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Short papers and notes

THE PREVALENCE OF THE BORING CLAM *Diplothyra smithii* TRYON RELATIVE TO THE HABITAT OF ITS HOST, *Mercenaria mercenaria* (L.), IN COASTAL GEORGIA

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The boring clam, *Diplothyra smithii* Tryon, 1862, occurs from Massachusetts to Texas burrowing into the shells of other bivalves, gastropods or coquina rock (Turner 1955). *Diplothyra smithii* has been observed in *Crassostrea virginica* (Chesnut 1981; Galtsoff 1964; Harry and Mock 1968; Turner 1955), *Fasciolaria gigantea* (Turner 1955), *Thais haemastoma* (Gunter 1979), and in *Busycon carica* (personal observations) shells. An adult oyster from Matagorda Bay, Texas, was recorded being parasitized by over 200 boring clams (Galtsoff 1964).

The hard clam, *Mercenaria mercenaria* (Linnaeus, 1758), is an important commercial species inhabiting the creeks and river systems of the salt marshes of coastal Georgia. Hard clams occur in a variety of substratum in coastal Georgia including sandy-mud, mud, or shelly bottoms (Walker and Tenore 1984). They grow to 130 mm in shell length and have been aged to 40 years (Walker 1989). Hard clams represent an important host because of their high densities, large size, and long life expectancy.

It is the purpose of this paper to determine the prevalence of *Diplothyra smithii* in relation to the habitat of its host within the coastal waters of Georgia.

MATERIALS AND METHODS

Hard clams were collected by clam rake or hand from 18 populations from the coastal waters of Georgia from May 6 to August 17, 1988. Hard clam populations were selected so that 6 populations each came from sandy-mud, mud, or shelly substrata. Clam populations are definited as areas inhabited by clams, but separated from other populations by areas barren by clams. Hard clams were measured for shell length (dorso-ventral, *i.e.*, longest possible measurement) with Vernier calipers to 0.5 mm and checked for the presence of boring clams. The number of burrowing clams per host size was recorded.

RESULTS

Of the 1282 hard clams, which ranged in size from 23.8 to 130 mm, 5.2% were infested by one or more boring clam(s) (Table 1). The number of boring clams per infected host ranged from 1 to 22 with a mean infestation number of 4.8 ± 0.5 (SE). No hard clam less than 49.4 mm in shell length was found parasitized, with those hard clams parasitized ranging in size from 49.4 to 113.1 mm with a mean size of 86.8 ± 1.5 (SE) mm (Fig. 1).

A higher percentage of hard clams from shelly substratum were infested by boring clams (an overall percentage of 13.1) compared with those from mud (1.9%) or sandy-mud (0.7%) substratum. The results of a 2-way ANOVA (alpha = 0.05) are given in Table 2. No significant differences in incidence occurred between replicates, but a significant difference was determined between substrata (Table 2). Significant differences (1-way ANOVA, alpha = 0.05) did occur between substrata type, but only the clams from shell substrata were significantly higher in precent infestation by boring clams.

DISCUSSION

The number of *Diplothyra smithii* parasitizing the shells of *M. mercenaria*

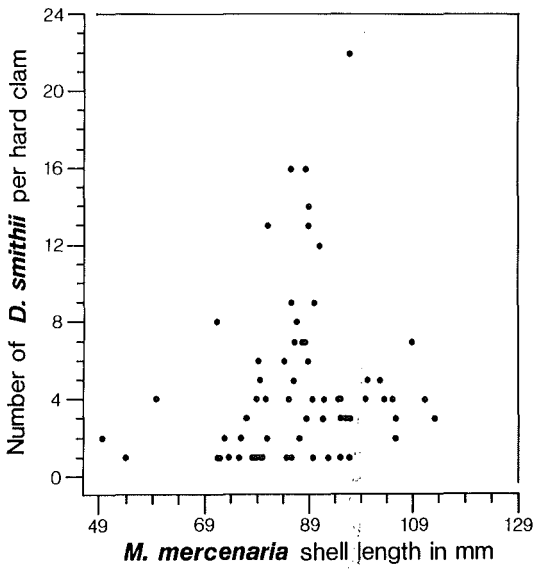

Figure 1. The number of boring clams relative to the size of its host hard clam.

in the coastal waters of Georgia is lower (up to 22 boring clams per hard clam) than that reported for parasitized American oysters (up to 200 boring clams per oyster) in Matagorda Bay, Texas (Galtsoff 1964), or in Mississippi Sound (up to 109 per oyster) (Chesnut 1981). Oysters are epibenthic while hard clams are benthic, thus it is not surprising that hard clams are not parasitized as much as oysters. The site of infestation on hard clams is generally on the posterior end of the shell, or the area closest to the sediment water interface.

