

Aquaculture Workshop Report



ACKNOWLEDGEMENTS

The Organizing Committee of this workshop would like to thank the many participants who took the time from their busy summer schedules to attend. During the last 18 months, the Department of Commerce has been in the process of developing a Department-wide policy that could satisfy the requirements of the National Aquaculture Development Plan (NADP) as well as the many laws and regulations that govern the Department. Commerce has interests in all aspects of aquaculture through financial and technical assistance, regulatory concerns, economic and social considerations. While much has been done and will continue to be done with respect to landside and nearshore aquaculture activities, the ocean along with its many challenges remains the last frontier for exploring aquaculture growth. To achieve economically viable and environmentally sound marine aquaculture will require the best efforts of many agencies and interests. This workshop hopefully made a strong contribution to bringing such interests together to discuss the issues. It helped to establish some priorities for future cooperative efforts to facilitate sound aquaculture growth.

This workshop would not have been possible without the foresight of Mr. Roan Conrad, the Director of the Office of Sustainable Development and Intergovernmental Affairs (NOAA/DOC). He insured the Organizing Committee had the resources and encouragement to put on the workshop and was instrumental throughout in its organization. We acknowledge the financial contributions of the National Sea Grant Office and the Build Sustainable Fisheries Office for their sponsorship of the workshop and participant travel. We would especially like to thank Gale Peek, Heather Valentine and Ellis Godfrey from the Coastal Science Center in Charleston, S.C. Their organizational skills and tireless efforts with travel arrangements and conference facilitation were largely responsible for being able to pull off an almost impossible task.

In our effort to ensure compatibility with the NADP and the Joint Subcommittee on Aquaculture, the Organizing Committee asked for guidance from Drs. Meryl Broussard and Gary Jensen. They were extremely helpful in identifying the types of issues for the workshop to cover based on their working knowledge of where the NADP was heading. Hopefully, the results of the workshop will build on the already considerable efforts of the JSA and NADP. They were also instrumental in providing travel support for some of the attendees.

Early on, the Organizing Committee was considering a series of regional meetings vs. one national meeting. To get the best of both it was decided to ensure that invitations would go to a wide spectrum of interest groups in each of the major regions of the United States. This was a challenge beyond our capabilities so we asked three key individuals from each of six regions to come up with a list of 15 names in the fields of academia, industry, government, environmental NGO's, and others. We would like to thank those individuals who served on our Steering Committee, and their names are identified in Appendix C. If it appeared that there were fewer representatives from a stakeholder group than there should have been, then it was not because individuals and organizations were not identified and invited but because there were conflicts with their schedules.

We are grateful to all representatives who spoke to us during our plenary sessions. We are especially happy that Drs. Harald Rosenthal and Tohru Morikawa could join us to give us some idea of what is happening in two advanced and aquaculturally supportive areas in the world and some of the difficulties they have encountered.

Lastly, we are indebted to those individuals who were asked to chair our breakout sessions and to the rapporteurs. They were constantly under pressure to organize and keep dialogue moving and to report to everyone what the outcomes of their sessions were. They were good sports and good colleagues and certainly not paid enough for their efforts.

This report will be used within the Department of Commerce in the years to come. We value the efforts and views of the participants. Wherever there are opportunities to make a difference when we look at the topics covered by this workshop, we will keep the issues and priorities identified by the participants in mind in developing implementation plans and other mechanisms that will help satisfy the goals and objectives of the Department of Commerce Aquaculture Policy. Likewise, please use the results of this workshop however it may best suit your particular interests.

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***SPECIAL
SUMMER OF 1999
AQUACULTURE
WORKSHOP
REPORT***



**A WORKSHOP HELD IN THE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION'S
SCIENCE CENTER AUDITORIUM
ON AUGUST 11-13, 1999**

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DOC Aquaculture Policy

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Part I. Welcome and Introductory Remarks

Dr. James P. McVey, Workshop Facilitator, Aquaculture Program Director, National Sea Grant Program, Office of Oceanic and Atmospheric Research, NOAA

Our theme is "Working together to develop environmentally sound marine aquaculture and defining the pathway to develop marine aquaculture in the 21st Century". Working together means partnerships and what we have tried to do is to bring a broad array of partners to the table to discuss how to implement the new Department of Commerce Aquaculture Policy. Sitting around you are representatives of key federal agencies, state managers, the aquaculture industry, the academic community, private research organizations, professional associations, extension personnel, and regional aquaculture centers. Our workshop assignment is to provide the basis for developing an implementation plan based on the National Aquaculture Development Plan and the new DOC policy.



Our vision is:

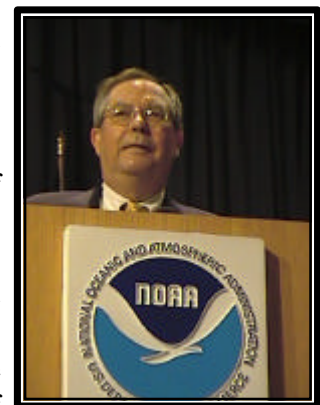
to assist in the development of a highly competitive, sustainable aquaculture industry in the United States that will meet growing consumer demand for aquatic foods and products that are of high quality, safe, competitively priced and are produced in an environmentally responsible manner with maximum opportunity for profitability in all sectors of the industry.

Your contributions at this workshop will help set our course of action for the future.

Roan Conrad, Director, Office of Sustainable Development and Intergovernmental Affairs, NOAA

It is my hope, and the hope of our organizing and steering committees, that you will find this particular workshop to be worth your time and participation and whatever sacrifices you had to make to get here.

The Office of Sustainable Development and Intergovernmental Affairs, provides staff support to Dr. James (Jim) Baker, the Administrator of the National Oceanic and Atmospheric Administration, Terry Garcia, our Assistant Secretary for Oceans and Atmosphere and other senior officials. It is fair for me to say that they personally have been the driving force for our office to develop fair and balanced policies in support of economically and environmentally sustainable aquaculture and to use what resources we have to support the implementation of the policies. In fact, Dr. Baker and Terry made sure I had the funds to sponsor this workshop and we are pleased to have received support from other NOAA Line Offices. We'll hear from



some of the leaders of those offices this morning. We are also grateful to Dr. Meryl Broussard, Gary Jensen and others from the Department of Agriculture who helped develop the format of this workshop. We fully agreed with Meryl when he said it's time to "roll up our sleeves, get to work and start implementing the most important provisions of the National Aquaculture Development Plan".

NOAA's Strategic Plan contains a strong mandate to "accelerate the growth of U.S. marine aquaculture". Over the last few years, we have been working on developing a policy for NOAA and a policy for Commerce. You will hear more about those policies shortly. Many members of the Commerce Aquaculture Task Force are here today, and I would like to personally thank them for their diligence over the last year and a half in developing a policy we feel we can all live with.

We have helped review legislation drafted by our NOAA General Counsel's Office called the National Marine Aquaculture Development Act of 1999. We have been actively involved in developing a 5-year budget initiative called Build Sustainable Fisheries that Gary Matlock will describe in further detail. Aquaculture is one of the major underpinnings of the initiative. When we had some funding left over from a disaster assistance package to the New England fisheries, we were able to take \$450,000 and pass on to the National Fish and Wildlife Foundation and requested that the funds be spent on cooperative ventures in the region for aquaculture. This resulted in the award of matching funding for 10 excellent projects. We believe this will result in some good products.

I would like to thank Gale Peek and other personnel from the Charleston, S.C. Coastal Services Center, who have done all the administrative chores with arrangements, travel, and everything associated with the workshop. We couldn't have done it without them. I would also like to thank those individuals who have volunteered to chair the upcoming breakout sessions and the rapporteurs.

David Festa, Senior Advisor to the Secretary of Commerce

I would like to give you a warm welcome on behalf of the Secretary (William M Daley) and the Deputy Secretary (Robert Mallett). This is a distinguished group of people and I am pleased to see so many folks here and gauging from the topics it looks like you are going to have a very interesting program. I would also like to say that it is encouraging to see the diversity of people here, not just from the U.S. but from overseas, not just from the Federal government but also with NGO's and the business community. That really speaks to the fact that Federal agencies have an important role to play in developing aquaculture, but our success in having sustainable aquaculture depends on the partnership with you.



Last night I met with the Secretary of Commerce and went over the Department-wide policy and he said: "Sounds Great!" So we have a Department-wide policy. (Applause)

Now let me say why there is a Department of Commerce Aquaculture Policy, not just a NOAA policy and why the Secretary and Deputy Secretary of Commerce are interested in aquaculture. Both of them are and have offered OpEds in a variety of newspapers and magazines and have spoken on these topics. Why is that? How many people know of any other agency other than NOAA in the Department of Commerce? (Amazing, more than zero raised their hands.) DOC consists of NOAA, the International Trade Administration, the National Institute of Standards and Technology, the Economic Development Administration, the Patents and Trademark Office, the Economics and Statistics Administration, the Minority Business Development Agency, and several others.

One of the things the Secretary has tried to do is to change the way we think about the DOC. It is perhaps hyperbole, but this is the one department where we can really be the "Department of Sustainable Development". More typically, the mission is focused on protection or economic growth. As you can tell from the list of our agencies, Commerce does both. Within that, aquaculture is the perfect case study of why and how we should be doing something in a sustainable way and how we can bring to bear multiple skills and resources that we have within Commerce. Our resources include not just people and money, but partnerships and relationships we have with people and their communities.

Let me run through a few things. *Environmental Protection.* Our National Marine Fishery Service is charged with protecting our fishery resources. Our National Ocean Service is charged with protecting our coastal resources. The oceans, as you know, are stressed. More than half our stocks are over fished or we simply don't know enough about them to know what their status is. We need to take some of the pressure off these wildstocks. Aquaculture can be an important tool to allow us to do that. But we need to make sure that we don't create new problems. I really enjoyed Dr. Rosenthal's presentation about some of the issues they were considering in aquaculture development.

Let me just give you one illustration about unintended consequences. In the 1930's, there were concerns that the Dust Bowl of the mid-West would spread to the South. So the Federal Government decided to plant a ground cover that would hold onto the soil. They needed a plant that was robust and spread reasonably fast. They did some research and found there was a perfect species out there called kudzu (an import from Asia). But now we have a problem with kudzu "deserts" where the vine has overgrown trees and is outcompeting the local NOAA scientists and researchers are in a perfect position to work with you to make sure you are able to do things like Dr. Rosenthal was talking about (right research, right regulations, right policies) to help avoid unintended consequences. That's the first thing.

Technology. Now the second thing is, this isn't just a science issue but a technology problem as well. It is quite a daunting task, as all of you know, to figure out how to do some of this stuff. Our National Institute of Standards and Technology is well positioned to contribute. Another area is economic development. We have the Economic Development Administration that provides grants, helps with planning, and works on creative financing programs. Since it was started in 1964, EDA has produced high returns to the American Public.

There is also a trade component. We would like to expand our exports and create more. But there is more to it than that. One of the things the President and the Secretary have talked about is how to make trade policy and environmentally policy mutually supportive. Aquaculture is a great place to begin to work on that.

Let me give you an example. As a part of our contribution to the long run reconstruction of Central America after Hurricane Mitch, one of the things we are looking at is the shrimp aquaculture down in the Gulf of Fonseca. We are evaluating the idea of creating a Center of Excellence for aquaculture to raise the regions environmental standards for aquaculture while at the same time providing an important food resource.

These are some of the reasons why the Secretary of Commerce is interested in aquaculture and the aquaculture policy. Based on my comments you can get a sense the vision we have. We want to build a sustainable aquaculture industry in this country and assist our friends overseas in doing the same. And relieve pressure on our wildstocks and fish while providing jobs.

Thank you and I look forward to reviewing the results of this workshop.

Question

As the Department of Commerce, how do you look at the balance between trying to develop aquaculture in the U.S. in comparison with helping our neighbors develop their capabilities?

Response

Without doubt the priority has to be working with our constituents here in the U.S. When we work overseas we have to address this question everyday. One of our goals is not to make foreign industry more competitive but more compatible with how we want to do business so that businesses are competing on a level playing field. If there is going to be international competition, then we would like the rest of our competitors playing with the same rules and same standards that we have.

Question

How do you see the interagency cooperation between Commerce and Interior and EPA taking place where you put a cage offshore and anchor the bottom? Multiple interests and jurisdictions are affected. Who will have lead agency responsibility? We (aquaculture farmers) see a big problem here.

Response

I don't have a recipe but the solution involves a lot of coordination and this workshop may help to identify where the problems lie. We will work towards minimizing the potential problems that industry faces with the permitting process.

Monica Medina, General Counsel, NOAA

On behalf of Dr. James Baker, the Under Secretary for Ocean and Atmosphere and the Administrator of the National Oceanic and Atmospheric Administration and Terry Garcia, our Assistant Secretary, I would like to welcome you to this timely and important workshop. Both are away at this time and send their best wishes and regrets for not being able to attend as they are supporters of sustainable aquaculture practices and believe strongly that NOAA will continue to play an important role in support of these practices.



We are pleased you were able to take the time from your busy schedules and even summer vacations to attend. Dr. Baker supported Roan Conrad's request for funding for this workshop because he felt it would be timely to have one now before we embarked on the 5-year Build Sustainable Fisheries Initiative that was developed last year. I would also like to thank Jay Johnson who works in my Office of General Counsel. Both have worked tirelessly to foster a spirit of cooperation and support within NOAA for aquaculture and are extremely able advocates. I think you should feel good where we are in NOAA. We are on the verge of having a Department policy; we are working hard on legislation. We have not stopped focusing on this. We have new money to dedicate to aquaculture this year. Last year as part of the President's National Oceans Conference, one of the deliverables was increased money in NOAA's budget for aquaculture. It was one of the completely new initiatives to come out of the Ocean Conference. Much of the new money was for inline needs but we were able to push this to the front so we are pleased to have this new funding. We hope you can help us identify how best to use that money to promote and help the industry and the efforts to take off in a meaningful way.

In February of last year, Dr. Baker enthusiastically signed a NOAA policy on aquaculture. Many of NOAA's Services and Line Offices are involved in aquaculture in one form or another in research, regulatory reviews, education and outreach, improving technology, grants and financial support, and others.

I would like to say a few words about the NOAA policy signed by Dr. Baker. This policy is also in your packet.

NOAA with its many programs has great responsibility for sustainable use and conservation of the marine environment. There are many national interests in these waters and some are competing interests. The NOAA policy identifies our Line Office interests in assisting in the development of aquaculture. Our policy directs our attention to four major issues. They include:

Research, Development and Technology Transfer which includes research on ways to minimize any adverse impacts of aquaculture on the environment and wildstocks; assisting in the development of cost-effective, environmentally sound aquaculture and hatchery technology for transfer; growth and production of marine species, biotechnology development, technology transfer, and improved coastal management to avoid user conflicts, and disaster mitigation and prevention. They are critically important to us as we try to rebuild wildstocks, we want to also have a viable and strong aquaculture

industry and not have those two competing but be on parallel tracks. They are two very important pillars on which our Build Sustainable Fisheries goal in NOAA is built.

Financial Assistance to Businesses. We have several authorities that help fishery industries including aquaculture to access capital for investment purposes including the Fisheries Finance Assistance Program. We are requesting a change to the Capital Construction Fund to allow the use of funds for more than the investment in fishing vessels. This would allow us the chance to help new business get off the ground.

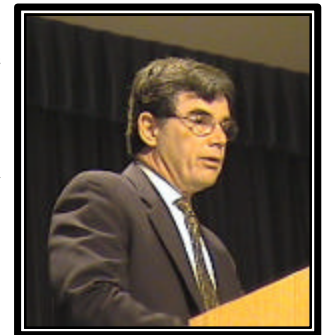
With respect to *Environmental Standards*, we hope, once again working in partnership, to develop more efficient Federal and state permit processes to promote industry development. The policy says we want to facilitate the permit approval process within the EEZ and we will use sound science to identify areas that reduce conflicts with other uses and resources. Our draft National Marine Aquaculture Act of 1999 that is currently in circulation for Federal approval before it is submitted to Congress gives the NMFS authority to find suitable lease sites in the EEZ and provide long-term leased areas for industry. As a lawyer, I can't stress enough the importance of this provision to help stabilize the industry in the future. It should make a huge difference in getting the finances, help set standards, and clear regulatory guidelines. We are dedicated to doing this and I believe you will hear in the next few months from the White House about their dedication and desire to do this in a way that will help you and balance your needs with the needs of the environment. We must keep working together to get this approved.

Finally, we identify the need for *Coordination* with others as a priority. We want to pursue opportunities for joint activities and programs with Federal, State and local agencies, as well as industry, academia and foreign institutions.

Policies such as the NOAA and the Commerce policy can help us visualize the common goal and be confident that it satisfies most interests in a balanced way. I hope you keep up the good work and do not get discouraged if difficulties arise in your path.

Dr. David Evans, Assistant Administrator for Oceanic and Atmospheric Research, NOAA

I think that research has a critical role to play as we move forward in aquaculture. I know there are a number of other issues that need to be dealt with over the next few days. Issues we have been struggling with in the Department over a period of time having to do with regulation, technology and environmental concerns, but all of them depend in a fundamental way on our understanding of the marine systems in which we are operating.



OAR is the principal organization in NOAA for leading its research efforts. One of the components is the Sea Grant Program, but there are other activities within OAR that address aquaculture as well and that is a relatively recent development. For a number of years, no one in NOAA would actually admit to doing aquaculture or even doing research on

it. The NMFS has a laboratory that has a long and proud scientific history of working on aquaculture. You could be an employee in NOAA, even a very high official, and not know that the laboratory in Milford conducted regular conferences in aquaculture, transferred technology in aquaculture, and had a prominent role to play because the visibility was kept very low for reasons of higher level policy.

I think the good news right now is that those policies have changed and they have changed dramatically and in a fundamental way so that this conference today isn't a conference sponsored by the Milford Lab, or the National Sea Grant Program, or an individual Sea Grant Program. It is not a conference sponsored by NOAA research but is a conference sponsored by the Department of Commerce to bring together people to deal with a variety of issues pertaining to aquaculture, not the least of which is research. There is really quite a lot of work to do. Ron Baird has mentioned 20 years of work in Sea Grant. I don't know what the history of the Milford Lab is, but I would imagine that it is in excess of 30 years. Other component parts of OAR, such as the National Undersea Research Program and the Caribbean Research Center, have had an on-going program for monitoring aquaculture activities and developing technology and gear.

There are a lot of other technology programs in OAR that have specific relevance for gear development and work in the marine environment. OAR is also home for marine related panels such as the U.S./Japan Natural Resource Panel on Aquaculture. So there is an international connection. That panel is 28 years old and is another one of those activities that have been going on for a long time but have had a low profile. OAR is also the home for the U.S./China Marine Fisheries Science and Technology Exchange; the 20th anniversary for this international agreement will be celebrated this fall with a meeting in Beijing. OAR is the home for New Hampshire's offshore aquaculture project that Ron mentioned. As you listen to the kind of work Sea Grant has been sponsoring, you will find that we are trying to build the traditional bottoms-up principal investigator (P.I.) driven research projects as well as focus on a few national and regional aquaculture issues. In each region, there are different environmental and ecological conditions as well as different species to consider.

We don't want to try to do everything at one time. We need to focus our efforts, develop the science, develop the technologies that are pertinent to particular ecosystems, explore the best possible options and look for opportunities to concentrate our limited research funds. Our efforts need to be more applied and technology intensive to really provide a boost to the emerging industry.

In terms of the near-term future, I would say that OAR has been a partner in and aggressive player in the growing budget initiatives for aquaculture inside NOAA and the Department of Commerce. It is an area we think is critically important. We will be helping to lead the national competitions for developing partnerships on a variety of research topics. We look forward to the outcome of this workshop to help set the research and outreach agendas so that we can make appropriate choices in our funding decisions in national competitions. We will continue to be involved in supporting a broad range of research in the marine environment that the aquaculture industry and scientific community can draw upon. We will continue to contribute to the policy development issues and continue to be aggressive in our push in support of the Department of

Commerce's programs in aquaculture as we bring the science to bear in a really important area for all of us.

It is a tribute that there are so many of you here in attendance and I look forward to seeing the results of this workshop, as it will help set our research agenda in the future.

Dr. Ron Baird, Director, National Sea Grant College Program, NOAA

I would like to express my thanks to the Department of Commerce Aquaculture Task Group for their tireless work to push aquaculture in this agency. They were instrumental in getting us where we are today. The attendees here this morning represent a broad array of interests and whose inputs will be essential to making this a productive workshop. Make no mistake about it; we will need these perspectives if we are to develop the purposeful planning we need to efficiently invest scarce resources that we have to enhance marine aquaculture in this country.



We have reached a situation in the U.S. and globally, where under the best of circumstances wildstocks of seafood are fundamentally inelastic in terms of production. You all know that human population and demand for seafood products continue to increase. What that means simply, is that humans are going to increase production of fish products from aquaculture. And the open ocean represents an enormous opportunity for farming the sea. So in the global scheme of things, the question is not whether aquaculture will grow, but only what role the U.S. will play in this industrial sector. We will no doubt purchase, process and consume product, but what we actually produce remains to be seen. The environmental, regulatory, technological and public policy hurdles at present, have relegated the U.S. to a minor role globally in the production side of this industry.

Sea Grant has long realized the opportunity in mariculture and over the years through investments, particularly at our local programs, we have helped develop a substantial base in virtually every coastal state of facilities and well-trained manpower for aquaculture, and this is particularly true for marine aquaculture. While it is not widely known, we currently support about 100 individual research projects. We have 30 extension specialists out in the field in virtually every coastal and Great Lakes state who are transferring technology and interacting with industry. We recently developed aquaculture as one of Sea Grant's major theme areas for the 21st Century. We have a management group who will help us with oversight of that theme area. I am pleased to see that most of those folks are in attendance today and hope you have a chance to interact with them and get some sense of the installed base that is out there.

We intend to build on our two decades of investment by joining in partnerships with other elements of NOAA, the Department of Commerce and other agencies in promoting the development of aquaculture in this country. In addition to investments by individual Sea Grant Programs, we at the national office have obligated about \$1.6 million in the next two years in a more directed research effort looking at key technologies we need to drive this industry forward. We now have offshore projects in New Hampshire and Hawaii and on the Gulf coast. We have created an information network including AQUANIC, the NOAA Library, the University of

Delaware, and the Minority Business Development Agency. We are also sponsoring a workshop on marine ornamentals, another important element in this industry in the fall of '99 in Hawaii.

Let me wish you every success in developing this country's agenda in marine aquaculture. The opportunities are substantial and the Department of Commerce has made a commitment to building a successful, environmentally sound industry.

Dr. Andrew Rosenberg, Deputy Assistant Administrator, National Marine Fisheries Service, NOAA

My job as Deputy Director of the National Marine Fisheries Service is to oversee the science and management policy in the agency as a whole. This conference is quite important to us in that regard. I think it is no surprise that aquaculture is clearly within the mandate of the NMFS and within NOAA, but it is in some sense a newcomer within that mandate although many of our laboratories -- the Woods Hole Lab, the Milford Lab, etc. -- are primarily aquaculture facilities and are some of our oldest facilities. It is clear that NMFS for many years has focused on capture fisheries and more recently on protected resources and habitat issues and has always had aquaculture as part of its mandate. But that I think is changing now. I think that is a change for the good because I think that balance of providing seafood for the country and internationally is shifting somewhat. It doesn't mean that I think we are going to move from captive fisheries to aquaculture but that I think the balance between the two is becoming a bit more even. That means that within my purview in the agency, the aquaculture side is becoming increasingly more important. Hopefully you all see that as a positive. This conference, organized by NOAA, is quite an important step in trying to raise the profile of aquaculture within our agency and hopefully within the government as a whole with regard to the needs of continued development for the industry.



Now our mandate is clearly "environmentally sound aquaculture". That should be no surprise to anyone as that is common parlance to everyone in the aquaculture world. And one of the things I would say is that we have, in addition to all the exciting opportunities in aquaculture for growth of an industry, we also have an exciting opportunity to learn from what's happened in some of the other resource management areas such as capture fisheries and to learn from the mistakes in capture fisheries. In many cases, the regulators have been in somewhat of a tug-of-war with the capture fisheries industry. In other cases, that has not occurred. This is an opportunity for aquaculture development to try a completely different approach. As opposed to arguing about competing needs, we could be in a problem-solving mode from those competing needs. The only way that's going to happen, of course, is if our agencies and the industry view each step in the development of aquaculture as a problem solving exercise just as you solve problems in your businesses or we solve problems in our scientific enterprises, and so on.

Dealing with the issues of how to ensure development while ensuring that development is environmentally sound is a problem to be solved. Inevitably it does get solved by taking only one point of view into account or the other. I say that very broadly. That means that as we, the NMFS look at policy, we can't assume that the habitat concerns, the capture fishery concerns, the

endangered species concerns override the need for aquaculture development. On the other hand, we can't assume that they are subsumed by the need for aquaculture development. On the industry side, we could argue long and hard about whether there are protected species concerns or whether there are habitat concerns or we could figure out how to find a workable strategy to address those concerns in a satisfactory manner, and I hope we will all do the latter.

In order to do that, we need a lot of help. We've got a lot of people. Looking around the room I see Ed Rhodes, Spencer Garrett, Harry Mears -- who know a lot about the science of aquaculture development, doing research and development, regulatory requirements, etc. But they are not running aquaculture businesses. We need a lot of help in understanding how those things fit together. We can do the old caricature of the capture fisheries models and all retreat to our corners and fight and hopefully come to some resolution in the middle. Kind of like the cartoons with everybody spinning around in the middle and something pops out in the end. Well, I have done that long enough in fisheries management councils and I am not looking forward to doing that again.

What I am suggesting is that we stay far away from that model. Not the model of councils and discussion but the models of arguing over whether one persons point of view needs to be accommodated as we move forward with development. Specifically, I know that just briefly in the halls in talking with Jim, Tony, Ed and Harry, it would be useful to think about what kind of structures would be most helpful in solving problems. You could do it in conferences like this, but you need a long-term, regular forum for discussing issues as they come up. One such forum is like an Industry Advisory Committee. We have a Marine Fisheries Advisory Committee that advises the NMFS. It is high time that we have an Aquaculture Advisory Committee to advise NMFS and NOAA in general. Perhaps the NOAA Science Board, newly created by Dr. Baker, should have a specific discussion of aquaculture issues, or perhaps there are other fora that should have specific opportunities for the kind of interactions that I am referring to. Please don't misunderstand me. I am not saying that you industry, or you--a particular part of government, must do this. I am saying that we must figure out a means of solving some of the problems that will come up with an industry that has an extremely high growth potential and market potential and will raise lots of controversies in lots of areas. That is just a fact of industry development in coastal areas now. You can't easily ignore the controversy. You can approach it from a battle stance or a problem-solving stance, and clearly I am arguing for the latter.

Our agency, although I referred to some of us as regulators a few minutes ago, always has and always will be a science agency. OAR always has and always will be a science agency. At least two-thirds of NMFS is the science component of our service with the science centers around the country. We need to utilize that very substantial science capability as an integrated part of development. One thing that I will say -- it may be an incorrect observation but it is my perception -- is that while we have had that scientific basis at Milford, doing good work which private entities have picked upon, I am not sure we have always integrated the scientific work in the overall development of our strategy for dealing with aquaculture. I am arguing that we need to do that. I think as we consider how we are going to develop advisory bodies, how we are going to work towards budget initiatives, etc. it would be a real mistake if we didn't consider the scientific development for all aspects of aquaculture development as a critical component. And when I say all phases, that doesn't just mean methods for culturing growth, disease prevention,

etc., it means develop that scientific base for habitat evaluations, for protected species interactions, for capture fisheries interactions. That should be a critical component at the outset of putting forward a plan for the continued development of aquaculture projects. The reason I say that is again from the capture fisheries model, we can argue over the science forever, or we can develop it cooperatively. I would suggest those scientific resources are critically important as they are in capture fisheries, are critically important to development of the industry. They are also critically important to the development of the solutions to those problems that are going to crop up as industry expands and grows and produces more products.

