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In This Issue:

Oyster Hatcheries in Maryland

Don Meritt, Shellfish Specialist

For much of this century, oyster hatcheries did not seem to be necessary in the Chesapeake Bay. When harvests of public grounds in Maryland first plunged in the 1920s, the state passed legislation that initiated annual placement of shell in areas which historically had high sets of new oysters: the new spat were then moved to depleted oyster bars for replenishment. While overfishing, land runoff and pollution continued to damage or eliminate many oyster reef habitats, annual harvests of 2 to 4 million bushels were enough to satisfy most participants in Maryland's industry. In the 1960s, however, harvests once more declined — the Department of Natural Resources countered with a new oyster repletion program that involved dredging fossil shells from the Upper Bay.

Harvesting oysters from public grounds has dominated the Maryland oyster fishery. Still, oyster farming on private leaseholds has also had a long history in the state, though it accounts for only a small portion of the total oyster fishery (9,000 acres of leased bottom compared with more than 250,000 acres of designated public grounds). While the private fishery has been productive over the years, state law has made it nearly impossible for leaseholders to obtain young oysters from Maryland's public grounds. Most leaseholders have obtained oysters from Virginia, where until recent years the James River had heavy sets of young oysters that were available for sale.

With the decline in natural production in the 60s, questions were raised about the potential of using hatcheries for producing oysters. One of the first hatcheries in Maryland got started when a small group of biologists at the Chesapeake Biological Laboratory (part of the University of Maryland Center for Environmental Science, UMCES), among them Herb Hidu and Francis Beaven, converted part of the boathouse into an oyster culture lab. Early efforts centered on conditioning and spawning local stocks of oysters. They put into use techniques employed at other established hatcheries and were successful in spawning larvae and producing spat. However, they were constrained by a small working space and the lack of an adequate seawater system.

Early Hatcheries in Maryland

While production was extremely limited, probably no more than a few hundred thousand spat a year, large quantities of hatchery-produced spat were not the aim — the primary objectives were to determine the feasibility of using hatcheries in the Chesapeake Bay and to investigate the potential for establishing private hatcheries for commercial uses. Two entrepreneurs, Frank Wilde and Max Chambers, worked with the CBL researchers and started their own hatcheries.

Wilde focused on producing cultchless oysters primarily for off-bottom rearing in racks or floats — he was also one of the first to employ selective breeding techniques to improve stocks by selecting fast-growing deeply cupped oysters. Though Wilde produced oysters for 15 to 20 years, limited production capabilities and off-bottom growout systems proved to be unprofitable. Chambers first located his FloMax hatchery on the Nanticoke River; while successful in producing large amounts of seed, Chambers had to move his hatchery to an area with much poorer water quality for oyster culture; after a few years, the hatchery closed.

In June, 1972, Hurricane Agnes hit the Chesapeake Bay — a storm of the century, it caused major, long-lasting changes to the Bay's ecosystem. Many habitats were severely damaged or destroyed, particularly shellfish beds in the upper reaches of the Bay and the major tributaries. The Chesapeake was inundated with enormous volumes of fresh water in June, a period when oyster and clam populations are metabolically active; unable to withstand long-term exposure to fresh water, they suffered major mortalities. In response to the heavy loss of oysters throughout the Bay system, the University of Maryland received funding to construct a hatchery. The aims were three-fold: to produce selected broodstock oysters for use in the upper Bay region, to perfect hatchery techniques for use in the region, and to work with industry in rehabilitating depleted oyster stocks.

Originally intended for the Chesapeake Biological Lab, the hatchery was built in 1973 at the recently established UMCES Horn Point Laboratory. Incorporating features of successful hatcheries in the northeast region but largely patterned after a private hatchery on the Potomac River near Colonial Beach, Virginia, efforts during the first few years of operation focused on producing cultchless spat for use in both on-bottom and off-bottom growout. Early production showed that there were biological and economic problems with this approach for on-bottom culture: cultchless spat were expensive to produce, expensive to rear and were subject to siltation and severe predation by blue crabs; meanwhile off-bottom growout in trays and racks were threatened by winter ice conditions.

