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Assessment of Shellfish Survival and Growth in the Pamet River System

Report prepared for the Truro Shellfish Advisory Committee
Chair: Ansel Chaplin

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Prepared by:

Bill Walton, Ph.D. & Diane Murphy

Cape Cod Cooperative Extension
PO Box 367
Barnstable, MA 02630
(508) 830-6478
Fax: (508) 362-4518
wwalton@whoi.edu

Introduction

The Pamet River system is one of Truro's most prized natural resources, and has long provided essential habitat to a number of shellfish species, including quahaugs, oysters and soft shell clams. In turn, these shellfish have long provided enjoyment and sustenance to the community. The Pamet River system, however, has long been subject to dynamic geological conditions and human-induced changes.

In recognition of both the value of the shellfisheries and the dynamic nature of the estuary, the Truro Shellfish Advisory Committee (SAC) and Shellfish Constable Tony Jackett sought to identify those sites where shellfish growth and survival were best. This information could be used to guide management of existing populations, assist implementation of stock restoration efforts, aid possible designation of aquaculture sites, and inform decisions on other uses of the estuary.

In response to this request, Barnstable County's Cape Cod Cooperative Extension (CCCE) Marine Program staff conducted a test for differences among sites of interest by conducting short-term (2 month) assessments of the growth and survival of oysters (*Crassostrea virginica*), quahaugs (*Mercenaria mercenaria*), and soft shell clams (*Mya arenaria*) at various locations. At each site, we used similarly sized juvenile shellfish supplied from the same hatchery and cultured identically, to provide a standard, or 'yard stick', that would allow a relative comparison of sites.

Methods

Within the Pamet River system, the Shellfish Constable and SAC agreed upon ten sites to compare and provided these sites to CCCE (Fig. 1). These sites varied in terms of substrate and tidal height, and are described qualitatively as follows:

- Site A: Sandy with great deal of sediment movement, mid-intertidal
- Site B: Very muddy, mid-intertidal, close to channel with very soft mud
- Site C: Muddy, relatively high intertidal, above softer mud with high degree of organics
- Site D: Firm sand, mid-intertidal, near rocks
- Site E: Sandy, high intertidal, along eastern side of creek
- Site F: Red sand, near rocks and old dike, mid-intertidal
- Site G: Sandy with some sediment movement, mid-intertidal
- Site H: Sandy with great deal of sediment movement at major bend in river, mid-intertidal
- Site I: Sandy, mid-intertidal, adjacent to deep hole
- Site J: Sandy with great deal of sediment movement, mid-intertidal

To minimize confounding variation among shellfish, we purchased shellfish of each species as a single batch; juvenile oysters and quahaugs, called seed, were obtained from the Aquaculture Research Center in Dennis, MA, while seed soft shell clams were purchased from Beals Island Regional Shellfish Hatchery in Beals, ME.

Table 1: Size of shellfish seed upon deployment on July 1, 2003

Species	**Shell Length**	**Standard Deviation (mm)**
Oysters	8.47 mm or 0.33"	$\pm$ 1.50
Quahaugs	6.72 mm or 0.26"	$\pm$ 0.74
Soft Shell Clams	7.34 mm or 0.29"	$\pm$ 0.71

For oysters, we placed three vinyl-coated trays (0.5" x 0.25" mesh) at each site, and propped up on 2" PVC pipe with the intent to keep them above the sediment (Fig. 2). Each tray was stocked with 25 oysters. Due to their small size, these oysters were initially enclosed in 3 mm mesh pouches within the cages. After 1 month, we released the oysters from these pouches to allow greater flow of seawater.

For both quahaugs and soft shell clams, at each site we placed six plastic plant pots (10" diameter and 10" deep, or 0.55 ft^2) in the substrate (flush with the bottom) and filled each with the removed sediment, including any infaunal organisms residing in the sediment. For the quahaugs, each pot was stocked with 50 individuals, while the soft shell clam pots were stocked with 25 clams. To test the effects of predators, half of these pots were protected from predation by the addition of predator-exclusion netting over the top of the tray (held by a rubber band). Due to an inadequate supply of soft shell clams, these were only deployed at two sites, sites F and G.

Upon collection of the shellfish on August 29th, surviving oysters were counted and measured. Any signs of predation were noted. Similarly, surviving quahaugs and clams were retrieved by sieving the contents of each pot over 3 mm mesh screen. Survivors and any natural set of shellfish were counted and measured. Again any signs of predation were noted. See Figure 3 for samples of retrieved shellfish.

The survival and growth data were assessed statistically and graphed. In many of the graphs comparing sites, the following convention is used: sites that do not vary significantly from one another are connected by a commonly colored horizontal line. This means that although the averages did vary some (as evidenced by the different bar heights), this difference could be accounted for by what is called natural variation and did not amount to 'true' differences among sites.

