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Development of Halibut Aquaculture

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Background

California halibut (*Paralichthys californicus*) are a mild-tasting flounder sold fresh at gourmet restaurants and exported to Japan, where they are used as a substitute for hirame. Although commercial flatfish aquaculture may be a decade away, many consider California halibut an excellent candidate for domestication.

Studies have shown the fish are tolerant to crowding and grow rapidly even when reared two-layers thick on the bottom of a tank. Because adults spend their lives nearly motionless on the sea floor, feed costs are expected to be relatively low. Another plus is that a halibut hatchery has been in operation at Redondo Beach for more than a decade, so basic techniques for hatching the fish are in place. The hatchery provides a source of halibut eggs and larvae for scientific experiments.

Declines in commercial landings of California halibut—from highs exceeding 2,000 metric tons falling to 450 metric tons a year—are yet another factor that has increased interest in the idea of farming halibut.

Project

Continuing California Sea Grant's long tradition of investing in the early stages of aquaculture, Drs. Raul Piedrahita and Douglas Conklin of the University of California at Davis received support to advance routine culture and juvenile grow-out techniques for California halibut.

Because of the regulatory environment in California, as well as the high costs of energy and coastal real estate, the project focused on developing a closed recirculation system for rearing fish. A closed system is one in which there is neither a continuous input of new water nor a discharge of wastewater. Instead, the same water recirculates through the tanks, reducing pollution, energy and water use.

During the course of their grant, Piedrahita and Conklin built a prototype closed recirculation system at Bodega Marine Laboratory. It is a model for the design and operation of a commercial halibut farm that can pass California's relatively high environmental standards. The system includes an innovative, low-energy biofilter that continuously removes nitrogenous waste.

The tank system is not entirely closed, and it requires a steady input of fresh seawater to maintain optimum growing conditions for fish. However, the amount of fresh seawater has been reduced significantly.

In addition to engineering integrated waste-removal and energy efficiency systems, the scientists experimented with different feeding regimens and developed a diet that promotes the conversion of protein into edible muscle tissue. In other nutritional studies, they looked at the relationship between diet, water quality and culture on fish growth, as well as the nutritional values of the fish for humans, including levels of polyunsaturated fatty acids.

Another advance made during the course of this grant was the success in developing techniques for rearing halibut larvae. At the start of the grant, survival rates for halibut larvae were less than five percent. By changing feeding regimes and tank designs, the researchers have increased survival rates to 50 percent. In collaboration with scientists from Centro de Investigación Científica y de Educación Superior de Ensenada (CICESE) in Baja California, the scientists are now working to pinpoint the optimal time to wean halibut larvae from live prey to formulated diets.

The California halibut is a flatfish that inhabits shallow sand and mud bottom waters off the U.S. West Coast and Baja California, Mexico. Unlike fish that swim upright, they lie flat on the seabed. The eye on their "downside" migrates to the "upside" early in life to make this possible. Photo: Julie Doroshov

Impacts

The success of Piedrahita and Conklin's prototype has revitalized interest in the potential for stocking coastal waters with hatched halibut.

"The hatchery technologies we are developing for aquaculture can easily be used for producing juveniles for stock enhancement," Conklin said.

In San Diego, Hubbs-SeaWorld Research Institute is developing methods for tagging juvenile halibut to see where they go, their habitats and how long they live—all needed for deciding whether, how, and where to release hatched halibut.

The project's success has led to The Cultured Abalone in Goleta hiring Douglas Bush, a Sea Grant trainee who worked on the halibut research. Bush will be developing abalone diets and investigating whether halibut should be a second product line at the abalone farm.

Highlights

California Sea Grant researchers have developed:

- a nonpolluting, energy-efficient culture system for halibut that ultimately could be operated inland, where real estate is more affordable.
- reliable techniques for rearing halibut larvae. With a new tank design and better nutrition, the scientists were able to increase larvae survival rates from less than five to 50 percent.

Collaborations

California Halibut Hatchery Program, Redondo Beach
Dr. Harry Daniels, North Carolina State University
Hubbs-SeaWorld, Carlsbad, California
Dr. Karl Shearer, National Marine Fisheries Service, Seattle, Washington

Publications

Gisbert, E., G.E. Merino, J.-B. Muguet, D. Bush, R.H. Piedrahita, and D.E. Conklin. 2002. Morphological development and allometric growth patterns in hatchery-reared California halibut, *Paralichthys californicus,* larvae. *J. Fish Biol.* 61:1217–1229.

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Trainees

Douglas Bush
German E. Merino
Jean-Benoit Muguet

Thesis

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