Marine Extension Bulletin

From the Woods Hole Oceanographic Institution Sea Grant Program

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Clam Tents: A New Approach to Soft-Shell Clam Culture and Management

Soft-shell clams, *Mya arenaria*, are an enigma to scientists, managers, and shellfish harvesters in southeastern Massachusetts and throughout the bivalve's range. One year, clams may settle in very dense concentrations, while, the following year, there may be no soft-shell clam recruitment at the same site. Why?

Recruitment

Recruitment refers to the naturally-occuring replenishment of a population. To fisheries managers and biologists, recruitment is generally gauged by the number of a specific year class that survive until they reach a harvestable size. A female soft-shell clam, two and one-half inches long, is capable of producing three to four million eggs when she spawns. Of the millions of eggs generated by a population of clams, Belding (1930) estimated that one clam out of two million survive to harvestable size. In southeastern Massachusetts, a female may spawn twice a year. The larvae live in the water column for several weeks before settling to the sediment. During the planktonic stage, larvae are subject to tides, tidal currents, wind-driven currents, waves, and other natural and episodic events that affect water movement. For example, if the wind blows offshore for the week that the larvae are ready to set, all or most of the larvae could be transported out to sea and the potential intertidal population for that spawning event will be lost.

Mya arenaria larvae that survive the planktonic stage metamorphose and settle on sediment or other substrates as post-set juveniles. These newly settled clams are tiny, less than 0.25mm in length. Soft-shell clam juveniles can burrow quickly and attach themselves to sand grains or other hard structures using byssal threads. However, these tiny clams may attach to small particles which themselves may be moved by wind and currents. Other potential dangers are broken or detached byssal threads, which increase the risk of these small clams being transported away from the tidal flat.

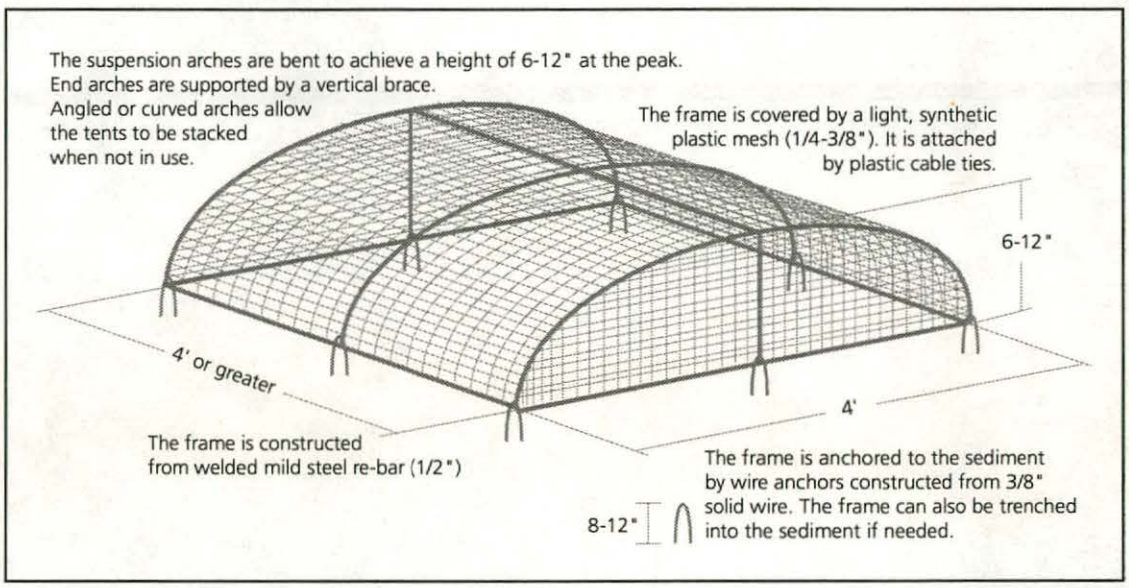

Figure 1 - A freestanding clam tent is constructed as a modular unit with a rigid frame. The size of the footprint varies with one's ability to handle the frame. A 4'x4' tent is preferred for one person, while up to a 4'x12' can be handled by two or more people.

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Predation

As if physical forces weren't enough, the young clams are also at risk from predators. Early post-settlement mortality is typically around 80% in the first 100 days, primarily due to predation. Moon snails, whelks, most species of crabs, lobsters, ribbon worms, and many birds and fishes all eat tiny clams.

