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THE METHODOLOGY USED FOR THE LONG TERM MONITORING OF WATERBIRDS IN A LARGE RIVER. THE DANUBE RIVER BETWEEN GÖNYŰ AND SZOB (river kms 1791-1708) IN HUNGARY, A CASE STUDY

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ABSTRACT

The Danube is crossing Middle Europe in a West-East direction, thus is bisects the migration route of a large proportion of the waterfowl. The section under examination has a middle type character with a large diversity of habitat. It's normally open water (in winter) can result a large concentration of waterfowl.

The study is continuing since 1982 with a regular monthly surveys. This paper present a 10 year analysis for the period of 1982-1992.

A long-term monitoring allows a meaningful analysis of species, habitats, communities, river sections and environmental factors as well the clarification of their interconnections.

The results thus obtained may be used:

- in the Hungarian Waterfowl Management Plan
- in the practice of nature conservation
- in the planning and practice of water management.

INTRODUCTION

Few countries in Europe posess less wetlands than Hungary. Since most countries have lenghty sea coasts or lake districts, therefore their rivers that are smaller than the Danube receive very little attention. Outside the countries of the Danube basin in Central Europe, "river

oriented" research is also known in Poland. Luniak (1971) published an extensive study of the birds of the middle reach of the Vistula River. Weselowsky *et al.* (1984) considered the limnology of the same area along with the distribution and the size of the breeding populations of waders, gulls and terns. Lewartovsky (1989) studied the waterbirds and the impact of the cultivation of the flood plain on the fall migration in the Warta River. Andres *et al.* (1994) published the results of 15 year observations of the waterbirds on a 185 km reach on the River Rhine in Alsac, France. The average number of 105,000 waterbirds represents 13% of the waterbirds censused in France.

Undoubtedly, large rivers are important habitats for waterbirds and they need to be considered in the census and long term monitoring of waterbirds. Thus there is a need to develop a reliable methodology to monitor waterbirds. To this end an example of the methodology used in such a monitoring in the Danube River is presented. It is hoped this methodology can be adapted and used in other similar studies.

STUDY AREA

The river reach investigated comprises the first 83 river kilometers of the middle course of the Danube (Festetics and Leisler, 1971) which is strongly influenced by human culture, moreover from industry, heavy water traffic and river-bed dredging. The Danube flowing from the West to the East, its direction is perpendicular to that of bird migration going on from the North to the South. Tributaries from the North or South help birds to move to the Danube **(Figures 1 and 2)**.

Meteorological data of the towns Komárom and Esztergom indicate Atlantic-continental character of temperature and precipitation. Annual mean temperature: 10.4 °C, total precipitation: 522-549 mm. Due to mild winters, freezing-over of the Danube did not ensue in the period investigated, and icing occurred only in 2 or 3 winters.

Water-level data for the days of observations are presented according to gauge readings from the towns of Komárom and Esztergom.

Water quality was characterized on the basis of samples taken monthly in the Almásneszmély section (1751.8 km). Analyses were performed in the laboratory of the North

Transdanubian Inspectorate of Environmen Protection. The methodology of monitoring of water quality employed in this study is given by Horváth and Bartalis (this volume).

Figure 1: The Danube from the Black Forest to the Black See

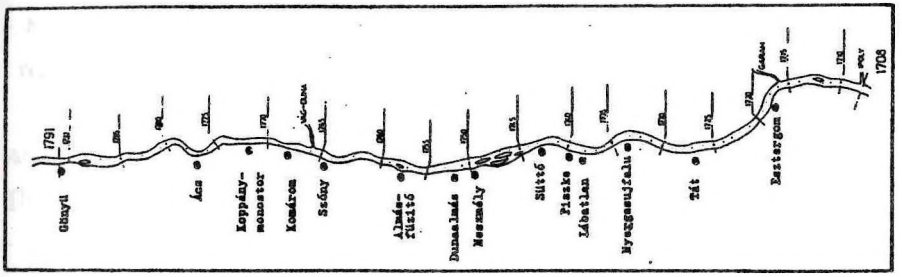

Figure 2: Investigated reach of the Danube between Gönyü and Szob (river km 1791-1708)

MATERIALS AND METHODS

Observations were carried out between October 1982 and April 1992 once per month from the ship "Kitűző VI" of the North Transdanubian Directorate of Water Administration. Observations were not conducted in June, July and August. During the 10 years of study 83 observations were made. The season, August-April was divided into 4 periods:

