

CYGNUS COLUMBIANUS BEWICKII IN THE BORDER LAKES OF THE IJSSELMEER POLDERS

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Introduction

The shallow coast of the IJsselmeer and the border lakes of the IJsselmeer polders (Fig 1) have always been an important area to the western palearctic population of *Cygnus columbianus bewickii*, which winters in northwest Europe. Regular counts of the swans present during the winter have been carried out since the end of the 1950s.

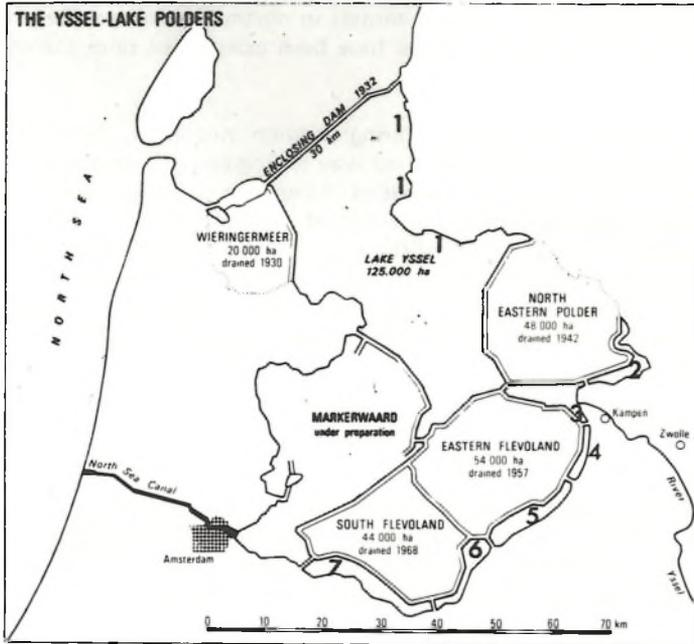
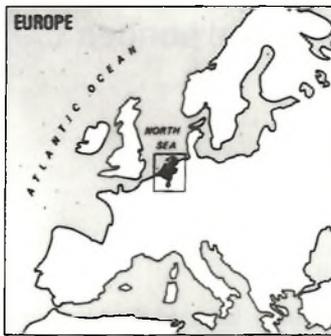
The highest numbers are present during autumn migration, from October to December, when birds that stop on their way to England and Ireland and the birds that will stay for the winter are assembled. As arrivals and departures of transient birds take place before and after the period of peak numbers, the total number of birds that exploit the food supply of the area is greater than indicated by the maximum number present. The maximum numbers (4203 on 18 November 1976; 2790 on 21 October 1977; 2561 on 7 November 1978; 2649 on 25 October 1979) amount to between 20% and 30% of the western palearctic population, assessed at about 13 000.

Food

The food of the swans in the IJsselmeer and its border lakes consists of the nutritious perennial organs of pondweeds, ie tubers of *Potamogeton pectinatus* and stolons of *P. perfoliatus*. When the water level is lowered in the autumn for hydrological reasons, new food supplies come within reach of the swans.

During the late 1960s the water quality in the area deteriorated quickly, hypertrophication causing the pondweeds and other submerged vegetation to vanish from most of their former area. The swans, having lost much of their rich food-stock, became field-feeders on pastures, grass-ley, winter-wheat, waste potatoes and sugar-beet leaves and tops. Some parts of the border lakes where the vegetation of pondweeds remained or where it recovered after being nearly exterminated are still of importance to the swans.

Measures are in operation or planned to improve the water quality of some lakes, including phosphate-retainment at the purification plants and at the sources. These can be expected to end the permanent bloom of blue algae *Oscillatoria agardhii*, enabling the pondweeds to grow again in extensive zones and high biomass.



- 1 FRISIAN COAST
- 2 ZWARTE MEER
- 3 VOSSEMEER
- 4 DRONTERMEER
- 5 VELUWEMEER
- 6 WOLDERWIJD
- 7 GOOIMEER

Fig 1. Europe, the Netherlands and the IJsselmeer border lakes. 1 Frisian coast; 2 Zwartemeer; 3 Vossemeer; 4 Drontermeer; 5 Veluwemeer; 6 Wolderwijk; 7 Gooimeer.

