DOI: 10.17242/MVvK_3.05

FLUCTUATIONS OF WATERBIRD NUMBERS WINTERING ON LAKE ATTERSEE (AUSTRIA): GLOBAL VERSUS LOCAL EFFECTS

G. Aubrecht[1] and H. Winkler[2]

[1] Dr. Gerhard Aubrecht, Biology-centre of the Museum of Upper Austria, J. W. Klein Straße 73, A-4040 Linz-Dornach, Austria
[2] Univ. Prof. Dr. Hans Winkler, Konrad Lorenz-Institute for Comparative Ethology (KLIVV), Savoyenstraße 1a, A-1160 Vienna, Austria

ABSTRACT

At lake Attersee (Upper Austria) waterbird census data (January) from 27 years were set in relation to local limnological and meteorological conditions and to the middle European trend of waterbird populations. Preliminary results obtained by applying multiple regression analysis show a relationship of local abundance related to global trend numbers at least in the case of the Tufted Duck (*Aythya fuligula*) whereas Pochard (*Aythya ferina*) numbers of lake Attersee show a possible link to local temperature situations. More data about feeding habitats are needed for explaining the fluctuations of wintering waterbird numbers on wintering sites.

INTRODUCTION

Migrating waterbirds are integrated elements of wetland ecosystems using a wide geographical area for their yearly life-cycle. In the non-breeding season and especially at wintering sites the distribution and abundance of waterbirds is mostly explained by size of the site, by availability of food resources, by the diversity of habitat structures and by the influence of human disturbances (Aubrecht 1992, Aubrecht and Winkler 1984, Eichelmann 1994, Eisner 1986, Musil and Salek 1994, Parz-Gollner 1989, Pykal and Janda 1994, Rauer 1989, Reichholf 1994, Suter 1991, Tuite *et al.* 1984).

Therefore wintering waterbird communities which use waterbound food resources are not distributed randomly on a site. Due to specific behavioral and morphological adaptations and to energetic demands they are only able to forage and roost in specific microhabitats which also determine the dominance structure of the waterbird community.

When the numbers of wintering waterbirds on a selected site are analysed, high fluctuations in the abundance of different species can be observed over the years (Aubrecht and Böck 1985). Such year to year differences have been widely explained by changes of site-specific parameters like habitat structure, extent and availability of food resources, local climatic conditions and disturbances but also by non site-specific parameters like breeding success in sometimes far distant regions and continental climatic conditions (Aubrecht *et al.* 1990, Ridgill and Fox 1990).

In the western palearctic region it proved difficult to get accurate numbers about the yearly breeding success of waterbirds. Therefore the census results of wintering birds (organized by IWRB) are commonly used to estimate overall population numbers and trends (Rose and Scott 1994, Rose and Taylor 1993).

This study focuses on an oligotrophic lake in the prealpine part of northern Austria where limnological parameters have been investigated (Moog 1989) and waterbird censuses have been carried out regularly (Aubrecht 1979, Aubrecht and Moog 1981, 1982). The dominant foraging guild of waterbirds in January is represented by diving ducks and coot. According to published and unpublished results the water quality of the lake is increasingly ultra-oligotrophic as indicated, for instance, by high Secchi-depths. Macrophytes (Aubrecht and Steiner 1979, Schröder 1982) and zebra-mussel (*Dreissena polymorpha*) (Aubrecht and Winkler 1984) grow in wide areas of the epilitoral and are harvested by waterbirds according to their diving depths. The observed stable limnological condition of the lake makes a high yearly variation in the abundance of macrophytes and zebra mussels unlikely, however this is not proved. At the study site no disturbances have been observed influencing the abundance of waterbirds in winter.

We hypothesize that at the study site the food resources within available diving depths are not limited. Limitations might occur in relation to the birds' energy demand when diving for food with limited nutrient contents at very cold conditions might become too costly for the birds' metabolic needs.

Furthermore, if the waterbird abundance is not limited by site-specific factors we suggest that an external factor (non site-specific) like the „global" central European population trend might additionally explain the variable population numbers on the study site.

We therefore put the question: Do waterbird numbers of certain species or the whole population at lake Attersee in January fluctuate annually according to local conditions represented by water quality (Secchi depth) and mean air temperature or according to central European waterbird population trends?

STUDY AREA AND METHODS

Lake Attersee is situated at the northern base of the Alps at 469 m and has an area of 4560 ha. More hydrologic and morphometric data of lake Attersee may be obtained from Moog (1989).

The waterbird community includes 23 species (dominant species are Coot, Tufted Duck, Mallard and Pochard) in January with a mean of 4808 individuals; maximum numbers (1990) were 10368 individuals.