The higher frequency of parasitized hard clams from shelly substrata may be explained by either the inability of hard clams to bury efficiently in some cases within shelly substrata or that the boring clam larvae may settle out at a greater frequency within shelly versus mud or sandy-mud substratum. Chesnut (1982) observed that larval *Diplothyra smithii* underwent metamorphosis only after shell substrata was present. In some areas of shell bottom, the shell may be so dense that hard clams are unable to vertically migrate. In Georgia hard clams are generally found in association with shelly substratum (Walker and Tenore 1984), with the shell generally consisting

Table 1. The location and substrata, number of hard clams, *Mercenaria mercenaria*, mean shell length, number of clams parasitized, and percentage of parasitism by *Diplothyra smithii*.

Location	Substrata	No. Clams	Shell Length $\bar{x}$ ± SE	No. Infested	%
House Creek	Sandy-Mud	26	100.2 ± 4.32	2	7.7
Whiskey Still Hammock	Sandy-Mud	77	66.8 ± 1.69	0	0
Cabbage Island	Sandy-Mud	97	67.8 ± 1.36	0	0
Big Hole	Sandy-Mud	74	77.6 ± 1.61	0	0
St. Simons Island	Sandy-Mud	70	61.5 ± 1.08	0	0
Deans Creek	Sandy-Mud	84	71.4 ± 1.30	1	1.2
	Total	428	70.9 ± 0.78	3	0.76
House Creek	Mud	69	95.3 ± 1.03	2	2.9
Pa Cooper Creek	Mud	42	77.4 ± 1.65	0	0
Unnamed Creek	Mud	79	96.3 ± 1.43	6	7.6
McCloys Creek	Mud	67	78.4 ± 0.89	0	0
Cabbage Island	Mud	98	68.9 ± 1.36	0	0
Cabbage Island	Mud	72	68.8 ± 1.52	0	0
	Total	427	80.5 ± 0.79	8	1.87
House Creek	Shell	112	82.7 ± 1.29	5	4.5
House Creek	Shell	85	81.0 ± 1.18	14	16.5
House Creek	Shell	58	85.9 ± 1.49	11	19.0
Wassaw Island	Shell	60	66.5 ± 1.46	3	5.0
Doboy Sound	Shell	73	68.0 ± 1.64	6	8.2
Petit Chou	Shell	39	78.4 ± 2.17	17	43.6
	Total	427	77.6 ± 0.70	56	13.1

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Table 2. Statistical analyses of hard clam infestation according to hard clam substrata type. The percent infestation values from Table 1 were arcsine transformed before entering into ANOVAS.

Trial	Factors (Tested)	F-Ratio	(D.O.F.)	Prob. (Fo)	Sign.
2-way ANOVA					
Shell *vs.* Mud	Substrate	8.342	2	4.10	S
vs. Sandy-mud	Replicates	0.682	5	3.33	NS
1-way ANOVA					
Shell *vs.* Mud	Substrate	11.348	1	4.96	S
Shell *vs.* Sandy-mud	Substrate	12.463	1	4.96	S
Mud *vs.* Sandy-mud	Substrate	0.021	1	4.96	NS

of oyster shell. In some cases, the shell may be large clumps of oyster shells which may prevent hard clams from burrowing efficiently. In this study, the highest percent infestation (43.6%) in a hard clam population occurred in a substrata of dense oyster shell (Table 1).

Few reports pertaining to the life history of *Diplothyra smithii* exists. With the exception of Chesnut (1982), only taxonomic descriptions (Bartsch and Rehder 1945; Turner 1955) or marine mollusc field guides (*e.g.*, Abbott 1974; Emerson and Jacobson 1976; Ruppert and Fox 1988) deal with *Diplothyra smithii*. Chestnut (1981) describes the various morphological stages that occur as *D. smithii* matures. Furthermore he determined that *D. smithii* matures in late spring to early summer, with an apparent mid-summer spawning for populations from Mississippi Sound. *Diplothyra smithii* was found to spawn at water temperatures between 24° to 30° C (Chesnut 1982). Metamorphosis began on day 29 only after addition of shell substrata.

Let us assume that *Diplothyra smithii* populations in Georgia spawn about the same time (mid-summer) as those in Mississippi and that they have a relatively short larval cycle (*ca.* 29 days). Furthermore, Georgia hard clams occurring in sandy-mud to mud substrata are usually buried within the sediment during summer, whereas many hard clams in shelly substrata are somewhat exposed because of burrowing difficulties associated with the substrate type. Thus the latter hard clams may be providing a larval settlement site for *Diplothyra smithii*, whereas those (buried) in other substrata are not. Furthermore, as *Diplothyra smithii* is a calcareous borer, it may very well possess some chemoreceptor capable of detecting the presence of a calcareous substrate. Thus there may be heavier larval settlement in shelly substrata leading to higher incidences of parasitism among cohabitant hard clams.

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