I certainly think that as we put forward initiatives and as we ask for advice, everyone should be thinking about what is the scientific basis that we need to develop to insure that what we are doing won't meet a technological roadblock; or, at least that we have a way to address that technological roadblock. That we won't get to the point saying: "Well, we have to evaluate what the protected species impacts are, but we forgot to look at them to this date, so let's see if we can scrape together some information quickly." Then we put that together as an integrated package and we develop the science along with trying to develop policy along with trying to develop the industry itself. So, while most people see us (NMFS) as a regulatory agency, please remember we are primarily a science agency. If we can have the scientific information and programs moving forward then the regulatory part of that can be simplified in many cases and can flow from that science as opposed to be struggling without a strong scientific base.

Finally, as a note of caution, recognize, as I have to do every day, that there are competing interests. We, the NMFS, because of different mandates of Congress, must address the public's competing needs. That doesn't mean they are not solvable, but they are competing. There will always be someone who feels that a protected resource issue should dominate in a particular circumstance or an industry concern should dominate in a particular circumstance. And we have to sit in the middle and try to balance those competing needs. And that is a difficult task. I have the bruises to show you why it is a difficult task of falling off the fence in the middle. But those competing needs are real and there are ways to find a balance and they have to be based as strongly as possible on a scientific basis.

But the thing we are looking for, day after day after day, is people coming forward with solutions, solutions that recognize those competing needs as opposed to positions. You can either take a position in a debate or you can offer a solution. Obviously, it makes our jobs easier if we move towards a solution and a less stressful life in many cases. I would tell you we want to move forward as an increasing part of NOAA and NMFS is focusing on aquaculture development because there is no question but that it is a wave of the future. Not at the expense of capture fisheries or protected resources, but as more balance within the organization. I do think we understand the issues, but many of those issues are of competing needs. What we would like to do is sit down and problem solve with you. And I think today, within your breakout sessions, people may want to specifically think about what structures they need to provide that information back and forth as issues arise to our agency as well as other government agencies. What structures are most effective for doing that so that we can address problems not after they have arisen and become a big problem but in the course of our planning and development?

Again, thank you all for coming to the conference. I hope this is the first of many and I hope there is an ongoing dialogue.

Question

Not too long ago I approached a NMFS laboratory and I asked them if I could come and visit them to see what they did. I was told they didn't do aquaculture. Well, I said, I just want to find out what you do, explain the science that you do. I was led through the lab and talked about how they felt the service [PC's], reproductive physiology, habitat, etc. I asked how is that science different from what is done in hatcheries? The reaction was "I guess there isn't any difference." I pose that to say that well that's kind of been the state of things in the past and we are very pleased to see this kind of a session. When you start the national level to move obviously with competing needs throughout the field, you have a major challenge in turning this institutional shift and we appreciate your efforts. I'd be curious if you give us some ideas on how you think you might be able to jump start that change of viewpoint throughout a large organization.

Response

First of all you make a distressing point that people would say that we don't do aquaculture and a very good point that the fundamental fisheries biology, oceanography, etc. are part and parcel of the science we need to do aquaculture, and we do that. Recognize that by federal government standards, the NMFS is a very small organization -- 2,400 people. In the fisheries world it is quite a large organization because most fisheries industries are very small businesses. People tend to focus on our employees just as some of your employees tend to focus on their primary area of interest. It's a little slow, in some cases, to say, well, what I do actually does pertain to that new opportunity. One of the biggest challenges in managing an agency is to try to make the turn, as you just said. I think there are some ways to do it. Some of that needs to come from our science directors. We've had a fairly regular turnover in science directors in the past few years. One thing we might consider, and I might consider is having this kind of a session directly focused on aquaculture with our science directors and science board so that people get a broad overview of what scientific capabilities within the agency are in the industry. The Science Board hears a broad overview from industry representatives of the kinds of things you need out of that scientific capability. Even though we are a small agency, we still have the largest cadre of marine scientists in the country, I think, certainly within NOAA.

The other thing is that the easiest way to steer any entity (business or government), is just like you steer greyhounds at the racetrack, you put a little bait out in front usually known as budget appropriations. Its amazing how quickly people will view that their work could pertain directly to a problem if there are resources that could be brought to bear on that problem as there are prospects for getting additional research dollars, personnel, etc. So I think that NOAA needs to be and will be very aggressive in pursuing the resources to do the kind of development and change in direction we are talking about. We can't drop all those other things. The capture fisheries aren't going to go away but we are trying to achieve a better balance. That may sound like empire building--I just want to get more money--, but realistically, if you are going to get people to do additional things, take new directions, etc., you have to give them new tools and new dollars to do that. So I think we have made a substantial start in this Administration, for NOAA to start to look for aquaculture resources. But we have a long way to go and that's how the change of direction would go. But again, we do have structures, Executive Board, Science

Board, that can try to provide a forum within industry to do some of the things you are talking about.

Question

Microphone didn't pick up question but essence of question was a follow-on to the first question regarding how leadership and mechanisms for allowing the industry and other interests to reach NMFS leaders.

Response

I would agree with you and that is why I am suggesting having a session, not a big conference, but a session of some representatives from industry and other academic partners with the Science Board. The Board consists of the science directors who run each of the regional laboratories and would probably include the regional directors as well. Or the Executive Board for the NMFS because I would agree with you that people are not going to take up the opportunities they might see unless they feel there is some direction from the top that says: "Yea, we want to go that way." Some of that is structural and I am not looking to build a big structure here but I am saying we need to have a regular dialogue component. We have to have a group that can sit down with our science directors, our regional directors and or program offices and try to specifically raise particular issues, particular needs. One thing I've found in the Fisheries Service, which I think is an organization of outstanding scientists and policy people, is that when presented with a problem, you get a lot of people that say: "I know something that can work here," or that "we can do this". But they have to be presented with the problems in a clear manner. You are right that that has to come from the top, as do the resources. But we have to have a structure to make sure that those problems are posed and not what I think up in my office, but what industry, academia and other interests see are problems that need to be resolved down the road.

Question

There was a question regarding the budget and the resources that would be needed for an aquaculture initiative and funding to address some of the problems that have been brought up.

Response

We as a Federal agency cannot lobby Congress. You as private industry can. While we cannot lobby, we provide Congress with information if they ask for it. Our dollars flow from appropriations. Those dollars for our people to do the scientific work are tightly constrained by Congress. If I decide today that what we need is an aquaculture initiative, I can't take dollars from one program into another (constraints on redirection of resources). That is illegal and it will only work if Congress gives us funding specifically for aquaculture. NMFS has about 150 line items and you can't move money between categories. You are right that this must be a concerted effort. We can't go outside of Administration policy. The President can submit a major initiative on aquaculture and we adhere to whatever that Presidential budget is. We cannot lobby Congress for any additional resources. We can provide information to any questions they ask or you ask. So it is appropriate to have people sit down and think about how we are going to approach this strategically, so that the Nation, i.e., Congress in this instance, that this is a policy and science issues that some resources should be directed towards. Again, having a forum for how we go about doing that is important.

(Note: At the National Ocean's Conference in Monterey, California in May 1998, the President allocated a total of \$9million in new monies toward achieving sustainable aquaculture objectives. That would include \$3million for each of Fiscal Years 2000, 2001, and 2002. But as the cliché goes, "the President proposes and the Congress disposes". In addition, from an Executive Branch standpoint, NOAA has developed a 5-year Build Sustainable Fisheries Initiative that includes elements devoted to the capture fisheries, fishing communities, and aquaculture. Budgets are prepared through an integrated team of NOAA specialists (see Dr. Gary Matlock's speech below) with input from stakeholders. Those budgets are developed using zero, five and ten percent increases from previous year budgets. After NOAA approval of these budgets, they must further be approved through DOC, OMB, and the Congress. What is often left at the end is not necessarily what is submitted in the beginning. The point to note is that the BSF Team does consider what they believe are the resources needed to achieve NOAA's strategic objectives and many of the recommendations brought up by this workshop will receive consideration by the BSF Team. With the approval of the Commerce Policy, that process can be said for relevant agencies in addition to NOAA.)

Question

What is the possibility of NMFS developing an Aquaculture Advisory Committee?

Response

It should be a NOAA Advisory Committee if we are to go in that direction. Secondly, as you probably know, Advisory Committees have to be chartered under the Federal Advisory Committee Act (FACA) and that takes a while to do. If you don't get a start on it, it doesn't get any closer. I think that at the very least, there ought to be a NOAA Advisory Committee. How that NOAA Advisory Committee works with other Departments, I wouldn't want to prejudge. There is a number of ways to go. You could have a broader Advisory Committee and it may get a little diffuse as it splits between Departments, or you could have a NOAA Advisory Committee with inter-departmental cooperation. The structure is something people would have to talk about. My first thought would be to have it at NOAA, but that is from where I sit. I don't think it would be helpful solely to have a NMFS Advisory Committee although I would be willing to do that if that is something that could be put together more quickly than a NOAA Advisory Committee. Ultimately, there should be a FACA chartered Advisory Committee that can produce consensus recommendations. You can have Advisory Committees that don't produce consensus recommendations that are not FACA chartered, so there are some oddities in the law.

Dr. Gary Matlock, Director, Office of Sustainable Fisheries, NMFS

I would like to talk to you about the Build Sustainable Fisheries (BSF) Initiative from a process standpoint. The reason for that is because the process has been created to allow you (the members who are effected by government activities) to effect what government does to you. The process having been created is one that should be taken advantage of. Secondly to talk about BSF from a substance point of view and most importantly talk about it from within the NOAA perspective as reflected by my membership on the BSF Team. I am the chairman of a NOAA Strategic Planning Team called BSF, which was established by the



Administration to develop a strategic planning process so that the budget would be driven by strategic goals as opposed to the reverse. NOAA developed a number of different teams, BSF being just one of those. Building sustainable fisheries was one of the major goals identified by NOAA back in the early 1990's. There was a recognition that fisheries needed to be rebuilt in such a way that they could sustain themselves.

The BSF team consists of representatives from several of the line offices because to achieve the goal, we need to look at the capabilities and responsibilities beyond NMFS including sound science as well as regulations. The team meets in the fall and starts to look at what types of activities we need to pursue within the initiative. The process continues through the next summer in order to deal with the budget that will begin two years later. So it is important to have sound input and foresight since the earliest you see the results will be two years down the line.

NOAA has also developed a process that encourages constituents to provide input into the budget process by identifying priorities for the strategic teams to consider. The constituent meetings are held in Washington, D.C. in early spring. Constituent input through brainstorming sessions has been helpful for the teams to develop initiatives around the outcomes of the meetings. We are required to tell the constituents the following year about what has been done to address their concerns through out initiative budget development process. We consider these processes important and I encourage you to take advantage of them when possible. (Note: Dr. Matlock introduced members of the BSF Team so participants could meet with these folks during the workshop.)

From a substance point of view, what this team has developed relative to aquaculture is that there are two perspectives that we are trying to balance and integrate across NOAA and Commerce. One is the development of aquaculture. We believe aquaculture has a tremendous development potential, that it will develop with or without us in the U.S., and its development is an appropriate thing to happen. When we use the term aquaculture, we don't mean producing food simply to feed someone. We mean it in a very broad sense because animals and plants can be cultured for a variety of reasons. In addition to that, we don't restrict it to mean the marine environment. We also mean it to include marine animals and the determination about where, in effect, our interest or purview begins and ends with the intersection between the operation and the effect on the marine environment which NOAA has responsibility for managing. So our view is that aquaculture within that broad context but focused somewhat within it, should be developed, it is going to develop, and that development should be managed. It should be managed in such a way that the mistakes made with respect to capture fisheries don't get repeated and get so large that we have to deal with it in a post-facto perspective. Our view is that the development should occur as the management is occurring. We need to foster both at the same time and not one or the other. One of the significant issues that there are people in the U.S. that think aquaculture should not occur at all because of the environmental concerns. There are others that feel aquaculture should occur absent any kind of management because it is an economic endeavor we can benefit from. Our view is that you need to balance both of those. We do feel that within Commerce there is an appropriate role for us to play to make sure that the development we think should occur for commercial enterprises is done in an environmentally sound way.

We think that one or two or the most significant aspects to accomplishing that objective are one, stability, and a second is certainty. Trying to provide within a management arena the knowledge that people know what to expect what's coming as they develop their commercial enterprises can only be beneficial. So our initiative and objectives within this BSF Team have been to use the scientific foundation (biology, economics, sociology). All sciences should be brought together in an integrated way. It is appropriate that should be done within NOAA which is, in fact, an integration within Commerce, of these various capabilities to make sure the development that goes on is scientifically sound, has a good basis, that people can understand its objectives, and that it will lead to environmentally sound aquaculture in the future. Our budget initiatives have been structured around accomplishing the objectives of getting very sound science in these various disciplines and using that then to create the stability and certainty within a management arena that aquaculture needs to develop.

One piece of that stability and certainty is to do things as transparently as we can. Thus this kind of meeting, where we are here as an entity, as NOAA, to try to bring as much information to you about what we are doing, how we are doing it, and why we are doing it so that it can be used to help you guide us in any kind of changes or additional work that we should be doing. There are two areas we have focused on in aquaculture. The first is developing as much as we can, a set of maps that are based upon the notion of exclusionary mapping that would tell people where we think aquaculture has potential and can be conducted. We would eliminate, for example, shipping lanes as a place where people would be doing aquaculture in the future because it makes no sense to put an operation in the middle of a shipping lane used by tankers. Using that kind of logic then to rule out places where it just not going to be a feasible activity, would allow us to identify the areas by exclusion that it does have potential.

The other area we are focusing on from a management perspective is to develop as simple permit system as we can. By that we don't mean the elimination of any requirements of permits or consideration of permits, but we do mean making the process simpler so that a person can get all of the permit information they need, know what they must provide and to whom, without going to twenty or thirty different agencies. Those are two areas we are focusing on in the short term to try to create the stability, the certainty and doing it in a transparent way. From the research perspective, our focus is on this interdisciplinary approach that includes the biological, economic, and social sciences.

Thank you for being here. We look forward to what you have to say and we will make as much use of it in the BSF process as we can.

Dr. Meryl Broussard, Chairman, Joint Subcommittee on Aquaculture, USDA

I would like to welcome everyone on behalf of the USDA and the Joint Subcommittee on Aquaculture (JSA) to the Washington, D.C. area. What you are doing here in the next few days is important from a national and federal perspective. Gary Jensen and I met with the Workshop Organizing Committee several months ago to help in formatting this meeting and it is amazing what has been accomplished in such a short time frame. They insisted from the very beginning that what is accomplished be consistent at the federal level with what the National Aquaculture Development Plan (NADP). I would like to congratulate them for working within that framework. Jim (Dr. McVey) read a mission statement to you about aquaculture development and this is a mission statement we are adopting essentially federal-wide with the NADP. We have goals and strategies we are developing together, not just with Commerce but all the federal agencies involved in aquaculture.



There are some key things I wanted to bring to your attention. One of the key things is that about one year ago, the National Aquaculture Development Act of 1980 was reauthorized and we thought this was critically important. The funding authorities for that had expired. There were lots of discussions about what a National Aquaculture Act should look like. The Administration supported reauthorization with the Act with some amendments (which were not included). It is critical to look back at that Act because there is some critical action that it accomplished for us. The Act, in 1980, established a national policy. We talk about policies and we need policies. That policy is "to encourage aquaculture development in the United States". Very simple, very direct! We need to keep looking back at that when we coordinate our federal programs. It is not whether it is good or bad, it is national policy. The Act also defined aquaculture for us. That is important from a federal perspective when we coordinate our programs. The Act also established a coordinating structure. This is the JSA, which reports to the Committee on Science in the National Science and Technology Council within the White House. Aquaculture has gotten a pretty good level of visibility within that structure. So we think the coordinating structure, the JSA, has served its purpose in program coordination making sure the agencies are talking to each other. But we also have to respect the integrity of the implementing agencies, their authorities, their budget bases, and what they can do to contribute. Sometimes we have to put a little bit of realistic expectations and ground truthing on what an interagency coordinating committee can do. But I do applaud the efforts with Commerce as we do move forward.

Jim McVey, Ed Rhodes, Gary Jensen and I also serve on the Executive Committee of the JSA along with Hank Parker and someone to be identified from the Department of the Interior. During the last year we have been active and drafted a revision of the NADP (not revised since the early 1980's). The last three years we have been working on the revision of that plan. We held a series of stakeholder workshops all over the country jointly sponsored by Agriculture and Commerce. And now the real challenge is to develop the implementing strategies.

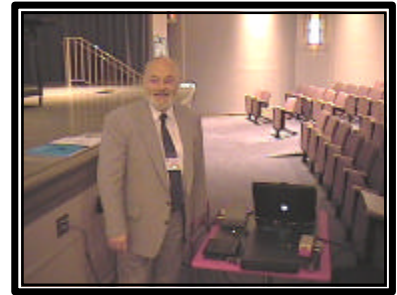
Part II. Special Presentations

Dr. Harald Rosenthal, Professor, Institute for Oceanography

Aquaculture Practices and Technology in the European Union¹

I want to take you on a tour of some developments that have taken place in the aquaculture scene that may lead, in one or the other way, to sustainability.

I want to first address some of the production trends and show you, for those who are not familiar with the industry, some types of systems, and then I want to address two of the major issues related to sustainability: aquaculture and its interaction with the environment. Aquaculture has often been blamed as a cause of pollution - and definitely it can cause pollution if not properly managed and diverted.



But I also want to be very provocative today and address the issue of interaction with other resource users, particularly the impact others have on aquaculture, and a view that is very seldom clearly expressed. We have to look at each house from four sides, otherwise we describe just a wall and not the house, and we'll never see what's in it. That will lead me automatically to questions of co-management and conflict resolution, and we will see many similarities with the fisheries and, if time permits, a few future outlooks.

Very briefly, aquaculture is not a new industry. It's a historically well-established industry over thousands of years. The Chinese saying, from around 2000 BC, "Give a man a fish and he has food for a day, teach him to culture fish and he has food for the rest of his life" is well documented. I will say something later on the Chinese system.

Over the past two decades, we have seen a fourfold increase in aquaculture production. There's a consistent increase that will continue over the next years. With the growth of the industry, the potential for environmental adversities is increasing as well, and we all agree that tighter regulations will be necessary. And if so, these tighter regulations must hold for both the aquaculture industry and for the other resource users in the vicinity of aquaculture developments.

Let's first have a look at some types of systems. Many of the farming systems have been in place for a long time. Japanese yellowtail farms often use large cage arrays. In some places they produce about 1,500 tons of yellowtail and about 800 tons of red sea bream in cages. Cage farms operate in flotillas and single cages in all kinds of designs around the world.

¹ Dr. Rosenthal made an excellent slide show presentation but transcribing his remarks without the slides would not make sense. This speech embellishes the many points he made and is taken from Conference Proceedings of the "Summit of the Sea - Understanding and Managing the Oceans" St. Johns, Newfoundland, September 1-6, 1997.

Modern farming systems tend to go further offshore, to more exposed sites. There are longline cultures that deal with oyster farming along the coast and very protected bays or coastlines with high productivity, and it's amazing the biomass productivity in a short time. Very small mussels here on the string on the longline grow very quickly to massive strings, using their own bristle threads to hold on to the line, and they can be harvested automatically. In themselves, these longline mussel cultures provide a fantastic habitat for all kinds of sea life, protecting even juvenile fish and providing food, cooperating very nicely with some of the local fisheries.

Systems range also from coastal seaweed culture like the Nori culture in Japan, which needs very protected waters because any storm would destroy it very quickly. Or seaweed farming in Chile on the beaches at low tide, originally picked up by potato farmers who used to plant their potatoes in rows with seaweed, and apparently pretty successfully.

Other bottom culture systems where modern equipment helps seed scallops or other species include units with very wide tires so as not to press too hard on the mud in the sea bottom and damage sea life. There are even regulations nowadays for this unit in Europe.

There are systems that are coastal-bound or inland; huge pond cultures for shrimp farming in the mangrove areas. This can be debated a lot - there are quite a few negative impacts but also there are positive examples. Finally, there are land-based systems that are entirely away from the coast, used for culturing seaweed and also for fish farming. Other land-based farm systems are quite common and I think they're on the increase.

Let's talk about interactions with the environment. This is a particular area of concern not only to environmentalists but also to fish farmers. Unlike most other industries that can pollute the environment but still produce a high quality product, the fish farmer is the first who suffers from the ill effects of the environment in which he is operating, and therefore has a vital interest that the quality of the final product is not impaired. So the fish often becomes his own biomonitor. Before Greenpeace notices a problem, he has already lost biomass productivity, not necessarily to disease, but often has lost feed conversion efficiency, which puts him out of the competition.

A number of international organizations have dealt with the questions of the environmental interactions of mariculture for a number of years. ICES (International Council for the Exploration of the Sea) is one of them. EIFAC, the European Inland Fisheries Advisory Commission, has had a working party on fish farm effluence for the last ten years, and they have given some good advice on effluent standards. GESAMP Working Group 31 has put together several documents, one on the interaction of coastal aquaculture, particularly for developing countries. And also the EEU is very concerned to have harmonized regulations and control over fish farm effluents in their jurisdictions after the common market. Of course, various national committees and research programs are underway and have been in place for many years. ICES lists about 390 projects in the last seven years and over 1,800 peer reviewed publications in the area. So our knowledge base has improved over the last few years. The question is to put it to work.

Looking at Europe, the EEU is on the way to harmonizing its regulations. Many countries already have in place a number of regulations to limit the environmental impact from marine cage farms, and also to safeguard the industry. Discharges are regulated in some countries. Production capacity, nitrogen phosphorous output, carbon loading per unit area, feed composition and feed conversion are all regulated. Feed conversion is a very important aspect - if you don't get the right fuel mileage in your car, you get your license removed. Environmental impact assessment and water quality monitoring is required, and stocking density is also regulated in quite a few countries.

One of the concerns with aquaculture, and rightly so, is that it may contribute to eutrophication, or at least to enrichment of nutrients. But a lot of progress has been made recently - eight years ago the nitrogen content in the feed was 8.2%. This had been reduced to 6.2% through better husbandry techniques. The feed conversion efficiency has progressed from 1.7 to 1.1 and many claim they are down to 1.0. That means, in other words, in the past we output about 110 kilograms of nitrogen per ton of fish produced, and we have achieved an almost 60% reduction in this output. Compared to agriculture, I think this is an achievement that is quite noticeable.

The same holds for phosphorous. While the content of phosphorous has been reduced from 1.1 to 0.7%, again, the feed conversion efficiency has improved and there's been a 66% reduction in the output of phosphorous per ton of fish produced.

A big step here was made by the fish feed industry, which changed the composition of feed to high-energy feeds where fat is used for metabolic activity and protein is provided only to an extent that it's immediately transferred into growth of biomass, and therefore the output of nutrients is reduced substantially.

The figures I have just given apply for northern Europe, and it is an area of concern that in many other countries, we still have a long way to go to reach these reductions.

The use of antibiotics is also of great concern, not only from an environmental aspect. The aquaculturist is particularly concerned in case resistance builds up in his farm, which will be difficult to handle in the management scheme. Norway handled this very well in the early 80's when the industry boomed and started to really take off. Tight controls, long retention times and withdrawal periods are employed, particularly in the EEU. This actually puts the farmer in a bad position if he wants to use antimicrobials - he may have to wait 180 days before he can sell the fish, and if he has to handle it a second time he may never sell his fish. Therefore, he better improve his husbandry in the first place.

In Norway, the improvements were also substantial in reducing the use of antimicrobials. In 1987, 50 tonnes of antimicrobials were used, but in 1996 only one tonne was used, despite the fact that production increased from 107,000 to 330,000 tonnes, a factor of three. The use of antimicrobials has been reduced by a factor of 50 - that is an achievement that needs to be acknowledged.

There's no way to say that we do not need antibiotics at all. We still need them. It's also unrealistic to say that we will have airplanes flying without any oxygen masks in the overhead bin or any life vests under the seat. It has to be there, but the life vest should not become the seat. I think the Norwegian example clearly shows that the industry is on the right way.

I can also quote examples that are not as positive in other parts of the world. We in the western world are partly guilty for supporting this market related to the shrimp industry, where we have a long way to go to make similar advances. There are still problems that need to be studied within the system. The use of probiotics will probably help further mitigate the need for antimicrobials. Better vaccines are one reason why we have already achieved so much reduction in the use of antimicrobials. We also have a better understanding of the mechanisms that transfer effective concentrations into the animal, allowing us to reduce the total amount needed.

In the receiving waters, we still have two big issues that need to be addressed: the fate of residuals in the environment and their breakdown products. The risk of plasmic transfer, particularly to consumer products is also of concern, but a recent review shows that the problem may not be as great as anticipated.

There are other issues on the environmental side that I cannot address for time reasons. The interaction of wild and cultured species is of course of concern. In fresh water, we have many of positive and negative examples of how to handle this.

Sea lice and other active parasites are of great concern. There are a number of research projects under way that look promising, particularly husbandry strategies that are presently being developed. Site rotation and the recovery time of sites for cage farms is one of the issues which is being severely studied, but also year class separation has helped to dramatically reduce the sea lice problem.

Dr. Rosenthal provided an example of a study of tagged salmon being released from netpens in Canada and using satellite telemetry to track them. The results were startling to see the salmon stay around the cages or go to other cages because of their conditioning to get food. Stream imprinting was also confirmed and the point that the salmon could be recaptured or caught by sport fishermen around the cages perhaps deserves further study.

Co-culture is being investigated to see how the nutrients released by one form of culture will be picked up by another the waste of one culture becomes a resource for the next. I think that's part of integrated systems.

Another big concern is the density of cage farms on-site, which are not only a concern for the fish farmer but also an aesthetic problem for the public and tourists. There's a fear that this impairs the view, the scene. But I think we have to be realists and use good sound scientific criteria rather than emotions when dealing with these issues.

So aquaculture, as mentioned before, needs protection from its own capability to pollute. Many studies have dealt with the impact of released suspended solids, feces and feed from cage units. We now have models in place that can even accommodate different current speeds in the tidal regime. They can account for different particle size and density, where they settle so that we can clearly tackle it, holding capacity - or assimilative capacity - on the bottom. In these simulation models we can incorporate bio-turbation depending on the benthic community reported to us, and also the fish that come to the fish farm for breakfast to participate in the feeding, and nowadays also bottom topography.

So this modeling allows us to predict where carbon settling will be, and how much we would permit to go, and how much spacing should be there to do this. We are very pleased to say that the present models which have been tested in Norway, Scotland, here in Canada, and in Chile, are very consistent and give us results which predict about 80% of the true values measured by profiling. The other 20% are underestimates, which means these models describe the worst-case scenario in terms of environmental quality change.

Of course our knowledge is far from giving the accurate data for the accurate model, but if our knowledge improves the worst-case scenario can be reduced. That would mean we would still be on the safe side before overloading an area. The problem is implementing this knowledge, to have it used in the licensing process everywhere in the world. That is unfortunately not the case to date.

