

Prevalence of *Mytilicola intestinalis* (Copepoda: Mytilicolidae) and *Urastoma cyprinae* (Turbellaria: Hypotrichinidae) in marketable mussels *Mytilus galloprovincialis* in Italy

G. Canestri Trotti^{1,*}, E. M. Baccarani¹, S. Giannetto², A. Giuffrida³, F. Paesanti⁴

¹Dipartimento di Biologia Animale e dell'Uomo, Università di Torino, Via Accademia Albertina, 17, I-10123 Torino, Italy

²Cattedra di Parassitologia Veterinaria, Università di Messina, Via S. Cecilia, 30, I-98123 Messina, Italy

³Istituto di Ispezione degli alimenti di origine animale, Università di Messina, Via S. Cecilia, 30, I-98123 Messina, Italy

⁴Goro Acquicoltura s.r.l., P.le Leo Scarpa, 45, I-44020 Goro (Ferrara), Italy

ABSTRACT: Marketable mussels *Mytilus galloprovincialis* traded with commercial certification from production sites in Italy and abroad (France, Spain) were examined for the presence of *Mytilicola intestinalis* (Copepoda: Mytilicolidae) and *Urastoma cyprinae* (Turbellaria: Hypotrichinidae) from October 1994 to February 1996. The prevalence of *M. intestinalis* was 4.1% and 4.7% respectively in mussels from Lerici (La Spezia) and S. Pietro in Volta (Venice), whereas it rose to 57.9% in the samples from Spain. *M. intestinalis* was absent in mussels from Chioggia (Venice), Ganzirri (Messina), Taranto, Trieste and France. The prevalence of *U. cyprinae* varied considerably, ranging from 0.3% in mussels from Trani (Bari) to 33.2% and 86.3% respectively in those from Chioggia and Trieste. It was 85.7% in samples from France and 63.7% in those from Spain.

KEY WORDS: *Mytilus galloprovincialis* · *Mytilicola intestinalis* · *Urastoma cyprinae* · Parasitology
Epidemiology

INTRODUCTION

Mytilicola intestinalis is a copepod parasite in *Mytilus galloprovincialis*, *M. edulis* and in several other shellfishes. The parasite can injure the intestinal epithelium of heavily infested mussels on the Atlantic and Mediterranean coasts of Europe. Mytilicolosis was studied along the Italian coasts by Meyer-Waardeen & Mann (1953), Bacci et al. (1958), Genovese (1959), Giusti (1967), Scarcella (1981), Brisinello et al. (1986), D'Alba et al. (1986), Ceschia et al. (1992) and Ceschia & Mion (1995).

Urastoma cyprinae (Turbellaria: Hypotrichinidae) has been observed in various bivalves: *Mytilus edulis*, *M. galloprovincialis*, *Modiola modiolus*, *Cyprina islandica*, *Solen vagina*, *Crassostrea virginica*, *Tridacna gigas* and *T. maxima*. Some authors consider it as commen-

sal: it was found free-living by Westblad (1955) among marine algae. Recently Robledo et al. (1994b) demonstrated that the turbellarian, at high infection levels, can cause pathological reactions in its host with a consequent disorganization of the gill filaments and a reduction of the feeding capacity of the mussel.

The aim of the present work was to study the prevalence of *Mytilicola intestinalis* and *Urastoma cyprinae* in marketable mussels from several production sites in Italy and other countries (mussels imported from France and Spain, held and packed in Italy, but without detailed statement of origin).

MATERIALS AND METHODS

A total of 6005 *Mytilus galloprovincialis*, 24 to 30 mo of age, 5 to 8 cm in length, traded with commercial certification, were examined between October 1994 and

*E-mail: canestri@dm.unito.it



Fig. 1. Italian localities of samples

February 1996. The occurrence of *Mytilicola intestinalis* was checked in 3416 mussels from 9 production sites: Chioggia (Venice, VE), Ganzirri (Messina, ME), Lerici (La Spezia, SP), S. Pietro in Volta (VE), Taranto, Trani (Bari, BA), Trieste, France (indeterminate localities) and Spain (indeterminate localities) (Table 1, Fig. 1). The occurrence of *Urustoma cyprinae* was investigated in 2589 mussels from 7 production sites: Chioggia, Goro (Farrara, FE), S. Spirito (Bari), Trani, Trieste, France (indeterminate localities) and Spain (indeterminate localities) (Table 2, Fig. 1).

