OOGENESIS AND FECUNDITY IN BATHYAL PENAEID PRAWNS, *ARISTAEUS ANTENNATUS* AND *ARISTAEOMORPHA FOLIACEA*.

Lidia Orsi Relini and Mirella Semeria

Laboratori di Biologia Marina e di Ecologia Animale — Istituto di Anatomia Comparata
Università di Genova

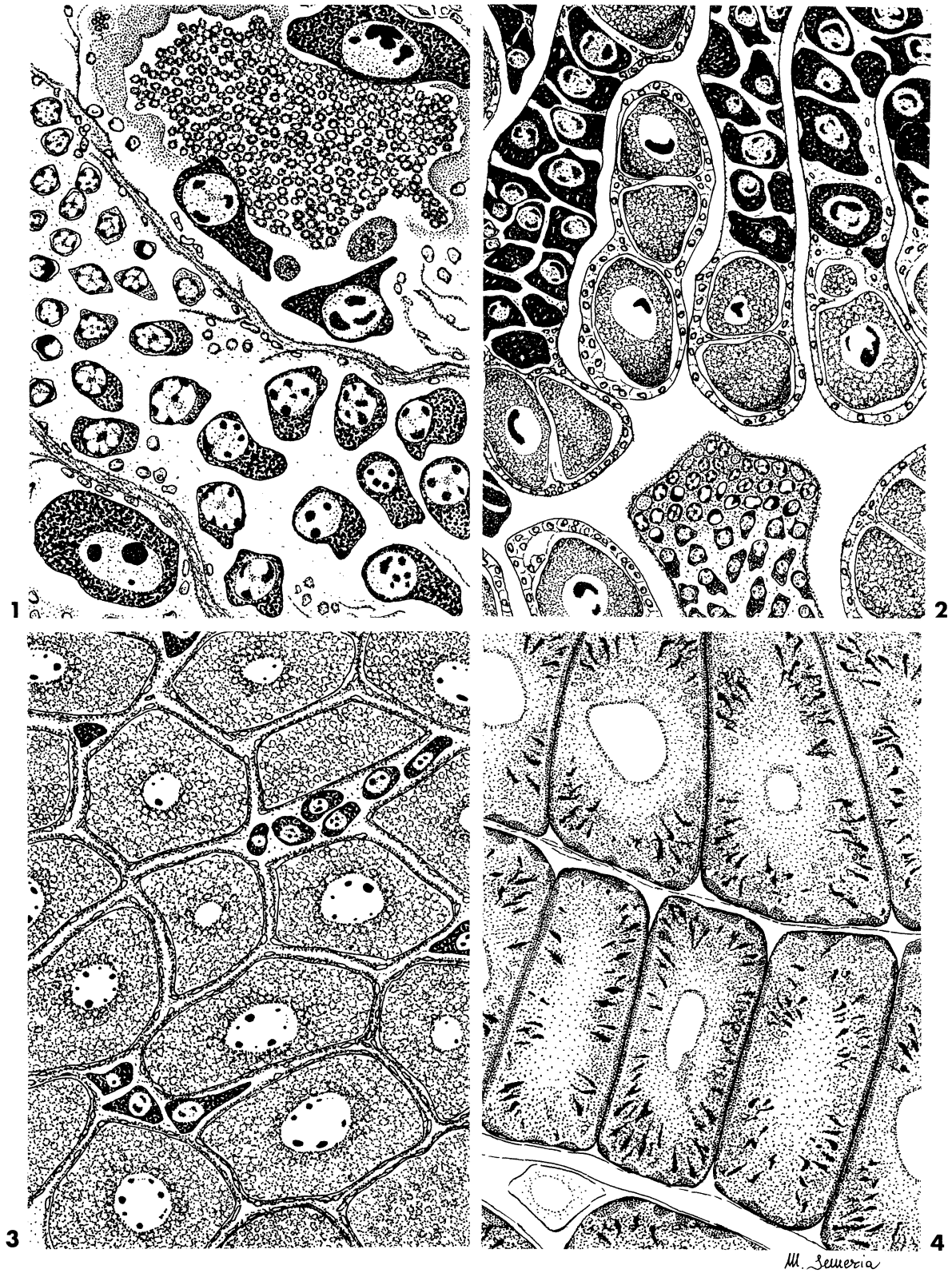
Résumé — L'ovogenèse et la maturation d'*A. antennatus* et *A. foliacea* ont été étudiées par des méthodes histologiques et histochimiques; la fécondité a été évaluée par le comptage des oeufs dans les ovaires mûrs. Dans des complexes oocytes-cellules folliculaires différemment organisées on retrouve le même modèle de synthèse de vitellus. La fécondité réduite de *A. foliacea* est due à une production d'oeufs plus grands.

Summary — Oogenesis and maturation were studied in *A. antennatus* and *A. foliacea* by histological and histochemical methods. Fecundity was evaluated by egg counting in mature ovaries. Similar patterns of yolk synthesis were observed in oocyte-follicular cell complexes differently organized. In *A. foliacea* a reduced fecundity is due to the production of larger eggs.

