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Contents

Marine Aquaculture in Maine:
Preserving industry's place on a changing coast

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The marine aquaculture industry in Maine currently faces numerous challenges. In past years, the primary challenges of this industry have been technological and the Maine Sea Grant program, the University of Maine and other scientific institutions have conducted studies to help the industry to develop better gear, husbandry, disease diagnostics and prevention, and species development. However, many of today's challenges are more sociological than technological. Issues around conflicting uses and access to near-shore waters are prevalent and have become significant barriers to development and growth in the marine aquaculture industry in Maine. Maine's coast is being bought-up by people who are interested in using these properties for vacation and solitude and their desire to preserve viewscapes and other aesthetic characteristics tends to disregard the traditional working water front uses of the coast including commercial fishing and aquaculture. In addition to these issues, there are also several contentious policy issues facing the state regulatory agency and the industry. These include: development of criteria for permitting aquaculture facilities that satisfy conflicting uses, accommodating the recent listing of the wild Atlantic salmon as an endangered species, the development of best management practices for the industry that satisfy environmental protection needs under the consideration of a discharge permitting system, and others. How best can an extension program such as Sea Grant and Cooperative Extension participate in meaningful ways amidst all of this conflict? This presentation will highlight some of these challenges and provide a forum for discussion of the ways that our extension programs can help address these issues.

Comparison of Two-phase with Traditional Three-phase Production of Hybrid Striped Bass in Earthen Ponds

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Introduction

A three-phase growout process is commonly used in the commercial production of hybrid striped bass in earthen ponds. Phase I fingerlings, 2.2 to 3.3 lb/1000, are stocked into phase II ponds at a density of approximately 12,000/acre. Harvest of fish (2.2 to 4.5/lb) from phase II ponds is followed by size grading that precedes stocking into ponds (3,500/acre) for the final growout phase. Size grading is designed to reduce the degree of variation in harvest weight after the final stage of growout has been completed and may contribute to significant mortality. The prospect of completely bypassing phase II of growout in favor of a direct stocking of graded, phase I juveniles into ponds has been investigated for the past four years. Fish larger than those traditionally stocked into phase II growout ponds would be used in this direct stocking procedure.

The advantages of this management practice can translate into a more efficient enterprise. Mortality that often arises from the inability of smaller fish to transfer from a live to a formulated diet after stocking into phase II ponds would be minimized. Larger juveniles are already feeding on a formulated diet before stocking into the final growout ponds occurs. In addition, by stocking larger fish, the total growout time necessary to produce an acceptable market size would decrease.

Approach

Recent experiments at the Eastern Unit of the NWAC have demonstrated that this proposed management practice potentially has application and is economically practical. Juveniles harvested from phase I of growout were graded to produce two relatively uniform individual weight classes, 6.6 lb/1000 (3 g each) and 11.0 lb/

1000 (5 g each). These fish were then stocked at either 3,500/acre or 4,500/acre into ponds that represented the second (final) stage of growout in the direct stock procedure. After stocking, the fish were fed commercially manufactured > 40% crude protein feeds daily to satiation for 17 months. At harvest, survival of fish in all ponds ranged from 51 to 99%, but was consistently highest in ponds stocked with 5-g juveniles (83% versus 70%). Average production for the 3,500/acre and 4,500/acre stocking densities, 5-g stocking weight, was 4,020 and 4,952 lb/acre, respectively.

A comprehensive economic analysis revealed that the treatment consisting of a 4,500/acre stocking density and 5-g stocking weight yielded the highest net return. Variable costs increase due to the higher cost of purchase of larger juveniles to stock. However, this cost is of little consequence when compared to costs incurred from mortality and the labor to harvest fish from phase II ponds and then grade them for stocking into phase III ponds.

Within the total population of fish harvested from ponds stocked with 5-g juveniles, 18 to 30% weighed more than 1.25 lb, the size generally in highest demand. A 4 to 5 month extension of this final stage of production, equivalent to the total combined time commonly needed for traditional second and third phases of production, would probably have yielded 50% of all harvested fish being market size. For a 17-month experimental growout period, economic analysis indicated that the direct stock, two-phase growout management practice is more profitable than the traditional three-phase growout.

This successful experimental demonstration of the direct stocking procedure for commercial production of hybrid striped bass in earthen lays the foundation for future investigations. For example, using lower stocking densities and a stocking weight even greater than 5 g should reduce the time to market size to approximately 14 or 15 months, rather than the current combined 20 to 24 months for phases II and III. Despite the lower overall production per pond resulting from lower stocking densities, more crops can be harvested per unit of time, and significantly higher returns over time would eventually be realized. In addition, if the time to final harvest is reduced, then the risk of crop loss due to disease or adverse environmental conditions is correspondingly reduced.

Conclusions

With the scaling up the direct stocking procedure from small experimental ponds to commercial ponds, a management problem arises. Fish stocked at low densities into ponds of 5 to 10 acres may not be able to encounter a sufficient amount of formulated diet for maximum growth. The resulting slower and most probably disproportionate growth would probably contribute to a greater variation in the individual size of fish within the pond population. A seemingly practical solution to this problem is to confine the originally stocked fish temporarily (2 to 4 weeks) to a small section of the pond. The reduction in feeding area achieved by this "penning" procedure should serve to enhance encounter to feed, and the higher density within the confined area should also help to stimulate feeding activity.

The continued success and development of the aquaculture industry in the United States require the incorporation of management practices that improve economic return to the producer through an increase in the efficiency of the use of resources. The direct stock management practice currently under investigation for hybrid striped bass production responds to this need.

UNH's Open Ocean Aquaculture Project: A Research, Extension, and Commercial Fishermen Partnership

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Introduction

In the early nineties, New Hampshire Sea Grant Extension was encouraged to look for opportunities in marine aquaculture. After attending many regional and national aquaculture meetings and visiting marine aquaculture facilities on both coasts as well as in Norway, Iceland, and Canada, Extension came to the conclusion that marine aquaculture would have to take place in a warehouse setting or move offshore. New Hampshire's short coastline with no protected sites and a very active and diverse group of users offered no near shore area where aquaculture could take place.

New England fishermen have had their fishing days greatly reduced by fishing regulations. So, the idea of conducting marine aquaculture offshore was interesting because it could be an opportunity for commercial fishermen to use their knowledge of the ocean, boating skills, vessels, and work ethic in a new business.

There was very little information available on aquaculture being conducted in an exposed, open ocean, high-energy environment. Extension had two proposals funded to sponsor a three-day international symposium asking the questions: "what do we know, what don't we know, and what do we need to know about open ocean aquaculture." The symposium brought more than 30 speakers and 150 participants from a dozen countries together in May of 1996, creating a very exciting high-energy meeting. The 600-page proceedings became the bible for open ocean aquaculture.

The University of New Hampshire's Open Ocean Aquaculture Project

The workshop created a lot of enthusiasm for open ocean aquaculture and researchers could see a multitude of research opportunities, but they all realized the traditional funding streams would not be sufficient to develop a good research project.

A meeting was arranged with New Hampshire's Senator Judd Gregg and a local group that included the UNH president, the director of NH Fish and Game, a local member of the governor's executive council, the NH Sea Grant director; six UNH researchers, the owners of Great Bay Aquafarms (a private fish hatchery), the NH Sea Grant/Extension educator, the president of the NH Commercial Fishermen's Association, and the president and manager of the Portsmouth Fishermen's Cooperative. Extension's role was to get the fishermen to the meeting.

The fishermen told Senator Gregg that their fishing effort was being greatly reduced by new restrictive fishing regulations and they were looking for alternative business opportunities that would allow them to continue fishing. Marine aquaculture, where they could use their vessels and skills, was very appealing. The fishermen's testimony was very important in convincing the senator to support an open ocean aquaculture project. After the meeting he asked for a proposal.

Extension was invited to meet with 10 UNH researchers and the owners of Great Bay Aquafarms to develop a proposal. Being included in the initial discussions was a great opportunity for Extension. Most of the researchers realized that an Extension component was going to be very important because of its relationships with the existing marine users. One of the first things this group did was elect a three-member executive committee to lead the effort. The extension educator was one of the three, which guaranteed that Extension was going to be an important part of the project.

After word was received that the project had been funded, the first important task was to select a site. Extension played an important role in this process. A general area was selected based on water depth and bottom composition. There was a lobster fishery that operated in the area for five or six months a year and shrimp fishermen had a few tows in the area in the winter. Extension arranged a meeting with the lobster fishermen. After listening to the project description and goals the lobster fishermen identified the areas that would have the least impact on them. The next step was to meet with the shrimp fishermen and, of course, the lobstermen who had picked the areas where they could tow a shrimp net. After back and forth meetings with the two parties, a 30-acre site was selected. Many of the researchers attended these meetings and good relationships between them and the fishermen were developed. A couple of the researchers had worked with the fishing industry on other projects.

When it came time to get a permit for the project, it was decided to apply for a commercial rather than an experimental or research permit. To make it a true commercial permit, the local fishermen's cooperative was asked if they wanted to be part of the project. Again, Extension had a long history of working with the cooperative so they played a part in arranging meetings with the cooperative directors and spent a lot of time meeting with fishermen one-on-one to talk about open ocean aquaculture. At the permit public hearing, no one spoke against the project.

In the first year of the project, Extension arranged a meeting with state legislators. The researchers made presentations on the various components of the project and cultured mussels were served for lunch.

Whenever possible, fishermen were hired to work on the project moving fish, feeding fish, and transporting people to the site.

During the past three years, Extension has participated in dozens of planning meetings, kept fishermen and other marine users abreast of project activities, appeared on public television, presented papers at national and international meetings, met with decision-makers, brought decision-makers and the media out to the aquaculture site, produced a fact sheet and video on mussel culture, and hosted numerous meetings with fishermen.

The UNH Open Ocean Aquaculture project has two components, finfish and shellfish. The finfish part of the project revolves around two open ocean cages built by Ocean Spar Company of Bainbridge, WA. The project has had summer flounder and cod in the cages and is presently growing halibut and haddock in them.

The shellfish component has had four successful crops of blue mussels grown on a submerged longline. This technology is ready to be transferred to the private sector. The target audience for this technology is the commercial fishing fleet. Extension has held four mussel workshops for fishermen over the last three years explaining the technique, project progress, and results. The next steps will include helping interested fishermen prepare business plans, develop marketing strategies, identify appropriate sites, obtain permits, acquire gear, collect seed, and start grow out.

Conclusion

Extension can be a very important component of a large multi-disciplinary research project. The first contribution is usually identifying the opportunity or need for the research effort. To be effective, Extension needs to be involved in the project from the beginning. If Extension is not involved in the planning, chances are they will be left out or their contribution minimized.

The most obvious contribution Extension can make is connecting the project with users who should be involved from the very beginning of the project. Most funding sources in aquaculture want to see how the research is going to be applied. Researchers who have learned to partner with users have a better chance to be funded than those who neglect this important reality. It is important for Extension to let the researchers know that they can help make that important connection.

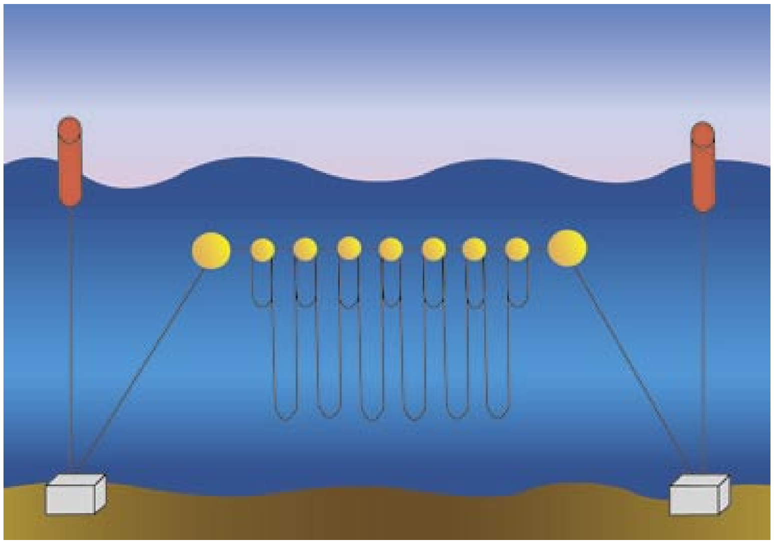
Extension can help educate the public, media, decision-makers, and regulators about a research project through workshops, publications, fact sheets, videos, one-on-one meetings, news releases, and the media. Extension staff are experts at arranging workshops and meetings. Most researchers who try to run a workshop don't understand the complexities and drop the ball. Extension makes fun of itself by bragging about its ability to arrange a room or make coffee at the appropriate time, but it's the details that make an event successful.

Many researchers don't appreciate the importance of public education until they try to implement a new idea that is rejected by the public because they don't understand the concept. A clear understanding of what is being proposed is very important and Extension can help that happen.

In this project, many important relationships were developed. First, Extension was a full partner with a dozen researchers and the level of respect and trust between Extension and researchers was greatly enhanced. Hopefully, the researchers now see the value of having an Extension component in their proposals and have learned about Extension and its mission.

Relationships between fishermen and researchers were also developed at this time; researchers learned that fishermen can make a great contribution to a project and fishermen began to respect and trust the scientists. Several of these relationships have developed into other projects.

Some researchers find that they like working with users and end up spending time and effort in outreach activities. Extension can call on most of the marine researchers at UNH to make presentations or to take part in needs assessments and problem-solving processes. The best scenario is when researcher, user, and Extension lines become a little blurred and all become equal; that is when there is true partnership and trust.



Fish Health Certification and the West Virginia Salmonid Industry

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Fish health certification can help protect individual fish farms, aquaculture industries and wild fish populations. Fish health certification can also be used as a marketing tool by the producer. In 2001 and 2002, West Virginia salmonid farmers were offered free farm certification to meet requirements for export to Maryland and other Mid-Atlantic states.

A farm qualified for sampling if salmonid fish were produced on site from the egg stage. Fifteen farms were sampled in 2001 and 2002. Eight farms were privately owned and seven were run by a state government agency. Farms produced trout (rainbow, brook, brown, golden) and Arctic char. Total production at all farms for both years was 900,000 to 1.2 million pounds. About 75% of this production was intended for stocking/ fee fishing; the rest was sold directly as food. All farms used spring water that was presumed to be specific-pathogen-free. One combined spring water with river water. For three farms, the water collected in a pond or ran above ground before entering the rearing units. All of the private trout farms purchased specific-pathogen-free (SPF) eggs from Washington. The Arctic char producer purchased SPF eggs from Canada. Eggs for the government farms were supplied by their own brood stock.

Fish were sampled according to requirements of the state of Maryland. A comparison of certification results from 2001 and 2002 and a summary of the cost of providing this service will be presented. As part of this service, farmers have been given suggestions about farm management to reduce the risk of infection with certifiable pathogens. In 2002, farmers were asked about implementation of recommended management changes, perceived advantages and disadvantages of fish health certification and willingness to pay for the service in the future. These results will also be presented.

SEI: A tool for Offshore Aquaculture Site Selection

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Introduction

Cage culture is practiced in coastal bays, fjords, and lochs in numerous countries throughout the world. With increasing seafood demand and coastal expansion bottlenecks, associated with potential self-pollution by the aquaculture sector and user conflicts for limited space, open-ocean aquaculture has received some recent attention to make new sites available for grow-out. However, even when operating in more exposed but nearshore locations (still within state waters) user conflicts, spatial limitations, and even self-pollution might be a reality, depending on the location and operations.

