Occurrence of *Minchinia* sp. in Species of the Molluscan Borer, *Teredo*

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ABSTRACT–Shipworms collected near a power-generating station on Barnegat Bay, N.J., were infected with haplosporidian parasites. Three or four species of shipworms, Teredo navalis, T. furcifera, T. bartschi, *and immature stages of an unidentified species, were infected with spores and sporonts of the genus* Minchinia. *Spores and late sporocysts were the most prevalent stages found and they occurred in every tissue type, although not all tissues of a given shipworm were necessarily affected at the same time. Infections seemed to be most prevalent from mid-autumn to early winter, often with all of the specimens from a given station being infected. Since the species* Minchinia *found in the shipworms resembles* M. nelsoni, *the oyster pathogen, in size and shape, the possibility of* Teredo *species being alternate hosts for* M. nelsoni *is discussed.*

Introduction

During a study of the effects of a power-generating station on reproductive cycles of woodboring teredine mollusks in Barnegat Bay, N.J., occasional sections prepared for analysis of gonad development were found with several life cycle stages (including spores) of a haplosporidian parasite. The cells were found in the tissues of shipworms of the genus *Teredo,* including *T. navalis, T. furcifera,* and *T. bartschi,* and immature specimens too young to be identified to species. The parasite has been identified to the genus *Minchinia* (Hillman, 1978).

Materials and Methods

The shipworms were recovered from wooden panels exposed at 17 stations around Barnegat Bay (Fig. 1). The panel arrays were initially submerged during the week of 2 June 1975 and the first specimens were recovered from the panels in August of that year.

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Each panel array consisted of seven 10- × 3.5- × 0.75-inch untreated soft pine panels, plus two soft pine panels containing a marine-grade creosote treatment. Before submersion all untreated panels were conditioned for 2 weeks in flowing seawater passed through a Steroline Aquafine Electronic Liquid Sterilizer (Model PVC-6)[1].

The panel racks were suspended vertically at each station just below the low tide line. At the end of the first month two untreated panels from each rack were removed and replaced. One of these, the short-term panel, continued to be replaced on a monthly basis, providing information on the monthly occurrence of borer settlement. One each of the five remaining untreated panels at each station was replaced in sequence over the next 5 months so that at the end of the 6 months a short-term panel and one that had been exposed for 6 months (the long-term panel) were replaced monthly. The treated panels were part of another phase of the study and were not removed. The 6-month cycle was necessary because untreated panels left exposed for more than 6 months are often completely destroyed by the borers and unable to provide specimens for study.

[1]Mention of trade names or commercial products or firms does not imply endorsement by the National Marine Fisheries Service, NOAA.

Following removal, the panels were returned to the laboratory in Duxbury, Mass., where the shipworms were removed, identified, fixed in Bouin's solution for 24-48 hours, and rinsed in 70 percent denatured ethanol. The portion of the shipworm containing the gonads was excised, dehydrated through a series of denatured ethanols, two changes of methyl benzoate, and three changes of benzene. They were embedded in Paraplast, sectioned at 6 μm, and stained in Harris' hematoxylin and eosin.

Results and Discussion

Over 650 shipworms were recovered from the panels between June 1975 and March 1977 with most being *Bankia gouldi*. Only 225 shipworms represented the genus *Teredo*. Of these, 141 were *T. navalis,* 24 were *T. furcifera,* 11 were *T. bartschi,* and 49, too small to be identified beyond genus, were labelled *Teredo* spp.

Table 1 shows the numbers of infected specimens relative to the numbers of *T. navalis* collected at each station each month. Unfortunately, no shipworms could be recovered from April through July because of the apparent lack of shipworm larvae in the water from November into early July and the consequent lack of setting.

