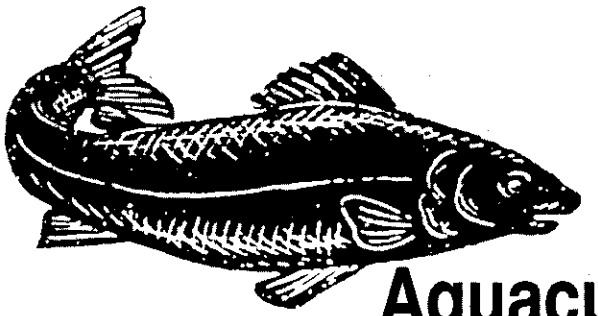


Aquaculture Research at the University of Maine

RESEARCH UPDATE

Aquaculture in Maine: *Wave of the Future*

Aquaculture—the cultivation and harvest of plants and animals in water—is the fastest-growing agricultural industry in northern New England and the nation. Production doubled between 1984 and 1995, and by 1996 aquaculture represented 25 percent of world seafood supplies.

Estimates are that the annual demand for seafood products will increase by 350 million pounds by the year 2000.

In Maine, a few entrepreneurs first experimented with commercial mussel, oyster, coho salmon, and rainbow trout farming in the early 1970s.

There are currently 1,280 acres of ocean leased by the Maine Department of Marine Resources for farming at 76 different sites in Maine. The 23 aquafarms along the Maine coast include 10 companies that produce farmed salmon. The harvest has grown from a 1988 landing of one million pounds to over 22 million pounds in 1996.

Research conducted by scientists at the University of Maine and other institutions in the state may make raising cod, haddock, and halibut practical and cost-effective in the future.

The greatest concentration of finfish operations is in Downeast Maine, where the winter water temperatures tend to be higher than the estuaries west of Penobscot Bay. Most shellfish farms are in the midcoast region, while Maine's lakes are ideal places for finfish hatcheries. ■

Helping Maine's Fish Farmers Raise Superior Salmon

The salmon you buy at the market or order in a restaurant may not have been caught in the sea or a river, but raised in a "farm." And if it happens to be Atlantic salmon, the odds are very good that it came from one of the region's sea farms.

In Maine, farmed salmon is the state's second most valuable fishery after lobster, with a landed value of $55 million for the 1996 harvest.

The University of Maine has long been involved in studying migratory fishes, particularly the Atlantic salmon (*Salmo salar*). In 1976 microbiologist Bruce Nicholson began to evaluate the susceptibility of Atlantic salmon to infectious pancreatic necrosis (IPNV), a virus of trout which had been isolated from apparently healthy Atlantic salmon.

In the early 1980s, Nicholson and co-researcher Paul Reno tried to solve the mystery of IPNV by applying genetic engineering principles to biological processes. They adapted the monoclonal antibody technique invented in 1975 for diagnosing and treating human viruses and cancers.

Over the last 10 years, research sponsored by the University's Sea Grant Program and the Maine Agricultural Experiment Station has resulted in the development of a series of improved diagnostic tests for identifying aquatic birnaviruses in fish populations.

Nicholson and his UMaine colleagues Charles Moody and John Singer developed novel birnavirus antigens for use as inexpensive, effective, standardized vaccines, and as improved diagnostic reagents.

(continued on page 2)

Researchers Raising Cod and Haddock

Cod and haddock are prime candidates for aquaculture in the Gulf of Maine. In the last three years, UMaine nutritionist Linda Kling and her associates at the University of New Hampshire and the University of Rhode Island have been developing techniques for raising cod, the backbone of New England's traditional ground fishery.

Kling has dramatically improved the success rate of raising cod larvae from eggs.

Kling got her research start working with chickens in the early 1980s. The decline of Maine's poultry industry and the rising importance of aquaculture convinced her to switch to fish.