No aquaculture industry currently exists offshore in U.S. federal waters within the Exclusive Economic Zone (EEZ). Introducing a new use for the offshore U.S EEZ presents significant challenges for appropriate offshore aquaculture site selection. Numerous users of the EEZ are established in the Gulf of Mexico (GOM) including commercial (specific fishing grounds) and recreational fishing (established artificial reefs), oil and gas (minerals rights and future exploration), shipping (established channels), military zones (for national defense and training), and dumping zones. Existing uses potentially limit access to appropriate grow-out sites, especially coupled with the list of environmental and oceanographic criteria required for optimal sites. Selected offshore aquaculture sites may also have production limits prior to negatively impacting the environment, thereby decreasing the economic potential of specific sites to investors.

Environmental impacts from cage culture operations include benthic carbon loading, water column nutrification, and stimulation of algal blooms. Benthic impacts associated with waste solids accumulation can be attributed to poor site selection, management decisions, site overproduction, or some combination of these. Just as computer models are being developed for economics, weather and climate change prediction, and engineering simulation, poor offshore aquaculture site selection and overproduction will be mitigated through development and use of predictive environmental impact models. The integration of impact models will fall largely on the extension community to provide the technology transfer to educate the new industry participants of effective model use and interpretation.

Numerous authors have discussed the mechanics and relationships involved in modeling benthic impacts from fish farm wastes (e.g., Hargrave 1994). Complex hydrodynamic models have been developed for specific regions (Panchang et al. 1997), but are unlikely to be general and therefore limited for use elsewhere. DEPOMOD is a more generic, end-user benthic impact model developed for the Scottish cage culture industry (Cromey et al. 2002). Although generic to the sea loch systems in Scotland, limitations to its use for siting and managing operations in the open ocean are likely. To this end, the Simulation for Environmental Impact (SEI) model was created to provide a tool that can be integrated into the development of an offshore aquaculture industry for appropriate site selection, optimal enviro-economic management decisions, and application of medicated feed (Riedel and Bridger 2003).

Specific objectives during its development were to:

Provide predictive capabilities through conceptualization of the potential environmental impacts, measured by benthic carbon loading, associated with various environmental and management decision criteria.

Develop a manual and graphical user interface (GUI) tool that extension professionals may easily transfer to industry to assist in determining the suitability of offshore aquaculture sites and appropriate management strategies to mitigate environmental impacts based on visual output of model results.

Provide industry and regulatory agencies with advanced statistical diagnosis to assist with environmental monitoring and future application of medications by the industry.

Approach

The Gulf of Mexico Offshore Aquaculture Consortium (OAC) hosted a two-day regional offshore aquaculture retreat in September, 2002 that allowed discussion to formulate a research and development strategy for an offshore aquaculture sector in the GOM (Bridger 2002). Attendees realized at this time that suitable methodology must be identified to allow comparisons across the GOM region and to support impact assessment modeling, among other applications. The OAC has been developing standard operating protocols (SOPs) for monitoring the environmental effects of offshore aquaculture in the GOM. SOPs are developed to monitor near-field effects of aquaculture on the local environment in the most cost-effective and practical manner while not burdening the industry with substantial financial and time effort. Although SOPs have been developed, use of sampling values will be meaningless to both regulatory agencies and operators without some means to effectively visualize trends and significance of impacts that will allow determination of optimal site production capacity and alteration of management practices to alleviate concerns of environmental impacts. Lack of meaningful interpretation of monitoring data provided the impetus for developing SEI for offshore aquaculture.

Outcome

Use of SEI will assist regulatory agencies, industry, and extension professionals with site selection efforts and predict farm solids accumulation associated with a suite of possible management strategies (e.g., feeding schedule, stocking density, production limits) and fish growth and mortality parameters derived from extended data sets (i.e., annual) (Fig. 1). Compressed data sets could be used to provide decision-making capability to set medication limits and isolate sampling stations to monitor overuse of medication during treatments (i.e., over a 24 or 48-hour period). Output data may be analyzed using advanced spatial statistics for more in-depth interpretation of model scenario results (Fig. 2). For effectiveness, SEI must have an appropriate GUI and require data that would be gathered during the site selection process (i.e., characterization of current speed and direction) and required farm monitoring procedures (i.e., total organic carbon). Use of existing data sets will ease the cost and time burden otherwise required of the industry. In contrast to the DEPOMOD program, SEI does not integrate benthic community response nor a resuspension model component in an attempt to ensure that it remains generic for all offshore regions throughout the nation and eliminate location-specific issues associated with benthic community and resuspension. Instead, SEI uses total organic carbon as the indicator of benthic impact and a user defined threshold for acceptable carbon loading on the environment.

Conclusions

Several aquaculture professionals are currently utilizing the SEI “de-bug” version. Provided comments regarding ease of understanding and use of both the screens and user manual will be incorporated into the model prior to release of version 1.0 in the coming months. Lab experiments will assist us in suggesting likely ranges for various input parameters associated with a given species being grown offshore. Additionally, validation of model results will be an on-going process through actual monitoring of environmental impacts associated with offshore aquaculture operations throughout the nation. Offshore aquaculture will be a technical industry heavily dependent on mechanization and careful management decisions to ensure farm worker safety and economic success. Development of an environmental impact simulation model will prove to be a large part of this success through thoughtful site selection and management decisions. Intimate understanding of this model by extension professionals will ensure its use by industry and regulatory agencies is most effective.

Acknowledgments

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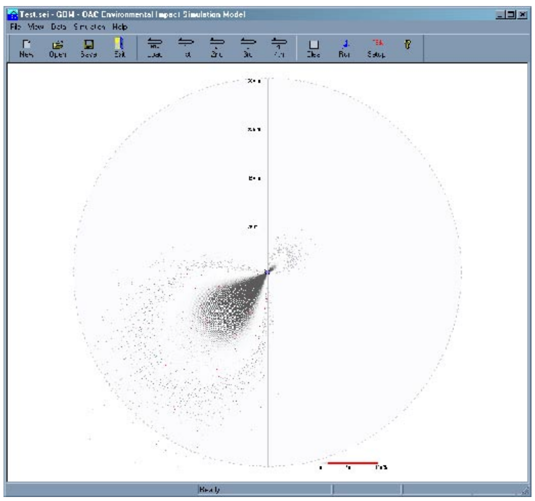

Figure 1. *The SEI graphical user interface and an example of model scenario output.*

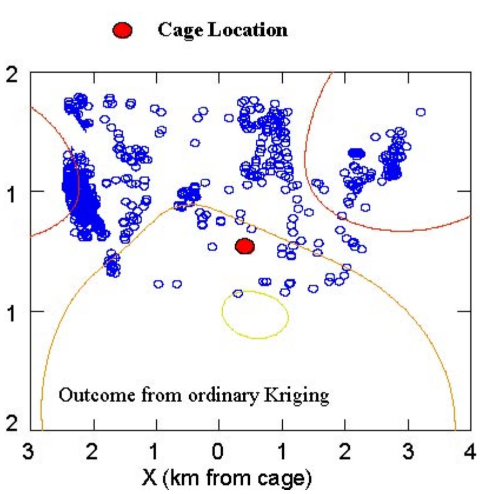

Figure 2. *Representation of spatial statistical analysis of model output data depicting impact contours.*

References

Bridger, C.J. 2002. Development of a Responsible Offshore Aquaculture Industry in the Gulf of Mexico – Research and Development Strategy. Mississippi-Alabama Sea Grant Consortium, Ocean Springs, MS. MASGP-02-008. 15 pp.

Cromey, C.J., T.D. Nickell, and K.D. Black. 2002. DEPOMOD – Modelling the deposition and biological effects of waste solids from marine cage farms. Aquaculture 214: 211-239.

Hargrave, B.T., editor. 1994. Modelling Benthic Impacts of Organic Enrichment from Marine Aquaculture. Canadian Technical Report of Fisheries and Aquatic Sciences 1949.

Panchang, V., G. Cheng, and C. Newell. 1997. Modelling hydrodynamics and aquaculture waste transport in coastal Maine. Estuaries 20: 14-41.

Riedel, R. and C.J. Bridger. 2003. SEI (Simulation for Environmental Impact) User Manual (and associated SEI program on CD-ROM). Mississippi-Alabama Sea Grant Consortium, Ocean Springs, MS. MASGP-03-001-01.

Reality: Defined by Perception or Fact

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Introduction

What people perceive as real can be and is defined by fact and/or perception. As scientifically literate professionals we recognize and appreciate that natural processes are best described, understood and manipulated by factual knowledge. Concurrently, we acknowledge that many decisions and pursuits are strongly influenced, often determined, by perceptions that may be factual or biased. In a world populated by nearly 6.3 billion human beings (World Population Calculator 2003), it is critical that humankind not only appreciate the difference between fact and perception, but pursue actions based upon factual information.

The relative newness, rapid growth and increasing importance of aquaculture have catalyzed social disruption as hunting and gathering of seafood transforms into cultivation of the seas. Close scrutiny has and will occur as people assess the cost: benefit of aquaculture. Often aquaculture has been assayed by incomplete, inaccurate or biased information. As extension specialists and educators one of our most daunting challenges and exciting opportunities involves helping our clientele and the general public to distinguish between fact and perception.

Aquaculture provides a unique and timely conduit to educate people on how factual information can be used to describe accurately a situation or distorted intentionally or accidentally to misrepresent the situation. Characterizing the ecological impacts of Atlantic salmon (*Salmo salar*) culture in net-pens constitutes a contentious and important initiative where fact and perception are often blended (Goldburg and Triplett 1997, Naylor et al. 1998, Goldburg, et al. 2001). One concern that has received focused attention involves the sustainability of salmon culture, specifically the efficacy and wisdom of utilizing large quantities of fish to support salmon production. The purpose of this paper is to calculate and quantify the efficacy of assimilation for food ingested by wild and cultured salmon based upon factual information.

Natural Systems

Classical ecological theory characterizes energy transfer between trophic levels as 10% efficient (e.g., Krebs 1994). Carnivorous fish such as salmon are ecothermic organisms that exist in an essentially gravity-less environment, water, and their assimilation efficiency varies between 10-40% (e.g., Krebs 1994, Evans 1998, Forster 1999). If we assume the most efficient assimilation efficiency (40%) for wild Atlantic salmon and calculate assimilation efficiency for salmon cultured in net-pens, the values can be compared to determine which production system is most efficient.

Feed Conversion

In aquaculture, assimilation is commonly expressed as feed conversion, which is essentially the inverse of assimilation and may be defined by the following equation:

$$\frac{\textit{mass of food ingested}}{\textit{increase in mass of fish}}$$

A 40% assimilation value, for wild salmon, translates into a feed conversion of 2.5:1. The average feed conversion in 1997 on Norwegian farms was 1.15:1; however many farms were operating at 1.3:1 while some producers achieved 1:0.09 (Anonymous 1997, Wedemeyer 2001). These data suggest that cultured salmon convert feed more efficiently than wild fish, but the comparison represents an incomplete assessment and is therefore inaccurate.

Fish are typically 70-80% water (Pennington et al. 1985, Exler 1987, Wedemeyer, 2001), while commercial rations are commonly <10% water (Wedemeyer 2001; feed specifications for Silver Cup, Steam Pelleted Salmon Feed, Murray, UT and Zeigler Salmon Grower, Gardners, PA). A factual comparison of feed conversion rates in wild and cultured salmon requires a correction for water content.

Water Correction

Assuming an average feed conversion for cultured salmon of 1.2:1 with a water content of 10%, a feed conversion for wild fish as 2.5:1 and that fish are 75 % water, dry weight to dry weight conversion efficiencies may be calculated as follows:

Feed Conversion on a Dry Weight Basis

Wild salmon *(2.5) (100%-75%) / 100 : (1) (100%-75%) / 100 = 0. 625 : 0.25* or **2.5:1**

Cultured salmon *(1.2) (100%-10%) / 100 : (1) (100%-75%) / 100 = 1.08:0.25* or **4.3:1**

When corrected for water content it appears that wild fish convert feed on a dry weight basis more efficiently than cultured fish. However the calculated conversion efficiencies do not account for differences in proximate composition, most notably protein. Commercial rations used to growout salmon are typically 40-50% protein or 44-56% on a dry weight basis (Wedemeyer 2001, Feed Specifications for Silver Cup, Steam pelleted Salmon Feed, Murray, UT, Zeigler Salmon Grower, Gardners, PA, Hans Carlsson, Corey Aquafeeds, St. George, NB, personal communication). Edible portions of forage fish consumed by wild salmon such as anchovies, sardines, and herring as well as salmon themselves are approximately 20% protein or 80% on a dry weight basis (Pennington et al. 1985, Exler 1987). A factual assessment of feed conversion in cultured and wild salmon requires a correction for protein content.

Protein Correction

Estimating the protein level on a dry weight basis in commercial rations used for salmon growout at 50% and in forage fish ingested by salmon at 80%, corrected conversion efficiencies on for wild and cultured salmon can be determined as follows:

Feed Conversion on a Dry Weight Basis for Protein Content

Wild salmon *(2.5) (80%) / 100 : (1) (80%) / 100 = 2.0 : 0.8* **or 2.5:1**

Cultured salmon *(4.3) (50%) / 100 : (1) (80%) / 100 = 2.15 : 0.8* or **2.7:1**

When examined on a dry weight basis for protein consumed, wild and cultured salmon convert ingested feed with nearly the same efficiency. While we could justifiably conclude our comparison between wild and cultured salmon at the protein to protein level; the increasingly important consideration of protein source would be neglected. Fish and fishmeal are finite resources and essential dietary constituents for both wild and cultured salmon. A factual assessment of feed conversion in cultured and wild salmon requires a correction for source of protein.

Fish Meal Correction

While wild salmon obtain their protein from the fish they consume (100%), prepared rations contain sources of protein other than fish. Salmon growout rations typically contain 30% (range = 25-35%) fish meal that is 70% protein (Hans Carlsson, Corey Aquafeeds, St. George, NB, personal communication; Todd Powless, Zeigler

Feed, Gardners, PA, personal communication). On a wet weight basis (30% x 70%/100%), fishmeal represents approximately 21% of dietary protein in prepared rations. Correcting for water content (10%), on a dry weight basis the percentage protein from fish in salmon growout ration is 19%. Using these data it is possible to calculate and compare conversion efficiency for fish protein on a dry weight basis for wild and cultured salmon as follows:

Feed Conversion on a Dry Weight Basis for Protein from Fish

Wild salmon *(2.5) (100%) / 100 : (1) (100%) / 100 =* **2.5:1**

Cultured salmon *(2.7) (19%) / 100 : (1) (100%) / 100 =* **0.5:1**

When foods ingested by wild and cultured salmon are compared on a dry weight basis for protein that originated from fish, cultured salmon exhibit a feed conversion efficiency that is five times better than realized by wild salmon.

So What?

Our comparison of feed efficiencies achieved by wild salmon foraging on fishes and cultured salmon fed a prepared ration demonstrate the efficacy of fish culture. Cultured salmon grow more efficiently and utilize less fishmeal than their wild conspecifics and efficacy of production is improving. What has been perceived too frequently as a biological shortcoming is more correctly characterized as a societal challenge. Consumers prefer salmon, a top carnivore which graces our dinner table only after several repackagings and considerable loss of energy. A sociological response is indicated to shift consumer preferences to embrace herbivorous or omnivorous rather than piscivorous fishes.

The process illustrated by our meticulous comparison of feed conversion in wild and cultured salmon can be applied to other issues both within and beyond the realm of aquaculture. Factual information is pre-requisite to the "constructive dialogue and effective collaboration," recognized by the FAO Fisheries Department (1997) as the foundation of issue resolution. Students, culturists, elected officials, activists, and the general citizenry in a democracy can better interact and achieve mutually beneficial ends when issues are defined by factual information vs. perceptions.

References

Anonymous. 1997. The Art of Low-cost Production. Fish Farmer 11(2): 38-39.

