Baby Billfish – Figuring Out Who's Who

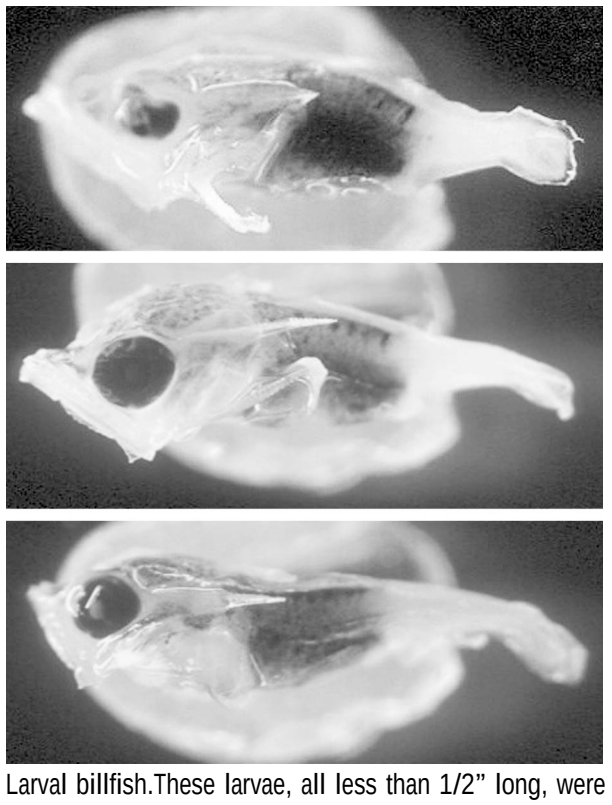
An important part of any fishery management plan is the definition of "essential fish habitat." For many coastal fishes there are specific environments critical for spawning, nurseries, feeding, etc., and these areas need to be protected if the species are to remain at healthy levels. Do open ocean fishes such as tunas and billfish have specific essential habitats?

In the case of billfishes, we don't know enough about their life histories, facts like where and when they spawn or where their larvae and juveniles live, to define essential habitats. A major impediment to studying the early life histories of billfish is that, although adult and juvenile billfish are very distinctive, it is extremely difficult to identify larvae to the species level (or: it is extremely difficult to tell them apart).

These bizarre forms (see figure) don't look at all like adults but they look a lot like each other, and most larval fish biologists agree that the physical characters (morphology) currently used to distinguish among the species are suspect.

Fortunately, VIMS fish geneticists have a whole new arsenal of molecular tools to help with identifications. Researchers in the VIMS Fisheries Genetics Laboratory, under the direction of Dr. John Graves, have been developing molecular markers to identify the different billfishes. Ph.D. student, Jan McDowell determined that the molecular techniques for identifying billfishes would most likely work with larval billfish. To pursue this research, McDowell established collaboration with graduate student, Stacy Luthy, at the Rosensteil School of Marine and Atmospheric Sciences (RSMAS) of the University of Miami. Together, they have adapted these molecular markers for the identification of billfish larvae. This definitive identification will give scientists information about when and where the different species of billfish spawn.

Several years ago the VIMS Fisheries Genetics lab received a grant to develop molecular markers to identify the different billfishes. The objective was to find genetic characters that differed between species, but had little variation within a species. McDowell, took on the project. After considerable work she found two gene regions that when digested with specific restriction enzymes generated different fragment patterns for each species of billfish. The identification process doesn't take that long. In two to three days McDowell can isolate the DNA, amplify the gene region using the polymerase chain reaction (PCR), digest the gene region with the appropriate enzymes, and separate the resulting fragments on a gel.



Larval billfish.These larvae, all less than 1/2" long, were identified using species-specific molecular markers.
Top: Sailfish *(Istiophorus platypterus)*
Middle: White Marlin *(Tetrapturus albidus)*
Bottom: Blue Marlin *(Makaira nigricans)*

McDowell realized that the molecular techniques for identifying billfishes would probably work with larvae, but billfish larvae are few and far between in our waters off Virginia. Fortunately, colleagues at the RSMAS have been ramping up a billfish program within their Center for Sustainable Fisheries, and were collecting

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Oyster Reefs Restoration: How Should Sanctuary Reefs Look?

In January 1999 a group of academic and governments scientists from around the Chesapeake Bay met at VIMS' Eastern Shore Laboratory to outline a scientifically sound course for restoring oyster populations in the Bay. One of the major components of the restoration plan was the establishment of oyster reef sanctuaries. The plan also identified the need for constructing complex, 3-dimensional reef bases, instead of low-relief shell plantings often used in harvest areas. Since that time Dr. James Wesson, who heads up the Virginia Marine Resources Commission Oyster Repletion Program, has been implementing the plan, completing over 30-reef sanctuary sites to date.

But just how much do we know about how to restore oyster reef habitat? According to Dr. Mark Luckenbach, Director of the VIMS Eastern Shore Laboratory, while there is much that we do know, there is much that we still have to learn. "For instance, we've learned over the past few years that certain aspects of the architecture of the reefs, namely vertical relief and interstitial space, are critical to the development of viable oyster populations," said Luckenbach, "but we know little about how the size of reefs or their arrangement in the landscape affect their development."

Depositing oyster and clam shells to construct a research reef.

During the summer of 2000, Luckenbach in collaboration with Wesson, designed and constructed a series of experimental reefs at four sites in the lower Rappahannock River. The sites were chosen because they historically contained oyster reefs.

"We designed the reefs so we could study the role reef architecture and size may play in restoration success," said Luckenbach. "As we embark on large scale restoration efforts, it is important for us to know what really works. Especially in light of the fact that shell and other substrate resources are limited, it is important to optimize its use in restoration activities."

Wesson and his crew used approximately 2000 cubic yards of oyster and clam shell in the construction of a replicated block design that established four reef bases of varying sizes.

Luckenbach and his team, with support from the Virginia Sea Grant Program, are following the development of the community of organisms, including oysters, on the reefs. The researchers are monitoring water quality, including salinity, temperature and dissolved oxygen and mapping the flow fields at each site. The team used side-scan sonar to develop detailed, 3-dimensional maps of the reef field. "Through the use of the detailed maps and characterization of the flow fields around the reefs, we hope to learn more about how to construct reef bases and understand the factors that affect the development of reef communities," said Luckenbach. "We are especially interested in the numbers and growth rates of oysters and the abundance of transient finfish and blue crabs on different size constructed reefs." The group is also conducting experiments on the reefs using hatchery-produced oysters to test hypotheses about growth and survival in relation to reef size.

Numbers of oysters in the lower Bay are at an all time low and diseases remain widespread. Nevertheless, in most of the lower part of the Bay, oyster populations are slowly, but progressively becoming established on the sanctuary reefs. "Recovery of viable oyster populations is not going to occur in a few years" notes Luckenbach, "it may take several decades of sustained effort to make this work." The work being done by Luckenbach and others at the Eastern Shore laboratory will provide much needed information for continuing restoration efforts. Of the community of organisms living on a reef sanctuary, Luckenbach says, "if we build it, they will come, but how we build it and manage it may determine if they stay."

(Dr. Mark Luckenbach, Director Eastern Shore Laboratory, recently testified before the House Subcommittee on Fisheries Conservation, Wildlife and Oceans on the status of oyster restoration efforts in Virginia.)