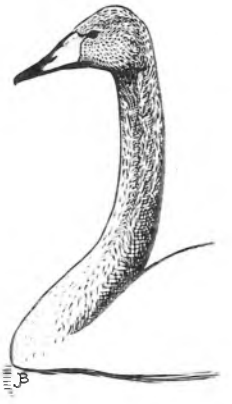
The impact of hunting disturbance on a protected species, the Whooper Swan *Cygnus cygnus* at Lake Constance



MARTIN SCHNEIDER-JACOBY, PETER FRENZEL, HARALD JACOBY, GERHARD KNÖTZSCH and KARL-HEINZ KOLB

A large increase in Whooper Swans was recorded at Lake Constance since the wintering tradition started in the late 1950s. Eutrophication, which caused an increase of the food plant Potamogeton, *might have played an important role in this development. A ban on shooting in 1985 turned a formerly infrequently used bay into the most important site at the lake. Shooting had made the exploitation of the large food supply in this part of the lake impossible.*

Lake Constance is the southernmost regular wintering ground of the Whooper Swan, *Cygnus cygnus* in central Europe. The lake is more than 400 km from the next wintering site in the north of West Germany (Atkinson-Willes 1980). Other lakes or rivers in the surrounding area are visited by only a few swans (e.g. Aubrecht & Böck 1985 for Austria, Hölzinger 1987 for Baden-Württemberg, Suter & Schifferli 1988 for Switzerland, Wüst 1981 for Bavaria).

The isolation of Lake Constance enables monitoring of population fluctuations, habitat preferences and the impact of man to be more easily studied than at less isolated sites. The Whooper Swan is a protected species in all three countries around the Lake. The Mute Swan, *C. olor*, is a quarry species in West Germany, but very seldom shot. Coot, *Fulica atra*, Tufted Duck, *Aythya fuligula*, and Mallard, *Anas platyrhynchos*, are regulary bagged by hunters.

Whooper Swans winter only in some parts of Lake Constance (Fig. 1). The three most important areas are the Ermatinger Becken (West Germany/Switzerland), Eriskircher Ried (West Germany) and Rheindelta (Austria). The number of swans at these sites can vary due to unsuitable water levels, fluctuations in the food supply or disturbance by man (e.g. Schuster *et al.* 1983).

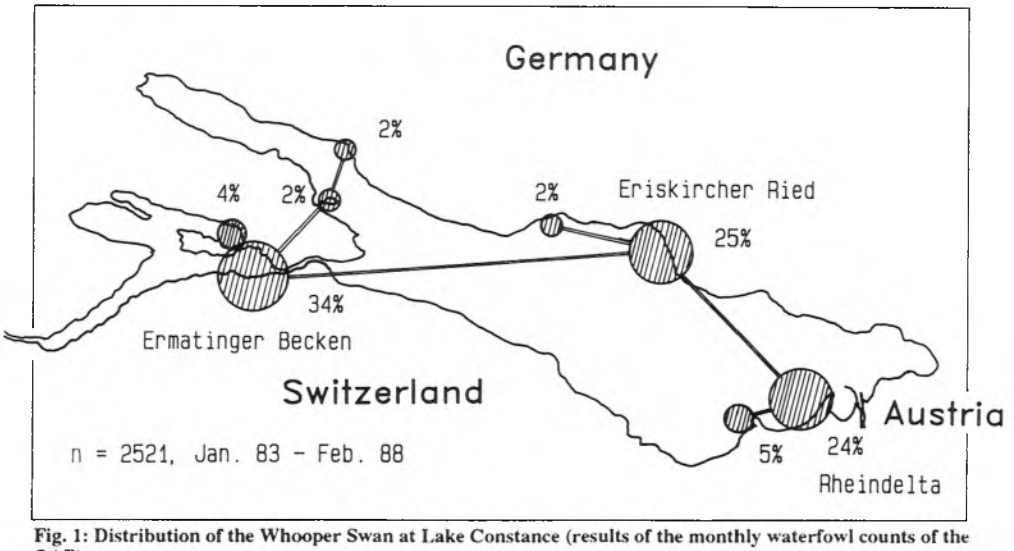


Fig. 1: Distribution of the Whooper Swan at Lake Constance (results of the monthly waterfowl counts of the OAB).

