

MIGRATION OF *CYGNUS OLOR* RINGED IN DENMARK IN WINTER AND DURING MOULT

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Introduction

Since 1963 a great number of *Cygnus olor* have been ringed in Denmark. Large-scale ringing has been carried out on the wintering population and on the flightless moulting swans in summer.

Materials

Some 17 000 *C. olor* have been ringed, 9000 when moulting, the rest in winter. They have so far given about 13 500 recoveries. This total includes birds found dead and, the greater part, those resighted while still alive. All resightings of a particular swan at the same locality within a period of 30 days have been counted as one recovery only. Thus the 13 500 do not include these multiple resightings.

Ringing localities with similar recovery patterns have been grouped together. The swans ringed in winter have in this respect been separated into seven groups, each comprising three to seven ringing localities (Fig 1). This allows a more detailed analysis within each group. Most of the swans were ringed in the eastern part of Denmark. In 1970 and 1979 a small number of swans were ringed in Jutland and on Funen, but the number of recoveries of these birds is insignificant.

Moulting localities have been analysed separately.

The recoveries have been recorded on magnetic tape and analysed using a computer. In this paper a grid with 1° latitude by $\frac{1}{2}^{\circ}$ longitude is used, the area of each block decreasing to the north. The differences are, however, small and thought to be of minor importance. For every block the promille of the total number of recoveries in the group investigated was computed.

The material has been split up in several ways:

- 1) The total number of recoveries
- 2) Recoveries of birds found dead
- 3) Recoveries where the bird has been reported as breeding.

For each of these groups the geographical distribution in five 'seasons' of the year has been tabulated:

- a) January to March (winter)



Fig 1. Main ringing localities in winter for *Cygnus olor*. The localities have been grouped as follows: A: Isefjord. B: Roskilde Fjord. C: Køge Bugt. D: Møn. E: Grønsund. F: Guldborgsund. G: Southwest Sjælland.

- b) April to May (spring dispersal of non-breeders)
- c) June to August (moulting and breeding)
- d) September to October (post-moulting)
- e) November to December (autumn migration)

This will, of course, give a great number of distribution maps difficult to interpret. An easy and quick way of getting an impression of the distribution patterns is to have the ellipse of concentration plotted on the grid. The mathematical way of computing the ellipse of concentration is described in the appendix.

Bias in the materials

If distribution maps for birds recovered alive and birds recovered dead are

compared, it is obvious that these two groups are not identically distributed. The resightings are concentrated at certain places in the southeastern part of Denmark, along the coast of the German Democratic Republic and the west coast of Sweden, depending on where enthusiastic amateur 'swan-ring-readers' are resident.

It is therefore concluded that the distribution of birds found dead will be the least biased. But when giving percentages, one must bear in mind that these reflect only the distribution of recoveries and not necessarily the distribution of the population. However, it is thought that differences between populations are reflected in the material.

Multiple resightings of the same bird, as is often possible when using neck-collars, are most valuable, but will not be specially treated in this paper.

Ice conditions and distribution of *C. olor* in the Baltic area

The breeding distribution of *C. olor* in the Baltic area appears to be determined mostly by the length of the ice-free period at the breeding places. This will allow the swans to breed as far north as 62°N in Sweden and along the coast of south-eastern Norway and southwestern Finland. In Estonia, Latvia and Lithuania the population is increasing but an extension of the breeding range farther to the east and southeast will hardly be possible if the birds are still bound to use the Baltic Sea as a wintering area.

The distribution in winter is restricted mostly to areas around or west of the 0°C isotherm, which runs through Denmark. The birds gather in the shallow coastal waters in Denmark and along the German Baltic coast. Along the North Sea coast the swans find hardly any suitable feeding places. Along the Swedish and Polish Baltic coast the few shallow areas suitable to the swans are ice-covered for too long a period to allow the swans to survive under natural conditions. Swans wintering in this area normally benefit from the activity of man (harbours, sewage outlets, feeding, etc).