Limnological data refer to Moog (1989) and Jagsch (pers. comm.) and meteorological data have been provided by Mahringer (pers. comm.). Distribution of macrophytes has been investigated by Aubrecht and Steiner (1979) and Schröder (1982). The occurrence of zebra-mussles has been discussed by Aubrecht and Winkler (1984). Waterbird census data from lake Attersee refer to Aubrecht (1978), Aubrecht and Moog (1981, 1982) and unpublished results of the International Waterfowl Census. The international trend data derive from analyses of P. Rose (IWRB). Imputed proportions of all middle European census data (Switzerland, South Germany, Czech Republic, Slovakia and Hungary) for trend analysis vary between 80743 (27,9%) and 329080 (33,1 %) individuals for *Aythya fuligula* and between 52058 (40 %) and 178258 (45,7 %) individuals for *Aythya ferina* (1970-1993). Until november 1994 only data for Tufted Duck (*Aythya fuligula*) and Pochard (*Aythya ferina*) were available.

The analysis was based on data from the years 1968 to 1994 and included Secchi depth (yearly minimum, mean, maximum); waterbird census data from January including ducks (Anatidae), grebes (Podicipedidae), divers (Gaviidae), coot (*Fulica atra*) and moorhen

(*Gallinula chloropus*), total sum of individuals, numbers of Pochard (*Aythya ferina*), Tufted Duck (*Aythya fuligula*), Goldeneye (*Bucephala clangula*), Mute Swan (*Cygnus olor*), Coot (*Fulica atra*); guild of fish foragers, guild of diving benthos foragers, guild of dabbling foragers; central European trend numbers for Tufted Duck and Pochard, mean air temperature measured at Weyregg am Attersee from all months, seasons and yearly mean.

Statistical analysis was carried out using standard multiple regression techniques.

RESULTS

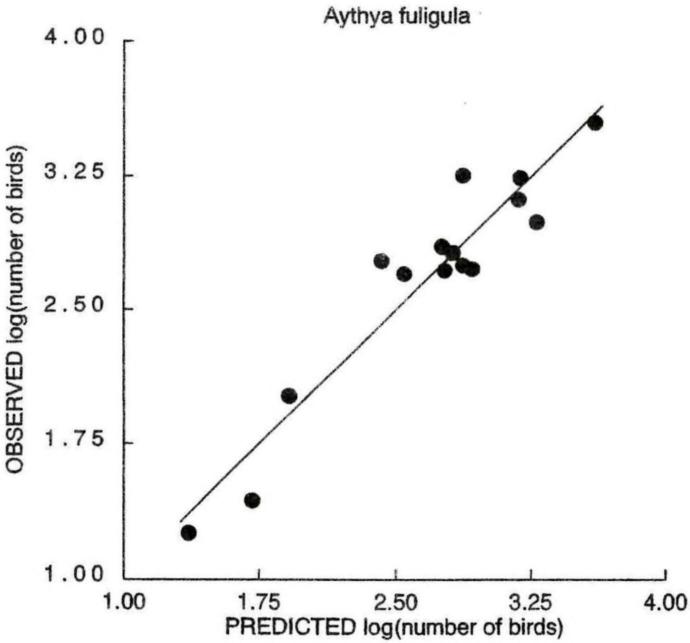

Figure 1: Observed log-numbers of *Aythya fuligula* and predictions derived from multiple regression analysis. Variables included were Central European trend, mean air temperatures in October and September and Secchi-depths. Multiple correlation coefficient is = 0.9 ($p<0.0001$, $F_{(4,10)} = 23.38$).

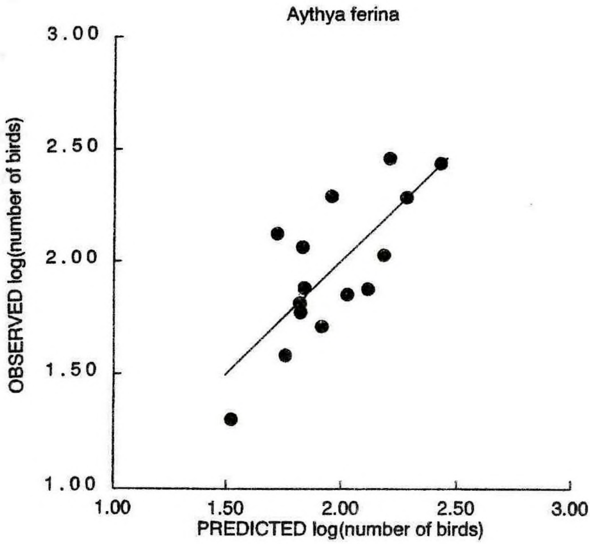

Figure 2: Observed log-numbers of *Aythya ferina* and predictions derived from multiple regression analysis. Variables included were mean air temperatures in August and autumn. Multiple correlation coefficient is 0.62 ($p<0.005$, $F_{(2,12)} = 9.87$).