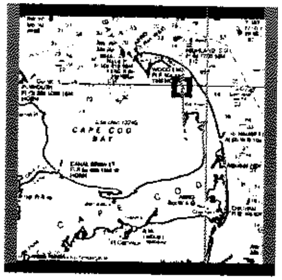
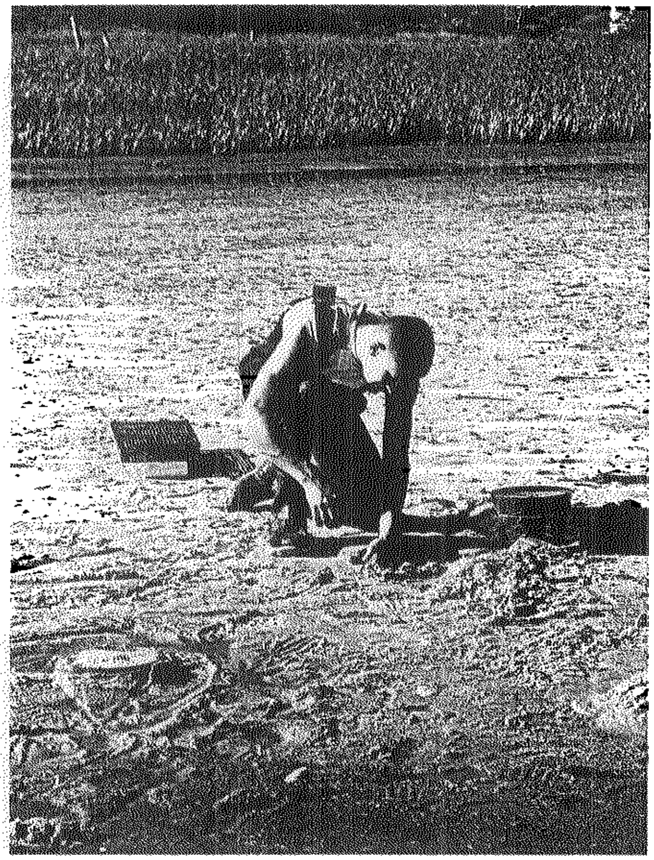
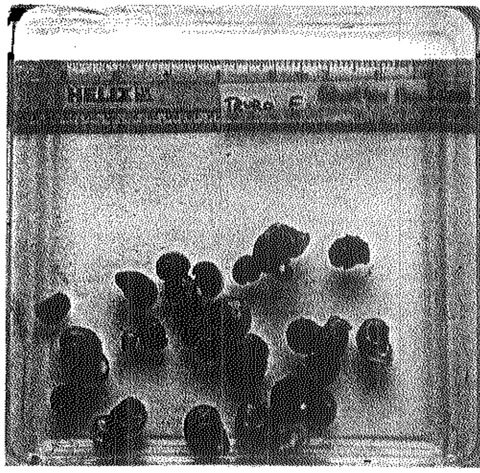


Figure 1



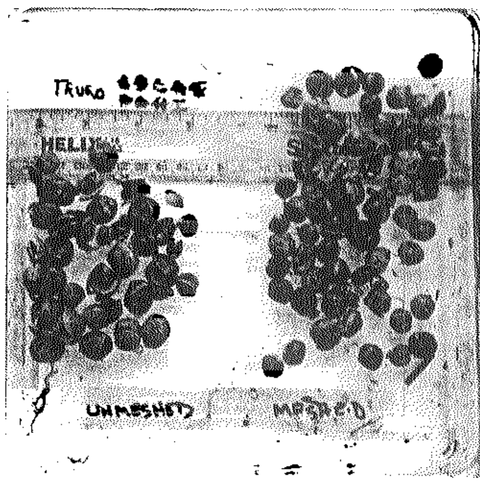
Lucas Drake, a Cape Cod Community College intern, helps set up the experimental units.