About every seven to nine years the winter climate in the Baltic Sea is much more severe than average. Cold winters occurred in 1962/63, 1969/70 and 1978/79. In these winters the shallow areas were frozen for about three months, and the swans suffered severe losses (Andersen-Harild 1981). In 'normal' winters the shallower parts of the western part of the Baltic Sea and the Danish waters freeze over only for a few weeks. Most of the birds are then able to feed at holes in the ice. Most ringing in winter has taken place in years with severe ice conditions. In such winters considerably higher numbers (70 000) of birds winter in Denmark than usual (40 000).

Results of ringing moulting swans

Large-scale ringing of moulting swans has taken place at Rødsand, Saltholm, Skålø,

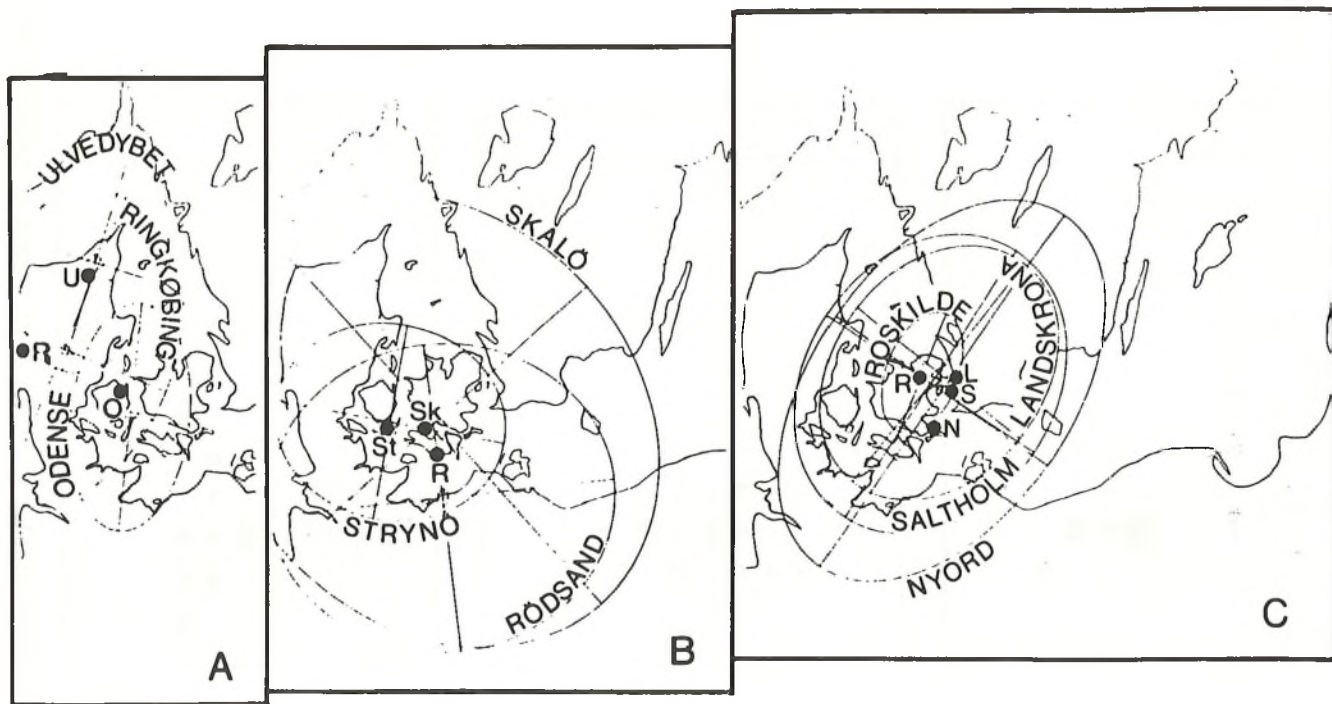


Fig 2. The ellipse of concentration for the recoveries of *Cygnus olor* ringed at various moulting places in Denmark.

