Egg Production and Viability in the Copepod *Temora stylifera*

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Egg production rates in marine copepods are known to depend on several factors. It has been shown that there is a positive correlation between fecundity and phytoplankton concentration up to a saturation level beyond which reproductive rate remains unchanged. Other studies suggest that variations in food quality interact with food quantity to determine copepod fecundity. However, very little information is available on the viability of these eggs. Viable eggs are defined as those that develop to hatching giving rise to a living nauplius. The concept of egg viability is important for estimating copepod secondary production since it is only this fraction of the total production that is transferred to the next trophic level.

The discarding of non-viable eggs has been reported by many authors in the past and this phenomenon has generally been related to an absence of remating. But IANORA *et al.* (1989) showed that even after remating, hatching success never exceeded 80% and was about 30% for *Temora stylifera* females maintained on a diet of the laboratory-cultured diatom *Thalassiosira rotula* suggesting that factors other than remating determined the production of viable eggs. Recent studies by IANORA and POULET (submtd.) have in fact shown that egg viability or hatching success is strongly dependent on food quality. A dinoflagellate diet (*Prorocentrum minimum*) induced the production of good quality eggs as compared to the diatom *T. rotula*. Here we investigate how diatoms affect egg production and hatching rates in the copepod *T. stylifera*. Diatoms are known to be a major phytoplankton component of productive marine ecosystems and are largely responsible for the spring phytoplankton bloom in most coastal areas of the world. Their role in the feeding biology of copepods has recently been questioned since they may be potentially less nutritious than dinoflagellates or microplankton (KLEPPEL *et al.* 1991).

In this study, zooplankton was sampled in the Bay of Naples from October 1991 and brought to the laboratory within 1h after collection. There, female and male *T. stylifera* couples were sorted individually into crystallizers with 100 ml of 0.45 µm filtered seawater and one of several diatom diets given in excess concentrations *(T. rotula, Chaetoceròs curvisetum, Skeletonema costatum* and *Phaeodactylum tricornutum).* These results were compared to those obtained for couples fed the Prymnesiophyceae *Isochrysis galbana* which is widely used in aquaculture and is presumably a good quality food for copepod egg production. Egg counts, egg viability, spermatophore production and faecal pellet production were monitored daily for each couple which was then transferred with a pipette to a new container with fresh media. Details of methods are reported in IANORA *et al.* (1989).

The results obtained for copepod couples fed either *I. galbana*, *T. rotula* or *C. curvisetum* are shown in the figure. All diets induced egg production but the first two were better than the third for producing more eggs. The diets also differed in their capacity for producing good quality eggs. Hatching success was only about 20% with *T. rotula* and *C. curvisetum* as compared to 79.4% for *I. galbana*. Low egg viability was also observed with the other diatom diets.

IANORA and POULET (submtd.) showed that dinoflagellates were potentially more nutritious than diatoms since they contained higher values of protein, vitamin C, carbon and nitrogen. Our results confirm that diatoms are a poor food item to maintain high egg viability thus placing in doubt the importance of diatoms in the copepod diet. To compensate for a poor quality food, copepods may optimize food conditions by selecting for more nutritious food items such as dinoflagellates. But during periods of high diatom abundances such "selection" may not be possible.

