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PHYTOPLANKTON WORKSHOP

Modifications in phytoplankton size structure by environmental constraints induced by regime shifts in an urban lake

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Abstract Size related changes of phytoplankton biovolume and species composition have been analysed for forward and reverse regime shifts in a shallow, urban, seepage lake. As a consequence of changes in the hydrology, the pelagic switched from a clear water, macrophyte dominated state to a turbid stable phase with an abundant cyanobacterial population. Experimental nutrient reduction forced the system into a recovery phase. Each state change was associated with significant changes in total biovolume, species composition and size structure affecting surface to volume ratios (S/V). Chlorophyll-*a* content and S/V drastically increased during the early recovering phase due to small cell sized species developing. As expected, state transitions were associated with significant alterations in size structure and composition.

Keywords Allometry · Stable states · Restoration · Surface volume ratio · Shallow lake

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Allometric scaling and size related community structure has been established for a wide variety of processes in phytoplankton from both marine and fresh-waters (e.g. Moloney & Field, 1989; Lewis, 1977; Nielsen & Sand-Jensen, 1990; Joint, 1991; Shkundina, 1991; Teubner & Dokulil, 2000; Havlicek & Carpenter, 2001; Finkel et al., 2004). Here we demonstrate changes in biovolume, species composition and related size structure during ecosystem state change.

Data originate from a shallow urban lake, Alte Donau, in Vienna, Austria. Hydrological changes induced a forward switch from a macrophyte dominated clear water system to a turbid, algal controlled phase in the early 1990s. Internal restoration measures forced the system back to the original stable state (Dokulil et al., 2000, 2006; Donabaum et al., 2004).

Nutrient reduction by internal phosphorus flocculation in early 1995 and 1996 drastically reduced total phosphorus concentration (TP) from an annual average of 70 μg l^{-1} in 1994 to less than 20 μg l^{-1} (Dokulil et al., 2000). Concomitantly phytoplankton total biovolume