In the early 1980s, Maryland Sea Grant Extension partnered with the UMCES Horn Point Lab to support outreach programs that could demonstrate the use of hatchery technology for private aquaculture and oyster restoration efforts. Problems with obtaining good quality oyster seed at a reasonable cost had been plaguing the private industry in the state since Agnes. Instead of cultchless spat, emphasis shifted toward producing spat on shell for use in traditional on-bottom oyster culture systems that were commonly employed in Maryland at the time. An important breakthrough was the adaptation of remote setting techniques developed by the oyster industry in the Pacific Northwest, which depends on hatcheries for most of its commercial production.

Remote Setting of Oysters

In remote setting, growers obtain eyed oyster larvae (before they have set on shell and metamorphosed to become spat) from the hatchery and set oysters on cultch at their own sites. Such approaches had not been employed on the east coast. Combining hatchery techniques for producing eyed larvae with the techniques of remote setting, Sea Grant Extension began working with a group of oyster planters who had leaseholds on the Nanticoke River — the aim was to demonstrate the effectiveness of using hatchery reared larvae in Maryland.

Early efforts were encouraging and after some trial and error, growers successfully deployed remote set oyster spat at several sites in the region. Growth and survival were proving to be excellent and oysters were nearing harvest size when they were hit by a major outbreak of both MSX and Dermo disease. Oysters throughout the Chesapeake, whether produced in the hatchery or the wild, were decimated by one or both of these diseases. Because oysters in higher salinity waters are especially susceptible, planting efforts with hatchery seed were moved farther north in the Bay in an attempt to manage around their impacts. Several important discoveries were made during the trials in the Nanticoke River, perhaps the most important being that oyster seed need to grow to a sufficient size prior to planting directly on the bottom. Spat taken directly from the setting tanks and deployed on bottom grounds experienced a near 100% mortality while those that were held on nursery grounds until they reached 12 to 15 millimeters fared well. It was also found that spat could not be planted directly on the bottom — bottom grounds had to be prepared with a base of shell or other suitable materials. Both of these steps are critical if there is to be any chance of successful on-bottom farming of oysters.

Over this last decade, Sea Grant Extension has expanded its remote setting demonstrations to include sites in Nanticoke, Bellevue, Kent Island, Crisfield, Elliott Island, and Cambridge on the Eastern Shore and several sites in St. Mary's, Anne Arundel and Calvert counties on the western shore. While the results of these trials were encouraging, disease killed most of the larger oysters before they reached market size; still, several growers were successful. Most impressive were several trials in the Tred Avon River near Bellevue in which one grower successfully raised marketable oysters in 22 months; however, because the oysters were not harvested, they soon after succumbed to an outbreak of Dermo.

Looking Ahead

Interest in doing remote setting among Maryland's private oyster growers has been low because the specter of Dermo or MSX hovers in most areas where there are leaseholds. Still, there is promise for the future of hatcheries for producing oysters, not only for aquaculture but for habitat restoration projects. Long-term research on breeding oyster strains (CROSBreed oysters) that can resist both MSX and Dermo has shown promise — field trials of the CROSBreed oyster at various sites in Chesapeake and Delaware Bays continue. If successful, these oysters could be made available to commercial hatcheries for scaling up production of larvae that could be made available for remote setting operations. (CROSBreed is one of several projects in the National Sea Grant College Oyster Disease Research Program; see www.mdsg.umd.edu/Research/OysterDisease.html.)

For some years, Maryland commercial harvesters were reluctant to embrace hatcheries as a meaningful tool for producing oyster seed for repletion efforts. While the Horn Point hatchery was one of the largest in Maryland, it was not designed to produce the volume of spat on shell necessary for large scale outplantings. In the last several years, the Horn Point hatchery has been overhauled, with production-scale larval culture tanks, setting tanks, and an 1,800 square-foot greenhouse to provide additional larval production and greatly improve production of cultured algae. In addition, a major setting facility at the Horn Point pier is capable of producing more than 40 million spat on shell in a good production season.

These efforts and those of the Maryland Oyster Recovery Partnership which works hand in hand with the UMCES and Sea Grant Extension efforts have resulted in minimizing the bottlenecks that previously existed in the Horn Point hatchery. Production has increased dramatically, from an average of a couple of million spat on shell in the mid-90s to over 15 million in 1999. This production capability has enabled the use of hatchery spat in sizeable outplantings in several Bay tributaries in recent years. Local watermen have also assisted in these operations — they have witnessed the impressive numbers of seed oysters planted from a relatively small amount of shell material. Many are becoming aware that hatcheries can be useful for producing oyster spat for both private aquaculture and restoration of reefs. _Such efforts can directly benefit the commercial fishery and, in the long run, the overall health of the Chesapeake Bay.