History of Soft-shell Clam Population Management

Historically, management of soft-shell clams was limited to monitoring productive areas and harvesting legal sized clams when and if densities were high enough to make it economically feasible. In the early and mid-1900's, some attempts were made to relay clams from areas of good recruitment and high density to areas with good growing conditions but low recruitment. Those early efforts were unsuccessful, primarily because predators had easy access to the relayed clams.

Since the early 1990s, quahog (*Mercenaria mercenaria*) farmers from lower Cape Cod observed that the nets they used to protect their hatchery-reared quahogs were collecting soft-shell clam seed. These nets were laid down over the seed quahogs to protect them from predators and from washing out of the sediment. The soft-shell clam seed apparently settled and attached to the nets with their byssal threads. Later in the season, the quahog farmers found the soft-shell clams growing rapidly in the sediment alongside their quahogs. Initially, the quahog farmers considered the volunteer soft-shell clams a nuisance, competing with their farmed quahogs for space and food. Eventually, they saw it as an opportunity and began collecting the soft-shell seed as an additional component of their shellfish harvest.

Clam Tents

Before long, quahog farmers were placing netting on the flats with the sole intent of collecting wild soft-shell clam spat as a commercial crop. This practice originated the concept of the clam tent. Following their informal experimentation, Cape Cod growers realized they could increase the rate of "catching" soft-shell clam seed by modifying the way the net was placed over the sand flat. They experimented with mesh size, form of structure, height of netting off the bottom, and orientation of the tent to the current.

The designs of modern clam tents vary depending on the location it is used in and the grower's own preferences. Generally, variations fall under two basic designs: free-standing and raceway systems.

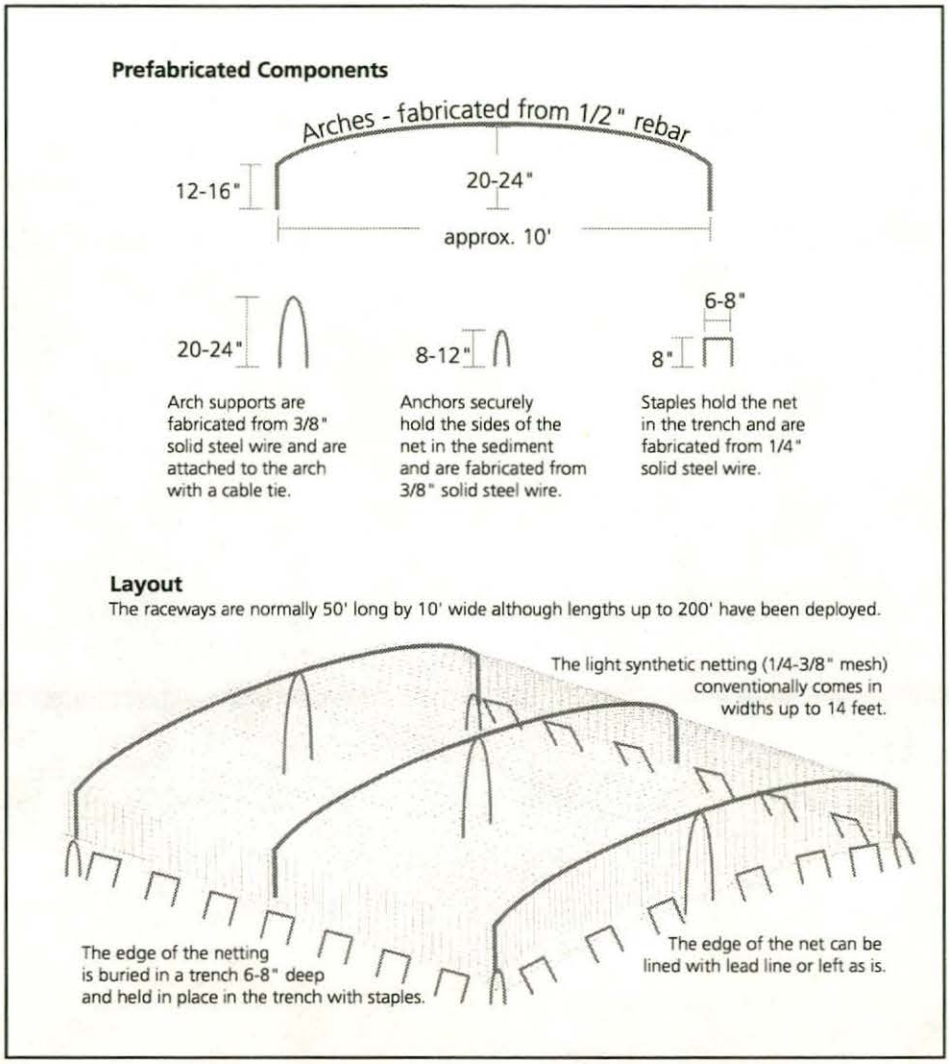

Figure 2 - A sand anchored clam tent can be considerably larger as the unit is assembled from prefabricated components on the site.

