Appendiculaires mésopélagiques, indicateurs potentiels des couches riches en matière organique

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L'étude des couches profondes est techniquement complexe. L'utilisation des submersibles pour l'échantillonnage et l'observation devient une méthode importante permettant de mieux comprendre le fonctionnement et la distribution des populations dans la colonne d'eau, et permet aussi l'estimation et le prélèvement des particules organiques en suspension (Youngbluth 1984).

Malgré le petit nombre de campagnes océanographiques consacrées à l'étude du milieu aphotique marin à l'aide de submersibles, il apparaît que le macrozooplancton gélatineux joue un rôle plus important que prévu dans le flux de la matière organique. De manière générale, ces animaux délicats généralement détruits par les méthodes classiques de capture appartiennent aux différents groupes zoologiques: Ctenophora, Cnidaria, Siphonophora, Tunicata. Les filtreurs gélatineux, herbivores, exercent une pression trophique importante sur la production phytoplanctonique. La rapidité de leur développement entraîne des pullulations saisonnières. D'autre part les prédateurs gélatineux, semblent contrôler l'expansion des herbivores majeurs dans l'océan (Andersen and Nival 1986).

Un nombre de travaux croissant montre l'importance des appendiculaires dans le processus de production, d'agrégation et de transport des particules organiques (Alldredge and Silver 1988). Selon Davoll et Youngbluth (1990), la présence de ces filtreurs à des profondeurs allant jusqu'à 1000 m est universelle et peut contribuer significativement (5-10%) au transfert du carbone organique vers les couches plus profondes.

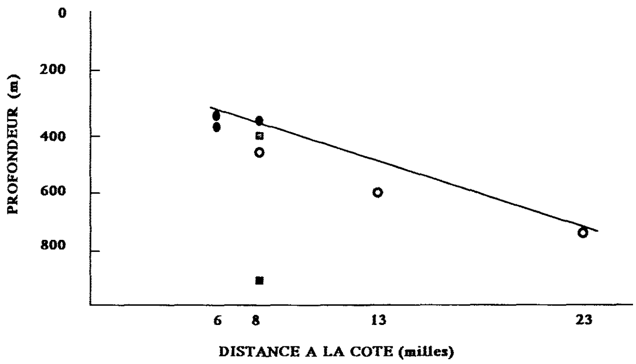
Plusieurs campagnes océanographiques utilisant le submersible CYANA (IFREMER) et son navire porteur, le NOROIT (IFREMER), ont été effectuées dans la zone du front Liguro-Provençal, sur la radiale Nice-Calvi, entre les années 1985 et 1989. La présence d'un appendiculaire mésopélagique du genre *Oikopleura* (nov. sp.), en cours de description (R. Fenaux com. pers.), a été mise en évidence. Les observations ont démontré sa présence indépendamment de l'année ou de la saison (Laval et al. 1989 et observations non publiées). La profondeur de sa première apparition dans la colonne d'eau augmente avec la distance à la côte (voir Figure).

La zone examinée est la zone d'un front permanent où la circulation entraîne la biomasse des couches superficielles vers les profondeurs (Boucher et al. 1987). Cette biomasse semble être la source nutritive de ces filtreurs. Selon les résultats obtenus durant différentes campagnes, on observe une augmentation de la concentration de la matière organique et les valeurs maximales se trouvent dans la couche des appendiculaires mésopélagiques (données non publiées).

Lors des plongées effectuées durant la campagne MIGRAGEL II (observateur M. Youngbluth), une autre espèce d'appendiculaires appartenant probablement au genre *Pelagopleura* a été observée à partir des profondeurs avoisinant 800 m.

Les appendiculaires sont des filtreurs passifs ayant une courte durée de cycle vital et peu de réserves lipidiques. Ils sécrètent des structures mucilagineuses à l'aide desquelles ils filtrent et ingèrent des particules en suspension. Ils abandonnent périodiquement ces structures pour en sécréter des nouvelles (Fenaux 1985). Ainsi ils modifient le spectre de taille des particules dans leur environnement par l'agrégation des particules de petite taille en grandes amas mucilagineux. Ces amas deviennent des microcosmes ayant une activité biologique (Davoll and Silver 1987). Récemment il a été démontré que les couches où l'on trouve les populations d'appendiculaires mésopélagiques sont celles pour lesquelles l'oxygène dissous a la valeur minimale et l'activité ETS (potentiel respiratoire, Savenkoff 1990) la valeur maximale.

Il est donc possible que des appendiculaires soient des indicateurs des couches riches en matière organique. C'est uniquement en utilisant des méthodes nouvelles (submersibles, caméras et pompes immergées etc.) que l'on pourra valider ou invalider cette hypothèse.



