Completion Report

Period: 2/1/2014 - 1/31/2015

Project: R/LME/N-6 - *Fish Aquaculture Simulation Model and GIS: Validation and Adaptation for Government Management Use*

STUDENTS SUPPORTED

No Students Reported This Period

CONFERENCES / PRESENTATIONS

California Sea Grant Invitational Meeting, Long Beach CA. "Offshore Aquaculture State of the Science" Sponsored by California Sea Grant, Long Beach Aquarium, NOAA Aquaculture Division and Hubbs SeaWorld Research Institute. Talk title: "Computer Modeling of Net Pen Effects"., SG-sponsored, 45 attendees, 2015-04-28

California Sea Grant Invitational Meeting, Long Beach CA. "Offshore Aquaculture State of the Science" Sponsored by California Sea Grant, Long Beach Aquarium, NOAA Aquaculture Division and Hubbs SeaWorld Research Institute. Talk title: "Offshore Net Pens: Benthic Effects & Prevention of Coastal Eutrophication", public/profession presentation, 50 attendees, 2015-04-28

Aquaculture Canada 2015: Blue Revolution 2.0, Vancouver Island Conference Centre, Nanaimo, BC, May31st to June 3rd, 2015. Invited presentation: Aquaculture Association of Canada, Annual National Meeting, Environmental Session. Naniamo B.C. "AquaModel Validation Worldwide"., public/profession presentation, 500 attendees, 2015-05-31

Open Ocean Aquaculture Modeling Validation study
Slide show and model in operation demonstration to the Open Ocean Aquaculture Monitoring and Coordination Working Group at the NOAA Pacific Region office in Honolulu Hawaii., public/profession presentation, 35 attendees, 2014-07-14

ADDITIONAL METRICS

P-12 Students Reached:	**P-12 Educators Trained:**
Participants in Informal Education Programs:	**Volunteer Hours:**
Acres of coastal habitat protected, enhanced or restored:	**Resource Managers who use Ecosystem-Based Approaches to Management:**
Annual Clean Marina Program - certifications:	**HACCP - Number of people with new certifications:**

ECONOMIC IMPACTS

No Economic Impacts Reported This Period

SEA GRANT PRODUCTS

Description	Developed?	Used?	ELWD?	Number of Managers	Names of Managers
AquaModel Software to inform fish aquaculture	Yes	Yes	No	0	

HAZARD RESILIENCE IN COASTAL COMMUNITIES

No Communities Reported This Period

ADDITIONAL MEASURES

Number of stakeholders modifying practices:

Sustainable Coastal Development

# of coastal communities:

PARTNERS

Partner Name: Dr. David Fredriksson, U.S. Naval Academy

Partner Name: Professor Jon Grant, Dalhousie University, Halifax New Brunswick

Partner Name: Sweeney International Management Corp.

IMPACTS AND ACCOMPLISHMENTS

Title: **Washington Sea Grant-supported research delivers software to improve siting and operation of fish farms and forecast their environmental effects**
Type: impact
Relevance, Response, Results:
Relevance: One constraint on the contribution of marine fish farming to global food supplies is limited ability to predict site-specific environmental impacts. In areas with sufficient water flow, fish farms produce waste that is rapidly assimilated into marine food webs, preventing sea-bottom deposition. Until now, government and industry managers had no adequate modeling tools to accurately assess such effects and evaluate prospective sites for environmental and operational efficiency. Growers have had to configure and manage their operations through trial and error.
Response: A national strategic initiative, funded through Washington Sea Grant, is systematically testing and refining AquaModel, an accessible software tool that evaluates benthic and water-column effects of farm operations, determines regional carrying capacity, and helps configure and manage operations more efficiently. Researchers used field data and operational records from farms in Atlantic Canada and the Gulf of Maine to validate and calibrate AquaModel—correcting software bugs, adding and improving utilities, and simplifying user interfaces. Work continues in Chile and Hawaii.

