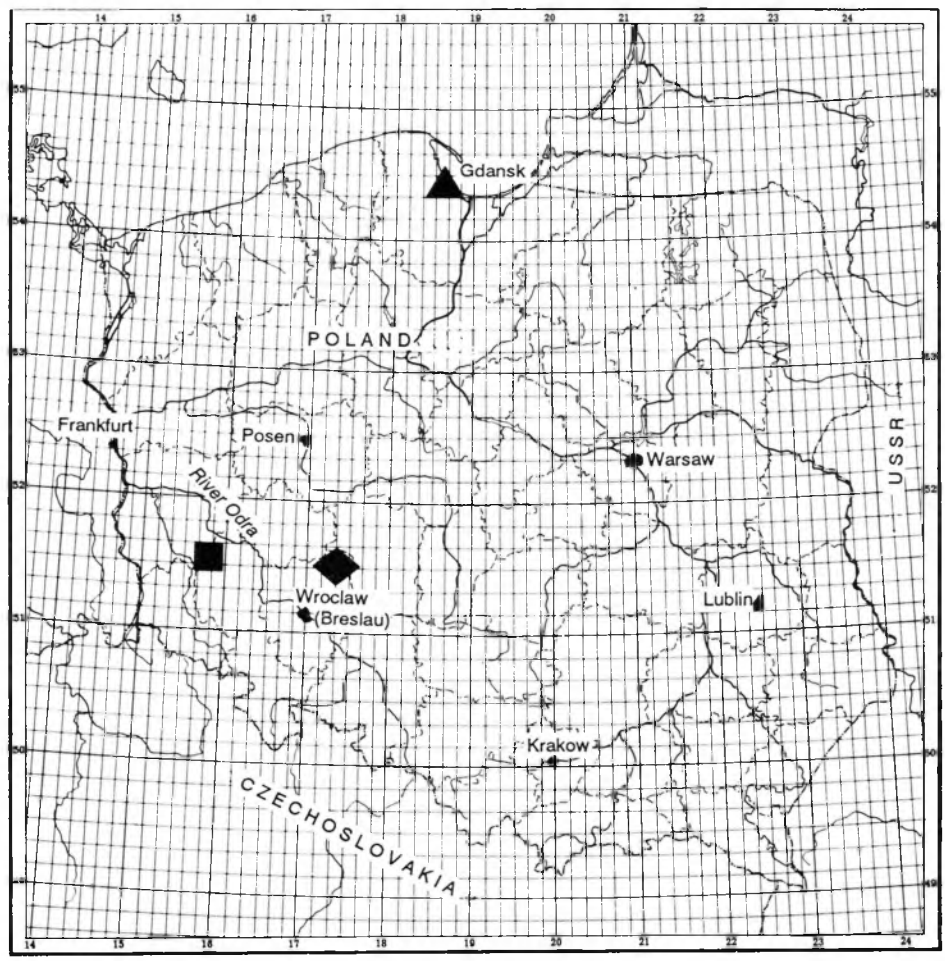

Figure 1. Location of study areas in Poland. 1 - Gdansk area, 2 - "Przemkow ponds" Reserve, 3 - Milicz fishponds.

accuracy of 0.1 mm. The egg volume was calculated from a formula described by Hoyt (1979). In calculating the laying date for nests with complete clutches, it was assumed that swans incubation lasts for 35-36 days (Bauer & Glutz 1968, Reynolds 1972). Intervals in egg laying was based on Nedzinskas (1972). The number of fledged cygnets was determined in late August and early September.

Results

Time of breeding

The first egg in the earliest clutch was laid in late March and in the latest brood in late May (combined data from Reserve Przemkow and Milicz ponds; Fig. 2). The peak laying period was in early April. Mute Swans from the Gdansk area had a more extended breeding season with the first egg in the earliest clutch laid in mid-March and in the last clutch in early June. The peak laying period was about 20 days later than in Silesia (Fig. 2). This difference was smaller (around 10 days) after the mild winters of 1988 and 1989.

