

NOTE

Hermaphroditism in *Ruditapes decussatus* (L.) (Bivalvia) from the Galician coast (Spain)*

MARINA DELGADO and ALEJANDRO PÉREZ CAMACHO

Instituto Español de Oceanografía, Centro Costero de A Coruña, Apdo. 130, 15.001 A Coruña, Spain.
E-mail: alejandro.perez@co.ieo.es

SUMMARY: Immature individuals of *Ruditapes decussatus*, collected from the Galician coast (Spain), were maintained in a laboratory open-flow seawater system over a 76-day period at a temperature of 18-20°C and fed with *Isochrysis galbana* clone T-ISO. A histological study of gonad development was performed in subsamples of clams collected every 15 days. Although this species is considered strictly gonochoristic, two individuals displayed hermaphroditism in which both male and female gametes were present. It is suggested that these are cases of consecutive hermaphroditism.

Key words: *Ruditapes decussatus*, carpet-shell clam, hermaphroditism, Galician coast (Spain).

The sexuality of bivalve molluscs ranges from the extreme of strictly gonochoristic to functional hermaphroditism. The sexes are generally divided according to whether their behaviour can be classified as unisexual, dioecious or gonochoristic (Sastry, 1979). Hermaphroditism, which occurs in several species, has traditionally been classified into four different categories: functional hermaphroditism, and consecutive, rhythmic consecutive and alternate sexuality (Coe, 1943). Occasional cases of it have appeared in the literature, as examples of an unusual and extremely infrequent phenomenon in dioecious species such as *Mytilus edulis* (Sugiura, 1962) and *M. galloprovincialis* (Lubet, 1959) or *Ruditapes philippinarum* (Devauchelle, 1990; Ponurovsky and Yakovlev, 1992).

A comprehensive anatomical and histological study of the species with which we are concerned,

Ruditapes decussatus, has previously shown that there is no coexistence of male and female germinal lines in the same specimen, thus confirming its gonochorism (Vilela, 1950). This observation has been subsequently corroborated by other authors studying the same species (Pérez-Camacho, 1980; Shaffee and Daouidi, 1991; Villalba *et al.*, 1993; Xie and Burnell, 1994), as well as species in the same genus (Ponurovsky and Yakovlev, 1992). However, in certain Veneridae, *R. decussatus* being amongst them, Lucas (1968, 1969) observed an occasional early and fleeting manifestation of hermaphroditism in juvenile individuals of between 10 and 20 mm in shell length. The same author described the presence of previtellogenic oocytes, spermatocytes and spermatids in the same follicle as being the most common situation but, due to the poor characterisation of the structures and the transitory nature of their occurrence, he did not venture to definitively specify the existence of juvenile hermaphroditism. These

*Received March 23, 2001. Accepted October 19, 2001.

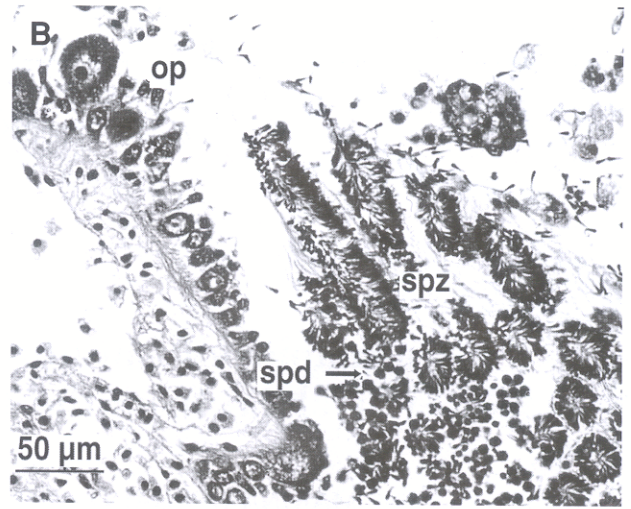
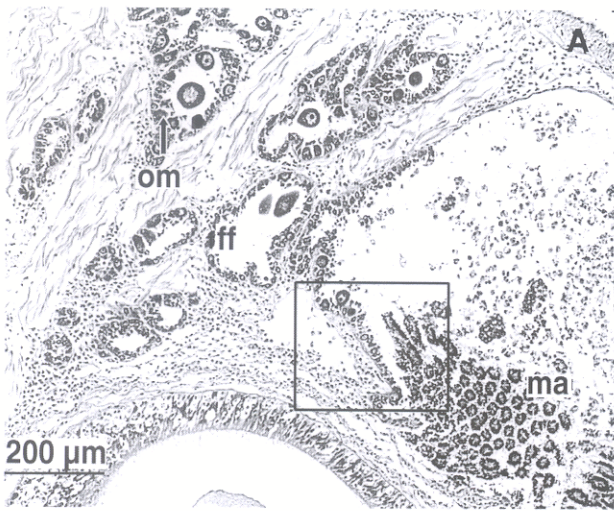