Figure 2

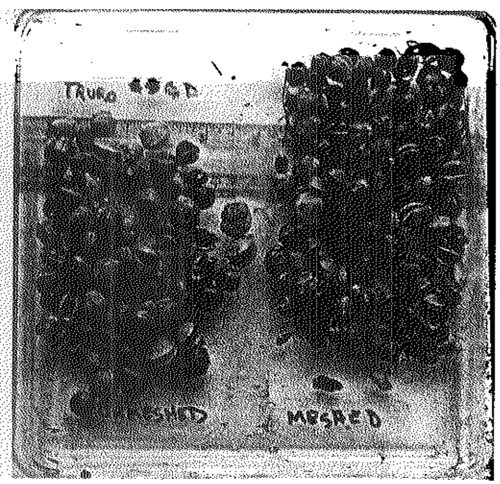


Site F

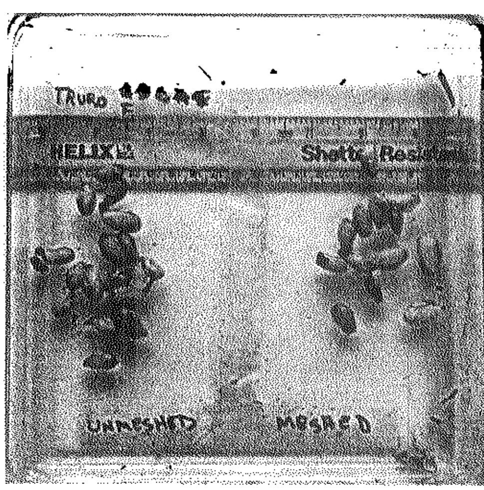
Site G



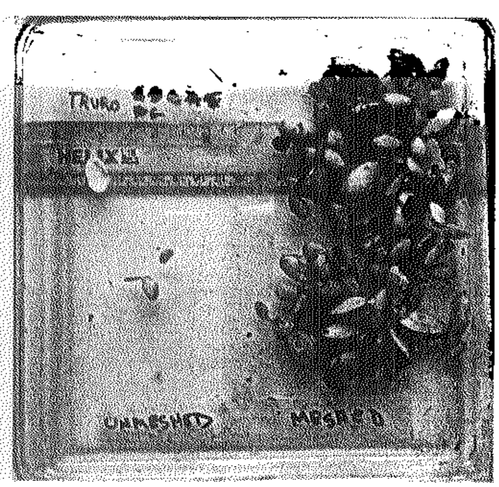
Site I



Site D



Site F



Site G

Figure 3

Oyster Results and Recommendations

In terms of survival (Fig. 4), the ten sites examined broke into two groups: poor and good survival. Site F, I and J all had relatively low survival around 40-50%, while the remaining sites were all above 80%. No evidence of oyster drill predation was observed. Presumably some of the observed mortality was due to burial though some sites with a great deal of sand movement (e.g., H) did not show high mortality.

Oyster growth was more complicated (Fig. 5), with four distinct tiers of sites. While the poorest sites (E, F and J) only exhibited a 100% increase in shell length, the top group of sites (A, B and G) were all over 200%. Growth at sites C and H was better than the worst sites, but still less than that of sites D and I, which in turn were less than the best sites.

Given the poor survival at sites F, I and J and the poor growth at F and J, we do not recommend these sites for significant oyster enhancement efforts at this time. Conversely, given the good growth and survival at sites A, B and G, we would recommend these sites as good candidates for restoration efforts. Note that site C had good survival but relatively slow growth, and thus may not be a primary candidate for management.

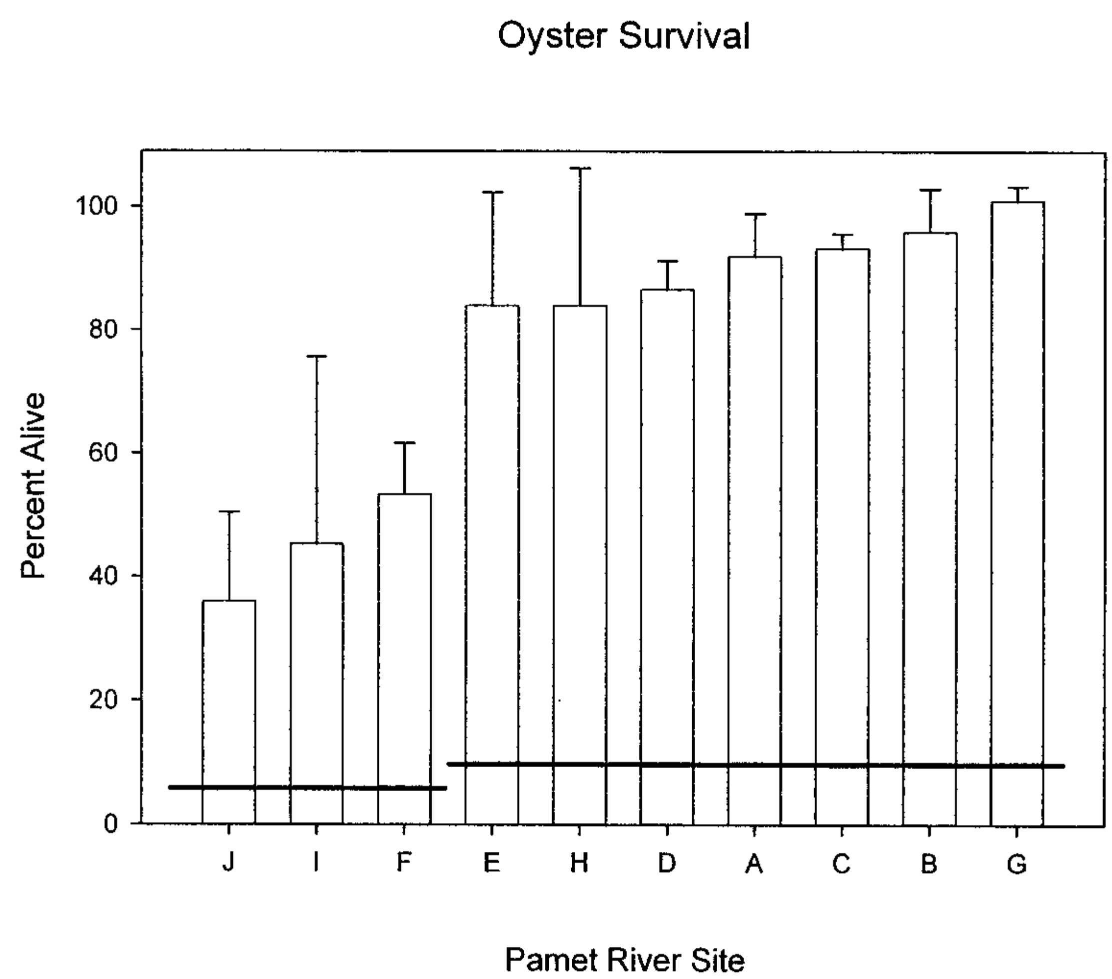

Oyster Survival
Percent Alive
0
20
40
60
80
100
J
I
F
E
H
D
A
C
B
G
Pamet River Site

