RESEARCH NOTE

Eggs of *Rossia mollicella* (Cephalopoda: Sepiolidae) deposited in a deep-sea sponge

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During the cruise of the R/V *Tansei-Maru* of the Ocean Research Institute, University of Tokyo, the second author (TS) collected a hexactinellid sponge with eggs of *Rossia*, from bathyal depth in the Sea of Enshu-Nada in Japan, using a 3 m Oregon-type beam trawl (34°20.09′N, 138°00.70′E–34°19.53′N, 138°01.48′E, 563–605.3 m deep at Station EN3-1 in the cruise KT-02-05 on May 25, 2002). This first observation on the spawning habit of deep-sea *Rossia* is reported in this paper.

The specimen of hexactinellid sponge measured *ca*. 11 cm in height and *ca*. 7 cm in diameter. Thirteen eggs were deposited in the oscula of the upper globose part of the sponge (arrowheads in Fig. 1A, B), but none on the 'stalk'. Each egg is firmly fixed to the sponge surface without a specific attaching structure (cf. an attachment ring in the egg of *Sepia*, e.g. Boletzky, 1998), and it is clearly refuted that the eggs were accidentally trapped in the oscula during trawling. In the same sponge, several unidentified fish eggs were also found (fe in Fig. 1A, B). One detached squid egg is slightly ellipsoid, measuring 10.2 mm in major diameter and 8.1 mm in minor diameter (Fig. 1C). Most eggs contain the last-stage embryo ready to hatch (Stage XIX to XX of Naef; Fig. 1C), but some are more immature, still showing the outer yolk sac (oys in Fig. 1D). The medial and lateral branches of Hoyle's organ (Hm, Hl in Fig. 1E) are apparent, but the terminal spine is indistinct. A single individual was removed from the preserved egg capsule (Fig. 1E, F).

The gross morphology of the hatchlings suggests that the present specimens belong to *Rossia* (*Allorossia*) *mollicella* Sasaki, 1920, based on the following characters (Kubodera, 2000; Okutani, 2005): (1) The mantle margin is not fused with the head, but clearly demarcated (Fig. 1E, F). (2) The nuchal cartilage is oval, not attenuated. (3) The arm suckers are biserial. (4) Tentacular suckers are in eight rows (Fig. 1G). (5) The rectum carries no papillae on either side.

In terms of geographic distribution, there are three candidate species in the genus *Rossia* in Japanese waters. Among them, *R. pacifica* Berry, 1911, a subarctic Pacific species, is unlikely to occur in deep waters in this area. *Rossia pacifica* is characterized by attenuating nuchal cartilages and is known to lay eggs in a small cluster on common substrata on the sea bed, such as a fragment of clay tube (J. Nakata, personal communication). The remaining two species, *R. (Austrorossia) bipapillata* Sasaki, 1920 and *R. (Allorossia) mollicella* Sasaki, 1920, have oval nuchal cartilages. These two *Rossia* species are separable by the configurations of pallial organs, but because the pallial cavity of the present specimens is still filled by internal yolk, the present specimens do not exhibit adult characters. The tentacular suckers are not yet fully developed. However, the observation of the tentacular club with a scanning electron microscope revealed that the suckers are developing into approximately eight rows (Fig. 1G) rather than in a diffusing pattern. This character strongly suggests that this embryo belongs to *R. mollicella*. The possession of a pair of papillae on both sides of the rectum, which is one important character of *R. bipapillata*, is not observable in the present specimens. Adults of *R. mollicella* have very soft bodies and large heads wider than the mantle openings, but such tendencies are not yet apparent in the present specimens.

Only limited data on the reproductive biology of the genus *Rossia* have been reported (Anderson & Shimek, 1994; Boletzky, 1998; Mangold, 1989; Summers & Colvin, 1989). The best studied species may be *R. macrosoma* (delle Chiaje, 1829) in the Mediterranean Sea. The species lays 50–100 eggs (7 × 8 mm) on 'normal' substrata (Mangold, 1989). The eggs observed here seem to be fewer in number, but their size is larger than in those of *R. macrosoma*.

Sepiolid eggs are usually laid on coarse substrata and covered with sand grains, shell fragments or even sponge spicules (Arnold, Singley & Williams-Arnold, 1972; Okutani, 1979). There have been only a few descriptions of *Rossia* eggs from sponges or cnidarians (Steenstrup, 1900; Cuenot, 1936; Akimushkin, 1963; Boletzky, 1998). To our knowledge, this is the first report of *R. mollicella* depositing eggs in a deep-sea hexactinellid sponge.

Egg deposition in sponges is a rare phenomenon in cephalopods. In addition to sepiolids, some shallow-water Sepiidae, such as *Sepia orbignyiana* Férussac in Orbigny, 1826 (Akimushkin, 1963; Mangold, 1989), *S. erostrata* Sasaki, 1929, *S. tokioensis* Ortmann, 1888 and *S. misakiensis* Wülker, 1910 (Tsuchiya, 2002), are also known to use sponges as substrata for egg-laying. Functionally, laying eggs in sponges is probably advantageous in defence against predators and may increase the supply of oxygen through water currents created by the host sponge. The sponges may provide the only hard or semi-hard substrate for egg deposition by *Rossia* in the bathyal depths.