Although *Teredo* spp. were collected at every station except 13, 14, and 16, infections were only seen at seven stations: 1, 2, 7, 8, 9, 11, and 17. Infections tended to be heaviest at stations 2 and 17. No statistical differences in salinity, water temperature, dissolved

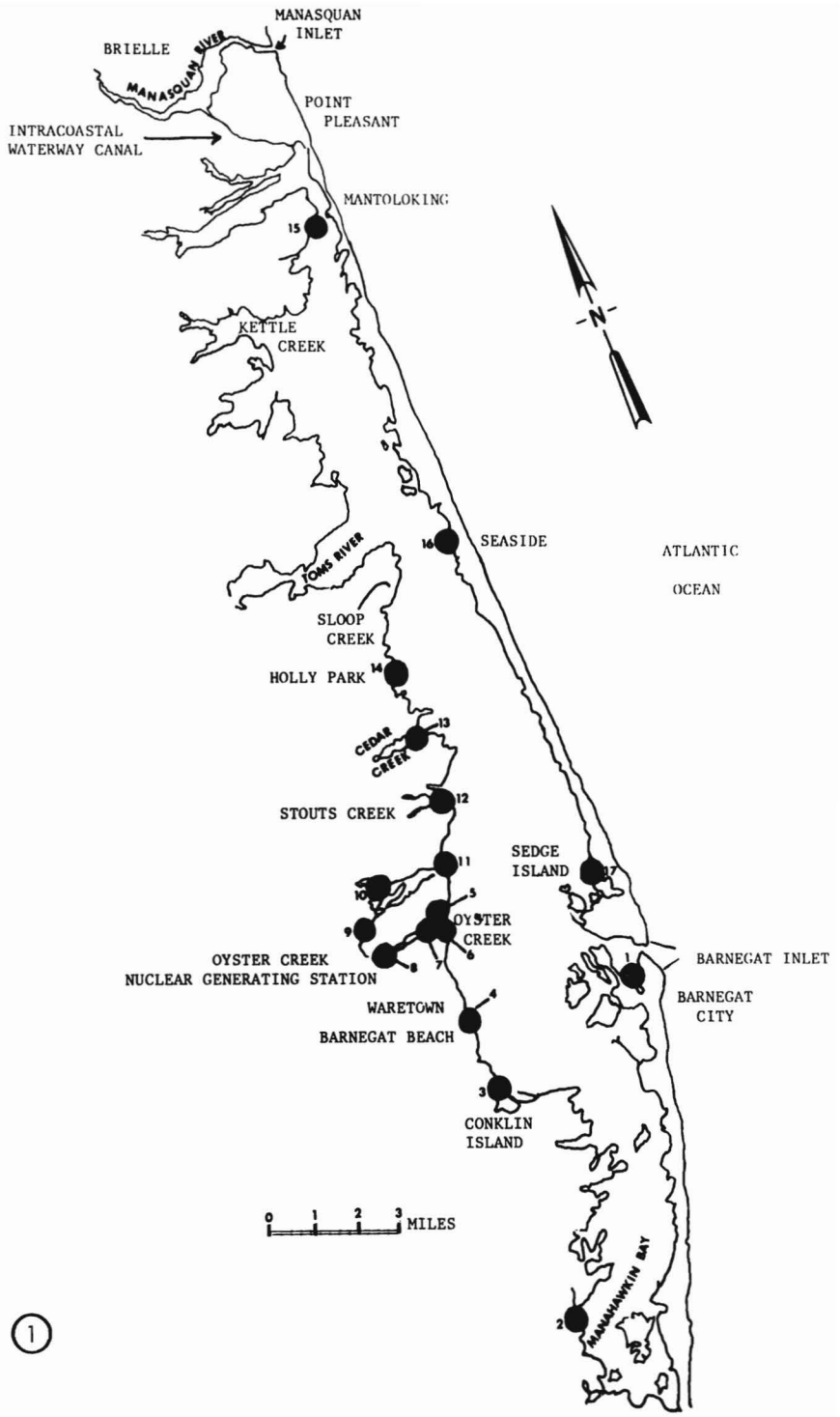

Figure 1.—Outline of Barnegat Bay, N.J., showing locations of exposure panel racks used for sampling teredine borers.

oxygen, or pH were noted among any of the 17 stations.

The highest percentages of infected *Teredo* occurred from mid- to late-autumn, often with all of the specimens collected from a station infected.

