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# *Mytilicola intestinalis*, parasitism

Original by V. Dethlefsen
Revised and updated by John P. Bignell

ICES International Council for the Exploration of the Sea
CIEM Conseil International pour l'Exploration de la Mer

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## Contents

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### Susceptible species

*Mytilicola intestinalis* primarily affects the marine mussels *Mytilus edulis* and *M. gallprovincialis*. *M. intestinalis* has also been shown to affect *Ostrea edulis* and *Crassostrea gigas* in both field and laboratory studies (Baird, R.H. *et al.*, 1951; Dare, 1982; Aguirre-Macedo, M. L., and Kennedy, C. R. 1999).

### Disease name

*Mytilicola intestinalis* (Steuer, 1902; Steuer, 1905), parasitism, red worm disease, cop rouge.

### Aetiological agent

*M. intestinalis* is a parasitic copepod belonging to the family Mytilicolidae and similar in appearance to the *M. orientalis*. The planktonic phase lasts three to four days, the larvae then descend to bottom; total free-living stage is 10 to 14 days; breeding and reproductive cycles depend on the geographic distribution. Two complete breeding cycles with two generations are observed; recruitment takes place in summer and autumn; there are seasonal cycles in sex ratio and abundance at some places; in the Mediterranean there are no seasonal cycles.

### Geographical distribution

*M. intestinalis* is primarily found in the Mediterranean Sea, North Sea, and other coastal regions of the North East Atlantic (including the United Kingdom and Ireland) from Spain to and inclusive of Denmark. The widespread distribution within the North East Atlantic region is believed to originate from the transferral of *M. gallprovincialis* on the hull of shipping from the Mediterranean (Minchin, 1996). Whilst this parasite has not officially been reported within the Baltic Sea, an unidentified parasitic larval copepod was reported in mussels sampled from the northern Baltic (Gilek *et al.*, 1992). Outside of this geographical distribution, *M. intestinalis* has been found in the Indian Ocean–Malacca Strait (Wickstead, 1960).

### Significance

Mixed evidence exists within the literature concerning the impact of *M. intestinalis* on their molluscan host. Previous reports suggest *M. intestinalis* is capable of decreasing the general condition of the host (Thiesen, 1987) in addition to causing significant mortalities (Lauckner, 1983). Reports elsewhere suggest this is not true in all cases (Dethlefsen, 1975; Davey, 1989). Moreover, factors including, host size, reproduction and seasonal cycles are all more likely to affect the condition than parasitism with *M. intestinalis* in isolation (Gee *et al.*, 1977).

### Associated environmental conditions

The mixed reports concerning the impact of *M. intestinalis* on their host suggests that other factors may play a role in the ability for parasitism to elicit adverse effects e.g. environmental conditions.

### Gross clinical signs

Host species do not exhibit gross clinical signs, although adult *M. intestinalis* are readily observed in the dissected stomach and intestinal tract of infected hosts.

### Control measures and legislation

Parasitism with *M. intestinalis* is primarily dictated by survival of the planktonic stage (Figure 1: third planktonic stage) and the ability to locate a suitable bivalve host (Davey *et al*., 1978). Gee and Davey (1986) demonstrated this to be largely influenced by the host's field of filtration and the strength of the inhalant current. Other factors that can influence the infestation and spread of *M. intestinalis* include the age and density of larval population; host population size and density; wave action, current speed, turbulence and water depth; and, temperature and salinity (Paul, 1983; Davey and Gee, 1976; Robledo *et al.*, 1994; Fuentes *et al.*, 1998; Rayyan *et al.*, 2004). Parasitism and spread of *M. intestinalis* is reportedly reduced by restricting mussel density and avoiding sheltered coastal areas where wave action and currents are reduced (Andreu, 1963; Brienne, 1964).

Parasitism with *M. intestinalis* is not reportable to the World Organisation for Animal Health (OIE).

### Diagnostic methods

#### *Gross observations*

Adult *M. intestinalis* are readily observed in the dissected stomach and intestinal tract of infected hosts. Their vivid red-brown colouration aids their identification without the requirement for a compound dissecting microscope. Individual copepods may be carefully removed from dissected mussels with the aid of forceps, prior to identification. Chemical digestion of tissues using pepsin, followed by filtration, can be used to reveal more cryptic individuals that may not be removed via mechanical methods.