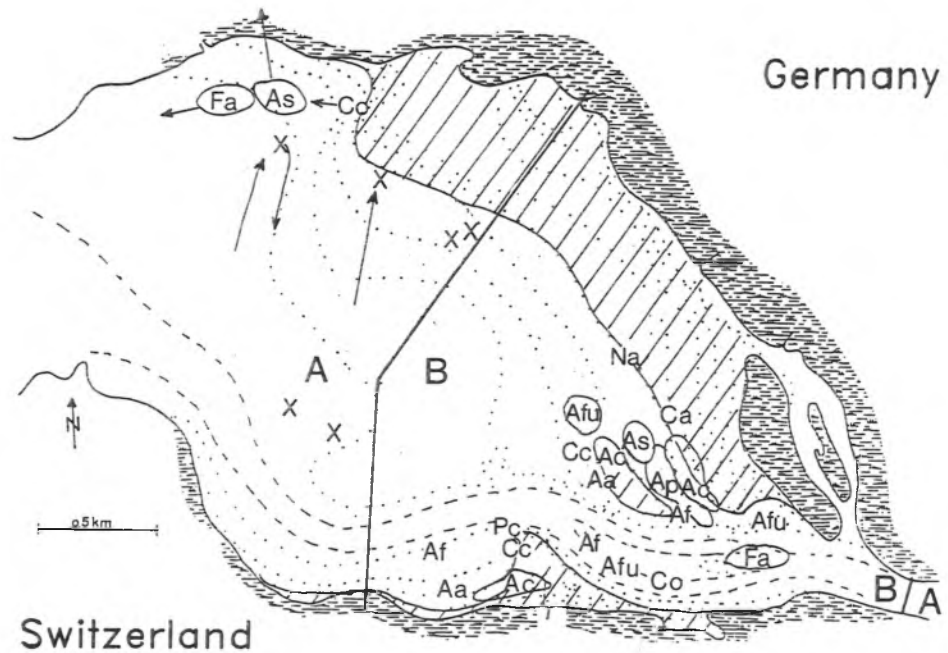


Fig. 2: Splitting of the Ermatinger Becken into a shooting (A) and non-shooting zone (B): Distribution of hunters (X) and water birds on 3 February1984. Pc = *Phalacrocorax carbo*, Co = *Cygnus olor*, Cc = *C. cygnus*, As = *Anas strepera*, Ac = *A. crecca*, Ap = *A. platyrhynchos*, Aa = *A. acuta*, Af = *Aythya ferina*, Afu = *A. fuligula*, Fa = *Fulica atra*, Ca = *Calidris alpina*, Na = *Numenius arquata*. Hatching = sand and mud banks, the contour lines in the shallow water zone are dotted (Schneider 1986).

Interchanges between these sites are observed.

The total surface area of Lake Constance is 538 km². Due to its maximum depth of 252 m only small parts of the lake normally freeze in winter. Sites preferred by Whooper Swans are characterized as follows:

— shallow water and mud banks for feeding and roosting,
— outflows of rivers, preventing the littoral zone from freezing even in severe winters,
— reed belts (*Phragmites austrialis*; mainly in nature reserves) protecting the swans on the water against disturbance by human activities on the shore.

Eutrophication increased until the end of the 1970s and caused drastic changes in the submerged vegetation of Lake Constance (Lang 1981). Formerly widespread *Chara* species have been replaced by associations of *Potamogeton pectinatus* which increased from 740 ha in 1967 to 2440 ha in 1978 (Lang 1981). The Whooper Swan feeds on the tubers of *Potamogeton pectinatus*, which are dug out of the sediment down to a depth of 24 cm. No other waterbird is able to exploit food resources so deep at the bottom of the shallow water zone at Lake Constance. Diving ducks and Coots benefit from the Whooper Swans by feeding around them ("commensalism", Jacoby *et al.* 1970).