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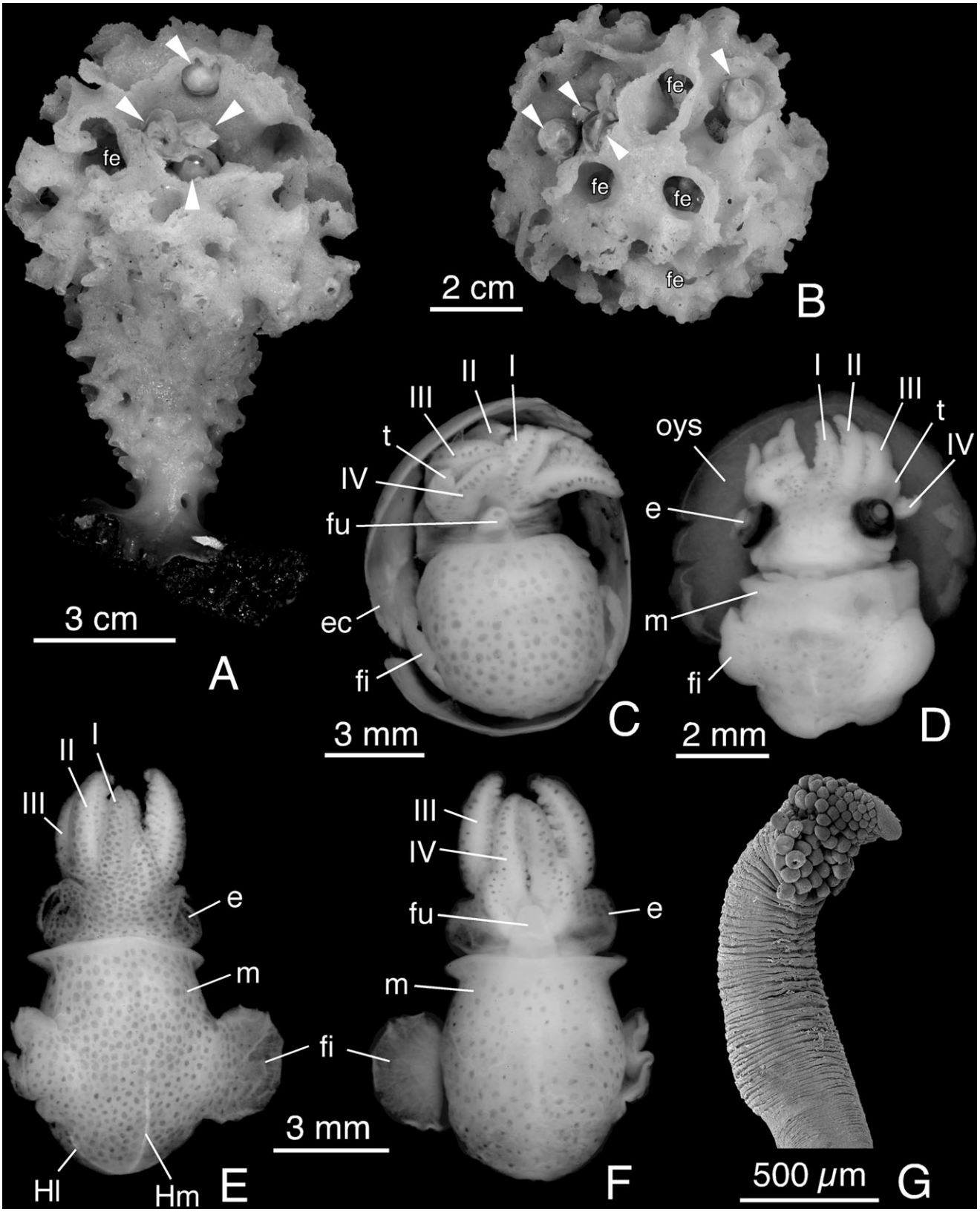

Figure 1. *Rossia mollicella*. **A–B**. Eggs (arrowheads) deposited in a hexactinellid sponge. **C–D**. Embryo. **E–F**. Hatchling. **G**. Enlarged view of tentacle of hatchling. Material is deposited in Department of Historical Geology and Palaeontology, The University Museum, University of Tokyo (UMUT). **A, B**, UMUT RM29006; **C**, UMUT RM29007; **D**, UMUT RM29008; **E–G**, RM29009. Abbreviations: e, eye; ec, egg capsule; fe, fish egg; fi, fin; fu, funnel; Hl, lateral branch of Hoyle's organ; Hm, median branch of Hoyle's organ; I–IV, arms I–IV; m, mantle; oys, outer yolk sac; t, tentacle.

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