Water quality

Other shallow waters where extensive fields of *P. pectinatus* grew in the past and where large numbers of swans used to stay, ie the Frisian coast (4000 to 7000 at peak), Zwartemeer and Vossemeer (Fig 2), are all in open connection with the outlet of the River IJssel (a tributary of the River Rhine) and will remain hypertrophicated and polluted. The swans will therefore be entirely dependent on the purified lakes, Veluwemeer, Wolderwijd (including Nulder nauw) and the Gooimeer. None of these is protected by law and apart from one or two small islands there are no reserves. All these lakes are used for recreation and no restrictions have been made on behalf of the birds. Indeed, sailing, boating and wind-surfing show increasing tendencies to extend far into the waterfowl winter season. All the lakes are State-owned and their main function is hydrological.

Conditions in individual border lakes

VELUWEMEER (Gelderland and IJsselmeer district)

2880 ha. 52°25'N 5°45'E. Shallow eutrophic freshwater lake (depth: 0.1 to 2.5 m; salinity: 100 mg/l).

Main habitats: Reedbeds on the shallow side, on average 20 m wide; local sandbanks with clumps of *Scirpus maritimus*; zone of submerged waterplants, notably *Potamogeton pectinatus*, extending from 0.3 to 1.0 m below summer level; zone of deeper water with patchy distribution of *P. perfoliatus*.

Avifauna: Birds of reed-land and marsh, waders, dabbling and diving ducks, swans and roosting geese.

The lake is of international importance for the western pale-arctic population of *C. c. bewickii* (Fig 3) and *Anas clypeata* (average 1250).

Before hypertrophication the area was also of international importance to: *Anas acuta* (average 15 000), *Mergus albellus* (average 350), *Bucephala clangula* (average 5000), *Aythya ferina* (average 3000).

The lake has been of outstanding importance to migrating and wintering *C. c. bewickii* since 1935. Submerged waterplants, notably *Potamogeton pectinatus*, became more abundant when the area was separated from the IJsselmeer in 1956. Regular counts have been carried out since 1957. Fig 3 shows that the swans occurred in large numbers in winter as well as in autumn.

The summer water level was raised by 30 to 40 cm in 1959, 1960 and 1961, result-

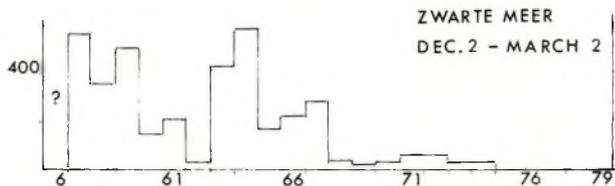
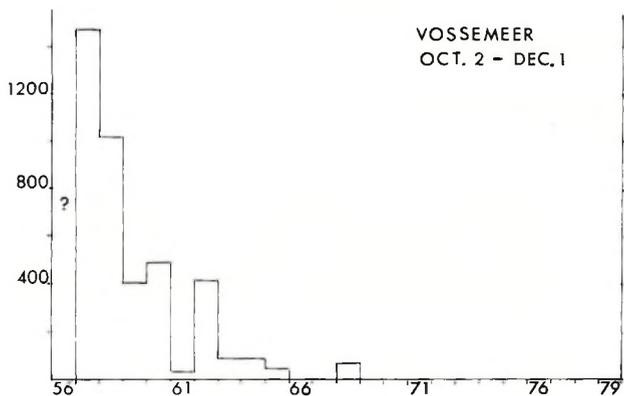
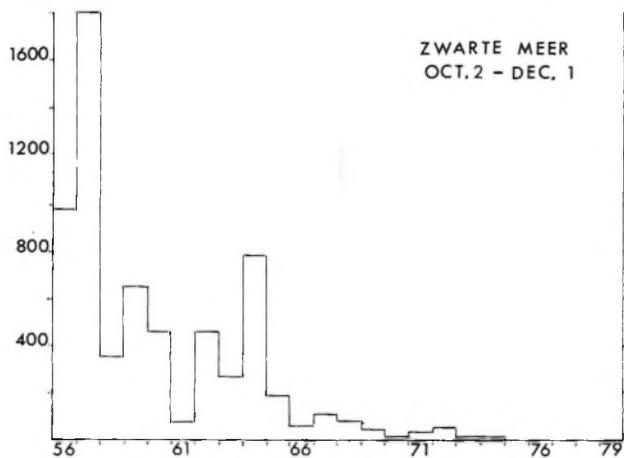


Fig 2. Average numbers of *Cygnus columbianus bewickii* at Zwartemeer and Vossemeer.

