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Seasonal changes in densities of cyanophage infectious to *Microcystis aeruginosa* in a hypereutrophic pond

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Abstract

Seasonal changes in densities of cyanophages infectious to *Microcystis aeruginosa* were studied in a hypereutrophic pond from March 1997 to January 1998 to elucidate the potential impact of the cyanophage on *M. aeruginosa* mortality. Densities of *M. aeruginosa* ranged between 1.8×10^4 and 9.4×10^5 cells ml^{-1}, while those of the cyanophages were between 2.0×10^2 and 4.2×10^4 PFU ml^{-1}. Sharp decreases in densities of *M. aeruginosa* were detected on 10 June and 24 September, as densities of the cyanophages increased, suggesting release of the cyanophages due to the lysis of infected *M. aeruginosa*. Thus, infection by cyanophages may have a substantial effect on cyanobacterial succession in the pond. Densities of cyanophages became undetectable when those of *M. aeruginosa* were at low levels during winter. We suggest that there is a tight host-pathogen relationship between *M. aeruginosa* and the cyanophage in the pond.

Introduction

A great deal of attention has been paid to the eutrophication of freshwater environments and to the concomitant occurrence of cyanobacterial blooms. The latter cause enormous economic damage due to deterioration of water quality, deoxygenation of underlying waters, their toxicity, foul odours and the resulting decrease in aesthetic values (Angeline et al., 1994; Watanabe et al., 1996). Among the cyanobacteria, blooms of filamentous *Anabaena, Oscillatoria, Nostoc, Aphanizomenon, Hapalosiphon* and colonical *Microcystis* are particularly harmful (Watanabe et al., 1996).

It has been suggested that some microbial processes may be responsible for decomposition of cyanobacterial blooms. Fungi (Canter, 1972), bacteria (Stewart & Brawn, 1969; Shilo, 1970; Daft & Stewart, 1971, 1973; Granhall & Berg, 1972; Gromov et al., 1972; Daft et al., 1975; Yamamoto & Suzuki, 1977; Caiola & Pellegrini, 1984) and protozoa (Hilda et al., 1968; Cook et al., 1974; Theresa & Alexander, 1974; Yamamoto, 1981) are all known to play important roles in decomposing cyanobacterial blooms. Mortality due to viruses has also been highlighted as an important factor which terminates cyanobacterial blooms (Safferman & Morris, 1963; Singh & Singh, 1967; Daft et al., 1970; Kenneth & Haselkorn, 1973; Padan & Shilo, 1973; Robert et al., 1976; Yvonne et al., 1981).

Although cyanophages infectious to *Synechococcus* spp., (Leach et al., 1980), *Lyngbya* spp., *Plectonema* spp., *Phorimidium* spp. (Safferman & Morris, 1963, 1964; Daft et al., 1970) and *M. aeruginosa* (Fox et al., 1976) have been reported from marine and some eutrophic environments, most studies of cyanophages have been reported in terms of their isolation, morphology and biology in the laboratory. Thus, information is still limited about the relationship between

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