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Developing Aquaculture in Maryland

DONALD WEBSTER, *Sea Grant Extension Eastern Shore Agent*

It is not easy for an industry as entrenched as the Maryland seafood industry to move in new directions. While most venerable institutions tend to resist change, change is inevitable. The paradox is that while Maryland's fisheries have changed dramatically in recent decades, most changes have not been for the better. Oysters have declined to a virtually irrelevant harvest and many fish species are either highly regulated or under harvest moratorium.

Today we face a situation where we have nothing to lose and everything to gain by making major changes to the way Maryland manages aquaculture. Nothing in business remains static and those who resist change are usually left behind by those who embrace it. While Maryland has tried to cling to the nineteenth century in the vain hope of ensuring a few jobs for a declining number of watermen, other states

Maryland Aquaculture Development Conference



have moved ahead by streamlining laws and regulations, increasing production, and penetrating old markets while building new ones. Watermen who could benefit the most from a vibrant aquaculture industry in the state have often been those most opposed to the changes needed to get us there.

Our challenges are great and many progressive changes are needed to move Maryland from a taxpayer-supported fishery to an industry based on individual initiative and private entrepreneurship. All segments of the

Continued on page 2

Needed: A New Climate for Commercial Aquaculture

ANDY LAZUR, *Sea Grant Extension Aquaculture Specialist*

Chesapeake Bay may be the largest estuary in North America but when it comes to employing its waters for commercial aquaculture, Maryland hardly ranks — this is not the case for Virginia where the cultured hard clam industry is among the leaders on the east coast. Maryland's two most successful aquaculture industries are aquatic plants and ornamental (or aquarium) fish, neither of which depends on the Chesapeake. Though there is some fish farming, especially in recirculating systems and shellfish farming, it is relatively limited. And yet, the potential of aquaculture in Maryland could be enormous — the question is, what will it take?

Aquaculture enterprises in a number of coastal states have made much progress over the last decade. In Alaska, Florida and Virginia, for

Continued on page 4

Contents

- 1 **Developing Aquaculture in Maryland**
Opportunities for Growers
 - 1 **Needed: A New Climate for Commercial Aquaculture**
Encouraging Progress
 - 5 **Maryland's Oyster Fishery**
Let's Enter the 21st Century
 - 8 ***Crassostrea ariakensis***
Triploids in Chesapeake Bay
 - 10 **Oyster Research Restoration in U.S. Coastal Waters**
Setting a National Agenda for Research
- Rapa Whelk: Aliens in the Chesapeake**
Multimedia Education CD ROM
- 11 **Sea Grant Extension and Finfish Aquaculture Research**
Yellow Perch, Sturgeon, Tilapia, Baiifish
 - 12 **New Publications, Etc.**
Chesapeake Quarterly
C. ariakensis Research
Seafood Cookbook
Rapa Whelk CD ROM
Oyster Management

Aquaculture, from page 1

industry can benefit from change. Existing aquaculture businesses should continue to be supported while others develop through the interaction of research, outreach, and commercial development. Maryland can have a bright future but new actions will need to be taken. Among these are the following:

Create a Strong Office of Aquaculture Coordinator (OAC)

- The OAC must provide information about permits required for aquaculture and tracking of these applications through administrative systems. The OAC should be directly attached to the Governor's staff or be housed in the Maryland Department of Agriculture (where it is now) but with access to the Governor's staff.
- The OAC must provide continued monitoring of aquaculture permits for timeliness and oversight of problems with both state and federal agencies; and it must provide mediation of disputes and document problems within and between agencies for governmental resolution.
- The OAC must provide liaison with the Maryland Legislature to correct problems affecting aquaculture and requiring changes in state law; it will also serve as the primary liaison with federal agencies involved with aquaculture in Chesapeake Bay.

Reorganize the Maryland Aquaculture Advisory Committee (MAAC)

- The MAAC must be renovated to make it substantive and worthy of participation by appointees and agency designees: industry appoin-

tees must be active aquaculture producers. Federal agency partners and non-governmental organizations should be added as members.

- The MAAC must be used for problem identification and front-line discussion and resolution of key issues affecting the industry.
- The MAAC must annually prioritize major goals for industry development, provide oversight of progress made toward them and submit an annual report to the legislature on the progress and problems affecting the industry.

Take Decisive Legislative Action

- The Maryland legislature should legally define aquaculture as a priority activity for state waters for the production of aquatic plants and animals and establish "Aquaculture Enterprise Zones" as priority areas for leasing.
- Authorize a committee to create criteria for assessing on-bottom and off-bottom culture areas for suitability as sustainable production regions. It is critical that the legislature open leasing in all waters of the Chesapeake and coastal bays, allowing private entrepreneurs to choose where best to locate their operations. At the same time, they should create a monitoring program to ensure active production by lessees and provide a system for return of leases to the state in the event of non-use or other reasons with criteria for transferring use rights to other potential producers.
- In order to move the industry from wild harvest to production, there should be a program instituted to provide existing full-time commercial watermen with leases and to support educational programs that

give them the skills to move to sustainable production aquaculture. A pilot program for this should take place with the hard clam industry in the coastal bays.

- Make theft of aquaculture products a felony with confiscation of equipment used in commission of the crime and forfeiture of commercial or recreational licenses for those convicted; fund Maryland Natural Resources Police so that they can properly enforce aquaculture property rights and direct the agency to enforce these property rights as a priority.
- New and innovative methods of supporting aquaculture research and development should be investigated and instituted by legislative action.

Engage Our Federal Partners

- Create a program for off-bottom aquaculture permitting operated by the state of Maryland but meeting legal needs of federal agencies as has been done with environmental and health programs.
- Work with our federal partners on cooperative research projects to provide scientific answers to defined questions on key aquaculture questions such as development of new species and systems.
- Provide educational material about federal agency regulatory requirements and support programs to industry through outreach programs.

Involve Environmental Non-Government Organizations

- Consult with key environmental groups in the development of Best Management Practices that can be

used to develop sustainable aquaculture production.