Early autumn period:	August - September	18 days of observation
Autumn period:	October - November	18 days of observation
Winter period:	December - January - February	27 days of observation
Spring period:	March - April	19 days of observation

Data analyses was performed according to river sections, water birds species and habitats. The data and its analysis are given in detail by Faragó (1996). Thus only the outline of the analysis and the major conclusions are summerized in the followings:

ANALYSIS ACCORDING TO RIVER SECTIONS

General data on water-bird communities:

- summed-up maximum of population numbers
- average maximum of summed-up population matrix
- mean total population numbers for each period
- mean total population numbers for the whole season (August-April)
- species with highest number of individuals in the respective area

Characteristics of water-bird communities in various periods:

- species richness
- total number of birds observed/species
- density of individuals (ind./5 km), and mass density (kg/5 km): D_e and D_t
- individual and mass dominance (%): DO_e and DO_t
- constancy (%): C
- diversity: H
- evenness: J
- community dominance index according to number of individuals and to mass, respectively (Krebs, 1978): KDI_e and KDT_t

The following are presented for the total period (August-April):

- species density rank curve (Moskát, 1988)
- dominance curve (Waliczky, 1992a).

Waterbird communities of each period, and the characteristics of various communities are compared by means of the following methods:

- Jaccard's species similarity index
- Sorensen's similarity index
- Hutcheson's method for comparing diversities.

Methods applied for comparing waterbird communities of various river sections:

- graphic comparison of parameters
- establishing order of rank in the individual periods and in the total season (August-April), respectively. On the basis of orders of rank: calculating rank numbers (so-called cumulative indices)
- defining species similarity by Jaccard's method
- establishing rank order of evenness; calculating rank numbers (cumulative indices)
- cluster analysis
- principal coordinates analysis (= metric multidimensional scaling.)
- Method used for defining connections between community structure parameters: linear regression analysis.

ANALYSIS ACCORDING TO SPECIES

The following factors were analysed and presented in the same way for each species:

- population dynamics (1): on the basis of summed-up results of the 83 kilometers covered by our investigations
- population dynamics (2): maximum, minimum and mean numbers of individuals observed per month
- average flock size in each period and in the total season, respectively
- habitat use (%)
- dispersion: total numbers of birds observed per km; number of observation days
- important Danube section with respect of migration and wintering of the species dealt with

ANALYSIS ACCORDING TO HABITAT

Characteristics applied for describing the main features of habitats:

- total number of individuals
- number of individuals per observation
- individual and mass dominance: DO_e and DO_t
- constancy (for each of the species observed)
- diversity
- evenness

Comparison of waterbird communities present in various habitats:

- graphic method
- method of rank order (cumulative indices)
- comparison of diversities by Hutcheson's method
- cluster analysis
- principal coordinates analysis (=metric multidimensional scaling).

SPECIFIED ANALYSIS OF OBSERVED WATERBIRD SPECIES

In course of the 10-year period of our investigations we observed 58 waterbird species within the Danube reach Gönyü-Szob.

Analysis of common species

Analysis of the 33 species bearing major importance is given according to the following points of view (shown by the example of *Anas platyrhynchos*):

- Population dynamics: referring to the investigated reach of the Danube, for the 10-year period of investigations long-term dynamics (**Figure 3**) and phenology (**Figure 4**) of each species were defined.
- Flock sizes: for each period separately and also for the total season. (**Figure 5**)
- Habitat use: for each period separately and also for the total season. (**Figure 6**)

- Dispersion: analysed on the basis of sightings per river km and on that of observed total numbers of individuals belonging to the respective species (**Figure 7**) as well as by means of the map drawn according to the data mentioned above. (**Figure 8**)
- Definition of status: after summing up the criteria listed above.

Analysis of rare species

For the 25 species appearing more seldom, besides faunistical data (habitat type, data and place of observation) also statements on habitat use and dispersion, furthermore maps showing the appearance of the respective species at the Danube are included in our report.

Evaluation of the avifauna

The zoogeographic evaluation - i.e. by classification according to faunatypes - clearly illustrate the changes of fauna during the course of various periods. Referring to the total season, share of arctic, holarctic and palearctic fauna elements amounted to 74.1 %. Together with old-world and cosmopolitan species their percentage was found to be as high as 93.1 %. The rest of fauna elements appeared only as interesting rarities in the waterbird communities observed.