Mussels were dissected and examined with the aid of stereomicroscopy. The number of parasites was recorded to estimate mean and range of intensity, and abundance (Margolis et al. 1982). Parasites were identified with light microscopy by *in vivo* observations in sea water and *in toto* mounted specimens; some parasites were also examined by histological methods and scanning electron microscopy (SEM; Cambridge Stereoscan 240) after being pre-fixed in glutaraldehyde, post-fixed in a 1% solution of osmium, dehydrated and coated with a 20 nm layer of gold palladium.

RESULTS

Mytilicola intestinalis infected mussels are recognized by the presence in the gut of red worm-like organisms, 4 to 10 mm in length (Fig. 2). The prevalences are shown in Table 1.

Urustoma cyprinae infected mussels are recognized by the presence of whitish ellipsoidal worms (Fig. 3), swimming in the pallial cavity, measuring 450–850 × 350–450 μm, or of whitish spherical bodies resting amongst the gill filaments. External features allowed us to identify the turbellarian: uniformly ciliated body, 2 pigmented eyes near the front end, pharynx in the posterior end, a common pore for mouth, male genital duct and female duct at the posterior end, and location of testicles, ovaries, large intestinal cells and vitellogenes. The prevalences found are shown in Table 2.

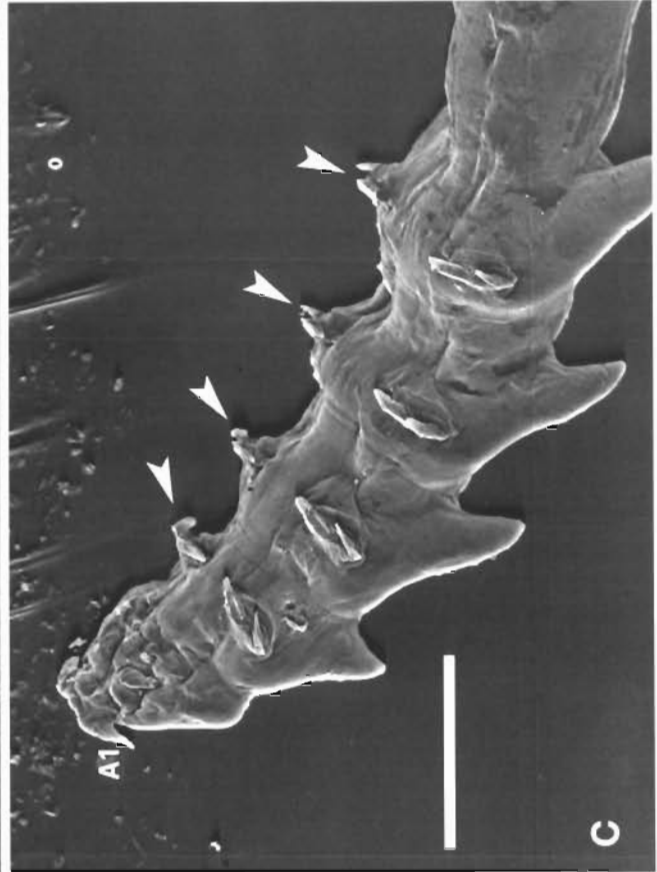
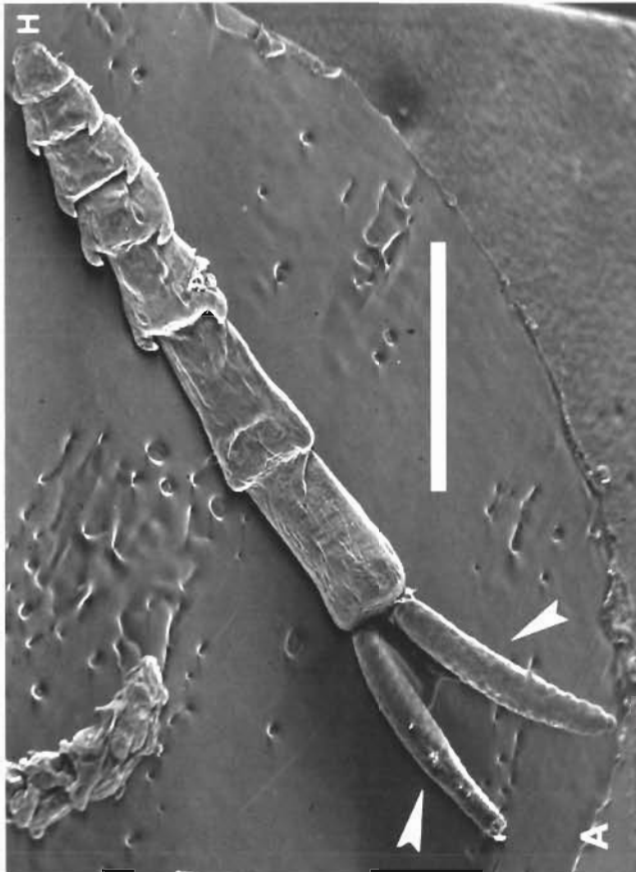
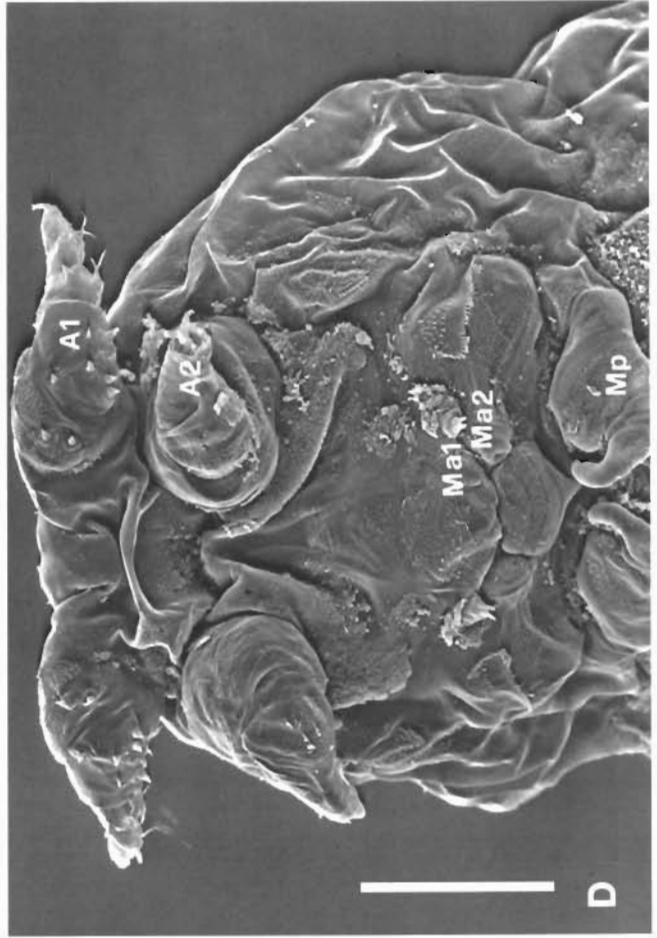
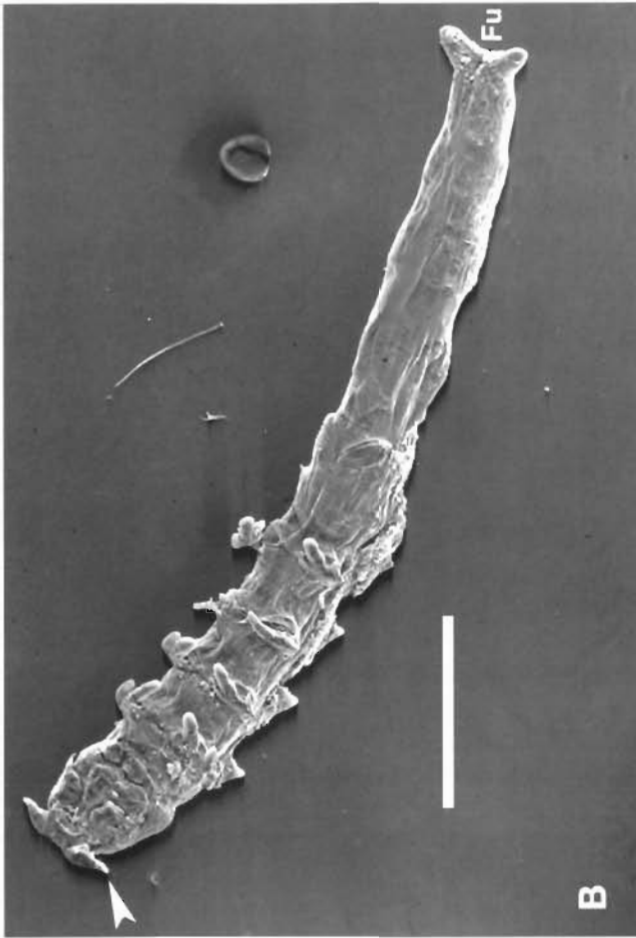
DISCUSSION