- Interest NGOs in research projects to provide an understanding of the role of aquaculture in the cleanup of our waters and restoration of natural aquatic resources.
- Assist environmental NGOs in developing restoration projects and obtaining seed, plants, or other products from commercial producers to create a bridge of interaction between the groups.

Support Directed Research Programs

- Continue state support for both basic and applied aquaculture research and actively encourage continued and enhanced research into the restoration of declining or depleted natural resources using aquaculture as a tool.
- Guide the development of research priorities addressing defined industry needs through formal and informal interactions between these groups.
- Involve and integrate Maryland aquaculture producers into research-related field studies and demonstration projects to move from the laboratory to the industry.
- Applied research should be funded through an appropriation of one-half million dollars annually and administered by the Maryland Agricultural Experiment Station similar to recent USDA funds and guided by a committee representing industry, research, and extension to guide use of the funds on priorities set and reviewed by industry annually.

Provide Extension Services for Industry Education

- Define the Maryland Sea Grant Extension Program (MSGEP) as the lead organization within the state for aquaculture outreach education and any required certification programs.
- Stipulate that the MSGEP organize and conduct an annual forum for University System of Maryland scientists and industry in order to engage these groups in dialogue that will lead to the solution of problems; provide continued funding for this purpose.
- Mandate that the MSGEP conduct and evaluate annual programs for industry training, submitting reports to institutional and legislative authorities for assessment of progress.

Over the last 20 years, the Maryland Sea Grant Extension Program has developed expertise in finfish and shellfish aquaculture, while drawing upon the vast scientific capabilities within the University System of Maryland. In addition to organizing workshops and demonstration projects for aquaculturists, Sea Grant Specialists have produced print, video and web-based materials aimed at furthering the industry's technical and business educational skills. Sea Grant Extension can and should help lead the effort to move aquaculture in Maryland into the 21st century.

This article is adapted from Don Webster's presentation at the Maryland Aquaculture Development Conference. He can be reached at dw16@umail.umd.edu or (410) 827-8056, ext 127. Many MSGEP publications are on line at www.mdsg.umd.edu/Extension/index.html.

New Climate, *from page 1*

example, aquaculture now accounts for some \$15 million and many new jobs for commercial fishermen. What did these states do to encourage that progress? The Maryland Aquaculture and Sea Food Task Force — established by the Maryland General Assembly in 2002 — undertook its first steps to find out. This summer they held the Maryland Aquaculture Development Conference, which brought officials from states with successful aquaculture operations together with Maryland legislators and representatives from state regulatory agencies, the aquaculture industry and the commercial fishing industry to learn about aquaculture development in those states.

With backing from the Maryland Agricultural Experiment Station, Maryland Department of Agriculture and Maryland Sea Grant, the conference included some 70 participants. Among the out-of-state speakers were a Florida legislator who has authored several aquaculture bills, state aquaculture coordinators, directors of aquaculture programs, Extension specialists and shellfish producers, and representatives of the ornamental fish and plant industry.

Participants discussed issues such as the benefits of aquaculture to the state economy and to commercial fishing communities, the processes of expanding aquaculture enterprises, the pitfalls and success of various regulations and the lessons that they learned along the way. A number of specific regulations and policies were identified that could better facilitate aquaculture development while addressing environmental concerns.

Among the recommendations were the following:

- Ensure a clear definition of aquaculture as agriculture, including culture leases.
- Establish legislatively a one-stop shop agency, which issues one permit and coordinates the process with other agencies via memorandums of understanding.
- Develop a certificate program, which validates producers as bonafide aquaculture producers providing tax and other agricultural benefits and mandates adhering to certain management practices.
- Develop best management practices that are updated annually for all cultured species (fish, shellfish, and plants) that producers can follow, including site selection review, culture guidelines, and effluent management requirements.
- Develop research and development support grants and funding for training programs, and formation of an industry-based advisory committee that identifies priority needs and provides recommendations to the lead aquaculture agency.

Speakers also identified ways to achieve effective aquaculture regulation. For instance, agencies, industry, non-government organizations and the state legislature must work together to identify specific regulatory changes. They must make all the desired changes at one time rather than fixing individual regulations or statutes. There were other suggestions as well: permit applications should be

short, potentially web-based, with a 30-day reply limit; the designated lead regulatory agency must be funded to provide the necessary staff, including field inspectors to work with industry at on-site locations on development and effluent management options; and enterprise zones should be established for shellfish culture leases with strict penalties for theft of cultured organisms.

As critical as government will be in providing the climate for aquatic farming to grow, aquaculture enterprises need to do their part: they must organize as an industry and work together and project a united message. The industry needs to develop its goals and propose policies for achieving them.

During the meeting's two days, it became clear that aquaculture in Maryland is at the stage that progressive and well-established aquaculture states were some years ago before they made a strong commitment to aquaculture development. The conference was a lens on what could be a more user-friendly accountable process in Maryland with proactive aquaculture development that has state support, effective partnerships among stakeholders, economic prosperity for individual farms and commercial fishing communities. The recommendations and insights that the Task Force came away with will greatly aid in identifying policies and regulatory changes that it can recommend to Maryland legislators.

For information on aquatic farming, see www.mdsg.umd.edu/Extension/aqua_fish.html. Contact Andy Lazur at alazur@hpl.umces.edu or (410) 221-8474.

Maryland's Oyster Fishery

Let's Enter the 21st Century

DONALD WEBSTER, Sea Grant Extension Eastern Shore Agent

In the late 1800s, Dr. William K. Brooks of Johns Hopkins University was the voice of conservation and progress for the Maryland oyster industry. As Director of Hopkins' Chesapeake Bay Zoological Laboratory, Brooks had spent years studying the bay fishery (he was also the first to spawn *Crassostrea virginica* under controlled conditions) and grew increasingly vehement about what he viewed as the plundering of the state's great natural resource. "It is a well-known fact that our public [oyster] beds have been brought to the verge of ruin by the men who fish them," he wrote, adding bleakly, "all who are familiar with the subject have long been aware that our present system can have only one result — extermination." Management of the oyster fishery, he wrote as Maryland's first Oyster Commissioner, "has been a failure. It has yielded on the average some ten million bushels of oysters annually from grounds which are capable of yielding five hundred million bushels each year. It has led to the ruin of some of our finest beds and to the very great injury of all of them." Think about this: during the 2002-2003 season, watermen in Maryland and Virginia together harvested less than 80,000 bushels of oysters from the bay bottom.