Regarding expert system modeling, we are pretty well advanced worldwide in our use of various modules where feed composition, fish metabolism to temperature, size and species is taken care of. The dispersion of suspended solids has also been incorporated in the sediment module. We also have in our models the only thing which is really missing and which is a major step still to go, which are interactions with other resource users. What does it mean if you want to partition and share resources?

We need to develop expert systems that have ecological models in their background, which are very sophisticated and very complex. We have seen that fisheries are very complex, but we have though a little advantage in aquaculture. The ownership and the space in which we operate is controllable, and you receive signals much earlier than from open fish stocks.

The problem is that it's very difficult to translate the knowledge of such complex models. Luckily enough we do have systems that can assist us to digest this material and translate it into something meaningful. Still, I think, we have problems. We need to integrate this set of biological models into management schemes. Some call for an integrated approach, but it is a very big and difficult step to translate this complex information from a set of models into a clear and informative report that managers can use in their decision-making process. People are often simplifying too much and then the answer at first sight looks very, very awkward.

I would now like to discuss other resource users that impair aquaculture. In this sense there are many similarities to fisheries. We have to deal with people in rural settlements, ecotourism developments, and effluence from nearby industries and so on. There are others inland. The

coastal zone is not an area with a limit. Inland agriculture has a dramatic impact on aquaculture in many regions of the world where the run off of nutrients and pesticides have been proven to impair activities. Particularly nutrient output. We have seen much improvement within the aquaculture industry in reducing output per ton produced. We don't see any progress in agriculture to reduce this output in an equivalent manner, and if the effluent gets into the receiving water, aquaculture usually has very little space left.

Riptides can also threaten aquaculture. In one example in Japan, the wind pushed in a rip tide that totally wiped out two years' production of the fish farmers in the entire region within hours, including the investment.

There are other activities that can impair aquaculture activity. It's interesting to note that even if you have sanctuaries or expanded reserves, it can have an impact. For instance, increasing bird populations in the area can affect aquaculture opportunities. Without getting into too much detail, forestry, coastal construction, causeways, bridges, -- everything can change what otherwise would be very suitable environmental conditions for aquaculture.

Another area of concern is the ballast water issue. Every twelve weeks a new species is established. The aquaculture industry is also very concerned about this. In many of our countries we have tight fish health regulations, and Canada has taken the lead in them. But we are at risk from ballast water in the vicinity of our farms: permanent cysts of toxic algae have been confirmed, transmission of shellfish diseases has been confirmed in several continents, transmissions of human pathogens have been confirmed. Aquaculture also needs some protection, along with the other coastal resource users.

There are now container ships that are almost 30% ballast -- they only have 70% loading capacity on average, and the volume of ballast is quite substantial. The ICES Working Group on Introductions has recently estimated that there are over 3,000 species in transit intercontinentally, daily. So twelve weeks for establishment is a very low result so far. We are lucky.

ICES has tried to establish a code of practice, but there has been a reluctance to accept this because people still think, "Shipping has been in place for ages and everything that could be done by now would be done by now." This argument is contradicted by the facts I have just given you. Since 1979, ICES has developed a code of practice to avoid the risks of transfer from introductions. The aquaculture industry has been very keen to follow this advice, but I don't know how we can convince the fish farmer to continue to be honest when others just dump foreign species and disease-inducing agents in front of his door. These indiscriminate, ocean-wide transfers are happening right now and we need to do something about them quickly.

The question arises, why do invasions continue to occur when the transport sector has long been in place? Technically, from the aquaculture viewpoint there are an increasing number of activities that increase the chances for contact. The increasing density of units near shipping routes - everybody wants to be close to the infrastructure - increased sea traffic, number of ships and routes, increasing speed - less transfer time means that more organisms arrive alive. Because of increasing ship-size, there are larger ballast volumes and more oxygen available for a longer

journey, so organisms will survive. There's also been a change in ballast water management - there's a more frequent exchange of water, and the ballast water nowadays is much cleaner, so survival is greater. We also have increasing human population density in the coastal zone, with increasing poverty and a lack of satisfactory hygienic conditions.

Finally, we have changing donor and receiving environments. What does that mean biologically? What conditions in these environments must be met to establish an invader? That is an issue that needs to be tested and studied scientifically to help avoid these risks. The question is whether mariculture units can function as reservoirs.

The simple framework I use to visualize this has an analogy to a filter set. In any ecological system you may see one species either pass through each of the filters uninhibited or be repelled, leading to a failed invasion. For example, a tropical species would not survive in the winter in cold-water habitats, it would be wiped out before it could settle. But if you have an aquaculture unit that uses waste heat, it may act as an interim host for those pathogens, allowing them to survive a bit longer. They can then target either the aquaculture unit itself or the unit can act as a reservoir from which the pathogens impair other units. We have to have an interdisciplinary approach to address this.

Another example is the zebra mussel problem. You might think that this is a freshwater issue, but it may have a severe impact on mariculture in another continent. As we know, this introduction to the Great Lakes can be traced through a few ships in 1988, and it has spread consistently.

How can ballast water transfer to the US influence aquaculture in other continents? Mind you, the zebra mussel out-competes native freshwater mussels. The EPA (Environmental Protection Agency) is considering listing these as an endangered species, and then fishing these species will be prohibited. These freshwater mussels provide the best nucleus material for pearl oyster culture in Asia and the Pacific. High quality pearls depend on those, and we have no replacement to date. If this nucleus material is not available, the quality of the pearl will be affected. That's big business -- we even have developmental aid programs in the Pacific Islands to help them develop some sustainable aquaculture. But these pearl markets -- they're controlled from Paris at the moment -- may be disrupted very quickly.

This brings me to conflict management, conflict resolution, and co-management. We all heard Elisabeth Mann Borgese talking about preserving and protecting productivity and biological diversity, promoting rational development. What does it really mean?

In the coastal zone we have a number of users of resources, and the small ones, of course, are the aquaculturists. Everyone wants to maximize the output of these resources for their own business, maximize profits. If they are lucky, they are the only resource user. Most often they have to compete for resources. What they forget to do is to look at the ecological and socioeconomic functions that maintain these resources and enable continuous utilization. These functions are studied by natural scientists, but the problem is that the scientific community looks at these largely - except for fishery science which does go further -- as an ecosystem without considering the use of the resources. One should consider resource use in science. On the other hand, the

resource users and managers seldom make the functions that maintain the resource their principal consideration.

What is needed is integrated resource management. We have to acknowledge the dependence of economics and socioeconomics on the ecosystem, and these have to be incorporated.

So what does it mean for a farmer? Let's take an example, shellfish farming. Let's assume the shellfish farmer has a licensed area with a certain capacity for production. We all agree he depends on local resources - for simplification, let's say good water quality, good water exchange and a good salinity regime for his oysters. He also needs sufficient nutrients, as few toxic algae blooms as possible, and natural protection against storms.

But there are other users here. Agriculture, which competes for resources and also puts aquaculture at stress, reduces the carrying capacity for shellfish farming in the area somewhat. Ecotourism may compete for space through boating and surfing, and the capacity for shellfish may be reduced further. If shipping comes along -- with ballast water release causing toxic algae blooms - a very risky operation will become marginal. Forestry can cause enough erosion to change sedimentation along the coastline, and a site, which was identified as a good site for shellfish farming, may disappear altogether.

We may say, "That's all right, we'll pay him off," because all the other industries are more important. People tend to forget to look at the feedback these little resource users can have on others - feedback that helps economically and ecologically stabilize the system. My plea is for an optimum use mix, rather than a maximization of production. Aquaculture in this sense is not too different from fisheries.

To get this optimum resource allocation, we need new scientific criteria to assess and control local resources. The multiple-use concept provides an escape hatch against failure of any one use of a resource, and provides flexibility in the face of unexpected change in the marketplace or in the natural variation of the productivity of the resource. We also talk about preserving biodiversity. Diversification in economic production is also important for a sustainable population in an area.

Where do we go from here? I think aquaculture can take the lead in developing environmental control measures and safety standards, because it's one of the industries where the quality of the final product is noticed first. Aquaculture, like any other industry, has the potential to cause alarm if not properly managed, and I emphasize that "if". We have seen failures around the world, and we still continue to see failures when newcomers come in without enough background knowledge in the subject area. The aquaculture industry must be proactive in planning, and should foster development by setting a good example.

I believe production will continue to increase. I can't give you a finite number for the upper limit, but it is growing consistently every year, and that will continue. New species will be cultured, species we have not considered before. There will be a diversification of production systems:

land-based systems, onshore tidal systems, recycling systems that have better control of environmental issues than water-based systems will be of growing importance.

New systems will also use new marine technologies. Even onshore tidal systems will be dependent on hurricane forecasts, for example. These technologies will benefit everyone in the coastal zone.

Offshore systems may develop here and there. I would be very cautious before saying that they'll develop rapidly, because there are many questions to be answered, but they will arise to some extent. We will see a diversification in systems and co-culture systems.

I would like to mention integrated farming systems, where waste from one resource user becomes a resource for another. It's a very important aspect that has been almost neglected. If you look at the Chinese pond system - which actually produces a major share of our fish aquaculture production today, several million tons a year - they are using wastes.

Disease control is a big item that needs to be addressed by the scientific community. Diseases will always be with us. It is unrealistic to assume a healthy system without any disease agents, pathogens or parasites. There is no species that does not have at least one parasite or disease agent. About 50% of the biodiversity in the world is parasites and disease agents.

Genetic engineering - I can't give you an answer. There are many people who are very keen on it, but I am very reluctant to accept it, particularly because in Europe the consumer is not accepting it.

Ranching will be revisited. Artificial reefs. Once again the question of escapees may be raised. Open sea production --enhancement is an area that is meant for strategic research. Recently in Southampton I was in a meeting where the idea of fertilizing areas of the sea to increase productivity was brought up. But we know how complex ecosystems are, and we don't know whether we can channel this increased productivity to something reasonable. Research is needed to see whether the predictability of these manipulations could be realistic.

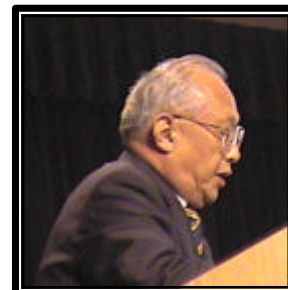
Last but not least, I would like to say that if we don't have the right tools, and if we don't apply the appropriate criteria, we may not succeed in helping aquaculture achieve what it can. Whatever view we take, we must have good and proper knowledge -- the practitioner must be supported by research. My plea is for an integrated approach -- that aquaculture be given a chance in the context of integrated management with other resource users, including fisheries. Thank you very much.

Dr. Tohru Morikawa, President, Overseas Fishery Consultant Association - Japan

Sustainable Marine Aquaculture and Stock Enhancement in Japan

INTRODUCTION

(Fig. 1) Until 1988 Japan had been the world's leading nation in fishery production. However, the total catch has decreased significantly in recent years reaching 7.42 million metric tons in 1997 due mainly to the sharp decline to sardine landings.



(Fig. 2) Fish resources in the waters surrounding Japan have generally been under pressure in recent years because of the degradation of the coastal environment and the imbalance between population size and fishing effort.

(Fig. 3) As you know, in Japan, fisheries play a significant role in maintaining healthy dietary habits of the Japanese people who depend on marine products for 40% of their animal protein intake. Therefore, increasing production through marine aquaculture, as well as enhancing fishery productivity in coastal waters through fish farming, fishing ground improvement and development are vital to ensure a stable supply of fishery products for food. As a result of positive efforts to promote stock enhancement and rational utilization of fisheries resources, Japan's coastal fisheries production from capture fisheries has remained at about 2 million tons over the 30 years (Fig. 1).

2. PRESENT STATUS OF AQUACULTURE IN JAPAN

On the other hand, aquaculture production in the coastal waters increased 24% in volume during the last ten years accounting for almost half of the entire coastal fisheries production.

An increasing number of species (more than 64 marine species) including mostly fin fish such as sea bream, Japanese flounder striped Jack, amberjack and striped knifejaw and scallop, are being cultured to meet strong consumer's demand for high value fish and shellfish. A stable and reliable supply to consumers irrespective of weather condition and establishing a new distribution system of live fish for restaurants throughout the country are also reasons for strong demand for cultured fish.

(Fig. 4) Laver is the largest production in marine aquaculture, then scallops, and then oysters. Among finfish, yellow tail is biggest in production.

(Fig. 5) The share of cultured to the overall fish and shellfish production has been increasing visibly. The production of oysters, pearls and laver in Japan is almost entirely dependent on culture fisheries. For other species, aquaculture production represents 84% for sea bream, 73% for yellow tail, 51% each for flounder and scallop, 46 % for kuruma prawn and 30% for kelp in

1991 and these shares have been affected a little by market prices, but maintained at almost the same level.

In Japan, there are no rights governing the utilization of the surface seawater for aquaculture from the viewpoint of environmental preservation or giving priority to leisure like in your country. Fishing rights of aquaculture grounds in Japan are managed and controlled by local fishermen's cooperatives under this law of fishery. Recently, the prospects for marine aquaculture are not very good due to the extremely low price for the product, lack of skilled successors in the next generation of labor, deterioration of the aquatic environment by pollution through discharge of effluent, and self-contamination by aquaculture in calm inner bays, as well as the sharp fall in sardine catch, sardines being required to produce fishmeal as the feed for fish culture. Moreover, it is very hard to expand aquaculture grounds in Japanese coastal waters because all suitable areas for coastal aquaculture such as calm waters with favorable current are already fully utilized as aquaculture grounds.

3. NEW TECHNOLOGICAL DEVELOPMENT ON AQUACULTURE

(Fig. 6) Japan has been developing new technologies for marine aquaculture it's solve these problems taking a leading part in new offshore culture projects. Automation and mechanization in aquaculture operations is most important to solve labor shortage problems. Creation of calm water areas by installing wave-damping dikes and development of offshore aquaculture is the most important way to expand aquaculture grounds in Japanese coastal waters.

I will mention an example of aquaculture ground development work here:

(Fig. 7) A 480m gravitational and floating wave-damping dike was constructed to develop 39.7 ha of calm water area in this district from 1984 to 1989. After the work, yellow tail aquaculture production increased to 1584 tons in 1991, 5 times that of pre-construction.

(Figure 8 deleted)

(Fig. 9) Marino-Forum 21 has developed experimental high wall structures at sufficient strength and stability for net cages with flexible rubber frames. Such pilot farm stations equipped with automatic feeding machines using extruded dry pellets are fixed in offshore area by tension leg or jackup methods. Pilot form stations for offshore culture are set up off Hokkaido (northern Japan) and Kumamoto (southern Japan) for rearing fish in extensive, clean seawater and preventing sea pollution using sufficiently strong current. The stations are equipped with remote controlled automatic feeding systems and a wide range of instruments recording water temperature, tidal current, DO, salinity, wind velocity and direction, wave condition and air temperature, as well as a TV monitoring system for inside and outside of cage net. The equipment is entirely controlled and monitored remotely from the onshore station through fiber-optic cables or from boat by wireless. In addition, the automatic feeding machine is connected to a computer to calculate the appropriate amount of feed using data on size, number of fish, health condition, nutritional retirement of cultured fish, and also date monitored from the pilot station.

The computer control system is useful to save feed cost and to prevent sea pollution by avoiding unnecessary feeding.

(Fig. 10) A private company with Nagasaki-prefecture developed different type of large-scale offshore aquaculture system that is called "AQUA SYSTEM" as shown in Figure. During the test of the System, the facility was struck by three large typhoons. There was no damage on the floating structure. However, cage nets were broken by rubbing with the inside of the floating structure. The damage to the cage nets was caused by difference of the movement between cage net and floating structure during the typhoon strikes. We are still working in engineering a better system.

To solve the problem of the sharp decline in feed fish (mainly sardine for fish meal), Japan is developing a new type of feed using substitute protein such as soybean cake, corn gluten, and feather meal for fishmeal. Results of experimental culture of yellow tail using the new feed containing 20% fish meal (it contains more than 50% normally) and 30% of a different protein, shows that the fish grow effectively. The growth rate of fish cultured with the new feed was 92 % of that obtained with the original fish meal compounded feed, and feed efficiency was 84% of the original feed. The appearance of the fish, color, taste, and quality fresh meat was better than these of fish reared on fresh fish feeds or moist pellets. The results hold good prospects for using feed with less fish meal content and avoiding sea pollution as well as contributing towards rational utilization of valuable marine living resources as food directly for mankind.

(Fig. 11) One of the important technological advances in seed production is the development of an appropriately formulated microdiet. Based on experiments with Sea Bream, it is possible to replace two-thirds of live microorganisms with artificial microdiets without affecting the survival rate. Vitality of juveniles fed with artificial, microdiet have been found to be stronger. One of the tasks remaining in this area is to determine how to prevent pollution of rearing water by artificial feed.

Increasing the number of cultured species is also important to establish a stable aquaculture industry giving full attention to the consumer's needs and preferences. The Japan National Fish Farming Center has been developing technology for artificial fish fry production of new species.

Many agencies are engaged in aquaculture such as the National Fish Farming Center, Kinki University, Marino-Forum 21, as well as some private enterprises have been trying blue fin tuna cage culture for more than ten years and an effective culture system has been developed recently.

(Fig. 12) The Japan National Farming Center have started a sea farming study of the northern blue fin tuna utilizing 40m diameter circular pens in Amami, Okinawa and 367 blue fin tuna from 2 years class to 11 years class are rearing now. In 1998, 5, 10 and 11 years class blue fin tuna had spawned 200 million eggs and about 200 young tuna of 30cm size were produced from the eggs in the cage. From these 200 tuna, 111 young tuna of 30cm size were experimentally released in the sea with tags and 50 remain and are rearing continuously at the station successfully since 1998.

(Fig. 13) This figure shows 430kg, 9 years class of blue fin tuna reared in net cage from 200gr. natural young tuna.

What is remaining issue to solve in blue fin tuna culture is to develop reliable artificial reproduction technology, to prevent death by impact with the net and cannibalistic behavior.

4. POLICY RELATIVE TO SUSTAINABLE AQUACULTURE IN JAPAN

As I mentioned at the start, aquaculture production in Japan plays an important role to secure supply of fishery products that are in great demand to consumers. Aquaculture policy has been concentrating on the measures that help to establish sustainable aquaculture in coastal waters.

Recently, the environment of aquaculture grounds has worsened rapidly due mainly to excessive feeding. Also, damage to marine living resources by disease, and are in serious condition.

(Fig. 14) To ensure stable and sustainable aquaculture production through eliminating the main causes of those problems, the government of Japan last May has conferred new regulations. The regulation is composed of two important measures including measure for the improvement and preservation of aquaculture grounds, and preventing the spread of fish and shellfish diseases. Under the law, the Agriculture Ministry has to establish basic guidelines that contain the targets and measures to improve aquaculture grounds and to prevent the spread of disease. Each fisherman's cooperative should follow these guidelines when they establish the plan to improve their aquaculture grounds and to prevent the spread of disease. When serious fish disease outbreak in the rearing act, fisherman should destroy the diseased fish caught by burning. In the case of sea surface aquaculture, it was determined that the guideline for dissolved oxygen of the seawater in the cage should be more than 4.0ml per liter. The quantity of existing sulfide in the bottom mud immediately under the cage should be not less than the oxygen available to react with the sulfide. In the benthos, aids such as lugworms should always exist in the mud directly under cage nets. Recently technological development aimed at the establishment of a new aquaculture system of "no contamination" and "no disease outbreak," including a closed re-circulating aquaculture system has been started by Marino-Forum 21.

5. FISHERIES MANAGEMENT AND STOCK ENHANCEMENT IN JAPANESE COASTAL WATERS

(Fig. 15) An increase in coastal fishery production including aquaculture was mainly as a result of Japan's efforts in promoting stock enhancement and sustainable utilization of fishery resources implemented under the "Coastal Fishing Grounds Improvement and Development Project." The project, to promote agricultural fisheries is still underway, is designed to enhance the productivity of fisheries resources in coastal waters through the improvement of fishing grounds based on the concept of restoring resources by farming and marine ranching utilizing all of essential technological elements that we have developed. It includes the development of artificial fish reefs for the protection of released fish and propagation, development of suitable habitats for fishery resource enhancement, creation or restoration of seaweed beds and tidelands

recovery or improvement of existing fishing grounds by dredging, creating water routes and removing accumulated sludge, installation of upwelling flow generation structures and establishment of floating shelters, etc. The total amount for the projects in 1999 fiscal year is about 100 billion yen (governmental budget is more than half). Due to the recent economic stagnation in our country, the costs and benefits of these programs have been stringently re-evaluated.

Next, I will explain these works individually, utilizing the following overhead slides:

A.) Artificial Fish Reefs Project

(Fig. 16) Artificial fish reef installation project applied the habit of fish aggregation at natural reefs on the sea bed and aims to create suitable habitat and propagate marine living resources. This project is implemented to install a durable structure such as concrete blocks and steel construction in the ocean to form good artificial reef fishing grounds aiming to maximize fish reef effect, including stability, aggregated nature, whirlpool and upwelling flow generation, and shadow cast area, etc.



(Fig. 17) Those are typical artificial fish reefs for fish aggregation and propagation purposes.

(Fig. 18) We create nursery ground habitats to support forage species and provide habitat to released fish. The evaluation of quantitative description on fish reef effect is not easy, however. I will give a few examples out of many fish reef installation works here.

(Fig. 19) The project was formerly poor due to sea bream resources. The development work of protection and rearing grounds was implemented by installing concrete blocks, seed release and fishery restriction enforcement for four years. As a result, sea bream harvest increased by four times the pre-project level.

(Fig. 20) Total 300 propagation concrete blocks for spiny lobster juvenile and adult lobster were installed in 250 ha. The production had started to increase on the half way of project and harvested 9 tons after work. This is 3 times pre-installation.

(Fig. 21) This is an example of sea weed propagation blocks installation and its result.

B.) Artificial Upwelling Flow Generation System Project

Development of a large-scale artificial upwelling flow generation system is one of the important big projects to propagate marine living resources.

(Fig. 22) To prove effectiveness of the project, we selected the sea bottom of Seto Island Sea at depth of 46-50m with tidal current speeds of 40-50cm/s and installed plural-column panel style structure like this figure.

(Fig. 23) By the remote sensing survey, cold water mass appeared on the surface from sea bottom layer by the structure.

(Fig. 24) This figure shows high-density area of chlorophyll. It has been confirmed that the density of nutrients (DIN 2.63 times), phytoplankton (7.5-25 times), zooplankton (2.3-2.6 times) increased around the structure after installation.

(Fig. 25) According to results of research vessels, the fishing operation area increased around the structure and CPUE within the effective area was 33.36kg, which was 1.7 times that of outside.

(Fig. 26) Similar technological developments to generate upwelling flow called "Ridge Fishing Ground Project" were carried out in Nagasaki recently. The technology aims at constructing an ideal ridge by manufacturing safe, strong, low cost concrete blocks utilizing fly ash, and accurately and simultaneously depositing them on the seabed at greater depth than before. The project is still underway, so we have to wait to evaluate the effectiveness of the work of the upwelling generator until completion of the project. However, according to scientific surveys by echo sounders and ROV (remotely operated vehicle) cameras, it has been confirmed effective results as the fish reef (fish aggregated around the ridge).

C.) Sea Farming Project

(Fig. 27) Sea farming aims at restoring and increasing the level of the target species' population.

In nature, marine organisms produce a large number of eggs but only a small portion survive to grow and procreate because of predation and lack of sufficient food. In sea farming, juveniles are raised in large quantities under human control, and when they acquire sufficient capability to survive, they are released into the suitable natural ocean environment where they grow and mature.

(Fig. 28) 17 national and 53 local government sea farming centers are today developing advanced technologies for fry production and about 80 varieties of seed are released nationwide.

(Fig. 29) In 1995, 3.8 billion seeds of 11 major species were produced and 14.4 billion seeds were released, including those naturally collected.

(Fig. 30) Little is known about the effectiveness of seed release. Limited results from recapture surveys indicate that over 90% of scallops produced in Japan were estimated as released individuals. About 20-30% of kuruma prawn, swimming crab and abalone, 10% of sea urchin and 15% of Japanese flounder are considered to have come from sea farming. In contrast, the proportion for sea bream which have migratory character is still rather low, at about 4%.

In order to increase natural resources by means of fish farming in the coastal waters of Japan, it is necessary to further increase seed release by improving the releasing technology including tagging. Significant results can be obtained through production of low cost, healthy, high quality seed and concentrated release in the appropriate site with the consideration to ecosystem, such as carrying capacity and genetic diversity. As the same time, it is important to strengthen regulatory measures aimed at protection of seed after release until they reach a certain size, as well as ensuring cooperation from harvesters. It is also important to develop methods for accurate determination of the economic effectiveness of release programs and ecological information such as carrying capacity of the environment.

D) Marine Ranching Project

(Fig. 31) New technological development of marine ranching systems designed to protect and cultivate while preventing the scattering of released juveniles, using a combination of audio-signal-training with feeding equipment protective fish reef and seaweed bed, etc. In nursing (intermediate rearing), artificial seeds are given training in a tank or cage by audio-signal-training system. They are then released into the natural sea where an audio-signal-training system is installed with favorable environmental conditions as a habitat for released fish. The juveniles are thus gradually accustomed to natural environment with high survival rate and remain for several years in the released point. It has already been proven that released fish are likely to remain within several miles of released point and not only released fish but also natural fish inhabiting the vicinity become trained.

(Fig. 32) Marine ranching based on audio-signal-training has already achieved results as a step to more complex and wide area marine ranching targeted for the future utilizing more advanced technology.

E.) Coastal Fishery Grounds Preservation Project

Coastal fishing grounds preservation work is conducted through such operations as accumulated sludge removal, bottom quality improvement by tilling (turning up bottom mud), dredging, fairway forming, building guide-walls, removing predators, and water current or stream generator installation to promote sea water exchange.

(Fig. 33) This is one of the experimental work or water flow generation systems to improve propagation in the closed bay. This comprehensive purification system was utilized many ways, such as overturning bottom mud and benthic organism transfer to purify the sea floor, as an aeration device and water flow generator to improve water quality condition, and for dredging to promote fresh sea water entering, etc.

(Fig. 34) Seaweed bed and tideland creation have been implemented to capture nutrients via organisms for preventing coastal water eutrophication, and to develop habitat for coastal marine living resources to preserve marine ecosystems. This figure shows seaweed restoration system utilizing artificial seaweed bed that is filled with wet concrete into a polyester bag from the vessel and put the encapsulated seaweed's seed into a bag or planted seaweed on the bag.

(Fig. 35) This figure shows an example of artificial substratum for kelp forest creation.

(Fig. 36) The grounds in this district were formerly worthless for clam fishery because of uneven topography. As a result of 68ha of tideland development by canal excavation, clam production in the district increased by 1700 tons from nothing before the project.

(Fig. 37) Agitation to create a vertical flow of the sea water is considered an effective way to purify eutrophic, stratification-induced polluted sea area. Since 1997, density current generator for demonstration research has been in operation in Gokasho Bay.

*Generator is placed at 15m depths.

*Impeller is driven by valor cell electric power 12kw.

*Volume of mixed water discharge 170,000 tons per day.

(Fig. 38) It is confirmed density current generating steadily across a wide area. As a result, temperature stratification in the seawater had weakened and transparency had improved. Also, red tide, which normally appeared in the summer season, did not appear after this research work.

