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The European Union Water Framework Directive and the ecological status assessment of inland waters

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Upon accession to the European Union in June 2004, Poland recognized the legal jurisdiction of community laws, including that of the Water Framework Directive (Directive 2000/60/EC). This directive effected a fundamental shift, at least in member countries, in the approach to water management which included classification and assessment methods for inland waters. The WFD provides principles for assessing the status of entire aquatic ecosystems based on various biological elements or organism assemblages inhabiting waters (Soszka and Lyche Solheim 2011). The WFD sets forth provisions for the development of national assessment systems, with the novel requirement of taking into consideration reference conditions, according to which the degree of transformation in a given area of surface waters is assessed. River basin management plans created according to WFD provisions should include all surface waters within natural hydrographic units, which are divided into water segments and include surface water categories of rivers, lakes, transitional waters, coastal waters, and artificial and heavily modified water bodies. The WFD also underscores the necessity and provides general guidelines for developing the appropriate tools for conducting assessments of surface water status. The biological elements should include the following parameters and groups of organisms: composition, abundance, and biomass of phytoplankton; composition and abundance of other aquatic flora; composition and abundance of benthic invertebrates; composition, abundance, and age structure of ichthyofauna. Unfortunately, this definitive list excludes zooplankton, which has been established by science as being a significant bioindicator (e.g., Karabin 1985).

According to the WFD, the status of aquatic ecosystems can be assessed using national methods; however, appendix V stipulates conducting intercalibration exercises that ensure comparability among results from all over Europe. The foundation for intercalibration is the so-called normalized ecological quality ratios (EQRs), which represent the relationship between the values of the biological parameters observed in a given body of surface water and the values of these parameters in the reference conditions applicable to that body. The EQR class boundaries for the high/good (H/G) and good/moderate (G/M) status in different types of water bodies were verified during these intercalibration exercises, and the comparability of the boundary limits adopted in different countries was tested. Commission Decision (2013/480/EU), which was issued following the completion of these exercises, set forth the numerical

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values for classification purposes in monitoring systems for each type of surface water body and national method. Polish methods that were verified in this way included metrics for assessing river ecological status with benthic macroinvertebrates, macrophytes, and diatoms. Intercalibration exercises on methods for assessing lake ecological status based on phytoplankton, macrophytes, and phytobenthos were also concluded (Commission Decision 2013/480/EU); however, the results of the intercalibration exercises for fish in rivers and lakes are not yet available.

Commission Decision (2013/480/EU) reports that some ecological quality ratios for assessing the ecological status of some waters were harmonized, and these can be used to determine the good ecological potential in bodies of water corresponding to intercalibrated types when they are heavily modified. This stems from the fact that, to date, the issue of heavily modified water bodies has not been addressed in national methods and has yet been subjected to intercalibration exercises. It appears, however, that investigations and assessments of the ecological potential of heavily modified water bodies could provide interesting information regarding newly-developed methods for the assessment of ecological status. This was the impetus behind this series of studies that focus on different segments of waters that are all linked by their heavily modified status. Among these are two lakes undergoing restoration. One has been under restoration since the mid 1950s by the selective removal of hypolimnion waters (Jaworska et al. 2014). An important aspect of this work, in the context of verifying the Polish method for assessing the ecological status of lakes based on phytoplankton, is the conclusion that the values of the Cyanoprokaryota Biomass Metric had a significant effect on the final results of the Lake Kortowskie assessment, according to which this lake was classified as being in poor ecological status. The phytoplankton of this lake was dominated by cyanobacteria. The first Polish publication of the results of the application of the PMPL method for assessment of ecological status by applying the cyanobacteria metric to lakes in the Wel River basin indicated fluctuations within a narrow range in four of five stratified lakes, which placed them in the poor class and just one in the moderate class (Hutorowicz et al. 2011). The study by Jaworska et al. (2014), who expanded the range of assessment, confirms that this metric is a good indicator of blooms in lakes.

The assessment of the ecological status of another strongly eutrophic, shallow, flow-through lake located in the Wielkopolskia region, which has been under intense restoration since 2011, confirmed the poor state of the basin prior to the application of the measures described above (Kozak et al. 2014). It is plausible that the status assessment based on chlorophyll *a* concentrations and supporting physicochemical elements permits evaluating the effects of restoration in accordance with the requirements of the WFD. The next publication refers to lakes with clean water, which have, to date, maintained status bordering on high and good (Napiórkowska-Krzebietke and Hutorowicz 2014). The results of ecological status assessments performed with PMPL and indicators stemming from other methods for assessing planktonic algae biomass and taxonomic diversity were verified as thoroughly as possible. The results of these studies confirm that, as it is set forth in the principles of the WFD, the structure of these assemblages is good indicator of changing eutrophication. They indicate very clearly that this type of relationship is noted even in clean lakes, and that PMPL is responsive to such short-term changes.