In 1997, Kling and UMaine Cooperative Extension veterinarian Michael Opitz received a $477,000 federal grant from the National Oceanic and Atmospheric Administration (NOAA) to develop commercial methods for raising cod and haddock in aquaculture pens. ■

(continued from cover)

As an outgrowth of their research, Nicholson and Singer have developed a diagnostic kit to diagnose and treat infectious fish diseases caused by aquatic birnaviruses. These kits are now available commercially for use by aquaculturists and fish pathologists throughout the world.

Manpower plays a primary role in the success of any aquaculture venture, and training for future finfish growers has been offered since early 1990 at the Marine Trades Center of the Washington County Technical College in Eastport. The program, funded by the University's Sea Grant Marine Advisory Program, Quoddy Regional Job Opportunity Zone, and UMaine Cooperative Extension, has provided workshops on automatic feeding systems, mooring and anchoring systems, cage designs, and control of predators and parasites.

In 1993, microbiologist Chris Bartlett, a University of Maine graduate, assumed the newly created position of Sea Grant finfish aquaculture specialist at the Marine Trades Center, where he assists fish farmers on cage sites with smolt transfer, harvesting, and health monitoring.

In 1996, salmon farmers requested Bartlett's help in fighting sea lice—parasites that suck blood from salmon and other fish. The outbreak was particularly severe just over the border in New Brunswick, Canada.

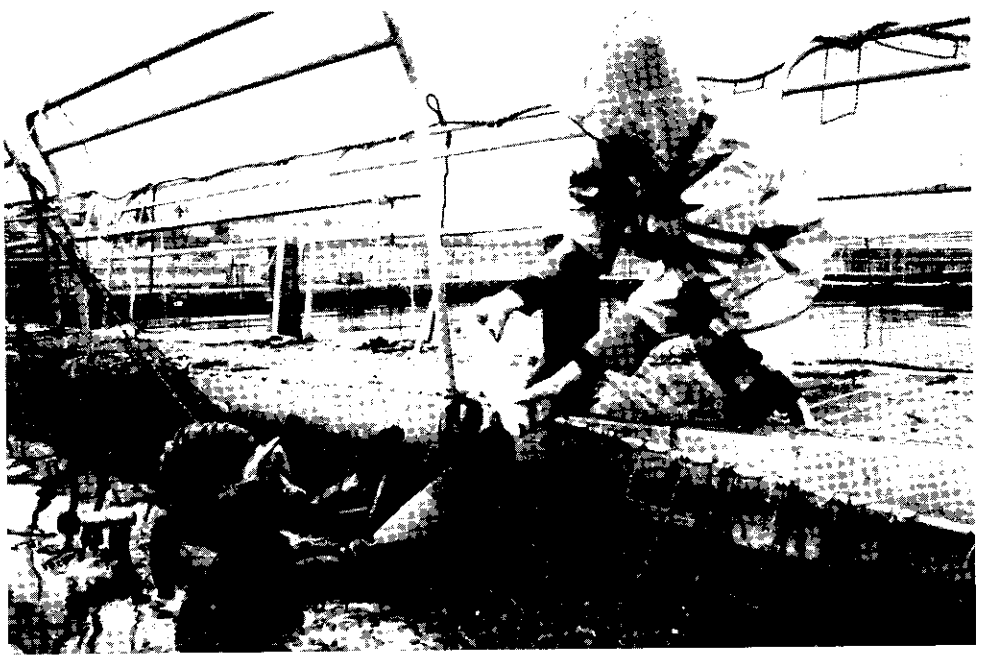
Bartlett worked with fish veterinarian Michael Opitz of the UMaine Cooperative Extension to monitor the infestation's impact on Downeast salmon farms.

The team successfully coordinated the use of an FDA-approved sea lice treatment, cypermethrin, which has a lethal effect on all stages of lice and has a high safety margin with fish.

In the early 1990s, UMaine marine biologists Robert Findlay and Les Watling spent two years determining what effects salmon-cage culture has on the surrounding ocean bottom and the animals or plants in the areas.

Their findings showed limited negative effects associated with salmon net-pen aquaculture at the sites they studied in Eastport coastal waters and at Toothacher Cove, Swans Island.