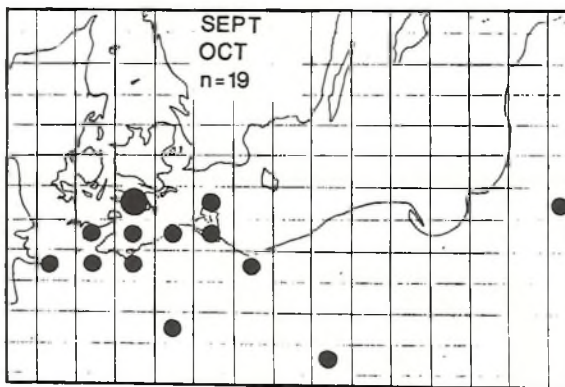
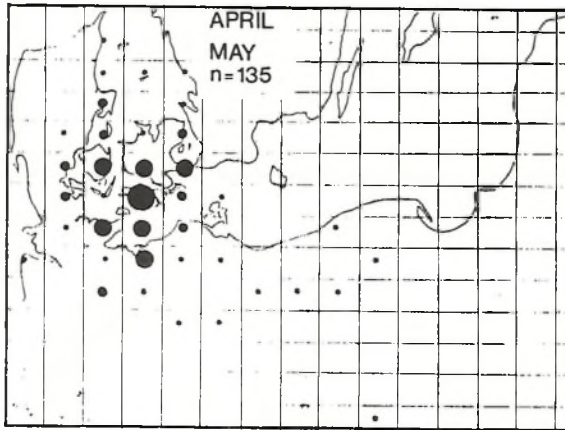
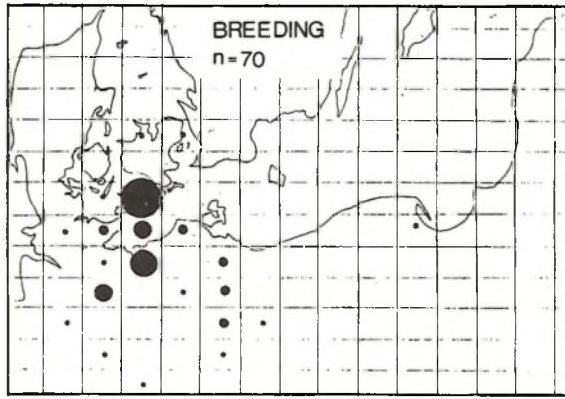
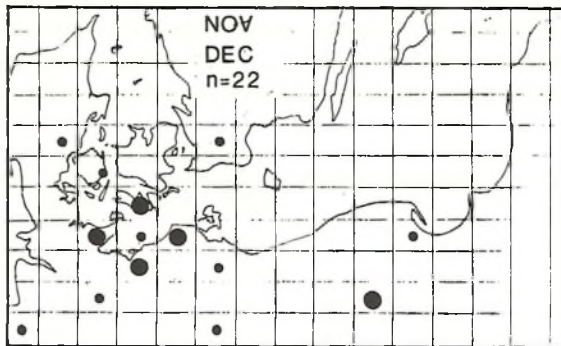
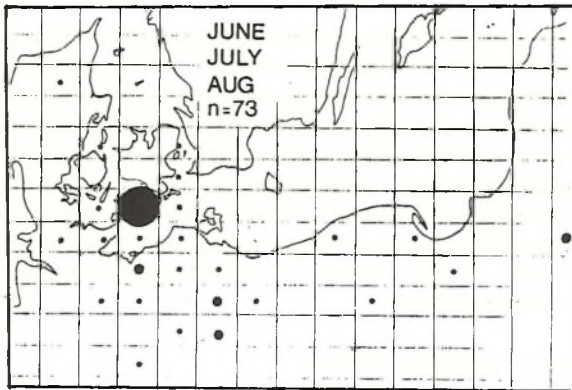
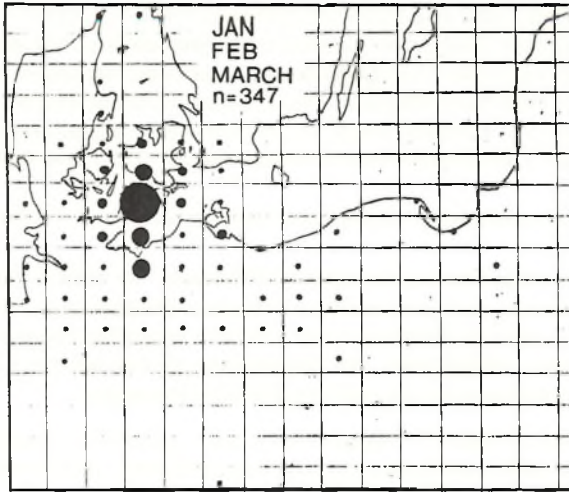