Clutch sizes

Annual variation in the mean clutch size occurred in the Gdansk area. After severe winters (1986

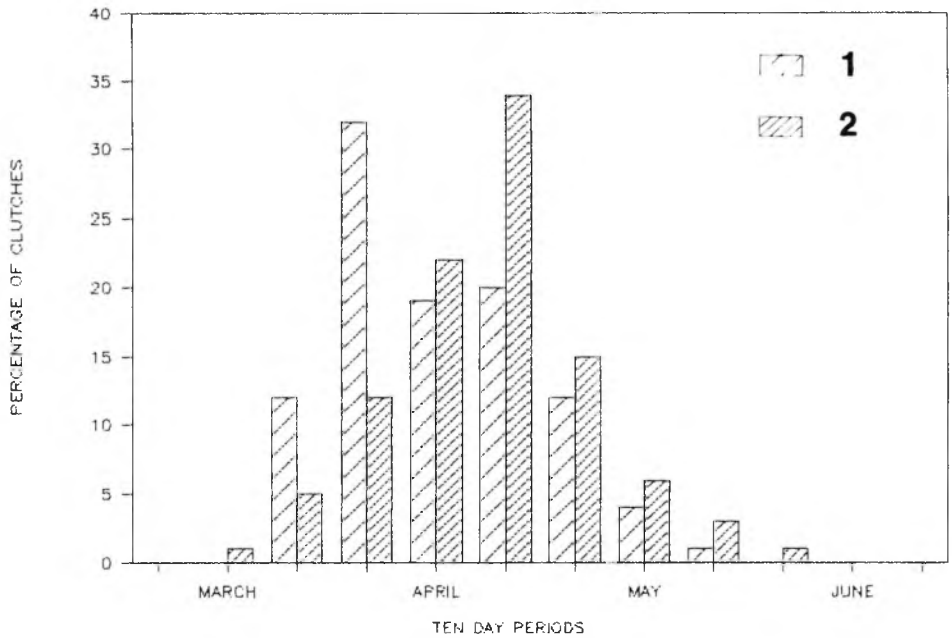

Figure 2. Percentage distribution of laying dates of first egg for Mute Swans. 1 - Silesia (combined data from "Przemkow ponds" reserve and Milicz fish-ponds), 2 - Gdansk area.

Table 1. Clutch sizes of Mute Swans at "Przemkow ponds", Milicz fishponds and Gdansk area. Differences between means are not significant.

Study area	Years	*n*	Clutch size 1	2	3	4	5	6	7	8	9	10	11	Mean	SD
Przemkow	1981-84	55	—	—	2	5	19	9	8	7	4	—	1	6.1	1.69
Milicz	1988-89	71	—	—	4	3	11	23	21	8	1	—	—	6.2	1.30
Gdansk	1983-89	88	1	2	6	9	16	25	11	16	2	—	—	5.8	1.71

and 1987) swans laid significantly fewer eggs ($\bar{x}$ = 5.5, SD = 1.53, N = 25, combined data for both years) than after mild and warm winters (1988 and 1989) ($\bar{x}$ = 6.3, SD = 1.82, N = 38). This difference was significant ($t = 2.00$, $P < 0.05$). In the Barycz Valley mean clutch size in 1988 was higher ($\bar{x}$ = 6.4, SD = 1.49, N = 38) than in 1989 ($\bar{x}$ = 5.9, SD = 1.75, N = 33) but the difference was insignificant. A similar trend (larger clutch size in 1988) was found in the Gdansk area (6.4 and 6.1 respectively) but again the difference was not significant. The mean clutch size using all available data was similar in all three study areas and differences were not significant (Table 1). Within any one year there was no significant correlation between clutch size and laying date in the Milicz ponds and the Gdansk area. A significant negative correlation was only found for the Przemkow reserve in 1981 ($r = -0.70$, $P < 0.001$) (Fig. 3). However, in all three sites clutches from the first part of the breeding season (first egg laid before 20 April) were larger than ones from the second part (first egg laid after 20 April). These differences were highly significant ($P < 0.01$; Table 2).

