POSSIBLE PHYTOPLANKTON SPECIES AS INDICATORS OF EUTROPHICATION IN THE NORTHERN ADRIATIC SEA

Noelia Revelante[1] and Malvern Gilmartin[2]

(1) Department of Botany and Plant Pathology, University of Maine, Orono, Maine 04469, USA.

(2) Department of Zoology, University of Maine, Orono, Maine 04469, USA.

ABSTRACT

The use of the quantitative (i.e. abundance) characteristics of certain phytoplankton species, rather than the presence/absence of (often rare) species, is proposed for their use as "indicator species" of eutrophication in the northern Adriatic Sea. Floristically the region, both temporally and spatially, acts as a homogenous whole, preventing the use of the presence or absence (solely) of species as indicators of eutrophication. This analysis indicates that over the past ten years the spatial quantitative distribution of three species could be used to indicate the extent of eutrophication in the region.

- 0 -

Aquatic eutrophication has far reaching ecological effects, from increased productivity (often positive) to major food web alterations (usually negative). The problem is to measure the spatial, and time course of eutrophication in a particular ecosystem.

Phytoplankton, due to their fast physiological response to nutrient input, can indicate the temporal and spatial characteristics of regional eutrophication. We have successfully used an indicator species approach in the northern Adriatic, which combines the magnitude of the phytoplankton standing crop, with the dominance of certain bloom species, to indicate the extent of eutrophication. This contrasts with the traditional "indicator species" approach where the presence of certain species (often rare) are used to identify water masses. The approach was necessary in the northern Adriatic because an analysis of long term phytoplankton community structure and species composition showed that qualitative species changes were not significant ... the entire northern Adriatic functions as a coherent system (Revelante, et al., 1984). However, the analysis suggested that the increases in crop biomass, when containing certain species, could be a good indicator of eutrophication.

In the northern Adriatic the three key species for this approach are Skeltonema costatum, Nitzschia seriata, and Prorocentrum micans. These species are prominant bloom constituents of the annual cycle in eutrophic areas of the northern Adriatic under the influence of the Po River discharge. Generalized to the entire northern Adriatic, these species always bloom early in the succession, even at different stages of an annual cycle which has three seasonal maxima. The maxima are forced by different degrees of nutrient availability, and water column stability. An example of crop response to Po River nutrient input in 1978 is presented below. The stations cover a ca. 40 X 60 km^2 off the delta.

Position	Nitrate (μg-at l^{-1}) 6/16	6/22	6/26	7/21	8/21
stations north & east	.5	.5	.2	<.1	.3
Po River influence	6.6	<.2	.2	1.5	.3
	25.2	2.8	.3	.1	.5
	13.1	10.1	nd	.1	.2
	.3	.3	.3	<.1	.4
south & east stations	.2	.2	.3	<.1	.3

Position	Silicate (μg-at l^{-1}) 6/16	6/22	6/26	7/21	8/21
stations north & east	4.2	4.4	5.8	.1	.2
Po River influence	9.0	2.2	2.0	.1	.1
	16.8	4.9	1.6	.1	1.5
	15.2	13.2	nd	.1	1.4
	2.1	5.8	5.1	<.1	<.1
south & east stations	.4	1.7	1.2	<.1	<.1

Position	Skeletonema (10^2 l^{-1}) 6/16	6/22	6/26	7/21	8/21	Nitzschia (10^2 l^{-1}) 6/16	6/22	6/26	7/21	8/21	Prorocentrum (10^2 l^{-1}) 6/16	6/22	6/26	7/21	8/21
stations north & east	-	-	-	-	-	-	1	1	-	-	11	8	30	57	-
Po River influence	340	-	-	-	-	4	1	2	-	-	88	2	22	163	-
	4469	7548	-	-	-	7	1265	30	-	-	622	266	56	65	-
	6112	nd	-	-	-	15	nd	nd	-	-	30	nd	nd	56	-
	-	-	-	-	-	7	6	2	-	-	8	333	44	-	-
south & east stations	-	-	-	-	-	4	-	-	-	-	-	-	12	63	-

In this example S. costatum initially reached maximum concentrations in mid-June immediately off the river mouth, and was subsequently replaced by N. seriata in late June. Extant nutrient concentrations concurrently decreased from seasonal maxima to moderately high concentrations by mid-bloom with a shift from Skeltonema to a Nitzschia dominated community. The two species subsequently phased out of community dominance to be replaced by Prorocentrum. These three species consistently displayed separate sequential abundance maxima in the northwestern Adriatic, apparently related to major pulses in nutrient input, and collectively can be used to indicate the spatial and temporal extent of eutrophication.

Long term observations in the entire region indicate that S. costatum is, quantitatively, the most important of the three indicator species on the eutrophic western side of the northern Adriatic whereas N. seriata and P. micans become increasingly more important in the lower standing crop bloom densities in the less eutrophic eastern parts of the northern Adriatic Sea. Temporally S. costatum and N. seriata are the microplankton species primarily responsible for blooms under isopycnal water column conditions, while P. micans dominates blooms in the summer under stratified conditions.

For the past decade the three species have been the most predictable bloom species in the northern Adriatic, apparently being able to readily capitalize on nutrient pulses resulting from fluctuations in river discharge rate, and (it is hypothesized) variations in lagoon tidal discharge. Other sporadic bloom species may occasionally reach bloom densities, e.g. Asterionella glacialis, Nitzschia longissima, and Lauderia annulata, but not with sufficient predictability to serve as indicator species of eutrophication.

- 0 -

Revelante, N. W. T. Williams and M. Gilmartin. 1984. A numerical assessment of the temporal and spatial distribution of phytoplankton assemblages in the northern Adriatic Sea. J. Exp. Mar. Biol. Ecol., 77:137-150.