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Preliminary evaluation of the quality of water in the Mierzęcka Struga River by a biological method

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Abstract

The Mierzęcka Struga River is the longest right tributary of the lower Drawa River. The organisms which live in the river reflect the quality of its water. On the basis of the research conducted between 2000 and 2004 in the Mierzęcka Struga River, it has been found that the organisms which live there are typical of clean water or slightly polluted water. Among others there were leeches: *Glossiphonia heteroclita*, *Erpobdella nigricollis* (typical of the quality class II), snails: *Theodoxus fluviatillis L.*, *Gammarus roeseli,* bivalves: *Pisidium amnicum*, *Unio tumidus*, *Unio crassus*, mayflies: *Ameletus inopinatus*, *Oligoneuriella rhenana*, caddis flies: *Hydropsyche lepida, Rhyacophila nubile*, *Anabolia nervossa*. The most numerous group are leeches (*Hirudinea*), which, as eurytop animals, unfortunately are not the best indicators of the quality of surface waters because they show great toleration towards pollution. For this reason it is more justified to look into greater groups of aqueous animals, so called stenotop taxa, which have adapted to living under particular conditions, for example: mayflies, caddis flies, *Tricladida* and gammarids which are more sensitive to pollution. Analyses of water in the Mierzęcka Struga River show significant pollution downstream of Wielgie Lake; in this lake the final reduction of pollution occurs. In the lower part of the Mierzęcka Struga River, from the town of Mierzęcin to the outlet, the amount of waste is limited as there is a biological sewage treatment plant (constructed wetland with reed) in Mierzęcin. The more the water in the river is polluted, the more differences one can notice as far as species, their number and the location of sensitive specimens are concerned, e.g. *Erpobdella nigricollis*. The presence of particular species reflects living conditions in the river. For this reason it is necessary to take up some activities which will minimise the degradation of the environment in the river. These activities would include

limitation in usage of chemicals on fields, modernisation of the sewage treatment plant, limitation of the amount of waste from private properties, further monitoring of waters and the establishment of an effective policy of tourist development, with preservation of all natural values.

Key words: biological method, water quality assessment, macroinvertebrates

Introduction

River quality assessment upon the basis of aquatic macrofauna incidence is already applied in European Union countries. The EU Water Framework Directive (Directive 2000/60/EC) dated October 23, 2000, lays the member countries under an obligation to carry out the biomonitoring of rivers. River classification applied in Poland since 1991 (Regulation of 1991) until 2004 (Regulation of 2004) is based mainly upon physical-chemical data and bacteriological indicators (Coli titre), as well as upon the measurements of saprobic index of seston. Upon the basis of the measured values, the quality of water was assessed according to three classes of quality. In which particular class the tested water should be included is often decided by an indicator least important from the point of view of its usefulness for given purposes.

In the European Union countries biotic indices are commonly used for the assessment of the quality of rivers. They are based mainly upon the analysis of the taxonomic composition of macroinvertebrates. Different geographical rangelands of macroinvertebrate species as well as biotypological diversification among watercourses do not allow the use of one universal biotic index. It is necessary to adjust the indices to the local conditions of particular countries. Fulfilling the river quality assessment criteria consistent with the European Union requirements necessitates the undertaking of research that will allow the appropriate biotic indices to be evaluated.

The River Mierzęcka Struga is not exposed to industrial contamination, moreover, in its basin there are 39 lakes including a few large ones that are sinks which neutralize pollutions from cultivated fields. This provides an opportunity to test a particular biotic index for small watercourses in the northwest of Poland. First, we tried to assess the quality of the waters of the Mierzęcka Struga using the Brown and Schroeder (Häffner 1993) method.

Research area characteristics

The Mierzęcka Struga is the longest (22.8 km) right-bank tributary of the River Drawa. Its source is situated southeast of Chłopowo village and later, as the Ogardna, it flows through the lakes: Górzno, Ogardzka Odnoga, Osiek, and via Wielgie Lake it heads to Drawa, which it joins at 19.2 km of its course.