In 1905, Brooks published *The*

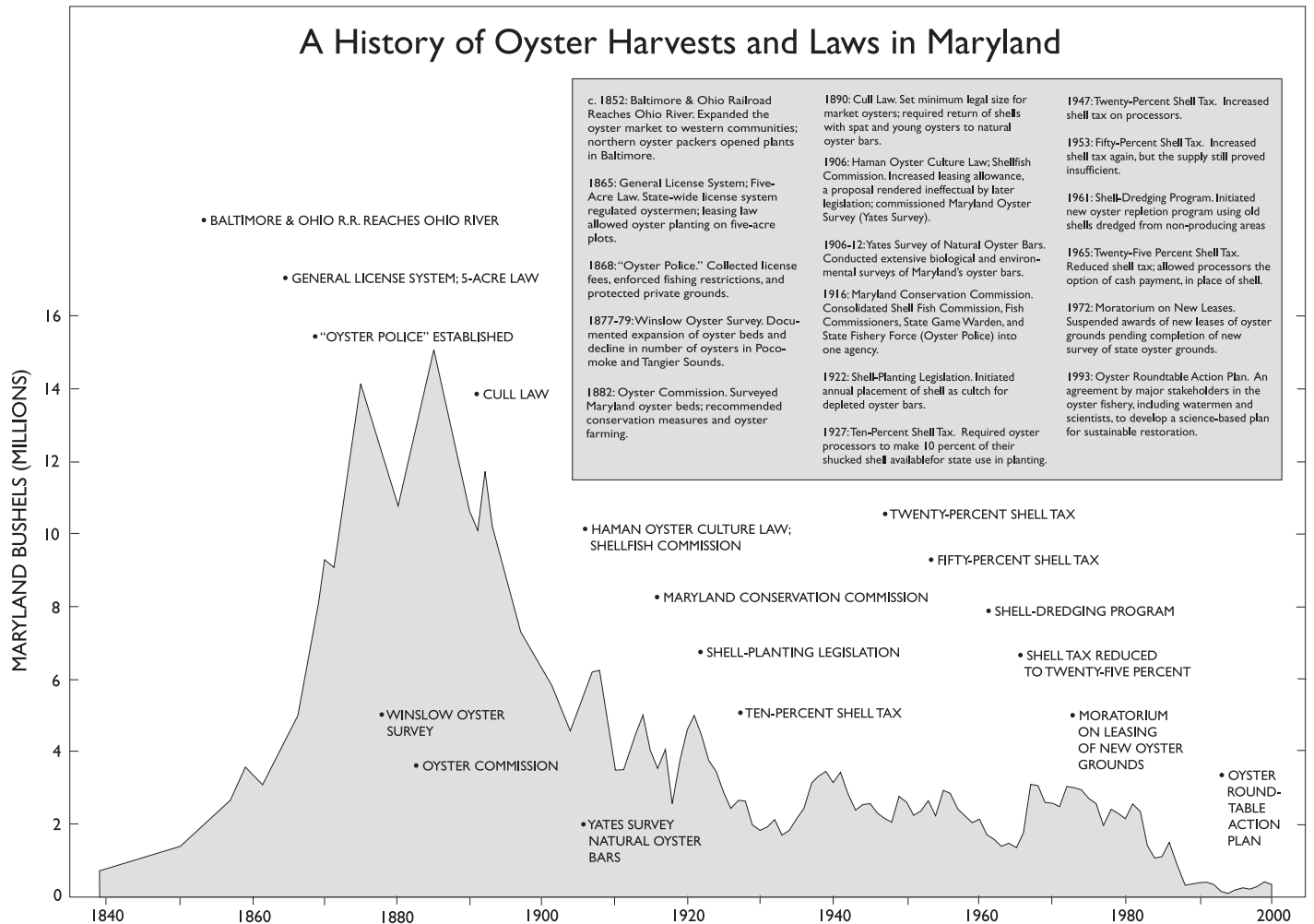


Oyster, a popular book that chronicled the history of Maryland's oyster fishery — a final chapter entitled "The Remedy" set out a road map for the future. While others before him had advocated the leasing of bay bottom for private growing of oysters, Brooks forcefully argued that leasing was the oyster's only hope in Maryland. He called for the state to rent tracts of barren or unfertile grounds (grounds that did not have natural oyster reefs) so that oyster farmers could cultivate those plots, plant oyster seed and harvest the resulting crops. Such beds would benefit both the public bars and the oyster catchers (as watermen were often called) who fished them.

Though Francis Winslow had

surveyed bottom grounds in Pocomoke Sound near Tangier Island in 1876-77 and recommended the leasing of large tracts of bottom for oyster farming, Brooks' prodding held sway and led to the first survey of the natural oyster bars in Maryland as a way to distinguish "natural" from "barren" grounds. Between 1906 and 1912, crews in small boats dragging chains to feel the pull of the oysters crisscrossed the bars as a way of identifying natural reefs. What resulted was a set of official state charts delineating the Natural Oyster Bars (NOB) as they then existed. These were to be set aside for the public fishery and placed out of reach of those who could then lease bottom to grow their own oysters.

A History of Oyster Harvests and Laws in Maryland



Leasing of bay bottom was not new to the state — as early as 1830, the Maryland General Assembly passed legislation that allowed citizens one acre of bottom for planting and growing shellfish. By 1865, the state increased the grounds available for leasing to five acres. Still, there was little incentive for private farming, given the extent of the natural oyster grounds and the strong prospect of theft on planted ones. With the decline of harvests in the early part of the 20th century, the Maryland General Assembly passed the Haman Oyster Act, which allowed private planters to lease 30 acres in the tributaries, 100 acres in Tangier Sound and 500 acres in the bay's open waters. Widespread leasing was on the horizon — or so it seemed.