Ci-dessus, les profondeurs de la première apparition de l'appendiculaire mésopélagique observé durant la campagne MIGRAGEL II au printemps 1988. Les cercles noirs représentent les plongées de nuit, le carré grisé la plongée du matin, les cercles blancs les plongées du jour et le carré noir la profondeur de la première apparition du genre *Pelagopleura*. La droite correspond au début de la couche des appendiculaires mésopélagiques.

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The Phytoplankton composition and population enrichment in gelatinous "macroaggregates" in the Northern Adriatic during the Summer of 1989

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Summary

Phytoplankton cell densities in the gelatinous "macroaggregates" were up to 4 orders of magnitude higher than in surrounding water. Microplankton exhibited the highest enrichment factors relative to nano- and picoplankton (20X and 12X respectively). A high association of the diatoms Nitzschia longissima and Nitzschia closterium with the "macroaggregates" suggested aggregate formation at an earlier time or site.

In the summer of 1988 and 1989 dense patches of large (up to 2m maximum dimension) gelatinous mucous "macroaggregates" were observed in the northern Adriatic Sea. The brownish-yellow masses were initially observed in the upper water column, or floating at the surface where they often coalesced into extensive "blankets". Subsequently, the gelatinous masses extended throughout the water column, and by early autumn had settled to the bottom. The "macroaggregates" were similar to but very much larger than "marine snow" aggregates reported from other regions.

Samples were collected along an east-west trans-Adriatic trophic gradient between the Po delta, Italy and the Istrian peninsula, Yugoslavia. Eight to ten "macroaggregates" were collected in syringes by divers at 10 meters, together with samples of the "surrounding" water, fixed with formaldehyde, and stored at 2-3°C until enumeration. Collected "macroaggregates" (N=72) with volumes ranging from 2.5 to 17 ml, were subsequently homogenized and pico- and nanoplankton counted by fluorescence microscopy. Microplankton samples were enumerated by the Utermohl method (Hasle, 1978).

The average population densities of all three size classes in the seawater increased from east to west toward the Po delta area. In contrast, the "macroaggregate" population densities, with the exception of the nanoplankton component, did not exhibit a significant east to west gradient. In fact, there was a tendency for the micro- and picoplankton densities to be higher in the "macroaggregates" at the eastern station.

Densities of all phytoplankton size classes were enriched in "macroaggregates" relative to the surrounding seawater, although the degree varied among different fractions. The levels of enrichment ranged up to four orders of magnitude. The average enrichment factors for the picoplankton ranged from 38 to 668, with means ca. 5-fold higher at the eastern relative to the western side of the transect. The average nanoplankton enrichment factors ranged from 46 to 491, with similar means at the eastern and western sides. The average microplankton enrichment factors ranged from 227 to 13,009, with means 3 to 5-fold higher at the eastern side. The microplankton enrichment was ca. 12-fold higher than the nanoplankton and ca. 20-fold higher than the picoplankton.

The "macroaggregate" enrichment by some microplankton species exceeded 4-5 orders of magnitude. The diatoms Nitzschia longissima/N. closterium showed the highest association with an average enrichment of 12,236X (c.v. 67; n = 64) relative to the surrounding water at 10 m. This strongly suggests that the "macroaggregates" may have accumulated this particular component earlier in time or at a different site. Nitzschia longissima/N. closterium, both temporally and spatially, was the dominant microplankton component in the "macroaggregates", irrespective of changes in the species composition of the microplankton in the surrounding water.

The microplankton population densities in the seawater at the "macroaggregate" collection depth (10 m), were very significantly correlated with the cell densities of "other" species, indicating that species other than Nitzschia longissima/N. closterium made up the bulk of the microplankton population at that depth. However, microplankton cell densities at the surface were strongly correlated with the Nitzschia longissima/N. closterium cell densities, suggesting that this component contributed significantly to the microplankton population at the surface. These interrelationships imply a "macroaggregate" origin higher in the water column than the 10 m depth where they were collected.

Conclusions

- The temporal variations of microplankton cell densities in "macroaggregates" did not reflect variations in cell densities in the surrounding water (c.v. 45 vs 140) indicating that contemporary processes in the "macroaggregates" were independent of those in the surrounding water.
- Very significant correlations between enrichment factors and "macroaggregate" cell densities, combined with poor correlations with seawater cell densities, suggest that growth within the "macroaggregate" was more dependent on the environment within the "macroaggregate" than on contemporary process in the surrounding seawater.
- A consistent dominance by Nitzschia longissima/N. closterium of "macroaggregate" microplankton, in spite of changes in the dominance rank in the surrounding seawater community, further implies that Nitzschia became embedded in the gelatinous matrix at an early stage of "macroaggregate" formation.
- Collectively these tentative conclusions support the concept that the origin of the "marcoaggregates" occurred at an earlier time and/or different site than where they were collected.

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