The Spionidae (Polychaeta) act as invertebrate hosts for marine Myxozoa

M. Køie*

Marine Biological Laboratory, University of Copenhagen, DK-3000 Helsingør.

Abstract
Actinosporean stages including spherical pansporocysts and oval tetractinomyxon actinospores about 8 µm long were found in two unidentified spionid polychaetes in the northern Øresund, Denmark. The myxosporean stages in fish are unknown. Members of the Spionidae occur worldwide and at all depths and it is likely that they act as invertebrate hosts for several species of Myxozoa.

Marine actinospores have been recorded in both oligochaetes, polychaetes and in a sipunculid worm (see Køie 2000, 2002). Those found in polychaetes and in the sipunculid worm are of the tetractinomyxon type. Only two two-host life cycles with tetractinomyxon actinospores are known: *Ceratomyxa shasta* Noble, 1950 (Ceratomyxidae) uses the freshwater polychaete *Manayunkia speciosa* Leidy as invertebrate host (Bartholomew et al. 1997) and *Ellipsomyxa gobii* Køie, 2003 (tentatively placed in the Ceratomyxidae, see Køie, 2003) uses the marine polychaetes *Nereis* spp. as invertebrate hosts (Køie et al., 2004). Tetractinomyxon actinospores have until now been found in polychaetes belonging to the following families: Sabellidae, Nereidae, Spirorbidae and Serpulidae (Bartholomew et al., 1997; Køie, 2000; 2002; Køie et al. , 2004).

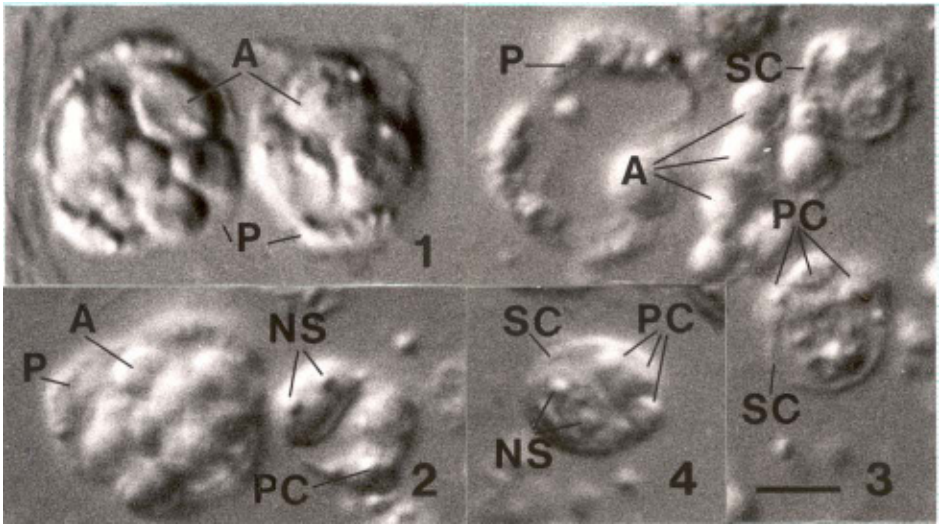
The material used in this study was collected in the northern Øresund, Denmark, in December 2004 and January 2005. Benthic samples were taken with a dredge at depths of 12 and 18 m. Polychaetes were removed from sieved (mesh size 1.0 mm) bottom material under a binocular microscope. Fresh squash preparations of whole polychaetes or pieces of polychaetes were examined at high magnification.

All polychaetes in the present material were examined but only two specimens belonging to the family Spionidae were found infected with actinosporean developmental stages. Both infected worms were too damaged to be identified to genera but their affiliation to the Spionidae was evident. In all about 200 spionid specimens were examined. The less than 1 cm long threadlike spionids occurred in flexible tubes of fine sand grains. Two (about 1 %) of the examined spionid worms were infected.

The infected spionid worm from 18 m harboured immature pansporocysts only (Figure 1), whereas that from 12 m contained both pansporocysts and apparently fully developed actinospores (Figures 2-4).

The actinosporean developmental stages were found outside the flattened polychaetes. It is

*Corresponding author's email: mkoie@bi.ku.dk



Figures 1 to 4. Fresh squash preparations of actinosporean stages from spionid polychaetes, the northern Øresund, Denmark. **1** from 18 m, **2-4** from 12 m. **1.** Pansporocysts with undeveloped actinospores. **2.** Pansporocyst with undeveloped actinospores and an apparently fully developed actinospore. **3.** A ruptured pansporocyst with undeveloped actinospores and two apparently fully developed actinospores. **4.** An actinospore. A: undeveloped actinospore; NS: nucleus of sporoplasm; P: pansporocyst; PC: polar capsule; SC: shell valve cell. Interference contrast. All to same scale. Scale bar = 5 μm.

unknown where they occur in an undamaged host, but they did not appear to live in the digestive tract. Each infected worm released only a few pansporocysts. The subspherical pansporoblasts in both spionid worms measured 11-14 μm in diameter. It was possible to count eight actinospores in a few of the examined pansporocysts.