For a copy of the fact sheet Producing Oyster Seed by Remote Setting, contact Maryland Sea Grant at 301-405-7500, or order from our online catalog at www.mdsg.umd.edu/store/index.html.

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The Values of Oysters

Douglas Lipton, Marine Economic Specialist

In recent years, there has been an increasing recognition that oysters and oyster reef habitats have an important ecological function in the Chesapeake Bay. Where arguments for oyster restoration once focused solely on the oyster's importance for the commercial fishery, those arguments now include benefits for the ecosystem. The issue is often posed as a choice between economics and ecology — do we restore oysters for their ecosystem role or for the income-producing benefits they provide as food? The question implies that the oyster's ecological role is independent of economics — in fact, the two can be seen as interdependent.

From an economic perspective, the value of any good (in this case, oysters) can be determined by other things we are willing to forego in order to have the good we want. Goods also have value if they are a necessary input for producing something else which is directly valued. With regard to oysters, the confusion between economic value and ecological value stems from the fact that the oyster is directly valued both for consumption and as an input for oyster reef habitats which may help improve recreational fishing and maintain water quality. It is more straightforward, however, to measure the direct value of oysters as a good or commodity than it is to measure the indirect value of their importance in water quality or recreational fishing.

Measuring the Value of Oysters as Food

Because oysters are bought and sold by producers and consumers in the market, their value to watermen is the income they earn from oystering, over and above the income they can earn from alternative income-producing activities. Similarly, other producers in the commercial sphere, such as oyster processors and wholesalers benefit from the marketing of oysters. Finally, the consumer benefits from having the opportunity to purchase oysters for consumption. We can estimate the value of oysters to consumers as the difference between the maximum they would be willing to pay minus the market price. If a dozen oysters cost $10 at a restaurant, and consumers would have been willing to pay $12 (though no more), the net benefit to consumers who purchase those oysters is $2. With enough market data about oyster production costs, alternative opportunities for watermen, retail price and consumption data for consumers, it is possible to estimate this type of direct consumption value. Though such an economic study has not been conducted, we can estimate the total revenues of watermen from oystering by multiplying the dockside price and the quantity landed; this ex-vessel value was equal to $7.4 million in 1998 for the Maryland harvest. The economic value of oysters to watermen is significantly lower once harvest costs and alternative income earning opportunities are subtracted.

Measuring the Value of Oyster Reefs

Measuring the indirect value of oysters in the ecosystem is more difficult, though economists have developed techniques for estimating the dollar value of environmental amenities such as enhanced oyster habitats. One reason economists have not done this for oyster reefs is that scientists have not yet been able to quantify the ecological role of oysters as habitat for fisheries or their role in improving water quality. Once they do, we could employ economic techniques for estimating the benefits in dollars for restoring oyster reefs. To demonstrate how we might go about measuring this indirect value of oysters, I'll use a hypothetical example.

Let's assume that oyster reef restoration in the Bay has improved striped bass habitat and ultimately results in the average recreational angler having an increased probability of catching a striped bass on any given fishing trip. In a recent economic study of recreational fishing, we calculated that an increased catch from 1.3 fish per trip to 1.8 fish per trip is worth $4 million a year. If the increased catch were solely due to the restoration of oyster reefs, a $4 million per year benefit, discounted at 5 percent, would mean the oyster reefs contributed $80 million in value over time. This figure could be compared to the cost of constructing and maintaining the reef to see if the benefits outweigh the costs. The other benefits such as increased fishermen incomes, cost savings from sewage treatment plants because of nutrient removal by oysters and anything else that could be attributed to oyster reefs would have to be added to the value, as well as any increase in commercial harvest of the oysters that was allowed.

The importance of such economic analyses is that they can give us a more comprehensive perspective about the benefits of restoration efforts — if we were to base benefits only on directly measurable values such as the commercial fishery, we could seriously undervalue the importance of oyster reef habitats.