A few years ago — less than 25 — *A. antennatus* and *A. foliacea* were abundant on bathyal trawling grounds of the Ligurian sea; now the stocks are seriously reduced and *A. foliacea* forms only 2.4% of the catches (Relini Orsi et al. 1981). The reproduction of the two species was studied in order to get a better understanding of their ecology. Fecundity was evaluated by eggs counting in mature ovaries: in *A. foliacea* these ones are black and are found mainly from May to October, in *A. antennatus* they are dark violet and are found in July-December. Differentiation and growth of oocytes were studied by histological and histochemical methods in samples collected all year long.

While the ovarian gross anatomy is similar in the two species (gonads are divided in several slender lobes radiating from a dorsal centre) at microscopic level the ovarian parenchyma is divided in lobules in *A. antennatus* and in tubular units in *A. foliacea*. Oogenesis showed many common features. Each ovarian lobe has germinal centers in its basal central region: here the main cell types are ovogonia and cells undergoing meiotic prophase (fig. 1-2). Oocytes arising from germinal cords have basophilic cytoplasm and ameboid properties, particularly when the ovary is recovering after a recent ovulation (fig. 1). Migrating ova, mixed to mesodermal cells, invade the empty stroma; oocytes increase in diameter and the yolk synthesis starts as minute granules in perinuclear position (endogenous yolk).

In *A. antennatus* the ova, when they reach 80-100 u, are enveloped all around by mesodermal cells so that follicles are formed (fig. 3). In *A. foliacea*, after the phase in which


1
2
3
4
M. Semeria

migrating cell cords reinvade the stroma, well defined spatial relations are established both between oocyte and mesodermal cells and among adiacent oocytes (fig. 2): the resulting structure is a tube formed by follicular cells and filled by a single row of oocytes that contact each other like coins in a pile (fig. 4).

As soon as follicles and tubular units respectively are organized, yolk synthesis is enhanced (exogenous yolk). In both species, growing yolk platelets (fig. 3) are characterized by increasing affinities for Bromophenol Blue and Sudan Black B as expected in carotenolipoprotein complexes (Ceccaldi 1968); tyrosine and tryptophan are important components of the protein fraction. Mucin-like substances, that in Penaeids give a peculiar cortical reaction (Hudinaga 1942, Clark et. al. 1980), were traced since when vitellogenesis was not completed, i. e. in ova coloured in light violet and in grey respectively *in vivo*; a P.A.S. positive substance appears around the nucleus in long vesicular bodies that move to the surface. In advanced maturity (violet and black ova) club-shaped bodies are situated in the peripheral cytoplasm (fig. 4); in abortive eggs, occasionally retained in the oviduct or still enclosed in the parenchyma in both species, two components of the jelly envelope were observed, an internal P.A.S. positive and an external alcianophilic substance. Mature eggs have an ovoid profile in *A. antennatus* and a cylindrical shape in *A. foliacea*. Measures of the eggs were done both at the dissecting microscope on formalin fixed tissues and on paraffin embedded-stained tissues and the egg volumes calculated as spheres in *A. antennatus* and as cylinders in *A. foliacea*: in the latter the egg volume resulted three-four times larger (about 0.024 mm^3).

As to the volume and weight, the ovary is generally larger in *A. foliacea* than in *A. antennatus* (fig. 5), but mature ova produced in a unitary weight of the parenchyma are generally four times more numerous in *A. antennatus*, as could be expected by the above indicated cell sizes; as a consequence, fecundity ranges between 100,000 and 250,000 ova in each ovulation in *A. foliacea* and 140,000-900,000 in *A. antennatus.*

In conclusion, the anatomical arrangement of ovarian tissue in *A. foliacea* is suited to produce a small number of large ova: also in larvae were observed larger sizes (Heldt 1954-55). Many ecological inferences could be drawn: in our opinion, discussing the better competitiveness of *A. antennatus* versus *A. foliacea*, beside the reasons related to trophic levels (Lagardere 1971-72), also the higher fecundity should be kept in mind.

FIG. 1, 2, 3, 4, DRAWN FROM HISTOLOGICAL PREPARATIONS

1 – *Aristeus antennatus*: above ameboid oocytes phagocytizing yolk remnants of an abortive egg; below a germinative centre. H. e. 400 X.

2 – *Aristaeomorpha foliacea*: early organization of tubular units composed by oocytes and follicular cells; below a germinative centre. H. e. 160 X.

3 – *Aristeus antennatus*: hexagonal pattern of follicles in advanced maturation, ("light violet" ovarian stage). H. e. 160 X.

4 – *Aristaeomorpha foliacea*: mucin like substances in the peripheral cytoplasm in advanced maturation, ("dark grey" ovarian stage). Alcian-Blue-P.A.S. double stain 160 X.