Their research was supported by Sea Grant and the Maine Aquaculture Innovation Center. ■



UMaine
Shellfish Research Spawns an Industry

Due primarily to Sea Grant-funded research in the 1970s at the University of Maine in mussel culture techniques and the development of pearl-free mussels, mussel businesses in Maine now supply 90 percent of all the mussels harvested in New England.

Today, largely as a result of those Sea Grant efforts, the mussel industry continues its rapid growth and is now the largest shellfish aquaculture industry in the region, with sales approaching $2.1 million.

Instrumental in advancing aquaculture research in the state through the University's first Sea Grant-funded project in 1970, biologist Herbert Hidu, now retired, has often been referred to as the "Father of Maine Aquaculture." Many of Hidu's students are now active in the business of aquaculture at Great Eastern Mussel Farms, Dodge Cove Marine Farms, Mook Sea Farms, and Pemaquid Oyster Company.

Carter Newell, quality control biologist at Great Eastern Mussel Farms (GEM), received his training with Hidu at the Darling Center in the late 1970s. Through Sea Grant-supported research, Newell studied growth rates of the soft-shell clam with fellow UMaine graduate student Jane Arbuckle, now stewardship coordinator of Maine Coast Heritage Trust. Their work has had important implications for public clam management in the state.

According to Bill Mook, former UMaine graduate student in oceanography and president of Mook Sea Farms in Damariscotta, an oyster hatchery and grow-out operation, "One reason that aquaculture developed on the Damariscotta River is that the University's oceanography department was also located there. This is where much of the technology that early aquaculture employed was developed and tested." ■

S O S For Soft-shell Clams

Approximately 95 percent of the soft-shell clams, *Mya arenaria*, harvested commercially in the Northeast originate in Maine and Massachusetts. In 1996, 103,000 bushels of clams were harvested commercially in Maine, and the landed, ex-vessel value of the state's catch was $5.4 million. Clearly, the soft-shell clam is a profitable industry in Maine, but current production is at or near historic lows.

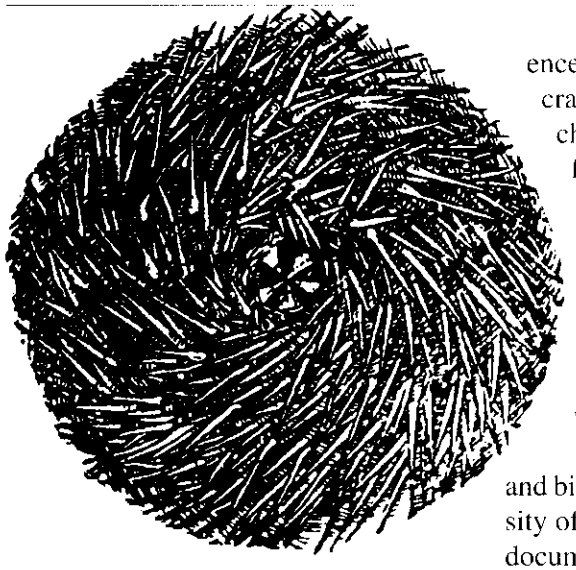
Over two decades of Sea Grant-funded work by University of Maine researchers and Cooperative Extension specialists has helped dozens of towns assess their clam resources and develop new management techniques. A multi-community clam hatchery has sprung up, seeding experiments have been successfully carried out, a mechanical seed harvester has been developed, and the effects of digging on clam flats determined.

In response to the dwindling clam supply, six Downeast coastal towns got together in 1987 and started the Beals Island Regional Shellfish Hatchery in Beals, Maine—the first shellfish management program in the country using hatchery-reared, soft-shell clam juveniles to rebuild depleted natural stocks.

Since its inception, the Beals Island hatchery has provided millions of clams to over a dozen towns on the Maine coast and recently supplied seed clams to several towns in Massachusetts.

In 1997, hatchery biologist Brian Beal of the University of Maine at Machias and John Riley of the UMaine School of Marine Sciences (SMS) received funding from the Maine Aquaculture Innovation Center to refine the design of a new type of dredging machine to harvest wild seed in flats depleted by overharvesting and pollution. Beal is a SMS cooperating faculty member.