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Shellfish Aquaculture and HACCP

Tom Rippen, Seafood Technology Specialist

Most aquaculturists are aware that the production side of their businesses are exempt from new federal food safety regulations, the Hazard Analysis Critical Control Point program (HAACP). Subsequent to its implementation, the Food and Drug Administration has issued policy statements which exempt harvesters who follow simple "processing" procedures such as boxing and icing for transport to market. However, some molluscan shellfish aquaculture operations do fall under this HACCP regulation, and all must comply with certain other health regulations. Any commercial enterprise dealing with oysters, clams and mussels, must be aware of its responsibilities under the regulations.

The aquaculture exemption does not apply to operators who also deal in products produced by other companies. If they inventory products or act as a wholesale distributor, they must comply with the HACCP regulation. Also, although aquaculture grow-out operations are exempt from the HACCP regulation (the one that went into effect December, 1997), culturists of molluscan shellfish must still comply with National Shellfish Sanitation Program (NSSP) requirements. This is a joint program administered by state health agencies, FDA and industry for assuring the safety of molluscan shellfish for raw consumption. The NSSP issued a Model Ordinance in 1997 (since revised) that details procedures for growing waters, product handling and state enforcement. This model ordinance is largely HACCP-based and contains HACCP features that apply to aquaculture.

Both the NSSP Model Ordinance and the FDA HACCP regulation require that molluscan shellfish come from approved growing waters. The HACCP record is usually a tag identifying the type and quantity of shellfish and the waters of origin. This documentation must accompany the shellfish throughout distribution. For most wild-harvest shellfish, this operation is controlled by the packers or distributors at product receipt (a Critical Control Point, CCP). They confirm that the shellfish are properly tagged and were harvested by licensed commercial fishermen. Aquaculturists should check with their state shellfish control authority to determine how the regulation affects them. The state of Maryland treats shellfish culturists who distribute their own shellstock (for direct consumption) as shellstock shippers.

In addition to monitoring the safety of growing waters, the Model Ordinance requires shellstock shippers to implement a Critical Control Point at storage. Once placed under temperature control, the shellstock must remain iced or refrigerated at 45¡F or less. If removed from refrigeration, it must be returned to a temperature controlled environment within two hours. The shellfish control authority will normally allow time to either truck or sell shellfish before refrigeration or icing is required: typically four hours. This time interval and/or refrigeration temperature/presence of ice will likely be included in the aquaculturist's HACCP plan as critical limits. As with all Critical Control Points, these conditions must be routinely monitored and a record kept of results. If monitoring indicates that critical limits were not met, an appropriate corrective action must be implemented and documented.

Commonly, an aquaculturist contracting to grow shellfish for a wholesaler who sorts, packages and markets the product will not be required to implement HACCP. The wholesaler carries the responsibility. However, the contract grower will need to tag or otherwise properly identify the shellfish in order to sell to the wholesaler. Shucking or any additional processing of shellfish will require a HACCP program that addresses the potential food safety hazards associated with the product. If the state shellfish control authority expects an aquaculture operation to have a HACCP plan because of the nature of their business, it must also implement a sanitation monitoring program. The regulations list eight key sanitation concerns which must be routinely evaluated and findings recorded, usually on a checksheet.

Copies of the NSSP Model Ordinance are available from regional offices of the U.S. Food and Drug Administration. In the mid-Atlantic, contact: Baltimore District Office, Investigations Branch, 900 Madison Ave., Baltimore, MD 21201

For more information on HACCP, contact Tom Rippen at 410-651-6636.

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Fish Culture in Maryland: A Conversation

For nearly 15 years, Reginal Harrell lived a dual professional life: as a professor at the University of Maryland Center for Environmental Science (UMCES) Horn Point Laboratory, he did wide-ranging research on striped bass and hybrids and other fish species; as the Finfish Aquaculture and Biotechnology Specialist at the Sea Grant Extension Program and for Maryland Cooperative Extension, he worked with aquaculturists in Maryland and the mid-Atlantic and with state and federal agencies. Harrell has left UMCES and Sea Grant to become the Eastern Shore Regional Director for Cooperative Extension. His departure was the occasion for a conversation with Merrill Leffler about fish culture in Maryland and the role of the University System of Maryland. The following is an excerpt of that conversation.

ML: How has finfish aquaculture changed over the last ten years in Maryland? How far have we come, not only in commercial production but in aquaculture as a way of thinking about the future?

RH: Until the mid-80s raising ornamental fish was the only finfish aquaculture industry in the state. It was very select, very focused, very quiet and very successful. While it still constitutes the bulk of finfish aquaculture in Maryland, we have developed three major producing species in the last 10 years — tilapia, striped bass and catfish. They are major for Maryland, but not when you compare us nationally. We don't rank with states that have production level USDA reports — we are grouped under "Others."