In the Ermatinger Becken a gamelaw from the Middle Ages allowed the inhabitants of Constance and the villages bordering the lake to shoot ducks and Coots (e.g. Jacoby 1974). Because of the international importance of this 5 km² large bay for wildfowl (e.g. Ramsar Site, European Diploma: Jacoby & Dienst 1988), the site has been under steady observation. A ban on hunting introduced in 1985 enabled ornithologists to compare the usage of the bay by waterfowl under different conditions.

Until the winter of 1981/82 and in the winter of 1984/85 shooting took place from 26 November to 14 February every Tuesday, Thursday and Saturday. In the winter of 1982/83 and 1983/84 a non-shooting zone was established, which covered 50% of the area. The shooting rhythm remained unchanged (Fig. 2). After 1 October 1985 shooting was banned from the Ermatinger Becken. In Switzerland it was allowed again in 1986, but only from the shore and not in the shallow water zone.

Materials and methods

Despite the fact that West Germany, Switzerland and Austria border Lake Constance, simultaneous mid-monthly counts have been organized from September to March by the Ornithological Working Group of Lake Constance (OAB) for the whole lake since 1961 (Schuster *et al.* 1983). The shore line is split into 26 sections, from which the birds are counted by 40 observers.

In addition, almost daily counts have been made in the "Ermatinger Becken" since 1980 by the German Society for the Protection of Birds (DBV), which is in charge of the nature reserve Wollmatinger Ried.

All censuses are made with telescopes; the swan are counted individually.

The work is supported financially by the DBV, Landesverband Baden-Württemberg and the Sandoz "Rheinfonds".

Results

Since 1955 Lake Constance has been regularly visited by Whooper Swans (Jacoby *et al.* 1970). The population has increased exponentially (Fig. 3). Since the beginning of the 1970s the Ermatinger Becken was regularly visited by Whooper Swans due to the increasing number of wintering swans at the lake (Fig. 4). The shooting however prevented the birds from staying in the bay until 1985 and only very few birds visited the feeding ground on the non-shooting days (Fig. 5). Although shooting was prohibited for four days of the week, the Whooper Swans were not able to adapt to this

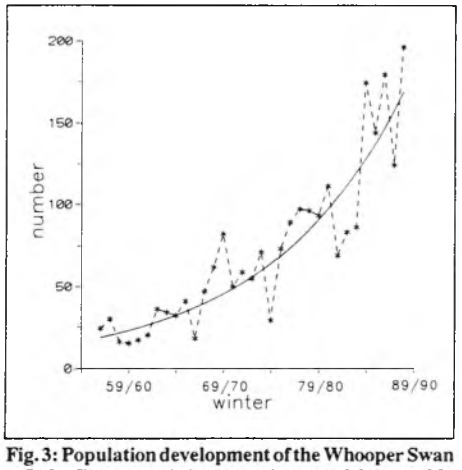


Fig. 3: Population development of the Whooper Swan at Lake Constance (winter maximums of the monthly waterfowl counts of the OAB; $y = 17{,}3 + e^{0{,}0689 \cdot x}$).

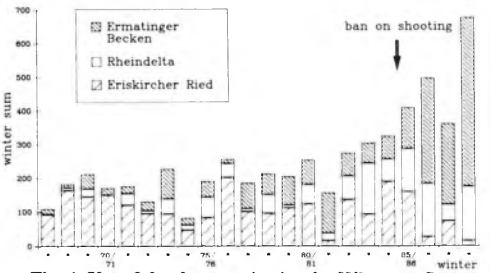


Fig. 4: Use of the three main sites by Whooper Swans at Lake Constance (winter sum = sum of the monthly waterfowl counts by the OAB for each winter). The arrow marks the ban on shooting in the Ermatinger Becken in 1985.