The next work discusses long-term changes of diatoms in the phytoseston of the Vistula River, and includes the artificial Włocławek Reservoir (Dembowska 2014). The study was based on diatom trophic requirements (after van Dam et al. 1994) and IFPL, which is a newly-developed system for assessing rivers based on phytoplankton (Picińska-Fałtynowicz and Błachuta 2011). The study indicates that, despite concentrations of nutrients characteristic of eutrophic and hypertrophic waters, the ecological potential of this lowland river with well-oxygenated waters can be classified based on chlorophyll concentrations variably from poor to good and even maximum ecological potential. The

range of classifications stemmed largely from the occurrence of diatom species in the Vistula River that are indicative of oligotrophic and oligo-mesotrophic conditions and high and very high oxygen conditions.

The lowland polymictic Siemianówka Dam Reservoir, in which the toxic cyanobacterium *Planktothrix agardhii* is dominant from summer to autumn, was the subject of a study that examined the links between various environmental parameters (water temperature, light regime, oxygen and nutrient concentrations) and the occurrence of cyanobacterial toxins (microcystins) in waters in 2010-2011, and was also a response to the phytoplankton multimetric for rivers (IFPL) with the distinct dominance of this species (Grabowska and Mazur-Marzec 2014). In the conclusions, the authors present a proposal for including studies of cyanotoxins occurrence in ecological assessments of similar water bodies. Creating such an assessment method would correspond perfectly with key area "Food security, sustainable agriculture, marine and maritime research and the bio-based economy" within the new framework program for research funding European Union Horizon 2020.

The comparison of various phytoplankton-based environmental assessment methods in the canals of an electric power plant cooling system is also interesting (Napiórkowska-Krzebietke 2014). Four indexes are compared – the algal genus pollution index, the Shannon-Weaver diversity index, the saprobic index, and the trophic index, which is one of the two modules of the IFPL multimetric phytoplankton index created for river ecological status assessments in accordance with the WFD. This work examines one of the main issues with assessments, which is variation in results depending on methods applied. It addresses not only the application of different methods, as in this publication, but also assessment results obtained using various biological elements, which, in light of current research, is the rule rather than the exception (Moe and Soheim 2011). Additionally, it discusses a topic that is still rarely addressed in the literature, namely indicator integration and the formulation of integrated assessments and misclassification risk assessment (Moe and Lyche Solheim 2011).

References

Commission Decision of 20 September 2013 establishing, pursuant to Directive 2000/60/EC of the European Parliament and of the Council, the values of the Member State monitoring system classifications as a result of the intercalibration exercise and repealing Decision 2008/915/EC. Official Journal of the European Union 2013/480/EU.

Dembowska E. 2014 – Diatoms of the lower Vistula River phytoseston – Arch. Pol. Fish. 22: 53-67.

Grabowska M., Mazur-Marzec H. 2014 – Vertical distribution of cyanobacteria biomass and cyanotoxin production in the polymictic Siemianówka Dam Reservoir (eastern Poland) – Arch. Pol. Fish. 22: 41-51.

Hutorowicz A., Napiórkowska-Krzebietke A., Pasztaleniec A., Hutorowicz J., Lyche Solheim A., Skjelbred B. 2011 – Phytoplankton – In: Ecological status assessment of the waters in the Wel River catchment (Ed.) H. Soszka, Wyd. IRS, Olsztyn: 143-168 (in Polish).

Jaworska B., Dunalska J., Górniak D., Bowszys M. 2014 – Phytoplankton dominance structure and abundance as indicators of the trophic state and ecological status of Lake Kortowskie (northeast Poland) restored with selective hypolimnetic withdrawal – Arch. Pol. Fish. 22: 7-15.

Karabin A. 1985 – Pelagic zooplankton (Rotifera + Crustacea) variation in the process of lake eutrophication I. Structural and quantitative features – Ekol. Pol.: 33:567-616.

Kozak A., Kowalczewska-Madura K., Gołdyn R, Czart A. 2014 – Phytoplankton composition and physicochemical properties in Lake Swarzędzkie (midwestern Poland) during restoration: Preliminary results – Arch. Pol. Fish. 22: 17-28.

Moe J., Lyche Solheim A. 2011 – Integrated assessment of ecological status and estimating erroneous classification risk – In: Ecological status assessment of the waters in the Wel River catchment (Ed.) H. Soszka, Wyd. IRS, Olsztyn: 267-290 (in Polish).

Napiórkowska-Krzebietke A 2014 – Phytoplankton of artificial ecosystems – an attempt to assess water quality – Arch. Pol. Fish. 22: 81-96.

Napiórkowska-Krzebietke A., Hutorowicz A. 2014 – Phytoplankton in an ecological status assessment of the vendace-type Lake Dejguny (northeastern Poland) – Arch. Pol. Fish. 22: 29-40.

Soszka H., Lyche Solheim A. 2011 – Introduction – In: Ecological status assessment of the waters in the Wel River catchment (Ed.) H. Soszka, Wyd. IRS, Olsztyn: 7-9 (in Polish).