

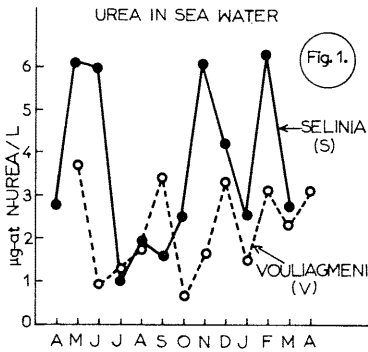
UREA FLUCTUATIONS IN A EUTROPHIC AND AN OLIGOTROPHIC ENVIRONMENT

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This investigation describes the annual fluctuations of N-urea in a eutrophic environment influenced by domestic sewage and an oligotrophic non-polluted environment. The quantitative relationships between N-urea and N-NH₃, N-NO₂ and N-NO₃ as well as the phytoplankton in cells/l and chl *a* have been also examined.

Monthly measurements of N-urea concentrations were made in the Saronic Gulf, Aegean Sea, at two stations, one inshore eutrophic (S), and one inshore oligotrophic (V). Water samples were collected with a van Dorn sampler from 1 m depth and filtered immediately through membrane filters (0.8 µm pore size). The filtrates were analysed for N-urea (Newell et al., 1967), N-NH₃ (Liddicoat et al., 1976) and N-NO₂, N-NO₃ (Strickland and Parsons, 1968). Chlorophyll *a* determinations (Strickland and Parsons, 1968) and phytoplankton cells/l were also determined.



The monthly variability of N-urea at both stations is described in Fig. 1. It is seen that in the eutrophic station S the concentration of N-urea was higher (1.51-6.60 µg-atN/l) than in the oligotrophic station V (0.61-3.46 µg-atN/l). The fluctuations of the N-urea concentration with time had irregular pattern at both stations.

Fig. 1. Monthly variability of N-urea at the eutrophic (S) and the oligotrophic (V) station.

Non-parametric (Spearman's rank) correlation coefficients were calculated in order to clarify whether the concentration of N-urea was correlated with the concentration of other N-compounds as well as with the phytoplankton mass parameters (cells/l, chl *a*). The results showed significant relationships only between N-urea vs N-NO₂ and N-urea vs N-NO₃.

The percentages of N-urea, N-NH₃, N-NO₂ and N-NO₃ to the total nitrogen (N-urea+N-NH₃+N-NO₂+N-NO₃) are given in Fig. 2. It is seen that at the oligotrophic station V the relative percent for N-urea overscaled the percentages of the other nitrogen compounds in all instances. At the eutrophic station S the percentage of N-urea to the total N was not always higher but it appeared in certain occasions equal or lower to the N-NH₃ percentage (Aug., Oct., Dec., Jan., March).

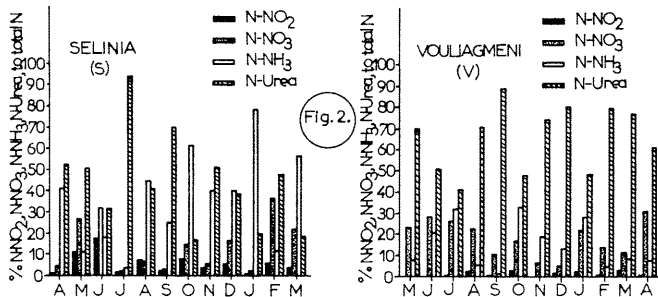


Fig. 2. Relationship of percentages of N-urea, N-NH₃, N-NO₂ and N-NO₃ to the total Nitrogen.

The results concerning the irregularity in the fluctuation pattern of N-urea with time and the lack of its relationship with the phytoplankton mass parameters are also in agreement with the findings of other investigators (Remsen, 1971; Turley, 1985). These inconsistencies might be due to the preferential assimilation of N-sources (ammoniumurea>nitrate) by phytoplankton (Harvey and Caperon, 1976) which was influenced by environmental factors (Terlizzi and Karlander, 1980).

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DYNAMICS OF PLANKTONIC BIOMASS SPECTRA DURING A WINTER PRODUCTION PULSE IN THE BAY OF MALAGA (NW ALBORAN SEA)

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As an alternative to the community approach, the analysis of the size distribution of biomass has emerged during the last years as a useful tool in the analysis and understanding of pelagic ecosystems. However, until very recently (Rodriguez & Mullin, *in press*) the basic question of whether there is a simple relationship between the biomass (as the amount of living material per unit of environmental area or volume) and the size of planktonic organisms remained unanswered. Rodriguez and Mullin (*op. cit.*) have demonstrated that this relationship exists at least for the plankton of an oligotrophic ecosystem such as the central gyre of the North Pacific Ocean. A log-log plot of biomass vs. size is linear with a negative slope.

However, what is the situation in ecosystems far from the stationary character of the oligotrophic ocean?, how do fluctuations and perturbations propagate along a spectrum of sizes and biomass?. In the coastal waters of the Mediterranean Sea it is frequent to observe sharp fluctuations in plankton biomass. In such a case we expected to find: A) High variability in the slope of the more or less characteristic biomass spectrum, and B) A fluctuation in the photoautotrophic size range to propagate along the biomass spectrum like a damped wave of energy, possibly with resonant effects.

We tested these hypotheses on the winter fluctuation depicted in figure 1 of Jimenez et al. (this volume). Methods are basically described in that paper but there are supplementary samples studied. Approximately 30 L of sea water were filtered through a 45 µm mesh for microplankton analyses. Zooplankton was sampled by means of Bongo-type nets, equipped with 100 and 200 µm mesh respectively and flow-meter; hauls covered the euphotic zone. A combination of microscopical techniques and image analysis permitted us to characterize each sample as a biomass spectrum.

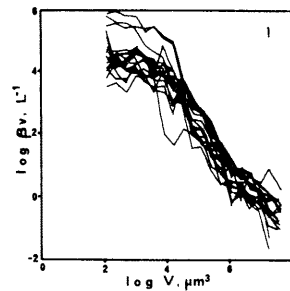


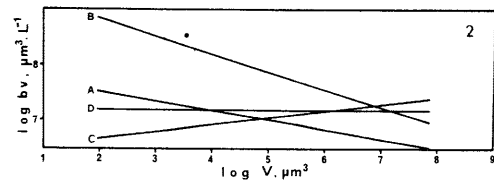
Figure 1 represents spectra variability during the fluctuation studied. These spectra are normalized, that is, $\beta(v_i) = b(v_i) / \Delta v_i$, where $b(v_i)$ is the absolute value of biomass and Δv_i is the width of each size class. In the log₂ scale of sizes used (see Jimenez et al., this volume), $\Delta v_i \sim v_i$; assuming that all the organisms in any size class have the same size, then these normalized spectra would be equivalent to density spectra.

Covariance analysis was used to define groups of spectra on the basis of existing significant differences in slope and position. In figure 2 we represent the dynamics of de-normalized groups of spectra which show how the fluctuation propagates. The fluctuation implies an increase of total biomass as well as the increase of the negative slope of typical winter spectrum (from A to B). With time, the slope becomes positive (C); this is supposed to be an unstable situation with most of the biomass in consumers. A resonant-like effect takes place and the spectrum approaches the zero slope again (D).

Further development of this approach is important, among other things, because it permits to characterize the planktonic community and the pelagic ecosystem in a rapid, repetitive and objective way.

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