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Development of Rope-Culture Methods for Red Seaweed Aquaculture in California

Michael H. Graham
San Jose State University—Moss Landing Marine Laboratories

Background

With the collapse of California's commercial abalone fisheries, aquaculture has become the sole source of commercially available abalone in the state. Although there are many challenges to making abalone aquaculture profitable, the continued demand abroad and domestically for high-quality shellfish, particularly for sushi and other Asian cuisines, creates an economic impetus for exploring techniques to maintain the industry's profitability.

One basic element of successful abalone farming is having a readily available, inexpensive source of feed. At present, cultured abalones in California are usually fed kelps harvested from wild beds. Kelps are a natural part of abalones' diet and hence are nutritionally complete. Studies have shown, however, that abalones that are fed red and green algae in addition to kelp have faster growth rates. Pigments in red algae are also the source of color in red abalone shells, a desirable goal as red abalones whose shells lack red hues sell for less.

To boost abalone growth rates and to ensure desirable shell color, some farms feed their abalones synthetic pellets, a sort of abalone chow. These feeds, however, are costly.

Monterey Abalone Company president Art Seavey holding up a Gracilariopsis outplant line.
Photos this story courtesy Michael Graham

Project

In this project, Michael Graham, a marine ecologist at Moss Landing Marine Laboratories, demonstrated the feasibility of vegetatively propagating red algae for the Monterey Abalone Company, a medium-sized abalone farm in Monterey Harbor that does not use synthetic feeds in its culturing operations. The main success of the project was the ability to grow algae on 10-meter rope lines placed just outside Monterey Harbor.

Part of the research focused on identifying which red algae species could be grown vegetatively. The experiments showed that Gracilariopsis, Cryptopleura and Gracilaria were all promising candidates. Outplants of these three species also had very high rates of survivorship—higher than 95 percent in some cases. The algae Gracilariopsis and Gracilaria were also observed to grow quickly, which is desirable for a commercial endeavor.

While the fourth species studied, Mazzaella, could not be propagated vegetatively, scientists were able to seed ropes with a high abundance of spores. Resulting germlings were healthy and highly pigmented though small and slow growing.

This research represents the

first time red seaweeds have been propagated in California for the sole purpose of feeding farmed abalone. The success of this pilot study has resulted in Sea Grant funding a two-year follow-up project in which many unanswered questions about algae culture can be more comprehensively studied.

This new project, to begin in March 2006, will establish protocols for growing red algae and kelp for abalones at the Monterey Abalone Company. Scientists will continue to experiment with different techniques for growing different species of red algae and kelp on ropes hung inside and outside Monterey Harbor. Their goal is to determine how to grow as much seaweed as needed as fast as possible and in the smallest possible space.

Other related studies will address such practical issues as: What is the best way to harvest algae? and What is the biomass of alga needed to support the farm's annual production of 36,000 abalones? The research will also include feeding experiments to identify the quantities of red algae needed to enhance abalone growth and shell color. The ultimate goal of the project is to develop an operational seaweed-culturing plan for the abalone company.

Applications

Besides addressing the needs of abalone aquaculture, this work has direct relevance to managing coastal resources. The California Coastal Commission, which is charged with protecting coastal resources from new development and other activities on the coast, has expressed concerns about proposals to increase kelp harvesting to support new, proposed abalone farms. This research offers an alternative to harvesting wild beds and thus can alleviate concerns about the effects of intense kelp harvesting. In addition, kelp aquaculture results in a net removal of nutrients from ocean waters and could benefit coastal water quality in areas where nutrient loading is of concern.

Collaborations

The Monterey Abalone Company has provided matching support for this project and will provide matching funds for the follow-up project. All seaweed field-culturing experiments and animal husbandry will be conducted at the company using its extensive abalone rearing facility, flowing seawater system, small boats and other relevant equipment.

California Sea Grant Extension will assist in the production of educational and instructional

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"user-friendly" material for the aquaculture industry. This material will be based on findings from this project.

International Implications

Japan, Mexico, Chile, Australia, New Zealand and South Africa raise abalone for human consumption. These countries can adapt techniques for culturing red abalone to their respective aquaculture operations.

For more information:
Dr. Michael H. Graham
Moss Landing Marine Laboratories
Tel.: (831) 771-4481
Email: mgraham@mlml.calstate.edu

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California Sea Grant College Program
Russell A. Moll, Director • Paul Olin, Extension Director • Marsha Gear, Communications Director
University of California, San Diego, 9500 Gilman Drive, La Jolla, CA 92093-0232
Phone: (858) 534-4440 Fax: (858) 453-2948 Web site: http://www.csgc.ucsd.edu