As Brooks had argued, it made good sense to lease areas that were not naturally productive since it would provide a means of increasing production by using private capital, and that it would bring increased harvests and extended seasons for sale. By setting aside those areas for cultivation that had never exhibited natural production, he believed, both the public and private fisheries would complement each other.

Unfortunately, the Haman Act continued to draw opposition from Maryland watermen, who saw it as removing bottom from their potential harvest areas and as competition in the marketplace. Over the next several years, bills were passed that effectively crippled the progressivism that the Haman Act was promoting. One argument the opponents used was

that just because oysters didn't grow on bottom identified as barren didn't mean oysters might not grow there eventually. Another was that if bottom grounds were leased and cultivated by planting shell and seed, then that must be a sign those grounds weren't supposed to be barren to begin with. This illogical thinking flew in the face of the argument that barren bottom was so because there were no natural reefs or shell for young oysters to set on — if a leaseholder placed shell and seed there, it was from their efforts and not through nature that production occurred.

The battle in Maryland between those wanting only public bars for harvest and those who wanted to grow oysters on leased ground went on for over a century, with the growers for the most part losing. The

Commonwealth of Virginia went in the opposite direction: while their Baylor ground survey set aside defined oyster reefs for public harvesting, the state actively encouraged leasing. Virginia also had the rich spawning and nursery grounds of the James River that provided the spat oyster farmers needed to plant their grounds. As a result, Virginia led Maryland in oyster production, mostly from private growers, until MSX disease in the late 1950s and early 1960s largely wiped out the oysters on both the public and private grounds in Virginia's higher salinity waters. Because Maryland waters in the upper bay were less salty — and therefore oysters were less susceptible to MSX and Dermo — Maryland came to dominate oyster production.

Though some growers in the state were engaged in raising oysters on private grounds, the bulk of Maryland's harvests were from the public grounds. In the 1980s changing salinity patterns, over-harvesting, and questionable management practices led to the spreading of Dermo disease throughout the bay's oyster bottom — even into Maryland's lower salinity waters — also led to the demise of the industry in the northern bay. As a result, there is little left of the oyster industry in either state. Maryland is down to a small number of harvesters and a handful of shucking houses that are hanging on, largely because they are importing oysters from other states, while employing foreign labor.

In 1905, W.K. Brooks wrote that “our oyster beds are our greatest source of wealth, and upon them, more than upon our commerce, our manufacturers, or our farming land, the future wealth and prosperity and



population of our State depend.” Today, Maryland's oyster industry is no longer important.

While overfishing, habitat loss, and pollution may be the major assaults that have brought Maryland's oyster fishery so low, disease has been and remains the primary impediment to oyster recovery today. Major research and outreach efforts have been underway to try and counter the impacts of disease — from ongoing efforts to breed disease-resistant stocks to considering the importation of a non-native species (*Crassostrea ariakensis*) to techniques for managing around disease. Regardless, the rebuilding of Maryland's oyster industry will, for the foreseeable future, depend on aquacultural techniques, whether they are directed at creating oyster sanctuaries or managed reserves for public harvesting, and/or building up a large corps of private culturists for commercial production. If there is to be an oyster industry in the state, Maryland must

take progressive actions in a number of areas.

Oyster Leases

Many bayshore counties have had the legislature ban the leasing of bottom grounds for raising oysters within their waters. These bans have prevented prospective growers from obtaining grounds in areas of lower salinity where oysters might better survive disease. Oysters could be produced in these lower salinity waters and later transferred to areas of higher salinity to finish growing, depending upon growth rates, survival and changing salinity patterns. Most current leases exist in areas that are high in both the occurrence and intensity of disease.

Consequently, only a few percent are actively being farmed today and most leases currently lie fallow.

Public Oyster Fishery

In effect, oyster harvesters are subsidized by Maryland taxpayers — though a fee is paid on each bushel of harvested oysters that goes towards oyster rehabilitation, restoration of “natural” or public oyster bars is largely paid for by government agencies in order to maintain a “traditional way of life.” As much as we might long for the “old days” of a bay teeming with watermen and scenic skipjacks dredging oysters under sail, we do not do the same for occupations like shepherds or blacksmiths. We need to drastically rethink the management of the oyster fishery and the restrictive legislation that keeps it from being a force for change and increased production — in the long run, an aquaculture industry will help watermen to continue working the water for a living. Currently, there are likely fewer than one hundred

watermen still oystering in Maryland. In essence, there is no industry to argue about any more.

Natural Oyster Bar Charts

The charts of state oyster bars are relics of the past century that bear no resemblance to reality anymore. Most of these bars long ago ceased to produce; they have passed out of existence and are covered with layers of silt that make whatever remaining shell there unavailable in the odd chance that oyster larvae were looking for a place to attach. In most cases, the entire environment of the former oyster bars has changed. To say that having some shell buried in the mud constitutes a “natural oyster bar” that may one day be productive again is a delusion. There are estimates that perhaps 75 to 80 percent of those formerly productive areas are now gone. Relying on the old charts for guidance in restoring the oyster fishery is like loading a family into a minivan for a trip to Disney World and using a map from 1900 to get there.

There are some 250,000 acres of natural oyster bars on state charts today. If public funds enabled the full restoration of 1,000 acres per year — a monumental task — it would take 250 years to do it all. That rate would also not allow the constant rehabilitation of areas once they were renovated. With public budgets in a depressed state, that is obviously not going to happen. The answer, then, is to rely on private capital to assist in bringing oysters back to the bay. It has been amply demonstrated that oysters are not only important commercial shellfish but are critical to a healthy environment by filtering phytoplankton and utilizing nutrients

that are a major threat to water quality. Oyster reefs also provide essential habitat for many other organisms, including refuges for fish and crabs.

Private Aquaculture

The Maryland General Assembly needs to renovate all existing laws regarding oyster culture — key among these would be the elimination of county prohibitions against leasing, redesignation of those oyster bars that are still productive, and opening up of bottom grounds to leasing. A system of objective measurement is needed that can be used to decide whether sufficient oysters exist in a given area to justify refusal of that area for leasing. Those who obtain leases should be required to demonstrate through adequate records and reporting that they are actively engaged in using those grounds. If they are not, then the grounds should revert back to the state and be made available for leasing to others who want to farm oysters.