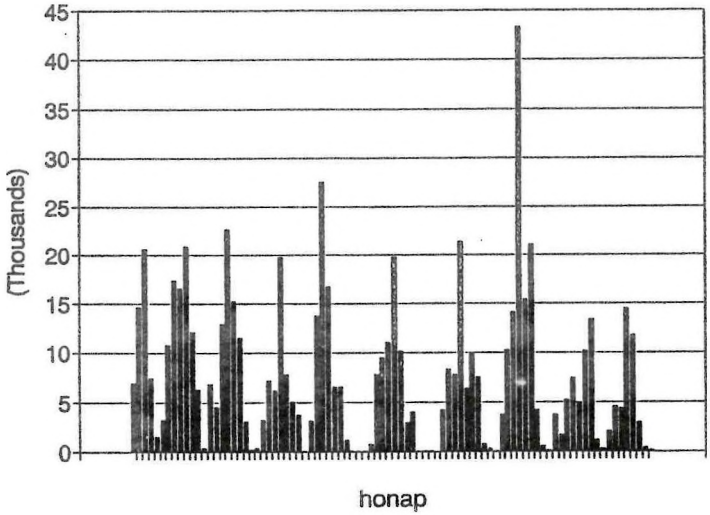

Figure 3: 10-year period of investigations long-term dynamics of *Anas platyrhynchos*

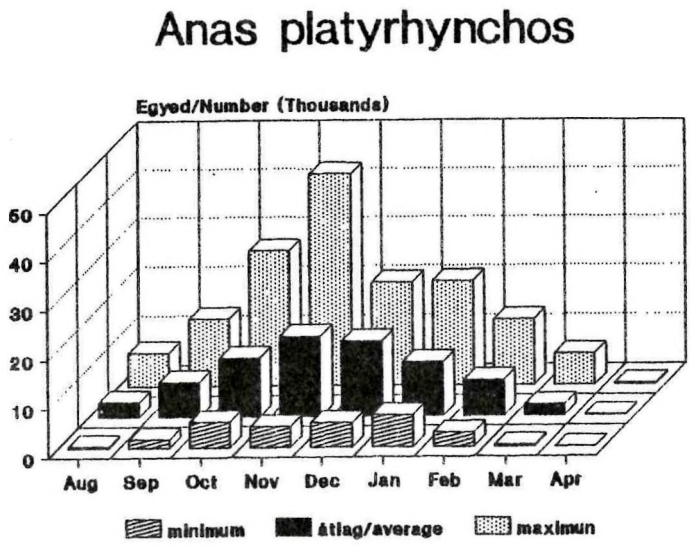

Figure 4: Phenology of *Anas platyrhynchos* on the Danube

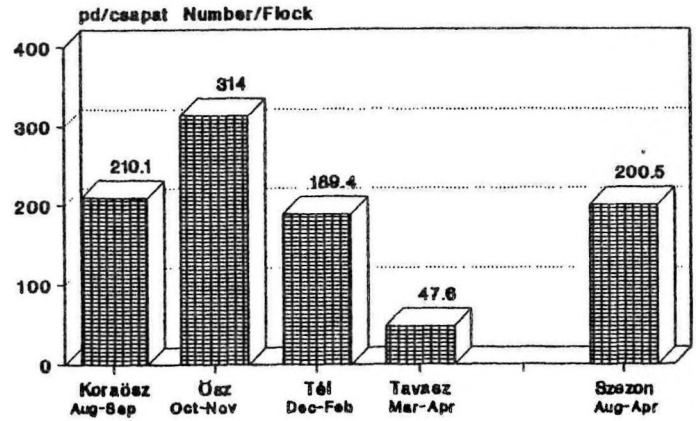

Figure 5: Flock sizes of *Anas platyrhynchos* for each period separately and also for the total season.

