

Desmids as indicator organisms in the Water Framework Directive

Phytoplankton in the WFD

The European Water Framework Directive (WFD) requires assessment of the ecological status of surface water (EC, 2000). Tools have to be developed for several biological quality elements, including phytoplankton in stagnant waters. For a good ecological status, selected biological parameters may indicate 'low level of distortion resulting from human activity', but only a slight deviation from the undisturbed situation.

The Dutch phytoplankton tools

In the Netherlands the methods for the phytoplankton evaluation focus on total biomass (chlorophyll-a) and species composition. With respect to species composition two measurement tools are proposed:

(1) A tool to measure the strength of anthropogenic influence based on blooms of phytoplankton species. The WFD states that phytoplankton blooms may occur in undisturbed waters. The extent and nature of blooms may however change with increasing human activity, especially phosphorus load.

(2) A tool to measure the weakness of anthropogenic influence, reflected by the presence of biological communities that are vulnerable to these influences. The proposed tool is based on the desmid flora. Background and method of this tool are outlined below.



Cosmarium protractum is a highly sensitive species of meso- to eutrophic shallow waters. It was found in eutrophic shallow lakes in the beginning of the 20th century, but disappeared in the course of progressive eutrophication and concomitant loss of submerged vegetation.

The indicative value of desmids

The species composition of desmid communities in permanent water bodies is primarily determined by the buffering capacity and ionic content of the water (related to alkalinity, pH and trophic state) and secondarily by the structure of the habitat (related to gradients in light, nutrient availability and grazing pressure). Habitat structure comes with progress in ecosystem maturity and is counteracted by disturbances, either by man or by nature itself. In desmid communities progress in ecosystem maturity is not only reflected in an increase of biodiversity, but also in the number of sensitive, ecologically specialized species and the number of rare species, indicative for the uniqueness of the ecosystem. Based on this observation Coesel (1998, 2001) developed a method for the assessment of nature conservation value in lentic freshwaters. The application of this method to various types of waters has yielded valuable information in addition to the quality assessment based on macrophytes and epiphytic diatoms (Coesel 2003, Bijkerk *et al.* 2004).



Cosmarium formosulum is a moderately sensitive desmid of meso- to eutrophic waters, that can be found in eutrophicated shallow waters.

Desmids in the WFD

The assessment method elaborated by Coesel (1998) evaluates the present ecological status relative to the potential desmid flora in the water type. This potential is equivalent to the reference condition in terms of the WFD, evaluated with an Ecological Quality Ratio of 1.0. For appliance in the WFD quality assessment, a modified measurement tool was developed based primarily on sensitivity. In this (preliminary) tool the desmid species are distinguished into four classes of sensitivity towards deterioration of the environment. If a viable population of a sensitive or highly sensitive species is detected the ecological quality class of the water is judged as good or very good respectively (Table 1). The final score is adjusted if species richness is lower than expected. The analysis and assessment are straightforward and not very sensitive to differences in analytical effort or expertise.

Table 1 Assessment of ecological quality status by the presence of sensitive desmids.

Quality status	Sensitivity level of desmid species in the sample			
	Low	Moderate	High	Very high
Bad	-	-	-	-
Poor	+	-	-	-
Moderate	+	+	-	-
Good	+	+	+	-
High	+	+	+	+

Literature

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