In the adults, the body is elongated and worm-like, and has thoracic segments with paired dorsal processes. Segmentation of the abdomen is incomplete. The head carries a median eye; the first antennae have four joints, the second have three, and the last are forming a hook. Females frequently have paired egg sacs at the posterior end of the body. Subadults are frequent in direct intestine and first recurrent intestine. Juveniles occur in ramifications of digestive gland. Individuals may be misidentified with *M. orientalis,* although several morphological differences exist: (a) the caudal ramus of *M. intestinalis* and *M. orientalis* are both elongated although it is more divergent in *M. intestinalis*; (b) the second antenna has three segments (podomeres) in *M. intestinalis* compared to two in *M. orientalis*; (c) female *M. intestinalis* are generally shorter than female *M. orientalis* (Bower, 1994).

Sizes in the different stages of the *M. intestinalis* life cycle: the planktonic stages: 1) nauplius, 0.20 mm; 2) metanauplius, 0.25–0.26 mm, 6 segments; 3) first copepodid (cyclopid), 0.40 mm; and the parasitic stages: 1) second copepodid, 0.48 mm, very similar to third planktonic stage (Figure 1); 2) third copepodid, 0.49–0.52 mm (Figure 2); 3) subadults, 1.5–1.7 mm (Figures 3 and 4); 4) adults, 4.0–8.0 mm (Figure 5).

### *Histology*

*M. intestinalis* can be seen in histological cross sections located in the stomach and intestinal tract of affected animals. It is not unusual to observe several copepods within one host. Individual copepods may be seen attached to the stomach or intestinal epithelium through the use of hook-like appendages (Figures 6 to 9). These attachments can result in metaplastic changes including replacement of ciliated columnar cells by non-ciliated cuboidal cells (Moore *et al.*, 1978). Although not typical, a marked haemocytic response may be observed if individual copepods breach the epithelium through to the vesicular connective tissue (Bignell, unpublished).

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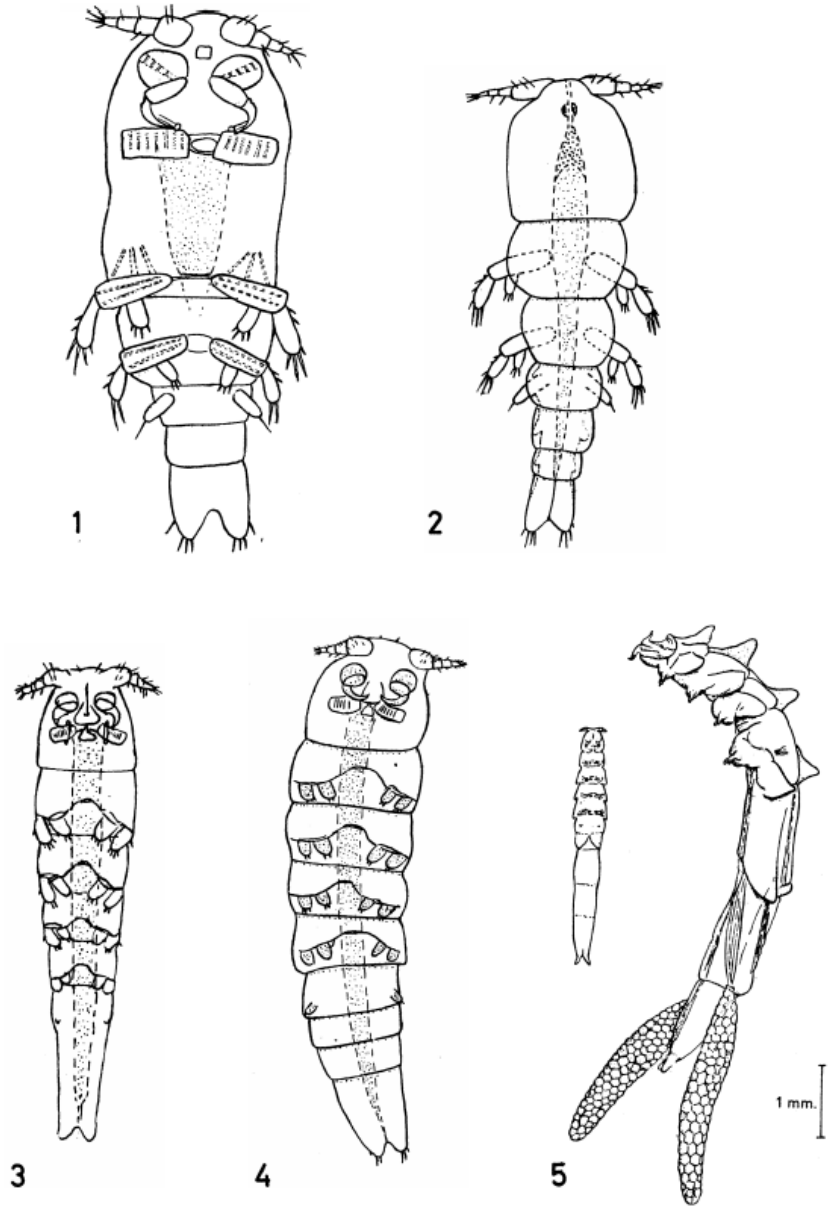