Figure 4

Oyster Growth

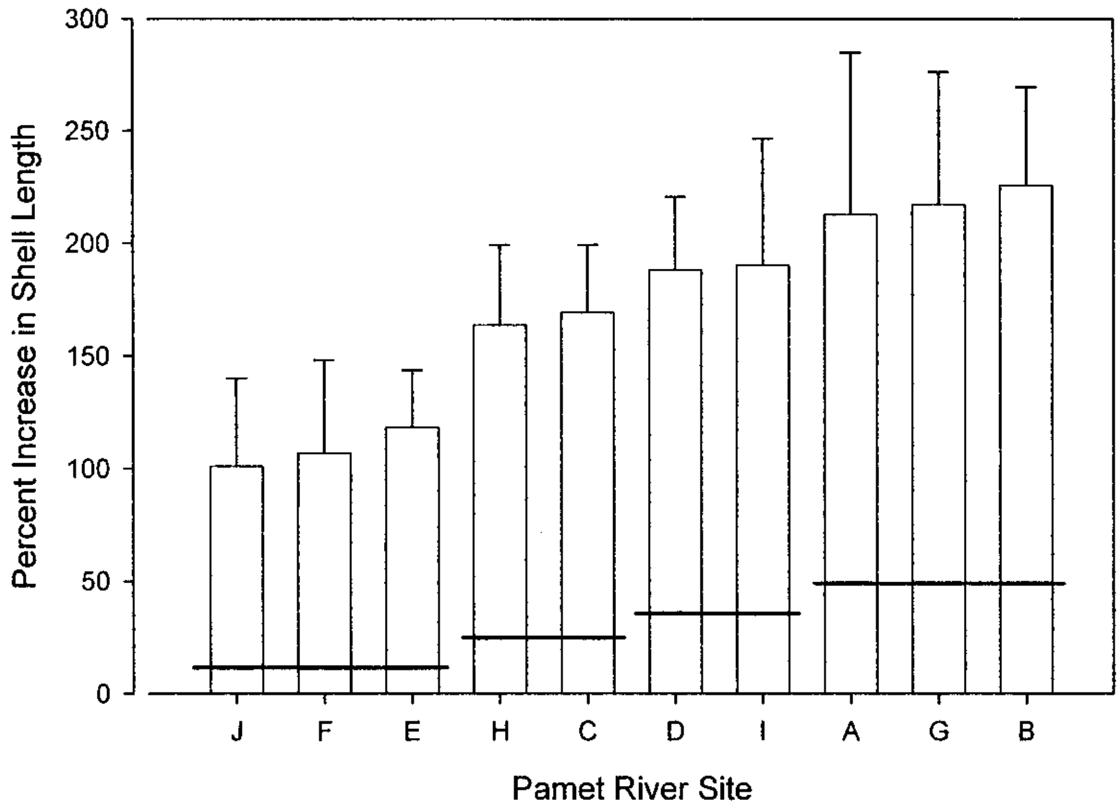


Figure 5

Quahaug Results and Recommendations

In terms of quahaug survival (Fig. 6), there was a great deal of overlap among sites, leading to results that are confusing at first glance. Where sites overlap (e.g., site G overlaps with I, but also C, D and F) the site in question did not differ from either group but is clearly a transition between these two groups; note that I does differ from C, D and F. Although survival did vary among tiers of sites (Fig. 6), survival was below 50% at all sites except C, D, F and G, with the best survival at site C.

Notably, predation did significantly reduce survival (Fig. 7). Quahaugs protected under mesh survived better at all sites than those left unprotected. This would seem to be an important component of any restoration efforts, unless seed larger than those tested could be obtained and deployed.

As with survival, growth among sites was complicated by overlap among sites (Fig. 8). Despite this variation, it is apparent that sites E and F had the slowest growth, while site D had reasonable growth and sites, and sites A, G and I had the best growth rate (over 90% increase in shell length). Note that quahaugs and oysters grow substantially differently and that the growth rates for the quahaugs should be compared only with other quahaugs.

Interestingly, site C did not have good growth for quahaugs despite its central position among good sites. This may have been the result of the relatively high intertidal location of the site. Unfortunately, lower intertidal sites at this location did not provide suitable substrate for quahaugs.

