

## Initiative for the Integration of Zooplankton into the Assessment Methods of the Water Framework Directive (WFD 2000/60/EC - Review 2019)

*Zooplankton is an important integrative indicator for the assessment of the ecological status of standing waters that to date has not been included in the array of biological standard methods of the WFD. However, Zooplankton metrics are cost-efficient tools for comprehensive and long-term monitoring of food web effects on water quality, e.g. by fish. The application of these metrics may result in substantial improvements for water management and facilitate the derivation of actions to be taken.*

### **Why zooplankton?**

Although zooplankton plays a central role in the food web of standing waters, it has not become one of the biological standard methods that were implemented by the EU WFD. The pending revision of the EU WFD provides an opportunity to fill this gap. In the context relevant to water protection zooplankton encompasses rotifers and crustaceans within a size range of about 0.05 to 5 mm. They are the main consumers of phytoplankton biomass and at the same time the most important food source for juvenile fish. Grazing zooplankton may clear water bodies of any size from planktonic algae within a few days (clear water phase). This potential must be used to achieve the quality objectives of the EU WFD.

### **Zooplankton is a good indicator of ecological status**

Many studies (e.g. Cid et al., 2014, Jeppesen et al., 2011) have shown that zooplankton react very specifically to stress factors in the aquatic environment. Zooplankton metrics integrate effects that result from complex interactions in the planktonic food web. Therefore, the zooplankton is particularly suitable for the long-term monitoring of environmental stress in surface waters that are caused by mismanagement, eutrophication, acidification, salinization and climate change, as well as for surveying the success of management strategies applied to reduce stress.

### **Benefits to the assessment of the status of the water environment according to EU-WFD**

The analysis of zooplankton may elucidate changes in the structure and function of the pelagic food web, which are not sufficiently explained when only monitoring phytoplankton and fish. Alternatively, comparable results may only be achieved at very high costs, e.g. by extensive fish surveys. 18 years after the EU WFD has been implemented, many lakes have still not reached the required "good ecological status". However, current nutrient loads of phosphorus and nitrogen may not be responsible alone for excessive levels of phytoplankton biomass. Unfavourable conditions affecting the food web also have to be taken into account, in particular the intensive feeding pressure of fish on filter-feeding zooplankton. Using specific zooplankton metrics, major problems can be identified that prevent lakes from reaching the "good ecological status" and recommended actions can be derived. Also, zooplankton metrics such as the "mean cladoceran body mass" may serve as specific target variables to improve fisheries management.

### **Integration of zooplankton into the EU-WFD is possible within a short period and at low cost**

Zooplankton as a biological quality element is urgently needed for the understanding and evaluation of lake-internal processes. A short-term and cost-effective implementation into the WFD is possible because the complete methodology for comprehensive monitoring is already available. The overall costs can be greatly reduced because zooplankton and phytoplankton is sampled in parallel at the same time. Species determination, quantitative sample analysis as well as interpretation of zooplankton data can draw on the extensive scientific literature that has been compiled over many dec-

ades. Long-term data series from different types of water bodies are available and may serve as references for evaluation. On the other hand, a comprehensive monitoring of fish populations in WFD waters would be unrealistic and financially unfeasible. On behalf of the environmental authorities of the German Federal States a zooplankton database has recently been developed (PHYTOLOSS project, Deneke et al., 2015) with the overall goal to standardize all methods. As of now it comprises a standardized zooplankton sampling protocol as well as a template for a standard database format, establishing an Operational Taxa List of Meta-Zooplankton (OTL-MZ) which defines a minimum level of determination and provides information on reference literature for the determination of each taxon. Moreover, PHYTOLOSS focusses on the development of new food web related zooplankton metrics by linking zooplankton data to the German phytoplankton database PHYTOSEE (Mischke et al., 2015). For the first time the grazing potential of zooplankton as well as a food quality index can be calculated. A summary with graphic visualization of all relevant zooplankton metrics (number of species, biomass, group dominance, body size, grazing effect strength, etc.) is generated as a specific "zooplankton fact sheet" for each water body. The PHYTOLOSS method which relies on the combination of phytoplankton and zooplankton data, can easily be adapted to existing plankton databases in other European countries, if appropriate zooplankton data are collected along with phytoplankton data in the future. An additional aspect that should also be taken into consideration is the possibility to use zooplankton samples as an archive for evaluating long-term environmental changes, since zooplankton samples can be stored for decades. Even very long periods of environmental change can be analysed when sediment sampling is included.

Cid, N., Cardoso, A.C., Nöges, P., Nöges, T. & Kernan, M. (2014): Zooplankton: an integrative Biological Quality Element for assessing the Ecological Status of lakes. Refresh Science Policy Brief No 1.

[http://www.refresh.ucl.ac.uk/webfm\\_send/2240](http://www.refresh.ucl.ac.uk/webfm_send/2240)

Deneke, R., Maier, G. & Mischke, U. (2015): Das PhytoLoss-Verfahren – Berücksichtigung des Zooplanktons in der Seebewertung nach EU-WRRL durch die Ermittlung der Grazing-Effektstärke und anderer Indizes. Deutsche Gesellschaft für Limnologie, Erweiterte Zusammenfassungen der Jahrestagung in Magdeburg-Stendal 2014, Eigenverlag der DGL, Hardegsen: 54-58. ISBN 978-3-9813095-7-7

Jeppesen, E., Nöges, P., Davidson, T.A., Haberman, J., Nöges, T., Blank, K., Lauridsen, T.L., Søndergaard, M., Sayer, C., Laugaste, R., Johansson, L.S., Bjerring, R. & Amsinck, S.L. (2011): Zooplankton as indicators in lakes: a scientific-based plea for including zooplankton in the ecological quality assessment of lakes according to the European Water Framework Directive (WFD). *Hydrobiologia* 676 (1): 279-297.

Mischke, U., Riedmüller, U., Hoehn, E., Nixdorf, B. (2016): Handbook Phyto-See-Index and Tool Guidance. Method description of the assessment of lakes and reservoirs with phytoplankton and the Phyto-See-Index in Germany. User handbook. Excerpt of original version Dec. 2016. LAWA, 78 pp.

[http://www.gewaesser-bewertung.de/files/english\\_handbook\\_german\\_lake\\_assessment\\_method\\_description\\_psi\\_dec2016-1.pdf](http://www.gewaesser-bewertung.de/files/english_handbook_german_lake_assessment_method_description_psi_dec2016-1.pdf)

Initiated by:

Working Group of Self-Employed Limnologists in the German Association of Limnology (responsible: Dr. Sabine Schmidt-Halewicz, Konstanz, Eberhard Hoehn, Freiburg, Dr. Thomas Schröder, Meldorf; contact: [schmidt-halewicz@limsa.de](mailto:schmidt-halewicz@limsa.de))

Dr. Rainer Deneke, PhytoLoss Project Management, contact: [info@zooplankton.eu](mailto:info@zooplankton.eu) [www.phytoloss.de](http://www.phytoloss.de)

**Please support the implementation of zooplankton as a standard method into the EU Water Framework Directive during the review process 2019 with your signature. Send your consent to the initiators or directly to [info@phytoloss.de](mailto:info@phytoloss.de). Please forward this call to others involved in the topic. Thank you.**