ML: Did you have greater expectations when you first came to Maryland? Did you expect that aquaculture here could have progressed differently.

RH: For pond-based systems, no. Aquaculture is expensive to get into in this state, given costs of land, regulations, and environmental concerns. In general, pond aquaculture is going to be limited to a few counties in the state. There are a few larger growers who are operating — but those like Tony Mazzaccaro in Dorchester County are more the exception. For the most part, pond culture operations in Maryland and the mid-Atlantic are likely to supplement other income. I have been disappointed that we haven't tapped the Bay as a resource. In my opinion, Maryland will never be a major competitor nationally without going to water-column aquaculture. We have not looked at the best approaches for aquaculture in Bay waters, and by best approaches I mean those that bring together economic, environmental, biological and ecological factors — in other words, how can we have a productive system and still protect the Bay, protect the resource and protect the aquaculturist. At best we have done only cursory work. There are numbers of issues — the concern over nutrient loading that results from concentrating fish in netpens; the worry over fish escaping and perhaps upsetting food webs; and then there are aesthetic concerns over what some see as fish factories.

> ***We have not looked at the best approaches for aquaculture in Bay waters. . . those that bring together economic, environmental, biological and economic factors.***

ML: Certainly the environmental issues are a great concern — a key feature of the Chesapeake Bay Program is slashing nutrients 40 percent from levels in 1985. Rearing fish in netpens could lead to heavy nutrient loading from fish wastes and artificial feeds.

RH: There is no question that excess nutrients are associated with aquaculture. Down here on the shore, everybody is especially concerned because of their potential relation to harmful algal blooms — the outbreak of Pfiesteria dramatized that for us. But it may not be as bad as some people seem to think. We don't know what the links are between nutrients and harmful algal blooms — the Chesapeake Bay is too complex for simple cause and effect relationships that simply speak of nutrients in general. We need to better understand the network of interactions of specific nutrients, phytoplankton, physical circulation, and a host of other environmental factors. And that understanding could be tied to research we have been doing in aquaculture ponds. For example, we did a study in the last few years on the environmental impact of raising striped bass in netpens in the Wye River. With Pat Glibert and Jeff Cornwell, both of the UMCES Horn Point Lab, we wanted to determine how much excess nutrients the fish added. To begin with, we found that for nitrogen, the background levels were higher than those resulting from the fish wastes and uneaten food. However, phosphorus associated with the operation was higher than background levels. If those findings are confirmed, it suggests that nitrogen from aquaculture is not the issue but that we need to adjust the level of phosphorus in the fish diet. Joe Soares at the University of Maryland College Park (UMCP) and Steve Hughes from the University of Maryland Eastern Shore are examining the issue from a nutrition perspective. In particular they are looking at the role of phosphorus as the enzyme phytase. Putting phytase into the diet allows the fish to be more efficient and utilize available phosphorus in the diet, so they would take up more instead of passing it through. George Ketoli with the U.S. Fish and Wildlife Service in Pennsylvania is looking at just how low we can go with phosphorus in the diet because of this very issue. So collectively there is a lot of good work going on in the region and in the state — what we need to do is to be able to bring it together.

ML: Are there coastal areas in the country where open water aquaculture is commercially successful?

RH: Most of it is limited to the salmon industry, though there have been some attempts with red drum and other species. The most success has been inland, in quarries and reservoirs where catfish and a few other species have been raised. There is no reason why the same technology could not be applied to coastal systems — sure there are different biological problems, for example, you get biofouling and there are the nutrient concerns.

Offshore cage culture is being done with large pelagic fish, especially in Asia, though it is growing in Europe and South America. There are systems in Japan where fish are trained to come feed; the advantage of offshore systems is that you don't have the nearshore pollution problems, primarily because of water circulation. There is a technology in use in freshwater systems in the midwest and south, a floating raceway, that I think could work in the Bay — it would allow you to do polyculture, both finfish and shellfish. Water is moving through constantly. There are a lot of places in the Bay that would be amenable to open water culture. With adequate flow in those shallow areas, the floating raceways could work very well.

> ***Recirculating systems are probably the way to go — they are the most environmentally benign and you can exercise control over water quality.***

ML: What about other prospects, recirculating systems in particular.

