

## NOTE

**Hyperparasitism of *Amyloodinium ocellatum* (Dinoflagellida: Oodinidae) on *Neobenedenia melleni* (Monogenea: Capsalidae)**

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**ABSTRACT:** During a simultaneous infestation of the gilt-head sea bream *Sparus aurata* by *Amyloodinium ocellatum* (a blastodiniid dinoflagellate parasite on fish gills and skin) and *Neobenedenia melleni* (a capsalid monogenean parasite on fish skin), *A. ocellatum* was found to parasitize not only the fish but the monogenean parasites as well. This observation indicates that *A. ocellatum* is able to obtain the necessary nutrients for its development from a non-piscine host.

**KEY WORDS:** Hyperparasitism · *Amyloodinium* · *Neobenedenia* · *Sparus aurata* · Dinoflagellate · Capsalidae

Infestations of the gilt-head sea bream *Sparus aurata* L. by the gill/skin parasite *Amyloodinium ocellatum* Brown, 1931, a blastodiniid dinoflagellate, and *Neobenedenia melleni* (MacCallum, 1927) Yamaguti, 1963, a capsalid monogenean of the skin, are frequent occurrences in the facilities of the National Center for Mariculture (NCM) in Eilat, Red Sea, particularly during the summer. The 2 parasites have occasionally been seen sharing the same host during simultaneous infestations (Ellis & Watanabe 1993, Colorni unpubl.). *A. ocellatum* is virtually non-specific in its fish host selection (Lawler 1980, Lauckner 1984) and *N. melleni* has been similarly reported to infest several species of commercial fish cultured in tropical seas (Gallet de Saint Aurin et al. 1990, Ellis & Watanabe 1993). Previously known as *Epibdella melleni*, *N. melleni* has been reported to infest many species of tropical fish held in marine aquarium systems (Jahn & Kuhn 1932, Nigrelli 1943). At NCM, *N. melleni* infested, besides *S. aurata*, the cichlid *Oreochromis mossambicus*, which was adapted to full strength seawater, and the dolphin fish *Coryphaena hippurus*.

The present report describes *Neobenedenia melleni* hyperparasitized by *Amyloodinium ocellatum*. The case was observed in July 1993 in a 17 000 l concrete tank in which over 100 adult *Sparus aurata* of about

900 g were found to be heavily infested with *A. ocellatum* and lightly infested with *N. melleni*. Water temperature in the tank was 25 °C and salinity 40‰.

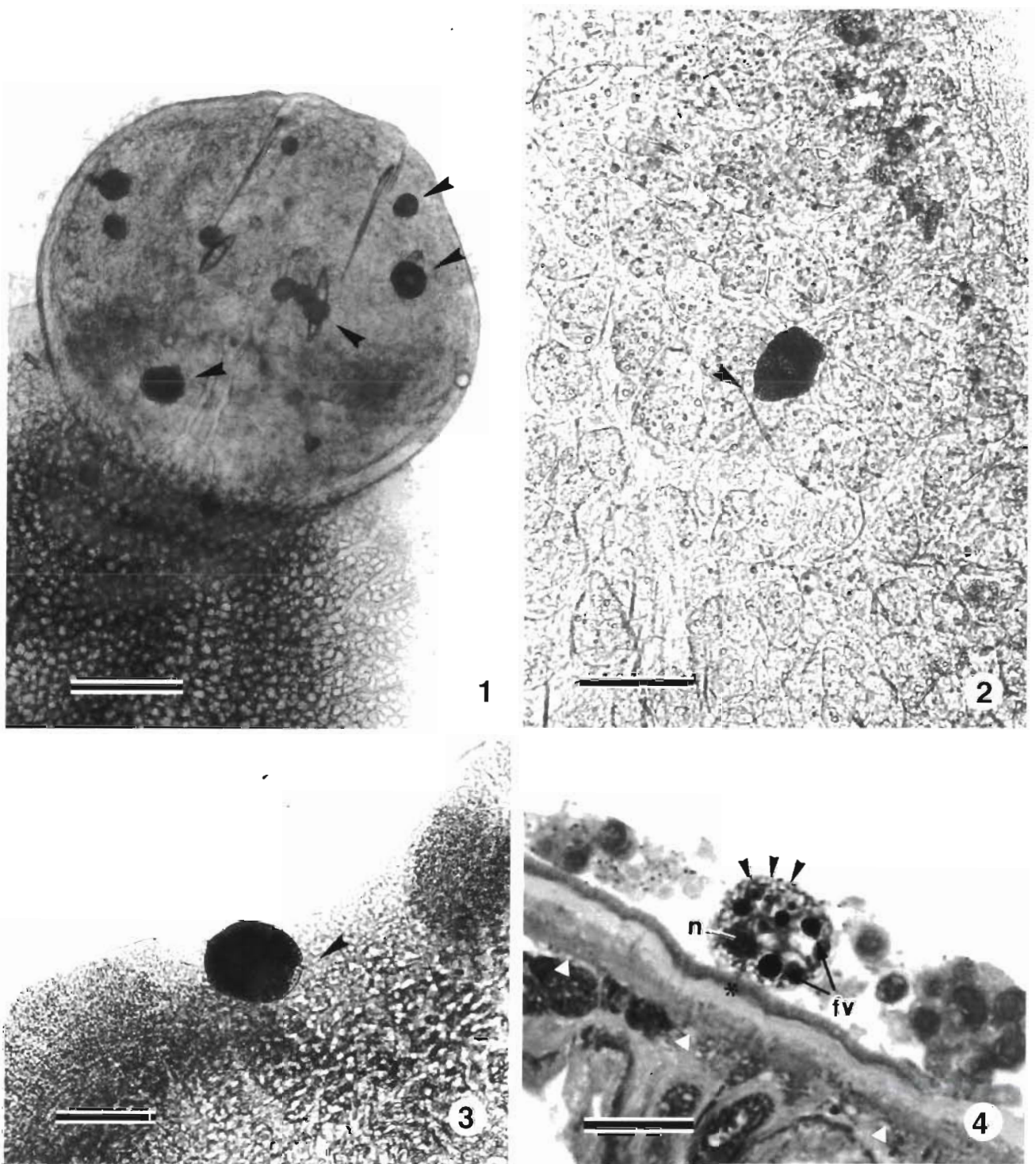
Fresh mounts were examined and photographed using regular light microscopy. Infested worms were fixed in 10% neutral buffered formalin and embedded in methacrylate blocks according to standard procedures (Clark 1981). Sections (2 µm thick) were stained with methylene blue – basic fuchsin, periodic acid Schiff, hematoxylin-eosin and hematoxylin – Biebrich scarlet – fast green. The last stain is recommended for determining the effects of parasitic protozoans on tissues of invertebrates.