Other laws regarding size limits, seasons, and harvest methods should not apply to aquaculture operations. The practice must be recognized for what it is — farming. Additionally, the use of the water column for production has been demonstrated in many countries to be productive and there are growers in Maryland who have used this method and are trying to expand it. The major problem has been one of obtaining permits. The U.S. Army Corps of Engineers has responsibility over navigable waters and coordinates these applications, obtaining comments from many state and federal agencies. Unfortunately, aquaculture permits rank low on the priority list of the Corps and they have demonstrated an appalling lack

of response to those trying to obtain permits to start a business. Many of the stipulations that are tacked onto their permits have come from bureaucrats with no background in aquaculture. Once they are issued, the Corps sees little reason to change them, even when scientific evidence has been provided about the costly nature of the required information and its irrelevance.

The state of Maryland is at a crossroads with regard to the oyster industry. We can either continue on the worn path begun over a hundred years ago of a publicly funded fishery or we can make substantive changes that can allow the engines of the private sector to help increase production. It will not be easy — oyster disease is the key limiting factor — but there are potential ways around the problem. It will also be expensive; however, if we are to succeed, we must bring to bear the resources of research, outreach and the ingenuity and inventiveness of the entrepreneurial spirit. A point that we have made for many years is that what we need is a thousand people trying new and innovative ways to grow oysters. What we have had is one in which 999 have tried to keep the one from being able to achieve success.



To Our Readers

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Crassostrea ariakensis Triploids in Chesapeake Bay

MERRILL LEFFLER, Maryland Sea Grant



At the beginning of October, after several months of delay, eight Virginia leaseholders began planting triploid *Crassostrea ariakensis* oysters on their leased grounds. Growers each have about 100,000 sterile oysters, which they hope will reach market size by next fall or the following spring — the growers are members of the Virginia Seafood Council, which had previously submitted a proposal to the Virginia Marine Resources Commission, “Economic Analysis and Pilot-Scale Field Trials of Triploid Aquaculture,” on their behalf. The outcomes are likely to be of great interest to leaseholders and public watermen since rearing cultchless oysters under confined conditions (e.g., bags, cages, floating rafts) is labor intensive and costly compared with growing oysters on bottom grounds.

The *C. ariakensis* were produced by Standish Allen and colleagues at the Aquaculture Genetics and Breed-

ing Technology Center, which is part of the Virginia Institute of Marine Science (VIMS).

“This is definitely the start of a new industry,” says Jeff Hamer, one of the eight growers in the program. His only concern, right now at least, is that Virginia growers continue to receive permits not only to rear the Asian oyster but to step up the numbers they are authorized to grow. Like other leaseholders in the program, Hamer is putting his faith in *C. ariakensis*, based on field trials a couple of years back that showed the Suminoe oyster outperforming the native *Crassostrea virginica* in growth and especially in its ability to tolerate MSX and Dermo, the two parasitic diseases that have so devastated oysters throughout the bay.

Despite the impact of disease on the native oyster, researchers and resource managers have not given up on its potential to resist disease and to try and manage around its impacts. While triploid oysters may serve a

commercial aquaculture industry, they do not hold promise for sustainable production of oyster reefs that aim at providing “ecological services” as habitat for benthic food webs and feeding grounds for fish and crustaceans. To recover those services, oysters need to reproduce in the face of disease and build reef biomass faster than it is lost by predation and sedimentation.

Whether the introduction of reproductive *C. ariakensis* into the bay can actually meet such a challenge is unknown. Especially unknown are the ecological risks of an introduction, as the National Academy of Science recently concluded in *Non-Native Oysters in the Chesapeake Bay*, a report based on a year-long study of existing research that could support risk assessments.

While Virginia leaseholders hope to cash in with *C. ariakensis*, researchers at VIMS are hoping to get a good deal of scientific information as well, especially because of the comparative studies they will be doing between *C. ariakensis* and *C. virginica* triploids at each of the eight sites. That testing has been made possible, Allen says, with “support from the Virginia Center of Innovative Technology.” In order to conduct these tests, VIMS scientists set aside replicate test species at each site: three bags of triploids of both species, which are not part of the growers’ production — they’ll be tracking disease prevalence, reversion, ploidy and measuring survival,

growth rates and meat yields.

Allen produced the *C. ariakensis* and the *C. virginica* triploids at the beginning of June. Their initial growth was similar to the native oyster, says Allen — he then moved the oysters to Cherrystone Aquafarmer where the *C. ariakensis* were placed in nursery upwellers: under these conditions, they doubled their growth. So did triploid *C. virginica*, which for biosecurity reasons were separated and placed in floating upweller systems.

Though Allen has seen some “amazing” growth of *C. ariakensis* in winter, “it’s probably not meat growth but putting on shell,” he says. He and his VIMS colleagues plan to begin monitoring this coming spring.

Triploid *C. ariakensis* in North Carolina

Allen has also sent *C. ariakensis* seed to the North Carolina Division of Marine Fisheries, which is running growth and survival tests, says Mike Marshall, Central District Manager for Fisheries Management. Initial support for the project came from a direct grant by the state legislature. The original plan called for two planting dates in spring and fall. The first batch, some 200,000 oysters, were doing well in a shore nursery for about five to six weeks, growing from 4–6 millimeters to more than

15 mm, Marshall says. However, as they were reaching a large enough size for transferring to a growout site, the oysters started dying. “It could have been overcrowding and/or high water temperatures,” says Marshall. “We moved the seed out of the nursery but they still continued to die. We were concerned over the unknowns and after a few days more of continued mortalities, we sacrificed the entire batch.” One potential cause — disease — was ruled out after sending the oysters to experts who could find no pathogens that could have caused mortalities.

In August, VIMS sent a second batch of about 300,000 seed oysters, which North Carolina researchers divided up, placing 180,000 in an upweller nursery and 120,000 in a field nursery. After 6 weeks, those in the upwellers showed similar mortalities to the first batch. “We did find a high incidence of polydora infestations,” says Marshall, “though the jury’s still out on whether this was the cause of mortality.” The 120,000 are still out in the field in different containers, culture cages, racks and bags on the bottom.