RH: Ten years ago Extension couldn't consider closed system culture because the technology was not there. The technology has finally made advances so that some operations are making profits at it. Closed systems are probably the way to go — they are the most environmentally benign and you can exercise control over water quality. On the other hand, they are also the most technologically driven system. That means you have to deal with a high dollar product to get a good enough return. Yonathan Zohar at the University of Maryland Center of Marine Biotechnology and Fred Wheaton at UMCP have done a lot of work with recirculating systems and have been advocates for doing recirculating aquaculture in urban areas.

ML: Do you think we should be focusing our efforts on recirculating systems? And if so, what do we need to do?

RH: Most of the recirculating technology has been done on freshwater systems — we need a good deal of research on marine recirculating systems. Our understanding of such systems comes from public aquariums, which don't have the loading densities that production aquaculture requires. We need to be able to blend the knowledge we have of freshwater systems with what we've learned from marine public aquariums. We need to improve efficiency of heating and oxygen transfer systems. Biologically, we've got to figure out a way to improve larval growth and early juvenile growth with new species. In the long term, we need to selectively breed animals that are adapted best for closed systems — most of our aquaculture animals right now are selected for pond systems. There are other issues as well, from genetics to technology to the business of operating recirculating systems profitably.

ML: Throughout the university, we've got wide-ranging work going on at different campuses — can we marshall this expertise to better advance the industry? What is our role?

RH: What we need is a joint university-industry research facility, an incubation operation where we would have closed system technology. At Horn Point, since it is located on the Choptank River, we could have open water technology. Turn it into a research demonstration facility, make it a functional operation to allow people to produce fish on their own where you have the expertise right here. You bring in the faculty to do what you need to have done. While you don't have to have such facilities in one central location, it is convenient when you are trying to make partnerships with industry.

The aquaculture industry in Maryland has been stymied because we have not demonstrated that aquaculture can be profitably done. Here's where Cooperative Extension and research-industry partnerships are so invaluable. Research needs to do the underwriting work._Extension can demonstrate it and educate the workforce. Business and industry then take over — they need to make the tough decisions. But they can't afford to make the big investment and lose the animals to find out what the best answer is. In research and extension, we can. Our job is to get scientifically credible answers. And that information is lacking with a number of species. We don't have some of the fundamental answers we need. With striped bass we do, with tilapia we do. We're getting better collectively in the country with flounder, sturgeon and paddlefish — but there are a lot of species we've hardly gotten anywhere with.

> ***The aquaculture industry in Maryland has been stymied because we have not demonstrated that it can profitably be done.***

ML: Does Maryland have the commercial climate to encourage such scaling up?

RH: As a whole, we have the climate, but we do not have the commitment. There is a lot of interest. But interest is not action. There has been some investment and that investment has been well spent. We've got some of the best scientists in the country looking at nutrition, reproduction, physiology and engineering. That is one of Maryland's great strengths. The Striper 2000 conference we had last year was the first time we have had researchers in Maryland together talking about what they are doing. But that was for a single species. We need to continue this sort of thing on an annual basis.

Some states have made tremendous commitments to aquaculture. Florida, Mississippi and Alabama are among them. There are legislators in Maryland interested in the potential of aquaculture in their own counties, but who really don't know what the prospects are. I am not sure that we are making a case.

ML: From the extension perspective, do we need to do things differently?

RH: We need two major things: specialists with the knowledge base and research support to address the questions of our field facility and clientele and a solid demonstration facility for closed system technology. Fred Wheaton at UMCP has some work but it is not set up on a production scale — it's a research scale. We need to have a site that we can send people to and say, okay, here is an RBC system, this is a bead filter system, this is good, this is bad. Now, you can cross them, you can buy a system by itself. Here are your vendors that sell this kind of equipment. Here is a list of vendors that sell fluidized beds. It's off the shelf technology. Here are capital costs, here are operational costs. Let our clientele make their informed decisions for what's best going to fit their operation. We don't have that capability, and for us to really be true educators, we are going to have to do that. That is going to cost money, however.

ML: Can you be specific?