Prevalence, mean and range of intensity, and abundance of *Mytilicola intestinalis* in Italian and French samples of *Mytilus galloprovincialis* were lower than in the Spanish ones, which showed prevalence of 57.9%, mean intensity of 2.5, range of 1–21, and abundance of 1.45, in accordance with the prevalences previously reported by Spanish authors (Figueras & Figueras 1981, Figueras et al. 1991, Robledo et al. 1994a). Therefore, the Italian mussels can be considered to be of better commercial value, in comparison with those imported from Spain and held by Italian producers. In

Table 1. *Mytilus galloprovincialis*. Localities and number of samples; prevalence, mean and range of intensity, and abundance of *Mytilicola intestinalis*

Locality	No. of mussels examined	Prevalence (%)	Intensity		Abundance
			Mean	Range	
Chioggia (VE)	103	0	0	–	0
Ganzirri (ME)	350	0	0	–	0
Lerici (SP)	990	4.1	1	1	0.04
S. Pietro in Volta (VE)	1040	4.7	1	1	0.05
Taranto	31	0	0	–	0
Trani (BA)	172	0	0	–	0
Trieste	226	0	0	–	0
France	129	0	0	–	0
Spain	375	57.9	2.5	1–21	1.45
Total	3416	8.9	2.1	1–21	0.18

Fig. 2. *Mytilicola intestinalis* (SEM). (A) Dorsal view of an ovigerous female. H: head; arrows: egg-sacs. Scale bar = 2 mm. (B) Ventral view of a male. Arrow: antenna 1; Fu: furca. Scale bar = 0.5 mm. (C) Ventral view of the anterior part of the body of a female. A1: antenna 1; arrows: thoracopods. Scale bar = 0.5 mm. (D) Head of a male, ventral view. A1: antenna 1; A2: antenna 2; Ma1: maxilla 1; Ma2: maxilla 2; Mp: maxilliped. Scale bar = 0.1 mm