In the last part of my speech I will state my view on fishery development projects.

(Fig. 39) In Japan, "fisheries based on stock enhancement" has been strongly introduced as a new fishery policy instead of the previous "production oriented fisheries." This is to be achieved

through sea farming (seed in the sea), and development and improvement of coastal fishing grounds (creation of suitable fields in the sea) as shown in this figure. The projects will contribute to sustainability and increasing resources to secure a stable supply of fisheries products through resource management oriented fisheries.

(Fig. 40) Fishery development can in one sense be considered as a nature-disrupting activity because human intervention is imposed into natural habitats. Some people may insist that fishery development damages ecosystem preservation. However, I do not agree with this opinion. I will emphasize the fishery development considered here is to restore fisheries destroyed by humans, and return fisheries to their original state and also to provide many facilities to places that are naturally low in productivity such as sandy sea bottom and enhance productivity so that organisms can comfortably inhabit such area.

(Fig. 41) The principal purposes of fishery development and improvement projects in Japan are:

- (a) to protect the released seeds by sea farming to raise the survival rate and to attempt to breed resources.
- (b) to provide grounds suitable for fish and shellfish habitation and reproduction.
- (c) to promote oceanic productivity by restoration of fishing ground, creation of sea weed forest and tidelands and upwelling flow generation, etc.

We have to create a new concept of sustainable agricultural fisheries to conserve the healthy and fertile coastal environment through the projects mentioned here. And we need more profound understandings for physiological and ecological processes to promote sustainable agricultural fisheries in the future.

Part III. Results of Concurrent Sessions

Note to readers: *This section describes the results of six concurrent breakout sessions. Each session includes the notes taken by the rapporteurs and other helpers and includes various styles and formats. Some follow the Workshop Topic Outline rather closely and other deviate as appropriate. Participants were asked to rank importance (from 1-5) to their recommendations and identify if these were short- or long-term projects or research activities. A second section includes pertinent questions and answers that were fielded after each presentation and hopefully reflects the gist of what was said. The results identified below may or may not represent a consensus of thought.*

CONCURRENT SESSION A: Regulatory Framework

Chair: Harry Mears

Rapporteur: Matt Borgia

Participants: Dan Swecker, Kim Young, James Murray, Rick Devoe, Gary Jensen, Bob Iwamoto, Per Heggelund, Jay Johnson, Mike Ludwig, Anna Marie Frankic, David Kaiser, Joe McGonigle, John Kubaryk, Ken Raif, Chuck Helsley, Solomona Aoelua, Bob Bastian



Identify challenges: How to deal with and understand siting/regulatory requirements. Current regulations will not likely go away, so emphasis must be on *partnering* between government officials, university researchers, and industry/aquaculturalists. One stop shopping? Remedy must address all needs and legal mandates.

Are there existing models that can be followed?

Yes. E.g., FAO's "Code of Conduct for Responsible Fisheries," (which in part addresses aquaculture protocols) could/should be part of what is used for U.S. aquaculture. Adherence to such standards may have remedied problems in past, based on global experiences.

Grass roots and bottom-up? Will it work? Commitment must be BOTH ways (Federal and State vs. public and industry). Interest seems to exist now from DoC, NOAA, etc. "Big-brother" phobia dissipating? Seems so.

Need for an organized constituency to make changes happen and the federal government to provide technological advice and assistance in meeting regulatory requirements.

Offshore/Exclusive Economic Zone (EEZ) Framework

Framework

What constitutes the current framework?

To a major extent, it is loosely structured and not well defined. Current approach is on a case-by-case basis for projects along with regional agency determination. This is a very difficult process.

Existing regulations are mostly onshore related with multiple agency jurisdictions. There are multiple frames of reference for issues that are largely related to siting requirements, but other issues deal with fishery management (FMP) regulations and marketing restrictions.

Similarly, regulatory framework also involves concerns related to the Lacey Act, product safety, and animal health. These issues are not discussed here, due to time constraints, but merit serious discussion.

Is more of a framework needed?

Yes. A programmatic (if possible) approach to a *process* is needed. For example, a one-stop or general permit (e.g. NPDES in WA State) that is a package of permits for all (or most) of regulatory requirements. Perhaps a (combined) permit process framework, such as a batch application. At the very least, such a framework should clarify what the sum total of these requirements is. (Do agencies have the incentive to institutionalize this? Will there be a volume of applications that make this worthwhile?) Agencies should address time-lines and streamlined requirements.

Standards should go with siting; need standards on area-by-area basis.

Five components that should be part of regulatory process (reasons):

1. Public involvement/review.
2. Environmental/regulatory measures.
3. Fisheries management aspect.
4. Response to use conflicts.
5. Proprietary interest - someone has control of the resource.

There is currently no leasing/licensing authority in the EEZ without legislation. The draft DoC legislation would provide a Federal mandate and funding authorization, with potential Congressional appropriations for responding to industry needs and offshore development of aquaculture.

If so, what are the missing pieces?

Need to define agency *roles and responsibilities*. Perhaps new a regime needs to be instilled.

Private ownership of fish in net pens - is it addressed in the legislation? License vs. lease. The legislation is NOT currently written as a leasing system - this is not "bankable" in industry terms. 20-year v. 30-year permitting - does it need to be more? Industry needs more, in lease and time. Will the lease/license be looked at as ownership and will they have proprietary rights to the ocean, water, ground, and products?

No lead agency exists. This leads to much confusion and regulatory complexity. The permit process is unclear.

Industry desires a sounding board for projects - so that applicants are apprized of process, learn regulatory compliance and rules. A multi-agency/industry partnering approach is necessary.

Some states support aquaculture, while others do not in their in state waters. Worry about lawsuits related to what's going on in EEZ or other states. Conflicting or divergent standards in these cases? User conflicts?

There are many good state-water standards - the Federal approach can mirror state approaches in these instances.

What is the role of Fisheries Management Councils and Commissions?

Easier to be put into a consultative role, shouldn't be a management/regulative body (general consensus).

New England FMC has a standing committee to convene stakeholders and act as a "sounding board" for aquaculture issues. Sort of a pre-screening and expedited approval process. They've done the most so far. Looking to be a facilitator, much like DoC/JSA wants to be. Still under consideration/debate.

Atlantic States MFC looking at partnering states and feds to streamline processes and seeking MOUs and consistent working relationships. Recently created a committee to evaluate such an approach.

How helpful will the DOC legislation be if enacted?

(See above)

The draft legislation focuses on environmental and marine mammal standards and impacts of aquaculture on wildstocks. Incorporating a public comment process to evaluate use conflicts and related issues. Moves toward a "one-stop shopping" approach. This is good, however, a *leasing process* should be the focus. A *license* might not be enough for industry.

The use of cookie-cut standards and regulations can be used as appropriate to some extent. However, new ones redesigned to EEZ aquaculture would be better, but harder to get to. *An evolutionary process approach is needed.* If successful, EEZ standards could be implemented through CZM into state waters. Property rights need to be incorporated to address industry economic interests. Can approach be modeled on (DoI) long-term leasing of mineral rights?

Are the roles of EPA, ACOE and other agencies sufficiently addressed?

No. Must be more integrated. Fragmented existing authority and regulations which are not designed and don't "work" for most aquaculture uses/designs. Not user-friendly, based on available information.

Some worry that EPA standards will "big brother" state standards and push into state rights areas.

Use of existing laws (piecemeal) being applied to this un-legislated/regulated aquaculture. Need new, directed focus for these issues.

Standards - Environmental standards and compliance

In addition to above discussion.

What form should the standards take? (BMP's, code of practice, regulation)

Clean Water Act exists, other EEZ standards would be needed to be developed.

Content of the standards? (effluents, disease protocols, therapeutics, genetics, escapes)

Enterprises will need to meet the current or future standards, no matter what. Likely made in consultation with DoC, and EPA, DoI, etc.

Siting

Can exclusionary mapping be used to assist in siting?

Good idea, bad name: should be called "Use Mapping." "Exclusionary" is a negative term. Use of McHargian or '>overlay' zoning should and can be used. Again, standards should be developed on an area-by-area basis.

How can we approach density of farms? (clusters, diffuse, strategies)

What can the ocean hold? (see Carrying Capacity below)

Does the concept of carrying capacity help?

Yes, but we must realize it's unrelated, naturally, to economics. We must make sure to balance biology/science and economics and have the research done to understand how it will work. Related to property/ownership issue.

The vision of offshore aquaculture in the future

"If the DoC/US Government builds an aquaculture regulatory framework and streamlines the EEZ permit process, the buyers/industry will come." However, (like Norway and New Brunswick) too many static rules or pre-packaged, baseless determinations of carrying capacity could choke the industry or make it unfeasible.

Need a measured start - an incremental pilot approach, making changes as necessary. Test, and then grow as experience and knowledge allows that growth to happen. Need to monitor and develop as first operations grow, measuring impacts and success. Leads to "batch processing" that would likely work for agency "critical mass" (i.e. critical mass of operations).

Recommend use of limited access approach for EEZ leases. Base approach on ecological factors, economic viability, and defined property rights. The key goals should include continued technological advances and a simpler regulatory climate for future EEZ aquaculture.

What is the production potential?

Based quite a bit on property rights, and technology transfer (water quality in EEZ is better, plus technology is catching up). Would the industry more likely go to 2 mi., 3 mi., or farther out? Industry response: Likely, as close as they could get to 3 mi. WA State says that the ONLY option is offshore in EEZ. Too many regulations, competitive use, complexity in its State waters.

Other Regulatory Frameworks

Is there a Federal role in the State or regional aquaculture?

"Cutting up the apple": Fed should be primary in EEZ (DoC lead in coordination, permitting, leasing, R&D, and technology transfer). Fed/DoC should be consultative (in such areas as environmental and fishery management) in state marine waters (see bullet 4 of Policy)

and involved in the provision of services. In freshwater and on-land, Fed role should be through extension and R&D.

What is the role of state Coastal Zone Management Programs for aquaculture (in EEZ)?

Review of federal activities to ensure consistency with CZM policies.

Note: in some states, the CZM office issues state permits/leases.

Are there different roles for the government players in near-shore and on-land marine aquaculture?

Yes. Extension, R&D, technology transfer. Also see above.

What are the international regulatory issues for US aquaculture?

FAO Code of Conduct for Responsible Fisheries (in aquaculture) - ICES/NASCO. Ensure consistency in accordance with international practices that the U.S. is signatory to. Issues include export/import, trade of stocks, disease risks, etc. that need more investigation.

IMPLEMENTATION AND MILESTONES

(Relative to the DoC aquaculture policy)

1. Modify draft legislation to enable granting of property right interests in the EEZ. (#5 - Near-term)
2. Design and implement limited access approach for EEZ *leases*/license aquaculture activities. Base approach on ecological factors, economic viability, and defined property rights. (#5 - Near-term, January 2001.) i.e. "sustainable aquaculture".
3. Modify draft legislation to address aquaculture species raised through permitted activities not be considered wildstocks or wildlife under federal law. (#4 - Mid-term) [e.g. shall not be subject to Lacey Act scope]
4. Ensure that organisms cultured under approved aquaculture activities are property of the license/lease holder. (#5 - Near/mid-term)
5. Create ground rules for demonstration projects (e.g. "Eco-industrial or aquaculture park" concept) B to facilitate technology transfer to foster viability of new aquaculture activities in the EEZ. (#3 - Near/mid-term)

Questions, Answers and Comments

Q: Did anyone discuss permitting process in terms of time frames, mandates for timely reviews?

A: Yes, in general terms, i.e. as part of general new regime.

Q: Our biggest problem is that the responsible bureaucracy is not prepared with a regulatory timeline, or people with the authority to approve our proposals for development - the paper gets circulated and no decisions are made. This applies particularly to the EEZ. (Round of applause)

Q: (Coastal States Organization) Could you provide some clarification on the private property thing?

A: As EEZ aquaculture develops, and secures financial assistance; we need to provide our investors with economic definition. As a project progresses, becomes successful, and begins to generate income, the growers need assurance that the profits belong to them. Such definitions will provide a level of comfort and legal protection.

Comment:

We often hear that as soon as regulations pass, and investors make decision, the regulations then change. The investors feel (quite rightly) that the rug has been pulled from underneath them, and avoid such investments in the future. A third world country would be more stable for aquaculture development than the U.S. Stability over time is absolutely necessary for long-term investment, and if aquaculture doesn't provide it the investors will take their dollars elsewhere.

A: No concrete answer to this problem. A possible model for the future could be the way fishery management councils are organized.

Comment:

What may address that situation if you are in the permitting process, is to grandfather the regulations so that you don't have to backtrack every time you change them. Then you have the certainty, with a phase-in period to enable the industry to catch up to new regulations without breaking themselves and losing the interest of their investors.

Comment

On the subject of EFH designation and the ESA. Suppose industry crafts and adopts an environmental code of practice - can we get the agencies to buy off on that? Farmers have one; perhaps can use that as a template? This also would provide regulatory stability.

Q: What do we do about establishing the ground rules for a demonstration project in the EEZ?

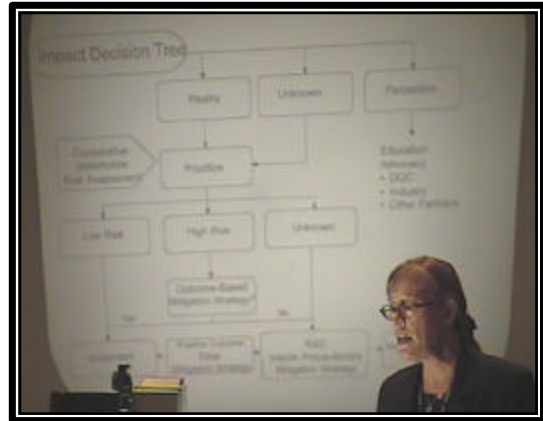
A: The DOC proposed legislation at this point contains no R&D component. However, it is a commitment with an authorization for technology transfer (engineering or biological assistance) to establish areas where cutting edge research, as well as business itself, could be conducted in the EEZ.

CONCURRENT SESSION B: Defining and Managing the Risks and Benefits of Aquaculture

Chairman: M. Elizabeth Clarke

Rapporteur: Bonnie Ponwith

Participants: Sebastian Belle, Claude E. Boyd, Charlie Brown, Harry Daniels, Bill Dewey, John Faudskar, Lori Howell, Wallace Jenkins, Richard Langan, Dale Leavitt, Ken Leber, Conrad Mahnken, Katie Moore, Beth Turner, and Alex Wertheimer.



Summary of Discussion

The group discussed the potential impacts of aquaculture and on the basis of these discussions listed the most likely positive and negative impacts. The group felt strongly that list of the impacts of aquaculture should include both the benefits and the risks of aquaculture. Furthermore, many of the benefits and the risks ascribed to aquaculture may be perceived rather than real. Misconceptions about impacts of aquaculture could put the future viability of the industry at risk. The group agreed that priority should be given to discriminating between reality and perception prior to imposing a scheme to manage and mitigate impacts. To this end the group designed a decision tree to establish a sequence of actions to guide the management of aquaculture impacts (Figure 1). This decision process 1) establishes the reality of the impact 2) prioritizes the risk of impact via risk assessment and 3) identifies an outcome-based mitigation strategy. The committee continued by recommending specific actions to alleviate other barriers and risks to aquaculture development. The lack of advocacy, the need centralized information and permitting system, and the prevalence of multiple-use conflicts were seen as the most significant of these barriers.

Defining Impact

The group defined the most of important impacts of aquaculture (Tables 1 and 2). The group felt that it was important to emphasize that the impacts of aquaculture can be both positive and negative. Therefore, their discussion of included an analysis of both the benefits and risks of aquaculture...Furthermore, the group pointed out that the risks and benefits of commercial aquaculture and stock enhancement can differ. Therefore, the group discriminated between impacts of aquaculture in general and the impacts that could be attributed solely to either stock enhancement practices or commercial aquaculture.

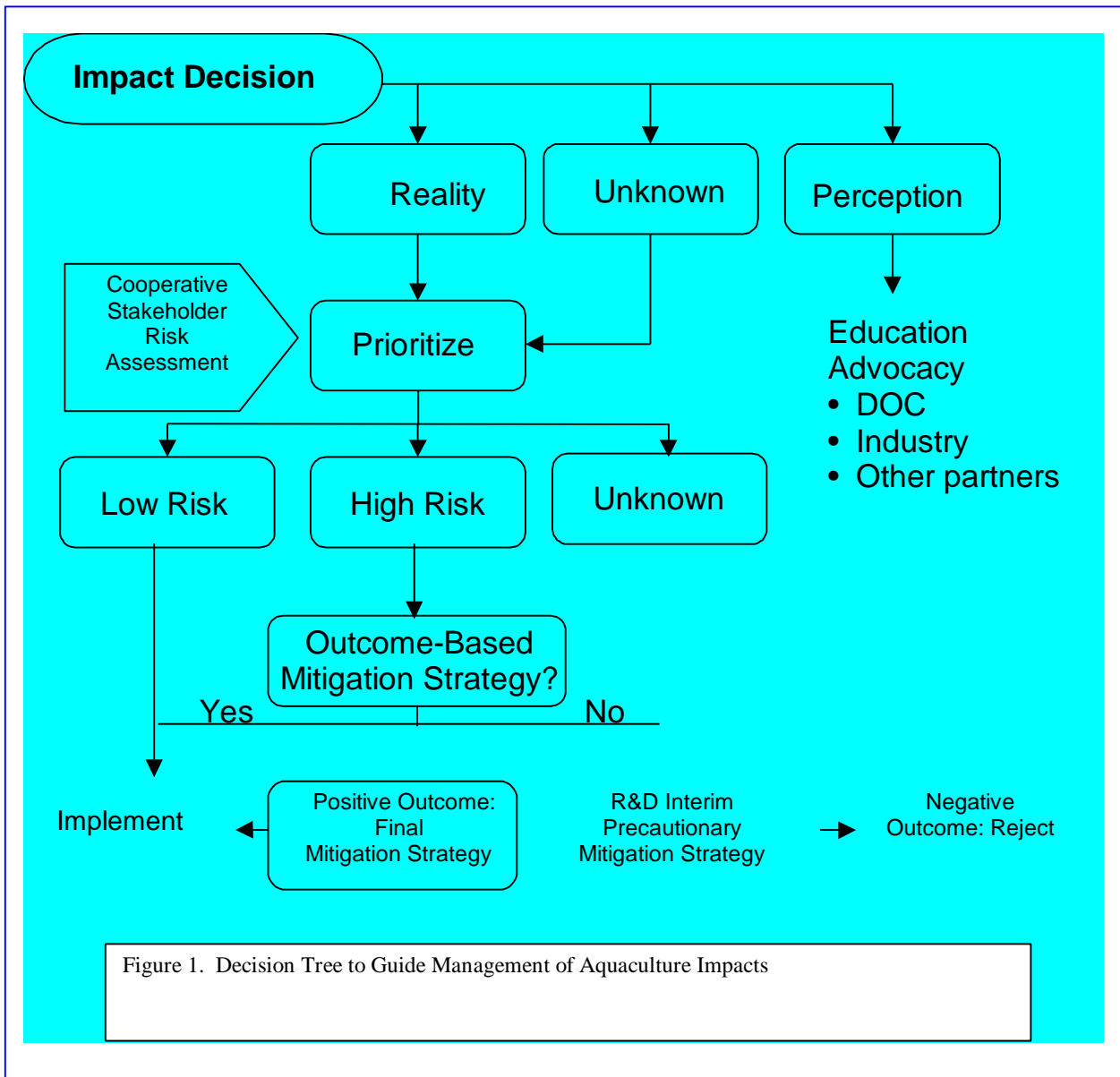


Table 1. Risks of Aquaculture

| Commercial | Stock Enhancement |
|--|--|
| Increases wetlands destruction | |
| Causes water use disputes | Causes water use disputes |
| Increases salinization | |
| Alters land Use | Alters land Use |
| Increases multiple-use conflicts by and on aquaculture | Increases multiple-use conflicts by and on aquaculture |
| Introduces nuisance species | Introduces nuisance species |
| Mines wild stocks for broodstock or grow-out | Mines wild stocks for broodstock or grow-out |
| Changes biodiversity | Changes biodiversity |
| Changes trophic interactions and productivity | Changes trophic interactions and productivity |
| | Displaces wild stocks |
| | Overharvests wild stocks |
| | Cannibalism on wild stocks |
| Outbreeding and inbreeding depression | Outbreeding and inbreeding depression |
| Alters genetic representation altered | Alters genetic representation altered |
| Enhances diseases and parasites in wild stocks | Enhances diseases and parasites in wild stocks |
| Alters coastal navigation | |
| | Displaces wild stocks |
| | Lacks demonstrated effectiveness |
| | Not cost-effective |
| | Diversion of resources from other core issues |
| Increases effluents (wastes and therapeutics) | |
| Transfers diseases and parasites to wild stocks | Transfers diseases and parasites to wild stocks |

Table 2. Benefits of Aquaculture

| Commercial | Enhancement |
|--|--|
| Recover protected species | Recover protected species |
| Supplements wild stocks | Supplements wild stocks |
| Maintains e of coastal fishing culture | Maintains e of coastal fishing culture |
| Maintains fishing infrastructure | Maintains fishing infrastructure |
| Reduce trade deficit | Reduce trade deficit |
| Increase education and environmental awareness | Increase education and environmental awareness |
| Stimulates technology development | Stimulates technology development |
| Enhances biodiversity (addition of structural diversity) | Enhances biodiversity (addition of structural diversity) |
| Improves or enhances habitat | Improves or enhances habitat |
| Provides food | |
| Increases jobs and economic development | Increases jobs and economic development |
| Protects wild populations from overexploitation | Protects wild populations from overexploitation |
| Advocates for protecting water quality | |
| Increases nutrient removal | |
| Removes of suspended sediments and nutrients | |
| | Develops urban fisheries |
| Develops methods to treat and manage disease | Develops methods to treat and manage disease |
| Stimulates research on early life history of fish | Stimulates research on early life history of fish |
| | Increases recreational fishing opportunities |
| Reduces variability in production cycles | Reduces variability in production cycles |
| | Increases habitat utilization |
| Reduces trade deficit | |
| | |
| | Increases recreational fishing opportunities |
| | Conserves genetic diversity of wild stocks |
| Stimulates development of disease resistant strains | Stimulates development of disease resistant strains |

Managing Impacts

The group designed a decision tree, which outlined a sequence of actions to guide the management of aquaculture impacts. The first step in the decision process is determining the reality of the impact. If, after a review of current information, the impact is verified to be real, that risk of impact is ranked as low, high, or unknown. The group discussed various strategies for making this determination. One strategy was to relegate risk analyses to a council, similar to the Fisheries Management Councils. The council would have representation from all stakeholder groups (e.g., state, federal, private industry, environmental NGOs). Another alternative discussed was for an independent body, such as the NRC to make the risk assessment. After some debate the group determined that an assessment by both stakeholders and independent assessors was the most viable option.

The group agreed that some level of impact by aquaculture should be tolerated. As one participant put it "there must be some level above zero tolerance on impact for the aquaculture industry to succeed". Therefore, some impacts should be categorized as low and tolerable. Aquaculture practices with low risk for impact should be allowed to proceed with routine monitoring. Impacts with high risk of impact could only proceed if an outcome-based mitigation strategy was in place. The groups felt very strongly that it was key that the mitigation strategy be outcome-based.

If the risk of impact cannot be determined, then research and development must be conducted to determine the actual risk and to develop a mitigation strategy. In some cases interim precautionary measures can be employed while the research and development proceeds. If no satisfactory mitigation strategy presents itself the activity should not be permitted.

Defining and Managing Negative Impacts: Recommendations

The group admits that one of the foremost barriers to the development of aquaculture is the lack of a strategy to efficiently define and manage the potential impacts. A great deal of the group's discussion centered on defining both the negative and positive impacts of aquaculture. A mere listing of the potential risks and benefits of aquaculture does not go very far in addressing the problem. To lower the barriers to aquaculture development in the U. S. the negative environmental impacts must be rationally assessed and managed via a process such as outlined in the decision tree.

Therefore the group recommends that:

- Outcome-based environmental codes of practice are developed with NMFS support. These codes should give the industry some regulatory stability.
- Strong collaborations be built among industry, academic, NGO, and Tribal entities for risk assessment.
- That decision trees similar to the one developed by the group be utilized as a framework to efficiently define the real impacts of aquaculture and to determine outcome-based mitigation strategies to manage them.

Reducing Other Barriers to Aquaculture Development: Recommendations

The risk of negative environmental impacts is not the only barrier to aquaculture development. The paucity of advocacy for aquaculture in the federal arenas, the potential for multi-use conflicts, and the lack of centralized information sources for risk assessment and permitting all pose major risks to the development of aquaculture in the U. S. The group recommended several strategies for mitigating these other impacts to development.

Advocacy and Information Services

The need for consistent advocacy for aquaculture was mentioned throughout the group discussions. Individuals felt that at the local, state, and federal levels, informed advocacy is lacking. A proposed solution was to establish both national and regional aquaculture offices within NMFS. Placement of an aquaculture specialist in each of the NOAA line offices to represent the interests of the industry was also proposed. Finally, pulling aquaculture from within the "Build Sustainable Fisheries" (BSF) strategic team in NMFS and giving it team status was proposed. Current placement of aquaculture within the BSF team may compromise industry interest due to the real or perceived user conflicts with the wild-caught sector of the fishing industry.

One of the major problems facing the industry today is that the inflexibility and complexity of existing regulations preclude new startups. As one participant put it, "can you imagine trying to get permits to develop the poultry or cattle industry or to mass produce corn or soybeans in this day and age?" A streamlined centrally located permitting procedure and information source would go a long way toward resolving the problem.

In order to improve advocacy and information transfer the group recommends that:

- A national NMFS aquaculture office with regional representation be established
- Aquaculture be elevated to a separate strategic plan element and that coordination between strategic plan teams be improved
- Aquaculture specialists be housed in each line office in NOAA.

Multiple-use conflict

The group felt strongly that aquaculture must be recognized as having equal rights as a coastal user. Some individuals even felt that aquaculture should be recognized a preferred coastal user since relative to some other coastal users the impact of aquaculture is minimal. Zoning was brought up and discussed as a mechanism of ensuring that the nascent industry had rights to waterfront property. Zoning was viewed as a good means of holding land, but has bad points as well. Someone made the point that if it is possible to "zone in" aquaculture, it can also be zoned out. Zoning could compress the industry into centralized locations, exacerbating potential disease, and primary productivity removal (shellfish) or increases (finfish).

In order to mitigate the multiple-use conflicts the groups recommends that:

- Aquaculture is recognized as a preferred water-dependent user in the coastal zone.
- NOAA exercises its advocacy role to help solve user conflicts.
The public (which includes the harvest industry) is educated on importance of aquaculture in coastal communities.

Questions and Answers

Q: What's is meant by "preferred use" for aquaculture?

A: On the West coast we determine if an activity is water *dependent* or water *related*. For example, tourism is related, aquaculture is dependent. It's a matter of emphasis, not necessarily one of preference.

Q: Don't practitioners of aquaculture ready to subscribe to codes of practice? Or are we the regulators going to cast the regulators in the role of "stay out of my face"? Most industries that buy into a code of practice will subscribe but then you have bandits who ignore them, and they undermine the system.

A: People from the industry were/have been pretty positive about the idea of at least trying them out. West Coast Shellfish people are very motivated to do this.

