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HYDROACOUSTICAL ESTIMATION OF FISH ABUNDANCE AND DISTRIBUTION IN THE SOLINA RESERVOIR

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On the basis of hydroacoustical measurements performed in Solina reservoir from May to September 1999 the mean abundance was estimated at 0.7 fish per 1000 m^3, and thus very low. Clear seasonal changes in fish vertical distributions, related to the hydrological parameters of the water were observed. Majority of fish performed diurnal vertical migrations to the productive surface water at night.

INTRODUCTION

Solina is the largest Polish dam reservoir of high quality water comprising about 15 % of the total water storage. Its principal morphometric characteristics are the following: length - 26.6 km, mean depth - 22 m, maximal depth - 65 m, surface area - 2105 ha and the water volume - 472 mln m^3. Due to a power station activity the fluctuation of the water level attains 10 m, which leads to a complete absence of littoral. The total water volume is exchanged about twice a year.

Concentrations of phosphorus and nitrogen compounts in the reservoir correspond to mesotrophy. Phytoplankton is predominated by diatoms and its concentration is rather low. Also numbers and biomass of zooplankton are generally low, not exceeding 300 individuals per 1 dm^3 and 2.3 mg/dm^3 respectively [Płużański et al. 1989]. Up to recently the acoustical estimations of fish densities in Solina were not performed. The only information about ichtiofauna come from net catches and from angling records. According to them mean concentrations of fish density are very low, of the order of 2-5 kg/ha [Œwierzowski et al. 1999]. The most frequent species are: *Abramis brama* -57.8 % share in net catches, *Carassius carassius* - 16.1%, *Rutilus rutilus* - 9.2%, *Stizostedion lucioperca* - 4.5% and *Perca fluviatilis* -4.8% [Epler and Bieniarz 1993].

The Solina reservoir fulfills multiple and often contradictory functions such as: hydroelectric power generation, flood control, a source of water supply for domestic, industrial and agricultural use, and as a touristic and recreational center. All these activities lead to permanent deterioration of water quality. For the proper management of these valuable water resources an adequate knowledge of the ecosystem is necessary. One of the

most perspective ways to cope with the requirements for sound environmental management of reservoirs is to apply mathematical models. Recently, a prognostic model of the Solina-Myczkowce cascade reservoir ecosystem is beeing developed and the aim of this work was to supply for it the necessary data on fish biomass and distribution.

1. MATERIALS AND METHODS

Hydroacoustical measurements were performed along a zig-zag scheme in May, June, and September 1999. Biosonics dual beam echosounder 101 with 420 kHz transducer was used and the fish counting method applied (TVG set to 40 log R) using Biosonics ESP software. Calibration of the eqipment using tungsten carbide standard target was performed at the beginning of each month measurements.

2. RESULTS AND DISCUSSION

Fish concentrations in Solina reservoir estimated with the echosounder were very low, below one fish per 1000 m^3. They fluctuated between day and night estimates and between seasons (May-September), but the differences were not large (Fig. 1). A slight trend of fish abundance increment with the season can be observed.

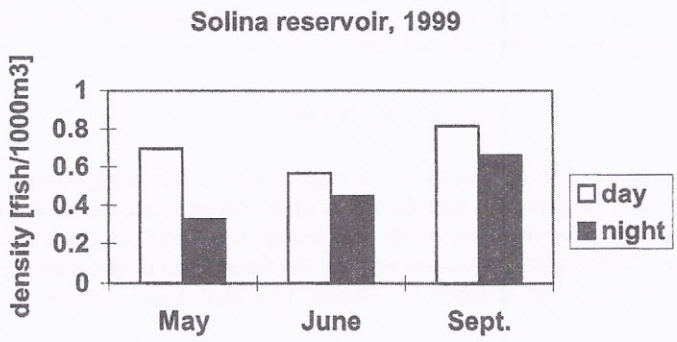

Fig. 1 Seasonal and day - night changes in the fish abundance estimates.

Fish distribution was patchy, with scarcely populated central basin near the dam and higher concentrations close to the rivers discharge and the locations of agricultural and touristic pollution (source of nutrients). Fig. 2 shows the changes in fish abundance and the mean target strength along the Solinka branch of the Solina reservoir, from the dam to the river discharge. Segments from I to IV are in direction of increasing trophy level. Observed trends agree with the theory of eutrophication [Opuszyński 1997].