Triploid Research on *C. ariakensis* in Maryland

In Maryland, Ken Paynter and Don Meritt have support from the National Sea Grant College Invasive

Species Program to characterize the survival and performance of *C. ariakensis* in Maryland’s lower salinity waters. Paynter, a professor at the University of Maryland College Park and faculty member at the University of Maryland Center for Environmental Science (UMCES) Chesapeake Biological Laboratory, and Meritt, hatchery director at the UMCES Horn Point Laboratory and Shellfish Specialist for Maryland Sea Grant Extension, were planning to deploy 4,000 *C. ariakensis* triploids in cages at sites in three Maryland rivers: on the Patuxent near CBL, on the Choptank near HPL and on the Severn. However, there’s been a delay in getting federal and state permits, says Paynter, which he first applied for in June. “It’s likely that we’ll hold the oysters, which are coming from the stock that Stan Allen spawned at VIMS, in flow-through tanks at the Horn Point hatchery and wait until early March to deploy them.” When he and Meritt deploy cages of *C. ariakensis*, they will also have cages of *C. virginica* so that, like VIMS researchers, they can conduct comparative studies as well.

With water temperatures falling now, oyster growth will slow down considerably. Tune in next spring for what will likely be the first reports on how the triploid *C. ariakensis* and *C. virginica* are faring.

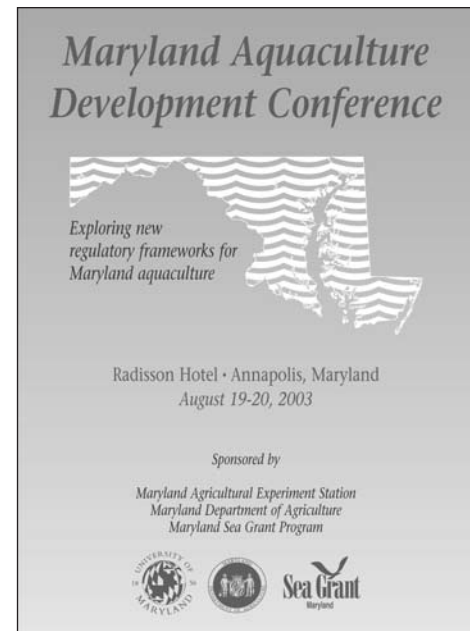
Oyster Research Restoration in U.S. Coastal Waters

Setting a National Agenda for Research

While disease has been the major limit to oyster restoration in Chesapeake Bay and other mid-Atlantic waters, other oyster-producing regions have also experienced problems with diseases and pathogens. Growers in the northeast, for example, have had to contend with Juvenile Oyster Disease, which can afflict hatchery-bred oysters. In the Gulf of Mexico, *Vibrio vulnificus* is a potential problem for at-risk consumers. Meanwhile, on the west coast where *Crassostrea gigas* is the major species, oysters are sometimes vulnerable to mysterious outbreaks of “summer mortalities.” In targeted efforts to combat disease and ensure the safety of public health in oyster consumption, the NOAA National Sea Grant College Program has supported two long-term research efforts — the Oyster Disease Research Program (ODRP) and the Gulf Oyster Industry Program (GOIP). Both programs have led to notable successes, for instance, in the breeding of various disease-tolerant strains of *Crassostrea virginica*, the species native to the east coast and the Gulf. Despite research advances that are being tested in the field, challenges remain, especially in the mid-Atlantic where sustainable production, even with the newly developed strains, is still problematic.

To assess the progress of both the ODRP and GOIP and develop priorities for targeted research, the Maryland and Virginia Sea Grant programs, in coordination with National Sea Grant, held a conference on Oyster Research Restoration in U.S. Coastal Waters in Annapolis in September that brought together scientists, resource managers and industry representatives from around the country. Participants broke into workgroups to develop prioritized recommendations for research needs in the following areas: (1) oyster fisheries management and restoration, (2) genetics and oyster populations, (3) frontiers of disease research, (4) aquaculture and hatchery issues, (5) public health and processing. A draft report is now in review and will be released before the end of the year.

To obtain a copy of the publication or to be notified when it is available on the web, please contact Maryland Sea Grant at 301-403-4220, ext. 22, or write connors@mdsg.umd.edu.



Sea Grant Extension and Finfish Aquaculture Research

Sea Grant agents and specialists are located throughout the state and work with citizens on a range of issues related to the Chesapeake Bay and Maryland's coastal bays — these include finfish and shellfish aquaculture, commercial and recreational fisheries, water quality, seafood technology, coastal communities and economics. In their efforts to serve Maryland citizens, SGEP faculty conduct workshops, conferences and seminars and also produce a variety of educational materials — from educational briefs, reports and newsletters to videos and web-based information. At the same time, they are also conducting research that has been identified as priorities by interest groups they work with. Finfish Aquaculture Specialist Andy Lazur is engaged in a number of research projects — the following brief summaries highlight several of them.

- **Increasing Yellow Perch Fingerling Production through Off-season Spawning and Larval Nutrition.** Growers have identified yellow perch as a food fish species with strong market demand at relatively high prices, compared with tilapia, currently the most widely cultured food fish in the state. The problem

growers face is the limited supply of fingerlings and their high cost. Most fingerling production depends on pond production and, therefore, only one crop a year.