A: In Maine, the salmon and other net-pen farmers produced a code to cover the issue of escapees so that farmers would police their neighbors. Trying to codify this isn't easy, but industry did come forward and ask to have this done.

A: Is anyone else here a representative from the environmental community? I don't think there are many here?

Q: Regarding codes of practice: We need periodic inspection/review and enforcement of that code to make sure it's working and give it added credibility.

Q: We also need to recognize that the industry is worldwide. Already a large body of knowledge exists and plenty of precedent in the appropriate environments and with the relevant species we can draw upon. We can easily jump start codes of practice by adopting others'.

Q: Having dealt with regulatory process in my own state, "No Risk" approach for permitting isn't realistic since we don't have perfect information, and discourages interest in aquaculture.

Q: There exist serious perception issues - it more than just an academic question. We need to do more outreach, get the scientists out into the field to educate the public about the honest, positive aspects of aquaculture.

Q: Are people going to come to NMFS for a source of expertise? Because we are not sure we could handle the additional responsibility.

A: Yes, NMFS needs to get more involved in this.

Q: In that case, you will see regulators in a position of having to promote that which they are regulating, get co-opted (i.e. Go native), and end up as advocates. A broader partnership, going beyond NMFS, to agencies like the EPA, the Corps of Engineers, they need to be involved, too. Therein lie the expertise, and the regulatory interest

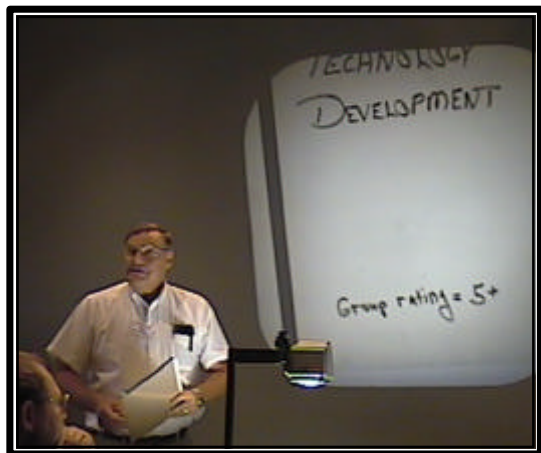
CONCURRENT SESSION C: Marine Aquaculture Technology Issues

Chairman: Robert Stickney

Rapporteur: Ben Mieremet

Participants: Russ Allen, Michael Osterling, Tony Calabrese, Michael Schwarz, Wade Watanabe, Scott Lindell, Paul Olin, Barry-Costa, Pierce, Al Tacon, Douglas Drennan, LeRoy Cresswell, Paul Bauersfeld, Michael Rust, Paul Brown, Cliff Goudey, John Cates, Al Stokes, Chris Langdon, Ken Chew, Ann Goodman

Technology improvements are needed if aquaculture is to grow at a rate that will support a five-fold increase over the next 25 years. Granted, many factors must be considered in the equation including economics and marketing, foreign competition, environmental and social constraints (politically correct and acceptable), etc., and all these factors must be integrated when defining priorities. Technology, however, will help the aquaculture industry overcome many of the obstacles it faces in meeting regulatory requirements, production and market acceptability.



Technology research and development is, or can be expensive, and we would clearly need funding that far exceeds the money considered, for example, under the Build Sustainable Fisheries Initiative or the President's Ocean's Budget for aquaculture. Partnerships will be needed between industry (and by that we mean from small co-ops to larger industrial operations), the academic community, governmental agencies like NIST and TA in Commerce. There can be a mix of collaborators or more effort to foster inter-departmental collaboration for both inland activities and marine waters. There is also expressed interest in greater international collaboration as there is much we can learn from overseas efforts since there is a great deal of overlap of issues being addressed and large sums of resources are being poured into aquaculture technology. While much of our technology has been shared overseas in the past, others have made many refinements and improvements. Formal partnerships with international experts are

something that NOAA could support or increase (including the need to pay for services, if needed). And once we learn things, we need a larger outreach program to distribute technologies (i.e., increase the number of Sea Grant extension agents to begin with).

We explored cage systems, recirculation systems, feeding technology needs such as first feeds which is a major limiting factor in the growth of many potentially lucrative new market fish (food and ornamentals), genetics, and some miscellaneous technologies. There is no lack of interest or need in any of these areas. Frequently brought up was the need to develop regional hatcheries (Centers of Excellence) where commercial scale research could be conducted and many different interests satisfied (federal, state, industry, environmental). There is one in each Japanese Prefecture but costs may be on the order of \$50 million. You can develop technology, but you have to have pre-approved places to try it out, otherwise the overall cost factor continues to climb. Without such facilities, it is likely we will continue to have disconnects between research, academia, industry and the regulators. This may require trying to remove some institutional/financial impediments on funding (e.g., Hawaii has been successful with demonstration grow-out development, but could not sell mature fish to recoup feed costs) if we are to achieve continual improvements and success. DOC should undertake a study to see if constraints on the use of funds will constrain achieving policy objectives.

Additionally, if research and technology development is to take place in the EEZ, then there is a need to develop aquaculture zones (parks) where this can take place as well as meet future industry needs. Consequently, technology development in some cases may be dependent on those who can develop such zones or parks and minimize the hurdles to allow design and experimentation which continues our theme of the need for collaboration and integration between interested and affected parties. Siting such zones may be dependent on the capabilities of structures, nutrients and salinities, etc., so it is not just a matter of where can we establish aquaculture that won't interfere with other ocean users. There was a general feeling that regional markets will help decide which species to concentrate efforts on and to focus on the technology that satisfies numerous types of fish species.

Genetic Technology

There are constant efforts being made to genetically improve species to make them more economically viable and marketable (i.e., grow faster, more disease resistant, etc.). However, once you make a better market species, then the Feds and others don't want any escapees into the wild where they may interact with wild stocks. It takes long-term research and large amounts of money to do a good job and the government should spend some research/technology money in this area consistent with other agricultural research. The types of technologies needed in this area include:

- biosecurity
- diagnostic techniques for monitoring (differentiate wild/modified species with genetic markers)
- sex reversal (monoculture through the use of temperature during the larval rearing stage and hybridization improvements)

- cryopreservation of genetic stocks and technology to preserve eggs and ensure year around production -- a germ plasma bank for aquatics
- "suicide" genes may hold promise but are often linked with transgenics which is controversial.
- a model or tools used to predict the degree of genetic "pollution" and its impacts
- molecular genetics and biotechnology

Feeds and Feeding Methods

The "feeding fish to fish" argument is of growing concern so technology needs are important here. There are problems with the phosphorus content of fishmeal and diotoxins and fats. There is a need to improve the quality of natural feeds as well as synthetic feeds. There may be some hope to use synthetic amino acids to supplement plant food for carnivorous fish. Herbivorous fish only is not the answer and even China is using less carp. Consumers want fish to be "greener" so much progress needs to be made. There is a feeling that there should be some defense made against articles on perceived impacts from the use of fish protein to grow fish because the articles do not tell the whole story. It was not clear as to how or how this should be done.

Both production and processing technology are things that require additional funding. Processing technology improvements are needed to customize and meet industry requirements and public health standards. Areas include:

- feed delivery systems including waste feed detection systems to stop waste,
- pellet stability,
- palatability,
- feed control,
- poly-culture,
- efficient feeding,
- first feeds, designer feeds (smoked vs. fresh), broodstock feeds, maturation or finishing feeds (first feeds need more work with respect to looking at the quality of natural feeds, the development of prepared foods, nutritional requirements of all species, and production technologies).
- recirculation system feeds.

In all cases we need to look at the environment in which the feeds are introduced and the ability to link nutrition with genetics (i.e., carnivores that can use plants more efficiently), nutrition endocrinology (feeds which influence hormone levels), and diseases (the topic of diseases was not discussed, deferring to the aquatic health breakout session).

Cage and Cageless Culture Systems

Can we invent better cages? Yes, there can be improvements made, but it is not possible to guarantee no future escapes. Industry should be the big driver in this area and they are working

on designing better cages. It is possible to improve the siting of netpens so that they are not located in the most damaging or environmentally sensitive areas. There are many factors that need to be integrated in the design of netpens (economics, fish physiology, physical stress, social concerns and other environmental interests) so the issue is greater than just engineering and technology requirements.

With respect to escapees, there are a number of approaches that can be tested to recapture or lessen interactions with wild species. Fish behavior (escapee biology), horns on cages and use of lights for 24 hour feeding can be employed. Biofouling of cages is also an issue related to netpen systems that needs further technological improvements as well as mooring systems to reduce marine mammal interactions that might harm such species. Partnerships between regulators, academia and the industry would be beneficial so that future cages are designed to meet major requirements and expectations.

Economically speaking, there is a need to grow high value, marketable species because of the cost of the structures. Consequently, protocols for species selection may be the engine for determining the technology needed (i.e., custom cages for different species). Netpens may only be acceptable in certain areas. Near shore, they are seen as visual pollution by coastal dwellers (vs. greater acceptance in the E.U. and Japan). Economics is a big issue in siting near or far from shore (greater energy costs, etc.), and so the effects of scale will be very important.

Non-moored systems and even cageless culture (aka sea ranching), may be especially important in the EEZ where mooring may not be feasible. It may be possible in Hawaii to employ drifting cages. Non-moored cages could result in no taxes for use of public resources.

Last, there is much work yet to be conducted on shellfish/non-fish (algae, other plants) culture technology.

Offshore Technology Development

There are a number of impediments to offshore (deep State water or in the EEZ) aquaculture development that may slow down technology development. There is a question if industry is enthusiastic because of regulatory hurdles, financial risks, and a potentially more threatening environment in which to work. The potential benefits, however, can be great (economies of scale, satisfying social and environmental concerns), so technology development may be significant in answering some of industry and regulatory concerns. Technology may include developing artificial upwelling systems to increase nutrients for shellfish (being practiced by the Japanese), automated systems (feeding, maintenance and surveillance) to reduce manpower requirements and be more competitive, feed holding systems, and feed stability in submerged systems. Funding should first go into moored pen systems.

Impediments to offshore development are many (legal, economic, physical) but include lack of data for siting good sites so much data may exist within NOAA but there is a need to get it and use it in the siting process.

Environmental Technology

This is a ripe area for technology development as many of the toughest issues relate to satisfying environmental requirements and concerns. Areas include:

- waste handling -- both treatment and recycle/use of products,
- biosecurity,
- marine mammal interactions,
- environmental manipulation (reducing waves, increasing nutrient upwelling (see examples of Dr. Morikawa),
- predator control,
- monitoring (habitats, prediction),
- siting (inland, estuarine, offshore),
- bioremediation,
- large scale system design (need collaboration with government, academia, industry and investors).

There is a strong federal role in many of these areas because they can satisfy federal requirements (i.e., protect water quality, marine mammals, etc.), but some can best be done by industry (cage system designs). It is estimated that this is a costly area for R&D but some work can be done with small funded projects on a short-term basis.

Recirculating Systems

"Recirc." systems hold great promise but are a moving target. They can help solve problems related to escape issues and water quality. There are so many systems that the government shouldn't be suggesting which is best so long as they meet required standards. The federal government could give advice on systems (through extension services), but large-scale federal demonstration projects are not required. Whether or not they can be economic for the production of final products depends on species, price, life stage (i.e., early vs. grow-out) and energy usage. A large part of the problem is the scale of operations and this is more technology driven than market driven at this time. It is likely we will see very large-scale recirc. systems (50 hectares) for shrimp using bioremediation on inland sites where land is cheaper than in coastal areas. Here is an area where we may see greater collaboration between traditional DOA sponsored research and NOAA sponsored research. Technology development is still needed for waste disposal from saltwater systems which cannot be disposed on land like freshwater systems, water quality and the product quality of the fish (taste), reducing energy usage and feeds.

Early Life Cycle

There is much effort needed to close the life cycles of emerging species and for non-food species (used for pharmaceutical and ornamental purposes), which have not received much attention for many years. They are big market items and can help satisfy other purposes (i.e., saving corals and reef fishes, satisfying national aquarium demands). First feeds, for example, are a major

problem for marine ornamentals and therefore the number of available cultured species is still small. Technology in this area is also needed for endangered species and stock enhancement purposes and how it can be done in an environmentally sound manner.

Group Priorities

During the second breakout session, the group was asked to identify research priorities with respect to importance and short-term, long-term timeframes for implementation. Technology development was lumped into three major areas:

Hatchery Technology (Rating: 5, Timing: Now)

There is a need for commercial state-of-the-art hatcheries that can supply the stock for grow out. Important issues include:

- diseases,
- biosecurity,
- bioremediation,
- life cycle closure (industry needs help with this),
- emerging species,
- genetics (do we want to create transgenic fish?),
- feeds, especially at the hatchery level,
- recirculation systems,
- nutritional requirements,
- automation.

Growout Technology (Rating: 5, Timing: Now)

Growout technology is important to the industry. Most of the hatchery technology issues above are linked to growout needs. In addition, the following issues are areas where improvements are needed:

- disease control,
- product quality, processing, and marketing,
- biotechnology,
- transgenics,
- probiotics,
- waste management in hatcheries and large systems with high biomass,
- offshore technology development,
- polyculture.

Post Release Enhancement Technology (Rating: 3, Timing: Long-term)

The group feels that protocols need to be developed by appropriate authorities and interest groups so that researchers will know what standards or constraints they are working under. Issues to be addressed include:

- ecosystem studies using markers (visible or genetic) and track, using fish attracting devices (ATD's), etc.,
- genetic diversity (as indistinguishable from wildstocks as possible),
- nutritional attributes (designer feeds) for survival enhancement,
- exotics and non-native species production while addressing environmental and safety concerns,
- monitoring technologies,
- artificial habitats.

Questions, Answers and Comments

Q: Was there any way to weigh the environmental costs/benefits of enhancement?

A: We were charged to look at technology development needs and technological improvements. We felt that what happens to species, their interactions, etc., once released, are major environmental concerns and would involve other interests.

Q: Was there any discussion of (salmon, trout) stocking programs? Have they been proven worthwhile?

A: These are not generally thought PC. They generally have not had to prove themselves to be cost effective to satisfy the recreational/sport industry. In the future, we want to be able to demonstrate that release programs are effective and make a difference.

Comment

South Florida has taken the stand that enhancement is politically incorrect.

Comment

Marking and tracking - lots of work has been done on this in Alaska.

Comment

With stock enhancement you have to track the progeny of wild stocks to determine the long-term consequences. Genetic markers are the only reliable means of determining where a farm-raised fish or its offspring originated; there is no other certain way.

Comment

Enhancement has been compared to privatizing a public resource.

Comment

We looked at it in the aquaculture impacts session. Responsible stock enhancement in South Carolina was offered as a model - published in the literature and referenced in other publications. It can be done.

Q: Regarding your facilities discussions, what was the consensus? Something like the Japanese projects?

A: Regional facilities. Large demonstration facilities for commercial viability. In partnerships.

Comment

Universities have already done well as locations for seed stock development, though they often don't close the growth cycle.

CONCURRENT SESSION D: Aquatic Animal and Plant Health Management and Product Safety and Quality

Co-Chairman: Spencer Garrett, George Flick
Rapporteurs: Dorothy Leonard, Bob Collette

Participants: Mike Jahncke, Bob Collette, George Flick, Emillo Cole, Tom Ellis, Jerry Erbacher, Sebastian Belle, Bryan Plemmons, Tom McIlwain, Otis Miller

Aquaculture Animal and Plant Health Management Issues

Role of Federal Agencies:

There are a multiplicity of Federal agencies (National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Agriculture (USDA), U.S. Department of Interior (USDI), Food and Drug Administration (FDA), Corps of Engineers, etc.) that play a vital role either directly or indirectly in aquaculture relating to aquaculture animal and plant management issues and resolutions.

There appears to be a misunderstanding by some in the positive role the USDA's Animal Plant Health Inspection Service (APHIS) plays in addressing many of the aquatic animal and plant health management issues.



Aquaculture, being the managed production of aquatic plants and animals, continues to grow as a major agribusiness enterprise. The USDA's APHIS provides these producers with a broad range of cooperative programs for protecting the health of animals and plants.

APHIS currently serves aspects of both plant and animal aquaculture involving disease, pest prevention and wildlife damage management. Because of increased global trade, APHIS is involved in facilitating importation and exportation of aquacultural products. Services for aquatic plant protection throughout the U.S. include prevention of importation and dissemination of plant pests and diseases, the control of undesirable aquatic plants and the development of pest and disease control methodology.

APHIS provides aquatic animal health activities that include diagnostic assistance to aquaculture producers and works with the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, and the Joint Subcommittee on Aquaculture in order to disseminate information to best meet the aquaculture industry's animal health needs.

Assignment: Identify needed aquatic animal and plant health services for aquaculture enhancement, and determine whether such services are of a short term or long term nature and indication of a priority ranking (one to five: one ' low, five ' high). The assignment also categorizes the issue resolution as being needed for stability, certainty or transparency for the aquaculture industry.

A. Background and Prevalence

- A1. There is a need to identify and prioritize aquatic animal and plant health and associated issues services, epidemiological impacts for which diagnostic services are required. Resolution for this issue should have a short-term priority of five and is necessary for stability and certainty. For example, where this has not been done by APHIS², the background and prevalence of Aquatic Animal Diseases (AAD) and Aquatic Plant Diseases (APD) should be determined. This could have a short-term priority of number five. Resolution of this issue is necessary for stability, certainty and transparency.
- A.2 Recognizing that background and prevalence of AAD and Plant Health Diseases (PHD) are difficult to determine without reliable tests, standard uniform protocols and methodologies should be developed for crustaceans as well as other species. This should have a high priority rating of number five, and is necessary for stability, certainty and transparency.
- A.3 Monitoring and Surveillance is necessary when warranted premised upon demonstrated need, i.e., research, control, or certification. This should have a long-term priority of five, be ongoing, and is necessary for stability, certainty and transparency.

2 This statement applies to a number of additional issues listed below and implies that there are areas where collaboration (in research, for example) and partnerships could be beneficial to the industry as well as agencies and is not intended to question or dispute legislated or lead agency responsibilities for these issue areas being addressed.

- A4. Outreach is necessary to engender mutual trust and recognition (public and industry) and should receive a long-term, priority five initially and three for ongoing efforts. Outreach is necessary for stability and transparency. Such outreach activities should include training in Good Management Practices of disease risks.

B. Diagnostic Services

- B1. Uniform regulations for testing and laboratory certification needs to be developed. This represents a long-term high priority number five rating. This activity is necessary for stability and certainty.
- B2. Uniform international certification schemes for products, procedures and methods need developing for both imports and exports. This would be a long-term effort with a priority rating of number five. The effort is needed for both stability and certainty.
- B3. There needs to be developed a provision which would differentiate between large and small operations regarding uncertainty in certification procedures. This could be a short-term effort with a priority of four rating and is necessary for stability and certainty.
- B4. A clarification of roles between government and private third party certification bodies in certification activities, particularly at the State level, must be defined. This would be a long-term priority activity with a number three rating and is needed for stability, certainty and transparency.
- B5. In terms of certification schemes, there needs to be a broader recognition of the wide diversity among and between the various aquaculture industries addressing food production, ornamentals, species (wild stock augmentation) and egg or juvenile production. This issue relates to stability, certainty and transparency.

C. Emergency Management/Emergency Preparedness

- C1. The current national notification scheme for reporting serious transmittable diseases needs to be more broadly understood. This issue is of both a short and long term nature and should receive a high priority (number five) in each case. Within the confines of the national notification scheme for reporting serious diseases, there should be a confidentiality provision. The notification system is necessary for stability, certainty and transparency.
- C2. Wherever monitoring and surveillance activities for emergency management and preparedness are needed, it should be done in a transparent fashion. This would be a long-term activity receiving a high priority (number five) initially and a number three for ongoing efforts.

- C3. When stocks or products are destroyed for regulatory purposes relating to AAD or PHD, an indemnification program should be implemented for stability and certainty purposes. This should receive a short-term priority rating of number five.
- C4. There is a need for a National Reference (Disease) Laboratory for aquaculture. This requirement would be a long-term effort receiving an initial high priority of number five, reducing to a lower priority of number three for maintenance of on-going efforts.

D. Prevention and Control of Predators

- D1. As a general issue research thrusts under this category of concerns are needed for stability, certainty and transparency and would be a long term, ongoing effort that should receive a high priority of number five.
- D2. Avoidance technology is an aspect of research, which should be pursued and, when available, should be implemented over the long term and should receive a high priority rating of number five.
- D3. Monitoring the interactive environmental dynamics (such as eating habits, habitat, migration habits, diet, etc.) should be researched and when determined known, be factored into all relevant Risk Assessments. This will be a long-term activity receiving a high priority rating of number five.
- D4. There should be developed uniform regulation standards, policies, etc. relating to prevention and control of predators and such activities would be of a long term nature receiving a high priority rating of number five. This is a need for stability, certainty and transparency purposes.
- D5. An ongoing outreach technical assistance program to assist operators in the prevention and control of predators needs to be developed. This would be a long term effort, receiving an initial high priority rating of number five to initiate the program, which would then have a reduced priority of number three for programmatic maintenance efforts. This activity is needed for both stability and certainty efforts.

E. Treatment and Prevention

- E1. Biologics, antibodies, therapeutics, vaccines and chemicals to treat or prevent diseases, or enhance broodstock resistance to diseases, need more rapid development, approval, and utilization. This is a long-term activity, which should receive a high priority rating of number five. This activity is necessary for stability, certainty and transparency.
- E2. Rapid test kits need to be more quickly developed, approved by APHIS, and utilized. This could have a short term rating priority of number three and is necessary for stability and certainty.

E3. Further research is necessary to enhance broodstock resistance to disease. This is needed for stability and transparency.

F. Animal Husbandry Methods

F1. Recognized General Principles and Guidelines for Biosecurity Control for Aquacultured Species and Processes should be developed. This should receive a high priority somewhere between four and five. These measures are necessary for stability, certainty and transparency.

F2. Nutritional requirements for certain aquaculture species need further definition, particularly as they may relate to animal health diseases. This would be a long-term effort and should receive a priority rating of number four and is necessary for stability reasons.

F3. A central information source should be recognized as an official repository of information. The Office of International Epizootics (OIE) does serve as this function. This should receive a high priority of five and is needed for stability, certainty and transparency.

F4. Improved waste management techniques needs development. This should be a high priority number of five and is needed for stability, certainty and transparency.

F5. Improved biosecurity techniques and systems (with possible redundancies) should be developed. While the priority for this development may change with the target species, nevertheless, overall it should receive a high priority number five and is needed for stability, credibility and transparency.

G. Definition of an Acceptable Level of Protection (ALOP)

G1. There should be defined or developed an Acceptable Level of Protection (ALOP) based upon Risk Assessment for AAD and APD that provides for a reasonable acceptable level of protection for AAD and APD which is minimally economically disruptive. The Office of International Epizootic's current standards should be evaluated to see if they meet these criteria. This would be a long-term effort with a priority rating of number five, and is necessary for stability, certainty and transparency.

G2. Risk Assessment is an emerging issue, which should receive a high priority (long-term, priority five) and is necessary for stability, certainty and transparency. The current Office of International Epizootics (OIE) and Codex Alimentarius (Codex) General Principles and Guidelines for the Conduct of Microbiological Risk Assessment should be evaluated for possible interleaving of requirements.

H. Information and Technology Transfer

- H1. There should be improved risk communication techniques and delivery systems developed and implemented. This is a long-term effort with a priority rating of number five and is necessary for stability, certainty and transparency.
- H2. Pilot Project Demonstration Centers should be developed and instituted. This would be a long-term effort receiving a priority of number five and would primarily relate to stability and certainty.

Aquaculture Product Safety and Quality

Reported by: George Flick

Report by: Uday Joshi

A. Chemical, Biological and Physical Hazards (Priority 5)

Chemical, biological, and physical hazards have been addressed by the Seafood Alliance which consists of a large alliance of agencies and organizations. A hazard guide is published by the Food and Drug Administration and will be updated on a continuing basis. Many hazards have already been defined by species and we just need to keep it going. There are four recommendations:

- A1. Identify new hazards and its sources unique to aquaculture.
- A2. Determine the effects of rearing (culture) systems on food safety, (i.e. polyculture).
- A3. Determine what hazards are reasonably likely to occur.
- A4. Develop hazard identification, hazard analysis and specific HACCO plans for aquaculture species and rearing systems.

B. Genetically Modified Organisms. (Priority 5)

- B1. Product safety needs to be determined for consumers
- B2. Research concerns to be satisfied:
 - a. address the problem of microbial resistance to common antibiotics
 - b. identify unknown hazards that could exist

C. Determine the effects of production methods on product safety (industrialized and non-industrialized countries). (Priority 5) Examples include:

- C1. Animal wastes used for pond fertilizer resulting in the transmission of various hazards;

- C2. Unwholesome products used in the production of aquaculture feed which can result in the transmission of various hazards,
- C3. Incorporation of untreated aquatic carcasses into aquaculture feed resulting in the transmission of various hazards.
- D. Determine the effects of drug usage on consumer safety. (Priority 5)**
 - D1. Antibiotic resistant microorganisms.
 - D2. Identify possible precursors to the formation of carcinogens, mutagens, teratogens.
- E. Develop and improve proactive communication methods for getting food safety issues to the consumers. (Priority 5)**
- F. Implement a mechanism to assist in obtaining resources, both financial and human, to address food safety issues. (Priority 4)**
- G. Equivalency of inspection having uniform national standards and eventually worldwide. For this we need rapid, reliable and affordable testing methodologies for chemical and microbiological hazards. (Priority 3)**
- H. Need industry to take advantage of state and federal (i.e., DOC, USDA) marketing programs. (Priority 3)**
- I. Need to develop a definition for "organic" as applied to aquaculture and seafood. (Priority 1)**
- J. Quality promotion activities should be addressed by state marketing agencies and industry groups. (Priority 1).**

Questions, Answers and Comments:

Comment

My growers (Washington) are very nervous in this area. We worked hard during the last 15 years to get APHIS in the lead, in particular areas like certification and diagnostics. The state legislatures funded diagnostic labs, agriculture extension programs, would we risk another regulatory layer built upon that which already exists? There is plenty of room for research and development. Already multiple layers in safety and antibiotic areas (HACCP, FDA) are in place. The DOC needs to take a close look before adding another layer or trying to jurisdictionally circumvent or take over when somebody else is already active in that area.

- A: I agree. It is not our intent to set up a new regulatory layer at all. We may serve as a one stop shopping center and try to coordinate some of these activities but would not duplicate any of these functions.

Q: You talked about fast tracking approval processes for treatments. We are interested in seeing regulatory approval process for groups of marine fishes - approval process by certain types - flatfish for example. Then you can write the regulations in a bunch because they are for a group that have the same habitat, feed, rearing and safety requirements.

A: The FDA Center for Veterinary Medicine is a more appropriate agency to which to address this question. NMFS would recommend a fast track approval system, but certainly wouldn't do it ourselves. We need to remember they have their regulatory and public trust responsibilities as well. We support some extra label uses as some of you know.

Comment:

On the shellfish side on the west coast for certification, there is a lot of shellfish in the culture mode that is moving up and down the west coast. You have hatcheries and nurseries and products moving back and forth and we do it with cooperation between different state departments of fish and wildlife and pathological certification and once again we want coordination with the state programs so we are not looking at a new layer. On the marketing end of it, there is an aspect brought up that I haven't heard of before, and as an industry particularly where some of this aquaculture energy is being directed at job retraining programs, e.g., Cedar Key Clam fishery that has evolved over the last few years and is now producing millions of pounds of clams. They have a pretty effective marketing program with assistance from the state. But what we are seeing nationally is an impact that drives the overall price for clams down for steamer clams. We need to look at some sort of national program to look at promoting aquaculture products in a marketing scheme so that as we are successful and we see these numbers, that we are not all affected in our bottom line by a reduced price.