Fig 3. The distribution of *Cygnus olor* ringed at Rødsand and later. The size of the dots refer to the percentage of recoveries within each square. Smallest dot =



recovered dead.

less than 2%, then 2.0 to 4.9%, 5.0 to 14.9%, 15.0 to 24.9% and the biggest dot more than 25%.

Strynø, Ringkøbing Fjord and Roskilde Fjord. At Rødsand, Nyord and Ringkøbing Fjord a small number have been marked with neck-collars, but only in Roskilde Fjord has a majority (more than 50%) of the birds been marked in this way. A few birds (50 to 175) have been ringed at Ulvedybet and Odense Fjord – most of them with neck-collars. For further details on the moulting places and the number of *C. olor* moulting in Danish waters see Andersen-Harild (1971 and 1981).

Fig 2 shows the concentration ellipse for all recoveries from the moulting localities.

Fig 3 shows the results from birds ringed at Rødsand. The birds arrive at the moulting place in June and July and leave in August and September. Birds previously ringed and then caught at Rødsand show that this moulting place is used by birds hatched in an area ranging from the Netherlands in the west to Lithuania in the east and from Copenhagen in the north to Berlin in the south.

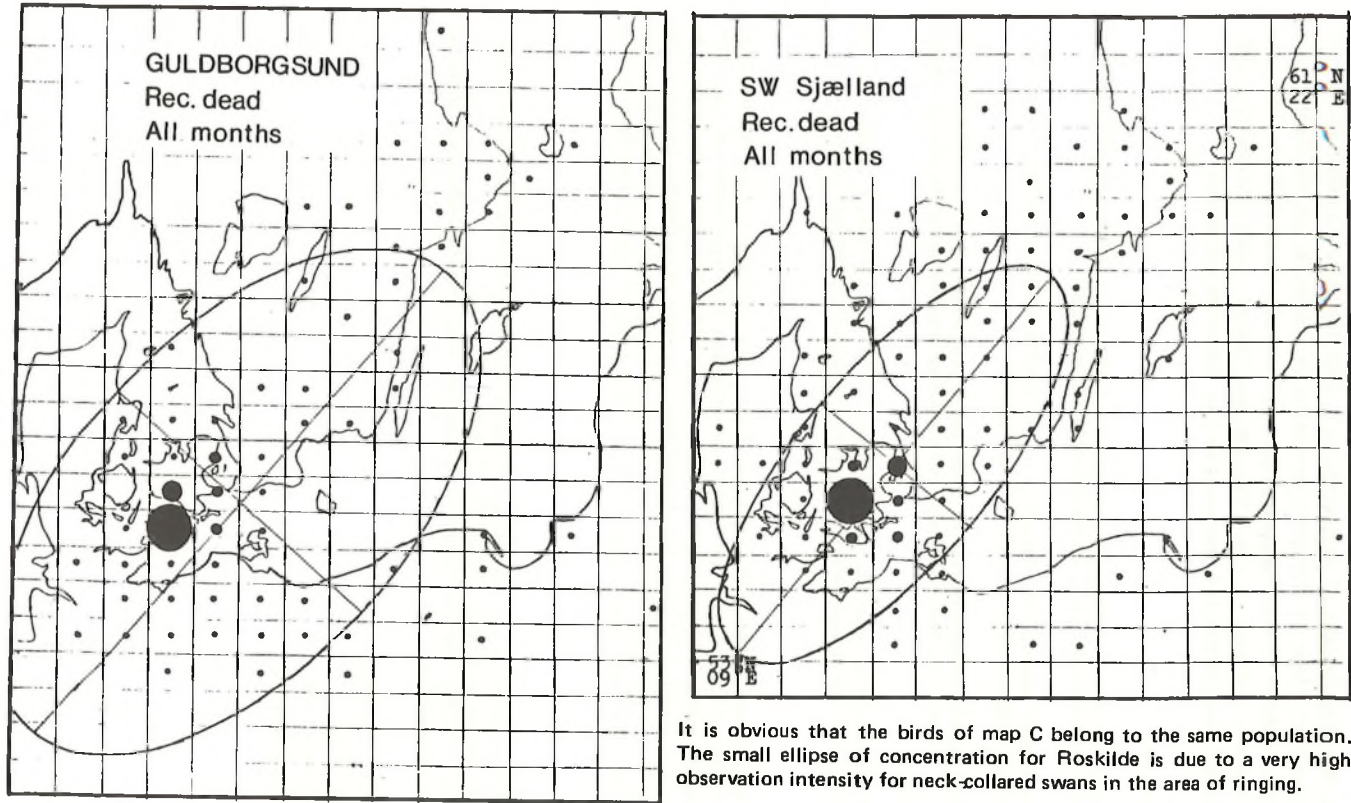
Recoveries of birds ringed at Rødsand and later reported as breeding birds show that most of the birds later breed around Lolland-Falster and in the northern part of the Germany Democratic Republic.