These basic designs are illustrated and described below, in Figures 1 and 2. These designs, often with modifications, are currently in use on the flats in southeastern Massachusetts. Figure 3 demonstrates a newer innovation developed by Karl Rask and Richard Dickey from The Resource, Inc. (Orleans, MA). Although the information contained in this bulletin is the most up-to-date available, clam tent designs are constantly changing as farmers and resource managers experiment with variations that work in their specific locations. Each clam flat represents a unique environment and may require modifications in clam tent design.

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Q&A

The following is an attempt to provide answers to some of the most frequently asked questions about clam tents.

What are clam tents?

Clam tents are netted structures that are placed over native intertidal sand flats to promote the recruitment of soft-shell clams. Their design is highly variable and can be modified to meet site specific conditions.

Why are clam tents being used?

As described above, larval and newly settled soft-shell clams are often lost to hydrodynamic perturbations or to predators. Clam tents offer juvenile clams the opportunity to establish themselves in the sediment and grow to a size less likely to be washed out of the sediment or to be consumed by predators. Flats with clam tents often yield higher densities of harvestable clams than areas without clam tents.

In an economic analysis generated by WHOI Sea Grant and the Town of Barnstable Division of Natural Resources, a tented flat recruited 13.6 harvestable clams per square foot in an area that had not had a clam set in twenty years. The tent promoted clam recruitment resulting in an estimated gross harvest of $42,458 per acre, at a landed value of $1.25 per pound of live clam. The estimated cost of materials and labor per acre for deploying and retrieving the tent was $4,533 per acre. The economic return for tenting the site was an estimated net profit of $37,925 per acre of tent, not counting the harvest cost.

Why do clam tents work?

Although growers and researchers are not sure exactly how clam tents work, it is commonly believed that they provide a refuge from swift currents by slowing down the movement of water as it passes through the mesh. In turn, this may reduce sediment movement and may allow the clams to attach more easily to the net or bottom sediment. Once the clams have settled under the tents, the tents serve as a refuge from many surface-active predators.

How do I build a clam tent?

The general concept of a clam tent is to suspend and anchor plastic mesh netting over the clam flats to exclude predators or competitors. Two common designs are included in this bulletin and can be used as a general guide to their construction.

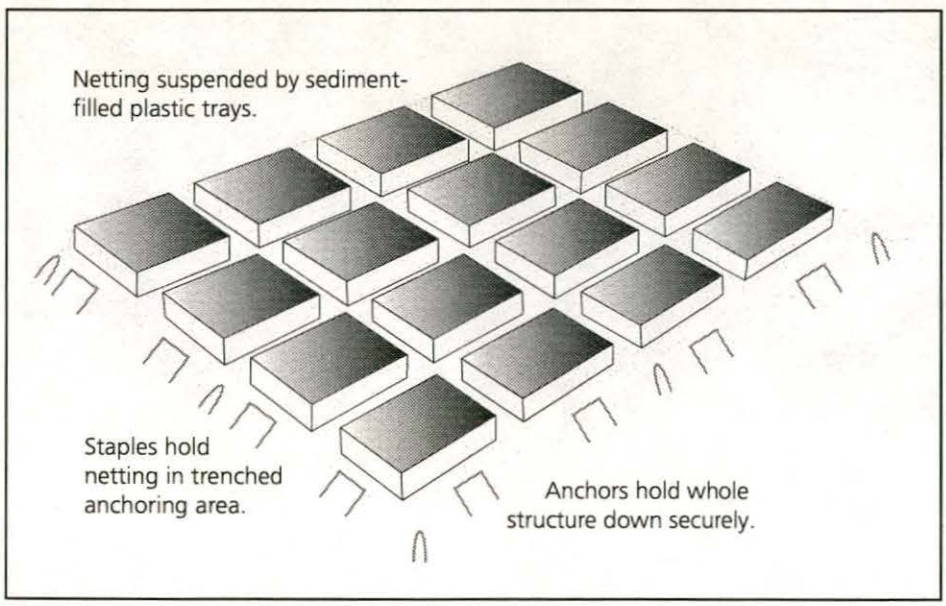

Figure 3 - Recent work by Karl Rask and Richard Dickey (The Resource, Inc., Orleans, MA) has placed sediment filled plastic trays under the tent to permit the newly recruited juveniles to be relayed to other sites.