CONCURRENT SESSION E: Building Partnerships with Federal, State, Industry and Stakeholders Participation

Chairman: Bill Rickards

Rapporteur: Olwen Huxley

Participants: Kevin Hopkins, Michael Cochrane, Ray Rolonde, Daniel Benetti, Linda Kahn, Jesse Chappell, Mike Hastings, Alan Bunn, Phil Pope, Scott Soares, Richard Ji, Ron Weidenbach, Robbins Buck, Gary Jensen, Jim Murray



Partnerships are essential if the aquaculture industry is to grow successfully. Activities that promote and improve partnerships should be given a priority 5.

Background:

The "Building Partnerships" group consisted mainly of university-related persons, with 2 or 3 industry members. Two NOAA members participated in selected parts of the group's discussions since they moved among the various other discussion groups.

The group was presented with a listing of questions and discussion topics which it could address during the allotted time, and the discussion leader was told that he could select from the list or add other topics, as desired. Rather than directing the group's topics, the leader solicited input from the group as to which points it wanted to pursue.

Thus, the group more readily addressed questions/topics with which it had some familiarity (i.e. how they view the various roles of potential partners, what is needed for a successful partnership, technology transfer). Because of limited time and a reluctance to address some of the questions/topics (i.e. role of JSA, international partners) due to lack of familiarity with these issues, the group focused its attention on matters related to the "who, what and how" of developing and maintaining partnerships.

The text that follows is a summarization of the group's discussions.

WHO:

Clearly, aquaculture partnerships can take many shapes, but the likely primary participants will be industry, academia, state and local agencies, foundations and the federal structure. If aquaculture is to become a functional sector of the national economy, all such effort must be industry-driven. The partnerships then evolve so as to be most effective in fostering aquaculture enterprise, and in many cases the academic and agency partners are in supporting roles.

Any combination of the entities listed can develop a functioning partnership, and over time, the partnership may include various combinations of the entities depending on the needs and functions to be fulfilled. All entities are not required for every partnership.

The group also noted that some private foundations (not named specifically) could be potential partners, primarily from the perspective of a partnering relationship with the industry or academic participants.

The group acknowledged that much of what it said on this topic was common sense, but it also emphasized that the success of aquaculture development rests with private enterprise and not with federal or academic programs by themselves.

WHAT:

The group identified several characteristics that are necessary for a successfully functioning partnership, regardless of which entities are involved. These included -

- * there must be a common desire or vision shared by the partners;
- * along with the vision, there must be shared objectives to hold the partnership together - but there can also be mutually exclusive objectives as long as they do not impede progress

toward the common objectives;

- * there must be an incentive for each partner to maintain the interaction;
- * information relative to the partnership must be freely shared;
- * the partners must present a unified, agreed upon position as the partnership functions are pursued;
- * the partnership must establish and maintain a local focus if the aquaculture enterprise is to emerge; and, above all,
- * all partners must communicate effectively with each other.

Successful inclusion of the above points will, over time, lead to the most important quality of a partnership, and that is trust. This cannot be legislated or mandated, and it depends greatly on personal interactions. Thus, the necessary trust is a tenuous and difficult quality to maintain - much attention need be given to developing trust, or the partnership will not reach its full potential.

HOW:

The group focused its attention on how successful partnerships might be developed and nurtured beyond the current workshop. In doing so, the group suggested follow-on functions, including:

- * agenda-development forums, involving all of the stakeholders in a mode similar to the current workshop, so that the requisite sharing of information and identification of common purposes could evolve;
- * any such partnership should set realistic and achievable goals so that success is possible;
- * follow-up meetings to review and revise the partnership's functions are needed;
- * mentoring relationships are needed in addition to the more customary accountability aspects;
- * the partners should leverage resources, thereby strengthening the reliance on each other and improving the partnership;
- * mechanisms must be developed for widespread local and regional input to the partnership; and, above all,
- * all partners must communicate effectively with each other.

FEDERAL ROLE:

The group also spent considerable time debating and identifying aspects of the federal role in various forms of partnerships (this was one of the primary topics provided by the workshop organizers).

- * Paramount among the federal roles noted was the continued support of relevant research and development, and the need for the research agenda to be driven by relevancy to industry needs and to include the ability to conduct long-term, more basic but relevant studies.

- * The need for aquaculture policy and regulation emerged as a frequently mentioned issue, as well as the need to examine regulations that currently impede the development of aquaculture.

- * The federal agencies are in a position to provide the needed leadership functions within the partnerships. The federal agencies may actually fulfill the leadership role, or they may assist another of the partners in assuming that function.

- * With industry input, the federal agencies are situated to be able to develop and promulgate industry-wide BMP's.

- * DOC's agencies are ideally situated to facilitate business development through low interest loans, and other forms of assistance, including revolving loan funds at the local level.

- * With the ability to have a "broader than local" view of emerging aquaculture, the federal agencies should promote stakeholder awareness of developments within the industry.

- * DOC should obtain stakeholder input through the creation of locally-based "advisory boards".

- * Federal agencies can facilitate all aspects of aquaculture education, through schools and universities, and including the public where seafood consumption may be expanded.

- * Through federal support, the technology transfer capabilities of existing extension and advisory services can be expanded to provide improved information resources for the emerging aquaculture industry. Expected results from increased emphasis on extension and technology transfer include -

- effective technology transfer networks can help avoid much of the "re-inventing of the wheel" syndrome that currently occurs in aquaculture businesses;
- knowledge from other countries is made available to an emerging business sector and the infrastructure that supports it;

- improved access to and awareness of the world wide web can bring significant benefits to the small aquaculture businesses that are struggling to keep up with technology;

* Federal support is also needed for conducting demonstrations of new and emerging technologies. Such demonstration projects should:

- be driven by local needs and input;
- include all partners;
- prove economic as well as technical feasibility;
- contribute to the development of trained aquaculturists; and
- encourage a shorter transition from the laboratory to actual application in an aquaculture business.

The "Building Partnerships" group hopes that its discussions contribute to furthering the DOC aquaculture initiative and that this initial workshop leads to a true partnering among all concerned parties.

Notes of the Session

Moderator: What are the various Federal Roles and Interactions?

General Comments:

Research - supporting public/private research. Federal role includes the long-term, basic research for which private funds are not really available. Even this area is fraught with difficulty. Universities never can provide funding long-term enough to embark on multi-year projects, so the federal government is going to have to do these types of projects itself, at its own institutions. Funding at the state level is unreliable, dependent heavily upon the inclinations of administration in power at the time.

Moderator: What is our goal when we leave here?

General Comments:

To come up with some recommendations/guidance for the Department of Commerce and other interested federal agencies. Fundamentally, with respect to partnerships, the role of federal and state governments is to create/permit a private sector aquaculture industry's existence. Right now, the development costs/effort are prohibitive (particularly the regulatory hurdles). We need opportunities, not obstructions.

Moderator: Do we need to develop this in isolation, or with the assistance of stakeholders?

Jesse Chappel:

We would like to see more of the private sector people at these kinds of meetings. Then you would see more buy-in from the private sector.

Federal and State Involvement

Moderator: Are there federal or state policies inhibiting the development?

General Comments:

Well, if the opportunity was out there, the people would be there, wouldn't they? The regulations that are on the books right now preclude aquaculture by default e.g. the catch-all limits on seasons and fish sizes by NMFS, not taking into account that aquaculture also supplies these species and that they are frequently out of season, undersized, or not permitted to be fished at all. A motley collection of statutes does everything BUT promote aquaculture. Aquaculture needs an all hands legislative and regulatory "house cleaning" to advance. The old statutes out there that pre-date development of aquaculture needs to be updated to take this into account.

Even today, contradictory policies being proposed by various agencies, also within agencies (no examples given).

Rosenthal: Who should be the lead agency in the states?

General Comments:

Industry has proposed a lead agency. It suggested the Department of Agriculture does that. We are being bombarded by problems and there is no clear authority.

Question: Should we separate mariculture and aquaculture?

Chappel: No. The work needs to be done; we don't care who does it. These separations may be meaningful to the federal agencies but the industry that does the work doesn't bother with this kind of distinction. It's not practical - it's political.

Regulations, Best Management Practices, and how to generate them

Wedenbach, Ron (Hawaii): Aquaculture regulations must be flexible enough to take into account regional and geographical differences. State governments tend to see a federal policy as an absolute, and the state governments don't get as involved as they should.

Chappel : What the aquaculture industry needs is a set of Best Management Practices (BMPs) - these would evolve constantly as the industry is evolving, too. So if you put these on the books in tremendous detail, they'll be outdated too quickly to remain standard. Keep them general and based on principles. But they will have tremendous utility.

General Comments:

The role of federal government - dole the \$\$\$ out to the universities for needed aquaculture research and keep the regulations science-based.

Refer to the Australian aquaculture development plan: it's very elegant.

Chappel: Lets take all the good stuff from all the other countries' plans. There is no point in trying to discover everything ourselves i.e. reinventing the wheel.

General Comments:

BMP's should be developed subject to scientific review and the industry must be kept apprised of results, and solicited for stakeholder input. (Some differences in opinion existed within the group on what BMPs are - some think they are a list of very general principles only, others think they are more detailed, with specific statements on safe environmental practices etc.)

The Federal Government has a role as a facilitator. We could use more assistance from the Economic Development Assistance (EDA w/in Commerce) program. The Federal Government has helped in funding the development of BMPs for the agricultural sector through consortia of university and industry researchers. Why not develop them for aquaculture the way USDA does their BMPs? We don't care which agency does them, by the way.

Maybe it would be better to try to get things done on the state level and develop a policy there. It may be unmanageable on the federal level to do this across the entire country and among all the species and geographic considerations. If there were regional issues, BMPs would have to distinguish between federal and regional jurisdictions.

Campbell: Perhaps at the state level we could render up 10 issues, they could get sent up to the regional/federal level and these could get sorted through and thus the national priorities could be generated from "grass roots". Perhaps we could have a priorities clearing-house manned by regional delegates. These priorities could get sent to the agency representatives and they could present these to their respective agencies. But - if the federal government doesn't come up with something, we the industry will.

An example. An Aquaculture Association meets, decides on priorities for legislation, research, etc. takes that as a working document, and takes that to Joint Subcommittee on Aquaculture level (Don't go through the states, it will take too long and be politicized).

Minnesota:

It's important who constitutes the membership of that board. The driving forces and priorities will derive from the membership. Try a national level Aquaculture Advisory Board. It would be better that industry end up determining the research and regulatory necessities. They could bring in the federal, state, and research people. Hammer out the issues at the National level. We can go to the regional level for specific solutions and information, if need be.

Moderator: Other suggestions of roles?

General Comments:

We desperately need regulations that are responsive to the needs and economic realities of a growing industry that competes with industries overseas that are well established. The role of the Department of Commerce is a coordinating function in this case. Particularly with NMFS.

Campbell: Traditionally, the Department of Commerce has dealt with marine aquaculture, but not trout, salmon, (i.e. river species) etc. in pens. So honestly aquaculture generally has not been the strong suit of Commerce, because although the marine sector has been a strong suit for Commerce, so much of the aquaculture in this country is inland, fresh water species. Aquaculture is farming, not the management of wild resources. Farming is agriculture, and the USDA should have jurisdiction in this area.

Someone From NOAA: NOAA has acknowledged this already.

General Comments:

However, the National Marine Fisheries people have been very important in learning about the fish life-cycle, and this has played an important role in commercial aquaculture development for marine species.

Hawaii: Having the federal government involved and endorsing an industry adds legitimacy to a business endeavor when dealing with a state agency/government who may be unfamiliar with the whole concept of aquaculture as a growth industry. If the federal government can review the issues scientifically, and make its approval of the industry known to the states, this defuses potentially emotional issues.

Rosenthal from Europe: You need to define the stakeholders in the marine environment where you practice/intend to practice aquaculture, because they have to adjust their practices to accommodate the equal rights usership of resources by this new industry. They need to be included and educated from the start in a proactive process to get them prepared, aware, and obtain their buy-in, etc. The Federal government can promote stakeholder awareness. There is an awful lot of ignorance about this. Then management comes from the point of view of ignorance and further inhibits the development of new aquaculture.

Moderator: Should the Federal Government lead? Is the government going to support leadership? Are we doing this from a corporate perspective? This is a fledgling industry.

General Comments:

Regulation: The Federal Government needs to do the regulation - that's its job. Industry can't/shouldn't do it, but it does need the regulation.

Research: the consensus appears to be that there's a role for the federal government to accomplish specific research goals, but where is the leadership coming for the accomplishment of these goals?

More coherent and realistic support: What we need is for the federal government to step in as they did with the computer and aerospace industries. When the federal government made an executive decision to pour massive quantities of research and development dollars into the industry, they backed winners and losers alike. The industry took off and here we are today, the world leaders.

Dissenting Opinion (Kehoe, Oregon): We have to look at this from the point of view of small business; the aerospace and computer-building industries are a few giants. Aquaculture isn't. These comparisons are invidious. We aren't in the Cold War anymore; this kind of thing isn't going to happen to aquaculture production. Besides, the Federal Government isn't going to do this as efficiently as private industry. Command industry isn't what the U.S. does well, and centralized planning wouldn't be popular.

General Comments:

Central planning approach is objectionable. But there is definitely a Federal role and the need for regulation - we need to solve the trans-boundary issues such as U.S.-Canada.

Federal role as a catalyst, a facilitator. Other agencies, not just the Department of Commerce, should be assuming those roles. They should facilitate leadership, but not actually lead. NOAA has a lot of other clients; it's not going to work for Department of Commerce to do it alone. Who should lead? Who should be the lead agency?

Minnesota: An aquaculture advisory body must be industry-driven. The driving force is better from industry, not from federal government because industry concerns would be addressed and action taken. The jurisdictional role should be determined from that point with industry the driver, federal government the facilitator, to pull the industries together.

General Comments:

Regarding aquaculture in the Department of Commerce - shouldn't there be better coordination between OAR and NMFS? They are certainly talking enough. Ref: Gary Matlock's opening remarks about sustainable aquaculture - these are particularly important. The politics that are playing out and the policies thus generated demand follow-through by federal agencies (i.e., Department of Commerce). There is enough interest on Capitol Hill, whether the authorizations (no specifics cited) lead to appropriations is another matter.

Marine departments in Department of Commerce (i.e. NOAA) have their acts together as much as they can. Other programs in Department of Commerce have to buy in to support this kind of thing. Especially NIST, ITA, and EDA, generally considered the other key Commerce players.

Since aquaculture has Commerce's attention (for now) it is important to get these other people more actively engaged in supporting the industry.

The Department of Commerce policy panel for aquaculture surprised NOAA at how much of a player other departments within Commerce were actually involved, EDA, NIST, etc. We have the Commerce aquaculture policy signed - now what?

Comments on the fact that whenever one deals with NMFS, it's confrontational. For the last few decades there has been withdrawal from aquaculture work by other agencies - remember when Fish and Wildlife service did aquaculture work? There isn't much money out there, either.

The Department of Commerce and Department of Agriculture must establish a tighter relationship in aquaculture. If there is no jurisdictional conflict between the two agencies, as everyone from those agencies insists, then they should act as if it's true.

We aren't seeing much in terms of interdisciplinary work. (Do we have enough money?) Remember that lasting partnerships are one-to-one things involving personal relationship, they aren't enforced, you can't legislate it, and they have to be developed over time. (Unclear whether this is reference to Commerce and Agriculture or a broader range of subjects).

How about partnership with foundations to help develop the industry? What about establishing local economic development boards? Regional, association types. If you had a lot of the local industries involved, then you are part of the group and have more power. Like the hardware, construction industry who would depend on and benefit from aquaculture development.

Moderator: In the interest of time, we shall skip down the agenda. What are the roles of DOC-USDA-DOI specifically? How should the DOC go about fostering these partnerships?

General Sense:

An MOU a la Massachusetts model (not described).

Streamline the mechanism within the department to sponsor research agenda sessions. E.g. NE aquaculture industry meeting and trade show. Difficult to transfer money from the department. This is probably more useful and relevant to the mission of EDA than Sea Grant.

How do you maintain the momentum? Follow-through is definitely a problem. The biggest constraint is people setting unrealistic goals and failing. Realistic timetables are important. Case studies/documentation of successes and failures in industry activity would be useful, with annual follow-up. This would give people a sense of the state of the industry and the direction it is going in, as well as current milestones and specific problems that ought to be addressed. Then, somehow, this has got to get into the NOAA/Commerce strategic planning process. Now would be a good time to get these activities explicitly cited into the strategic plan.

Chris Duffy (New Hampshire): Some people are nervous with the implication of accountability. Shouldn't the Federal Government be mentoring rather than big brothering? For example, the New Hampshire program that we are a part of - we oversee the program, not federal examiners.

General Comment:

Sea Grant extension agents don't get together very often. They aren't necessarily Washington-savvy. We could use some people in the field who represent the federal government but who have a notion of what's going on in Washington and how it's going to affect the local players. Perhaps NOAA could bring the Sea Grant extension agents in to DC more often - a "shadowing" experience.

Maintain the vision. Perhaps a centralized smaller steering committee. How about the Department of Commerce Aquaculture Coordinating Council. We already have this. What is missing and sorely needed is the link to the industry people. How do we coordinate the federal with the field?

Let's endorse the idea of the Coordinating Council.

OAR needs to educate NMFS on the value of aquaculture, NMFS sees every \$\$ out of NMFS budget to aquaculture is a drain on their other activities, not a complement that eventually will reduce the drain on their other activities as fish production is reoriented from wild capture to culture.

Moderator: What other Federal partners have we not mentioned? What other partnerships need to be encouraged for the good of the development of sustainable aquaculture?

General Comments:

The EPA for environmental regulation and research.

The FDA for drug approval such as antibiotics.

Federal-University partnerships have been beneficial and are expected to continue.

Federal-Industry partnerships should be strengthened.

International partnerships should also be strengthened, although there are potential pitfalls.

Moderator: What should be the Federal role in promoting and assisting aquaculture?

General Sense:

Financial assistance: grants, low interest loans, insurance support, disaster insurance, other mechanisms such as tax relief and state level block grants for revolving loan programs.

Aquaculture literacy: getting legislators at the federal and state level to understand what aquaculture is - that it is beneficial to state and federal economies, that its effects on the environment are not overwhelmingly negative.

Consumer education: On the value and safety of aquaculture products.

Promotion and Marketing: this is important to maintain the price of fish by increasing demand as the quantity produced increases. Can we up the national rate of consumption of fish? Can we shift national consumption patterns from imported aquaculture to domestically-produced? Certainly the "Buy America" sentiment is quite strong in Northern Maine. Also, in the U.S. people don't know how to cook fish. It's not as an integral part of our culture as it is in, say, Asia. Fish producers are competing not with each other, but with beef, chicken, and pork.

International Marketing: The inelasticity of markets in the U.S. being what it is, the U.S. producers may want to export fish and would appreciate the assistance.

Economic indicators: Weekly reports on the wholesale price of fish - Commerce can distinguish between the cultured and the wild products, we need better information on price and quantity. Potential investors need this type of data to take a business seriously to dedicate their capital. It will attract more participants to the industry.

Federal Grants Program and Demonstration Projects

Moderator: You have given a high priority for grants, demonstration projects, insurance, and all that - for what?

General Comments:

Small companies have an impossible time getting through the regulatory hurdles - they are very expensive, and time-consuming. If you are planning to start a fish farm, you have to hire a consultant to do it all for you, or you'll miss something, and this can cost up to \$300,000. EPA permitting process takes 6 months. If you are looking for venture capital these obstacles are discouraging to potential investors who can always find easier projects to put their money into, like the computer industry.

We are seeing people using EPA and other grants to do start-ups, where an EDA grant would be more appropriate, because the EDA doesn't look at aquaculture with great interest, doesn't see it as part of their portfolio. Grants to start-ups are not frequent, usually to already established companies. But it's the start-ups that need the grant money to become the established business - a chicken and egg phenomenon.

How about the Department of Commerce providing revolving loan funds to the states to use in aquaculture? That would constitute partnering with the states specifically for aquaculture, without creating new regulation or significant bureaucracy. It would also send a message to those states that need it that aquaculture is a federal priority and it would be worth their while to promote it. With federal funds a prospective start-up can go back to the states and leverage state and local funding.

Federal Role in Technology Transfer, an Aquaculture "drivers license" and Demonstration Farms

Moderator: Is there a Federal role in technology transfer? What are the roles of extension services and demonstration projects in this and other aquaculture activities?

General Comments:

YES there is definitely a federal role, especially since federal dollars and institutions sponsor and/or carry out much of the research that needs transferring to general use. However, this research is often disconnected from the day-to-day needs of the intended users (i.e. fish farmers). Transfers of technology in the future must be done with local input and must involve partners.

Perhaps the federal government should institute an aquaculture "drivers license" as per the EU model. There would be several benefits. For example, with this certification of a minimum standard, the insurance agents have a lower insurance rate for fish farms. Perhaps the governmental role in this in the U.S. would be Federal, using demonstration farms in various regions around the U.S. as training sites, e.g. the Alaska Science and Technology Foundation Center which funds practical applications of technology. These types of institution (partnerships again) would get the more "sciencey" people and the farmers together. This is done in Maine as well. It is a forum for the exchange of ideas as well as one-way educational flows of information and experience.

However, with respect to the use of demonstration farms as demonstrations of the utility of fish farming technology, all the technology is already there. Demonstration aquaculture projects serve only for federal agencies to prove to their skeptical masters that aquaculture is a viable industry, which is already known. Why are we trying to reinvent the wheel? We (the U.S.) should be sending trainees overseas to learn as quickly as possible the necessary techniques from other countries, instead of proceeding through a redundant "learn by trial and error" process at home. This is expensive and inefficient.

Moderator: Are the grants for technology transfer actively discouraging against developing "non-innovative" projects.

General Comments:

Demonstration projects/field trials for closing the life cycle which address all aspects of the grow-out are necessary, particularly for native species for which this hasn't been done yet. Then the industry could write a protocol based on the demonstration project - this could be another area of government-industrial collaboration.

Caveat - we need to distinguish between technical feasibility, and economic feasibility.

Ray, Western Region Aquaculture Consortium: I have done demonstrations of different products that remove NH₄ from water systems; these have been very successful and are well received by aquaculturalists.

Chappel: Could farms volunteer their information on their case studies, providing contacts for ad hoc consultation? Provide facts sheets to newcomers to the industry, technology, and techniques?

The NOAA/Sea Grant Extension Service

Jim McVey: The USDA used to have an aquaculture information center. It lasted only a short time because they couldn't show that people were using the information a lot. Today, we clearly need someone to help with real data, and need someone in the loop who can keep up to date on the issues.

With regard to the Sea Grant extension - most people even in NOAA and the Department of Commerce have no idea that there's an extension service out there for what we do. There are about 30 people doing aquaculture extension in NOAA, this is only a part-time thing. Is this enough? Probably not. We need the recommendation from people such as yourselves for increased attention in this area. The personal touch is what makes it work, however we have 1/3 the number of extension agents we had ten years ago and increasing demand for what these individuals can provide. With too much technology involved in their work - increased print matter and web sites, the relationships they develop become too impersonal. The Sea Grant extension agents get major kudos from the aquaculture industry and we recognize their popularity.

Maybe we should build on this, our strength, rather than overextend ourselves.

In Maine, extension agents get consumed by their clientele. The industry people tend to abuse the agents and take up all their time, distracting them from their other clients, once they know they are there. The people out in the field are where the rubber hits the road. How do we work at the regional level?

Comment: DC is like another planet to us. All the short-term stuff (research?) is rubbish; the long-term projects that need the funding don't get done. The Northeast Regional Aquaculture Center in Pennsylvania is not popular - they don't provide anything we need.

Jim McVey: Is there a way to reach the North Eastern producers - the mechanism or structure to reach them all doesn't exist, really. Should we create such a thing on a regional level? Is the Federal role best emphasized perhaps in information services?

Questions, Answers and Comments:

Comment:

Some of us are going to take these recommendations to the Secretary of Commerce and explain what you want. Think about partnerships -- four entities: foundations, federal/state

governments, industry, and academia. What are we trying to do here. We want to lay a regulatory, legal, technological, and environmental framework for the development of an industry. We need to consider more than devising flow charts that satisfy federal requirements. The goal is to stimulate an industry and any discussion on partnerships has to start with industry since that is where most of the capital is going to come from. You name me five foundations who are seriously interested in aquaculture research because I have talked with a lot of foundation people the last few years and those willing to spend tens of millions of dollars are not out there. If foundations are a partner, they are a partner in a very junior way dealing with micro-aspects of the problems we face. They should not be up there equal with the others. Talk about academia, talk about Sea Grant. They too have important rolls to play but they are not the major force here. We need to remember that the driving force are the entrepreneurs who are putting up the investment and we need to try to be more responsive to those needs. This discussion needs to get much more substantive by trying to identify what the partnerships consist of, what are the rolls of each of the partners and some differentiation of major and minor partners.

Comment:

Bill mentioned communications and one of the things that frustrates me with coming to meetings like this is that we go away and they become reports and get stuffed away and you never hear of them again. I think that for this whole idea to be successful, we need to set up some kind of long-term structure with this group. Maybe having a national meeting every two years for DOC to give us a report. Where have we gone in that two year period and in the off-year, we could meet in the regions. Most of the action will take place at the regional level, not at the national level so I would suggest that that could be one mechanism for us to be able to communicate and think ahead about the sponsorship of the meeting. We need to continue this communication process.

Comment

I agree. The two things I saw lacking in the explanation of partnerships were responsibility and accountability. If someone is a partner, then that partner has to agree to take responsibility for that part of the solution and they have to be held accountable. All too often they are dropped by the wayside and what we end up is a forum for people to posture with but not contribute to the solution of the problem and not polarizing the issue.

Comment

There is a lack of partnerships between agencies - I think the relationships need to be formalized in MOU's, for example, where the responsibilities are more clearly defined (example of EPA and DOC on permitting) What is frustrating to the entrepreneur is to see the bureaucratic circulation of process and no product. The only what to get something out the process is to get political pressure or to have a well defined process with an accountable administrator and a timeline and an agreement between agencies about what that process is.

Comment

Besides responsibility in partnerships, they need to understand the needs of the other partners. Partnership with industry requires getting something done in a timely fashion.

Waiting two years for a regulation to come out is not timely. We need to stress the need for decisions to come out in a timely way since time is money for an industry. So we have to urge everyone in a partnership to focus on the facts that need to avoid going around in the circle.

Comment

Two other partners haven't been discussed: the food suppliers, the companies who produce the raw materials to feed the fish. They have one of the great stakes in this industry and we should get them to be partners. The others are the buyers (purchasers of the food). We need to get the industry can adapt to what is raw material cost is going to be and what its sale projections are going to be. It isn't necessarily the federal or state governments' role to bring these industries to the table, but they should be involved.

Comment

There are too many DOC participants at this meeting, and not enough others from other agencies or from business (quick poll showed less than half). (A comment was made by the next speaker that while many may currently work for DOC, many also have long-time experience in working for industry during their careers so that might be taken into consideration).