Exler, J. 1987. Composition of Foods: Finfish and Shellfish Products. U.S. Department of Agriculture, Agriculture Handbook 8-15.

Evans, D.H. (ed.). 1998. The Physiology of Fishes, 2nd Edition. CRC Press, Boca Raton, FL. 519 pp.

FAO Fisheries Department. 1997. Aquaculture Development. FAO Technical Guidelines for Responsible Fisheries. No. 5. Rome, FAO. 40 pp.

Forster, J. 1999. Aquaculture Chickens, Salmon: A Case Study. World Aquaculture Magazine, 30(3): 33, 35-38, 40, 69-70.

Goldburg, R.J., M.S. Elliott, R.L. Naylor. 2001. Marine Aquaculture in the United States: Environmental Impacts and Policy Options. Pew Oceans Commission, Arlington, VA.

Goldburg, R. and T. Triplett. 1997. Murky Waters: Environmental Effects of Aquaculture in the United States. Environmental Defense Fund, New York, NY.

Krebs, C.J. 1994. Ecology, 4th edition. Harpers Collins College Publishers, New York, NY. 801 pp.

Naylor, R.L., R.J. Goldburg, H. Mooney, M. Beveridge, J. Clay, C. Folke, N. Kautsky, J. Lubchenco, J. Primavera, and M. Williams. 1998. Nature's Subsidies to Shrimp and Salmon Farming. Science 282: 88-89.

Pennington, J.A.T. and H.N. Church. 1985. Food Values of Portions Commonly Used. Harpers and Row, New York, NY. 257 pp.

Wedemeyer, G.A. (ed.). 2001. Fish Hatchery Management, second edition. American Fisheries Society, Bethesda, MD. 733 pp.

World Population Calculator. 2003. Current World Population. http://www.onlineconversion.com/world_population.htm

Marketing Options For Small Aquaculture Producers

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Introduction

Innovative approaches to marketing are usually the key to financial success or failure of small-scale aquaculture producers. Regardless of the size or type of venture, marketing is an essential component and requires a plan. Most producers would like to sell to one or two high-volume buyers such as a processing plant or distributor. This is a good marketing strategy if you are producing large quantities of fish. However, small-scale producers cannot take advantage of the economies of scale of larger producers and must therefore sell for a higher price to remain profitable. Their best option is to establish niche markets for their products. Considerable time is required to analyze and develop niche markets and a number of critical issues should be examined before marketing begins. These issues include the species, competition, product forms, pricing, promotion, market share and where and how to market the product.

Digital Information
Organization, Retrieval and Delivery of Digitized Information

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Introduction

Major changes in U.S. population demographics and a shift in political influence from rural to urban interests have imposed both economic and social changes on universities that traditionally support agriculture interest (Conte, 1993; Meyer, 1992, 1995, 1997). As a result, state Land Grant and Sea Grant (LSG) institutions have experience cyclic, financial challenges in their ability to match available resources to programmatic responsibilities. These financial challenges have especially impacted LSG outreach programs. Limited resources necessitate innovation and modification; and include how information is developed and delivered to both industry and urban clientele (Conte, 1997). The request for aquaculture information from urban audiences has expanded exponentially; and includes support for a broad range of interest ranging from school reports to large-scale financial aquaculture investments. Although our primary responsibility may be the aquaculture industry, the weight of political influence from urban audiences mandates service to both the general public and our traditional clientele. Our challenge is how to respond to general information requests and demonstrate the value of aquaculture; and all balanced with the maintenance of quality programs for the industry that we serve.

Extension programs nationally have recognized these changing trends for over a decade, and have developed computer support systems to address the challenges. Primary objectives include the development of computer-based programs that allow rapid response to public service requests, yet permit the time necessary to address the larger, more significant industry related issues of technology, public policy and the regulatory process. In many states, the funds available to publication units such as Agriculture and Natural Resources (ANR) cannot match the demand for production of information publications. County Extension staff usually establishes the subject-matter publication priorities for ANR, and more often the choices reflect the county’s own commodity priorities. States with few or no county Extension staff with aquaculture responsibilities seldom give priority to ANR aquaculture publications. To overcome these challenges, Extension personnel have adopted digitized publications and other digitized information to meet their own mandated university responsibilities. This experience and approach to the information-response challenge is mirrored among many states with large clientele demand, especially those with more limited resources. The following is based on the California experience, and will be used to trace and describe the philosophy of extending digitized information.

Approach: The approach for handling the increased demand for information by an expanding clientele base is the development of computer-based systems to produce, organize, retrieve and deliver digitized outreach materials with the following primary objectives and characteristics. 1) Produce high-demand and quality publications that do not have ANR priority for funding or hard copy production 2) Reduce and/or eliminate hard copy storage, and create instant access to the same materials from digital origins 3) Reduce the cost of publication and document production and modification 4) Reduce the time and cost to distribute publications and documents 5) Facilitate a more rapid turnaround for publication and document review and modification 6) Integrate the personal computer (PC) software and the Internet server with web site applications to extend information to clientele 7) Create the ability for relative unlimited digital information storage combined with rapid search and retrieval functions 8) Create integrated and multiple application, computer-based capabilities for dissemination of information ranging from traditional mail to Internet transmission

In the late-1980s, initial computer support information delivery programs consisted of combining word processing with macro-programs designed for rapid retrieval of stored documents and accompanying letters (Conte and Gibson, 1992). With the expansion of the Internet, these same information documents were applied to computer/server bulletin board systems used to manage and deliver documents to larger audiences. In the early 1990s, the Western Regional Aquaculture Center (WRAC) funded development of the Windows-based software, “Outreach for Windows”, which is a stand-alone PC program that stores, searches for, sorts, retrieves, prints and/or sends any digitized file formats in protected and unprotected format (Conte and Ahmadi, 1995a; 1995b; 1996). With additional availability of servers and websites, a second program, “Outreach Web” was developed. It is an Internet application of the same principle that can sort and search pre-selected file formats located on the campus-based, California Aquaculture “hub server”, or any other Internet website such as AquaNic or other aquaculture web sites.

The *California Aquaculture* website (http://aqua.ucdavis.edu) and "hub server" contains aquaculture information, related Internet links and over 300 publications and other digitized files. The public information, publication database contains the various USDA sponsored, Regional Aquaculture Centers' (RAC) digitized publications, and the University of California Davis, Department of Animal Science aquaculture publication series. Among the hub's features, are tools that may be used by Specialist and Advisors to deliver information directly to clients, including digitized publications in .pdf format, digital images, and videos. Information may be printed and mailed, faxed, or sent by e-mail directly from the Server, or the operator's PC (Conte and Ahmadi, 1997a; 1997b). Concurrent to the development of the software and systems, training sessions on effective use of the system, software and the Internet are conducted for industry and the general public (Conte, 1996).

Outcome: Over the past decade, computer support systems that integrate the PC with dedicated outreach servers and websites for Extension application were developed nationally. Development of more efficient commercial system platforms and digitized file formats, primarily the Adobe .pdf format, made the PC and digitized document standard tools in Extension outreach. The rapid expansion of the RAC and departmental digitized publication series provided the nucleus of supportive information for urban clientele and entry aquaculturists. Extension units that adopted the publication philosophy of first producing the digitized publication, followed by subsequent printed copies from these files, have been able to meet their own aquaculture program responsibilities, and use of regional and national peer review processes for digitized publications has maintained publication quality control.

Outreach software programs for the PC and server has facilitated the ease of delivery of digitized information in printed and transmitted format and has freed time for Extension personnel to address the more complex and pressing industry issues. The full integration of dedicated web sites and outreach servers as repositories of information has been a major step in outreach technology. When equipped with search, sort and distribution capabilities, integrated computer/server systems have become integral and major working tools for extension personnel. Outreach programs vary in their use of the web site, server and the Internet as the primary vehicles for information delivery. Because of the inevitable temporary failure of all technologies, our program employs the combined use of standalone PC software "Outreach for Windows" and "Outreach Web for the Internet" to provides essential backup when one or the other system is down for repair or maintenance.

Conclusion: In the past decade, production and distribution of digitized information in Extension outreach by individual Specialist and Advisors (Agents) has become the norm rather than the exception. Individual control in the linking of various national, regional and state websites in a readily accessible gateway to aquaculture information has become a common outreach function. The ever increasing body of digitized information will requires the integration of the PC and server to store and deliver information, and will require more effective and accessible search and sort engines to manage the expanding body of digital information.

References

Conte, F. S. and N. A. Gibson. 1992. Rapid retrieval computer information system for extension application. Proc. Nat. Aquaculture Extension Conf., Little Rock, AR. 8 pp.

Conte, F.S. 1993. The Land Grant University Concept In The United States: Brief Historical Overview and Evolution Impacted by Changing Social Patterns. Paper presented at Universidad\Autonoma de Baja California Sur, Baja, Mexico, December 2, 1993.

Conte, F.S. and A. Ahmadi. 1995a. Outreach for Windows: A computer based document management and delivery system. Proc. of the FACTs Conference, Orlando, Florida. 17 pp.

Conte, F.S. and A. Ahmadi. 1995b. Outreach: A computer based, document management system for extending information. Aquaculture 95', San Diego, CA. Abstract, pp 111.

Conte, F.S. 1996. Information by Computer: Getting Industry and the Public up to Speed. Aquaculture America 96', Arlington, TX. Abstract, pp 29.

Conte, F.S. and A. Ahmadi. 1996. Outreach: A document management and delivery system. Proc. 6th. Annual International Conference on Computers and Agriculture, Cancun, Mexico, Sco. Agri. Eng. Pub. 9 pp.

Conte, F.S. 1997. Land Grant and Sea Grant Institutional Modifications: The California model. Proc. Nat. Aquaculture Extension Conf., Annapolis, MD. Abstract.

Conte, F.S. and A. Ahmadi. 1997a. Extension Tools for Desktop PCs and the Internet. Proc. Nat. Aquaculture Extension Conf., Annapolis, MD. Abstract, pp 23.

Conte, F.S. and A. Ahmadi. 1997b. Outreach for Windows: Document Management for PCs with Internet Application. Proc. Nat. Aquaculture Extension Conf., Annapolis, MD. Abstract, pp 23.

Meyer, J.H. 1992. Rethinking the outlook of colleges whose roots were in agriculture. University of California Press.

Meyer, J.H. 1995. Transforming the Land Grant College of Agriculture for the twenty-first century. Kellogg Foundation. pp 30.

Meyer, J.H. 1997. Re-engineering the Land Grant College of Agriculture. Kellogg Foundation. pp 32.

Gallo Mussels and NPDES
Ninth Circuit Court, Processes and Extension's Role

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Introduction

A homeowner association of an island development community in Puget Sound, Washington, the "Association to Protect Hammersley, Eld, and Totten Inlets (APHETI) litigated before the United States District Court for the Western District of Washington against Taylor Resources, Inc. (Taylor). APHETI apposed the use of floating rafts and submerged longlines to culture the Gallo mussel, *Mytilus galloprovincialis* in inlets located near the island properties. The APHETI litigation was based on: 1) Taylor's mussel farms are Point Sources (for pollution discharges); 2) The non-indigenous mussels (*Mytilus galloprovincialis*) and associated wastes discharges from the mussel farms are pollutants; and 3) The mussel farms discharge pollutants into Puget Sound.

In view of the above points, APHETI argued that to operate in public waters covered by the Clean Water Act, the Defendant must obtain a National Pollutant Discharge Elimination System (NPDES) permit. The United States District Court for the Western District of Washington dismissed the complaint on summary judgment in 2001.

The Appeal: APHETI *(Plaintiff-Appellant)* successfully petitioned the case and judgment to the United States Court of Appeals for The Ninth Circuit. In 2002, APHETI presented its written brief as well as a supporting brief of *Amici Curiae* authored by the United States Public Interest Research Group, Washington Public Interest Research Group, and the Washington Environmental Council. In its briefs and presentation before the Ninth Circuit, APHETI presented arguments that Taylor required a NPDES permit to operate their existing mussel rafts based on three main points: 1) Non-indigenous species harmful affect to the environment constitute a pollutant; 2) Biological constitutions of non-indigenous species such as eggs, larvae, shell and waste products constitute a pollutant; and 3) Mussel rafts are a Concentrated Aquatic Animal Production Facility (CAAPF) which automatically require a NPDES permit

Taylor (*Defendant-Appellee*) was represented by Samuel Plauche' of the law firm Buck & Gordon LLP of Seattle, WA. Plauche' wrote the written brief and presented oral arguments to the Ninth Circuit court (Buck and Gordon, 2002). A brief of *Amici Curiae* on behalf of Taylor was authored and filed for the Pacific Coast Shellfish Association (PCSGA) by F. Robert Studdert (PCSGA, 2002).

Taylor Defendant-Appellant Position and Statement of Issues: Taylor requested a Ninth Circuit decision that their mussel culture activities are not subject to Clean Water Act permit requirements and to uphold the District Court's earlier decision. The District Court had ruled in favor of Taylor's position that: 1) The Clean Water Act's NPDES permit requirements did not apply to a mussel cultivation facility as it adds no materials to the nation's waters, but results in a net reduction of materials and enhancement of water quality; 2) Mussel culture does not discharge pollutants through a discernable, confined and discrete conveyance; and 3) The suit should be dismissed because the agency with jurisdiction has determined that an NPDES permit is not required and therefore cannot be obtained.

Extension Role and Approach: The Attorneys representing Taylor United (Washington) and PCSGA (Washington and California) requested Extension assistance for: 1) An analysis and interpretation of scientific literature used in the AFETI brief, and supporting briefs of Amici Curiae submitted by the environmental coalitions; 2) Provide scientific literature supporting positive attributes of shellfish culture on water quality, and chemical and nutrient cycling in the marine environment; 3) Provide written, science-based positions in the preparation of legal briefs to be submitted by Taylor and PCSGA to the Ninth Circuit; and 4) Participation in the Mock Court conducted by the legal representatives of Taylor and PCSGA in preparation for oral arguments to be presented to the Ninth Circuit.

The Extension assessments of scientific positions presented in the APHETI and *Amici Curiae* briefs, and the science-based positions in support of Taylor's position are reflected in the Taylor and PCSGA briefs (Buck and Gordon, 2002; PCSGA, 2002). The majority of the references used by APHETI were taken directly from the

Environmental Defense publication, "Murky Waters" (Goldberg and Triplett, 1997). As applied in this case, most were demonstrated to be miss-applied, or inaccurate in their interpretation.

Outcome: Ninth Court Decision (The Court)

Clean Water Act Citizen's Suit: The Court rejected Taylor' s contention that a private party cannot bring a Clean Water Act citizen's suit for unpermitted discharges when the state agency charged with administering the NPDES permit program has determined that such a permit is not required. It was rejected because it, "… runs squarely against the plain words of the statute and would frustrate the purposes of the Clean Water Act's empowerment of citizen suit." (U.S. Appeals, Ninth Circuit. 2002).

Non-indigenous Status of Gallo: The Court recognized the non-indigenous status of Gallo mussels and that the industry brought Gallos to Puget Sound in the 1970s and 1980s. However, the court also recognized PCSGA's *Amici Curiae* suggestion that Gallos may have also independently found their way to Puget Sound. The Court concluded that, "… no matter the route of introduction, they now reproduce naturally in Puget Sound, albeit in limited numbers, and have been observed in locations isolated from any mussel-harvesting facilities." (U.S. Appeals, Ninth Circuit. 2002).

Statutory Definition of Pollutant: The Court rejected APHETI's argument that products of the mussels meet the statutory definition of "pollutant." As stated, the argument must be rejected to preserve the integrity of the Clean Water Act. They were persuaded that, "… Congress did not intend that living shellfish and the natural chemicals and particulate biological matter emitted from them, or the occasional shells that separate from them, be considered pollutants." (U.S. Appeals, Ninth Circuit. 2002).