The Mierzęcka Struga basin has a poorly developed hydrographic network. Due to the large number of lakes and local territorial depressions, the flow of waters is gentle during thaw periods and it does not cause long-lasting floods.

Methods

The research was carried out in the period from April until the end of August. Five test stands for sample taking were fixed: Chłopowo, Górzno, Ogardzki Młyn, Osiek Lake, Dobiegniew, Nowy Młyn, Mierzęcin, Łęczyn, Grzmiąca. Research results concerning years previous to 2000–2004 were also used (Agapow 1982, Król et al. 1994).

The samples for the research were taken with the use of a net dipper on a sludgy and a sandy bottom and with the use of sieves with different net mesh size. Collected samples were inserted in containers and fixed with 4% formaldehyde solution.

In the biological analysis of the quality of the waters the Baur and Schroeder (Häffner 1993) method was used.

The collected material was determined according to the works of Łukin (1976), Stańczykowska (1986), Piechocki and Dyduch-Falniowska (1993), Engelhardt (1998), and others.

Results and discussion

Upon the basis of the research carried out in Mierzęcka Struga so far, the incidence of 39 species was found (Table 1). Some of them are considered indicatory for pure or slightly polluted waters. Those were, among others, leeches: *Glossiphonia hateroclita, Erpobdella nigricollis, Erpobdella monostriata*, snails: *Theodoxus fluviatilis* L., *Galba truncatula* O.F Muller, *Planorbis planorbis* L., crustaceans: *Gammarus pulex* L., *Gammarus roeseli*, bivalves: *Pisidium amnicum, Unio tumidus, Unio crassus*, mayflies: *Ameletus inopinatus, Oligoneuriella rhenana*, caddis-flies: *Hydropsyhe lepida, Rhyacophilanubila, Anabolia nervossa*. The most numerous group are leeches (*Hirudinea*) which, as eurytopic animals are not the best indicators for surface water assessment because most species show high tolerance to pollutants. Thus, it is more justifiable to consider larger groups of water animals, so called stenotypical species which are found in pure or slightly polluted waters such as, for example, mayflies, triclads, caddis-flies, or amphipods which are sensitive to pollution. The quality tests of the Merzęcka Struga water show considerable pollution from Wielgie Lake. This lake is a receiving water for poorly purified sewage in which appreciable reduction of pollution in this section of the river takes place. In the lower section of the Mierzęcka Struga, from the town of Mierzęcin all the way to the