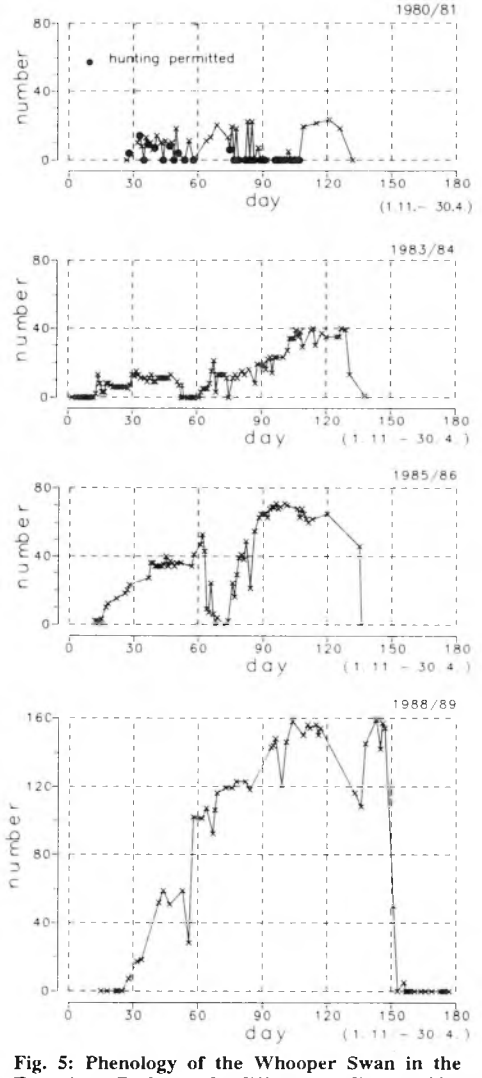


Fig. 5: Phenology of the Whooper Swan in the Ermatinger Becken under different conditions: 1980/81 shooting allowed, 1983/84 shooting banned from half of the bay, 1985/86 and 1988/89 shooting banned.

rhythm (Fig. 5 a). Only after 14 February (day 107 in Fig. 5a,b), the end of the shooting season, swans from other sites came to the Ermatinger Becken and the number stabilized.

In the winter of 1981/82 (Fig. 4) the water level of the lake was so high that the smaller shallow water zone in the Eriskircher Ried and Rheindelta was unsuitable for the wintering Whooper Swans. The overall population in this winter was very low at the lake, although some swans were able to stay in a small permanently protected zone in the Ermatinger Becken, near the nature reserve Wollmatinger Ried, which is normally dry in winter.

To assess the impact of shooting, hunters were banned from half the bay in 1983. Under these circumstances a few swans - e.g. a family with three young - stayed on after the other had left (Fig. 5). Splitting the area up, however, was insufficient to protect the wildfowl, because an important part of the bay, even though it was in the protected zone, was still disturbed. The shooting affected a 500 m broad strip within the protected zone (Fig. 2; Schneider 1986).

After the ban of hunting in 1985 the population at the Ermatinger Becken grew quicker and the birds stayed continually in the bay (Frenzel & Schneider 1987). In 1989 a new maximum was reached with 160 swans (Fig. 5). The Ermatinger Becken is now the most important site for the increasing number of Whooper Swans at the Lake (Figs. 1 and 4). The very low number of Whooper Swans in the Ermatinger Becken after 1 January 1986 was caused by boating and pedestrians during good weather. The birds had to move to other parts of the lake (Fig. 5 c, Frenzel & Schneider 1987). They are still very shy because of the shooting along the Swiss side of the bay.

The food resources in the bay are high with a mean biomass of 5.4 - 17.4 g dry weight/m² of *Potamogeton* tubers in the winters 1979/80, 1980/81, 1983/84 and 1984/85 (Zuur *et al.* 1983, Krämer in litt., Frenzel unpubl.). In the best winter 1984/85 a maximum of 1460 tubers/m² with a dry weight of about 47 g was found (mean of ten sampling units with 21.25 cm², Frenzel unpubl.). This part of the bay is the preferred feeding site of the Whooper Swans (Schneider 1986). In the winter 1984/85, when hunting pressure was heavy, the number of tubers remained constant from November to February (Frenzel unpubl.).