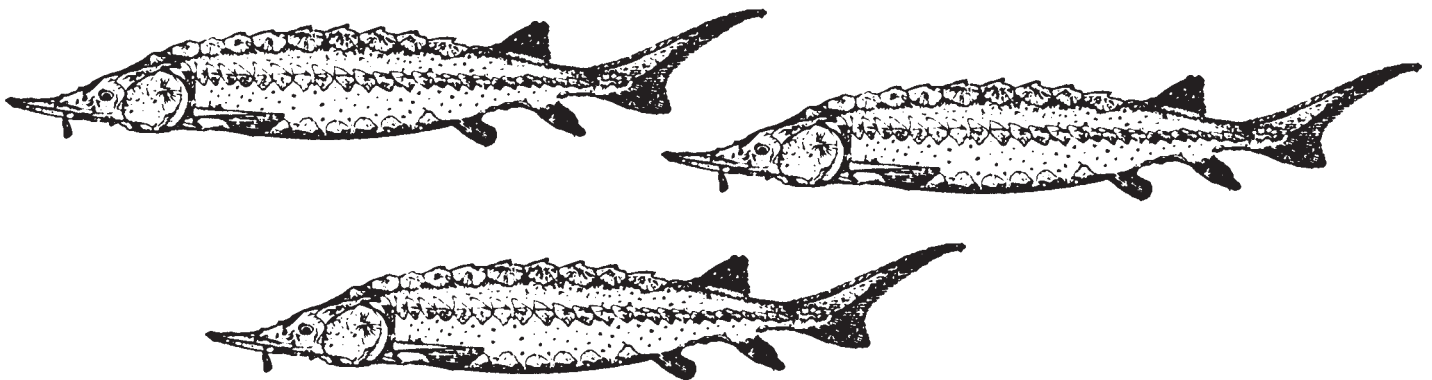
This project aims at spawning and maintaining yellow perch in recirculating tanks in order to produce fingerlings on demand and produce three or four crops of fingerlings a year. (Funding support from the Maryland Agricultural Experiment Station.)

- **Feed Training of Atlantic Sturgeon Broodstock and Sex Determination/Induced Spawning Technology Transfer.** If sturgeon are to be restored to the bay system, it will be necessary to establish a broodfish population that has maximum genetic diversity. Among this project's objectives are identifying the genetic diversity of existing stock through genetic profiling of all animals, collecting mature broodfish from the Delaware River and conducting studies to identify methods for training wild fish onto feed. The project is a partnership among the Maryland Department of Natural Resources, Mirant Power Company and the University of Maryland Center for Environmen-

tal Science Finfish Aquaculture Program at Horn Point Laboratory. (Funding support from Maryland DNR.)

- **Comparison of Operational and Economic Efficiency of Recirculating Systems for Producing Tilapia.** The aim here is to identify processes that can be improved in order to reduce production costs of tilapia. The project's a collaboration with Fred Wheaton, University of Maryland College Park. (Funding support from the Maryland Agricultural Experiment Station.)
- **Baitfish Marketing.** In order to develop basic information on opportunities for the baitfish aquaculture industry, this marketing assessment project, part of a larger regional effort, is surveying fishermen, bait wholesalers and retail shop owners to identify species and size preferences, demand, seasonalities and prices. (Supported by the Northeastern Regional Aquaculture Center.)

To learn more about Maryland Sea Grant Extension on the web, visit www.mdsg.umd.edu/SGEP



Following Those Who Follow the Water, Chesapeake Quarterly (vol. 2, no. 3)

In "A Life among Watermen," Jack Greer examines what University of Maryland anthropologist Michael Paolisso has been learning about the watermen communities that for generations on Maryland's Eastern Shore have depended on the bay for a livelihood. Paolisso has been studying the culture of watermen, deepening his understanding of their values and precepts. Paolisso has conducted a series of structured "dialogues" — conversations that have brought watermen together with scientists, environmentalists and resource managers to explore their differences in outlook as well as their similarities. His work, Greer argues, could have important implications for the way fisheries management in the Chesapeake is handled in the future. For a copy of this issue, call 301-403-4220, ext. 22 or visit the web at www.mdsg.umd.edu/CQ.

Reviewing Worldwide Research on *C. ariakensis*

Mingfang Zhou and Standish K. Allen, Jr. 2003. A Review of Published Works on *Crassostrea ariakensis*. *Journal of Shellfish Research* 22(1):1-20.

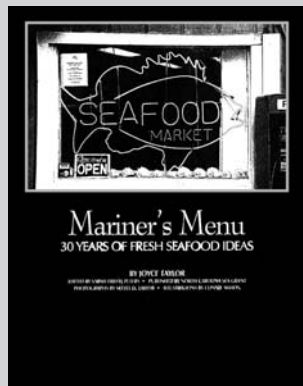
In *Non-Native Oysters in the Chesapeake Bay*, the National Academy of Science concluded that there is too little scientific information

about the ecological behavior of the Suminoe oyster to undertake a risk assessment on the potential impacts of an introduction in the Chesapeake Bay and mid-Atlantic waters. Though that is so, there is research literature on *C. ariakensis* — however, it has been unavailable to nearly all U.S. scientists since it is primarily published in Chinese scientific journals. Mingfang Zhou and Standish Allen have done a great service in summarizing the findings reported on in these journals (there are more than 20 references to articles in Chinese) and synthesizing the findings together

with the related research in the U.S. and France.

At the outset, the authors write, researchers need to read their summary of findings critically, since "it is unclear that data reported [on in the literature] always apply to *C. ariakensis*. Morphologic confusion is common with *Crassostrea* species." Those species referred to in the [scientific] literature as "*C. rivularis*, *discoidea*, *palmipes*, or *paulucciae* . . . might be the same species we call *C. ariakensis* today. In general, it is accepted that *rivularis* is synonymous with *ariakensis*, although it is still possible that

New Seafood Cookbook



North Carolina Sea Grant has produced an attractive new cookbook, *Mariner's Menu: 30 Years of Fresh Seafood Ideas*, that offers more than just recipes. Since 1973, representatives from home extension clubs in Carteret County, North Carolina, have met each month in a Morehead City kitchen to test new ways of handling, storing and preparing local fish and shellfish. Their thirty years of seafood wisdom are gathered in this comprehensive cookbook and guide for cooks who want to know more than just how to bake or fry fish.

Written by Joyce Taylor, a seafood specialist with North Carolina Sea Grant since 1974, *Mariner's Menu* contains more than 160 original seafood recipes developed by the dedicated testers and tasters of the Seafood Lab kitchen. Many of these recipes, such as broiled tuna Provençal and steamed clams in wine broth, use easily available ingredients and require little preparation. Separate chapters instruct cooks on broiling, grilling, frying and steaming. Important preparation techniques such as deboning fish, deveining shrimp and cracking crab are illustrated in detailed drawings by Morehead City artist Connie Mason.