It seems that received fish abundance was substantially underestimated, as compared with angling and nets estimates performed some years ago. This could be the result of aggregating behaviour of some of the species (in such case echointegration would be more appropriate) and not detecting fish close to the bottom Nevertheless fish densities in Solina are 2 orders of magnitude lower than in other lakes, where estimation was performed in the same way [Świerzowski 1999]. Such small fish abundance is probably the result of low

trophy of the reservoir. Both, the chlorophyll concentration and the zooplankton biomass in Solina are very low [Płużański et al 1990]. Also the high fluctuations of the water level , up to 10 m, must affect the fish reproduction, limiting it to the very low level.

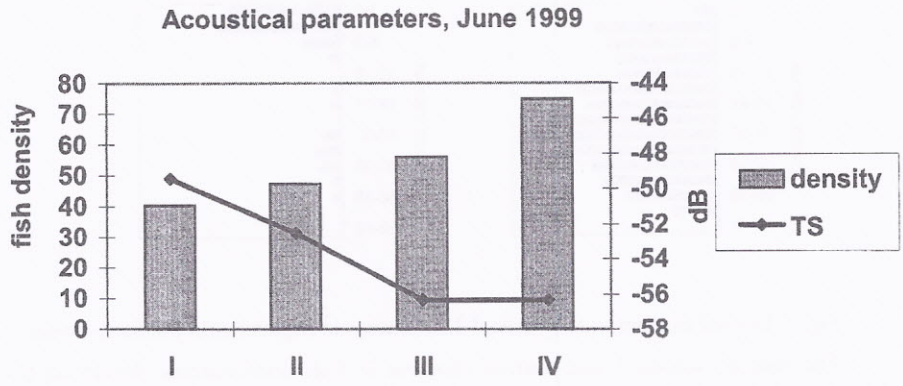

Fig. 2. Changes in fish abundance and mean TS with the increasing level of eutrophication (segments from I to IV) in the Wolkowyjka branch of the Solina reservoir

Fish vertical distributions differed through the season (Fig. 3). During a day in May fish occupied the whole water column with slightly higher concentrations between 6 and 12 m, i.e. within a thermocline. In June all the fish was concentrated in the upper 20 m with the clear maximum at the well developed thermocline. In September fish were distributed in the whole water column, like in May, but opposite to May concentrations at the depths corresponding to the largest temperature gradients were lower than at other depths, both below and above. Probably this was due to the very low oxygen concentrations, especially in the termocline.

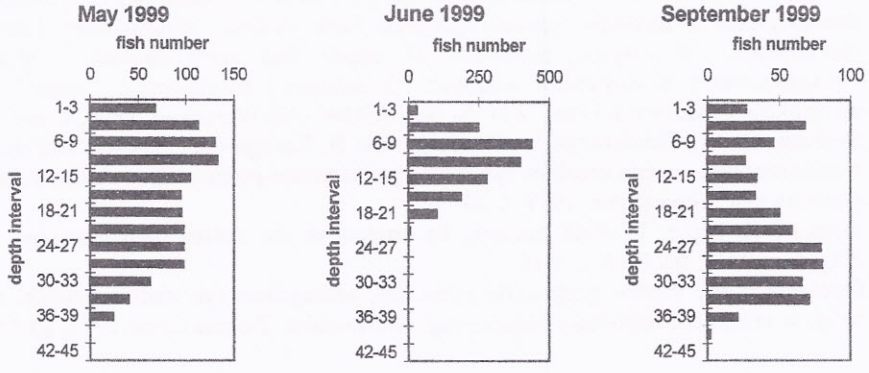

Fig. 3. Day fish vertical distributions in Solina reservoir in May, June and September 1999

At night majority of fish migrated to the warm most productive surface layers (Fig. 4).

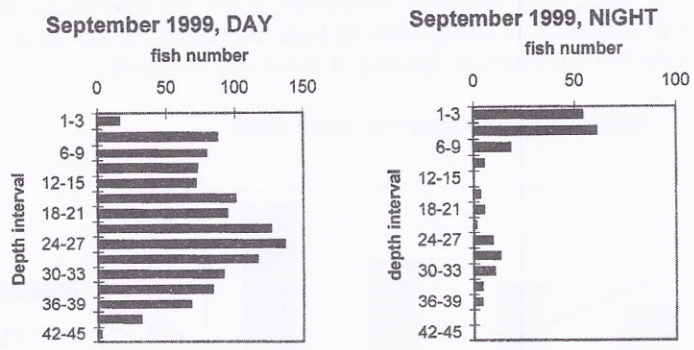

Fig. 4. Diurnal changes in fish vertical distributions in September in Solina reservoir.

The spatial, seasonal and diurnal changes in fish distributions, described above, will serve as the data for the prognostic model of the Solina ecosystem, which should help to manage these valuable resources in such a way, to enable conservation of clean water and high touristic value of Solina reservoir.

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