The Court also accepted arguments that mussel products do not significantly alter the character of Puget Sound waters, and instead that the mussel-harvesting operations generally purify the waters. Farther, the shells and natural byproduct of living mussels released result from natural biological processes of the mussels, not the waste product of a transforming human process. The Court affirmed that "biological materials" that are "pollutants" under the Act are materials that are transformed by human activity based on previous legal presidencies. The Court held that the mussel shells, mussel feces and other mussel byproduct released from

Taylor's live mussels thus do not fall within the statutory definition and meaning of "pollutant and rejected all broader interpretations of pollutant in this case (U.S. Appeals, Ninth Circuit. 2002).

Concentrated Aquatic Animal Production Facility: The Court recognized that Taylor's facilities met some criteria of EPA regulations defining a concentrated aquatic animal production facility (CAAPF). However, EPA excludes facilities which feed less than "[approximately 5,000 pounds]" of food during the calendar month of maximum feeding. Because Taylor does not add any feed to its rafts or to the surrounding water, the facilities fall under the second exception to CAAPF classification and are not "point sources" under the Act (U.S. Appeals, Ninth Circuit. 2002). The Court concluded, "… that mussel byproduct and mussel shells that enter Puget Sound from the living creatures suspended on ropes attached to Taylor's rafts are not "pollutants," Taylor's rafts are not "point sources," and Taylor's mussel harvesting on these rafts without a permit does not offend the Clean Water Act … are not "point sources" under the Act." (U.S. Appeals, Ninth Circuit. 2002).

Conclusions

The case had major importance. If lost, the potential impact would have resulted in NPDES permits being required to culture most of the shellfish farmed on the west coast and in many other areas of the nation. The Ninth Court's decision was determined by previous case-precedence and interpretation of precedence. Law is implemented not on a scientific basis, but it is influenced by scientific opinion, especially when backed by accurate assessment of relevant peer-reviewed publications. Extension's role in science interpretation and clarification is of major importance to legal teams addressing legal challenges to aquaculture. It prevents the attorney from being surprised and/or blindsided by the science, and can strengthen a legal position. However, the future performance of support groups and their legal representatives that are apposed to aquaculture will likely improve.

References

Buck and Gordon LLD, 2002. Association to Protect Hammersley, Eld, and Totten Inlets (APETI) (Appellant) v. Taylor Resources, Inc. (Respondent): Brief of Taylor Resources, Inc. No. 00-35667. On appeal from the United States District Court for the Western District of Washington. Filed by Buck and Gordon, authored by Samuel W. Plauche' and Peter L. Buck, Attorneys at Law. pp 35.

Goldberg, R. and T. Triplett. 1997. Murky Waters: Environmental Effects of Aquaculture in the US. Environmental Defense Fund Pub. pp 198.

PCSGA. 2002, Association to Protect Hammersley, Eld, and Totten Inlets (APETI) (Plaintiff-Appellant), Brief of Amici Curiae in support of Plaintiff-Appellant, United States Public Interest Research Group, Washington Public Interest Research Group, Washington Environmental Council v. Taylor Resources, Inc. (Defendant-Appellee): Brief of Pacific Coast Shellfish Association, No 00-35667. On appeal from the United States District Court for the Western District of Washington. Authored and filed by F. Robert Studdert, Attorney at Law. pp 17.

U.S. Appeals, Ninth Circuit, 2002. Association to Protect Hammersley, Eld, and Totten Inlets, a Washington non-profit corporation, Plaintiff-Appellant v. Taylor Resources, Inc. Defendant-Appellee. No. 00-35667, D.C. No. CV-99-05433-FDB(EM), **OPINION**. pp 21.

Aquaculture in a Declining Economy Coupled with Natural Disasters: What is Extension's Role

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After 4 years in a declining economy, a standstill in tourism after the September 11th attacks, and 2 of the worst storms in the last 100 years the aquaculture industry has remained a viable industry. After enjoying good economic conditions and bathing in the rewards of a rich economy, Guam underwent a drastic chain of events that would test the will and character of the individuals involved in aquaculture. The downturn of the Asian economy, particularly that of Japan has a direct impact on Guam's economy, since tourism is its largest industry and the Japanese are its largest group of visitors. This was amplified after the September 11 attack of the World Trade Centers. All travel was at a standstill and the number of visitors dropped to zero. The eventual return of tourists was slow and after a year and a half returned to a level nearing pre-911 numbers. Then in July 2002, a major typhoon struck the island (Typhoon Chata'an), causing millions of dollars worth of damage. For the next 3-4 months the island recovered slowly. When it appeared that things were starting to return to normal another major typhoon struck the island. This typhoon (Pongsona) was the worst storm to hit Guam in 100 years. Again major destruction put the island at a standstill. Emergency personnel from FEMA, Red Cross and other federal agencies were still on-island from the previous storm. Power, water, roads, air transportation were all damaged and out of commission.

Guam is no stranger to major storms and earthquakes. However, successive storms in the midst of an economic downturn are conditions for only the hardiest of souls. The aquaculture industry suffered major damage and loss. Experience from the previous typhoon (Chata'an) demonstrated the crucial role that Extension can play in disaster recovery. Local disaster funds were administered by Extension, with the assistance of the Guam Department of Agriculture. Additional forms of assistance were found to exist, but the information was not widely known. This glaring gap in information provided an opportunity for Extension to gather information on assistance programs for farmers and disseminate this information to its clientele. The information resulted in farmers registering for uninsured producer programs or other insurance programs in time for Typhoon

Pongsona. Regular communication with the Farm Services Agency is now occurring to set standards for aquaculture producers in Guam.

A major contributing factor to the recovery of aquaculturists lies in the camaraderie of its producers. The formation of the Guam Aquaculture Grower's Association (GA'GA) in 2000 has allowed producers, even non-members, an opportunity to talk and help each other with information, supplies, group ordering, etc. The Association also has allowed for the quick dissemination of information to the major producers. Involvement by the local daily newspaper has also stimulated discussion and has resulted in proposed legislation to support aquaculture development. It has also resulted in maintaining local funding for the government hatchery. This is a major accomplishment in light of the extreme austerity measures currently being implemented by the newly elected administration and lawmakers.

Field Results: Diuron For Off Flavor Control In Channel Catfish

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Introduction

Off flavor is a problem plaguing the channel catfish industry in the United States. In addition to tainting the flavor of fish in a pond, off flavor interrupts the orderly production and marketing cycle on a farm, and negatively impacts the industry as a whole.

Because of off flavor, market size fish must be held in ponds for extended periods of time. These larger size fish continue to grow, utilizing food resources needed for growth and development of the under-stocked crop. In many instances, the off flavor fish reach sizes larger than the 4 – 5 pound maximum size desired by the processing plants. These large fish must then be sold to alternative markets, or sold to processors at discounted prices, oftentimes for as little as $0.15 per pound.

In the delta ponds of Mississippi, Louisiana, and Arkansas, blue green algae is the major source of off flavor. Blue green algae, particularly the species *Oscillatoria perornata*, produce a compound known as MIB or 2-methylisoborneol. MIB imparts a musty, medicine like flavor in the fish's flesh causing processing plants to reject the fish based on flavor standards.

The key to controlling off flavor in catfish is to control the presence of blue green algae, which is next to impossible. Catfish ponds are ideal for the development of blue green algae blooms. Ponds are shallow, averaging 4 feet in depth, and enriched from a nutritional standpoint due to high levels of feed inputs. The ponds also become very warm in the summer reaching water temperatures in excess of 32^{o} C .

An interesting compound for control of blue green algae is the chemical Diuron (3-{3, 4-Dichlorophenyl}-1, 1 dimethylurea). In 1999, the United States Environmental Protection Agency (EPA) granted an emergency exemption underSection 18 of the Federal Insecticide, Fungicide, and Rodenticide Act allowing the use of diuron to manage blue green off flavor in catfish.

Diuron is an excellent chemical for off flavor control because of its availability, low cost, ease of application, and success across a wide range of environmental conditions. Labeled directions for diuron allow for a maximum of 9 weekly treatments in a period of one year. Treatment rate is 0.5 ounces per acre-foot per application. The chemical is mixed with water in a pail until a slurry is formed. The slurry is then poured in a pond adjacent to an aerator and allowed to disperse throughout the pond. Using this protocol, producers will not exceed the 2.0 parts per million (ppm) tolerance level established by the EPA.

One problem encountered with use of diruon is that very little information exists concerning number of actual treatments needed to bring fish “on flavor” in production size ponds. This paper will examine one such field study.

Approach

Double O Fish Farm of Parkdale, Arkansas was the cooperator in the study. The farm allowed the use of 9 production size ponds (4 – 5 ha average) for the duration of the study. Ponds used for the study were typical delta type levee ponds, with a 4 to 4.5 foot average depth filled with ground water. Fish stocking rates were 6,000 to 7,000 per acre, which is standard for the industry. Fish were fed a 32% crude protein, floating pellet from a local feed manufacturer. Feeding rate was capped at 125 pounds per acre per day. All ponds selected for the study had food size fish present at the onset of the study. Fish from the ponds had been sampled for flavor prior to starting the study and all ponds were scored as “off flavor”.

Treatment of ponds began on June 19, 2002 and continued to August 16, 2002, when the study was terminated. Initial treatments of individual ponds were staggered throughout the study. Due to large amounts of aeration equipment needed, not all ponds could be treated simultaneously, thus the need for staggering treatments. Fish were sampled for off flavor within a week of the treatment. As fish came on flavor, fish were either sold to a processor or treatment was halted. Please note, not every processor called every sample on flavor. If one processor called the fish on flavor, then the pond was determined to be on flavor.

Outcome

Results of the study revealed that 6 of 9 ponds came on flavor after diuron treatments. The number of treatments required to bring fish on flavor ranged from 2 to 5, with 4 treatments being the average number needed. All four ponds in which treatments began in June come on flavor. Two of 4 ponds in which treatment began in July came on flavor. The one pond in which treatments began in August failed to come on flavor during the study period. The data suggest the earlier a pond can be treated the more likely the pond will come on flavor. Results of the study can be seen in Table 1.

Conclusion

Diuron can be an effective means of controlling off flavor in channel catfish. The key to success is starting as early as possible.

Table 1. Treatment results using diuron to control off flavor in channel catfish.

X indicates pond treatment.

Treatment Date	Pond E-4	Pond E-16	Pond E-13	Pond E-20	Pond E-17	Pond E-1	Pond E-3	Pond E-12	Pond E-17	
June 19	X	X								
June 26	X	X	X	X						
July 2	X									
July 3				X						
July 4			X							
July 9	X	Sold								
July 10				X						
July 11			X							
July 16	X			X						
July 17			Sold		X					
July 23	Sold			X						
July 24					X					
July 26				Sold		X	X	X		
July 31					X					
August 2						X	X	X	X	
August 7					X					
August 9						X	X	X	X	
August 15					X					
August 16					Sold	X	X	X	X	
						Sold	Off flavor	Off flavor	Off flavor	

Developing Environmental Codes for the Pacific Coast Shellfish Industry: A Collaborative Effort

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Introduction

In a proactive effort to deal with multiple challenges facing the Pacific Coast shellfish aquaculture industry, the Pacific Coast Shellfish Growers Association successfully led a grassroots effort to develop Environmental Codes of Practice for the industry. The Codes of Practice encompasses best management practices for the cultivation of all molluscan shellfish species on the Pacific Coast, from Alaska to California.

By the very nature of their operations, which are entirely dependent upon the marine environment, shellfish farmers are particularly vulnerable to numerous environmental, regulatory and political factors. They operate in "critical" and "essential" habitat and often in areas that are shared with threatened or endangered species. The local, state and federal laws designed to address these habitat concerns often come to bear on shellfish aquaculture activities.

Growers are further challenged by the non-point pollution that comes from the increase of impervious surfaces, road runoff and failing septic systems that result from the ongoing trend of communities pushing out and into previously rural coastal shoreline areas. As a result, growing areas are lost because of poor water quality. At the same time, many of these shoreline homeowners do not appreciate a working waterfront and the noise and visual distractions that may occur with shellfish farming. Other marine resource users such as fishermen or boaters may also disapprove of farming activities. Many of the environmental laws designed to legitimately protect sensitive habitat have been used by these competing factions in an attempt to shut down shellfish aquaculture activities in some communities.

Shellfish growers, burdened by these overlapping challenges, have begun to take matters into their own hands through the development of environmental codes of practice that identify the potential positive and negative impacts on the environment caused by every method of cultivation currently in use on the Pacific Coast. The Codes are an exhaustive examination of every type of culture method for every type of shellfish currently in production, identification of best management practices in each of these areas, and a comprehensive bibliography that references every activity and potential impact identified to date. The Codes also contain a reference guide to the local, state, federal and international regulations that growers must comply with.

The Codes were developed over a period that extended over three years, in a process that was driven at the local level and assisted through Alaska, Washington, Oregon and California Marine Extension agents. Published in June 2002, the completed Codes have been adopted formally by the Board of Directors of the Pacific Coast Shellfish Growers Association and the membership. Growers are asked to complete their own individual Farm Management Plans, using the templates provided in the Codes document. The Association is now looking at models currently being developed in other aquaculture sectors to provide for an appropriate accreditation and monitoring system.

The ultimate goal in adopting the Codes of Practice is to assure shellfish aquaculture activities have the lightest touch on the marine environment, maximizing the positive impacts that shellfish provide to the ecosystem while minimizing those activities that may have unintended negative impacts. At the same time, shellfish growers need to be assured that their farms can continue to operate into the future, providing high quality protein and family wage jobs in rural communities.

Video Technology in PowerPoint and DVD-ROM for Teaching Fish Diseases

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Introduction

Video footage can be digitized and used in PowerPoint presentations and lectures. This technology benefits students by enabling them to view fish pathogens while they are moving as though they were being viewed under a microscope in a fish disease diagnostic laboratory. While it would take several years to view most significant fish pathogens encountered in a diagnostic lab, it takes only an academic semester to view the majority of these pathogens in PowerPoint lectures.

Likewise, students viewing the DVD-ROM *Diseases of Warmwater Fish and Trout Diseases* (figure 1) will be exposed to a large number of parasites in a short period of time. Movie footage of most significant parasites, bacteria and viruses of warmwater and coldwater fishes are covered in approximately 1 hour, and students are able to review specific pathogens conveniently. In this DVD, specific viral, bacterial, and parasitic pathogens can be selected from a menu and played by viewers, rather than having to fast-forward or rewind through a linear videotape. Also included in this DVD-ROM are more than 50 aquaculture fact sheets, the *Catfish Farming In Kentucky* booklet, and Web links to aquaculture and fish health sites on the Internet.

Approach

Video clips are digitized and loaded onto a computer hard drive. Video tape footage segments are streamed through a Dazzle Digital Video Creator (figure 2) (converting the analog video into digital format) and into a computer. These short video clips are compressed .mpg 1 (“mpeg one”) files and are then available for inserting into PowerPoint presentations. Under *Format* in the PowerPoint toolbar, *Slide Layout* is chosen and then the layout containing the movie “take one” icon is typically chosen. The movie icon is clicked and then *Insert* is chosen from the toolbar; *Movies and Sounds* is then selected followed by *Movie from File*. The file where video clips are stored by Dazzle is usually under *Program Files*, then under *Movie Star*, then under *Media*, and finally under *Clips*. PowerPoint presentations containing movie footage can be copied onto Zip disks as well as CD-R or CD-RW disks; one must make sure, however, that the disk contains the video clips as well as the PowerPoint presentation itself. In other words, when the disk is taken to another computer and the PowerPoint presentation is played, the video footage in the PowerPoint will not play unless the video clips are available on that disk.