Egg volume

In spite of the lack of differences in mean clutch

Table 2. Comparison of clutch sizes between early breeders (first egg laid before 20 April) and late breeders (first egg laid after 20 April) at "Przemkow ponds", Milicz fish ponds and Gdansk area.

Study area	Years	Early breeders n	Mean	SD	Late breeders n	Mean	SD	t	p
Przemkow	1981-84	28	6.9	1.87	22	5.0	0.76	4.86	0.001
Milicz	1988-89	50	6.5	1.09	19	5.3	1.38	3.29	0.01
Gdansk	1983-84	26	7.0	1.26	45	5.6	1.52	4.30	0.001

Table 3. Mean egg volumes of early clutches (first egg laid before 20 April) and late clutches (first egg laid after 20 April). Level of significance: NS – not significant, * – $P<0.05$, ** – $P<0.01$, * – $P<0.001$, **** – $P<0.0001$. The differences were tested using Student's t test.**

Study area	Early clutches n	Mean		SD		Late clutches n	Mean		SD	All clutches n	Min.	Max.	Mean		SD
Przemkow	20	319.3	NS	16.25	NS	20	308.9	NS	19.00	40	269.0	356.8	314.1	NS	18.22
Milicz	47	322.8	**** ***	19.40	*	20	309.7	NS *	21.50	67	267.7	357.4	318.2	*** **	20.64
Gdansk	13	345.0		15.20	***	16	321.6		17.61	29	299.5	365.5	332.1		20.15

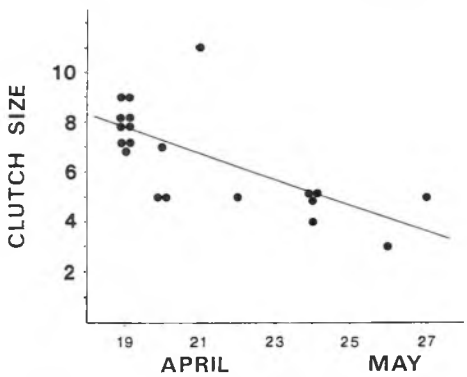

Figure 3. Linear regression of clutch size on laying date, r = 0.70, p < 0.001, N = 20. Dates in five-day period: Jan. 1st - 5th = 1.

size between areas there were differences in mean egg volume. Swans from the Gdansk area laid significantly larger eggs than those from Silesia (Table 3). The average egg volume was not correlated with date of first egg or clutch size. However, females which started to breed in the first part of the season laid significantly larger eggs than those in the second part (Table 3).

Breeding success

Breeding success was highest in the Gdansk area, lower in the Barycz Valley and lowest in the Przemkow reserve but only the difference between Gdansk and Przemkow was significant (Table 4). It is difficult to explain this result as sample sizes were small and data were collected in different years. About 50% of complete failures in the Przemkow reserve and Milicz ponds occurred during laying/incubation. Known causes were desertion, infertility, death of female, predation by wild boar *Sus scrofa* (in the Barycz Valley only) and man.

The mean number of fledged cygnets per successful breeding pair (raising at least one cygnet) and per breeding pair was very similar in all three sites (Table 5). Differences between values from the Milicz ponds and the Gdansk area were insignificant. It was not possible to compare data from these two places with the data from the Przemkow reserve. Adoption of cygnets and separation from their families made it impossible to calculate brood size precisely. The number of fledged cygnets was weakly correlated with the laying date. Comparison of data from the Milicz ponds (for 1989 only) and from Gdansk area (1988-89) showed that early pairs raised more cygnets than those breeding late but differences were significant only for the Gdansk area (Table 6). The number of fledged cygnets was weakly correlated with clutch size ($r < 0.52$) and was not dependant on egg volume. Strong positive correlations between the production of young and the number of hatched cygnets were found ($r = 0.66$ at least, $P < 0.001$).

