Open-Ocean Culture of Sea Scallops Off New England

Clifford A. Gooday
MIT Sea Grant College Program
Cambridge, Massachusetts
and
Ronald J. Strelowicz
Commissioner Rail
East Falmouth, Massachusetts

Abstract

A new-scale pilot site for the experimental culture of the giant scallop Pectenmaximus has been established in the U.S. Exclusive Economic Zone (EEZ) off the coast of Martha's Vineyard, Massachusetts. The goal of the project is the development of sustainable production practices for the New England scallop industry and the promotion of economic growth. The project, a series of methods of culture developed through the culture methods of being evaluated both biologically and economically.

The project is supported by the United States Army Corps of Engineers as an experiment in the EEZ. The project is the first project to be approved in the EEZ for scallop culture. It is also the first project to be developed under the North American and European culture systems and has been designed with full support by the United States Army Corps of Engineers.

This paper will briefly describe the project and its research agenda. The potential impact of the project on the industry will be described and a case study of the successful use of a commercial project conducted by the U.S. Army Corps of Engineers will also be described.

Sea Scallop Culture Around the World

Scallop culture, as practiced today, was pioneered in the Manx Bay region of Japan (Hayakawa, 1959). Before 1935, the scallop industry in that area was subject to significant fluctuations in abundance. Today
seventy percent of Japan’s scallop harvest is cultured.

The harvest is now stable, year to year and at an order of magnitude larger than the previous wild harvest history. There are over 1000 scallop harvesting farms in the Matsu Bay region alone, and many other regions also produce cultured scallops.

Since the 1970s, countries in other parts of the world have begun scallop culture operations based on the Japanese model (Kida, 1979; Paul et al., 1981; Royce, 1986; Nishi and Cahill, 1986). Scallop culture operations depend on obtaining a large supply of spat, commonly called seed. The two sources of seed are hatchery and spat collecting devices. Hatcheries take sexually mature scallops from the wild population and spawn them in captivity. Scallops are easily induced to spawn by raising the water temperature (Graff, 1972; Castello et al., 1973; Liu et al., 1975; Nishi et al., 1980). There are variations in the rearing techniques, with different levels of difficulty, depending on the species of scallop. In Japan, commercial growers have found spat collection from natural production to be the most economical approach to generating seed (Goto et al., 1991).

Scallops spat, if placed directly on the bottom, suffer high mortality. Therefore most culture operations hold the scallops in an intermediate culture phase until the scallops are about 30-30 mm in size. The most common method of holding utilizes strings of specially designed nonattached nets of submerged long lines. Holding the scallops in these nets, off the bottom, reduces predation and provides better feeding conditions, enhancing growth.

Final culture, or grow-out, can be conducted at a commercial scale using suspended culture or bottom culture (net ranching). The most common form of suspended culture utilizes a lantern net. The cylindrical cage of netting, about 10 compartments stacked one on top of another with a specific spacing of scallops placed in each. Scallops are periodically thinned and placed in large-diameter lantern nets. Another form of suspended culture is net hanging, where the scallops are tied to a string by means of a hole drilled in the hinge, or ear, of the shell. A third method involves hanging scallops to a hanger pipe (Copp, 1985). All these methods tend to be very labor intensive.

The least expensive method of grow-out is bottom culture where scallops are released onto appropriate bottom to grow to market size (Frohlich et al., 1980). In some cases, the bottom is cleared of predators such as crabs and starfish to reduce losses. Upon reaching market size the scallops are harvested by divers or longlines.

Re-Engineering the New Bedford Scallop Industry

The giant sea scallop, Placopecten magellanicus, is the mainstay of the New Bedford fishing industry. Declining resources of this species has recently led New Bedford to position itself as the leading U.S. fishing port in landed value. The industry and fishery managers have had to come to grips with the problems associated with open-access fisheries. As with groundfishing, a strict days-at-see has been imposed to allow scallop stocks to rebuild.

Some participants in the New Bedford sea scallop industry believe that increasing natural productivity is a better solution than scaling back effort. From that point of view, the Westport Scallop Project has been designed to apply to New England the scaling culture techniques that have been proved in other parts of the world. The project is a collaboration of scallop firm interests and a science and technical support base as listed in Table 1.

