

Histology of the gonads of *Rhopilema nomadica* (Cnidaria, Scyphozoa)
First observations

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The jellyfish *Rhopilema nomadica* (GALIL, 1990) - a new lessepsian migrant into the Mediterranean (GALIL *et al.*, 1990) - has been appearing since the mid-1980's in large swarms along the Levantine coast. During massive swarming periods dense aggregations of up to 25 specimens per cubic meter were observed to extend more than a 1000 m² - an enormous mass of jellyfish. Mass swarming occurs mostly in summer, during July and August, but a sizable presence has been witnessed during winter too, with individuals bearing mature gonads occurring during both summer and winter.

Laboratory studies of the life cycle of *R. nomadica* (LOTAN *et al.*, 1992) and its congener *R. esculenta* Kishinouye (DING & CHEN, 1981), have supplied us with descriptions of the various developmental stages. However, the duration and rhythm of the reproductive period in the natural environment are still unknown. In order to assess the duration of the reproductive period, we have analyzed the histological structure of the gonads of *R. nomadica* as part of a joint research effort between the Universities of Trieste, Haifa and the National Oceanographic Institute of Israel to study the biology, morphology and distribution of the new lessepsian migrant.

The four ribbon-like gonads are situated on the subumbrellar surface of the gastrovascular cavity, over the proximal portion of the perradial canals, at the base of the arm disc. The gonad is situated over the lateral borders of the scapulets, on the lateral wall of the gastric pouch, distally close to the emergence of the perradial canals in the scapulets and proximally divergent; viewed from below they seem V-shaped. Each gonad seems to be divided into two segments, so that at low magnification they seem as four pairs.

At the base of each gonad are found several small gastric filaments, bearing numerous nematocysts (mainly of eurytle type). Distally close to them there is the emergence of the evagination of the gonad, which is delimited by a monostratified layer of endodermal cells, cylindrical in the gastric pouch surface and flattened in the inner surface (which delimits the genital sinus). The latter layer (the secondary endoderm) gives rise to the follicles (in the testicles) and to the oocytes (in the ovaries).

In the male gonad the follicles are initially sub spherical and compact. Later, they turn polygonal. The follicles are monostratified in the gonadal ribbon. Each follicle is delimited by a monostratified wall of cubic cells which, mainly in the side opposite the secondary endoderm, gives rise to the first elements of the spermatogenesis. All specimens with umbrella diameter larger than 12 cm contain fully developed sperm. The trigonal sperm heads are positioned in the middle of the follicle, while their flagella, often packed in parallel bundles, are placed near the side in contact with the secondary endoderm. In mature follicles the cells in contact with the secondary endoderm are much flattened and, during sperm discharge, may separate and/or degenerate, allowing the sperm to exit into the genital sinus.

In the ovaries we observed no maturation gradient and the oogonia seem to originate everywhere in the secondary endoderm, which cells are flattened or cuboid. Different stages of oocyte development may be observed in each gonad. A mature oocyte measures about 100 µm in diameter. The oocytes adhere to the secondary endoderm, though they do not seem to form a distinct cell population. The cytoplasm development during vitellogenesis is similar to that observed in *Rhizostoma pulmo* (AVIAN & ROTTINI SANDRINI, 1991).

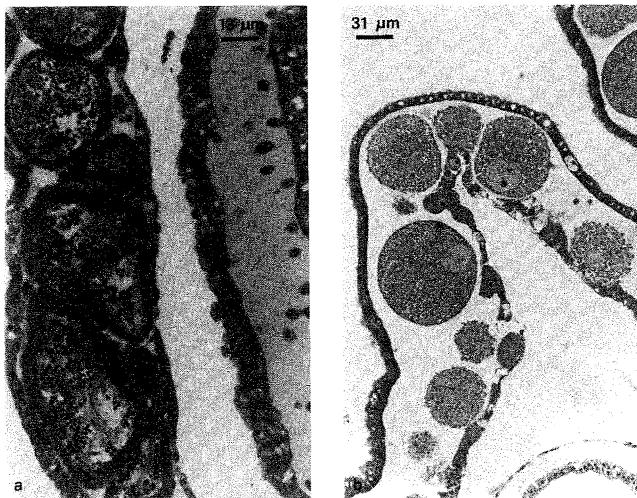


Fig. 1. a, light micrograph of a male gonad. b, light micrograph of an ovary.

