

Zooplankton under stress caused by sediment resuspension

L. A. Błędzki

Introduction

In the shallow areas of the Włocławek Dam Reservoir large oxygen deficits were found. The remarkable horizontal, temporal and vertical heterogeneity of oxygen concentration were also established (WIŚNIEWSKI & BŁĘDZKI 1989). Similar heterogeneity in investigated areas showed zooplankton too (BŁĘDZKI 1989).

The main factor caused this phenomena were hydrological (current) and meteorological (wind) changes as well as man-induced (dredging) sediment resuspension.

The aim of presented paper is an explanation of sediment resuspension influence on zooplankton.

Study area and methods

Włocławek Reservoir (Fig. 1) was dammed up in 1970 year. Its morphometry and hydrology parameters are presented in Table 1. Włocławek Reservoir has strongly eutrophic or even hypertrophic status. In re-

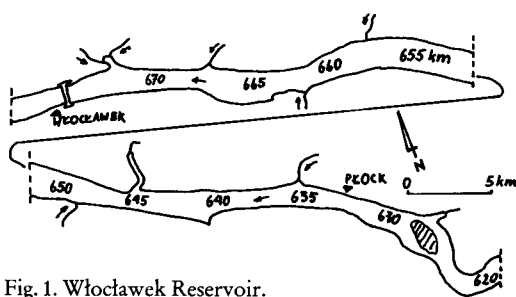


Fig. 1. Włocławek Reservoir.

Table 1. Morphometry and hydrology of Włocławek Reservoir.

Morphometry	Hydrology
Area: 75 km ²	Retention: 3–8 days
Volume: 408 mln m ³	Mean flow: 953 m ³ · s ⁻¹
Max. length: 57 km	Speed of water current:
Breadth: 500–2,700 m	upper part: 1 m · s ⁻¹
Max. depth: 15 m	lower part: 0.1–0.4 m · s ⁻¹
Mean depth: 5.5 m	

cent years the average numbers of zooplankton were 1,300 ind · dm⁻³ and biomass (dry weight) 0.57 mg · dm⁻³. Maximum biomass (21 mg · dm⁻³ d.w.) was noted in September 1988. Nitrogen and phosphorus concentrations often reached 2 mg and 1 mg · dm⁻³, respectively. Relation N/P often decreased below 5. Further chemical and biological data are presented in GRZIŃSKI et al. (in press).

Bottom sediments for the laboratory experiments with *Daphnia magna* were collected from shallow part of the reservoir (Fig. 1, profile A–B). Experiments were conducted at 23 °C. Oxygen analyses were done by means of the Winkler method.

Results and discussion

During laboratory investigations increase of SOD (Sediment Oxygen Demand) during sediment resuspension was shown. After some minutes more or less than 90% daily oxygen demand was found (Fig. 2). WIŚNIEWSKI (1986) obtained 10-

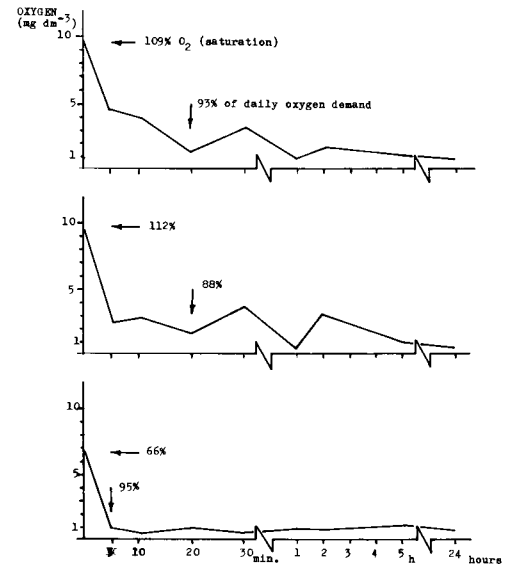


Fig. 2. Death rate of starved population of *Daphnia magna*.

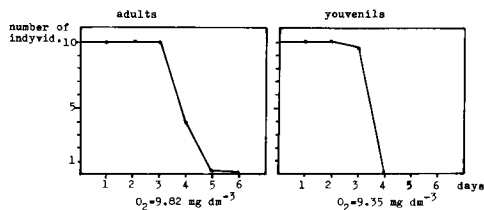


Fig. 3. Increase SOD after sediment resuspension.

times increase of oxygen demand during sediment resuspension.

Experiments in which lack of food was stressing factor showed the first adult individuals died on the fourth day of starvation. Then after six days of starvation the whole population died out. Analogous period of survival for juveniles was third and fourth days at the same conditions (Fig. 3). In the lowest oxygen concentrations ($1.16 \text{ mg} \cdot \text{dm}^{-3}$) adult population died after 4 hours. ŻUREK (1982) has found that starved population of *D. hyalina* died after seven days.

Laboratory investigations showed that all population of *D. magna* died on the fourth day in the water in which sediment resuspension took place previously. Slight decrease of the life length of *D. magna* may be insignificantly influenced by toxicants released from bottom deposits.

Main behavioural reaction of *D. magna* on resuspension was a migration of individuals to the layer with fine sediments (during weak resuspension) or migration to the upper layer (intensive resuspension). Results showed that all population of *D. magna* died after 20–30 minutes of intensive resuspension despite relatively good oxygen conditions ($2.5 \text{ mg} \cdot \text{dm}^{-3}$) what may have an important ecological significance.

One of the cause explanataing such rapid death could be an increase of metabolic rate connected with ingestion of mineral particles. Animals with intestine filled with mineral particles, beat with antennas about 13 per cent more frequently than

ones with empty intestines or filled with algae (ŻUREK 1982). It is also connected with fatigue phenomenon observed by SZLAUER (1959).

The obtained results shows that resuspension of bottom deposits causing usually oxygen deficites can cause increase of death rate of *D. magna* despite oxygen concentration is higher than critical value.

The above mentioned facts may be a main factors influenced considerable horizontal, vertical and temporal heterogeneity of zooplankton.

Acknowledgements

This work was supported by PAS grant CPBP 04.10.08. I would like to thank Mr. P. Napiórkowski for assistance in carrying out the experiments.

References

- BŁĘDZKI, L. A., 1989: Zooplankton ecology of Włocławek Dam Reservoir. – Ph. D. Thesis, N. Copernicus University, Toruń, 171 pp.
- GIZIŃSKI, A., BŁĘDZKI, L. A., KENTZER, A., WIŚNIEWSKI, R. & ŻYTKOWICZ, R., in press: Hydrobiological characterize of Włocławek Dam Reservoir. – *Ekol. Pol.*
- SZLAUER, L., 1959: The phenomenon of fatigue observed on plankton animals. – *Zesz. Nauk. WSR, Olsztyn* 83: 345–346.
- WIŚNIEWSKI, R., 1986: Bottom sediment resuspension influence the oxygen balance. – XIII Zjazd Hydrobiol. Pol., Szczecin, Str. Kom: 225 pp.
- WIŚNIEWSKI, R. & BŁĘDZKI, L. A., 1989: Factors influencing the microspatial zooplankton and oxygen heterogeneity in Włocławek Dam Reservoir. – *Ergebnisse der Limnologie* 33: 3–8.
- ŻUREK, R., 1982: Effect of suspended materials on zooplankton. 2. Laboratory investigations of *Daphnia hyalina* LEYDIG. – *Acta hydrobiol.* 24: 233–251.

Author's address:

Department of Hydrobiology, Institute Biology, University of Nicolas Copernicus, Gagarina 9, PL-87-100 Toruń.