Cliff Goodyer, MIT Center for Biology Engineering Research
Ron Blouin, Conservation Fund
Richard Katney, Martha's Vineyard Shellfish Group
Brock Ewart, Woods Hole Oceanographic Institution
Gary Lovblad, Undersea Technologies, LLC
Ken Reif, attorney, Gloucester
Pete Morales, Conservation Law Foundation
Rosanna Amorello, U. Penn Lab for Marine Animal Health
Bruce K. Powell, Woods Hole Oceanographic Institution

Table 1. Westport Scallop Project technical and science support.
The project is supported by a Submarine-Kennedy grant and focuses on the technology needed to culture scallops and the development of an industry infrastructure to support such a change in production methods. In order to "jump-start" the demonstration of the all-important final stages of production, the project focuses on the grow-out. We will use small scallops that are normally taken by harpoon in the commercial scallop fishery. These harvested scallops are typically 4-6 mm in shell height and are considered too small to attach profitably. The eventual hatchery development and wild spat collection are being addressed by other funded projects.

Grow-out Methods

The project will evaluate several approaches to final-stage grow-out. The first will be direct bottom seeding. This method is the simplest and requires the least change from current production methods. The logic behind this approach is based on the biology of the animal and the nature of its reproduction. Mature scallops can generate millions of planktonic eggs. These tiny drifting larvae feed on the current for several weeks, foraging on algae and other microorganisms until they reach a stage of development that requires a surface on which to settle. This settled spat then begins to form its shell and assume its role as a filter feeder.

During their early life stages, the sea scallop is prey to many other animals, suffering tremendous levels of mortality. When and where conditions are favorable for their survival, extremely dense populations of young scallops can result. Fishermen call these areas "peanut beds." However, due to fishing pressure, competition for food, and pollution, these beds seldom turn into a bounty of adult, harvestable scallops. By reestablishing these challenged juveniles, the Westport Scallop Project aims to reconstitute this lost productivity and develop a sustainable grow-out paradigm for the scallop fishery.

In addition to bottom seeding, some small scallops will be placed in bottom cages, which, as shown in Figure 1, look like conventional lobster traps with entry gates. Placed on the ocean bottom, these cages will protect the scallops from predation and allow easy monitoring and 100 percent recovery. As shown in Figure 2, these bottom cages will be rigged and handled in a tow-netting operation.

A third grow-out method will be a suspended culture where the benefit of greater plankton availability higher in the water column should offer more rapid growth. In order to fully exploit the involvement of commercial scallop vessels (35 to 50 ft long), we have developed a system called self-sustaining culture, which by their size (23 ft long x 4 m high) better match the lifting and manipulating capacity of these vessels.

These suspended grow-out units are pictured in Figure 3. The vertical location of the cage will be one of the important variables in our experiments.

Site Selection and Permitting

Site selection will be an important issue since the success or failure of commercial-scale scallop farming. This site is even more important in an experimental effort due to the importance of monitoring and maintaining experimental control. A site was selected close to New Bedford and Woods Hole, Massachusetts, to minimize logistic costs, but that was exposed to full ocean conditions. We also sought an area that was typical of commercial bottom and did not have summer temperatures that exceeded 20°C. We also needed a site that had some scallop productivity but not enough to mask our seeding efforts. To broaden the impact of our project, we wanted our site to be in federal waters. Finally, we sought a location with minimum conflicts with other fishing and maritime activities. NMFS data on fishing activity combined with some advice from local fishermen helped identify the location shown in Figure 4.
Aquaculture in the U.S. EEZ is a popular discussion topic but as of 1995, it is not yet a reality. For this reason, obtaining the needed permits for our project has taken on national significance. The U.S. Army Corps of Engineers (COE) has authority under Section 10, Rivers and Harbors Act of 1899. This Act relates to activities affecting U.S. navigable waters and the COE scrutinizes the placement and adequacy of aquaculture structures and methods.

In addition to these years of safety and adequacy, the COE application is a public review process and it is forwarded to other federal agencies for their review. Table 2 lists these agencies and their basis for interest.

The COE permit process is a mature regulatory function and its application to aquaculture operations has been under study by states for decades through legislation. Our COE application for a three-mile by three-mile square located south of the island of Martha's Vineyard, Massachusetts, was submitted in September 1994 and was issued in January 1995, the second such permit ever issued by the federal agency.

Due to the size of a native, filter-feeding species, the typical agency concerns over seed and water accumulation or the genetic consequences of escaped fish were not raised.

However, the COE permit simply allows the placement of equipment and conducting of activities. It does not deal with issues of “property rights” or “exclusivity.” The proposed site was in the middle of commercial fishing grounds and an avowed part of our project was the securing of this bottom. We needed some measure of exclusivity to properly conduct our experiments. In addition, the area was being a species regulated under the Fisheries Conservation and Management Act (FCMA) and for which the New England Fishery Management Council (NEFMC) has management plans in effect.

The authority of the NEFMC would have been less clear had we intended raising a species for which they do not have a Fishery Management Plan (FMP).