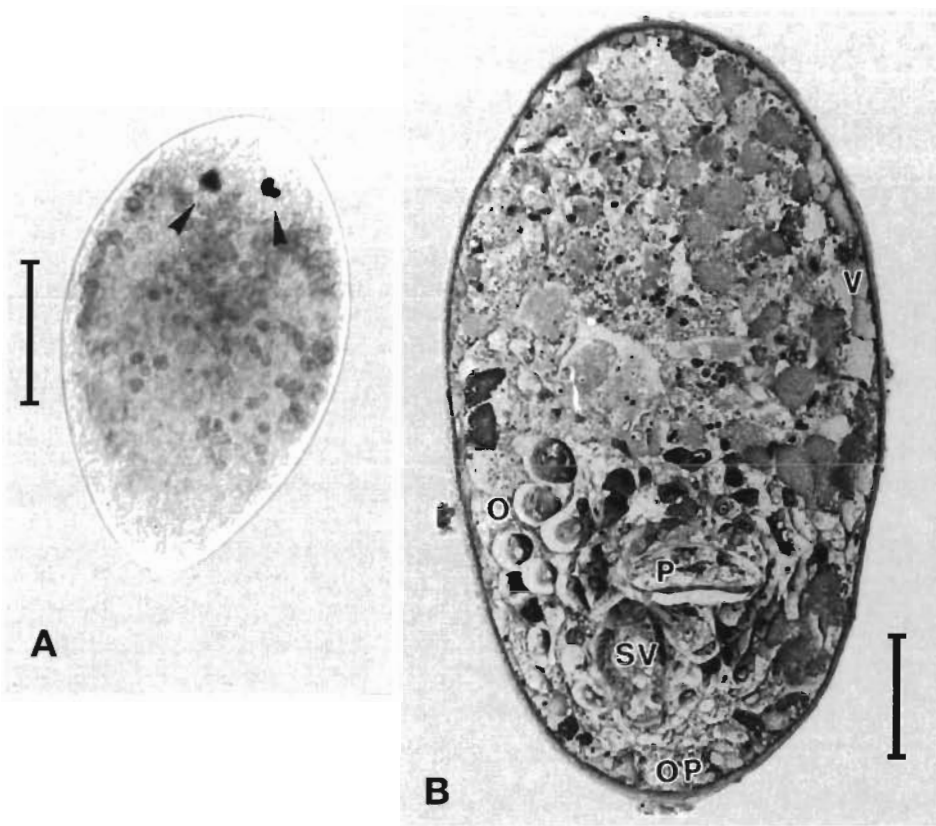


Fig. 3. *Urustoma cyprinae*. (A) Light microscope view of a lactophenol-treated specimen. Arrows: eyes. Scale bar = 200 µm. (B) Semifine section (1 µm). O: ovary; SV: seminal vesicle; OP: oro-genital pore; P: pharynx; V: vitellaria. Scale bar = 100 µm

consequence, the practice of holding unsold foreign mussels without complete sanitation in waters flowing into the sea could contribute to the spread of the parasite and should be strictly avoided.

The lower prevalence in Italian mussels indicates an improvement in their health in comparison with the past. In particular, the prevalence in Liguria (Lerici: 4.1%) is lower than those previously noticed in the same waters by Meyer-Waardeen & Mann (1953), Bacci et al. (1958), and Genovese (1959), which were respectively 19.2, 65, and 45%. On the other hand, the prevalence in Veneto (S. Pietro in Volta 4.7% and

Chioggia 0%) differs comparatively little from those reported in the same waters by Meyer-Waardeen & Mann (1953), Genovese (1959) and Brisinello et al. (1986), which were respectively 7, 20.9% and absence of parasite, but more from the 76.8% prevalence observed by Scarcella (1981). Only a monitoring program in the same environments over many years could shed light on the epidemiological factors that led to the parasite becoming less widespread. It is, however, quite probable that the contrast between these data and those of the previous years is related to the development in Italy of mussel culture in the open sea over the last 10 yr. Lerici producers, in fact, in past times bought spat at Taranto (Mar Piccolo), but today mainly buy spat from this new kind of mussel culture in the northern Adriatic.

Concerning *Urustoma cyprinae*, the differences between prevalences recorded in Italian localities are worthy of note. Even though the highest prevalence (86.3%) of the parasite was observed in mussels from Trieste, the highest mean intensity and abundance was found in mussels from France (22.7 and 19.4 respectively) and the highest intensity range in those from

Table 2. *Mytilus galloprovincialis*. Localities and number of samples; prevalence, mean and range of intensity, and abundance of *Urustoma cyprinae*

Locality	No. of mussels examined	Prevalence (%)	Intensity		Abundance
			Mean	Range	
Chioggia (VE)	743	33.2	4	1-10	1.3
Goro (FE)	276	0	0	-	0
S. Spirito (BA)	196	0	0	-	0
Trani (BA)	376	0.3	1	1	0.003
Trieste	226	86.3	3.8	1-7	3.2
France	196	85.7	22.7	1-105	19.4
Spain	576	64.1	5.5	1-110	3.5
Total	2589	37.9	7.9	1-110	3

Spain (1 to 110); we can therefore assert that the Italian samples of *Mytilus galloprovincialis* are generally less parasitized than the imported ones. In fact the parasite is widespread in French (Noury-Sraïri et al. 1990), Spanish (Robledo et al. 1994b) and Portuguese waters (Teia dos Santos & Coimbra 1995).

In the past, *Urastoma cyprinae* was observed in Italian waters only in the razor shell *Solen vagina* (cf. Graff 1913) or free living (Westblad 1955) in the Adriatic Sea; the relationship between *Mytilus galloprovincialis* and *Stylochus mediterraneus* (Turbellaria: Eulecitophora) is better known. This turbellarian, which measures more than 3 cm in length and 15 mm in width, was sampled from mussel beds along the coasts of Leghorn (Livorno, Italy) by Galleni et al. (1980) and in the Adriatic Sea by Ceschia et al. (1992) and Ceschia & Mion (1995).

Acknowledgements. Research was aided by a grant from the Italian M.U.R.S.T. 60%.

