Seasonal Changes in Mass Flux and Fecal Pellet Sedimentation at Monaco

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Since January 1989 a sediment trap (0.125 m^2 aperture) has been deployed 3 nautical miles off Monaco at 80 m depth (120 m above the bottom). Mass and fecal pellet fluxes have been measured weekly and variations in the pellet composition determined (Fig 1). High mass fluxes are associated with rainfall and high wind speed from SE and NW rather than with phyto- and zooplankton abundance (meteorological data kindly provided by "Sémaphore de Ferrat"; plankton data provided by M. Boisson, CSM Monaco). The highest pellet fluxes, both in number and in mass, occurred in november-december where they accounted for a maximum of 51% of the total mass flux. At this time salp pellets (2-4 mm) dominantly contributed to the high mass flux of pellets whereas ovoid pellets (200-400 μm) were by far the most abundant by number. The latter presumably have been produced by amphipods since their exuviae were collected in the trap in great numbers as well during that time (Fig 1b). Cylindrical pellets of various sizes, as produced by copepods and euphausiids, were more consistently present throughout the year though they also showed a fall-winter maximum. Despite the relatively few samples obtained during the spring phytoplankton and zooplankton blooms it seems that few fecal pellets were in fact sinking out of the water column at those times. This surprisingly low contribution of the pellets to the vertical mass flux at the time of maximum zooplankton abundance supports the hypothesis that coprophagy and coprorhexy (Lampitt et al, 1990) indeed may play an important role in preventing losses from the pelagic zone. The possibility that the abundance of sinking pellets in winter is due to a fall-winter zooplankton bloom not previously recorded and/or to a resuspension of settled particles during stormy weather is being investigated.

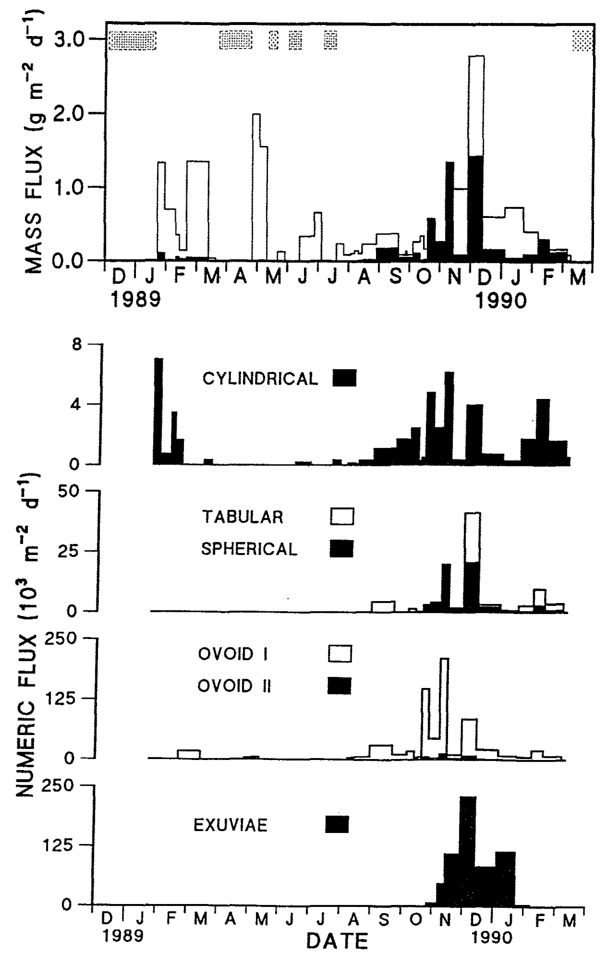

Figure 1. Vertical fluxes at a depth of 80m 3 NM south of Monaco during 1989. (a) Mass flux (excluding swimmers). The contribution of fecal pellets (solid areas) to total mass flux (open histograms) is estimated by the product of abundance of each pellet type and their respective mean dry weight. No data are available for those periods indicated by shading. (b) Flux of various types of fecal pellets (numbers) and of exuviae. Pellet types were determined by microscopy and are tentatively classed as cylindrical (copepods and euphausiids), tabular and spherical (salps), ovoid I (copepods and amphipods) and ovoid II (copepods and amphipods).

Reference:

Lampitt, RS, Noji, T & von Bodungen, B (1990). What happens to zooplankton faecal pellets? Implications for material flux. Mar.Biol. 104, 15-23.