Discussion

Lake Constance is the only regular wintering site of Whooper Swans in southern central Europe. An important factor for the continued use of Lake Constance is the ability of the swans to move between three main and a few small sites in different parts of the lake, therefore avoiding negative effects e.g. disturbance occurring at one or two of the sites. The dispersal of the subpopulations stabilizes the whole population at the lake (cf. Simberloff 1988).

A management plan by the OAB for Lake Constance proposes the protection of the most important parts of the lake. Up to now, due to the recreational activities and the international law for the lake, this plan is only partly realized. Especially large zones which are protected periodically during winter are still missing (e.g. Jacoby 1988, Schneider 1985). The protected zone in the Ermatinger Becken is still too small to function as a wintering site and dries up very often, or freezes (Frenzel & Schneider 1987).

The increase in numbers of Whooper Swans might be caused by several factors. The total population of the West Paleartic is increasing (Rüger *et al.* 1986) and the birds might be forced to search for new wintering sites. The Whooper Swans at Lake Constance feed on tubers of *Potamogeton pectinatus* which increased drastically, perhaps allowing more swans to winter at the lake. A number of other waterfowl species showed some increase during the last 20 years, but the duck were able to react much quicker to the changes in the lake (Schuster *et al.* 1983).

Shooting in the Ermatinger Becken reduced the potential size of the wintering ground at Lake Constance. Although the Whooper Swan - unlike the Mute Swan - is a protected species (Hölzinger 1987) the disturbance by hunters made a constant use of this site impossible until 1985. This resulted in very low consumption of the food resources, an effect which was also observed at other sites with shooting pressure (e.g. Madsen 1988). The shooting ban had a positive effect on the total number of Whooper Swans on the lake and increased the carrying capacity.

Shooting increases waterfowl flight distances and thus intensifies the conflict with recreational activities (e.g. Conrady 1988). At Lake Constance the season for watersports is now extended throughout the winter and is a serious threat for the wintering waterfowl (Frenzel & Schneider 1987, Schneider 1987). To reduce the flight distances of the Whooper Swans in the Ermatinger Becken, shooting must be banned on the Swiss side of this internationally important site.

Waterfowl, and especially swans, are the only animals that remove large quantities of

plant biomass from our lakes (e.g. Beekman *et al.* 1991, Reichholf 1973, Reichholf & Reichholf-Riehm 1982). Most of our wetlands are affected by eutrophication, and the number of consumers should not be limited by disturbance. Large undisturbed wetlands could also reduce the pressure on arable grounds by field feeding waterfowl.

References

Atkinson-Willes, G. L. 1981. The numerical distribution and the conservation requirements of swans in northwest Europe. In: G.V.T. Matthews & M. Smart (eds.), *Proc. 2nd Int. Swan Symp,* Sapporo, 1980. IWRB, Slimbridge Pp. 40 - 48.

Aubrecht, G. & Böck, F. 1985. Österreichische Gewässer als Winterrastplatz für Wasservögel. *Grüne Reihe des Bundesministeriums für Gesundheit und Umweltschutz*, Band 3, Wien.

Beekman, J. H., Dirksen, S. & Van Eerden, M. R. 1991. Tubers of pondweed *Potamogeton pectinatus* as a food source for Bewick's Swans *Cygnus columbianus bewickii*: exploitation and food choice patterns by flocks and individuals. In: J. Sears & P. J. Bacon (eds.). *Proc. 3rd Int. Swan Symp.* Oxford, 1989. *Wildfowl* (Special Supplement no.1).

Conrady, D. 1989. Die Jagd auf Vögel im Nationalpark Schleswig-Holsteinisches Wattenmeer. *Landesamt für den Nationalpark*, Töning, 44 p.

Frenzel, P. & Schneider, M. 1987. Ökologische Untersuchungen an überwinternden Wasservögeln im Ermatinger Becken (Bodensee): Die Auswirkungen von Jagd, Schiffahrt und Freizeitaktivitäten. *Orn. Jh. Bad.*-Württ. 3: 53 - 79.

