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Small Business Innovation Research (SBIR)

Modeling Mussels

by Stacy Kish, CSREES

Marine aquaculture, farming in the ocean, focuses on environmentally friendly and sustainable methods to cultivate marine biomass for human consumption. With funding from USDA's Cooperative State Research, Education and Extension Service (CSREES), a project team in Maine has measured the impact of mussel rafts, an aquaculture method used to grow shellfish, on the surrounding environment in coastal New England. >>

Carter Newell and John Richardson used a combination of field data and an advanced numerical model to determine how a variety of bivalves, including manila clams, geoducks and Pacific oysters, consume the particles that reach the ocean floor. The researchers conducted these studies in Puget Sound, Wash. and Ireland.

For the computer model, the project leaders customized user-friendly interface that included the following variables: bathymetry (ocean depth), tidal elevations and speed, wind speed and direction, number of rafts, raft dimensions, rope spacing, rope length, rope diameter, mesh size and depth of predator net, particulate matter and water temperature. Output from the model predicts flow patterns through shellfish rafts, particle depletion caused by the shellfish rafts, shellfish biomass and mooring requirements.

The researchers also examined water velocity and direction and modeled how fouling and seaweed might affect these values, which could affect shellfish survival and growth.

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Right: Water level view of mussel rafts in Maine.
Credit: Carter Newell

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Above: Aerial view of mussel rafts in Maine.
Credit: Carter Newell

The scientists measured the amount of chlorophyll, the green pigment plants use to collect sunlight, in the water in order to estimate food variability during tidal cycles. The data was compared to water filtration through the shellfish raft, based on the biomass of the shellfish. Model output using this information also produced a risk analysis related to site conditions and exposure to wave action.

Recent model improvements include an aquaculture geographic information system, computer aided-design representation of aquaculture structures and improved software for shellfish growth and particulate matter depletion models.

Mussel production using rafting aquaculture techniques in Maine and Washington State has been increasing since the 1990's. Currently, more than 2 million pounds are produced having an economic impact of over $5 million.

The model developed during this study can be used easily by sea farmers to make important decisions on mooring arrangements and raft modifications. The model output provides the seafood industry with a new set of tools to choose productive sites and plan management strategies that take environmental sustainability into consideration.

CSREES funded this research project through the Small Business Innovation Research (SBIR) program. CSREES advances knowledge for agriculture, the environment, human health and well-being, and communities by supporting research, education, and extension programs in the Land-Grant University System and other partner organizations. For more information, visit www.csrees.usda.gov. ■

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References

Newell, C.R. 2001. Sustainable Mussel Culture: A Millennial Perspective. *Bull. Aquacul. Assoc.* Canada 101: 15-21.

Newell, C.R. and J. Richardson. 2004. Shellfish carrying capacity and site optimization. *Aquacul. Ireland* 115: 15-19.

Newell, C.R. 2005. The effects of water velocity and particle characteristics on the feeding behavior of the blue mussel *Mytilus edulis L.* Ph. D. Thesis, University of New Brunswick, Canada. 178 pp.