Discussion

These data show some regional variation in laying dates. Mute Swans in the Gdansk area started to breed later than those in Silesia. This could be a result of differences in geographical position. The Gdansk area is located in northern

Table 4. Comparison of breeding success between "Przemkov ponds" Milicz fish ponds and Gdansk area.

Study area	Years	Successful pairs n	%	Failed pairs n	%	test	
Przemkow	1981-84	42	64.6	23	35.4	NS	= 7.58 $P<0.01$
Milicz	1989	32	72.7	12	27.3	NS	
Gdansk	1988-89	42	87.5	6	12.5		

Table 5. Production of young per successful breeding pair and breeding pair at "Przemkow ponds", Milicz fish ponds and Gdansk area.

Study area	Years	Successful pairs			Breeding pairs		
		n	Mean	SD	*n*	Mean	SD
Przemkow	1981-84	42	4.3	?	65	2.8	?
Milicz	1989	32	4.1	1.83	44	3.0	2.42
Gdansk	1988-89	29	4.1	1.84	36	3.3	2.33

Poland where winters are usually more severe and springs are later than in the south-western part of the country. From a British study of the Mute Swan (Birkhead *et al.* 1983) it has been shown that the mean winter temperature is the most important factor influencing the laying date. Temperature effects the spring growth of vegetation. It has also been found that laying date depends upon the food resources in the territory (Scott & Birkhead 1983).

Mean clutch size did not differ among the areas nor was it substantially different from other values reported elsewhere (eg. Bacon 1980, Spray 1981, Lipsberg 1972, Rutschke 1982). In a few studies of the Mute Swan (Bacon 1980, Perrins & Ogilvie 1981) it has been shown that early clutches are larger than those laid later in the season. Such a correlation was evident from our data in the Przemkow reserve and in the case of the Milicz ponds and the Gdansk area it was evident that clutches from the first part of the breeding season were significantly larger than those from later period.

Mute Swans from the Gdansk area lay larger eggs than those from Silesia but it is not clear why. It has been shown that females of different genotypes produce eggs of significantly different size (Bacon 1981). The proportion of genotypes is not equal in different regions (Bacon 1981, Walter 1981). This could explain the difference in mean egg volume between the Gdansk area and Silesia but the genetic composition of the populations is unknown. Mean egg volume was only weakly correlated with laying date although eggs of early breeders were larger than those laid by later breeders. Scott & Birkhead (1983) have found a similar trend between egg volume and laying date but no such relationship was found by Birkhead *et al.* (1983).

The numbers of fledged cygnets both per successful breeding pair and breeding pair in all three study areas corresponded to values found in other studies (eg. van Dijk *et al.* 1986, Rutschke 1982, Bacon 1980, Herredsvela pers. comm.). According to Birkhead *et al.* (1983) the clutch size is the most significant factor determining the number of cygnets fledged. Our data show that these features were only weakly correlated but it must be stressed that sample sizes here are much smaller.

Table 6. The production of young in relation to laying date at Milicz ponds and Gdansk area. Significant differences: Gdansk area early – late breeders successful pairs – $t = 4.56$, $P < 0.001$, breeding pairs – $t = 4.24$, $P < 0.001$.

Study area	Years	Early breeders						Late breeders					
		SP			BP			SP			BP		
		n	Mean	SD	n	Mean	SD	n	Mean	SD	n	Mean	SD
Milicz	1989	16	4.3	2.00	22	3.5	1.88	11	3.6	1.57	16	2.5	2.16
Gdansk	1988-89	19	5.0	1.49	21	4.5	2.06	11	2.6	1.29	15	1.9	1.62

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