Table 2 shows the percentages of each species of *Teredo* infected at each station. Over the 20-month sampling period discussed here, about 40 percent of *T. navalis* and *T. furcifera* were infected. Only about 18 percent of *T. bartschi* contained stages of *Minchinia* sp., but there were not enough specimens collected for that percentage to be meaningful. The juvenile *Teredo* spp. had the lowest infection rate (4 percent), but most of the 49 specimens collected were only 3-4 weeks old.

When an infection was noted, it generally occurred throughout all the tissues seen in cross section through the gonad, including mantle, gills, digestive gland, typhlosole, connective tissue, and the gonads themselves, although the gills appeared to be the most frequently infected tissues. Figure 2 shows, for example, sporocysts and spores in the gills of *T. navalis*.

The spores were 6-8 μm in height, and resembled, in size and general appearance, the spores of the oyster pathogen, *M. nelsoni,* as described by Couch et al. (1966). The spores and sporocysts in each of the species of *Teredo* examined were identical in size and gross morphology, and it was concluded that they probably represent the same species of haplosporidian.

No reports of haplosporidians occurring in any species of shipworm have been found in the literature, although Turner and Johnson (1971) cite Rancurel as having found a sporozoan in a

Table 1.—Prevalences of *Minchinia* sp. in *T. navalis* from wooden panels exposed at 17 stations in Barnegat Bay, N.J. Stations and months without shipworm specimens are omitted. Sampling was monthly from August 1975 to March 1977. No. *Minchinia* cases/No. shipworms.

	Station									
Date	1	2	7	8	9	10	11	12	15	17
1975										
Sept.										1/3
Oct.										3/3
Nov.		1/1		0/1		0/1		0/1	0/3	2/2
Dec.									0/2	4/4
1976										
Jan.		2/2					1/2		0/3	3/3
Feb.	0/2	0/3		0/1	0/1				0/4	1/4
Mar	0/2									
Aug.	0/3									
Sept.	2/8			1/1			0/8		0/1	
Oct.	3/7		1/1				6/6			3/4
Nov.	5/5		1/1				3/5			2/5
Dec.	2/6		1/1				3/5		0/1	4/5
1977										
Feb.							1/7			
Mar	1/11									1/2
Totals	13/44	3/6	3/3	1/3	0/1	0/1	14/33	0/1	0/14	24/35
Percent infected	29.5	50.0	100	33.3	0	0	42.4	0	0	68.6

Table 2.—Percent of *Minchinia* sp.-infected species of *Teredo* from wooden panels exposed in Barnegat Bay, N.J.

	Teredo navalis		*Teredo furcifera*		*Teredo bartschi*		*Teredo* spp.	
Stations	Number recovered	Number infected	Number recovered	Number infected	Number recovered	Number infected	Number recovered	Number infected
1	44	13	7	5			14	0
2	6	3					5	0
3			1	0				
4							1	0
5							4	0
6					6	0		
7	3	3	1	1	5	2	3	0
8	3	1						
9	1	0					1	1
10	1	0	1	0				
11	33	14	10	1			3	1
12	1	0					3	0
13								
14								
15	14	0					9	0
16								
17	35	24	4	2			6	0
Total	141	58	24	9	11	2	49	2
Percent infected	41		38		18		4	

teredine borer from the west coast of Africa, but Rancurel apparently did not elaborate further.

The similarity in size and morphology of the *Minchinia* species in *Teredo* to *M. nelsoni* raises the possibility that the parasite discussed here is indeed *M. nelsoni*, and that the various species of *Teredo* are the alternate hosts suggested by a number of workers (e.g., Sprague[2]; Farley, 1967). The fact that *B. gouldi* is the principal shipworm species in Delaware and Chesapeake Bays, where *M. nelsoni* is a particular problem casts some doubt, however, on the possibility of *Teredo* being the alternate host in those areas. It might be expected that there would have to be more *Teredo* in those areas considering the extent of the oyster mortalities. The relationship between the *Minchinia* species discussed here and *M. nelsoni* will probably have to be elucidated through electron microscopy and other

[2]Sprague, V., Chesapeake Biological Laboratory, Center for Environmental and Estuarine Studies, University of Maryland, Solomons, MD 20688. Pers. commun.