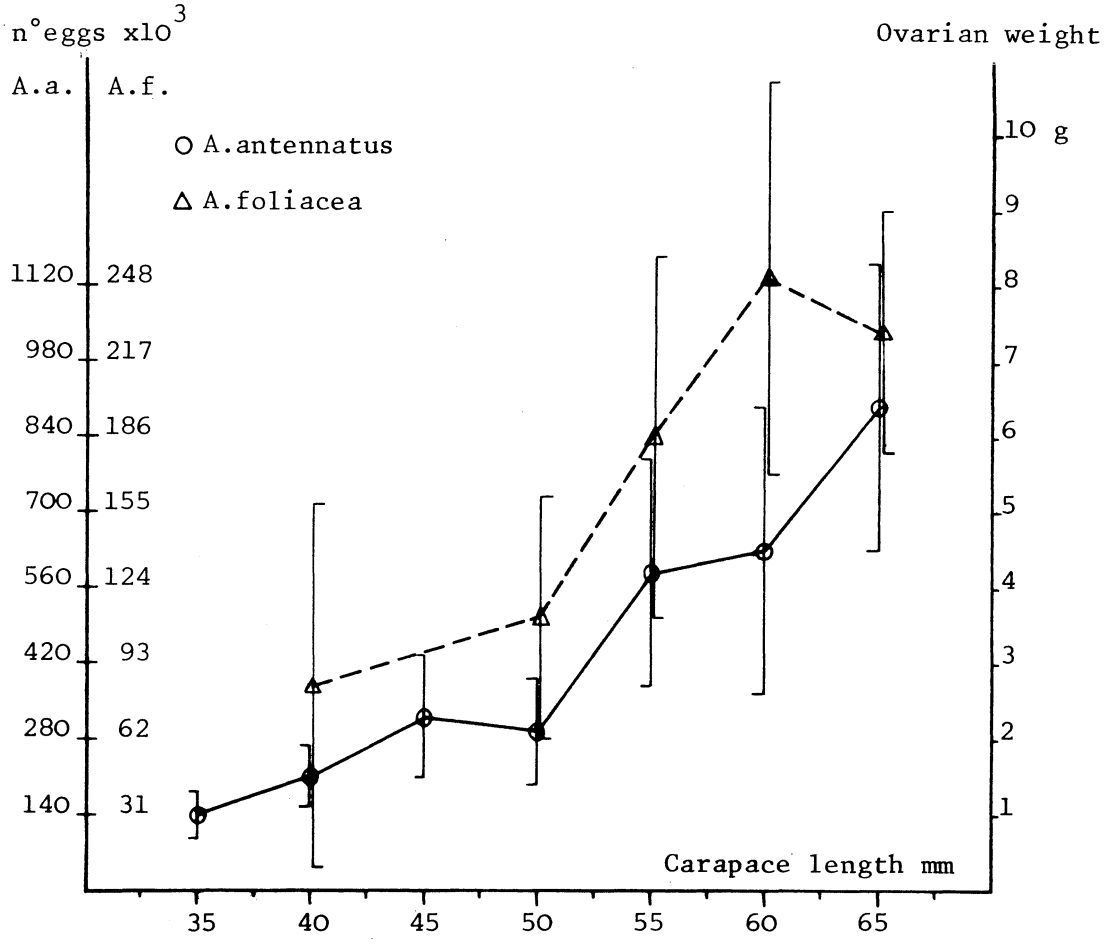


Fig. 5 — Weights of ripe ovaries in *A. antennatus* and *A. foliacea* of different carapace length. Vertical bars are twice the standard deviation. The equivalent number of eggs (thousands) for g of weight is given on the left.

BIBLIOGRAPHY

CECCALDI H. J. 1968 — Contribution à l'étude de la biologie des pigments de *Aristeus antennatus* (Risso 1826). *Rec. Trav. St. Mar. End.* **43** (59), 365-381.

CLARK W. H. Jr., LYNN J. W., YUDIN A. I. and PERSYN H. O. 1980 — Morphology of the cortical reaction in the eggs of *Penaeus aztecus*. *Biol. Bull.* **158** (2), 175-186.

HELDT J. H. 1954-55 — Contribution à l'étude de la biologie des crevettes pènéides *Aristeomorpha foliacea* (Risso) et *Aristeus antennatus* (Risso) (formes larvaires). *Bull. Soc. Sciences Nat. Tunisie* **8** (1, 2), 9-33, tavv. 1-17.

HUDINAGA M. 1942 — Reproduction, development and rearing of *Penaeus japonicus* Bate. *Jap. J. Zool.* **10**, 305-393.

LAGARDERE J. P. 1971 (1972) — Recherches sur l'alimentation des crevettes de la pente continentale marocaine. *Tethys* **3** (3), 655-675.

RELINI ORSI L., ISOLA G., MORI M., RELINI G., VACCHI M. 1981 — Risultati di un quinquennio di osservazioni sulla pesca a strascico profonda in Liguria. *Atti II Conv. Naz. P. F. "Oceanografia e Fondi Marini", Roma.*