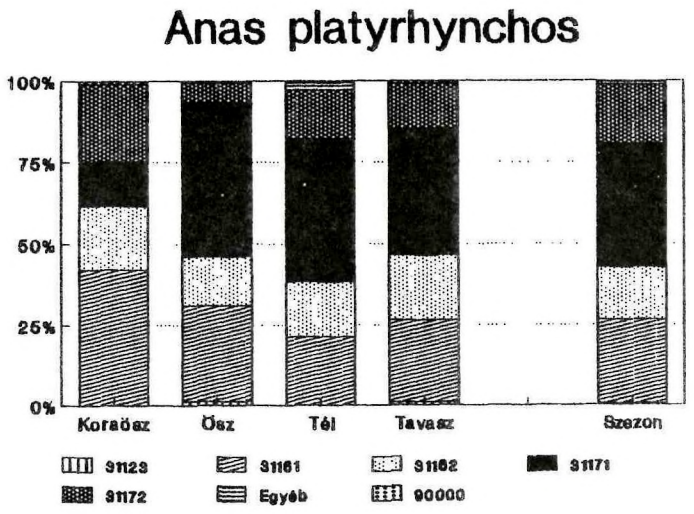

Figure 6: Habitat use of *Anas platyrhynchos* for each period separately and also for the total season.

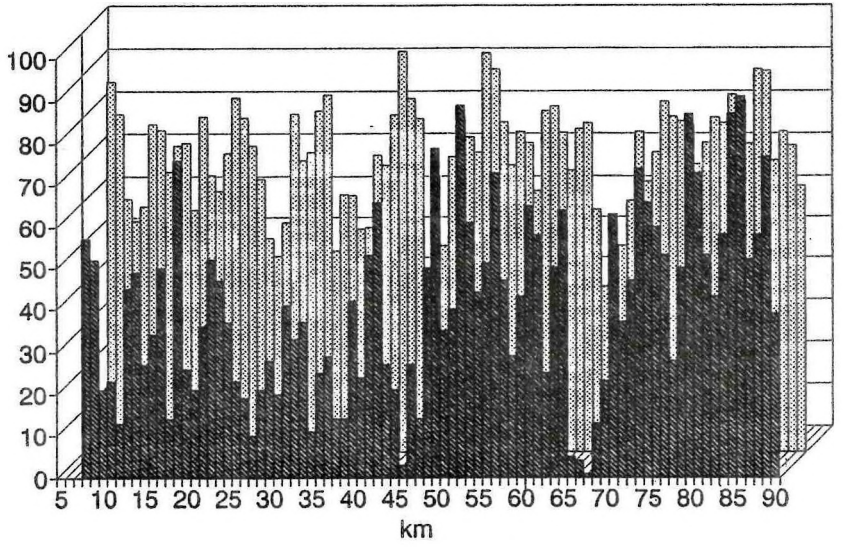

Figure 7: Dispersion of *Anas platyrhynchos* on the Danube analysed on the basis of sightings (number) per river km and on that of observed total numbers (on the figure 20 × ln number) of individuals.

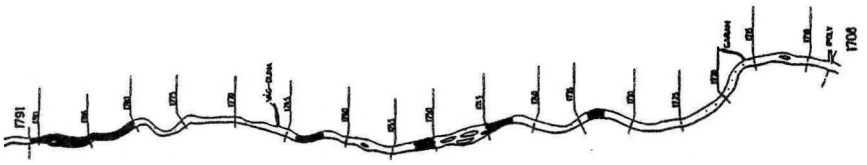

Figure 8: Dispersion of *Anas platyrhynchos* on the Danube.

Role of the examined Danube reach in waterbird migration. Evaluation of its significance

If the examined river sections with length of 5 km each are considered as units, the following can be stated: According to the latest values of the Ramsar criterion 3C (Rose and Scott, 1994), on the basis of great numbers of *Bucephala clangula* and *Mergus merganser* each of the examined sections - with the exception of the section at Komárom and the section Esztergom - must be considered to have international importance.

If the 83-km-long Danube reach that extends from the beginning of the middle course of the river to the clearly separated Danube bend is considered as unit, the results of our investigations prove the following : on the basis of quantitative criteria complied with by 4 species: *Anser fabalis, Anser platyrhynchos, Bucephala clangula* and *Mergus merganser* the Danube reach extending from Gönyü to Szob must be considered as aquatic habitat of international importance.

CONCLUSIONS

The data obtained by long term monitoring can be used for nature conservation and waterfowl managed either at a local or national level.

The monitoring site can be integrated into an existing national monitoring network (in this case the Hungarian Waterfowl Monitoring) as a representative of the region. It represents

a given region, it provides migratory data of certain species for the data base. It will make possible to introduce nature conservation and waterfowl management on a regional basis.

The data base of a monitoring site make if possible to practice nature conservation, including restoration or habitat improvement, i. e. "wise use", that would be done based on correct observations.

The long term monitoring replaces the static view with a dynamic view that will dominate both nature conservation and waterfowl management.

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