**Figure 1.** ***M. intestinalis*****, first parasitic stage, ventral view.**

**Figure 2.** ***M. intestinalis*****, second parasitic stage, dorsal view.**

**Figure 3.** ***M. intestinalis*****, third parasitic stage.**

**Figure 4.** ***M. intestinalis*****, oldest parasitic stage, 1.5 mm.**

**Figure 5.** ***M. intestinalis*****, adult male (left) and female (right).**

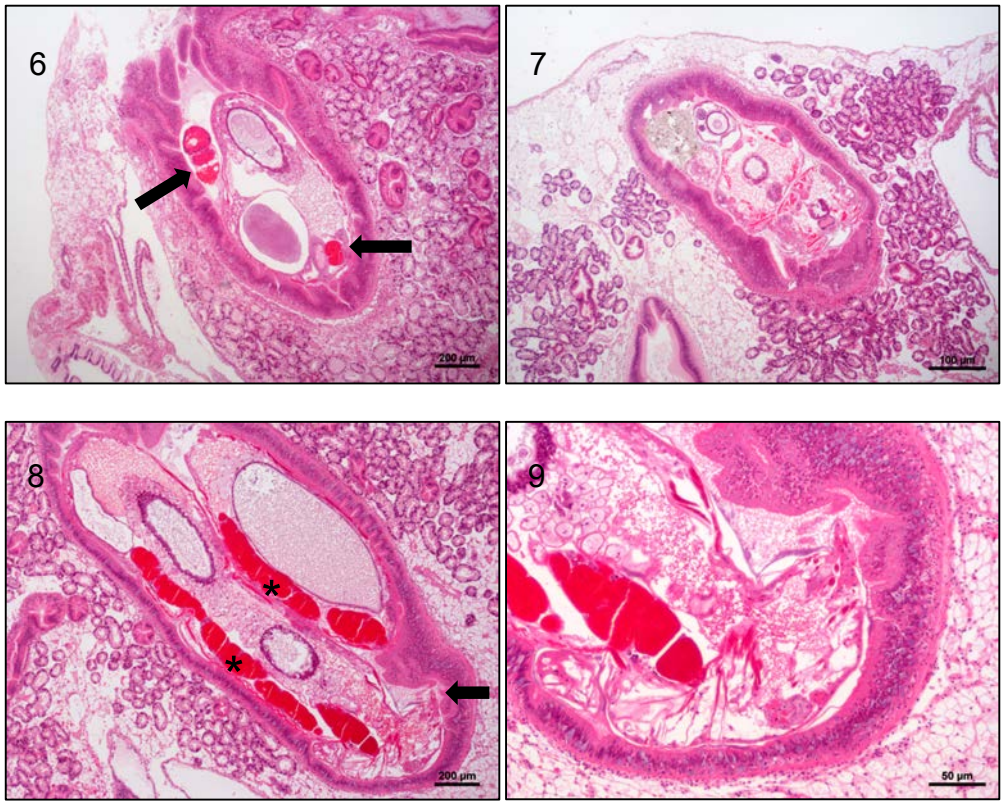


**Figure 6. Individual female *M. intestinalis* located within intestinal tract. Note the presence of eosinophilic egg sacks (arrow). Scale bar 200 µm.**

**Figure 7. Four *M. intestinalis* simultaneously affecting the intestinal tract. The presence of several copepods with an individual host is commonly observed. Scale bar 100 µm.**

**Figure 8. Two female *M. intestinalis* located within the intestinal tract. The eosinophilic egg sacks can clearly be seen (*). Note the presence of large hook-like appendage attached to gut epithelium (arrow). Scale bar 200 µm.**

**Figure 9. High magnification image of hook-like appendage shown in Figure 7. Scale bar 50 µm.**

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