Opportunities in International Extension

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While aquaculture has grown tremendously in the United States in the last 20 years, the growth in the rest of the world has been even greater. Per capita consumption of seafood and aquaculture products in the US is only a fraction of the amount eaten by most Asian and European populations. For example, the province of Guangdong in southern China has more people involved in the aquaculture industry than the entire United States. While the US is a major innovator of technology and equipment, other countries with much longer traditions of aquaculture and much larger industries have much to teach us.

Extension work in other countries affords extension professionals from the US opportunities to learn much that can be shared with US producers. Production techniques, equipment, processing and marketing ideas that are developed in other countries can be shared with US producers. Farmers realize that they compete in a global economy and that they need to have current information on what their competitors are doing. Unlike many industries that are more sophisticated in the US than abroad, aquaculture has as much, if not more to learn from foreign competitors. Scientists, especially extension scientists, who work abroad are likely to learn as much as they teach.

The most basic extension opportunity that many aquaculture professionals have had was a stint in the Peace Corps. Those who have gone through the experience usually describe it as the most challenging and rewarding time of their life. A number of non-governmental organizations (churches, civic groups, environmental groups and eco-tourism) have included aquaculture projects on their agenda. These NGO's frequently request aquaculture extension participation in their plans. Another avenue for international extension is private consulting. Farmers, potential farmers and investors frequently turn to aquaculture extension professionals for guidance in the planning and upgrading of aquaculture facilities in foreign countries. These are ideal opportunities for extension professionals to learn about international operations and how these will impact US producers and markets.

Finally, US and foreign governments frequently solicit extension expertise. In the US, the Agency for International Development is the most frequent client of extension assistance. AID supports the Aquaculture Collaborative Research and Support Program. The Aquaculture CRSP is a consortium of US universities working in conjunction with host country institutions http://pdacrsp.oregonstate.edu/ . There are great opportunities for aquaculture extension both in the host countries, delivering information developed in the US and within the US delivering information from the host countries. Another AID related organization is the Land O' Lakes Foundation. They coordinate the Farmer to Farmer program, which covers the expenses for volunteers to go to developing countries to assist small-scale farmers to improve their efficiency.

International extension work in aquaculture can be rewarding professionally, can be of great benefit to your normal home clientele, and can be some of the most interesting work you will be able to do in your career.

Idaho Waste Management Guidelines for Aquaculture Operations

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Introduction

In 1990, the Department of Environmental Quality (DEQ) declared the Middle Snake River's water quality was limited by human activities. This designation required the Environmental Protection Agency (EPA) under the federal Clean Water Act to institute a Total Maximum Daily Load (TMDL) pollution allocation for each industry impacting water quality. As a point source, aquaculture was regulated under the National Pollutant Discharge Elimination System (NPDES) permit limiting the discharge of solids. The TMDL, however, required an additional limitation on phosphorus discharge and prevented further expansion of new and existing facilities through a no net increase policy taken by DEQ.

To meet the new regulatory requirements, fish growers wanted to either modify their existing waste management systems or do a complete facility reconstruction. However, all plans and specifications for the construction, modification, expansion or alteration of waste treatment or disposal facilities for aquaculture must be approved by DEQ before construction may begin. The problem was that DEQ lacked the technical information to review plans and specifications, and fish producers lacked the technical information required to develop plans and specifications.

Approach

Beginning in 1992, Extension in cooperation with the aquaculture industry, DEQ, and the Idaho State Department of Agriculture began developing "Idaho Waste Management Guidelines for Aquaculture Operations." The purpose of the guidelines is to describe basic waste management systems and practices for flow-through aquaculture facilities, educate owners and operators on effective waste management systems, educate regulatory agencies and the public about aquaculture and aquaculture waste treatment, and identify Best Management Practices.

An extensive search of the scientific literature was conducted and used as the foundation for the guidelines, particularly Stechey and Trudell (1990). Writing assignments were divided among the cooperators and both DEQ and Extension provided editorial review. The industry also compared the dimensions of their settling basins and overflow rates to the recommended design criteria found in the literature.

The guidelines were officially approved, published and distributed in 1997 by DEQ. A University of Idaho critical issues grant of $700 went toward publication costs. Approximately 500 hard copies were published and distributed. A few years later an additional 100 copies were made. The guidelines are also available on the web at: **http://www.deq.state.id.us/water/gw/Aquaculture_Guidelines.htm**.
DEQ estimates 250 copies have been downloaded from their web site.

Outcome

Twenty-two of the approximately 100 facilities in south-central Idaho have used the guidelines to either modify their waste management systems or have done a complete facility reconstruction. Currently, there are another 6 facilities going through the approval process. The guidelines, according to fish producers, have made the approval process much easier and have speeded up the process because they knew what information to include in the plans and specifications submitted to DEQ. The design criteria and formulas in the guidelines were easy to understand and to implement in their plans and specifications. One producer stated his company went from marginal compliance with the NPDES permit to well within compliance as a result of modifications to their settling basins, based upon guideline design criteria. Several other producers have also seen improvements in their effluent water quality. Those that converted earthen ponds to concrete raceways using the guidelines report reduced labor requirements. Concrete raceways are also easier to manage and to keep clean, resulting in improved water quality and fish health. One producer has seen an increase in profitability as a result of reconstruction.

An unanticipated benefit of the guidelines has been the expansion of the industry under the TMDL, which had resulted in a no net increase. This expansion has occurred primarily through the conversion of earthen facilities into concrete raceways. In general fish production is greater in concrete raceways than in earthen ponds. One new facility was approved under the no net increase through a mitigation plan. Under the mitigation plan this facility diverts surface water through settling ponds to remove an equivalent amount of solids and nutrients that are discharged from the spring-fed production facility.

DEQ concurs with the fish producers, stating water quality has improved as a result of the guidelines and that that approval process is much easier for both fish producers and DEQ.

Numerous requests for the guidelines have come from outside of Idaho. It is not known to what extent the recommendations and design criteria are being used outside of Idaho. EPA in their proposed rule making process for national aquaculture effluent limitations and guidelines used the guidelines in their supporting documents.

Conclusion

The cooperative approach taken by the stakeholders involved has resulted in the development of guidelines that benefits both DEQ and the aquaculture industry.

References

State of Idaho, Department of Environmental Quality. 1997. Idaho Waste Management Guidelines for Aquaculture Operations. 80 pp.

Stechey, D., and Y. Trudell. 1990. Aquaculture Wastewater Treatment: Wastewater Characterization and Development of Appropriate Treatment Technologies for the Ontario Trout Production Industry. Queen's Printer for Ontario. 108 pp.

Aquaculture in Action: Tools for Teaching Science

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Introduction

In the last 20 years K-12 aquaculture education has moved from its place as an extension of vocational agricultural in the United States to having solidified itself as an integral part of environmental, biological and research related courses in classrooms across the country. This attention to aquaculture in the classroom has been driven in large part through the support by government agencies like the National Council for Agriculture Education, the US Department of Agriculture, NOAA/Sea Grant Colleges and the National Science Foundation as well as other entities such as aquaculture industry, university outreach and education programs, regional and state boards of education, and fishery management organizations at the state level. Congress recognized the opportunity for making significant progress in aquaculture development in 1980 by passage of the National Aquaculture Act (P.L. 96-362). The 1990 Farm Bill, also known as the Food, Agriculture Conservation, and Trade Act of 1990, (P.L. 101-624) reauthorized the Regional Aquaculture Center (RAC) program at $7.5 million per annum. Five centers were established: one in each of the northeastern, north central, southern, western, and tropical/subtropical Pacific regions of the country (http://www.reeusda.gov/pas/aquaculture/csrees_aquaculture_investment/regional/index.htm). These centers or "RACS" became the focal points of aquaculture and lent some support for educational efforts with teachers and students. However, a much larger boost of support came from The National Council for Agricultural Education establishing the infusion of aquaculture into the agricultural education curriculum as a priority in the late 1980's. The Council initiated the development of a national "core curriculum" for aquaculture education in 1990 with funding appropriated by the U.S. Congress.

The Council (1990) established the following long-term goals for its education initiative in aquaculture:

- To teach young people who are interested in aquaculture the principles of success in aquaculture;
- To impart scientific principles and to recognize the importance of properly managing aquatic resources;
- To use the aquaculture curriculum as a means to interest students in science, math and other relevant subjects;
- To encourage the integration of aquaculture in subjects taught by other teachers in the education system and to augment greater cooperation among individuals;
- To inspire secondary students to enter post-secondary study in
- Aquaculture or environmental science, thereby providing new talent to the industry; and,
- To explore the tremendous potential of aquaculture as an alternative enterprise in rural communities.

References give indications that aquaculture is an effective teaching tool (Caldwell, 1998) and students are highly motivated to learn in an environment that includes aquaculture (Wigenbach et al., 1999). In the following text an overview will be offered to illustrate the role of aquaculture in the education of our youth and how technology has increased the quality of such an educational experience for students involved in research projects. There are certainly numerous programs around the country utilizing aquaculture as an educational tool to promote stewardship of the environment and a growing industry and each program and its partners should be commended for their efforts.

Approach

In Maryland, the title *Aquaculture in Action* (a Maryland Sea Grant Extension K-12 outreach and education program that was established in 1997) was chosen to emphasize that aquaculture itself is a dynamic tool for learning and that participants in a focused training program would be well equipped with both knowledge and materials to put into practice recirculating aquaculture in their classroom (Costa-Pierce et al, 2003). The goal was to establish a network of Maryland teachers appropriately trained and equipped with the essential tools of an aquaculturist so that they could raise and release native species of fish while sharing the experience with their students. The model for this program is based upon successful aquaculture programs at the aforementioned South Carroll High School and Westminster High School in Carroll County, MD. In turn, the opportunity for students to learn the operation and management of fish in a recirculating aquaculture system lends itself to the integration of scientific concepts, their application, and improved problem-solving skills. The *Aquaculture in Action* (AinA) model also employs the use of web technology so that teachers and students can ask questions related to their system operation and also share descriptions and data from their individual school projects. Students are encouraged to work as teams to design and complete projects. Teamwork experience offers the students a feel for the modern workplace. Aquaculture projects involve students in "hands on" application of biology, chemistry, math, and physics skills, which can be related directly to classroom lesson plans and educational goals.

Aquaculture projects extend beyond the classroom. The improvement of environmental literacy is a major goal in science education today. These unique projects form life long relationships between students and local species in the Chesapeake Bay watershed. These relationships motivate students to investigate and perform stream restoration projects that can further improve conditions for local species. This is an essential part of the extension of aquaculture from the classroom to the field. Scientifically, aquaculture projects to become involved in the process of experimental design and data collection throughout a school year emulating the scientific process. The collection of data over the long-term allows students to identify trends and make connections between the physical and biological factors within a particular controlled setting. The end result is greater student awareness of applied skills, scientific knowledge, environmental literacy and an appreciation for the effort required to apply concepts in the field. The following goals are adapted from the Carroll County Science Research curriculum design specifically for aquaculture in the classroom.

Outcome

In 1998, 2000, and 2002 Maryland Sea Grant Extension Program in collaboration with the UMCES Horn Point Lab, UMBI Center of Marine Biotechnology and Carroll County Public Schools, MD, hosted the *Aquaculture in Action* workshop that trained and organized a network of aquaculture educators. A total of 26 teachers are now participating state-wide. The workshops are unique and have been developed in collaboration with Carroll County Public Schools and the instructors of the workshops are master teachers and education specialists experienced with aquaculture in the classroom. The *Aquaculture in Action* workshop engaged educators in "hands on" experiences for 5 days to learn and experience:

- Techniques for setting up a successful aquaculture system.
- The tools and techniques for monitoring an aquaculture system including lab based activities for students.
- Network development of raise and release programs that incorporate a variety of Chesapeake Bay species.
- Techniques for monitoring and restoring local wetlands.
- Successful grant-writing techniques.
- Using web-based technology to communicate and enter project data.

As a result of their participation in the *Aquaculture in Action* workshop in 2000, educators returned to their schools equipped with the following:

- A customized 210 gallon aquaculture system with supplies and materials.
- *Aquaculture in Action* companion manual.
- LaMotte AQ2, water testing kit.
- Clove oil anesthetic
- Two reference texts: The Aquaculture Desk Reference and Fundamentals of Aquaculture.
- Eligibility for credit from Maryland State Department of Education

Conclusion

Since the completion of the three workshops, the *Aquaculture in Action* Program has accomplished the following through close collaboration with its' partners:

- Successful implementation of the 210 gallon systems in each classroom at the start of the academic year with a support system via email, web, and phone to Maryland Sea Grant Extension Program (MSGEP) Specialists J. Adam Frederick and Jackie U. Takacs.
- Visits were made to each classroom to check progress and photograph working systems.
- MSGEP developed a partnership with the University of Maryland Center for Environmental Science (UMCES) Horn Point Lab and MDNR to supply fish requested by the educators.
- The program has been a regular feature in the Maryland Sea Grant Schools Network News newsletter.
- Expanded aquaculture projects to include the entry of data on the web so projects can be shared and tracked by students and teachers.
- Educators were successful in obtaining other grants to enhance current and acquire new systems.
- An Aquaculture in Action web page (*http://www.mdsg.umd.edu/Education/AinA/*), designed by Maryland Sea Grant, describes and displays the program goals, participating schools, and links to other aquaculture resources. Most importantly it offers a venue for educators and students to communicate via email by networking all participants directly on the web site.

References

Caldwell, J. (1998) Why Use Aquaculture as an Educational Tool?
The Conservation Fund's Freshwater Institute, Shepherdstown, WVA

Costa-Pierce, B. A., Peter Edwards, Dale Baker, and Alan Desbonnet (2003) Urban Aquaculture. Ch. 20. CABI Press, Boston, MA, in review.

National Council for Agricultural Education (1998) Aquaculture Education - Making a Splash! (http://www.teamaged.org/aquaculture/aquaculture1.htm)

Wingenbach, G. J., Gartin, S.A. and Lawrence, L.D. (1999) Students Perceptions of Aquaculture Education in the Northeast Region, *Journal of Agriculture Education*. Vol. 40 no 1.

Do All Roads Really Lead to Rome?
Constructing a Roadmap for Aquaculture Permitting in Connecticut

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Introduction

In 2001, the State of Connecticut developed a new permitting system for marine-based aquaculture, particularly with regard to the siting of fixed and transient aquaculture gear. These types of gear (longlines, cages, bags, racks, etc.) have shown to be an extremely efficient and productive means of culturing shellfish, however, their implementation in Long Island Sound has raised a number of permitting issues concerning: navigation, boater safety, aesthetics, environmental impacts, liability, and user conflicts.

The Connecticut Department of Agriculture, Bureau of Aquaculture (DA/BA) collaborated with the U.S. Army Corps of Engineers (USACE) to develop the Connecticut General Programmatic Permit for Aquaculture (PGP). This comprehensive new permitting process requires review of aquaculture applications by several federal, state and local agencies including: USACE, DA/BA, Connecticut Department of Environmental Protection (DEP), National Marine Fisheries Service (NMFS), U.S. Fish & Wildlife Service (FWS), U.S. Environmental Protection Agency (EPA) and municipal shellfish and harbor management commissions.

Due to the complexity of the new permitting system, the application process has become an daunting task for growers, not to mention a overwhelming undertaking for the large number of agencies involved in reviewing applications. Following mounting concerns from regulatory agencies and growers alike, a working group was formed to address the issues surrounding aquaculture permitting in the State.