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Vertical Fluxes of Particulate Material in a Frontal Zone off Corsica

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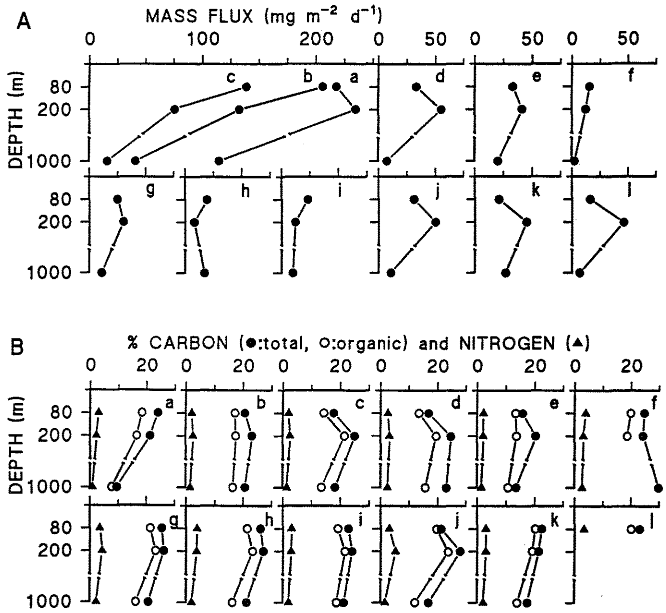
As part of the DYFAMED programme in the Ligurean Sea, cylindrical sediment traps (PPS3, Technicap) were moored 15 nautical miles off Calvi, Corsica, at 80, 200 and 1000 m depth in 2100 m of water from June to November 1987. The mooring site was situated in the Liguro-Provencal front which is persistent throughout summer and fall. At that time of year maximum chlorophyll a concentrations (ranging from 0.3 to 0.4 μg Chl a l^{-1}) are found at 60-80 m depth in June and 30 to 60 m depth in October (Hecq et al., 1986).

Mass flux integrated for 10 day collection periods and carbon and nitrogen composition were determined in the trap samples. In the upper 200 m, total mass flux was higher during June-July, exceeding 200 mg m^{-2} d^{-1}, and thereafter decreased to approximately 20-50 mg m^{-2} d^{-1} (Fig.1A). At 1000 m, the flux was generally lower than in the euphotic zone although it was relatively high (about 100 mg m^{-2} d^{-1}) at the beginning of the experiment. The pattern of carbon and nitrogen flux with depth closely followed that of mass flux except during the first period in which the increase in mass flux at 200 m was not associated with a concomitant increase in carbon and nitrogen fluxes.

Figure 1. Sediment trap observations at 3 depths, 15 NM off Calvi, Corsica.(A) vertical flux of particulate material for 10 day periods (a:22 June-2 July, b:2-12 July, c:12-22 July, d:22 July-1 August, e:1-11 August, f:11-21 August, g:11-21 September, h:21 September-1 October, i:1-11 October, j:11-21 October, k:21-31 October, l:31 October-10 November). (B) carbon and nitrogen composition in % dry weight of particles.



The carbon (total and organic) and nitrogen content of the particles was not correlated with total mass flux (Fig.1B); increases in mass flux were associated with either increases or decreases of C and N content. Mean values for total and organic carbon and nitrogen were consistently lower at 1000 m, although this relationship was not statistically significant. In the upper 200 m particles were normally less enriched in carbon and nitrogen at 80 m. Most of the carbon in the particles was of biological origin; the organic fraction accounted for an average of 84% of the total carbon at 80 m, 82% at 200 m, and decreased to 78% at 1000 m. Organic C/N weight ratios also show a continuous trend, increasing from an average of 6.2 at 80 m, 6.4 at 200 m, to 7.9 at 1000 m. This observation suggests that fresh biological material produced close to the surface degrades during its descent through the water column.

The higher flux of particles with lower carbon-nitrogen content noted during the period 22 June-2 July appeared to be due to a particle input associated with strong winds, exceeding 70 km h^{-1}, that were present for several days before the sampling started. On the other hand, the fluctuations in mass flux observed thereafter are most likely related to biological activity in the upper layers of the water column.

Reference:

Hecq, JH, Bouquegneau, JM, Djenidi, S, Frankignoulle, M, Goffart, A and Licot, M (1986). Some aspects of the Liguro-Provencal frontal ecohydrodynamics. In: Nihoul, JCJ (ed.), Marine Interfaces Ecohydrodynamics, Elsevier Oceanography Series 42, 257-271.