FIG. 1. – *Ruditapes decussatus*, of 24.4 mm in length. **A**, gonad; scale bar = 200 μ m. Abbreviations: ff, female follicle; ma, male acini; om, mature oocyte. **B**, gonad, magnification of squared area in Figure 1A; scale bar = 50 μ m. Abbreviations: op, previtellogenic oocytes; spd, spermatids; spz, spermatozoa.

cases differ widely from the case that we put forward, not only in the type of hermaphroditism they show, but also in the size of the individuals in which this characteristic appears.

In our research into reproduction in *R. decussatus* two cases of hermaphroditism were observed, representing approximately 1% of the population studied. A sample of 150 specimens of *R. decussatus* was taken from the intertidal environment and held in an open-flow system over a 76-day period at a temperature of 18-20°C, during which time they were fed with the microalgae *Isochrysis galbana* clone T-ISO. The size of the individuals was 20-40 mm. Thirty individuals were collected every 15 days during this period in order to carry out a histological

study of gonad development. Portions of the foot and associated gonad were fixed in Bouin's fluid, dehydrated and embedded in paraffin, and 4 μ m sections were prepared and stained with Harris's hematoxyline and eosine.

The two individuals which displayed hermaphroditism were of different size. One individual was 24.4 mm in length, and from its size probably in its first reproductive cycle (Vilela, 1950; Pérez-Camacho, 1980). The other individual was 39.2 mm in length and in its second or third reproductive cycle. In both cases, the female follicles occupied most of the tissue and were at a developing stage of gametogenesis, with their follicle walls covered in previtellogenic oocytes, although an occasional ripe loose

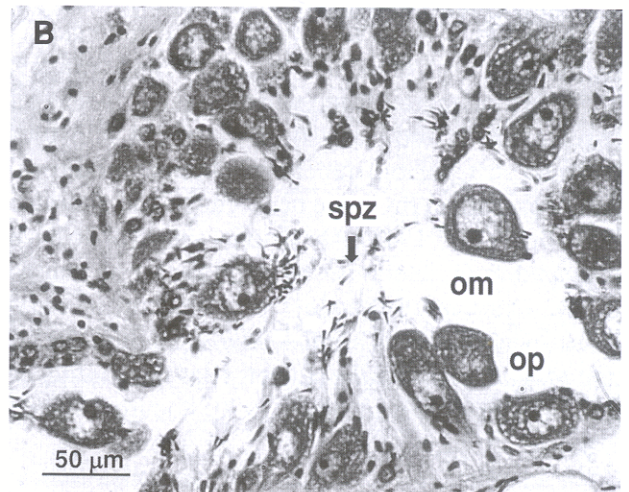
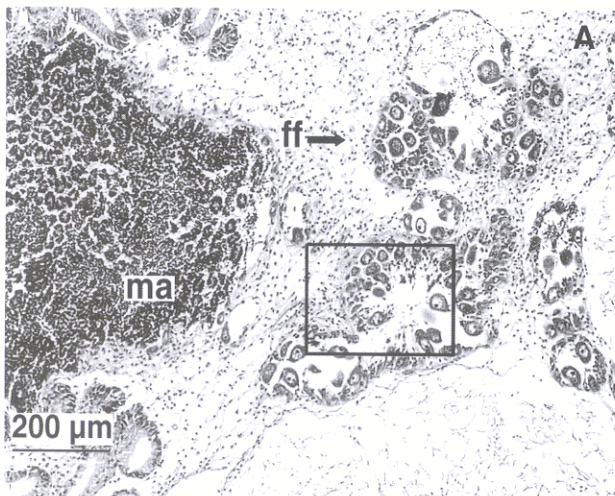


FIG. 2. – *Ruditapes decussatus*, of 39.2 mm in length. **A**, gonad; scale bar = 200 μ m. Abbreviations: ff, female follicle; ma, male acini. **B**, gonad, magnification of squared area in Figure 2A; scale bar = 50 μ m. Abbreviations: om, mature oocyte; op, previtellogenic oocyte; spz, spermatozoa.

oocyte could be identified in the lumen. The male gonadal acini contained large quantities of spermatozoa, spermatids and, to a lesser extent, spermatozoocytes. These were not so abundant in the second individual, but occupied a greater gonadal area in the first smaller bivalve (Fig. 1). In both cases we identified follicles with developing female germinal lines in their walls with groups of spermatozoa in the lumen, a clear sign of a possible previous spawning (Figs. 1B and 2B).