RH: I have been speaking of production here. But if you focus only on production, it could be tough to justify the level of investment versus the level of return. But aquaculture is much bigger than just production. It's business management, it's natural resources management, it's watershed management, its nutrient management. We can learn a great deal from aquaculture. One thing I have been pleased with in the last couple of years is that we have worked more at UMCES_with academic researchers like Pat Glibert and Todd Kana, whose expertise is on nutrient cycling, and Jeff Cornwell, who studies biogeochemistry — they are using aquaculture systems as a model for trying to figure out what's happening in the Bay. Diane Stoecker and Glibert have tied in with Tony Mazzaccaro's pond operation and collectively it's a tremendous resource to address questions you just can't address under natural systems.

ML: Where do we go from here then? Can you bring us to a conclusion, at least for now?

RH: That depends on what we as a state and university decide. As I've said, we have terrific research going on and we have first-rate research facilities — we have made major achievements. A good deal of that work has found its way into industry already — but much of that industry is outside the state. Do we have a goal for the state? Is there a place we want to get to? Defining these goals can help us gain focus, which in turn could help us go much further in the next ten years than we have in the last.

For a copy of *Striper 2000: Research Advances on Striped Bass and Its Hybrids, A Program Summary,* contact Maryland Sea Grant College at 301-405-7500, or order from our online catalog at www.mdsg.umd.edu/store/index.html.

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Upcoming Conferences

East Coast Commercial Fishermen's Trade Show and Aquaculture Expo January 28-30, 2000 Ocean City, Maryland

Blue Crabs

- An Overview of Stock Assessment and Management in the Mid—Atlantic — Panel Discussion, Representatives from New Jersey, Delaware, Maryland, Virginia and North Carolina
- Concepts for the Future — Doug Lipton, Maryland Sea Grant Extension

Shellfish Aquaculture

- CROSBreed Project — Don Meritt, Maryland Sea Grant Extension and UM Center for Environmental Studies and Tom Gallivan, Virginia Institute of Marine Science
- Cape May Harbor Oyster Production Demonstration Project — Stewart Tweed, New Jersey Sea Grant
- Practical Aspects of Purging Shellfish. Gary Richards, Delaware State University
- West Coast Shellfish Aquaculture, Where is the East Coast in Comparison? — Don Bishop, Fukui North America
- Oyster Culture Around the World — Standish Allen, Virginia Institute of Marine Science

Computers and Information Gathering for Commercial Fishing and Aquaculture

- Accessing Information on Aquaculture — John Ewart, Delaware Sea Grant
- Accessing Information on Commercial Fishing — Nils Stolpe, New Jersey

Fishing As a Business. Planning for Now and the Future

- Planning for Commercial Fishing and Aquaculture — Speaker to be announced
- Insurance for Commercial Fishing Businesses — Jack Devnew, Flagship Insurance
- Financial Planning, Easier Than You May Think — Diane Rowe, Maryland Cooperative Extension

In addition to seminars, there will be a Children's Marine Education Program on Saturday, January 29, coordinated by Jackie Takacs, Maryland Sea Grant Extension Program.

For further information, contact Don Webster, 410-827-8056 or webster@mdsg.umd.edu. Keep abreast of updates at www.mdsg.umd.edu

East Coast Live! The Business of Live Aquatic Products Conference and Trade Show November 1-4, 2000 Annapolis, Maryland

varieties of marine and freshwater fish, shellfish and aquatic plants continues to grow significantly in the eastern U.S. and Canadian markets. Sources of live product traded in these markets include regional capture fisheries and aquaculture farms plus domestic and international imports. Virtually every state in the U.S. and the Canadian inland and Maritime Provinces can cite significant economic activity, whether current or potential, related to segments of the live aquatics industry. Accompanying industry growth and development are an array of issues related to natural resources, economics and marketing, and research. East Coast Live! will follow related conferences that have been held in Seattle in 1997 and 1999 and Yarmouth, Nova Scotia in 1998 — it will address issues of special interest to those in the Eastern U.S. and Canada, although a significant international audience is expected to attend.

Modeled on the west coast conference in Seattle in November 1999, East Coast Live! will cover the diverse industry on this side of the country. Topics will include natural resource regulatory issues and ongoing research and development. Tours of nearby commercial facilities are in planning. A publication of summaries of all oral and poster presentations is also planned along with a concurrent trade show of suppliers to the industry, airline representatives, state, regional and federal agencies and other exhibitors relevant to the live aquatics industry.

For further information, contact Don Webster, 410-827-8056 or webster@mdsg.umd.edu.

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