The goal of the working group was to streamline the permitting process by providing stakeholders with detailed information on the State's aquaculture permitting process, and to provide growers with the necessary tools to complete applications for aquaculture projects. The objectives set by the working group to achieve this goal were:

1. To develop a series of permitting workshops specialized for various stakeholders including growers, policy-makers, researchers, educators, and the general public
2. To develop an application checklist for aquaculture projects
3. To develop an aquaculture permitting roadmap
4. To develop a guide to aquaculture in Connecticut
5. To work with State officials to develop a strategic plan for aquaculture in Connecticut

Approach

In order to facilitate communication and information transfer among stakeholders, a workshop series on aquaculture permitting in the State was developed by the Connecticut Sea Grant Extension Program (SGEP) along with partners including: USACE, DA/BA, DEP, and municipal shellfish and harbor management commissions. Two workshops have been held and three others are planned for 2003. Following the first workshop, a list of "stakeholder needs" was developed and prioritized. High on the list was the need to develop a checklist of items that growers should include along with their applications. This checklist is now attached to the DA/BA and USACE joint application for aquaculture. Another priority was to design an aquaculture permitting roadmap. A draft roadmap is now under review by each of the regulatory agencies. A guide to aquaculture in Connecticut is also in the works. It will include a detailed history of aquaculture in the State, the present status of the industry, and a comprehensive section on the leasing and permitting system. The guide will be updated yearly and will be available at the SGEP website, as will all of the other resources developed by the group.

The long-term goal of the permitting working group is to work with State officials to develop a strategic plan for aquaculture in Connecticut. If successful, we believe that these tasks will result in a streamlined process for aquaculture permitting in the State and will facilitate continuous communication among stakeholders.

Conclusion

Over eighty stakeholders including representatives from the permitting agencies, growers, extension, and the public, have attended the workshops. Growers have responded to workshop evaluations with comments such as, "I am encouraged by the helpful tone of the working group," and, "The agencies represented appear to be very helpful." Several growers acknowledged that they would be more comfortable completing applications after attending the permitting workshops. Some growers said that their opinions on the process were, "unchanged," but they would attend future workshops to learn more about the process.

Overall, the quality of the applications submitted to the agencies has improved recently which has expedited the permitting process dramatically. As growers continue to utilize the resources provided by the working group, it is anticipated that the system will prove to be more efficient. And hopefully, all roads will lead to Rome!

The Integration of Distance Delivered Technology in Aquacultural Extension Educational Programs

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Introduction

The success of any Extension Education program is based upon the delivery system or method that is used to deliver the educational materials or curriculum. The Agricultural Education Department in collaboration with Virginia Cooperative Extension has developed and is currently delivering both formal and non-formal courses to students and clientele across Virginia and to the Southern Region of the United States.

During the year 2000 the Virginia Tech College of Agricultural and Life Sciences administration agreed to establish the Agricultural and Extension Education Department. In addition, through a collaborative effort, a grant was obtained to develop a series of web based courses that would be delivered through a new effort in a distance delivered Masters program to Cooperative Extension professionals that are employed by Virginia Cooperative Extension. These partners include the Dean of Instructional Technology, the Associate Director of Administration for Extension, and the Agricultural and Extension Education Department Head.

Goal

The goal of the project is to enhance educational opportunities for Extension employees using distance delivered methodology.

Objectives

1. To develop an array of graduate level courses in the field of Agricultural and Extension Education.
2. To develop a marketing strategy and plan and recruit students to enroll in these graduate courses.
3. To satisfy the Virginia Cooperative Extension requirement that all newly hired Extension agents obtain a Masters Degree within six years of employment.
4. To effective deliver these courses by both web based delivery and video conferencing.

5. To provide an annual report for the Administration of both Virginia Cooperative Extension and the College of Agriculture and Life Sciences of Virginia Tech.
6. To develop a distance delivered Aqua-cultural Extension Education course that can be used for graduate credit and non-formal Extension Agent training.

Approach

January 1, 2000, the Director of Virginia Cooperative Extension and the Associate Dean of the College of Agriculture and Life Sciences set forth the effort to deliver graduate courses to clientele across Virginia. The primary audience consisted of Extension Agents. However, Agricultural Teachers and Agri-business were involved as well. A committee was formed to strategize how to develop this system. A grant was obtained from Virginia Tech's Center for Innovative Leadership to develop an array of web based courses. The first three courses that were developed were Program Planning and Curriculum Design in Agricultural and Extension Education, Foundations in Agricultural and Extension Education, and Research and Applied Settings. The first students enrolled in these courses Spring 2002. The next three courses developed were Youth Program Management, Extension Evaluation, and Community Partners. Students enrolled in these courses Fall 2002. The next three courses that were developed were Horticultural courses. These courses will be offered during Fall semester 2003. Currently, the Department of Agricultural and Extension Education is developing three courses that will finalize our project. These courses are International Agricultural and Extension Education, Advanced Agricultural Communications and The Foundation of Career and Technical Education. These courses will also be taught Fall Semester 2003.

All of these courses are not being converted to a non-formal basis for utilization in the Virginia Cooperative Extension Staff Development Training Program.

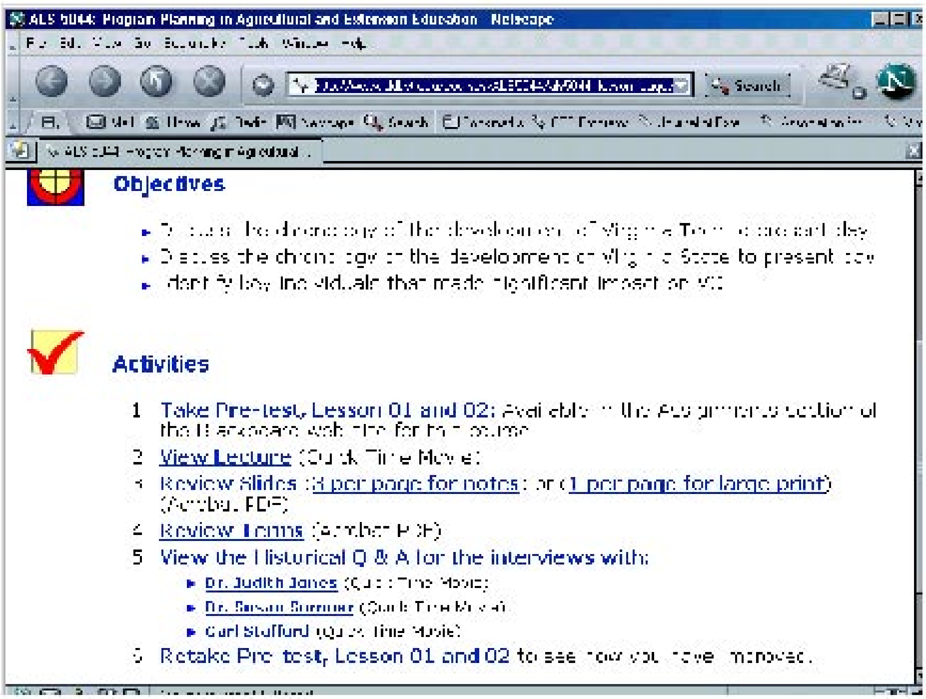
Outcome

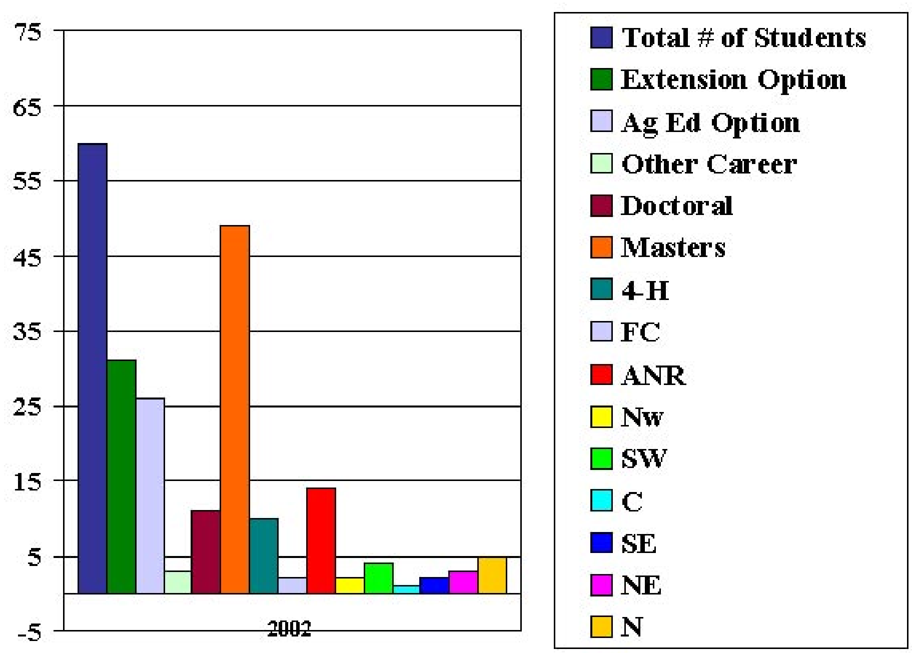
Data collected from the outset of this project reveals that a great void exists in Virginia. The need for Graduate Education in the field of Agricultural and Extension Education is enormous. Figure 1 shows the current breakdown in the graduate enrollment in the Department of Agricultural and Extension Education. Table 1 shows the evaluation for each of the distance delivered courses that have been taught. Table 2 reveals a sample lesson that is being used for the existing distance delivered courses. All components of this lesson could easily be converted to Aquaculture.

Conclusion

The collaborative effort between the Department of Agricultural and Extension Education, Virginia Cooperative Extension and the College of Agriculture and Life Sciences has proven to be a very valuable project. With the budget cuts and the need for quality education, this project will allow students to gain a quality education through this new and innovative delivery system.

Table 2 Sample Lesson





National Risk Management Feasibility Program for Aquaculture

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Introduction

The Risk Management Agency (RMA) of the United States Department of Agriculture and Mississippi State University (MSU) formed a partnership that will conduct a large-scale study known as the National Risk Management Feasibility Program for Aquaculture. The Agricultural Risk Protection Act (ARPA) of 2000 provides funds to investigate the potential of offering risk management protection to previously underserved producers. The study will provide RMA with risk management products, policies, and related materials for the agency to consider. Keith H. Coble and Terrill R. Hanson of Mississippi State University will serve as coordinators for this $3.6 million four-year project. The project will be carried out with five advisory committees providing assistance on project activities. One committee will be formed for each of the aquaculture species (catfish, baitfish, salmon, trout) and a fifth committee will be composed of individuals with agricultural insurance and risk expertise. These committees will be composed of five to eight experts from across the country. Through the assistance of these advisory committees, scientific reports will be commissioned and original research will be funded as needed.

Background - The Agricultural Risk Protection Act (ARPA) of 2000

The ARPA Act authorized the Federal Crop Insurance Corporation (FCIC) to enter into partnerships to increase the availability of loss mitigation, financial, and other risk management tools for producers, with a priority given to risk management tools for specialty crops, and underserved agricultural commodities. Aquaculture is one of the underserved commodities. The Act gives the FCIC authority to enter into partnerships with CSREES, ARS, NOAA, or other public and private entities with capabilities in developing and implementing risk management and marketing options for producers of specialty crops and underserved agricultural commodities. The purpose of this program is to conduct a large-scale study into the feasibility of developing and implementing risk management programs for U.S. aquaculture producers, and to provide FCIC risk management products, policies, and related materials necessary to implement these programs.

Project Objectives and Methods

Specific objectives of this project are to:

1. Organize and initiate a multi-year national program of integrated research that will support an assessment of the possibility of providing risk management tools for aquaculture producers.
2. Conduct four national workshops on aquaculture risk and insurance. These conferences will bring together experts from the various disciplines, producers, USDA officials, and industry representatives.
3. Collect data from published sources and conduct original research. The project will conduct listening sessions in aquaculture production and marketing areas, and gathering information from interested parties.
4. Produce risk management studies for the aquaculture species (catfish, salmon, trout, baitfish) with the greatest economic value. These studies will provide the information to assess the viability of alternative risk management designs.
5. A final project report providing a summary and overview of the entire project will be provided. This report will incorporate information from all interim species reports into the final research report.
6. Develop risk management program elements and documents necessary to implement a risk management program.

The overall project has the challenge of developing viable products through balancing effective production, cost, actuarial soundness and producer acceptance without creating production distortions. The plan of action is to form species steering committees for technical advice in developing a species research plan; collect existing and preliminary aquaculture species data; commission needed scientific reports and original research; develop potential risk management tools and products; and evaluate cost, acceptance, and feasibility of potential products.

Advisory committees for the project are consultative groups assisting in determining research needs. There is one committee for each species plus a risk management advisory committee and it is certain that members will play a key role in this project's success by providing valuable information for potential products.

Activities to date

The first National Risk Management for Aquaculture Workshop was held on April 2-3, 2002, in Memphis, Tennessee. The day-and-a-half meeting brought together approximately 40 specialists in aquaculture and risk management. From that meeting and the species-specific breakout sessions, specific coverage for aquaculture risk events included:

- Diseases (identified by the catfish, salmon, trout and baitfish species committee)
- Bird Predation (catfish, salmon, trout and baitfish)
- Floods (catfish, salmon, trout and baitfish)
- Water Quality (catfish, salmon, trout and baitfish)
- Oxygen Depletion,
- Algal toxins
- Electrical Power Outages (catfish and baitfish); and
- Off-flavor (catfish).

From this meeting authors and researchers were identified to write species specific reports. Each report will provide an aggregate species overview, including identification of production practices and risks, characterization of risks, and evaluate the feasibility of risk management feasibility.

There are many issues needing addressing in this project. We are attempting to move forward in a number of areas (underwriting, actuarial, research, producer acceptability) simultaneously. More details on the progress of the project will be provided at the presentation.

Project Timetable

The project began in the Fall of 2001.

Month	Activity
1	Organize activity and get contracts and staff in place. Recruit advisory committee members and meet to discuss program.
6-12	Conduct the first Risk Management for Aquaculture workshop and start species investigations; conduct listening sessions; conduct follow-up meetings with individual groups to determine research focus
16	Conduct a second Risk Management for Aquaculture workshop.
18	Conduct listening session.
24	Conduct a third Risk Management for Aquaculture workshop.
30	Develop potential program designs, draft policy, loss adjustment handbooks data submission elements, and underwriting procedures.
36	Conduct a fourth Risk Management for Aquaculture workshop. Conduct listening session and analysis of demand.
42	Draft final report.
48	Submit final report.

U.S. Consumer Perceptions and Attitudes toward Farm-raised Catfish

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Introduction

The consumption of seafood, including farm-raised catfish has become an important part of the diet for consumers in the United States. Although the average quantity of seafood consumption in the U.S. is not as high as beef and chicken, consumption of seafood has generally been constant during the 1990's to present (NOAA). U.S. per capita seafood consumption increased from 11.8 pounds in 1970 to a high of 16.2 pounds in 1987. Per capita seafood consumption in 2000 was 15.6 pounds and dropped to 14.8 lb/person in 2001 (USDOC/NOAA/NMFS, 2001). This recent decline in consumption has been attributed to recession fears and a drop in restaurant dining following the September 11th terrorist attack (NFI, 2002).

Fresh and frozen seafood products currently account for 67% of seafood consumption, compared to 57-60% in the 1970's (USDOC/NOAA/NMFS, 2001). Canned seafood products account for 31% of seafood consumption and cured fish products account for 2% of consumption. Among the fresh and frozen seafood products, finfish consumption increased from 4.5 pounds in 1970 to a high of 10.7 pounds in 1987 (USDOC/NOAA/NMFS, 2001). Finfish consumption in the 1990s ranged from 5.9 to 6.4 pounds per capita.