As a note of interest, meshing had an effect on growth that was dependent on site (Fig. 9). At sites E and J (marked with a black asterisk), quahaugs grew better under mesh than when not under mesh. Conversely at sites D and I (marked with a blue asterisk), quahaugs grew better when unmeshed than meshed. This presumably results from very site-specific conditions (predators, sediment transport, water flow, etc.) and unfortunately precludes a consistent recommendation based on its effect on growth.

Thus, in attempting to find the best compromise between survival and growth, we would recommend that quahaug restoration efforts focus on sites D, G and possibly I. Site A had excellent growth but poor survival; if survival could be increased, this site might serve as an excellent nursery. Lastly, it is essential to protect these seed from predation with mesh net, despite possible effects of this netting on growth.

Quahaug Survival

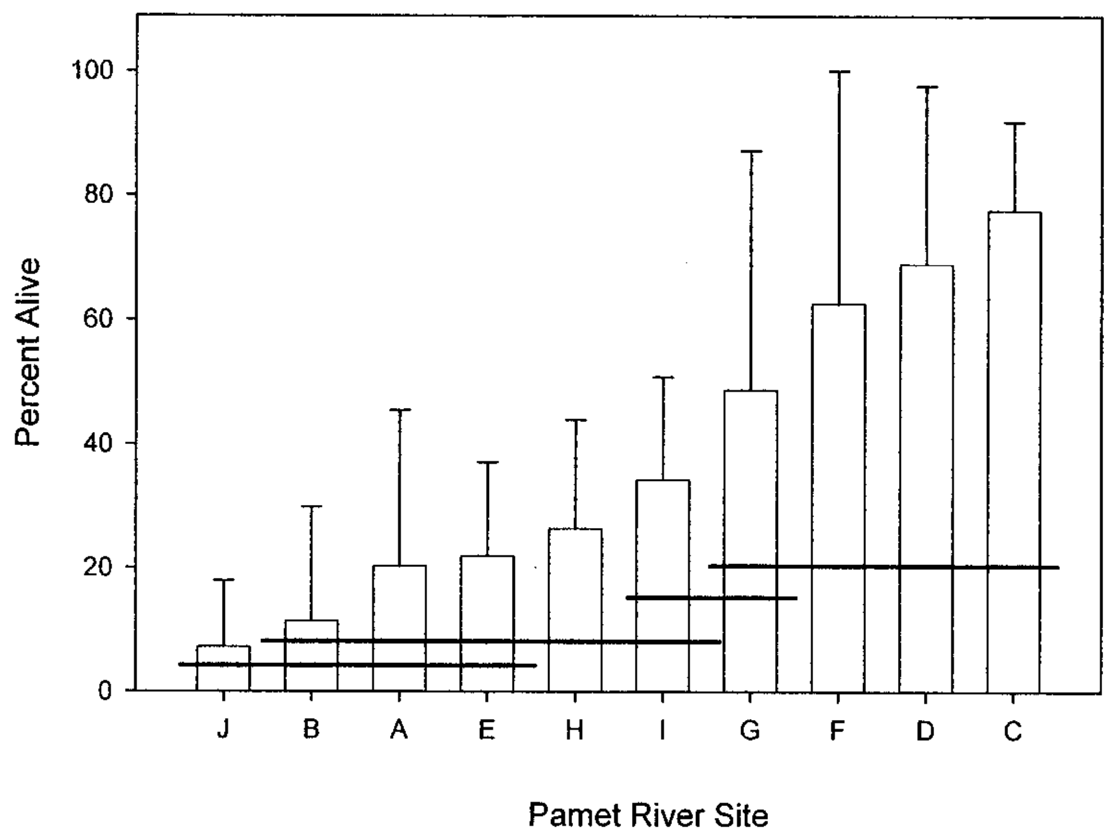


Figure 6

Effect of Meshing on Quahaug Survival

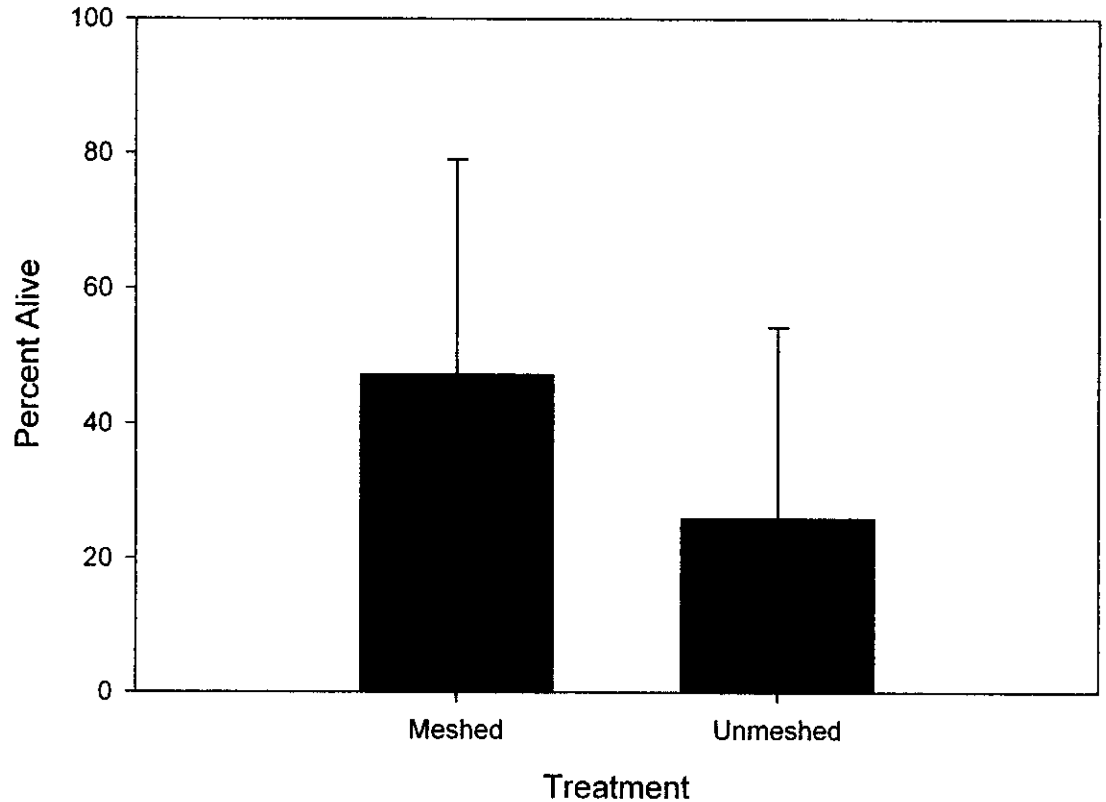


Figure 7

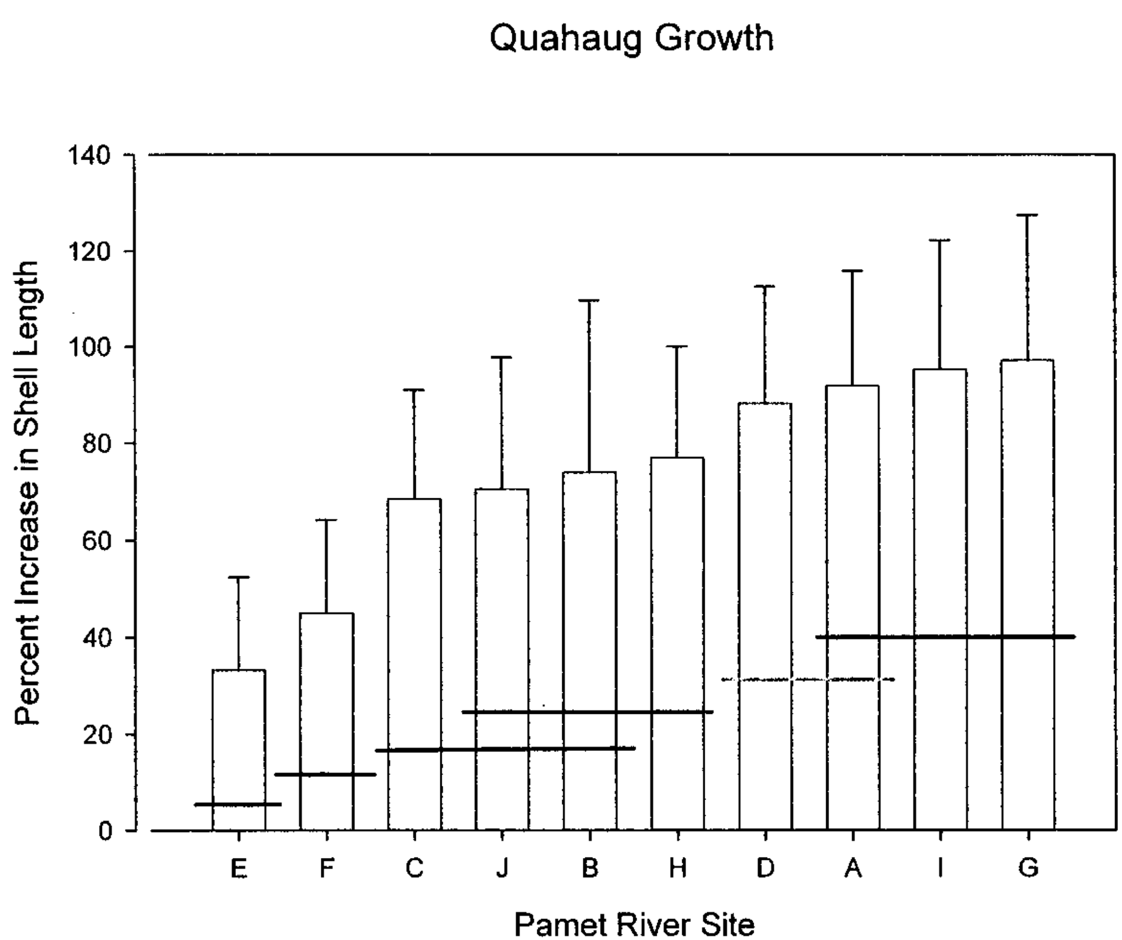

Quahaug Growth
140
120
100
80
60
40
20
0
Percent Increase in Shell Length
E
F
C
J
B
H
D
A
I
G
Pamet River Site