Comment

There is the feeling in the industry their message isn't getting through and maybe we need to turn the pyramid upside down and give them an incentive to participate (getting into the question of permitting is one example). It has to be timely process to allow them to get into the business to show there is an incentive to work with government agencies.

Comment

Confirms that we need something that works. We should move forward with as much political will as we can, e.g. permit action teams with reps from each agency to assist growers in getting rid of the bottlenecks. When we do that, we will have something to show. Start now, pick a team, a project and let's do it now. Don't wait for approval.

Comment

One way to provide a forum for input from the stakeholders. The JSA is currently working on the new Aquaculture Development Plan. We have specifically provided for a forum for stakeholder input at our JSA meetings on a continuing, consistent basis.

Comment

Regarding the code of practice and BMPs - this is not a federal role, it won't get done. It is better to get it from the industry and support them in their efforts, provide some feedback. With regard to academic partnerships, aquaculture training is a need from universities that they could supply. Regarding demonstration projects, as we get environmentally responsible culture practices, either through Sea Grant, or someone else, we would like to have field days or demonstration farms to show people how to do it more responsibly.

Comment

Our group did emphasize that industry is the key partner, and that was a given. One of the recommendations that we made was that there is a Commerce Aquaculture Coordinating Council (or whatever it is called--Steering Committee) to develop a Commerce policy. One of the ideas we suggested is that there be Secretary appointed industry advisory committee needed to oversee the policy from the industry perspective, and provide some accountability, and on-going communications.

Comment

I noticed that "increased seafood consumption" was on the list. In Japan, their consumption is probably double what we here in the U.S. eat (we can easily eat chicken, beef) and to the extent that we can increase or at least maintain it, then we will be doing the industry a favor.

Comment

Farmers want to know what the government is doing to help them. We need to leverage funds. DoC has the SBIR program, and this is good. Why not try to leverage that through partnerships from the states, the states would provide more if they see the federal government doing so. And we need on-site demonstrations. This, in my opinion, is the way the federal government can help the aquaculture industry.

CONCURRENT SESSION F: Expanding U.S. Aquaculture -- Where and How Will It Happen?

Chairman: Colin E. Nash

Rapporteur: Ken Lamon

Participants: Charles Yarish, Mac Rawson, Bruce Miller, Tohru Morikawa, Tom Farewell, Leon Weiss, Roy Castle, Leo Dunn, Larry Tagrin, Gary Donovan, John Kraeuter, Terry Nosh, Robert Romaine, Nathan Birnbaum, Bob Brick, Boyce Thorne-Miller, Chris Duffy, Lee Blankenship.



Summary of the General Discussions

The group believes that Aquaculture has the potential to become a \$5 billion industry by the year 2025, provided that it exploits all its seafood and non-seafood components. Particularly important are the non-seafood components, which include the ornamental fish trade, pharmaceuticals, jewelry, etc. In addition, the group notes the great economic and

environmental potential of producing aquatic organisms for bio-redemption and restoration of ecosystems.

Not included in the \$5 billion total are the many economic benefits of stock enhancement. This important role of aquaculture, which is difficult to measure in terms of financial returns, requires cooperation between public and private sectors for enhancement related to:

- Conservation,
- Recreational fishing, and
- Commercial fisheries

The group believes that the potential for producing aquatic species is virtually limitless, and should not be prioritized within this forum. The NRC has identified for the most part species relevant to the future of aquaculture in the U.S.A. already. Specific selection of priority species is more appropriate at a regional level, with full participation of all stakeholders. However, the group believes that ornamental species, and species which provide important non-food products, should be given equal emphasis with those which contribute to marketable seafood products. Ornamental species in particular have a large domestic market, they are well-suited to export, and rearing practices are at the cutting-edge of production technology. This entire field, with its advanced technology, will greatly assist DOC attain its goals of increasing the value of U.S. exports in aquaculture goods and services, and employment.

The group also believes that the best environments for aquaculture production cannot be usefully prioritized. Freshwater, estuarine, and marine environments all retain many options for expanding production. Estuarine environments, with their high productivity, remain very essential in spite of many competing uses. The aquaculture sector should not relinquish access to the estuarine and coastal environments but remain an integral part of managed coastal zones. With regard to management of the coastal zone, the group believes that emphasis at a regional level should be placed on the development of the "Total Aquaculture System" and not simply practices farming species in monoculture. In other words to practice 'integrated eco-polyculture' with schemes similar to those being developed in Japan.

Similarly, the group believes that the many production systems and practices of aquaculture for future development cannot be usefully prioritized. Any industry worth its salt will always respond to the challenges of growth by its own initiatives, provided there are conducive government support services, such as financing benefits and R & D. Hence there should be few constraints imposed on individual private enterprise. The majority of the group felt that, in spite of the advance state of the technology and little commercial use so far, re-circulating systems are still appropriate for future development of aquaculture in the U.S.A. However, future R&D should be on biological production of such systems, and less on fine-tuning the engineering components.

The group unanimously believes that improvements to speed up and reduce the long and convoluted permitting process (even for R & D projects) are of the highest priority. One way to circumvent the permitting process for R & D projects would be to create pre-permitted

industrial-scale R & D zones, where enterprises might test their systems at a pilot-scale level before investing in sites and processing permits elsewhere. However, special zones for aquaculture are not required if permits and leases guarantee long-term stability for individual enterprises.

The majority of the group believes that the future growth of aquaculture in the U.S.A. is not dependent at the present time on increased market demand. They consider the immediate priority is to provide the consumers with a consistent supply of high-quality products. A minority of the group feels that only an expanded market will expand national aquaculture production, and that a national marketing effort to increase per capita consumption of seafood (irrespective of origin) in the U.S.A. was the very highest priority.

However, the group agrees that the industry needs marketing assistance, particularly in: understanding global markets for products, and access to statistical market bulletins with current prices of products, price ranges, and market locations, programs for promoting aquaculture products, coordination of activities between, federal, states, and others active in marketing, programs to increase exports, and programs to educate consumers, food handlers and processors.

In addition to statistical marketing information, the group believes there are still inadequacies in the compilation and reporting of production statistics and other industrial data. Providing accurate statistics is an important government supporting service to the industry.

Conclusions and Recommendations to the Session

The aquaculture goals of the Department of Commerce will not be achieved without some specific new actions on the part of the U.S. government.

There are a number of limitations to expansion. These solutions for these constraints form the group's recommendations to the Workshop. They are grouped within general orders of priority, but not prioritized within the group.

Priority One

The aquaculture industry lacks trust in the government, specifically in Federal and State regulatory agencies. NOAA should give equivalent emphasis to both regulation and development of the industry. Many regulators are fisheries personnel who are not familiar with aquaculture, and they need to be more exposed to the operations of the industry. A demonstration of rebuilding trust could be the creation of a separate program for aquaculture in DOC, which would work, in close association with but not under Sustainable Fisheries.

The industry lacks the capital resources needed to develop. Rapid advances have been made in Europe and Asia through grant financing schemes. For example, the government needs to augment programs such as the SBIR, and establish a 100% loan guarantee program, similar to those used by the EU to advance aquaculture industries throughout their member nations in Europe. Models of loan-guarantee schemes used in the EU, and countries such as Canada

(Federal Business Development Bank Venture Capital), Norway (Regional Development Fund), Scotland (Highlands and Islands Development Board), Ireland (Irish Fisheries Development Board), and Chile (Fundación Chile) could serve as a relevant guide to the aquaculture industry - although the U.S.A. itself has a long history of backing agriculture investments with preferential loan programs through the FHA, the FCA, and the SBA.

The aquaculture industry (in the U.S.A. more than most other countries) is bogged down by the permit process as well as regulations that were originally framed for fisheries. The permit process needs to be simplified and made specific to aquaculture; i.e. there should be no confusion with aquaculture products and regulations regarding species quotas or size limitations, etc., created for the capture fishing industry. Again, permitting models developed and tested in Europe and Asia could serve as a guide. A second aspect of the problems associated with the regulatory process is the need to streamline import-export licensing through increased interagency cooperation.

The industry continues to be constrained by negative environmental impacts. These are frequently over-exaggerated whereas the environmental benefits of aquaculture are overlooked. The issues vary from region to region. Net-pen salmon farming and mollusk farming in the Pacific Northwest, for example, have poor public images, exacerbated by continuous bad publicity without any scientific basis. NOAA agencies need to give the public more confidence in the national aquaculture industry by becoming strong advocates for its future by presenting its case out in the field and disseminating unbiased scientific and technical facts about its operations. A demonstration of strong leadership could again be evident in a separate division/service within NOAA, and give the industry the weight it deserves.

Production-scale R & D continues to be a link in the chain that continues to be overlooked. The history of U.S. agriculture development, which is unparalleled in the world, was made possible by the agricultural experiment stations, where production-scale R & D, together with hands-on education and training (extension), was practiced in close cooperation with industry. There is a need to duplicate this approach by establishing a number of aquaculture experiment stations. These would be sites for R & D in grow-out technologies that are not currently supported (unlike hatchery technologies) due to their higher costs. Industry would participate in identifying and monitoring the activities of these stations, and fulfilling the role of '>cooperating farms' for hands-on practical work. In addition to these traditional roles, the stations could also be attached to vocational (non-degree) aquaculture schools, similar to those in Norway and Scotland, to train future farm managers and/or owners.

A lack of technical knowledge still constrains the aquaculture industry at the grass-roots level. The role of the extension system within the Office of Sea Grant appears to be diminishing rather than growing. Extension is a vital link between R & D and the industry, and needs revitalizing with funds. Agriculture extension has always been a forte of the US Government, and improving this service for aquaculture would help to rebuilding the industry's confidence in the future. A further useful area for extension is to agricultural bankers, who disburse loans, and to insurers.

Priority Two

The government should continue to provide critical support services in research and development within its own research centers. Too frequently the importance of the research and institutional memory of government research centers is overlooked. Some examples include, (i) a new aquaculture mandate for the NMFS Laboratory at Milford, CT., which pioneered considerable work in mollusk and seaweed production, and in micro-algal feeds, and (ii) revitalization of NMFS resource utilization services (food science and technology research) especially for adding value to raw materials by developing new products and product forms to meet the marketing trends set by modern consumers.

Government organization and management of the aquaculture sector in the U.S.A. is constrained, to some degree, by the size of the country and its diverse environments and ecosystems. As far as possible, it is important to devolve the practical responsibility for development to the regions, encouraging them to produce their own aquaculture development plans and budgets. Regional committees would be made up of all stakeholders.

Sustained long-term financial support is a constraint for most projects, but especially those dependent on the completion of biological life-cycles. There is a special case for endeavoring to provide long-term funding for many aquaculture activities, particularly R & D and demonstration projects that may require many years to produce results for analysis. One solution might be some creative financing specifically for aquaculture (and fisheries) projects, for example, from fines imposed on dangerous water-borne acts, such as discharging disease vectors in ballast water, discharging pollutants, or traversing the seabed with communication equipment, etc.

Priority Three

Aquaculture is frequently accused of being incompatible with the natural ecosystems. This is not the case, and aquaculture can play an important role in conservation. The government should co-opt the private aquaculture to assist in programs to conserve ESA-listed stocks. Industry hatcheries, for example, can be contracted to produce resources for conservation measures provided that they can meet the close specifications, which will be increasingly required. Managing captive broodstocks however would remain the responsibility of government, together with the management of habitat.

The industry frequently perceives aquaculture research projects at many government institutes as not always being relevant to the needs of the industry. While in-house research at NOAA agencies is integral to the future of the industry, there is a need to involve more stakeholders in a peer-review process.

The aquaculture industry in the U.S.A. is frequently constrained by antagonism between farmers and fishermen. In many countries, such as Japan, Norway, France, and Spain, there has long been close cooperation between the two. There are many opportunities for capture fishermen to find employment in commercial, recreational, and other aspects of aquaculture. However, the decisions to exploit such opportunities should remain theirs. Opportunities for interested

fishermen could be provided through training at aquaculture experiment stations and/or vocational schools.

Aquaculture development in any country is always constrained by the slow advance of key technologies, invariably due to cost. The advance of production technologies for aquaculture systems in the U.S.A. and Japan has been greatly assisted by sharing information over twenty years through the UJNR program. A similar program should be established by the NOAA international service to promote international cooperation with the EU and its member nations.

Questions, Answers and Comments:

Q: How much is it going to cost to boost the production as high as you said it did? How are we going to produce \$5 billion? Suppose we have a testing station - wouldn't we need something like \$50 million to create each one?

A: The numbers came from NMFS. The money isn't coming from the government. The federal government should be used to create the conditions for the industry to develop. We are being told that we are too involved. Let us solve the regulatory problems. We aren't going to have Congress appropriate billions of dollars for this type of activity in any case.

A: Well it was considered an attainable goal - 10% annual compounded growth. In terms of budgets, may be able to look at the appropriate roles of governments. The numbers include the feeds, technology etc. but we don't know how to measure that.

Comment

Congress isn't going to appropriate funds out of the blue. Go to your elected representatives and explain your situation. Regarding promoting fish consumption, you need to increase production and reduce the costs so that fish is cheaper than \$7/lb. The American Public isn't going to buy it at that price - they'll buy chicken instead.

Comment

We don't capture adequate information what is really being produced and what people are actually eating. We are bypassing that statistical system. We need to collect more data.

Comment

What is the role of Non-governmental environmental organizations? We think there is tremendous positive potential - we have public access, access to the foundations. Demonstration projects - foundations not interested, and foundations that would rather talk about the bad side of aquaculture. Industry needs to make some admissions of where mistakes have been made, and we can expand aquaculture in a positive way.

Comment

In Washington State there's an annual lease fee - if there's an efficient system to do this, people will pay this and then pursue their interests responsibly.

Comment

Don't neglect Sea Grant - we are built on the land-grant systems, but our budgetary restrictions are severe. In agriculture, we had an extension agent in every community. Don't say that you can expect to get more funding, you should DEMAND this. And - look at Asia, or Europe, there have been substantial government subsidies over a long period of time - research centers in every prefectures in Japan. We won't see growth in the U.S. at that level if we don't mimic them to an extent.

Comment

Private sector should build aquaculture - certainly, but need government input. Loan guarantees - there are none. The banks are not supporting us. The DOC could help out with these types of problems.

Comment

Some FAO projects have organized aquaculture familiarization courses for managers and loan officers in Agricultural Banks. They were effective.

Comment

The government needs to look at all the money it is losing in the seafood deficit, plus the lost tax revenues. It is such a moderate investment compared to the growth and sales potential.

Comment:

Aquaculture is an accepted use of loans under the Fisheries loan guarantees - loaned at 1% over Treasury's rate. This is underutilized capital.

Comment

Funding - we tried to get \$10K to develop applied research facility to do mock-up work to help a town that wanted to redevelop a Navy fuel depot into a fish farm and couldn't do it.

Comment

We still need information about the prices. One of the reasons the agriculture industry is getting continued investment is that it can show it generates money. Can we give tax breaks to aquaculture? The federal government should convince the local governments to woo the industries.

Comment:

Mindset is the problem - most of the advances in Asia and Europe are due to the fundamental fact that everyone over there thinks that aquaculture is positive thing. This is not the case here - ignorance and negativity prevail.

Part IV. Results of Regional Breakout Sessions

(Note: Workshop participants were given the opportunity to breakout into regional interest groups to discuss problems and opportunities they considered applied largely to their region. In addition to five major regional breakout groups, there was a group of individuals who preferred to discuss national and international interests and priorities.)

A. NORTHEAST REGION

Reported by Olwen Huxley

Report by Lori Howell

Participants: Chris Duffy, Jerry Redden, Charles Yarish, Mike Jahncke, Scott Soares, Dale Leavitt, Sebastian Bell, Leo Dunn, John Kraeuter, Bryan Plemmons, Leon Weiss, Ken Riaf, Paul Comar, Michael Ludwig, Tony Calabrese, Olwen Huxley, George Flick, Beth Turner, Lori Howell, Matthew Borgia, Harold Mears, Michael Schwarz

Our discussion highlighted the many different research and commercial aquaculture activities we have in the Northeast and the numerous different issues that affect each of us. The charge to the group was to determine how best to utilize a limited budget of \$1-2 million over the next year or two to best stimulate the growth of aquaculture in the Northeast, with the aim to achieve the DOC Policy objective of 10%³ annualized growth for 25 years. The participants quickly acknowledged that the sum allotted for the first year to two years was insufficient to achieve the stated goals. The group also acknowledged that the time allotted to the session was insufficient to fully consider the issues and make comprehensive meaningful recommendations.

There were many differences of opinion, perhaps brought about by the number of participants who did not know each other at the start of the meeting and contributed to by the pressure of insufficient time to discuss issues and make a plan. Regardless of the differences, there was a strong desire to tackle the issues; there was no shortage of effort and it can safely be said that the Northeast participants are indeed passionate about the subject of aquaculture- a key ingredient for success of an industry.

There were those who felt that it was essential to establish an off-shore experiment station or demonstration project; those who argued that the lack of a clear regulatory process for off-shore projects hindered development; others felt that the greatest constraints to growth of the industry were social in nature and included among others, issues of user conflict. Other issues included the need to provide funding programs for commercial expansion, infrastructure, and provide research on disease of aquacultured species. All present agreed that significant advocacy was needed at the federal level.

³ The working group focused on a five-fold increase over 25 years, with 10% growth annually as a target to achieve this goal. The actual annual growth rate would be closer to 7%.

The group discussed numerous critical elements that would be necessary to achieve the DOC Policy objective of 10% annualized growth for 25 years. It was concluded that the best use of the limited current budget allocation would be to use the funds to develop a "Business Planning Document" for the Northeast Region Aquaculture Industry.

The group discussed the following issues. Due to limited time the session participants did not prioritize these and they are not presented here in any order of priority. All were agreed that the issues need to be prioritized and a price tag attached to each. Key areas of discussion were:

- The permitting process for various sectors of the industry need to be reviewed to determine whether the process can be streamlined, there are conflicting rules and regulations that should be coordinated or eliminated, and there are needs for clarification between regulated wild harvest and farmed product.
- Development of modern, outcome based Best Management Practices (BMPs) needs to be done. This will require "buy-in" from the industry in order for adoption and utilization of BMPs to take place. This will assist with social as well as permitting issues.
- The financing requirements for a 10% annualized expansion need to be determined. The vehicles for funding demonstration, startup and expansion need to be addressed, and, if necessary, government support through loan guarantee or granting programs needs to be identified.
- Funding mechanisms for demonstration farms and expansion need to be identified.
- An evaluation of the efficacy of demonstration farms needs to be done.
- The aquaculture industry needs advocacy at the federal level to promote the benefits to the Northeast region.
- An evaluation of the efficacy of "experiment stations" needs to be done. If efficacious, the role of such experiment stations in providing demonstration and outreach and in serving as a commercial scale atmosphere for ongoing research should be described and funding requirements to establish experiment stations needs to be addressed.
- User conflict/riparian issues are seen as a significant hurdle to the development of near shore aquaculture projects. Mechanisms for addressing these issues are vital.

The group concluded that a working group should be formed to accomplish the goal of developing a "Business Plan" for the region. It is critical that industry is well represented in this working group. At the same time there are other stakeholders, including municipal, state and federal regulators and elected officials, wild harvest fishing groups, researchers and environmental groups, who may be included in this working group.

The group discussed how to accomplish this objective and who would champion the effort. It was recognized that while industry's input was critical to achieving expansion of the Northeast aquaculture industry it is unlikely that any industry partner would have the time available to spearhead such an effort. A consensus was reached that the best use of the limited initial federal funds available would be to use available funds to hire an independent professional firm. Notwithstanding this recommendation for an outside contractor, careful industry guidance will be required from all levels in order to achieve a representative document that evaluates each current or emerging option.

A working group should be formed to:

- draft an initial scope of work
- develop plan for review and process for awarding contract
- draft a request for proposal and make public in appropriate forums
- delineate time frame for completion of tasks, (the RFP should request plan implemation within one year of the initial funding date)
- designate the entity to receive the grant funds and make disbursements during contract.

DOC should consider compensating all members for their time in planning and working to develop the planning document. A development plan, implementation plan and time frame to accomplish the objectives outlined in the scope of work would be principal deliverables of the contracted firm. The qualifications for a contracted firm would include expert management; public relations experience and demonstrated success in assisting clients achieve objectives. Big Five-type accounting firms were suggested as examples of the types of firms that would be qualified to spearhead the project for the working group.

The DOC/NOAA should communicate with the region in a timely manner to advise of when funding will be forthcoming and should assist in convening the initial organizational meeting(s) of the working group.

There was a significant amount of discussion in the workshop meetings as well as in the Northeast's breakout session concerning a need for the agency to facilitate aquaculture development. The work group should confer with DOC representatives in developing meaningful changes within the agency that would assist the development of the industry. These changes could include, but are not limited to, leadership, advocacy and promotion of the industry, and assistance with navigating the federal permitting requirements.

Finally, DOC/NOAA should earnestly foster and continue this initiative. This must be done through open and regular communication with topical, regional, financial allocation, or species specific teams as determined. After the workshop report is issued, NOAA should begin work immediately with such groups to begin the promotion called for in the policy. NOAA should ensure that sufficient internal staff is dedicated to these efforts, just as NOAA has fishery management, protected resources and other task devoted staff. Industry as well as many coastal

scientists and managers are ready and excited about the policy outlined by NOAA, and we look forward to NOAA's proactive efforts as soon as possible.

B. SOUTHEAST REGION

Reported by Mac Rawson

Participants: Paul E. Bauersfeld, Wallace Jenkins, Al Stokes, Jesse A. Chappell, Richard DeVoe, William Rickards, Wade O. Watanabe, Harry Daniels, Katie Moore, and Mac Rawson

The participants in the Southeast region breakout session felt that the primary potential for aquaculture development is in the protected coastal areas. They felt that the risk to offshore aquaculture in South Atlantic Bight made this approach extremely unlikely in the foreseeable future. The greatest potential for marine aquaculture in the Southeast is in the nearshore zone and near the mouth of bays.

Potential species for aquaculture and issues in the Southeast region included.

Finfish

- Southern flounder (because of euryhaline characteristics)
- Red drum
- Black sea bass
- Snapper/ grouper B mutton snapper & gag grouper
- Cobia (very fast growth rate)
- Shortnose sturgeon (not for enhancement but for food fish and caviar)
- Baitfish B *Fundulus* sp., pinfish, finger mullet

Shellfish

Shrimp

- Development of a reliable and rapid diagnostic techniques for viruses
- Test of wild stocks to determine the prevalence of viral diseases (what is there?)
- Potential for transmission of disease through movement of bait shrimp from the Gulf of Mexico and east coast
- Potential transmission of disease from imported frozen shrimp used as bait
- Development of native shrimp species as culture species B Pink shrimp

Mollusk

- Quahog
- Surf clams B northern subspecies

- Angel wing clams

Use of mollusk in polyculture offers promise of improving the carrying capacity of culture systems and increasing productivity and economic stability

Marine Ornamentals

- Seahorses
- Live rock corals
- Tropical reef fishes

C. GULF OF MEXICO REGION

Reported by Barry Costa-Pierce
Report by Ben Mieremet

The GOM has unique assets for aquaculture. "Private tenure" has already been established with respect to oil and gas platform reuse. The public is used to "seeing" structures offshore and is not offended by their existence. The region is often thought of as the home of artificial reefs (about 10,000) and there are procedures to do that. Have some of the largest number of aquaculture scientists, aquaculture universities, the largest existing aquaculture industries in the U.S., and the largest number of feed mills in the U.S. There is generally low cost for land and labor, with inland areas used as new centers for brood stock and (low salinity) shrimp production.

The GOM regional interest group identified two types of projects that they would like to consider. The first were new, short-term, and small-scale projects. The second were long-term requiring larger funding type projects.

New, short-term, small-scale projects:

Will look for partners with whom we can conduct cooperative projects such as:

- Other ongoing state initiatives
- GOM EPA (oyster initiative)
- USDA-SERAC (joint demo for inland marine aquaculture)
- Texas Department of Parks and Wildlife (instrumental in Red drum)
- Alabama Claude Petite Mariculture Center
- Industry (collaboration, funding, demo projects)
- National Institutes of Health (pharmaceuticals), National Science Foundation, others

Potential short-term proposals:

- Restoration of oyster fisheries using aquaculture
- Evaluation of high value marine food species (techniques similar for many spp. and unlikely there would be competition from restored wild capture fisheries)
- Hatchery technology for high value marine fish (work on few stumbling blocks in early life histories, early feeds, etc.)
- Development of bio-economics and environmental techniques for inland marine species
- Marketing strategies for an expanded hard clam aquaculture industry (Florida example)
- Identification of aquaculture zones in the EEZ (GIS, work with MMS)
- Production, economics, marketing of aquaculture of bait species
- Cost/benefit analysis of enhancement contributions to recreational fisheries

Long-term, Larger Funded Projects

Land based (mostly inland out of coastal zone) marine aquaculture is future using biosecure, recirculating systems because of higher cost of coastal land, more conflicts, etc.

- Marine shrimp, high value marine species
- Hatchery and diseases of bi-valves, quality and processing
- Regional research, demonstration, experimental and training marine aquaculture facility (similar to Japanese facilities). Use 3-pillars of education, research and extension in one place
- Marine ornamental aquaculture
- Pharmaceutical aquaculture
- Genetic improvement and preservation (gene banks, sperm banks needed for threatened species)
- Bioeconomics and holistic perspective when considering offshore aquaculture conflicts and liabilities
- Marine habitat restoration with aquacultured species (*Spartina*, sea grasses, etc.)
- Methods to identify appropriate habitats when starting stock enhancement projects

D. CENTRAL/GREAT LAKES REGION

Reported by Richard "Ying" Ji

The top priority for our Central Great Lakes Region, as identified during our breakout session, is:

development of brood fish (like Yellow perch) along with other technologies such as recirculating systems, feed and nutrition, to enable grow-out of fish to market size in less than 3 months with a production cost of \$0.80 or less in 10 years.

The development of a major aquaculture species would have benefits to other support industries.

Other areas of work that may be undertaken include:

- lake white fish culture,
- shrimp culture,
- shrimp deheading mechanisms (to reduce labor costs), and
- revitalizing fish processing industries around the Great Lakes area.

E. PACIFIC NORTHWEST REGION

Reported by Bill Dewey

Report by Connie Mahnken, Bill Dewey

Attendees:

Bill Dewey, Lee Blankenship, Senator Dan Swecker, Conrad Mahnken, Bob Iwamoto, Alex Wertheimer, Per Heggelund, John Faudskar, Mike Rust, Ken Chew, Ray Ralonde, Chris Langdon, Paul Olin, Steve Joner, Colin Nash, Mike Cochrane, Terry Nosh,

Minutes of the Group Discussion

McVey: Questions for the Pacific Regional Forum: Which species and technologies have the greatest potential for development and sustainability in your region. What would the partnerships be? If there were limited dollars available to the region to implement the aquaculture policy how would they be leveraged locally?

There is a need for a Regional Aquaculture Advisory Board- Political reality is that the N.W. congressional delegation is small compared to East Coast constituency. Need for Advisory Board to transcend state boundaries.

Dollars will probably be available in OAR. RFP's need to go to industry to write and could include federal agencies. Difficult to get Sea Grant dollars into federal agencies. Swecker: "Need to get dollars directly into federal agency budgets and need to target congressional delegations". The new DOC aquaculture policy is prone to failure if the dollars are not appropriated to implement it. Industry is really the only partner in the caucus that can legitimately lobby congress for the funding.