When do I put the clam tents on the flats?

The idea is to get the nets onto the flats as the larvae are being spawned. Soft-shell clam larvae spend about two weeks swimming in the water column before settling to the sediment. If the nets are on the flats when the clams spawn, the tents will be in place when the larvae are ready to settle. The net will "season" in the water before the larvae settle, but will not be exposed so long that algae or other fouling organisms will settle on the nets first.

As timing is critical, it is important to know when the soft-shell clams are spawning in your area. In southeastern Massachusetts, the clams spawn in May and again in September. Further north, the clams spawn only once a year, usually in June or July. Spawning depends on local conditions such as air and water temperature and the availability of plankton. Check with your Sea Grant Marine Extension Agent or your local shellfish constable to get an estimate of when the soft-shell clams will spawn in your area.

When do I remove the clam tents from the flats?

Clam tents function both as a substrate for larval attachment and a trap that collects post-larval clams entrained in the moving tidal currents. After settlement, the tents continue to act as barriers to predators, so it is a good idea to keep the tents in place until the clams have grown large enough to anchor themselves in the sediment and to resist predators. Usually, tents are kept on the flats through the summer and into the fall. Once the water temperature has dropped below 10°C, predators will be less active (and therefore less of a threat), and clams should have reached 10-20mm in size. At this point, tents can

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be removed from the flats. **Tents must always be removed before the flats ice up during the winter.** Ice will destroy the tents and could transport them off-site where they may pose an entanglement threat to marine life and birds.

What kind of clam enhancement can I expect from clam tents?

An experiment was conducted in Barnstable Harbor, Massachusetts in 1995-1996 by the Barnstable Shellfishermen's Association, the Town of Barnstable Division of Natural Resources, and WHOI Sea Grant to test the effectiveness of clam tents. The study involved four intertidal flats, of which approximately 150,000 square feet were tented (3.43 acres). The Barnstable Harbor sites had a history of harvestable populations of clams but hadn't recruited any clams during the previous ten to twenty years. The 1995 summer season yielded no appreciable recruitment of soft-shell clams within the harbor and no recruits could be found in any the untented experimental flats. At one 700 square-foot tented site, clams were recruited at a density of over 100 clams per square foot (mean shell length 6.33mm or 0.25 in.) as recorded during Fall, 1995. The tents were removed in November, 1995, and by the following year the mean clam density was 13.6 individuals per square foot, at a mean size of 71mm (2.8 in.). If this recruitment success could be achieved routinely, the result would be a return of approximately 566 bushels of soft-shell clams harvested per acre of tents. As stated above, the estimated net profit per acre of clam tent would be $38,000. This represents a significant economic boost for the shellfish industry.

Who can use this technology?

Clam tents can be adapted for use by many different agencies interested in natural resource management. Currently, tents are being deployed by many shellfish aquaculturists on Cape Cod interested in diversifying their harvest from primary crops of cultured quahogs and oysters. In addition, some shellfish constables are investigating the use of clam tents in an attempt to stabilize the recruitment of soft-shell clams on their flats as a benefit to the wild fishery. Clam tents also have been employed by environmental management groups to reclaim flats that have lost soft-shell clam populations to adverse environmental conditions, overfishing, or other, unexplained factors. Essentially, clam tents offer a low-cost tool for promoting soft-shell clam recruitment to areas that can support them.

References

- Belding, D.L. 1930. *The soft-shelled clam fishery of Massachusetts.* Marine Fisheries Series #1. MA Division of Marine Fisheries. Boston, MA. 65 p.
- Marcotti, T. and D. Leavitt. 1997. *The Barnstable Harbor Shellfish Recruitment Enhancement Project.* Final Report to Barnstable Health, Safety, and Environmental Services Dept. – Natural Resources Division, Barnstable, MA. 47 p.

"Clam Tent" *Marine Extension Bulletin* written by: Dale F. Leavitt, WHOI Sea Grant Marine Extension Leader & Aquaculture Specialist, Barnstable County Cooperative Extension Service. June 1998.

For more information about the research or outreach projects profiled in the *Marine Extension Bulletin*, contact WHOI Sea Grant at the address listed above.