Figure 8

Effect of Meshing on Quahaug Growth

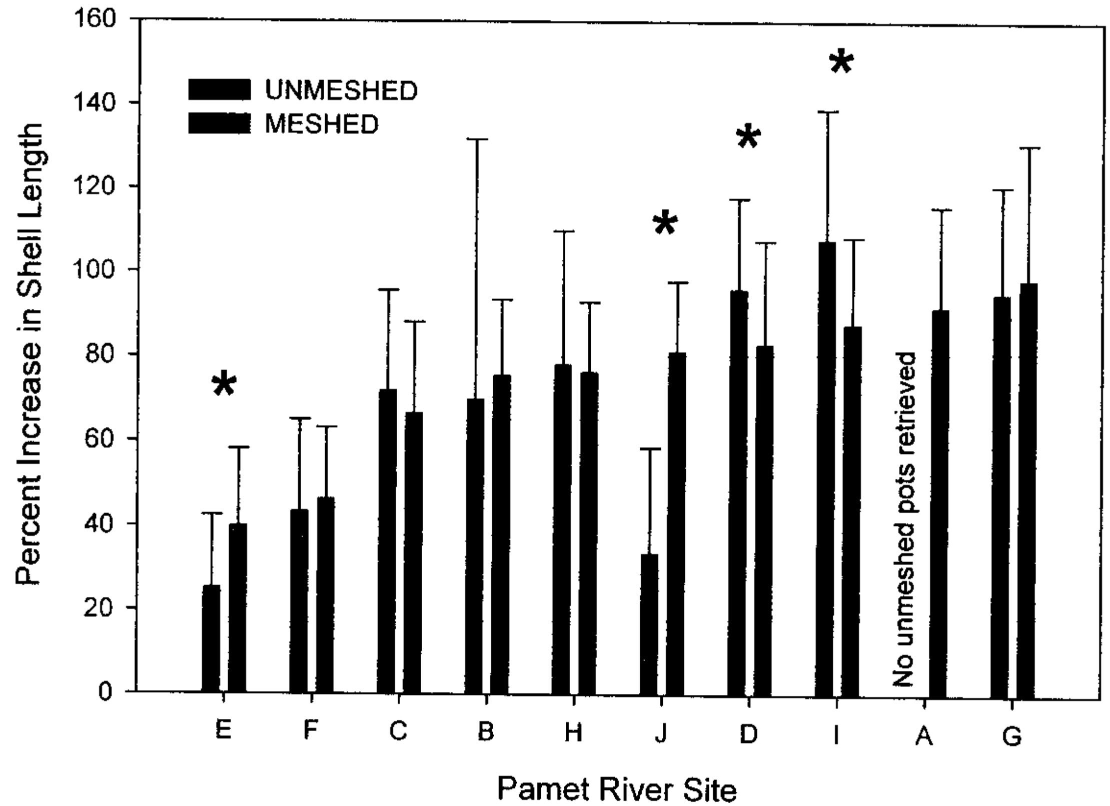


Figure 9

Soft Shell Clam Results and Recommendations

Due to the loss of pots from one site (F), we were unable to compare soft shell clam survival and growth between the two sites. We were however able to observe the following.

First, as with quahaugs, protection from predators was essential to soft shell clam survival (Fig. 10). Survival of clams in unprotected pots was very low.

Second, a set of soft shell clams was observed in the quahaug pots (Fig. 11). Around the estuary, the best set was observed at sites C and G, with a moderate set at site D. The set was estimated to be approximately 6-8 clams per square foot. Again, netting protected this set, and netting areas as is currently done by the Shellfish Constable is a recommended method of improving survival of natural soft shell clam set.