Multiple Regression Analysis shows that the global (Central Europe) trend alone explains about 64% of the total variance in the count data. When local effects, namely Secchi-depth, and air temperatures in September and October are also included, about 90% of the total variance is explained.

Thus, we conclude that large scale events are mainly responsible for the number of Tufted Ducks (*Aythya fuligula*) observed at lake Attersee.

In Pochards (*Aythya ferina*) only local effects exist. Mean air temperature in August and in the autumn explain together 62% of the total variance.

DISCUSSION

Lake Attersee has been investigated limnologically and ornithologically so that interdisciplinary analysis should be possible. A closer look at available habitat factors shows that we still lack comparable long-term data about litoral habitats which contain the main food resource for wintering waterbirds. So we can only refer to macrophytes according to distribution and density during one year, but not in the term of biomass, nutrient contents or even trends. Concerning the zebra mussel we have only qualitative observations. Therefore we are only able to discuss ecological relationships in testing hypothesis but for modelling ecological relationships we lack important factors.

Even within a close geographical area results of studies about the exploitation of benthic food resources by diving waterbirds vary widely. Reichholf (1994) reports a consumption up to 85 percent of the available benthic fauna when biomass density is high on the Lower Inn reservoirs whereas the studies of Eisner (1989) at the Lower Enns reservoirs show that the food requirements of waterfowl was always under 1 % of the standing crop.

There are studies showing that the influence of disturbance by hunting, fishing or just the presence of man explains a high amount of abundance variability (Eisner 1989, Reichholf 1994, Tuite *et al.* 1984).

The geographical site situation (Aubrecht and Böck 1985), abundance and diversity of food resources and habitat diversity relate to waterbird species numbers and the guild structure and dominance structure of the waterbird community (Aubrecht 1992, Bezzel and Engler 1985, Suter 1991). Shifting of the guild structure can be explained by the change of the above mentioned site-specific factors. But the explanation of the high variability of long-term and year to year changes in the abundance of waterbird populations on specific sites is still a problem (Bezzel and Engler 1985). Large scale weather conditions and the related changes of waterbird numbers across wide geographic areas are very difficult to explain because of the many factors involved (Ridgill and Fox 1990). Therefore the actual „global" trend numbers of waterfowl populations which for discrete geographical areas like central Europe are only available now may represent an important factor for explaining local waterbird abundances when other factors seem not to explain the variability of abundance. Our preliminary results at lake Attersee show a relationship of local abundance related to global trend numbers at least in the case of the Tufted Duck. For the Pochard which uses lake Attersee preferably in the months before January, and the presence of which in January is more variable, such relations could not be found. Results show a possible link to local temperature situations. This indicates that an analysis of the temperatures at other important sites should prove to be interesting. It will be necessary to examine more species and to find a way for regularly monitoring the abundance of benthic organisms in the epilitoral of the lake (Herzig and Pokorny 1994).

By understanding the site-specific and non-site-specific factors regulating waterbird abundances we will be able to use waterbirds as indicators for wetland monitoring and the interpretation of ecological changes in these ecosystems.

ACKNOWLEDGEMENTS

We thank Paul Rose (IWRB, Slimbridge, UK) for unpublished trend analyses about waterfowl counts in central Europe, Dr. Mahringer (Salzburg) for meteorological data and Dr. A. Jagsch (Scharfling) for the latest Secchi-depth data from Attersee.

REFERENCES

Aubrecht, G. (1979). Die Wasservögel des Attersees 1977 und 1978 - Diskussion der Ursachen für die zeitliche und räumliche Verteilung sowie Hinweise auf Naturschutzprobleme. Jb. OÖ. Mus.Ver. 124: 193-238.

Aubrecht, G. (1992). Die Bedeutung verschiedener Traunabschnitte in Oberösterreich für überwinternde Wasservögel - eine langfristige Populationsanalyse. Kat. OÖ. Landesmus. N.F. 54: 53-68.

Aubrecht, G. and F. Böck. (1985). Österreichische Gewässer als Winterrastplätze für Wasservögel. Grüne Reihe des Bundesministeriums für Gesundheit und Umweltschutz 3, Wien. 270 pp.

Aubrecht, G., H. Leuzinger, L. Schifferli and S. Schuster. (1990). Starker Einflug von Samtenten *Melanitta fusca* ins mitteleuropäische Binnenland in den Wintern 1985/86 und 1988/89. Orn. Beob. 87,2: 89-97

Aubrecht, G. and O. Moog (1981). Die Entwicklung des Wasservogelbestandes am Attersee vom Winter 78/79 bis Winter 80/81. Arb. Lab. Weyregg 5: 166-174.