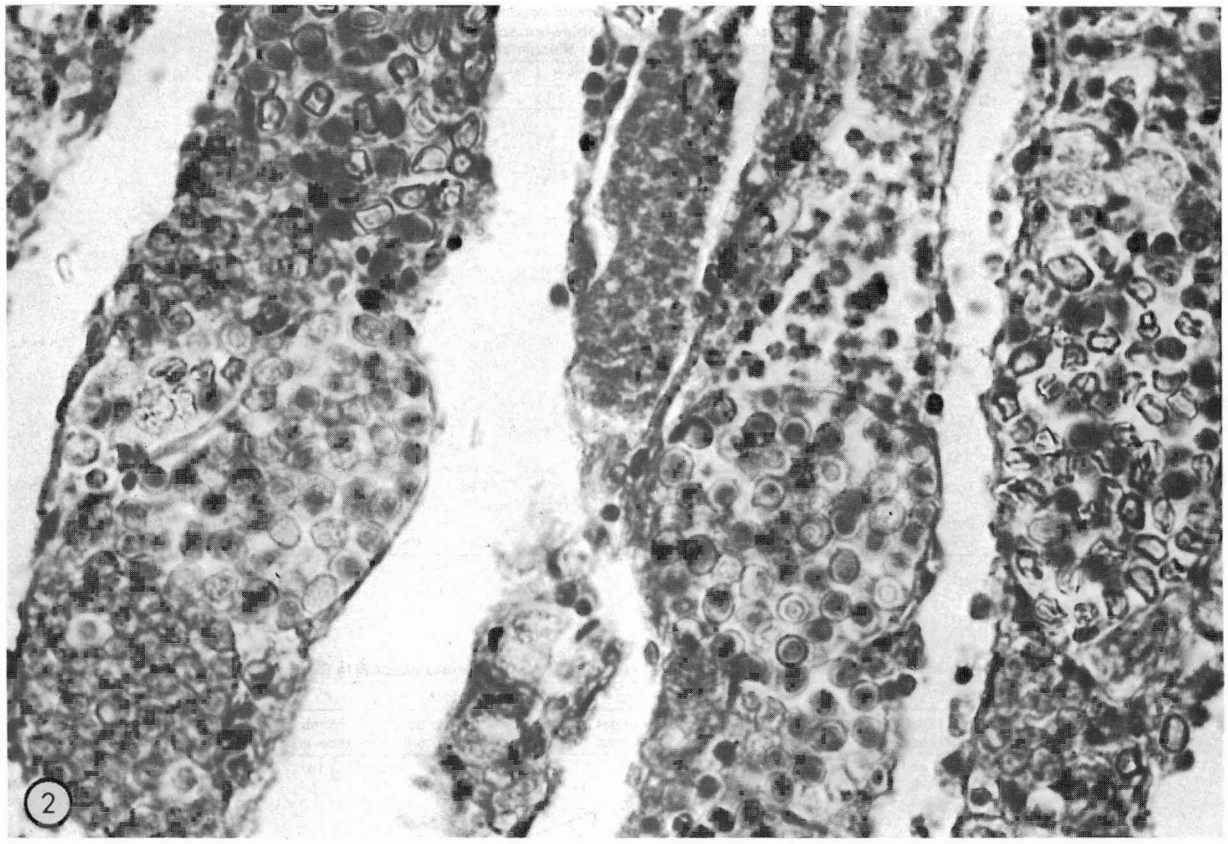

Figure 2.—Spores and sporocysts of *Minchinia* sp in gill of the shipworm, *Teredo navalis*. 700×.

histochemical studies currently underway at our laboratory.

Shortly after I found *Minchinia* sp. in *Teredo* from Barnegat Bay, I also found what appeared to be the same species in *T. navalis* from the eastern end of Long Island Sound, N.Y., so it is not necessarily restricted to the Barnegat Bay area.

Acknowledgments

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