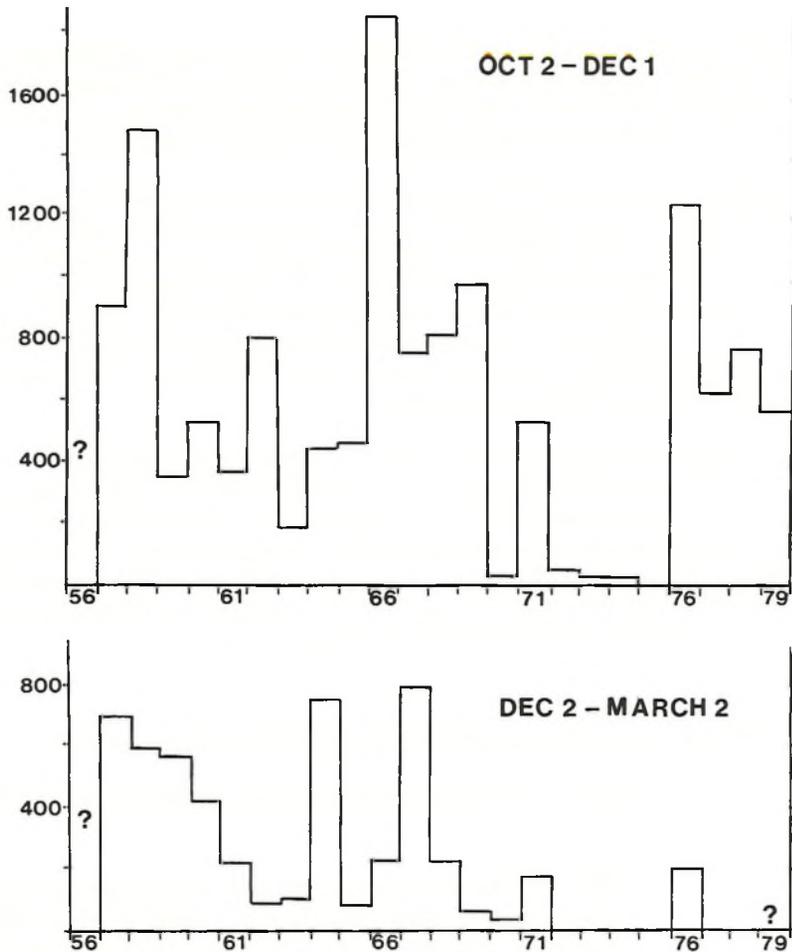


Fig 3. Average numbers of *Cygnus columbianus bewickii* at Veluwemeer.

ing in almost complete replacement of *P. pectinatus* by *P. perfoliatus*; the winter level was high in 1960/1961 and 1961/1962. These factors made the area less suitable for feeding swans from 1959 to 1961. During the following years *P. pectinatus* was again dominant, with the exception of 1965 when the water level in summer was again raised. During the 1960s the water quality gradually deteriorated through eutrophication. In 1969 the submerged vegetation was still in rather good condition. In 1970 the biomass suddenly dropped to less than 30% of that in 1969. In 1971 the submerged vegetation largely recovered but during 1972 to 1975 it was almost absent. Hardly any *C. c. bewickii* visited the lake for feeding during this period, either in autumn or in winter.

Since 1976 the water quality has been improved to some extent and the vegetation of *P. pectinatus* has partly recovered, especially in places where water percolates from the higher sandy soils of the Veluwe which borders the lake on its shallow side. The swans immediately took possession of the lake again that year.

In the autumn of 1978 and 1979 counts were carried out daily, resulting in 32 000 and 20 000 'swan days' respectively. The carrying capacity of the vegetation is still too low to supply a large number of swans with food as in former years, but can be increased to perhaps five times that of 1978 when further measures to repel eutrophication have been effected. Water quality improvement in the Veluwemeer has much greater potentiality than in other parts of the IJsselmeer area because of the relatively high quantities of water percolating into it. Phosphate is precipitated by the iron in this water in aerobic conditions.

Nearly half of the area of the lake (1375 out of 2880 ha) has a depth of 70 cm in the winter. This enables the swans to dig out tubers and stolons of pondweeds over large stretches. During the summer of 1978 the total area of *P. pectinatus* was 351 ha. Dry weight of stems and leaves was 23 718 kg (mid-July). This total biomass corresponds with 40 083 kg of tubers (sampling between 23 September and 8 November). From sampling in March 1979 it appeared that 17 500 kg of the tubers of *P. pectinatus* were consumed by the swans.

WOLDERWIJD, including Nuldernauw (Gelderland and IJsselmeer district)

2400 ha. 52°20'N 8°35'E. Shallow eutrophic freshwater lake (depth: 0.1 to 2.5 m; salinity: 100 mg/l).