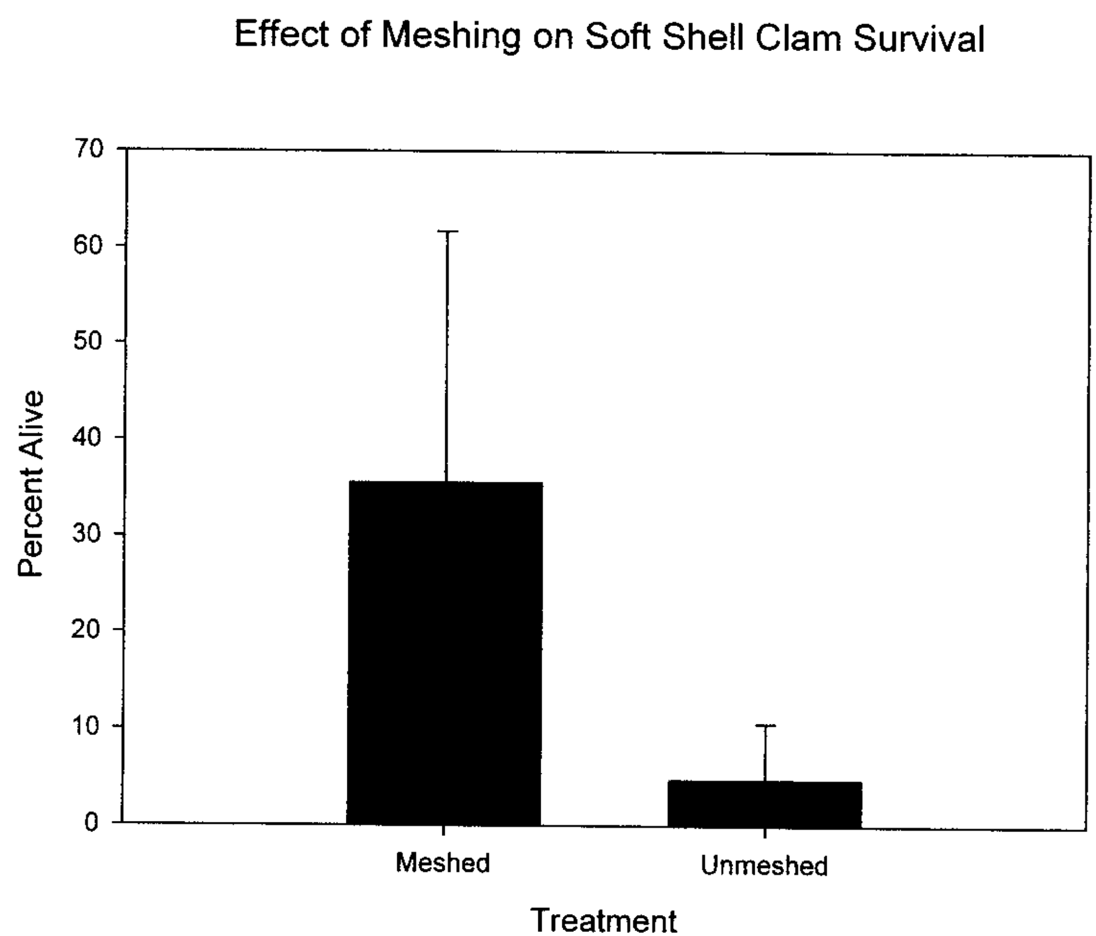

Effect of Meshing on Soft Shell Clam Survival
Percent Alive
70
60
50
40
30
20
10
0
Meshed
Unmeshed
Treatment

Figure 10

Set of Soft Shell Clams

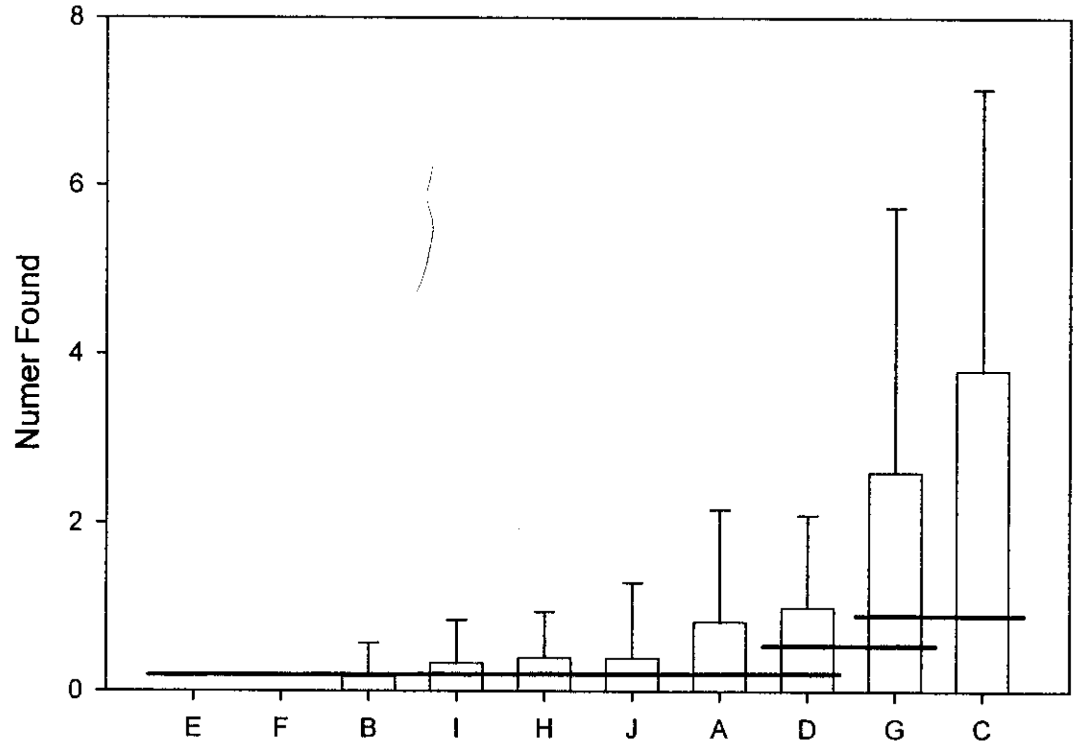


Figure 11