Table 1. Overview of the Mierzęcka Struga and lakes' fauna species

No	Species	Mierzęcka Struga					Lakes			
	Station	1	2	3	4	5	6	7	8	9
1.	*Piscicola geometra* L.	+	+	+	+	+	+	+	+	+
2.	*Glossiphonia complanata* L.	+	+	+	+	+	+	+	+	+
3.	*Glossiphonia heteroclita* L.	+	+	+	+	+	+	+	+	+
4.	*Hemiclephis marginata* O.F. Muller	+	+	+	+	+	+	+	+	+
5.	*Helobdella stagnalis* L.	+	–	+	–	–	–	–	–	–
6.	*Batracobdella paludosa* Carena	–	–	–	+	+	+	+	+	+
7.	*Boreobdela verrucata* O.F. Muller	–	–	–	+	+	+	+	+	+
8.	*Theromyzon tessulatum* O.F. Muller	+	+	+	+	+	+	+	+	+
9.	*Hirudo medicinalis* L.	–	–	–	+	+	+	+	+	+
10.	*Haemopis sanuisuga* L.	+	+	+	+	+	+	+	+	+
11.	*Erpobdella otoculata* L.	+	+	+	–	–	–	–	–	–
12.	*Erpobdella nogricollis* Brandes	+	+	+	+	+	+	+	+	+
13.	*Erpobdella testacea* Savigny	+	+	+	+	+	+	+	+	+
14.	*Erpobdella wilenensis* Liskiewicz	+	+	+	+	+	+	+	+	+
15.	*Erpobdella monostriata* Lind.et.Piet	+	+	+	+	+	+	+	+	+
16.	*Erpobdella lineata* O.F. Muller	–	–	–	+	+	+	+	+	+
17.	*Gammarus pulex* L.	+	+	+	–	–	–	–	–	–
18.	*Gammarus roeseli*	+	–	+	+	+	+	+	+	+
19.	*Bithynia tentaculata* L.	+	+	+	+	+	+	+	+	+
20.	*Theodoxus fluviatilis* L.	+	+	+	–	–	–	–	–	–
21.	*Lymnea (Myxas glutinosa)*	–	+	–	+	+	+	+	+	+
22.	*Galba trunculata* O.F. Muller	+	+	+	–	–	–	–	–	–
23.	*Radix auricularia* O.F. Muller	–	–	–	+	+	+	+	+	+
24.	*Lymnea stagnalis* L.	+	+	+	+	+	+	+	+	+
25.	*Planorbis planorbis* L.	+	–	+	–	–	–	–	–	–
26.	*Unio tumidus* Retz.	+	–	+	–	–	–	–	–	–
27.	*Unio crassus* Retz.	+	–	+	–	–	–	–	–	–
28.	*Anodonta cygnea*	+	+	–	–	–	–	–	–	–
29.	*Pisidium amnicum* O.F. Muller	+	–	+	+	+	+	+	+	+
30.	*Ameletus inopinatus* Eaton.	–	–	+	–	–	–	–	–	–
31.	*Baetis rhodani* Piet.	–	–	+	+	+	+	+	+	+
32.	*Oligoneuriella rhenana* Imhof.	–	–	+	–	–	–	–	–	–
33.	*Agrion slendens* Harr.	–	–	+	–	–	–	–	–	–
34.	*Dytiscus marginalis* L.	+	+	–	–	–	–	–	–	–
35.	*Gyrinus* sp.	+	+	–	–	–	–	–	–	–
36.	*Hydropsyche lepida* Piet.	–	+	–	–	–	–	–	–	–
37.	*Rhyacophila nubila* Zett.	–	+	–	–	–	–	–	–	–
38.	*Phryganea grandis* L.	–	+	–	+	+	+	+	+	+
39.	*Anabolia nervossa* Curtis	–	+	–	+	+	+	+	+	+

estuary, the flow of sewage from nearby human settlements is limited by the biological (constructed wetland with reed) sewage treatment plant placed in Mierzęcin. With the increase of the grade of the river water pollution, the species composition, quantitative as well as the location of the sensitive species, such as, *Erpobdella nigricollis*, bivalves from the *Unionidae* and *Sphaeriidae* families is affected

The monitoring of physico-chemical factors undertaken by the Regional Inspectorate of Environmental Protection (RIEP) in Gorzów Wlkp. (Szenfeld 2004) has shown that the waters carried by the river correspond to the class of quality II from the outflow from Wielgie Lake to the town of Nowy Młyn and in the section Nowy Młyn – Łęczyn, whereas from Łęczyn down to the outlet into the Drawa River the waters meet the requirements of quality class I. Our initial assessment with the biological method confirms the RIEP monitoring results, with the exception of the river section from Wielgie Lake to Mierzęcin, which we have classified as quality class III.

Conclusions

Macroinvertebrates found in the Mierzęcka Struga reflect the quality of its water. The presence of the mentioned indicatory species reflects the life conditions in the watercourse. Decrease of species diversity in the section down from Wielgie Lake necessitates measures which will minimize the degradation processes of the Mierzęcka Struga waters, and will make it possible to increase the biological diversity for this section of the river. These measures include: limitation of the use of chemical agents in agricultural farming, modernization of the sewage treatment infrastructure, limitation of the sewage flow from residential premises and further monitoring of the water quality. The regional policy of tourism and recreation should consider the rules of sustainable development. However, it is essential to remember that taxonomic diversity depends on environmental conditions, quality of water, speed of the river flow, type of ground, incidence of water plants (Agapow 1998, Dumnicka 1994, Korycińska 2004, Wojas 1959, Pawłowski 1936b). The efficacy of these activities will not only affect the environmental protection with all its elements, but will also raise the attractiveness of the region and enhance the further development of tourism in this area.

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