Fecundity in *R. nomadica* seems very high, with estimated egg masses of 34×10^5 in specimens with umbrella diameter of 30-40 cm. This high fecundity, together with an extended reproductive period may be the key to the rapid expansion of its populations along the Levantine coast.

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Resting eggs from the bottom muds of the Mar Piccolo (Taranto - Italy)

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Many organisms of neritic and lagoon plankton in temperate areas overcome adverse environmental conditions as resting stages. A number of copepods disappear from the plankton during some periods. They produce resting eggs which ensure the species survival during the unfavourable periods. The hatch of the resting eggs gives again the planktonic population when the favourable conditions return (UYE, 1985).

Sediment cores (from 0 to -5 cm) were collected from different sampling stations in the Mar Piccolo of Taranto at September 1991. In all the stations the ratio sediment silt/clay fraction ($0 < 63.5 \mu\text{m}$) was $\geq 90\%$. According to a tested method (QUARTA *et al.*, in press) the eggs were isolated from the sediment. They were subdivided in 10 morphological types. One of these was recognized as a *Scirpsiella* (Dinoflagellata) cyst. The 9 egg-types were reared in the laboratory under controlled conditions (21°C; 12hL:12hD) in filtered and sterilized seawater. The rearing units were supplied with *Isochrysis galbana* as algal food for hatch from which the species was recognized.

The 76.1 % of the 9 egg types were calanoid spiny eggs. In some cases (e.g., KASAHARA *et al.*, 1974) the spiny eggs were identified as resting stages of calanoid acartia. In *Acartia latisetosa* the spiny eggs were of two types: with short spines (subitaneous), and with long spines (diapausia) (BELMONTE, 1970).

The hatched nauplii were easily identified as *Acartia* nauplii (SAZHINA, 1985). Those hatched from spiny eggs A and B of Fig.1 gave respectively *Acartia* (*Paracartia latisetosa* (KRICZAGUIN) 1873, and *A. josephinae* CRISAFI 1976. For this last species this is the first description of the egg stage.

The egg density in the sediment diminished under the first cm (Fig.2) and in deeper layers the eggs with long spines were more abundant than in the surface layer. The chorion ornamentals are recorded also from other zoological groups (i.e., Rotifera and Tardigrada) which lay their eggs in the sediment. These structures probably favour the egg survival in the sediment keeping mud particles away from the egg surface and/or avoiding predation. Such ornamentals may be species-specific (e.g., among Tardigrada) and we think that more detailed morphological studies (e.g., at SEM) probably will allow us to better identify also calanoid species.

It was not possible to correlate the egg position in the core with the age, e.g., the resting time of the eggs. For this purpose, some spiny egg from deeper layers of sediment were put under stressed conditions (4°C; in the dark) for 60 days. When these eggs were exposed to rearing conditions (21°C, 12hL:12hD) the most of them hatched after 1-20 days.

These resting eggs should restore the acartiid plankton populations in the Mar Piccolo once the adverse period ended. In fact this sediment "egg bank" held up to 4,000,000 viable eggs per m² of sediment (within 5 cm of thickness), all potentially able to give nauplii.

The massive appearance of acartiids in some periods of the year and in some areas (swarms), and in general their population dynamics, must take in account the ecology of this "seed banks" (*sensu* ALLESSIO-LECK *et al.*, 1989).

Fig.1 Spiny eggs.
A: *Acartia latisetosa*.
B: *Acartia josephinae*.

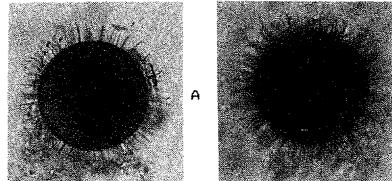
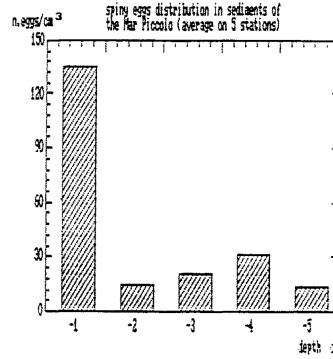


Fig.2



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