According to the National Agricultural Statistical Services (USDA/NASS Catfish Processing Reports, various months), catfish consumption has dramatically increased over the past decade. Processed weight has increased from 381 to 597 million pounds, a 57% increase, between 1991 and 2001 and foodsize fish sales have increased from $264 to $410 million during the same period (USDA/NASS Catfish Processing Reports, various months). Per capita consumption of catfish increased from 0.41 pounds in 1985 to 1.15 pounds in 2001, an increase of 180% (NFI, 2002).

Producers, processors and marketers of catfish are faced with new opportunities and challenges during these volatile times that have seen up-and-down sales volume, low producer and processor prices, and increased fish supplies resulting from low prices, high inventories, and additional imported fish fillets selling as "catfish." Knowing the characteristics of catfish consumers and non-consumers, why they choose these consumptive behaviors, and why they do not consume more catfish can be beneficial to those developing strategies to increase sales. Additional information on consumer's perceptions of the farm-raised catfish product, safety, nutrition, price, availability, etc., can be important to the industry in developing and expanding catfish markets.

Methods

The data for this study were obtained through a mail survey. Before the survey instrument was prepared, a number of focus groups were conducted in South Carolina, Mississippi, and Kansas to elicit issues to be addressed in a nationwide fish and seafood consumption survey. Results from these focus groups were used to develop categories for the questionnaire as well as test questions and phrasing of questions. The questionnaire was then mailed to a sample of 9,000 households in the United States, with 1,000 mailed to each of the nine major U.S. census regions. A stratified sample design was chosen as region was expected to be a significant determinant of both the choice to consume and the choice of how often to consume catfish. Surveys were mailed in late 2000 and early 2001. If households did not return the first survey, a second copy of the survey was sent. A total of 1,790 surveys, or 20.1%, was returned (after accounting for 'wrong address' returned surveys). Of these responses, 1,416, or 79%, responded to the questions regarding catfish consumption. The information obtained from these 1,416 responses is summarized in this report. Overall, 53% of the 1,416 respondents indicated that they consumed catfish.

Results

Catfish consumption did vary by region of residence, with consumers in the West South Central and East South Central regions of the U.S. most likely to consume catfish, Figure 1. Overall, 84% of the respondents from the West South Central region consumed catfish, compared to the low of 26% in the New England region. Other demographic variables that significantly differed between consumers and non-consumers of catfish included religion and ethnicity.

One finding of the study was that 53% of all respondents ate catfish 3.3 times per month. When respondents were asked why they consumed catfish, 68% said flavor was the number one reason. This was followed by reasons of health and nutrition (31%) and adding variety to their diet (22%,), Figure 2. The main reasons given for not consuming catfish more often were price by 22% of the respondents, non-availability of fresh product (16%), lack of preparation knowledge (14%), and too time consuming to prepare (13%), Figure 3. When asked what would increase their consumption of catfish, they responded with these reasons: lower price (response of 47% of all catfish consumers), increased availability (32%), more recipes (29%), government safety inspection program (27%), and more coupons (27%).

Nationwide, the public regarded U.S. farm-raised catfish as being very safe. Catfish consumers indicated that being farm-raised was very important to their buying and consumption decisions and 14% felt farm-raised catfish was the safest product of all fish and seafood products. Only 2% felt catfish were the least safe seafood product. In contrast, the response to safety for oyster products was more negative with 44% feeling oysters were the least safe seafood product.

As flavor was the most important reason consumers ate catfish, it also appeared to be the biggest reason why non-consumers do not eat catfish. Non-consumers of catfish cited taste (38%), smell (25%), lack of preparation knowledge (23%) and texture (22%) as reasons for not eating any catfish, Figure 3.

Perhaps the most surprising and important finding of the study was that 30% of non-catfish consuming respondents said they would like to try catfish. Thirty percent of the catfish non-consumer group would equate to roughly 38 million Americans, which is a lot of potential buyers.

Conclusion

The results of this survey identified characteristics and opinions of catfish consumers and non-consumers, knowledge that is useful to marketers of fish and seafood products. Results of an econometric study stemming from this data (Drammeh, House, Sureshwaran, and Selassie, 2002) indicated that there are statistically significant differences among the reasons why people choose to eat catfish and the reasons why catfish consumers choose how often to eat catfish. For this reason, this study divided the data into consumers of catfish and non-consumers and examined their characteristics. Results from this study can provide guidance toward addressing the challenges confronted by the catfish industry that is pursuing both market penetration (catfish consumers) and market development (non-consumers) to increase sales.

REFERENCES

Drammeh, L., L. House, S. Sureshwaran, and H. Selassie. 2002. Analysis of Factors Influencing the Frequency of Catfish Consumption in the United States. Selected paper presented at the Annual Meetings of the American Agricultural Economics Association, Long Beach, California, July.

National Fisheries Institute. 2002. U.S. Consumption of Seafood. http://www.nfi.org/news/topten.php

U.S. Department of Agriculture, Economic Research Service. 2002. Aquaculture Outlook. LDP-AQS-15, March 6.

U.S. Department of Agriculture, National Agricultural Statistics Service (NASS). 2002. Catfish Production. February 7.

U.S. Department of Agriculture, National Agricultural Statistics Service (NASS). Various months and years. Catfish Processing.

U.S. Department of Commerce, National Oceanic Atmospheric Administration, National Marine Fishery Service. 2002. Fisheries of the U.S., 2001. Current Fishery Statistics No. 2001. Silver Springs, MD, September. (http://www.st.nmfs.gov/commercial/index.html)

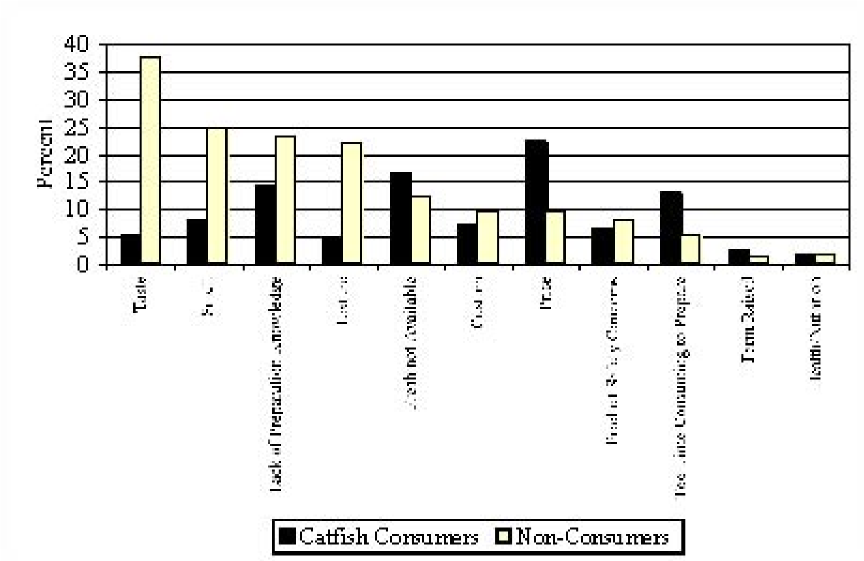

***Figure** 1: Percent of Respondents Consuming Catfish By U.S. Census Region[a].*

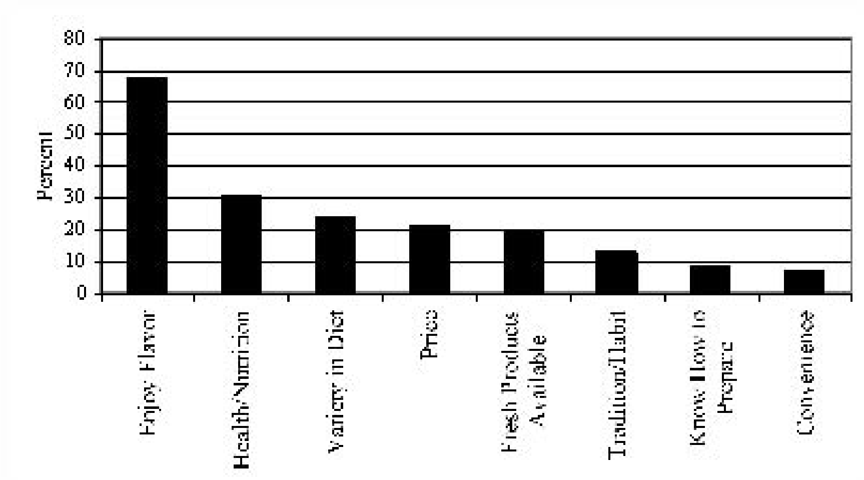

***Figure** 2. Reasons Consumers Eat Farm-raised Catfish (only catfish consumers are reported).*

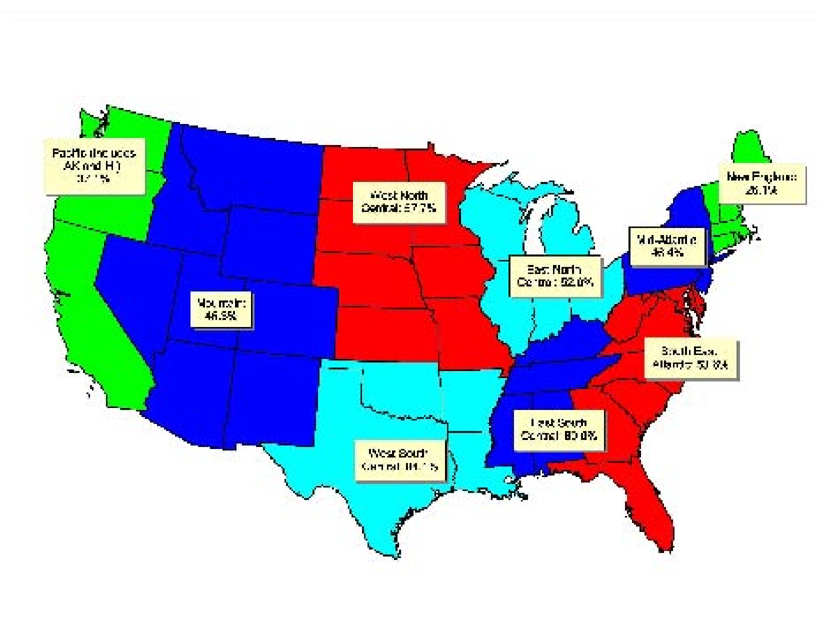

***Figure 3.** Reasons for No Catfish Consumption or No Increase in Catfish Consumption*

Packaging Yourself as an Extension Professional

Reginal M. Harrell
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Introduction

Defining the role of an Extension professional in a university setting where the concepts of application and development are often misunderstood by traditional academic faculty and administrators poses considerable consternation for many Extension agents/educators. This is especially true with regard to being considered a *bona fide* peer. Packaging ourselves as peer professionals within the research and teaching community as we strive to meet the mandate of Land Grant and Sea Grant institutions with respect to outreach education is becoming more of a challenge. Inescapably linked to this challenge is the fact that, as a society, we live in a fast-growing information age, intermeshed with rapidly changing age and ethnic diversity demographics. Also, in many states, our rural communities are transitioning to urban-suburban environments. All are demanding information outside the traditional norm for Extension professionals.

Extension, be it Cooperative Extension and to a lesser degree Sea Grant Extension, has a *persona* that keeps it in the service-directed, farm-oriented mindset of our clientele and professional peers. To remain relevant to the communities in which we work and serve requires us to repackage and/or reengineer ourselves by broadening our expertise across many disciplines and documenting our success. To do so, an Extension organization must evolve into a "learner-centered" institution. The institution then, as well as the individual, must present itself to all stakeholders in the proper, progressive perspective. To accomplish this evolution, identifying and meeting the needs of our stakeholders and partners is paramount. The dynamic, socio-cultural, and political environment within which we work requires each Extension faculty member to invest in, and commit to, what is known as the scholarship of Extension (Adams et al. 2002). Unfortunately, scholarship is a term more in use by our campus peers than by our Extension colleagues. However, developing, presenting, and packaging scholarly programming would be extremely beneficial in advancing the axiom that Extension faculty are professionals within their own right.

Approach

Outreach is a core function of Extension systems, and it represents the scholarship of application in a setting both internal but primarily external to the university or institution. Application focuses on education and service (Bull 1998). The role of service is viewed in different perspectives depending on whether the faculty member has a tenure-track appointment or a public service appointment. Where the appointment is as a public service employee, service is crucial to job security and promotion and personal performance criteria can be better defined than with situations where scholarship is the norm (e.g., tenure-track faculty). For instance, *public service is principally involved in the identification, development, and rendering of service to individuals, communities, organizations, and public service agencies in support of their own purposes and functions. Public service activities deal basically with the public-policy needs of society. Problem oriented, they rely heavily upon the integration of knowledge from many disciplines as well as the application of an experience-based understanding of real-world relationships and phenomena* (University of Georgia 2000).

In those institutions where Extension faculty progress through the promotion and tenure process there is a less defined "academic research model" that must be followed and, as such, packaging is extremely important. Therefore, service to the community, the university, and one's profession are important, but must be balanced by education and the scholarship of this education. Education focuses on outcomes, impacts and results, and changes in knowledge and behavior. These are all quantifiable terms. Education is also the basis of scholarly efforts and products associated with outreach. Because it is has quantifiable measurements, it provides an essential feedback for defining or refining future research needs. The challenge for the educator is to maintain an appropriate balance between education and scholarship and service (Bull 1998).

Due to the very nature of our work, Extension educators must be knowledgeable about the latest developments in their field and be well prepared to educate others. A mastery and demonstration of existing knowledge both in content and process is necessary to provide high quality assistance to outreach audiences (Portland State University 2000). Extension educators utilize the literature in their fields or disciplines, other sources of scholarly information or, occasionally, conduct applied research themselves to develop new extension outreach education models to further enhance existing programs. Thus Extension educators have a professional responsibility to contribute scholarly products and outcomes to their peers and clientele through the literature and to other knowledge and experience-based vehicles of information exchange (Adams 1999). Those who do are more readily accepted as an education professional among academic communities.

Outcome

Planning, evaluating, and packaging educational programming and scholarly materials is the responsibility and accountability of information exchange that serves to promote the Extension agent/educator as a professional. Whether peer-reviewed or popular literature, a crucial component of the scholarship of Extension is the effectiveness of communication (Olsen et al. 2001). Whether oral or written, clarity of communication of research- or community-based knowledge into a format or language easily understandable by a target audience is as much an art as a science and requires the individual to have that "mastery of knowledge" mentioned above. Boyer (1990) stated … "*To make complex ideas understandable to a large audience can be a difficult, demanding task, one that requires not only a deep and thorough knowledge of one's field, but keen literary skills, as well."* He felt that just as much as providing to the wealth of peer-review literature was important in defining scholarship, communicating to the non-specialist was a legitimate scholarly endeavor as well (ergo, it helps builds the case for professionalism expressed by Extension agents/educators). He further elaborated that while establishing the right standards and identifying proper peers for validation of this work may be difficult, it is nonetheless important. In other words, it is incumbent for Extension, as a culture, to develop its own national standards that define quality and utility. Educators should therefore subject their scholarly ideas and findings to critical inquiry and independent review among professional peers. The use of effective communication, regardless of the audience, facilitates the learning of new knowledge (Portland State University, 2000; Olsen et. al., 2001) and establishes a baseline for evaluating professional competence.