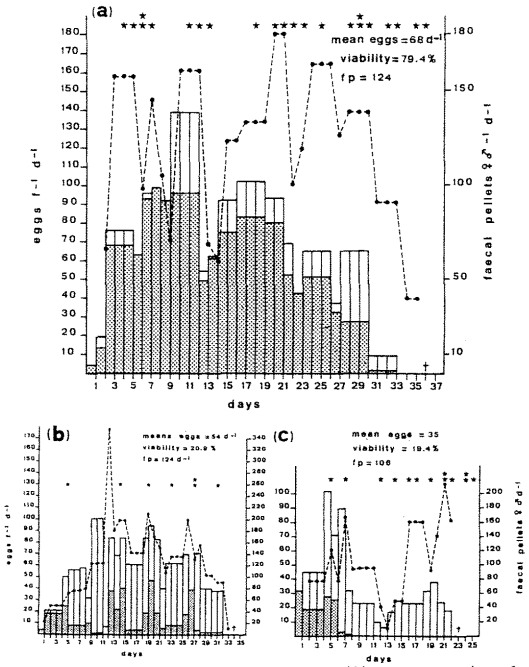

Figure 1: Daily egg production and viability (dark section of histogram), faecal pellet production (dashed line) and spermatophore production (★) for Temora stylifera couples maintained on a diet of (a) Isochrysis galbana1, (b) Thalassiosira rotula and (c) Chaetoceros curvisetum.

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Fertilization mechanisms in the Ibiza Channel (Baleares, Espana) in November 1990 and March 1991.

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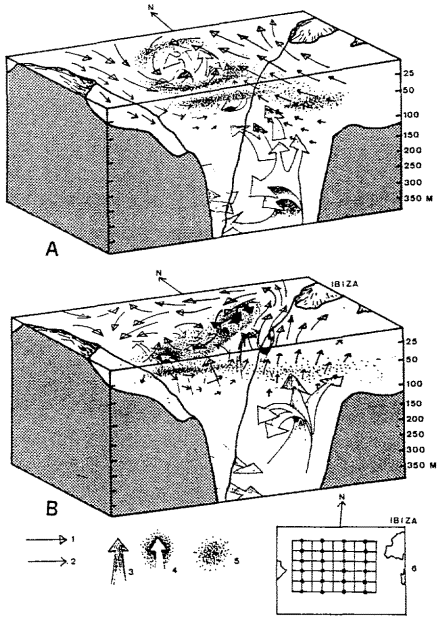
Nutrients dissolved oxygen and chlorophyll distributions are analyzed in relation to hydrographic dynamics (LOPEZ JURADO *et al.* in press) in two different situations observed in cruises carried out in November 1990 and March 1991. Oxygen and nutrients were determined according to STRICKLAND and PARSONS (1972). Chlorophyll a was measured according to spectrophotometric (SCOR/UNESCO, 1966) and fluorimetric (DURAN and JANSA, 1986) methods.

In November (the general analysis of the data is schematized in fig. A), the fertilization process is partially related to the presence of a cyclonic gyre. From nutrient data, a moderate subsuperficial enrichment, as a typical divergence dome in accordance with the gyre, was observed in the central area of the channel. Oxygen saturation percentage distribution showed a similar trend with higher values (> 100 %) more superficial in the central zone of the gyre that in the periphery. At the same time, two chlorophyll a maxima (> 0.5 mg m^{-3}) were observed at 25 m depth at the North and South of the cyclonic gyre respectively. A third maximum at 50 m depth (> 0.8 mg m^{-3}) near Ibiza was observed too, the interpretation of which is more problematic.

In March (fig. B) it appeared a joint process of mechanic accumulation phenomena and a complicated production inputs system, all this are related with a front (in the NE-SW direction) and cyclonic and anticyclonic associated gyres system. Chlorophyll a concentrations are locally important (> 2 mg m^{-3} at 25 m depth) in the frontal area. Also we can observe in this area the maximum nutrient values (nitrates, phosphates and silicates), consequently a water lense appeared between 25 and 50 m depth with deeper water characteristics. Unlikely cruise of November, the dissolved oxygen (> 100 % saturation) is more uniformly distributed in the 0-50 m upper layer.

Considering the two cruises together, the oxygen saturation, from 0 to 50 m depth, is higher than 100 %. Nutrient values are low and very similar to other observations (DEYA, 1978; ESTRADA and MARGALEF, 1988). As well the high chlorophyll a values measured in March have been previously observed in other areas of the Western Mediterranean Sea (DURAN and JANSA, 1986; ESTRADA and MARGALEF, 1988; FORTEZA *et al.*, 1988).



1 : surface current, 2 : subsurface current, 3 : vertical circulation, 4 : coincidence of nutrient supply with chlorophyll a maxima, 5 : chlorophyll a maxima, 6 : stations chart.

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