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Woods Hole Sea Grant: 1998-2000 Projects

Laboratory-based Transmission of the QPX Parasite in Cultured Hard Clams and Studies on the Progression of the Disease

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The farming of hard clams (Mercenaria mercenaria, aka, quahog) is one of the fastest growing aquaculture industries in the eastern U.S., with a 1995 value of $25 million. In Massachusetts alone, cultured quahogs generated an annual income of over $4 million in 1995, a figure that has been projected to reach approximately $40 million in Massachusetts in just a few years. These projections, however, do not take into account a disease that was discovered in farmed quahogs in Massachusetts in 1995, and has now been reported in cultured clams in Virginia and both wild and cultured clams in New Jersey and Massachusetts. In two Massachusetts sites, Provincetown and Duxbury, reports of mortalities for cultured clams as high as 95% have dealt a severe blow to growers. Because the discovery of the disease was so recent, much remains unknown about the organism itself, the mechanism of infection, the clam's response to the disease organism, and the time frame for progression of the disease in relationship to certain physical or physiological conditions. This study will use three methods of disease transmission (injection, waterborne exposure, and diseased animal exposure) to investigate initial infection by the QPX organism and progression of the disease in healthy animals under controlled laboratory conditions. The goal is to develop a method or methods of disease transmission that can be used to study specific characteristics of infection and disease production including: effects of environment and age on initial infection of animals, pathogenesis of the disease in the clams, and development of resistant animals in the laboratory. (R/A-39)

Understanding the Potential of Offshore Mariculture: A Bioeconomic Approach

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Many factors influence the economic success of a business. Offshore or open-ocean aquaculture is no exception. While many technical, biological, and regulatory constraints to marine aquaculture are now being resolved through research and demonstration projects, few offshore marine aquaculture operations have been commercialized to date. This is likely due, in part, to an incomplete understanding among both entrepreneurs and financial backers of the economics of offshore aquaculture operations. This project will apply financial business planning and risk assessment techniques to develop a model of offshore aquaculture economics and use the model to investigate the economic viability of prospective offshore aquaculture operations in New England. The model will use a bioeconomic approach to incorporate emerging information on construction requirements and biological growth processes in marine settings, the effects of engineering and biological uncertainties, the costs of regulatory compliance, and variability in supply and demand in the relevant product markets. The model will incorporate risk-based methods, taking into account the risky nature of offshore aquaculture operations. (R/A-40)

Reproductive Strategies and their Contribution to Genetic Diversity and Life Cycle Flexibility in the Commercially Important Squid, Loligo pealei

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With little known about the life history of the squid Loligo pealei, and an increase in fishing pressure on the species, local squid fishery managers are concerned about its future. Despite the fact that managers believe the fishery to be maximally exploited, recent developments have seen an increased winter offshore squid fishery that concentrates on pre-spawning adults, and a new export market for juvenile pre-recruits. This study, now in its second year, examines squid reproductive strategies and how they might affect gene distribution. In the first year, five weeks of field observations and five months of continuous laboratory experiments were conducted. Field studies led to the discovery of two new male tactics for copulation and verified multiple mating by females prior to egg laying. In the laboratory, investigators found that multiple male tactics are commonly used at each spawning event, two or more males sometimes mate with a female before laying eggs, and females mate with as many as four males in one day while laying eggs (one female had at least six mating partners over 33 days in the lab). Approximately 20,000 egg finger samples were gathered for use in paternity studies using molecular markers. In year two, investigators will continue laboratory work on paternity using two types of DNA fingerprints and will carry out additional field observations. (R/B-141)

Predatory Impact of Lobate Ctenophores on Commercially Important Fishes and their Prey

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Ctenophores are voracious macroplanktonic carnivores that use their tentacles or filmy oral lobes to catch their food. Because they grow and reproduce rapidly, populations of ctenophores can dramatically alter the structure of marine communities by predation on smaller zooplankton. For example, the lobate ctenophore Mnemiopsis leidyi was accidentally introduced into the Black Sea in 1982 from ship ballast water. Its predation on zooplankton and larval fish there caused severe damage to commercially important fish stocks for several years. On our shores, Mnemiopsis exerts a strong influence on copepod populations in estuaries and coastal waters. Its close relative Bolinopsis infundibulum may significantly impact prey populations that support cod and haddock fisheries on Georges Bank.

This project will incorporate field and laboratory studies to examine the mechanisms by which ctenophores catch their prey. This information could help scientists predict what kinds of prey will be vulnerable. First year results disproved the notion that lobate ctenophores are relatively passive, non-discriminating predators. New findings from laboratory investigations of water flow around ctenophores, apparent sensory responses, and anatomy of feeding structures reveal a combination of anatomical and behavioral mechanisms that allow these ctenophores to be effective and selective in trapping several types of organisms. (R/B-143)

Behavioral and Hydrodynamic Components of Postlarval Bivalve Transport within Coastal Embayments

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Commercial harvesting of soft-shell clam Mya arenaria contributes tens of millions of dollars annually to the New England economy. The

recruitment of these clams is, however, notoriously variable, both in time and space: while some years see virtually no clams settling in a particular bay, other years see clams settling at very high densities. Recruitment within a bay can be highly localized, and, because it has a strong influence on soft-shell clam population dynamics and productivity, recruitment variations can make the fishery difficult to manage. This study focuses on spatial variation by investigating the interactions between burrowing behavior and hydrodynamic transport of clam larvae. First year field work and flume results suggest that the practice of netting in bivalve aquaculture can be effective in reducing suspension in two ways: first, it may reduce flow speeds over the sediment and thus decrease loss at fast current speeds, and second, when snails and other disturbances are excluded, resuspension is also reduced. In the second year of the study, field experiments will be designed to characterize the flow speeds at which clams may be suspended as they age and grow. Another caging experiment may be attempted to determine the relative losses due to transport and predation. Flume experiments will attempt to determine the lowest speed required to suspend buried clams and compare it with the critical erosion velocity of unburied clams. Investigators may simulate a hypoxia event to see if it affects burrowing enough to lower the flow speeds necessary to resuspend the clams. (R/B-142)

Last updated: January 14, 2015

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