LITERATURE CITED

- Bacci G, Ballata M, Romani ML (1958) Rapporti numerici dei sessi in tre popolazioni di *Mytilicola intestinalis* Steuer. Rend Accad Naz Lincei Sci Mat Fis Nat Ser 8, 25(6): 557–563
- Brisinello W, Giassi F, D'Alba A, Giorgetti G, Vanelli M (1986) Incidenza di *Mytilicola intestinalis* e *Cercaria tenuans* nei mitili allevati (*Mytilus galloprovincialis*) nella zona centrale della Laguna Veneta. Atti Soc Ital Sci Vet 40: 1034–1036
- Ceschia G, Mion A (1995) Indagine parassitologica sui mitili (*Mytilus galloprovincialis*) allevati in Friuli-Venezia Giulia. In: Berletti M, Rossi R, Spreafico E (eds) Ricerche e sperimentazioni 1988–1994. PIMzone lagunari, Regione del Veneto, Venice, p 336–345
- Ceschia G, Mion A, Orel G, Giorgetti G (1992) Indagine parassitologica delle mitilcolture del Friuli-Venezia Giulia (Nord-Est Italia). Boll Soc Ital Patol Ittica 9:24–36
- D'Alba A, Giorgetti G, Ceschia G, Brisinello W, Labura Z (1986) Incidenza di *Mytilicola intestinalis* e *Cercaria tenuans* nei mitili (*Mytilus galloprovincialis*) allevati in Friuli-Venezia Giulia. Atti Soc Ital Sci Vet 40:1031–1034
- Figueras A, Figueras AJ (1981) *Mytilicola intestinalis* Steuer en el mejillon de la ria de Vigo (NO de España). Invest Pesq 45(2):263–278
- Figueras AJ, Jardon CF, Caldas JR (1991) Diseases and parasites of rafted mussels (*Mytilus galloprovincialis*): preliminary results. Aquaculture 99:17–33
- Galleni L, Tongiorgi P, Ferrero E, Salghetti U (1980) *Stylochus mediterraneus* (Turbellaria: Polycladida), predator on the mussel *Mytilus galloprovincialis*. Mar Biol 55:317–326
- Genovese S (1959) Sulla presenza di *Mytilicola intestinalis* Steuer (Copepoda Parasitica) nel lago di Ganzirri. Atti Soc Peloritana Sci Fis Mat Nat 5:47–53
- Giusti F (1967) L'azione di *Mytilicola intestinalis* Steuer sul *Mytilus galloprovincialis* Lam. del litorale toscano. Riv Parassitol 28(1):17–26
- Graff von L (1913) Platyhelminthes. Turbellaria. II. Rhabdo-coelida. Das Tierreich. Friedländer, Berlin
- Margolis L, Esch GW, Holmes JC, Kuris AM, Schad GA (1982) The use of ecological terms in parasitology (Report of an ad hoc committee of the American Society of Parasitologists). J Parasitol 68(1):131–133
- Meyer-Waardeën PF, Mann H (1953) Untersuchungen über die Bestände von *Mytilus galloprovincialis* an der italienischen Küste auf ihren Befall mit *Mytilicola intestinalis* (Copepoda Parasitica). Boll Pesca Piscic Idrobiol 8, ns:201–220
- Noury-Sraïri N, Justine JL, Euzed L (1990) Ultrastructure du tégument et des glandes sous-épithéliales de *Urastoma cyprinae* (Proleritophora), turbellarié parasite des mollusques. Ann Sci Nat, Zoologie 11:53–71
- Robledo JAF, Cáceres-Martínez J, Figueras A (1994a) *Mytilicola intestinalis* and *Proctoeces maculatus* in mussel (*Mytilus galloprovincialis* Lmk) beds in Spain. Bull Eur Assoc Fish Pathol 14(3):89–91
- Robledo JAF, Cáceres-Martínez J, Sluys R, Figueras A (1994b) The parasitic turbellarian *Urastoma cyprinae* (Platyhelminthes: Urastomidae) from blue mussel *Mytilus galloprovincialis* in Spain: occurrence and pathology. Dis Aquat Org 18:203–210
- Scarcella R (1981) Su *Mytilicola intestinalis*, Steuer 1902, e sua presenza in allevamenti di mitili nella laguna veneta. Tesi di laurea, Fac Med Vet Univ Bologna
- Teia dos Santos AM, Coimbra J (1995) Growth and production of raft-cultured *Mytilus edulis* L. in Ria de Aveiro: gonad symbiotic infestation. Aquaculture 132:195–211
- Westblad E (1955) Marine 'Alloeocoels' (Turbellaria) from North Atlantic and Mediterranean coasts. I. Ark Zool 7(24):491–526

Editorial responsibility: Wolfgang Körting, Hannover, Germany

Submitted: June 23, 1997; **Accepted:** September 15, 1997
Proofs received from author(s): February 16, 1998