However, under current legislation, the management councils are the only bodies able to deal with the conflicts associated with the use of federal waters and any impact aquaculture might have on wildlife (Brenner, 1995). In spite of the relevancy, aquaculture in an area of regulation in which neither the NEFMC, nor any of the other seven regional councils, have experience.

We first approached the NEFMC in August 1994. The subsequent two years revealed the inadequacy of the council process for dealing with aquaculture applications. In Table 3, a schedule of events and milestones is revealed, all related to meeting the Council’s requirements. The two-year duration of this process is not a measure of opposition to our project. Indeed, all elements of our project have been nearly unanimous in favor of our request. The delay is simply the result of the complex FCMA process combined with the enormous pressures on the Council staff and membership to deal with more pressing fisheries matters.

EEZ User Conflicts

The nature of the Council’s role in the future of EEZ aquaculture is the topic of considerable discussion. In an analysis of the Council’s responsibilities and
opportunities with respect to LGZ aquaculture. A neutral stance was recommended since the Council would be the arbiter of the inevitable conflict over user conflicts (Bennett, 1985).

The Wupatki Fishing Project was viewed favorably by the Council due to its broad industry base and its short-term (18 mo) duration. The Council members expressed concern about the perceived impacts of the project. The objections that were voiced at Council meetings, committee meetings, and at the January 1990 public hearing at Woods Hole we generally dismissed as not-in-my-backyard rhetoric.

<table>
<thead>
<tr>
<th>Event Description</th>
<th>Date</th>
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<tbody>
<tr>
<td>Apply to Council for site closure</td>
<td>Aug. 1994</td>
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<tr>
<td>Presentation to full Council</td>
<td>Sept. 1994</td>
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<tr>
<td>Presentation to Scallop Committee</td>
<td>Oct. 1994</td>
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<tr>
<td>Presentation to Interagency Committee</td>
<td>Nov. 1994</td>
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<tr>
<td>Council vote</td>
<td>Dec. 1994</td>
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<tr>
<td>Submit Amendment 6 Draft</td>
<td>Feb. 1995</td>
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<tr>
<td>Presentation to Aquaculture Committee</td>
<td>June 1995</td>
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<tr>
<td>Council vote on Amendment 6</td>
<td>Dec. 1995</td>
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<tr>
<td>Council vote</td>
<td>Feb. 1996</td>
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<tr>
<td>Industry meeting at Martha's Vineyard, Mass.</td>
<td>April 1996</td>
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<tr>
<td>Industry meeting at New Bedford, Mass.</td>
<td>April 1996</td>
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<tr>
<td>Council vote on site relocation</td>
<td>April 1996</td>
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<tr>
<td>Presentation to Scallop Committee</td>
<td>May 1996</td>
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<tr>
<td>Council vote on site relocation</td>
<td>June 1996</td>
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<tr>
<td>Second Federal Register comments closed</td>
<td>July 1996</td>
</tr>
<tr>
<td>Estimated closure of site</td>
<td>Sept. 1996</td>
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Table 3: Events associated with the NEFMC aquaculture process.

The available data on the spatial distribution of commercial fishing effort is compiled by NMFS from vessel landing reports. This information is based on blocks of 10-minute latitude by 10-minute longitude, an area of about 600 sq. km. The annual landings reported for the block at which the site was located were significantly less than the blocks nearby. However, this NMFS data is too coarse to allow identification of local "hot spots." As we came closer to having our site become a reality, specific information was made available to us regarding an anecdotal level of trawling through the middle of it.

Out our amendment specifically prohibits trawling, gillnetting, and non-project dredging within the site boundaries. This evidence of high fishing effort indicated that our location was not optimal from a minimum-user conflict standpoint. Therefore, we organized meetings on Martha's Vineyard and in New Bedford to discuss with fishermen how we might adjust the site location to reduce our impact on their operations. From these meetings, a consensus emerged for moving our experiment site eight kilometers to the west. This new site meets all the requirements of the project, including depth, temperature and bottom types (see Figure 4).

The move has been approved by the COR; however, the Council and NMFS were concerned that users of concerns over the new site might not have been aired at the original public hearing. A second public hearing was held and, with no objections aired, the Council approved the process has resumed, but with a two-month setback.

The lesson learned from this experience is that the current COR and NEFMC adjudication review processes do not adequately identify commercial fishing users. The detailed input strategy of commercial fishermen was very slow to provide "trade secrets." This information is not found in any public data base and will be revealed during initial public hearings or comments. Only when a project becomes reality will the specific basis for opposition emerge.
References:


Figure 1. Bottom Cages.
Figure 3. Bottom Cages rigged as in a laboratory operation.

Figure 3. Suspended "super-lateral" grow-out units.