The oval actinospores of the tetractinomyxon type measured 8-9 x 6-7 μm. Each actinospore is composed of eight cells, each with a nucleus. Only the nuclei of the binucleate sporoplasm were very large and distinct (Figures 2 and 4). One nucleus surrounds each of the three spherical polar capsules, which were 1.5 μm in diameter. The three nuclei of the shell valve cells were indistinct.

It is unknown whether the present material represents one or two species. Pansporocysts show little morphological variations. Most of the known pansporocysts contain eight actinospores and are more or less spherical, one has a constriction. Also the known tetractinomyxon actinospores show little morphological variation. They may be tetrahedal, conical, spherical or oval, all are without appendages. They measure about 10μm in diameter (Ikeda ,1912; Bartholomew et al., 1997; Køie, 2002; Køie et al., 2004).

Neither the morphology of the pansporocysts nor the morphology of the actinospores makes these stages suitable for taxonomic diagnosis. The myxosporean stages, especially the myxospores, are more suitable for taxonomic diagnosis, even though, preferably, both the

myxosporean and actinosporean developmental stages should be used for a confident taxonomic diagnosis. However, this is unrealistic, since the actinosporean developmental stages are known for only a few percent of the known freshwater myxozoan species, and for only one of the hundreds of known marine myxozoan species (see Køie et al., 2004). A new species of Myxozoa should not be described based solely on their actinosporean stages (see also the discussions by Kent & Lom (1999) and Lester et al. (1999)).

The Spionidae is a large family with members living both littorally and sublittorally to considerable depths. Members of the Spionidae are benthic deposit feeders, which use the two long tentacle-like palps for feeding, both free in the water or on the bottom. They occur among inhabitants on rocky shores or in bottom of shingle, sand and mud. They are free-living, tube living or burrowing in shells or limestone. Where the food is plentyful they may occur in enormous densities. Many are cosmopolitan. These ubiquitous worms are potential hosts for myxozoans at greater depths where suspension-feeding polychaetes, such as members of the Sabellidae, Spirorbidae and Serpulidae, are rare or absent.

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First occurrence of the invasive alien species Polydora cornuta Bosc, 1802 (Polychaeta: Spionidae) on the coast of Greece (Elefsis Bay; Aegean Sea). N. SIMBOURA1, K. SIGALA2, E. VOUTSINAS1 and E. KALKAN3. 1Hellenic Centre for Marine Research, Institute of Oceanography, P.O. Box 712, 19013, Anavissos, Attica, Hellas 2 University of Crete, Department of Biology, P.O. Box 2208, 71409, Heraklion, Crete, Hellas 3 Department of Environmental Science, Institute of Environmental Sciences, BogaziÃ§i University, Hisar Campus, TR-34342 Bebek, Istanbul, Turkey.Â According to a recently updated annotated list of alien marine species in the Mediterranean Sea. Medit. Mar. The Polychaeta /ËŒpÉ’lÉªËˆkiËtÉ™/, also known as the bristle worms or polychaetes, are a paraphyletic class of annelid worms, generally marine. Each body segment has a pair of fleshy protrusions called parapodia that bear many bristles, called chaetae, which are made of chitin. More than 10,000 species are described in this class. Common representatives include the lugworm (Arenicola marina) and the sandworm or clam worm Alitta. Â© INVERTEBRATE ZOOLOGY, 2020. Pygospio elegans (Annelida: Spionidae) â€” an annelid model for regeneration studies. V.V. Starunov. 1.Â It also displays a variety of feeding strategies and can act as a deposit-, suspension-and probably filter-feeder (Hempel, 1957). P. elegans displays opportunistic life strategy and takes advantage of the â€œpioneerâ€ niche rapidly re-colonising defaunated substrates (McCall, 1977; Morgan, 1999). Sexual reproduction and larval develop-ment.Â Animals were collected at the intertidal zone near the marine biological station Dalnie Zelen-tsi (Barents Sea, 69Â°07â€² N, 36Â°05â€² E). The animals were kept at 18 Â°C in plastic bowls filled with sand and artificial sea water (Red Sea Coral Pro Salt) with salinity about 32â€°. Annelid worms are known to act as hosts in the life cycle of some myxo-zoans (KENT et al. 2001). There are currently approximately 1350 described myxozoan species, in 55 genera (KENT et al.Â With the global expansion of marine and freshwater fish farming many myxozoan diseases have gained prominence. (MOSER & KENT 1994), although the effect. of myxozoan diseases on wild fish remains largely unknown.Â Molecular data implicate bryozoans as hosts of PKX (Phylum Myxozoa) and identify a cla-de of bryozoan parasites within the Myxozoa. â€” Parasitology 119: 555-561. BERRA T.M. (2001): Freshwater Fish Distribution. Overall, species sequenced from hosts belonging to Leuciscidae, Cyprinidae and Labeoninae grouped to form multiple distinct subclades within the tree topology.Â Thus, the discernment of phylogenetic patterns related to the invertebrate host may reveal other evolutionary signals that were decisive in the evolution of these parasites. Myxobolid biodiversity in endemic Iberian cypriniforms. A review of the available literature found 12 myxosporean species that have been reported from cypriniform hosts in the Iberian Peninsula.Â The joint evolution of the Myxozoa and their alternate hosts: a cnidarian recipe for success and vast biodiversity. Molecular Ecology, 27, 1651â€“1666. 31. Hudson PJ, Dobson AP, Lafferty KD.