Main habitats: Small reedbeds on the shallow side, on average 10 m wide; zone of submerged waterplants, notably *Potamogeton pectinatus*, extending from 0.3 to 1.0 m below summer level; zone of deeper water with patchy distribution of *P. perfoliatus*.

Avifauna: Waders, dabbling and diving ducks, swans.

The lake is of international importance for *C. c. bewickii* (Fig 4) and *Anas clypeata* (average 300).

Before hypertrophication the area was of international importance to: *Anas strepera* (average 100), *Anas crecca* (average 3000), *Anas acuta* (average 5000), *Aythya ferina* (average 3000), *Mergus albellus* (average 300), *Mergus merganser* (average 900).

The area has been of outstanding importance to migrating *C. c. bewickii* in autumn

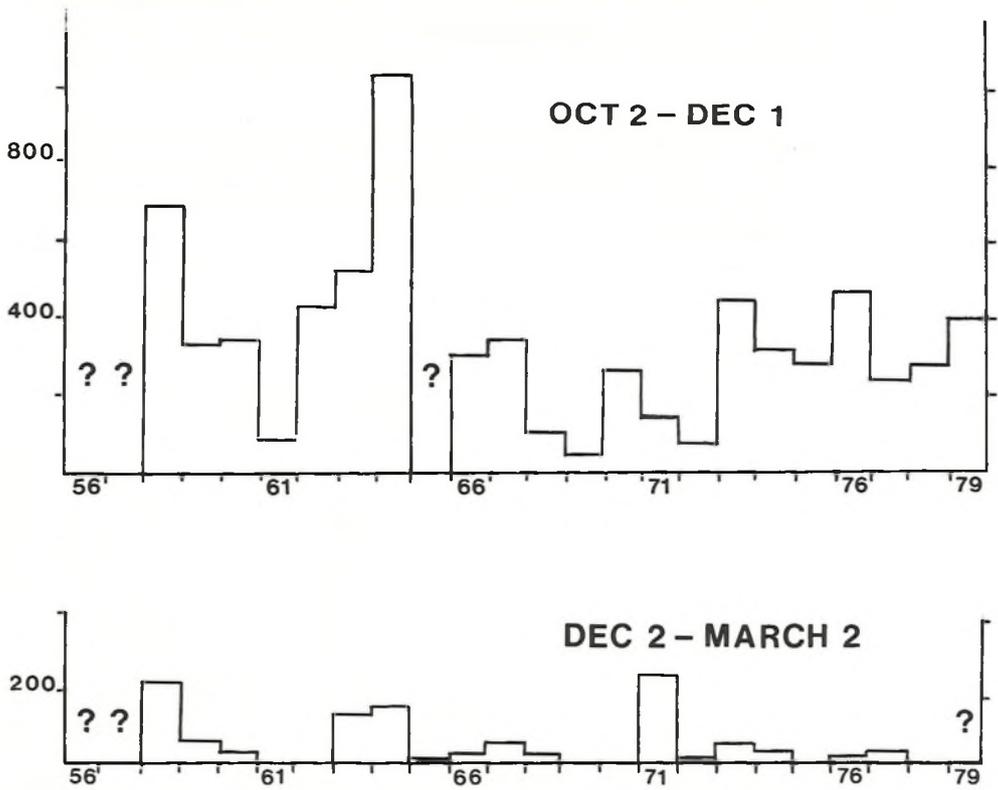


Fig 4. Average numbers of *Cygnus columbianus bewickii* at Wolderwijd.

since 1935. The vegetation of submerged waterplants did not become more abundant when the area was separated in 1967 from the IJsselmeer as it did in the border lakes Veluwemeer, Drontermeer, Vossemeer and Zwartemeer, because the water quality caused severe limitations as soon as dike-building for the new polder of South Flevoland was finished.

Regular counts have been carried out since 1958, but before 1969 most counts did not cover the whole area. Average numbers prior to 1969 are therefore too low in Fig 4. Contrary to most of the other areas where *C. c. bewickii* used to stay in the IJsselmeer area, the Wolderwijd (and Nulderneau) did not usually hold (and still

does not hold) large numbers of swans during winter: the carrying capacity of the vegetation was obviously too low. An explanation could be that before enclosure the water was too broken for extensive and high biomass pondweed vegetation, while after the enclosure the water quality was limiting because the effluent of duck-farms and purification plants was no longer diluted by the water of the IJsselmeer.

When water quality improvement measures have been taken it can be expected that the carrying capacity for *P. pectinatus* will increase. About 1000 ha of shallow water have a potential for carrying a high biomass of vegetation in water where the bottom is accessible to swans.