"It's a very exciting time," Beal says. "We're working with three towns, using hatchery technology and dredging to increase productivity." ■



Is Gold Rush Over for Urchin Industry?

Sea urchins are now the third largest capture fishery in Maine, but concern has been raised about the sustainability of the resource and whether or not it faces a boom-and-bust cycle. Sound management of this resource requires knowledge of its biology and ecology that goes beyond simply restricting harvest.

According to ecologist Bob Vadas of the UMaine School of Marine Sciences, "The first signs of a possible crash (boom and bust) in the sea urchin industry have been apparent for several years. After peaking at 41 million pounds in 1993, the harvest dropped to 38 million pounds in 1994. In addition, divers, dealers, and our studies indicate that fewer harvestable urchins are available in southwestern Maine."

With Sea Grant funding, Vadas and biologist Brian Beal of the University of Maine at Machias are currently documenting temporal and spatial patterns in urchin reproduction and spawning and correlating these patterns with environmental variables.The team is also determining changes in population size and age structure in harvested populations to assess harvest impacts on stocks.

Finally, Vadas and Beal are studying the effects of diet on roe quality to find out if urchins can be fed in captivity to increase their market value. These studies complement Sea Grant-funded research in New Hampshire on land-based urchin aquaculture. ■

Bonamia Studies Could Help Oyster Growers

European oysters, *Ostrea edulis*, were first introduced to Maine waters in 1949, with the hope of supplementing the soft-shell clam fishery. Although a small fishery with modest landings did result, the distribution and quantity of oysters today is sporadic.

Oyster culturists now producing Eastern oysters, *Crassostrea virginica*, are interested in culturing European oysters because of their high market value. They are concerned, however, about the presence of *Bonamia ostreae*, a protozoan parasite responsible for massive mortalities of *O. edulis* in Europe, and identified in Maine waters for the first time in 1991.

To help oyster growers determine the impact that *B. ostreae* might have on oyster culture in the Damariscotta River, UMaine marine biologist Bruce Barber and graduate student Adriana Zabaleta collected wild oysters from three locations in the river between June 1994 and April 1995.

They found that 5 percent of the oysters they examined were infected with *B. ostreae*. They also found that meat quality was not significantly different between infected and uninfected oysters.

The researchers concluded that although *B. ostreae* is present in the Damariscotta River, it does not appear to be causing disease and mortality in oysters in natural populations. This may be a result of the low density of oysters in natural beds and the relatively cold winters in Maine. ■

Selected AQ Publications

Application of Mathematical Models in the Environmental Regulation of Net-Pen Aquaculture. Vijay Panchang, Guo Cheng, and Carter Newell. Sea Grant Technical Report. 1993. MSG-TR-93-1. $7.50.

Environmental Impact of Salmon Net-Pen Culture on Marine Benthic Communities in Maine: A Case Study. Robert H. Findlay and Les Watling. Reprinted from *Estuaries*. 1995. MSG-R-94-19. $1.00.

Mussels & Eelgrass: A Mutual Attachment. Kathleen Lignell. Reprinted from *Nor'easter Magazine*. 1995. MSG-R-95-05. $1.00.

Preventing Fish Disease in the Northeast. John T. Singer and Bruce L. Nicholson. *Nor'easter Magazine*. 1992. MSG-R-92-26. $1.00.

Shellfish Aquaculture: SOS for Threatened Stocks. Susan White. Reprinted from *Nor'easter Magazine*. 1992. MSG-R-92-25. $1.00.

Audiovisual

Biosecurity in Aquaculture: Practical Steps for Healthy Fish. Michael Opitz, et al. Videotape. VT-MSG-92-01. $12.00.

Public Information Report
Research Update: Aquaculture
For additional copies of this report contact the UMaine Sea Grant Communications Office at (207) 581-1440.

Produced by Kathleen Lignell Ellis with assistance from Susan White, Nick Houtman, and Ann Shan.
Design: MaJo Keleshian
MSG-E-98-2