ENVIRONMENTAL FACTORS INFLUENCED ON PRIMARY PRODUCTION OF SHALLOW SALINE LAKES OF CRIMEA PENINSULA (BLACK SEA)

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EXTENDED ABSTRACT

Hydrological variables, phytoplankton chlorophyll-*a* (chl-*a*) and species composition, suspended matter and total phosphorus (Ptot), and primary production (PP) were measured in six aquatic ecosystems in the Crimea Peninsula (Black Sea) from August 2004 to December 2005. Shallow salt lakes are a typical environment along the steppe part of the Crimea. All of these water-bodies, by their origin, can be devided into two groups. The first group is coastal lakes with salinity from 25 up to 340 g kg^{-1}. These lakes formed from marine lagoons and they are characteristic water-bodies along the sandy coasts of the Black Sea. They feed by sea-water and are permanently or temporarily separated from the sea by spits. In windy and stormy years spits can be eroded and lakes transform into choked lagoons. The second group is continental lakes with salinity from 24 up to 260 g kg^{-1}. The investigated systems are very similar in many features, but due to the differences in abiotic factors (e. g. salinity and turbidity) phytoplankton abundance, species richness and PP differ from each lake to others. The studied lakes were shallow and PP was to a large extent influenced by frequent resuspension processes, which induced water turbidity and avoided light penetration into the water column. The great Ptot concentrations were probably due to the lakes shallowness and inherent resuspension processes, which are mainly wind driven. Based on conventional $P_{tot.}$ thresholds all lakes would be classified hypereutrophic (Vollenweider, 1975). However, for assessing the eutrophication status in shallow waters, phosphorus speciation and reactivity has to be taken into account, mainly when the sedimentary background is carbonatic (Rozan et al., 2002). The hypothesis that the total phosphorus was not readily available was supported by the low levels of phytoplankton chl-*a* and PP, which were in the range of oligo- to mesotrophic waters (Håkanson, Bulion, 2002). Salinity was identified as a factor selecting the brine shrimp *Artemia sp.* as the main component of the zooplankton community. In turn, *Artemia* exerted a top-down control of the phytoplankton community in the highly saline lakes. Grazing of *Artemia* was probably responsible for the shift in size distribution of phytoplankton in Kojashskoe Lake. The relatively large *Chlamydomonas angulosa* and *Dunaliella salina* (about 10 μ) dominated in winter, when brine shrimps were rare to absent, whilst in summer at high *Artemia* densities their biomass was 2 – 3 times lower. The very small *Microcystis salina* (about 1 μ), whose size is beyond the food size spectrum of brine shrimps, sharply dominated in summer, when their abundance was considerable. Overall, the deepest coastal lake Tobechikskoe was the most productive system, with episodic blooms of filamentous green macroalgae *Cladophora vadorum* and *C. albida*. Scheffer (1998) and later Davis with co-authors (2003) pointed out that submerged vegetation plays an important role in forming a clear macrophyte-dominated state in shallow lakes instead of a turbid phytoplankton dominated state. Submerged vegetation can also enhance water clarity by reducing resuspension of bottom material, suppressing algal growth by competing for nutrients, and releasing allelopathic substances that are toxic both to macroalgae and phytoplankton (Takamura et al., 2003). Changes of total phosphorus concentrations in the Tobechikskoe Lake was likely due also to the growth of *Cladophora*, which formed a

dense cover on the sediment surface contrasting resuspension and removing nutrients from the water. James et al. (2004) observed that submersed plants can decrease resuspension up to 50-70 %. The alternance of *Cladophora* and phytoplankton growth could be connected with meteorological fluctuation. In stormy years, wind-driven resuspension occurs in spring with an increase in water turbidity which leads to light limitation to *Cladophora*. In years with calm weather in spring the concentration of suspended matter and light limitation are lower, thus allowing better light conditions to establish which stimulate the growth of *Cladophora.* Overall, this study contributes new insights to productivity and plankton community structure of shallow saline lakes along the coast of the Crimea peninsula. Salinity changes and water turbidity have been identified as the main triggers of abiotic conditions and community responses. Both factors are of paramount importance since they depend on meteorological forcing factors, and thus are susceptible of further changes deriving from climatic changes.

KEYWORDS*:* hypersaline lakes, primary production, phytoplankton, phytobenthos, *Artemia sp.*

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