Hölzinger, J. 1987. *Die Vögel Baden-Württembergs*, Band 1, Teil 2. Karlsruhe.

Jacoby, H. 1974. Die Jagd auf Wasservögel auf dem Untersee und Rhein bei Konstanz. *Natur und Landschaft* 49: 38 - 40.

Jacoby, H. (1988). Wassersport und Naturschutz - Fallbeispiel Bodensee. 6. Bundeskongress der Naturschutzjugend im DBV "Freizeit und Umwelt", Tagungsband 1988: 109 - 121.

Jacoby, H., Knötzsch, G. & Schuster, S. 1970. Die Vögel des Bodenseegebietes. *Orn. Beob.* 67, Beiheft.

Jacoby, H. & Dienst, M. 1987/88. Das Naturschutzgebiet "Wollmatinger-Untersee-Gnadensee": Bedeutung, Schutz und Betreuung. *Naturschutzforum* 1/2: 205 - 306.

Lang, G. 1981. Die submersen Makrophyten des Bodensees - 1978 im Vergleich mit 1967. *Int. Gewässerschutzkommision für den Bodensee*, Ber. 26.

Madsen, J. 1988. Autumn feeding ecology of herbivorous wildfowl in the Danish Wadden Sea, and the impact of food supplies and shooting on movements. *Dan. Rev. Game Biol.* 13 (4): 1 - 35.

Reichholf, J. 1973. Die Bestandsentwicklung des Höckerschwans *Cygnus olor* und seine Einordnung in das Ökosystem der Instauseen. *Anz. orn. Ges. Bayern* 12: 15 - 46.

Reichholf, J. & Reichholf-Riehm, H. 1982. Die Stauseen am Unteren Inn - Ergebnisse einer Ökosystemstudie. *ANL Ber.* 6: 47 - 89.

Rüger, A., Prentice, C. & Owen, M. 1986. Results of the IWRB international waterfowl census 1967 - 1983. *IWRB Special Publ.* 6, Slimbridge.

Simberloff, D. 1988. The contribution of population and community biology to conservation science. *Ann. Rev. Eco. Syst.* 19: 473 - 511.

Schneider, M. 1985. Wassersport und Umwelt. *DBV Beiträge zum Naturschutz* Nr. 8: 85 - 95.

Schneider, M. 1986. Auswirkungen eines Jagdschongebietes auf die Wasservögel im Ermatinger Becken (Bodensee). *Orn. Jh. Bad.-Württ.* 2: 1 - 46.

Schneider, M. 1987. Wassersportler stören Wasservögel auch im Winter. *Vogelwelt* 108: 201-209.

Schuster, S., Blum, V., Jacoby, H., Knötzsch, G., Leuzinger, H., Schneider, M., Seitz, E. & Willi, P. 1983. *Die Vögel des Bodenseegebietes.* OAB, Konstanz.

Suter, W. & Schifferli, L. 1988. Überwinternde Wasservögel in der Schweiz und ihren Grenzgebieten: Bestandsentwicklung 1967 - 1987 im internationalen Vergleich. *Orn. Beob.* 85: 261 - 298.

Wüst, W. 1981. *Avifauna Bavariae*, Bd. 1. München.

Zuur, B., Suter, W. & Krämer, A. 1983. Zur Nahrungsökologie auf dem Ermatinger Becken (Bodensee) überwinternder Wasservögel. *Orn. Beob.* 80: 247 - 262.

Martin Schneider-Jacoby, Max-Planck-Institut/Vogelwarte, Am Obstberg, D - 7760 Radolfzell - Möggingen.
Peter Frenzel, SFB 248, Universität Konstanz, Postfach 5560, D - 7750 Konstanz.
Harald Jacoby, DBV & OAB, Beyerlestr. 22, D - 7750 Konstanz.
Gerhard Knötzsch, DBV, Moltkestr. 11, D - 7990 Friedrichshafen.
Karl-Heinz Kolb, Hauffstr. 8, D - 7542 Schönberg.