Aubrecht, G. and O. Moog (1982). Der Wasservogelbestand des Winterhalbjahres 1981/1982 am Attersee. Arb. Lab. Weyregg 6: 179-182.

Aubrecht, G. and G.M. Steiner (1979). Wasservögel und Makrophyten am Attersee. Arb. Lab. Weyregg 3: 253-261.

Aubrecht, G. and H. Winkler (1984). Zusammenhänge zwischen überwinternden Wasservögeln und der Beschaffenheit der Uferzone des Attersees. Egretta 27,1: 23-30.

Bezzel, E. (1986). Struktur und Dynamik binnenländischer Rastbestände von Schwimmvögeln in Mitteleuropa. Verh. orn. Ges. Bayern 24, 2-3: 155-207.

Bezzel, E. and U. Engler (1985). Rastbestände von Schwimmvögeln in Südbayern (Enten, Bläßhuhn). Anz. Orn. Ges. Bayern 24,1: 39-58.

Eichelmann, U. (1994). Vogelverbreitung und Hochwasserdynamik. Wiss. Mitt. Niederösterr. Landesmus. 8: 23-32.

Eisner, J. (1986). Auswirkungen der Sportfischerei auf die Artenzusammensetzung und Anzahl der Wasservögel am Stausee Staning. Arb.Ver.Ökol.Umweltforsch., Wien: 32-40.

Eisner, J. (1989). Wasservögel und Zoobenthos am Ennsstausee Staning. Schr.-R. Forschungsinitiativen Verbundkonzern 3: 187 pp.

Herzig, A. and J. Pokorny (1994). Monitoring lakes and ponds. *In*: G. Aubrecht, G. Dick and C. Prentice (eds.), Monitoring of Ecological Change in Wetlands of Middle Europe. Stapfia 31 and IWRB Publ. 30: 13-15.

Moog, O. (1989). The effect of reduced sewage input on the trophic development of an oligotrophic lake (Attersee, Austria). Symp. Biol. Hung. 38: 87-97 (*In*: J. Salanki and S. Herodek (eds.), Conservation and Management of Lakes. Budapest).

Musil, P. and M. Salek (1994). Changes in abundance of waterbirds in south Bohemia during the last decade: a summary review. *In*: G. Aubrecht, G. Dick and C. Prentice (eds.), Monitoring of Ecological Change in Wetlands of Middle Europe. Stapfia 31 and IWRB Publ. 30: 55-60.

Parz-Gollner, R. (1989). Veränderungen des überwinternden Wasservogelbestandes nach Errichtung des Kraftwerkes Altenwörth. Ökosystemstudie Donaustau Altenwörth, Österr. Akademie der Wissenschaften, MaB, 14: 182 pp.

Pykal, J and J. Janda (1994). Relation between waterfowl numbers on South Bohemian fishponds and fishpond management. Sylvia 30: 3-11.

Rauer, G. (1989). Endbericht der Fachgruppe Zoologie. Fachbereich Wasservögel. *In*: Interdisziplinäre Studie Donau.

Reichholf, J. (1994). Die Wasservögel am unteren Inn. Ergebnisse von 25 Jahren Wasservogelzählung: Dynamik der Durchzugs- und Winterbestände, Trends und Ursachen. Mitt. Zool. Ges. Braunau 6: 1-92.

Ridgill, S.C. and A.D. Fox. (1990). Cold Weather Movements of Waterfowl in Western Europe. IWRB Special Publ. 13: 89 pp.

Rose, P.M. and D.A. Scott (comp.) (1994). Waterfowl population estimates. IWRB Publ. 29: 102 pp.

Rose, P.M. and V. Taylor (1993). Western Palearctic and South West Asia Waterfowl Census 1993. IWRB, Slimbridge, UK. 215 pp.

Schröder, H.G. (1982). Biogene benthische Entkalkung als Beitrag zur Genese limnischer Sedimente. Beispiel: Attersee (Salzkammergut, Österreich). Diss. Göttingen, 178 pp.

Suter, W. (1991). Überwinternde Wasservögel auf Schweizer Seen: Welche Gewässereigenschaften bestimmen Arten- und Individuenzahl? Orn. Beob. 88: 111-140.

Tuite, C.H., P.R. Hanson and M. Owen. (1984). Some ecological factors affecting winter wildfowl distribution on inland waters in England and Wales, and the influence of water-based recreation. J. Appl. Ecol. 21: 41-62.