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Woods Hole Sea Grant: 2006-2008 Projects

Are Humans and Recovering Fish Stocks Targeting the Same Squid Prey?

Fishing pressure on squid has increased worldwide as other fish stocks have been depleted and fisheries target species lower on the food chain. Yet squid are preferred prey for many marine fish and mammals. Overexploitation of squid, wrote Francis Juanes of the University of Massachusetts, in this proposal, could have consequences that radiate throughout the marine food chain. Yet ecologists have had little information about trophic structure and interactions between squid and the animals that depend on them, many of them commercially important fish such as tuna, swordfish, sharks, and others. Few studies, for instance, have investigated prey size preferences of squid-eating fish, whether fish selectively choose larger (reproductive) squid or juveniles, or simply eat the sizes of squid in the available prey population. As well, the role of predator size in prey selection is unknown. In this project Juanes is examining three aspects of the fish-squid predation interaction in the Northwest Atlantic fish and squid species. First, he is characterizing size-dependent predation risk –the body size relationships between squid and their predators. Second, to determine the role of prey behavior in determining profitability for the predator – and quantifying squid defense and escape behaviors that may make them either a more profitable prey for the fish, or less vulnerable to predation. Third, studying preference and selectivity—investigating whether predators' preference for squid varies when there is alternate prey available. Juanes will use methods including statistical analysis applied to previously collected squid size distributions, fish stomach contents and predation data from long-term ecosystem monitoring programs; feeding experiments in tanks (at the Marine Biological Laboratory in Woods Hole) to examine size-based selection and profitability of squid as prey relative to other choices; and digital video analysis to capture and quantify behavioral interactions. Outcomes will point the way to knowing whether people and the very fish stocks whose recovery is desired and mandated are targeting the same size squid as prey. The results can provide data to help manage and regulate fisheries to achieve targeted, sustainable levels of both the prey (squid) and the predators (fish).

Tossed by the Currents ? How Mussel Larvae Settle in a Turbulent Environment

Quantifying how marine animals disperse in the ocean is a critical part managing marine habitats, yet is a very difficult undertaking. Mussels, which are stationary bottom-dwellers as adults, drift in the plankton as larvae for days or weeks, and sometimes for long distances. The distances they drift are important for determining how large marine reserves should be. The larvae are carried by currents, yet larvae don't behave purely as particles in a current. Larval transport is affected by behavioral responses of the larvae to water movements such as turbulence and downwelling, but such responses have been hard to measure in the past, with currently available flow tanks and analytical methods. Biologists Heidi Fuchs and Lauren Mullineaux, Woods Hole Oceanographic Institution, and Claudio DiBacco, Earth and Ocean Sciences, University of British Columbia, are using a novel downwelling chamber, improved turbulence-generating equipment, and a statistical approach to characterizing larval mussel behavior, to investigate and describe the responses. The goals of the project are to describe and characterize mussel larvae behavior in turbulent or downwelling flow in the laboratory; to develop models to estimate the relationship between turbulence or downwelling intensity and the behavior of larvae; and to couple such models with physical oceanographic models to estimate mussel dispersal patterns along the Massachusetts coast. The new downwelling chamber is the first of its kind, producing laminar downwelling flow; turbulence is generated in a previously constructed tank. Larval movements, captured via video, are a combination of how they are carried in the flow plus a variety of behaviors, including directional swimming, hovering, and more. These two aspects of larval movement can be separated statistically with a biophysical model, and the behavior estimated. A goal of the research is to couple this information with an existing physical oceanographic model of coastal Massachusetts waters. Behavioral information will fill a gap in the scope of current models, and enable better estimates of how mussel populations disperse along the coast, complementing other techniques, such as chemical tagging, for estimating larval dispersal.

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