Results: Testing resulted in optimal calibration and accurate predictions of sediment loading. A species-specific physiology submodel accurately simulated fish growth, physiology, and waste production. Modelers at NOAA's National Ocean Survey are relying on AquaModel as a primary tool to assess fish farm siting and feasibility in the U.S. exclusive economic zone. Asian, South American, and Canadian governments also are using it.
Recap:
Recap: Sea Grant-supported research improved and validated the first successful modeling tool for evaluating fish farm siting, environmental effects, and operational efficiency in diverse ecoregions and flow conditions.
Comments:
Primary Focus Area: LME (SSSS)
Secondary Focus Area: COCC (SCD)
Associated Goals: Support conservation and sustainable use of living marine resources through effective and responsible approaches, tools, models, and information for harvesting wild and cultured stocks and preserving protected species. (SSSS Industry)
Assist coastal communities and marine-dependent businesses in planning and making decisions that provide local and regional economic benefits, increase resilience, and foster stewardship of social, economic, and natural resources. (SCD Inter-relation)
Partners:
Dalhousie University
Sweeney International Management Corp.
US Naval Academy
Related Partners: *none*

PUBLICATIONS

Title: **Estimating Sediment Total Organic Carbon Loading from an Open Ocean Cod-Fish Farm in the Gulf of Maine**
Type: Technical Reports Publication Year: 2015
Uploaded File: *none*
URL: *none*
Abstract:
The future development of open ocean and nearshore marine finfish aquaculture depends upon effective environmental assessment of candidate sites, both in terms of environmental effects and optimization of facility layout and operation. An increase number of locations are being considered in more exposed, open ocean sites with the prospect of better waste assimilation and reduced user conflicts compared to coastal regions. These factors should be quantitatively determined in advance because of the difficulty to assess the connected biological and physical processes. In this study, a detailed set of environmental data parameters were used as input to a computer program called AquaModel (Rensel et al. 2007, Rensel et al. 2013). This software simulates a living population of fish that react to changing conditions while eating, growing, swimming, excreting and egesting wastes. The wastes are tracked separately as particulate waste feed and fish feces that sink to the bottom and

become available to competing populations of aerobic and anaerobic organisms in the surficial sediment layer.

A new AquaModel physiological submodel of Atlantic cod (Gadus morhua) growth and metabolism was utilized to calculate the growth of Atlantic Cod for an open ocean aquaculture (OOA) site in the Gulf of Maine, previously operated by the University of New Hampshire. The model was configured to simulate a grow-out period between February and November of 2005 when a stock of Atlantic cod were contained in a submersible fish cage at the site. As the fish biomass increased in the model, the sinking and trajectory of excess feed and fecal matter was calculated as concentrations of sediment total organic carbon (TOC). The movement of the particles in the model also considered resuspension effects when bottom currents exceeded specific threshold rates. Distribution of TOC values above the ambient conditions was estimated using a mass balance representation of carbon flux in the surficial, 2 cm deep surface layer of the sea bottom. The ambient conditions were set in the model based on sediment organic matter (LOI, loss on ignition dry weight) measurements collected near the site and converted to TOC with an estimated ratio appropriate for the region. TOC impact was also assessed as a function of time showing that calculated resuspension further disperses waste material. It is also expected that in the Gulf of Maine, addition spreading due to wave action from winter storms will occur. This analysis reviews the monitoring that was performed, the outcomes that occurred and other factors that may have influenced benthic effects of the operation.
Citation:
D.W. Fredriksson and J.E. Rensel. 2015. Estimating Sediment Total Organic Carbon Loading from an Open Ocean Cod-Fish Farm in the Gulf of Maine. Manuscript to be submitted.
Copyright Restrictions + Other Notes:
Journal Title: *none*

OTHER DOCUMENTS

No Documents Reported This Period

LEVERAGED FUNDS

No Leveraged Funds Reported This Period

COMPLETION NARRATIVE

Uploaded File: Rensel_7985_completion....2.pdf, 886 kb

This is not a completion report for R/LME/N-6 - *Fish Aquaculture Simulation Model and GIS: Validation and Adaptation for Government Management Use.*

It is rather a placeholder as we received an six month extension of this project that originally was to end at the end of January 2015. However, final completion of the entire project is anticipated in April 2015 and at that time a final report can be filed.

Sincerely

Jack Rensel