*Amyloodinium ocellatum* trophonts were firmly anchored to the dorsal sides of the opisthaptor (Fig. 1) and the body proper (Figs. 2 & 3) of the worm. Up to a dozen were found on each worm. The trophonts were of various sizes (35 × 45 to 64 × 80 µm) which, had they been growing on fish epithelia, would correspond to about 2 to 4 d of 'age' (i.e. post-attachment).

From the characteristic digestive vacuoles and the fine, PAS positive, polysaccharide granules present in the cytoplasm of *Amyloodinium ocellatum* trophonts (Fig. 4), it is evident that the dinoflagellates actively fed on the worms. The damage the trophonts caused to their unusual host was difficult to evaluate, but seemed minimal and in any case limited to a focal structural disruption.

*Amyloodinium ocellatum* is a highly adaptable, cosmopolitan parasite (Nigrelli 1936, Lawler 1980, Paperna 1980, Barbaro & Francescon 1985). Its tolerance to varying osmotic conditions (Paperna 1984) and lack of fastidiousness in its host range (Lawler 1980, Lauckner 1984) have rendered the parasite amenable to propagation on fish cell cultures (Noga 1987).

Once detached from their fish host, whether spontaneously or as a result of having been dislodged, the trophonts sink to the bottom and transform into divid-



Figs 1 to 4 *Amyloodinium ocellatum* infesting *Neobenedenia melleni*. Fig. 1. *N. melleni* opisthaptor (dorsal side) infested with a number of *A. ocellatum* trophonts of different sizes (arrowed) Wet mount, unstained. Scale bar = 200  $\mu$ m. Figs. 2 & 3. *A. ocellatum* trophonts attached to the dorsal side of *N. melleni*. Arrow: site of attachment. Wet mount, unstained. Scale bars = 80  $\mu$ m. Fig. 4. *A. ocellatum* trophont (n nucleus, fv food vacuoles, arrows: polysaccharide granules) parasitizing *N. melleni*: \*: site of attachment. White triangles mark the border between tegumental layers (above) and the underlying parenchyma of the monogenean. Longitudinal section, hematoxylin-eosin stain. Scale bar = 20  $\mu$ m.

ing tomites (Paperna 1984). There is no evidence that an established trophont can detach from its original attachment site and re-attach to a different site. Evidently, *Amyloodinium ocellatum* attached to the monogenean at the stage of dinospore. Although the breaking down of *A. ocellatum* specificity for fish was probably determined by the unnatural conditions of intensive mariculture, it is nevertheless remarkable that *A. ocellatum* was able to obtain the necessary nutrients for its growth and development from a non-piscine substrate.

The versatility and resilience of *Amyloodinium ocellatum* should be taken into account in the logistics for the control of this parasite, as attempts to eradicate it, for example by means of temporary fish exclusion (Bower 1987), may be frustrated by this organism's ability to exploit alternative host phyla.

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