Faudskar: If there are limited dollars available a wise approach would be do an initial cost benefit analysis of the various species, technologies and potential sites to be sure those dollars are prioritized where they will produce the greatest results.

Swecker: Executive Director, Washington Fish Growers, state senator from WA- Fish growers need aquaculture reserves. Have no new areas to establish farms. Suggests strategic plan for offshore (Juan de Fuca Straits) be considered as major initiative for Salmon industry. Partnering with agencies for technology, impacts, ESA is required!

Dewey: Problems to shellfish industry area all inshore (urban development, degrading water quality, multiple use conflicts, zoning and high property taxes precluding shoreline development, EFH, ESA) limit sustainability and expansion potential of industry. Need advocacy in State, Federal and Academia. The Pacific Shellfish Institute's "Goals 2010" project is a start B 8 research categories with year 2010 goals identified by the industry along with the research and initiative priorities needed to achieve these (see below). Perhaps all aquaculture industries should prepare similar documents to share with this caucus and DOC?

Swecker: Washington Fish Growers has a five-year strategic plan with 2 years remaining.

Ray: These plans should be drawn together as a regional initiative.

Dewey: Perhaps they could be pulled together on a common web page or list serve.

Swecker: Need a "N.W. Aquaculture caucus" to determine input to agencies and congress. Need to establish contact with Regional Fishery Councils. Needs to function as an advocate for aquaculture with a strong and singular voice.

Alex Wertheimer: Councils are major focus of NMFS and most of the agency resources are funneled to these councils.

Heggelund: Feels that the council approach would be non-productive because of their focus on fisheries. Must also deal with USDA.

Swecker: Caucus should include:

- Industry
- NMFS -- region and science center
- Universities
- State Fish Agencies

Joner: Wants presentation made to Fishing Council on this workshop (timing may not be right, until caucus is formed -- but Rust might talk on black cod project). Perhaps suggest marine reserves as site for aquaculture.

Blankenship: No -- a NMFS representative should address council and present NMFS plans. Someone at the top should present DOC policy to Council initially.

Wertheimer: We should include salmon ranching scenarios from Alaska.

Dewey: New marine finfish/ shellfish plans (with industry) for enhancement of natural stocks should be included. Aquaculture technology developed by private enterprises could be valuable in wild stock enhancement/restoration efforts.

Faudskar: The Western Regional Aquaculture Center's (WRAC) structure with an industry advisory council, technical committee research subcommittee and technical committee extension subcommittee may be a model that would be worth considering for this aquaculture caucus.

Dewey: Could we identify the participants that should be included in the caucus?

- Academia (research).
- NMFS (research, policy).
- Industry (shellfish and finfish).
- Alaska non-profit enhancement groups.
- Tribes
- State natural resource management agencies and public enhancement agencies.
- Tribes.
- Sea Grant.
- Environmental NGO's (later in process).
- Economic development agencies.
- Army Corp of Engineers.
- EPA.

Chew: Perhaps the WRAC model is good for the research segment of the caucus' efforts.

Chew: There is a need to push for a greater level of interaction between DOC, USDA and other partners including WRAC, JSA, and Dept. of the Interior. It may be that this Pacific Caucus could strive to set an example along these lines.

Joner: What are the appropriate states to include in the caucus ~ Wash., Ore., CA., Alaska, Idaho. What are the opportunities and needs of these various states regarding aquaculture?

California research needs -- Paul Olin: aquaculture under the Department of Fish and Game
Nutrition -- As relates to product quality, especially sturgeon caviar quality.

Also need to refine diets for sturgeon and striped bass

Recirculating systems -- Research to improve water quality.

Micro B algal culture. -- Need to improve nutritional quality and processing to prolong shelf life

Oyster genetics -- Continue support for selection programs currently underway.

Research to evaluate water quality and off flavor in sturgeon, tilapia and striped bass.

Environments benefits and risks of shellfish farming need to be quantified and risks minimized

California will be difficult state for offshore aquaculture based a lack of protected areas, winter weather and environmental concerns.

Oregon -- Langdon, Faudskar. State Department of Agriculture is the lead agency some permitting by ODF&W. Mostly shellfish aquaculture currently. Needs to address:

- Environmental issues.
- Social issues -- multiple use conflicts, limited tidelands available for lease.
- Oyster genetics.
- Burrowing shrimp control (or lack thereof!)
- Offshore -- ocean ranching not well received. Offshore aquaculture probably not a good option.
- State salmon enhancement programs are healthy.

Washington -- Blankenship, Dewey. State Department of Agriculture is lead agency, except disease policy. WDF regulates.

- Marine fish enhancement under fire in Department of Fisheries.
- Offshore culture is possibility for finfish unlikely for shellfish due to lack of primary productivity.
- Geoduck new candidate species with high potential for private culture and public enhancement.
- Olympia oyster restoration and other species.
- Suspended culture (mid - water) mussel, oyster huge potential, undeveloped due to upland opposition (aesthetics).
- Pharmaceuticals from shellfish, sponges.
- Attacks on finfish by opponents are concern, even in offshore.

Alaska: Wertheimer, Ralonde.

- Interaction between wild and hatchery fish is concern.
- Cost/ benefit analysis of private sea ranches is important.
- Loss of government advocacy for non-profits is a concern.
- Shellfish transport policy B perceived genetics issue a problem.
- Develop oyster broodstocks (WRAC and Molluscan Broodstock Program).
- New species, little necks, Geoduck.
- Value added products for shellfish. Topic is universal for PNW states.
- Macrocystis/ nori culture.

Chairman's Comments: This diverse group of people in the Pacific Region breakout group represents a formidable resource with a genuine enthusiasm for the promotion of aquaculture on the Pacific coast. All seemed to appreciate being placed in a room together in a proactive forum with others sharing a common goal. There was a desire by all participants to continue the forum after the workshop. Paul Olin with California Sea Grant volunteered to transcribe the rapporteur's notes and set up an internet listserver to facilitate communication amongst the members of the caucus. Bob Iwamoto and Connie Mahnken volunteered NMFS facilities and staff to facilitate future meetings. John Faudskar contacted me following the meeting to

volunteer OSU Sea Grant services in establishing electronic communication for the caucus as well. I am personally excited about the new DOC aquaculture policy. I hope we can maintain the momentum and enthusiasm for implementing it.

A recurring message I heard here in the Pacific Region breakout group and throughout the 3 days was the need for national and regional advocacy for aquaculture. A credible, authoritative voice to dispel myths, promote facts and generally advocate for aquaculture.

[Note: The following was submitted as an attachment to the Pacific Region discussions. From "Goals 2010, Research and Initiative Priorities"]

CALIFORNIA MARINE AQUACULTURE PRIORITIES

1. Management Strategies to Control Off-Flavor in Fish.

California Aquaculture is becoming increasingly intensive for many species, both pond and tank reared, and including tilapia, catfish, sturgeon, striped bass, and perhaps other species. The culture practices can result in off-flavor fish, which, if marketed while off-flavor, can cause severe damage to the reputation of the species and aquaculture in general. Significant research in off-flavor has been conducted, but primarily on pond reared catfish. The industry would benefit from research which:

- 1) Reviewed causes of off-flavor
- 2) Recommended guidelines to reduce off-flavor problems
- 3) Set depuration guidelines to eliminate off-flavor prior to marketing

2. Flavor and Shelf life manipulation in domestically produced White Sturgeon Caviar.

Historically sturgeon caviar has been produced from wild caught fish. The only chance to modify the flavor and/or shelf life of this wild caviar occurs during the processing of the eggs. With the advent of commercial scale white sturgeon culture, an opportunity exists to modify flavors and possibly enhance shelf life via diet modifications and/or manipulating the rearing conditions of the fish. In addition, domestically produced caviar allows the potential for more accurate timing of the harvest and the use of modern processing techniques to produce a more consistent and safer product. Domestic caviar production would benefit from:

- 1) Determining what causes various flavors, textures, colors and other sensory characteristics in caviar.
- 2) Determining how to manipulate these characteristics.
- 3) Developing the best processing methods using current food technology.

3. Use of High Energy Feeds on California Grown Finfish Species

The Salmon fish farming industry has seen great gains in egg quality; egg development feed

conversion rates, and growth, by using high energy feeds. These gains were realized after systematic testing of various energy/protein ratios as well as testing various types of proteins and oils. Similar results may be possible with other finfish species such as striped bass, sturgeon, and white sea bass. California finfish culture would benefit from:

- 1) Determining the optimum dietary needs of striped bass, sturgeon, and white sea bass when grown for meat production.
- 2) Determining the optimum dietary requirements for striped bass, sturgeon, and white sea bass fecundity and egg quality.
- 3) Recommendations on energy/protein qualities and ratios for growth, fecundity, and egg quality for the above species.

4. Improved, intensified, and recirculated Aquaculture Systems for fish and shellfish production.

Water is essential to any aquaculture operation. Water as a resource in California is becoming more and more precious. In order for the California aquaculture industry to survive and expand, better methods of water use and reuse need to be developed. Sturgeon, striped bass, white sea bass, abalone, mussel, and oyster seed operations are conducive to tank culture and varying degrees of intensification and recirculation.

Sturgeon and striped bass utilize precious freshwater resources for most/and or all of their culture. Fresh water resources are being placed under growing pressure by various special interest groups. Growing systems that allow for intensification by utilizing pure oxygen and recirculated systems that increase the reuse of the culture water would allow culturist to maintain and or increase production even though the available water supply is reduced.

White sea bass, abalone, mussel and oyster culture all utilize seawater. Seawater technically is more abundant but regulatory constraints by the California Coastal Commission and other State and local agencies are making it more and more difficult for aquaculture operations to use this resource. The logical answer to these dilemmas is to use the available water more efficiently i.e. intensification and recirculation.

The industry would benefit from:

- 1) a review of current intensification and recirculation technology
- 2) development of systems specific to the needs of California species.
- 3) production testing of these systems on the species in question.

5. Interaction of California Shellfish Farming and the Marine Environment.

The west coast shellfish industry is under increasing regulatory pressure as a result of salmon listings on the Endangered Species Act, the Sustainable Fisheries Act, and associated identification and protection of Essential Fish Habitat. West Coast shellfish farmers must develop and Environmental Policy and an Environmental Code of Practice. An essential part of

the Environmental Code of Practice is necessary research into shellfish farming practices and their effect on the environmental conditions in the farm area.

The industry would benefit from:

- 1) Exploring the option under the Endangered Species Act, Section 10 of developing the Environmental Code of Practice into an umbrella Habitat Conservation Plan. Individual farmers desiring protections from prosecution under the ESA can develop farm plans patterned after those in the umbrella Habitat Conservation Plan and receive certificates of inclusion.
- 2) Investigate the current oyster culture techniques used in California i.e. Rack and Bag culture, Floating Bag culture, Bottom Culture, and Suspended Culture to determine how current management practices are affecting the environment.
- 3) Determine the carrying capacity of intensively cultured estuaries to gain and understanding of the key phytoplankton population dynamics of species affecting growth, health and survival of the shellfish as well as other organisms in the water column and benthos.
- 4) Determine impact of Suspended Raft and Long Line Mussel culture on other organisms in the water column and benthos.
- 5) Determine impact of Bottom Bag Clam Culture on other organisms in the water column and benthos.
- 6) Develop, adopt, publish, and promote a shellfish industry Environmental Policy specific to growing and management techniques used by the California shellfish industry.
- 7) Develop, adopt, publish, and promote an Environmental Code of Practice specific to the growing and management techniques used by the California shellfish industry

6. Oyster Genetics, Biotechnology and Broodstock Development.

The West Coast oyster industry has a well developed hatchery system of which California secures 100 percent of its seed oysters, but has not develop the genetic lines capable of enhancing the industries potential as seen in salmonid aquaculture or traditional agriculture. The first programs in oyster genetic line development have been established, but additional research is required. Triploid animals produced through polarbody retention has demonstrated positive value to the industry, but research in tetraploid x diploid cross for triploid seed production, and to retain genetic options in triploid production programs requires additional research.

The industry would benefit from:

- 1) Increased support of oyster broodstock development, including support for genetic line assessment of heterozogosity and family trials.
- 2) Increased support for research in triploid production resulting from tetraploid x diploid crosses, and identification and retention of favorable family genetic traits.

7. Fish health continues to be a major priority in California finfish production. California

commercial fish production both for food and environmental enhancement is a major target for both the industry and the Resource Agency. Specific pathogenic associations restrict production economics and preclude some essential commercial fish from inclusion in natural resource enhancement programs.

The Industry would benefit from:

- 1) Research on control of viral diseases on production and conservation sturgeon aquaculture.
- 2) Research of the effects of disease on mitigation and enhancement programs of salmon and white seabass.
- 3) Research on the diseases of and relationship to wild and cultured abalone.
- 4) Control of bacterial pathogens of hybrid bass.

8. One of the fastest growing areas of California is Commercial Marine Algal and Micro-Invertebrate Culture as essential early stage food for finfish and the international shrimp aquaculture industry. California is among the recognized leaders in these areas. The rapid expansion in Europe in the culture of cod and flatfish, including halibut, flounder and turbot are of interest to California growers, but better information on nutritional relationships between cultured algal species and essential nutritional requirements of larval fish. Also required with these technologies, are methods of preserving and extending the shelf life of algal food products and developing the technology of bioreactor production of rotifers that was developed in Japan and which patent-protection has expired.

The industry would benefit from:

- 1) Increased information on the Nutritional Makeup of Algal Species such as Nannochloropsis, Tetraselmis, T-ISO, and Pavlova and how to nutritionally enhance the biological makeup of the algal cells.
- 2) Determine the nutritional requirements of early life stages of flatfish, including halibut, flounder and turbot and match the objectives of (a) to the requirements of these and similar fish matched through a blend of algal paste.
- 3) Improved methods of cryopreserving of silica-based species of diatoms and develop suitable extenders that will lengthen the refrigerated shelf life of algal paste (i.e. anti-fungal) to meet the needs of 3rd-world markets that lack freezing facilities.

F. PACIFIC ISLANDS/CARIBBEAN REGIONS

Reported by Tom Farewell

We have some interesting characteristics and features in the Pacific/Caribbean regions that are important because of the diversity of the regions, they are tropical/subtropical and when you

consider that about half of the world's aquaculture is done on tropical and subtropical species, longer growing seasons and about half of the U.S. EEZ, and they include about 80 percent of the U.S. coral reef systems. But more importantly to us, we have some unique characteristics. Culture and aquaculture go hand-in-hand for centuries of history in the islands. It is important for us to revive aquaculture not only from a local subsistence cultural point of view, but also to provide economic development opportunities to these places that don't have economic boom opportunities enjoyed by the mainland states.

Our discussions focused on:

Partnership

We have been working in the Hawaii/Pacific areas to develop partnerships. We have formed a Marine Pacific Aquaculture Center with the University of Hawaii, the Oceanic Institute, the National Marine Fisheries Service, Hawaii Department of Land and Natural Resources, the Aquaculture Development Program, and hope that this blossoms into a center that we can expand and incorporate the rest of the Pacific Islands, and key representation from the industry as well. As a result of that partnership, we have been able to influence some successes recently such as the new Open Ocean Leasing Law passed by the State Legislature this past year that paves the ground for offshore aquaculture.

In our discussion group, we thought there should be two separate centers notwithstanding our many commonalities and ecological systems. Historically, the distance has been too great (from Guam to the Caribbean), so there should be some separate regional activities. We believe there is considerable opportunity to increase our collaboration to help look at commonalities in our developments and take advantage where that is possible.

Demonstration Projects

Demonstration projects have not enjoyed a research funding priority and many of the smaller individual research projects just do not support demonstration activities as well as applied aquaculture activities in general. We see a need and an opportunity for this in the Pacific and Caribbean. In Hawaii, we already have our first cage project about ready to harvest with Pacific threadfin (moi), that has been a successful species in stock enhancement and we are ready to go to market with those fish in about three weeks and the results have been terrific. Using that as an example, demonstration projects do take a fair amount of money because feed alone for a project like that can be on the order of \$135,000 by itself, so it needs to be highlighted as being important. We have seen tremendous reaction from industry just in the initial stages of this alone because of the fact that we have something in the water that works and has great opportunity and there is nothing like seeing and believing to prompt economic development. In addition to demonstration offshore, we see a great need for land-based production. Again, there has not been the funding available or encouraged for growout production technologies in land based systems which are important for the Pacific, Hawaiian and Caribbean Islands moving inland like many other production systems. We do have an opportunity for expansion, particularly in

Hawaii, with flow-through systems with the Natural Energy Labs expansion that is planned, but our long-term focus has to be on those grow-out production technologies which cause those land based systems to be funded.

Focused Research

I use the term "focused" research because we have to admit that without direction from on high in the aquaculture technology arena, particularly the applied arena, we have to say that the research has not been focused on an objective such as land based systems and making it work. We talked about how you need consistent funding over a period of time to get successful end products. We certainly see that it needs to be pressed in a way. With our unique species, there is tremendous opportunity for food fish and shell fish, for coral, live rock, tropical ornamentals, and even plants and mollusks. But we need consistent, focused research to really help these areas move towards actual implementation and take advantage of what has already been done.

Marketing

As we do focused research, to really come out the end and have a product, we have to look at the upfront marketing of what is it going to be like once we get to the end of the product line of the research, the development, the demonstration, the extension, etc. to know what the market opportunity is, how we need to cultivate and motivate that market, how we need to look at the distribution system and the technology needed to transport that product, particularly in a geographically spread-out region like the Pacific and to some extent the Caribbean also.

Recirculation Systems

We need to focus on recirculation systems and species suited to that and suited to the cultural and subsistence areas throughout the Pacific Islands.

Offshore Systems

We see the opportunity in offshore work that need to be emphasized above and beyond the actual demonstration projects previously mentioned and work on some of the techniques. We need **hatchery development** work that focuses directly on species that are going to work well and be developed for offshore systems. **Feeds technology** to make the feed effective yet compatible with the environment needs work. **Containment systems** for the offshore systems including mooring, configuration, feeding mechanisms, all are opportune for work at this time. With our large EEZ's, we believe **non-moored systems** have a future and need to be looked at, although we believe non-moored systems have a longer production cycle.

In order to achieve Commerce policy objectives of reaching a \$5 billion goal, we view most of these items as being short-term priority needs and we estimate that it would take about \$15 million to make progress in these areas over the next several years for the Pacific and Caribbean regions.

[Note: While not discussed in the breakout session, Tom mentioned a number of opportunities for research partnerships based on facilities in Hawaii. They include: new feeds processing laboratory that is going into final design there will be opportunities support feeds, nutrition and processing research whether it be freshwater, cold water or otherwise. They have facilities to bring water from the deep ocean (6 degree Centigrade) to work on cold-water species. There is a U.S. Shrimp Farming Consortium with a large pool for genetic breeding done under the ICEES rules. There are stock enhancement programs for mullet and threadfin that have been successful. They would like to partnership with others interested in these projects or need such capabilities.]

G. NATIONAL AND INTERNATIONAL BREAKOUT GROUP

Reported by Robert Collett

Assignment: Identify national and international initiatives to stimulate the growth of an economically viable and environmental sound aquaculture industry

The group identified six national and four international initiatives that could be undertaken to stimulate growth of the aquaculture. Time was insufficient to prioritize the initiatives. Participants agreed that the list is not likely to be comprehensive and the identified initiatives require elaboration and additional analysis. The assumption was made that funding for national and regional initiatives might be limited.

National Issues

- A **simplified national permitting system** with a mandate for timely review and accountability should be established. It might be helpful for one agency to take responsibility for processing the permit applications and ensuring all requirements are met.
- **Improve statistical measurements** by developing uniform definitions among and between the various federal and state agencies as well as international organizations of the term aquaculture and products thereof, establishing a uniform species codes and setting timelines for reporting of production data. It was suggested that creating a tie with the USDA Agriculture Census and Atlantic Coast Coop Statistics Program could enhance this system.
- In the interest of **effectively communicating** the government's (particularly DOC's) national initiatives on aquaculture a formal advisory group, including stakeholders, should be established. There is a need to develop a clean and concise message regarding the DOC policy, especially the implementation plan for its programs/objectives and the integration of these activities with those of existing government programs.

- **Enhance and expand the existing Sea Grant Extension Program capabilities** in the area of aquaculture outreach. This Program has a proven ability to work on fishery-related technology problems at the grass roots level and is well positioned to deliver technical assistance, education and research programs to the industry. Statistics are needed on the accsp model to justify the budget increases.
- **Establish an acceptable level of protection for animal plant health through uniform interstate health certification standards.** The standards should not add additional layers of regulation at the federal level but rather should facilitate uniformity among states. A government agency could do this in consultation with an industry advisory committee. There are at least two possible models. The first is the WTO's Sanitary and Phytosanitary Standards (minimum food safety standards that are established and agreed upon by member countries. They can be exceeded only when a country can provide adequate evidence that additional standards are necessary for public health protection). The second model is that established by the International Organization of Epizootics for international reporting of animal diseases. The adherence to those OIE standards provides a legal safe harbor in WTO trade disputes.
- **A fast track approval process and a process that allows for easier adjustment to existing approvals for therapeutants and biologicals** is needed. There was also discussion about whether the government should facilitate the development of these compounds through funding or research but there was no consensus reached on this idea.

International Issues

- **Seek international cooperation and agreement for aquaculture based stock enhancement projects.** Modeled after e.g. OIE, UNNR, APEC or other appropriate fishery biologist research and service forums.
- **Investigate the possibility of establishing cooperative technology arrangements** including scientific and industry exchanges with other countries and regions for aquaculture modeled after the UJNR or similar approaches such as APEC.
- **Facilitate aquaculture trade by establishing an aquaculture action team in the Dept. of Commerce** to advance image and break technology barriers to trade through foreign trade missions and demonstration projects recognizing that not all institutional technical barriers to trade relate to animal or plant disease issues.
- **Explore the feasibility of developing additional uniform International standards and regulations** where needed.

Closing Remarks by Jim McVey

In every region there are different issues that have priority and we were able to get a feel for this spectrum through this workshop. Also some of the groups talked about a mechanism for coordinating. We want to work with the regions, where the action is going to occur with the industry people and the priorities that you have identified. At the national level, Ed Rhodes (NMFS) and I (Sea Grant) serve as contacts and coordinators. We have National Ocean Service Coordinators and they connect to coastal zone managers. Meryl Broussard and the Regional Aquaculture Centers (RACs), he connects there. At all levels you have representatives here in Washington that can tell your story or bring it into the equation as we try to go forward and organize how we are going to implement this Department of Commerce policy and the funding that comes with that policy. I want to bring to your attention that this year we had a national competition and we put out \$1.6 million through a Sea Grant process for aquaculture. We funded projects in the Western and Pacific area, in the Gulf of Mexico offshore, in Florida on scallops and coastal management, certainly on policy and regulatory side of things. We have made a beginning of a nucleus of support for your regions and that will come to fruition as the money becomes available October 1, 1999 and again in February (2000). So we have made a beginning, and as we expect additional funds, this is certainly part of what you have been involved in.

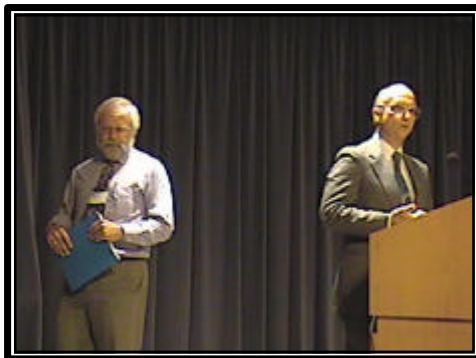
Closing Remarks by Ed Rhodes

Appreciate the fact that so many could attend this workshop and the energy level brought to our Headquarters. It is important that our DOC and NOAA representatives could see 140 dedicated, diversified interest people focused on aquaculture for three days. We'll have to see the final report to see all the issues more clearly identified, but let me make a couple of comments. We certainly heard from the top down about issues about a lead agency; about how the Department of Commerce, Agriculture, and Interior will act/interact will certainly come out of the report and be considered by us. We heard very clearly some coordination issues in NOAA, between Sea Grant and NMFS. We heard some strong partnership language. The roll of the JSA and this is very important to us. We also heard positive and negative things about the DOC draft legislation and some changes will be made based on comments received (e.g., license will be changed to lease). In terms of budgets, we heard about "Why this policy without the bucks attached to it to make it happen?" My response and what Andy (Rosenberg) was saying this morning is, we need an appropriate budget but we need to first identify the appropriate federal roll and then go for that. It might require some lobbying to get higher dollars than are in our budgets now.

One thing I heard is about selling aquaculture. We get bombarded everyday about the negative things associated with aquaculture. What are you going to do about shrimp viruses? What are you going to do about salmon escapes? What are you going to do this and that? We don't get many e-mails from the other side of things and it would be good to get some of those too so I can send them back to the other folks sending me the negatives. What we need to do at every level is to be truthful and put together aquaculture as we know it can happen in an environmentally sound way. We need to push that button from a NMFS

perspective, through Sea Grant extension, which can be so effective, and certainly the industry perspective. While we focus some on enhancement in NMFS, certainly private aquaculture is what we are talking about predominantly. Historically, NMFS was able to work closely with industry -- Milford on shellfish, Manchester/Seattle on salmon, Galveston on shrimp was very much a industry/government partnership and we need to continue to look at ways to productively continue this. We need to continue the dialogue and will work on this as best we can through the web, additional workshops and other opportunities.

Lastly, let's look for solutions and not confrontations on these very difficult issues.



Part V. Conclusions, Recommendations, and Future Courses of Action

Based on the reactions of many workshop attendees, this was a workshop begging to be undertaken. Suggestions were made that dialogue should continue nationally, in the regions, in the labs and workplace. New tools such as the use of the Internet to communicate will assist in this dialogue. Since the workshop, several regional caucus groups have formed. The need to formalize aquaculture advisory groups (one or more) through the use of an existing body such as the NOAA Science Advisory Board or a charter for a new Marine Aquaculture Advisory Committee has been recognized.

It is self-evident that there is much to be done by many different players. Among others, governmental agencies are admonished to work together to make improvements to regulatory procedures that satisfy agency mandates while reducing what industry views as uncoordinated and sometimes arbitrary hurdles. Researchers and the academic community are encouraged to refocus attention to priority areas which may transcend the realm of normal academic pursuits to assist in problem solving towards making aquaculture socially, economically, and environmentally sustainable (or, as one group has termed it -- politically correct). There are still many remaining issues and unexplored areas to cover and future opportunities will bring these to the top of the agenda. We have come closer to identifying on what and when (near-term, long-term) we should spend new or redirected federal dollars for research, technology development, outreach and other issues and how those dollars might be stretched through collaborative efforts with other stakeholders. For federal agency efforts, all this can be accomplished through the mechanism of the JSA and the NADP.

As an agency, this report will assist us in focusing our attention and resources towards a common goal of achieving sustainable aquaculture. With a recently approved Department of Commerce Aquaculture Policy and a number of related initiatives we can better evaluate which activities and studies may be the most propitious for Commerce agencies to undertake. Also, when we can join with other agencies and partners in working to overcome the obstacles to sound aquaculture development. Government, industry, academia and the environmental NGO community will all need to work to improve the process of aquaculture development. Whether we form partnerships out of necessity or some greater common vision won't matter as much as the fact that we do work together to best utilize what resources we have to satisfy the many interests and demands that are placed on aquaculture production. As our theme suggests, we have begun to "*define the pathway into the 21st Century.*"