The main winter quarters for the Rødsand population is the western part of the Baltic Sea (Lolland-Falster and Rostock, Wismar). In the hard winter of 1978/79, recoveries showed that a small proportion of the birds left the normal winter range and spent the winter in northeastern Holland (outside the map). In April and May the birds are found in the southern part of Denmark and the northern part of Germany. At moulting time the recoveries are concentrated near Rødsand. Most of the birds still not breeding will return to the moulting-place used the previous year. Swans changing moulting-place are for the greater part young birds ringed in their second calendar year. In the autumn the birds spread out over the whole distribution area of the population.

Results from birds ringed in winter

Table 1. Distribution (in %) of recoveries from the months June to September (inclusive) of *Cygnus olor* ringed in eastern Denmark in winter. The letters refer to Fig 1. Resightings made by ringers and co-operators in the swan research project have been excluded.

Place of ringing	Lithuania	Poland	Country of recovery			Sweden	Denmark
			GDR	FRG	Netherlands		
A Isefjord	—	—	—	—	—	83	17
B Roskilde Fjord	—	—	3	—	—	53	43
C Køge Bugt	4	—	—	—	—	62	33
D Møn	3	5	13	—	—	52	27
E Grønsund	1	5	11	2	—	69	14
F Guldborgsund	—	4	49	3	1	32	11
G Southwest Sjaelland	1	—	2	—	—	65	32



It is obvious that the birds of map C belong to the same population. The small ellipse of concentration for Roskilde is due to a very high observation intensity for neck-collared swans in the area of ringing.

Fig 4. The recoveries and ellipses of concentration for *Cygnus olor* ringed in two areas in Denmark in winter.

The number of recoveries is: Odense 70, Ulvedybet 328, Ringkøbing 175, Skalø 189, Strynø 313, Rødsand 1716, Roskilde 3785, Landskrona 227, Saltholm 753, Nyord 406.

Fig 4 shows the distribution of recoveries of *C. olor* ringed at Guldborgsund and southwest Sjaelland. Most of the birds wintering in Denmark are of Danish and Swedish origin. Only in the southernmost part of Denmark do birds from Germany and Poland form a majority of the wintering population. Table 1 shows the percentage of birds found in the different countries in the breeding season.

Acknowledgements

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Summary

Since 1963, 9000 moulting and 8000 wintering *Cygnus olor* have been ringed in Denmark, giving large numbers of recoveries. The plotting of an ellipse of concentration of recoveries to show recoveries is described and illustrated. Bias in recoveries is introduced by uneven observer effort and distribution of birds found dead shows least bias. Breeding distribution in the Baltic is determined by the length of ice-free period; wintering distribution is mostly around the 0°C isotherm, but severe losses occur in severe winters which occur every seven to nine years.

References

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