Thus, although *R. decussatus* is considered to be strictly gonochoristic, the conclusion can be drawn that there is the occasional occurrence of individual adult hermaphrodites. Given the presence of the mixed structures described above and the degree of maturity reached by the gametes (female gametes in the early stages of gametogenesis and fully ripe male gametes) (Figs. 1A and 2A), it is possible that there is a change of sex, from male to female, and thus we may have observed a case of consecutive hermaphroditism, which is common in other species of bivalve molluscs such as Oysters (Fretter and Graham, 1964).

REFERENCES

Coe, W.R. – 1943. Sexual differentiation in mollusks. I. Pelecypods. *Quart. Rev. Biol.* 18: 154-164.
 Devauchelle, N. – 1990. Sexual development and maturity of *Tapes*

philippinarum. In: (E.S.A.V., Ed. Verone), *Tapes philippinarum, Biologia e sperimentazione*, 3: 47-62.
 Fretter V. and A. Graham. – 1964. Reproduction. In: K.M. Wilbur and C.M. Yonge (eds.), *Physiology of Mollusca*, Vol. 1, pp. 127-164. Academic Press, New York.
 Lubet, P. – 1959. Recherches sur le cycle sexuel et l'émission des gamètes chez les Mytilides et les Pectinides (Mollusques bivalves). *Rev. Trav. Inst. Pêches. Marit.*, 23: 389-548.
 Lucas, A. – 1968. Mise en évidence de l'hermaphroditisme juvénile chez *Venerupis decussata* (L.) (Bivalvia: Veneridae). *C.R. Acad. Sc. Paris*, 267, serie D: 2332-2333.
 Lucas, A. – 1969. Remarques sur l'hermaphroditisme juvénile de quelques Veneridae (Bivalvia). *Proc. Third Europ. Malac. Congr.*, 9(1): 275-276.
 Pérez Camacho, A. – 1980. Biología de *Venerupis pullastra* (Montagu, 1803) y *Venerupis decussata* (Linné, 1767) (Mollusca: Bivalvia) con especial referencia a factores determinantes de la producción. *Bol. Inst. Esp. Oceanogr.*, 281: 353-358.
 Ponurovsky, S.K. and Y.M. Yakovlev. – 1992. The reproductive biology of the Japanese littleneck, *Tapes philippinarum* (A. Adams and Reeve, 1850) (Bivalvia: Veneridae). *J. Shell. Res.*, 11(2): 265-277.
 Sastry, A.N. – 1979. Pelecypoda (excluding Ostreidae). In: A.C. Giese and J.S. Pearse (eds.), *Reproduction of Marine Invertebrates*, vol. V, pp. 113-292. Academic Press, New York.
 Shaffee, M.S. and M. Daoudi. – 1991. Gametogenesis and spawning in the carpet-shell clam, *Ruditapes decussatus* (L.) (Mollusca: Bivalvia), from the Atlantic coast of Morocco. *Aquacul. and Fish. Manage.*, 22: 203-216.
 Sugiura, Y. – 1962. Electrical induction of spawning in two marine invertebrates (*Urechis unicinctus* and hermaphroditic *Mytilus edulis*). *Biol. Bull.*, 123: 203-206.
 Vilela, H. – 1950. *Vida bentónica de Tapes decussatus*. *Trav. Sta. Biol. Mar. Lisb.*, 120 pp.
 Villalba, A., M.J. Carballal, and M.C. López. – 1993. Estudio del ciclo gonadal de tres especies de almeja, *Ruditapes decussatus*, *Venerupis pullastra* y *Venerupis rhomboides* de las rías gallegas. *Actas IV Congr. Nac. Acuicult.*, 341-346.
 Xie, Q. and G.M. Burnell. – 1994. A comparative study of the gametogenic cycles of the clams *Tapes philippinarum* (Adams and Reeve) and *Tapes decussatus* (Linnaeus) on the south coast of Ireland. *J. Shell. Res.*, 13(2): 467-472.

Scient. ed.: C. Richardson