5 New Perspectives for Eutrophication Management

5.1 A New Dimension in Lake Eutrophication Management

Abiotic Stressors and Toxic Chemicals: Factors to Be Considered for Lake Restoration

Restoration management aims at reducing nutrient inputs and favouring daphnids in order to control phytoplankton, thereby reducing turbidity by turning the system from a turbid into a clear state (Carpenter et al. 1995a). This is especially important in spring, when environmental conditions are optimal for a stimulation of the phytoplankton biomass. However, restoration measures have proven to be ineffective over the long term in many cases, possibly because of reduced grazing effectiveness by daphnids on algae. Ineffective daphnid grazing, due to toxic substances and other abiotic stressors, has been proven in many laboratory and mesocosm studies to occur. Therefore, it may be worthwhile considering the presence of toxic or other stress factors in the waters where biomanipulation has failed in comparison to the waters in which it was successful. Toxicants can act as one of the forward switches responsible for a shift from clear to eutrophied water (see Fig. 5.1). The crucial question however is: does this occur in the field situation?

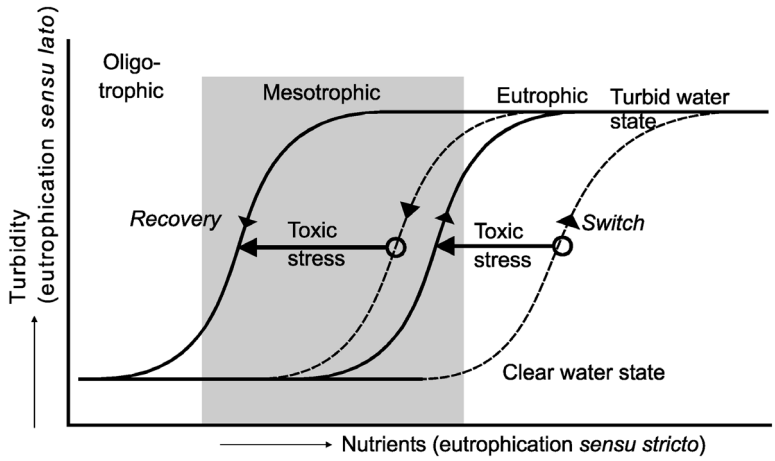

Fig. 5.1. Hysteresis effect in the response of lake turbidity to changes in nutrient status (adapted from Scheffer et al. 1993), extended for the impact of toxic stress

Table 5.1. LOEC data for toxic anorexia in daphnids from the toxicants tested in Chap. 3, in comparison to environmental concentrations and Dutch water quality standards for surface water

Substance	Source	LOEC daphnid grazing[1] (µg/l)	Concentration range in sewage water (µg/l)[6]	Concentration range in WWTP effluent (µg/l)[6]	Background concentration (µg/l)[2]	MPC (µg/l)
Cadmium	Mainly metal coatings	100	≤0.52	≤0.08	≈0.08[3]	0.4
Copper	Drinking water pipes, algicides, herbicides	30	76	≤10	≈0.44[3]	1.5
Dimethoate	Pesticides	18–320	≤0.27	≤0.01	≈0.05[5]	23
Fluoranthene	Treated wood, antifouling coatings, pesticides	5.6–10	≤0.27	≤0.01	≈0.009[4]	0.5
NaCl	Marine influence	3200000	–	–	–	–

MPC: Maximum Permissible Concentration (MTR in Dutch) n.s: not significant, n.a: not applicable

[1] see Table 3.3

[2] 90 percentile for fresh water systems; 10% of the measured concentrations were higher in 1998

[3] De Bruijn et al. 1999

[4] Van Steenwijk and Mol 1996

[5] Teunissen-Ordelman and Schrap 1996

[6] Gommers et al. 1999

Is Toxic Anorexia Likely to Occur in Practise?

LOEC data for toxic anorexia from some toxicants derived from the experiments in Chap. 3 are reviewed in Table 5.1. The LOEC is compared to concentrations of the selected substances in sewage water and effluent from a waste water treatment plant. Discharge of untreated sewage water may yield concentrations sufficiently high in order to stimulate occurrences of toxic anorexia, due to e.g. copper. The pesticide concentration in agricultural polder ditches can incidentally exceed the LOECs for toxic anorexia.

A further comparison is made with water quality standards. From the table, it can be concluded that, for most of the substances, the LOEC for toxic anorexia is well below the quality standard used for surface waters in the Netherlands. These MPC's (Maximum Permissible Concentrations) are calculated from the principle