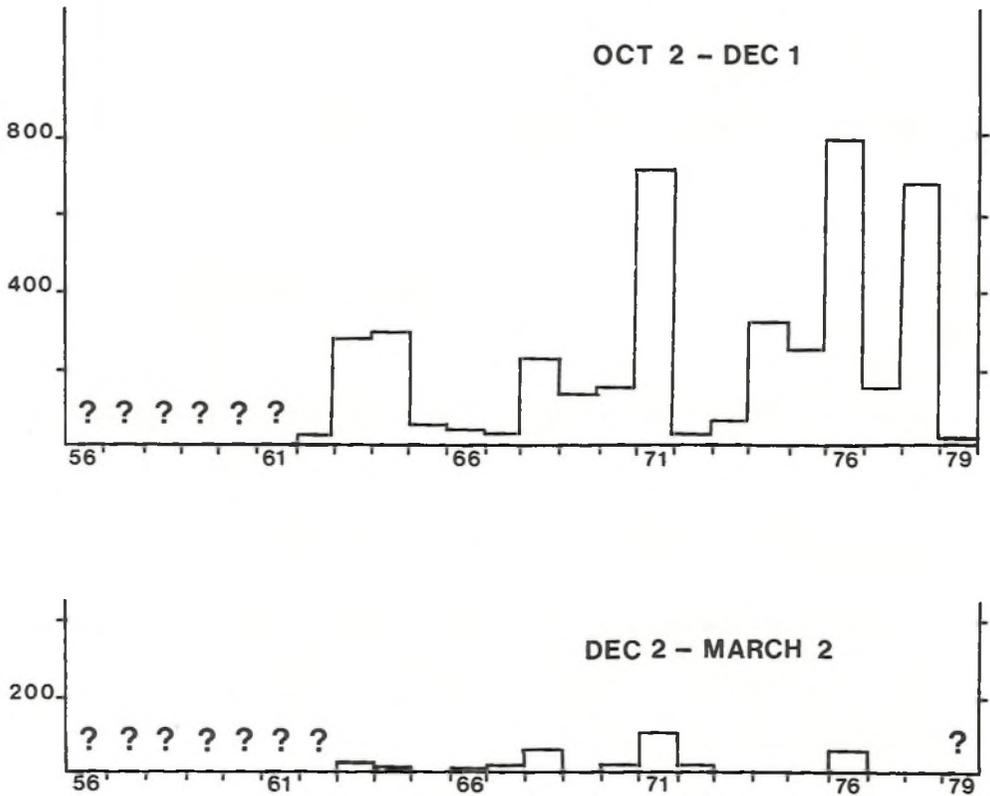


Fig 5. Average numbers of *Cygnus columbianus bewickii* at Gooimeer.

GOOIMEER (Province of Noord-Holland and IJsselmeer district)

2200 ha. 52°20'N 5°10'E. Shallow eutrophic freshwater lake (depth: 0.1 to 2.5 m; salinity: 125 mg/l).

Main habitats: Reedbeds on the shallow side, on average 20 m wide; zone of submerged waterplants, notably *P. pectinatus*, extending from 0.3 to 1.0 m below summer level; zone of deeper water where *P. perfoliatus* has disappeared.

Avifauna: Birds of reed-land and marsh, dabbling and diving ducks, swans, cormorant.

International importance to western palearctic population of *C. c. bewickii* (Fig 5), *Anas clypeata* (average 300) and *Phalacrocorax carbo sinensis* (feeding area for some hundreds of birds from the breeding colony in the Naardermeer).

Before hypertrophication the area was of international importance to: *Aythya fuligula*, *Aythya ferina*, *Bucephala clangula*, *Mergus merganser* and *Mergus albellus*.

The lake has been of outstanding importance to migrating *C. c. bewickii* since 1935. As in the Wolderwijd, the submerged vegetation of the Gooimeer did not become more abundant when the area was enclosed. It does not hold large numbers of swans during winter.

The carrying capacity of the lake for feeding swans may increase when measures to improve the water quality of the River Eem, which flows into the eastern part of the lake, come into full operation. As in the Veluwemeer, water from the higher sandy soils of the Gooi percolates into the lake. About 500 ha of shallow water is suited for high biomass pondweed vegetation in water where the bottom is within reach of feeding swans.

Summary

The paper reviews the numbers of *Cygnus columbianus bewickii* occurring in the border lakes of the IJsselmeer and their food. Because of hypertrophication and pollution on other waters in the Netherlands, the swans are dependent on these lakes. Conditions in individual lakes are reviewed.

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