To order a copy of the book, which sells for \$25.00, visit the University of North Carolina Press site at <http://uncpress.unc.edu/books/T-7465.html>, call 800.848.6224 or fax toll-free 800.272.6817 (24 hours).

rivularis/ariakensis was misclassified in certain publications.”

In their review, Zhou and Allen cover the following issues: Nomenclature, Morphology, Anatomic Characters, Geographic Distribution (the species “seems to occur all along the west coast of the Pacific ocean, from southern Japan to Pakistan”), Ecology, Physiology, Biochemistry, Genetics and Aquaculture. In a final discussion, they write, “the occurrence in river systems and apparent responsiveness to salinity changes for spawning cues suggests that the reproductive strategy of *C. ariakensis* is somewhat different from *C. virginica*.” Still, it is difficult to extrapolate *C. ariakensis* life history as reported in the literature because of uncertainties over species designation: “Some reports are clearly referring to *C. ariakensis*, e.g., those from southeast China where aquaculture activity is concentrated. . . . Other reports are not so clearly *C. ariakensis*, especially ones deriving from western India and Pakistan.”

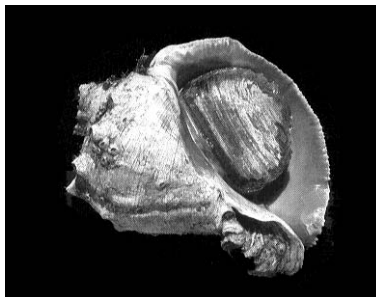
All in all, this review article will be valuable for researchers and others engaged in policy, environmental and related issues of *C. ariakensis*.

Reprints of this article are available from Standish Allen at ska@vims.edu

Veined Rapa Whelks: Aliens in the Chesapeake

A Multimedia Education CD ROM. Juliana M. Harding, Roger Mann, and Vicki Clark, Virginia Institute of Marine Science.

If you want to learn about the Veined Rapa Whelk invasion of Chesapeake Bay, this new CD from VIMS may be your best way to get a comprehensive introduction to this



invader’s biology, its range, its potential impact on bay fisheries, potential control strategies and more. Like the zebra mussel and many other non-indigenous aquatic species, the rapa whelk likely came in as larvae, discharged into the lower bay in ballast water releases. The CD is equipped with QuickTime videos and designed for educators and citizens concerned about the bay. The cost is \$10.

Make checks payable to the Virginia Institute of Marine Science and write, Juliana M. Harding, Department of Fisheries Science, VIMS, P.O. Box 1346, Gloucester Point, Virginia 23062

Oysters, Oyster Management & Maryland

Resources from Maryland Sea Grant

More than two decades ago, Maryland Sea Grant published Victor Kennedy and Linda Breisch’s *Maryland’s Oysters: Research and Management*, a book that has proved to be of great value for fishery resource managers, researchers and students of marine biology. In the section, “Biology of the Oyster,” Kennedy and Breisch brought together the most important literature on the eastern oyster, synthesizing this extensive material into an overall examination of the species. In “Managing Maryland’s Oyster Industry,” they tracked the vicissitudes of oyster management, beginning with a strong histor-

ical background and covering such topics as the many oyster commissions, rehabilitation measures over the years, private culture and leasing, fishing gear and more.

Though out of print for a number of years, we have continued to receive many requests for the book and have made it available on the Maryland Sea Grant website as a fully searchable pdf file: www.mdsg.umd.edu/oysters/research/mdoysters.html

Related articles on oyster management, oyster farming and restoration are also available on-line from previous issues of *Maryland Marine Notes*, *Chesapeake Quarterly* and *Maryland Aquafarmer*. Here is a selected list:

Uncertain Future for Skipjacks

www.mdsg.umd.edu/CQ/V02N1/index.html

Does the Bay Need a New Oyster?

www.mdsg.umd.edu/CQ/V01N3/main.html

An Asian Oyster for the Chesapeake: An Update on *Crassostrea ariakensis*

www.mdsg.umd.edu/Extension/Aquafarmer/Summer03.html#2

The Future of Oysters in Chesapeake Bay: Different Paths to Restoration

www.mdsg.umd.edu/Extension/Aquafarmer/Summer01.html#1

A Century of Conflict: Oyster Farming vs. Oyster Hunting

www.mdsg.umd.edu/oysters/history/history.html

Oyster Sanctuaries: An Ecological Approach to Restoration

www.mdsg.umd.edu/MarineNotes/Jul-Aug99/index.html

Aquaculture and Restoration

<http://www.mdsg.umd.edu/MarineNotes/Jan-Feb98/side1.html>

Sea Grant Extension Phone Numbers and E-Mail Addresses

Doug Lipton, SGEP Coordinator and Marine Economist	301-405-1280	dlipton@arec.umd.edu
Don Webster, Marine Agent	410-827-8056	dw16@umail.umd.edu
Jackie Takacs, Marine Agent	410-326-7356	takacs@cbl.umces.edu
Don Meritt, Shellfish Aquaculture Specialist	410-221-8475	meritt@hpl.umces.edu
Andy Lazur, Finfish Aquaculture Specialist	410-221-8474	alazur@hpl.umces.edu
Dan Terlizzi, Water Quality Specialist	410-234-8896	dt37@umail.umd.edu
Tom Rippen, Seafood Technology Specialist	410-651-6636	trippen@mail.umes.edu
Adam Frederick, Education Specialist	410-234-8850	frederic@mdsg.umd.edu
Gayle Mason-Jenkins, Seafood Specialist	410-651-6212	gmjenkins@mail.umes.edu
Merrill Leffler, Communications Specialist	301-403-4220, x20	leffler@mdsg.umd.edu
Michelle O'Herron, Project Assistant, Environmental Finance Center	301-403-4220, x26	oherron@mdsg.umd.edu



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www.mdsg.umd.edu/MDSG/Extension/Aquafarmer/index.html

Merrill Leffler, Editor, *Maryland Aquafarmer*
Maryland Sea Grant College, 4321 Hartwick Road, Suite 300
University of Maryland, College Park 20740
Tel: 301-403-4220, x20

MARYLAND SEA GRANT EXTENSION
Symons Hall
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