It is apparent therefore to be considered a professional in both our academic and stakeholder communities the scholarship of application, or outreach as defined by Bull (1998) is an expectation of all Extension employees. Thus, Extension agents should develop a diversified portfolio of scholarly and creative products and outcomes over the course of their career. This portfolio may include: newsletter and newspaper articles; fact sheets; bulletins and magazine articles; new curricula and courses; educational manuals and teaching guides; books; published abstracts and proceedings of presentations at professional meetings and conferences; peer-review journal articles; grant proposals; educational games; web sites; distance education non-credit courses; computer programs, simulations and data bases; videotapes, audiocassettes and CD-ROMs (Adams 1999; Portland State University 2000; Olsen et. al. 2001; numerous Appointment, Promotion, and Tenure Guidelines from various

Land-Grant Institutions listed in the references below). By widely disseminating the knowledge and experience gained in a research or community-based project through published scholarship efforts, Extension agents/educators share its significance with those who do not benefit directly from the project or program. Educators can make a substantial scholarly contribution and gain critical acclaim by communicating methodological innovations, curricular developments, and other results to professional peers who may adopt the approaches and findings (Portland State University 2000; Olsen et al. 2001). The portfolio package itself therefore reflects the level of professionalism of the individual as a result of, or foundation for, individual excellence in programming.

Conclusions

Extension agents/educators are constantly being challenged to not only stay current with new knowledge that is being developed at an extraordinary pace, but to be able to objectively sift through that information to determine its veracity. Likewise, as we learn more about learning styles we need to adapt to age and audience appropriate program delivery systems. The old model of Extension agents translating and transferring that information to a non-specialist audience, which had a service orientation to it, has yielded to the concepts of pedagogical and andragogical approaches that are learner-centered. These approaches provide self-directed learning opportunities, which allow the learner (whether child or adult) to use their preferred learning styles. They enable the learner to use their life experiences to comprehend the information, focuses on practical information the learner can immediately put to use, and allows for just-in-time learning. Or, better yet, learning at a time and place of the learner's choosing. Today Extension's clientele want knowledge and Extension agents, by necessity, must be Extension educators.

This change translates into the need for Extension employees to understand, develop, and provide appropriate scholarly materials in a format appropriate to learning styles about a wider variety of information than most ever dreamed possible. While this education is not the same as formal classroom contact teaching performed on campuses of the nation's colleges and universities, it is still education in its finest sense with distinct pedagogy, andragogy, and unique program design and delivery. As such, it is crucial for Extension faculty to be recognized as peers among academic communities and, to do so, requires a paradigm shift between academic and Extension communities alike. Extension's role involves developing and adopting national standards that will be comparable to more traditional academic environs and learning how to best package that information so it gains the recognition and acceptance of the research and academic teaching community as a peer in every sense of the word.

References

Adams, Roger G., Reginal M. Harrell, Deborah J. Maddy, Daniel J. Weigel. 2002. The Scholarship of Extension: Implementing Extension's Vision for the 21st Century. A White Paper by Extension Committee on Organization and Policy's Personnel and Organizational Development Committee.

Adams, Roger G. (1999). Cooperative Extension Unit (CEU) Criteria for Promotion, Tenure and Reappointment. University of Connecticut Cooperative Extension System.

Boyer, Ernest L. (1990). *Scholarship reconsidered: Priorities of the professoriate*. The Carnegie Foundation for the Advancement of Teaching. New York.

Bull, Nancy H. (1998). Defining Scholarship for the University of Connecticut Cooperative Extension System. University of Connecticut Cooperative Extension System.

Olsen, Charlotte S., Robert Bowden, Michael Langemeier, Charles Marr, Steve Paisley, Derald Stokka and David Mengel (2001). Scholarship of Extension. Kansas State University Agricultural Experiment Station and Cooperative Extension Service.

Portland State University (2000). Promotion and tenure guidelines. Portland State University. http://www.ozz.pdx.edu/oaadoc/PTGUIDE/Scholarship/scholarship4.html.

University of Georgia (2000). Public Service and Outreach Academic Rank Guidelines for Appointments and Promotion. University of Georgia, Athens.

Development of In-Pond Grading Technology for Catfish and Hybrid Striped Bass

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Introduction

Fish producers have historically used nets (live-cars, socks) with various mesh sizes to separate fish by size. This method of grading is not consistent, does not allow the producer to retain the small fish, does not allow for multiple grades, and does not work well at all for the deep bodied hybrid striped bass or other similarly shaped fish. In order to market tightly graded fingerlings, two of Arkansas largest catfish fingerling producers resorted to grading by hand with box graders in holding vat facilities. This procedure was labor intensive, time consuming, stressful to the fish, and inefficient overall, as graded fish had to be transported into and out of the vats. The food-fish processing sector has also long experienced inefficiencies associated with poorly graded fish from nets. Small fish cost substantially more to process per pound than larger fish and there is a very limited market for small whole fish and the fillets that result from undersized fish. This problem has plagued the catfish industry since its inception and many attempts have been made over the years to address the problem. Various fish grader designs were adapted for use on commercial pond levees, but ultimately proved either too costly or too slow or both to be commercially viable. Greenland and Gill (1972) developed a preliminary design for an adjustable horizontal bar grader that showed much promise for sorting large volumes of channel catfish in the production pond. This design required manual loading of fish onto the grading surface and thus was never adopted by the industry. However, with decreasing profit margins for producers (Engle and Kouka, 1996) and processing facilities shifting toward automated equipment that require more uniform fish sizes, the concept of in-pond grading is once again regaining consideration. Input from producers and processors alike indicated a need for an affordable, portable grading system that could sort fish by size in the production pond.

Approach

Stakeholder input, gathered through personal visits and advisory committee meetings, indicated that the goal should be to develop an in-pond grading system for channel catfish that would be portable, compatible with existing harvesting equipment, and capable of sorting large numbers of fish quickly (500 lb/min). A floating platform grader patterned after work by Thomas and Gill, 1972, was developed as a beginning point. The challenge from that point forward was to devise a system or strategy to deliver fish to the grading platform with as little stress and labor as possible. Approximately five years of research and development resulted in multiple iterations that were built and tested at the UAPB - Aquaculture/Fisheries Center, and then field tested in cooperation with commercial producers who had a strong interest in the project.

Outcome

The development of an eductor-style pump mechanism was the key to successfully delivering a steady supply of fish to the grading platform without lifting the fish from the water. This eventually led to the development of the current three-component grading system: a floating platform grader, an 8" re-lift style water pump/trailer combination, and the eductor system (Figure 1). The floating platform grader has a 6' by 16' horizontal bar grading surface with adjustable bar spacing. Four vertically adjustable floats can be set to maintain the appropriate panel pitch. A water jet system is situated over the grading surface to keep fish moving along the grading surface. Fish are supplied to the grading surface via the eductor system. The eductor system is a specially designed chamber fitted with a standard seine tunnel and an 8" water jet system. The water jet is directed toward a 14" flexible duct that is connected to the hopper end of the fish grader. Water is supplied to the eductor system with an 8" re-lift style water pump powered by a tractor with a 540 rpm PTO. The water pump is also the trailer that transports the fish grading system from pond to pond. A crowding boat is also necessary to facilitate the process of grading food-fish if more than 10,000 lbs are to be graded. This crowding boat consists of a flat-bottomed boat, a hand-winch reel system and a portable 4 HP outboard motor placed over the starboard side of the boat (Figure 2). The outboard motor effectively moves fish toward and into the eductor system at the appropriate density to maximize throughput across the grader while at the same time providing fresh oxygenated water to the crowded fish. This system can effectively sort fingerlings or stockers at a rate of 500 to 600 lbs/min and can sort food-fish at 800 to 1000 lb/min. An experienced crew can set up the grading system in 15 to 20 minutes. A typical five person crew can grade and load a truck simultaneously (Figure 3). This grading technology has been adopted by eight large fingerling/stocker producers, several food-fish operations, one catfish brood-fish producer, one large hybrid striped bass facility, and the UAPB aquaculture research facility. Research directly comparing the in-pond grader to overnight grading with traditional live cars at various water temperatures showed that the in-pond grader consistently removed more undersized food-fish (with no significant difference in harvestable sized food-fish) than traditional net grading (Table 1).

Conclusion

In-pond grading provides a more predictable, more consistent grade than net grading and eliminates the fish hauling associated with vat grading. The in-pond grading system has the added advantages of being adjustable and allowing for the retention of both large and small fish. This can eliminate additional seine hauls required to catch small fish that grade out of live cars. Channel catfish, channel x blue hybrid catfish, and hybrid bass have all been graded successfully with the in-pond grading system, but additional work needs to be focused on improving the eductor-system for channel x blue hybrids and hybrid striped bass, as these fish have behavioral characteristics that differ from channel catfish.

References

Engle, C. R. and P. J. Kouka. 1996. Effects of inflation on the cost of producing catfish. Report submitted to the Catfish Bargaining Association.

Greenland, D.C., and R. L. Gill. 1972. Development and operation efficiency of a catfish grader. Progressive Fish Culturist 34:186-190.

Figure 1. Components of the in-pond grading system.

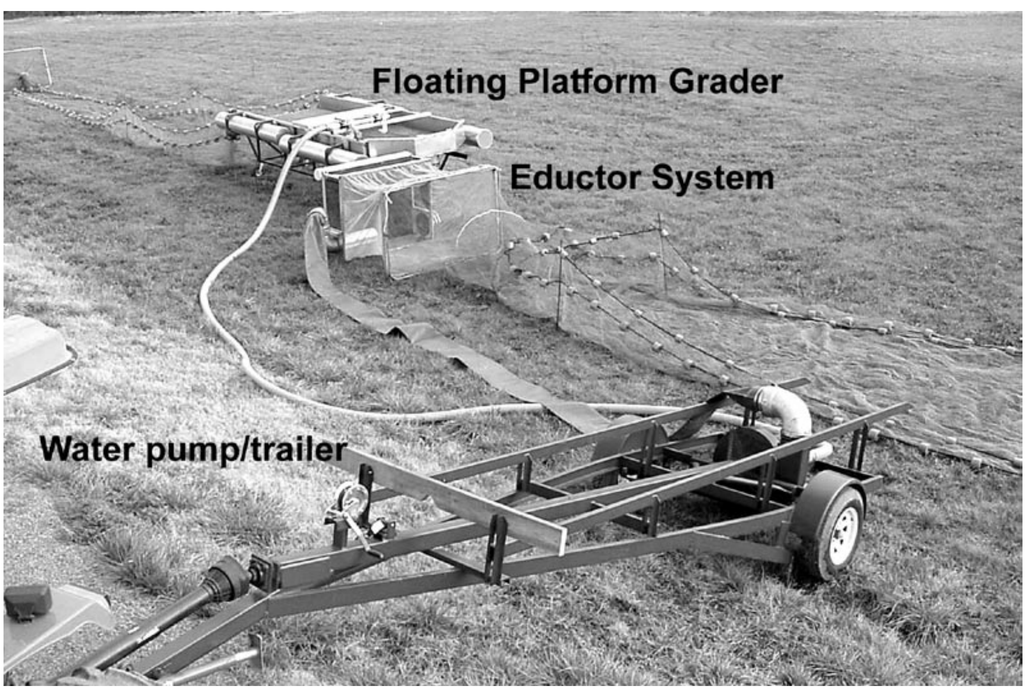

Figure 2. Crowding boat with hand-winch reel system and 4 hp long shaft outboard motor.

Figure 3. Grading food-size channel catfish and loading hauling truck simultaneously.

Table 1.

Results of Grading Trials as a Percentage of Sub-Harvestable Fish Before and After Grading

		By Weight			By Number		
Trial	Temperature	Pre-Grade	Heikes Grader	Live Car	Pre-Grade	Heikes Grader	Live Car
UAPB (75/25)	HOT	67	9	26	82	14	36
UAPB (50/50)	HOT	35	3	11	64	5	17
UAPB (25/75)	HOT	18	4	12	36	7	18
Com. Ponds	HOT	16	11	16	29	14	28
UAPB (75/25)	COLD	61	27	46	78	39	62
UAPB (50/50)	COLD	34	12	20	57	21	33
UAPB (25/75)	COLD	17	3	8	37	6	16
Com. Ponds	COLD	17	4	15	37	8	30
UAPB (50/50)	COOL	33	10	19	52	15	28
UAPB (25/75)	COOL	17	3	6	42	6	13
Com. Pond 1	COOL	46	23	39	70	36	58
Overall Average		**28**	**9**	**19**	**48**	**14**	**30**

Vaccines vs. Silver Bullets: A Tale of Changing Practices and Perspectives

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Introduction

North Carolina has more trout farms (56) than any other state, and is the nation's second-leading state in trout production, generating farm-gate income approaching $10 million in 2002. All of these farms are located in the mountains of western NC, many in counties with the highest unemployment rates in the state and little suitable land for other types of agriculture. Following its initial detection in North Carolina in 1976, *Yersinia ruckeri*, causative agent of enteric redmouth disease (ERM), soon became the leading source of disease-related losses of trout in the region. Trout farmers in North Carolina reported that at least 20% of the trout cultured in the region were lost to *Y. ruckeri* in spite of extensive use of commercially available vaccines against the disease. Of the two available antimicrobials for treatment of ERM in trout, only Romet®, a potentiated sulfadimethoxine, is effective against most isolates of the bacteria. Only about 50% of the isolates are sensitive to the other available antimicrobial, oxytetracycline. When resistant *Y. ruckeri* isolates began occurring in our lab in the early 1990's, we began a multi-faceted approach to reduce the impact of this disease in the industry.

Initially, growers asked for a 'silver bullet', an antibiotic that would rapidly cure the disease. That bullet also needed to be inexpensive and have a short withdrawal time, and, of course, none were available. Even if another antibiotic were available, 25% to 75% of the fish will develop a 'carrier state' following infection by *Y. ruckeri*, shedding bacteria into the water on a cyclical basis every 35 to 40 days. We thus began efforts to determine if vaccination efficacy could be improved, and if outbreaks of the disease could be linked to farm conditions or to the lack of development of a specific immune response to *Y. ruckeri* antigens.

Approach

With the participation of an area extension agent, graduate students, and growers, we followed the production cycle of groups of vaccinated (by immersion) and unvaccinated trout on four farms, correlating water quality, mortality due to ERM, and production factors such as handling and fish density. We sampled the trout for circulating antibody against *Y. ruckeri* and began evaluating different approaches to vaccinating trout including using adjuvants and injectable vaccines with commercial as well as autogenous antigens. In concert with our laboratory challenge studies, we evaluated the effectiveness of injection vaccination with on-farm trials, mostly to provide farmers with convincing evidence of it's capability to protect the fish in commercial production conditions. Once we determined our recommended course of action, five on-farm workshops were conducted between 1996 and 2002 to educate the growers and implement the recommendations.

Outcome

The results of the research and on-farm trials indicated that outbreaks of ERM could not be correlated with specific water quality factors on the farms, and that injecting the fish with either the commercial vaccine or an autogenous preparation provided nearly 100% protection against the disease. Adjuvants did not improve the protection significantly. At a cost of approximately \$0.02 - \$0.04 per fish, preventing the loss of only one market-size fish could pay for 25 - 50 vaccinations just in prevention of mortality. But convincing the NC trout industry in 1996 to give shots to 10 million small trout each year turned out to be the most difficult task of the entire project. Gradually after six workshops, numerous personal contacts and admonitions by the agent and specialist , this approach has been accepted with nearly 50% of the trout produced in 2002 now vaccinated by injection.

According to the primary feed supplier in NC, the percentage of medicated feed used in our area has dropped from 8.75% of total feed fed in 1996, to 1.42% in 1999, a reduction of 84% (Figure 1). Concurrently during that time the percent of trout injected increased to 34% of the trout stocked in 1999. The relative importance of disease as a source of trout loss in NC has dropped from 79% in 1996 to less than 30% in 2002 based on data from the National Agriculture Statistics Service (Figure 2), while total reported losses also declined. What started out as an industry request for a silver bullet took nearly 7 years to initiate, implement and measure significant results, and the bullet turned out to be a needle.

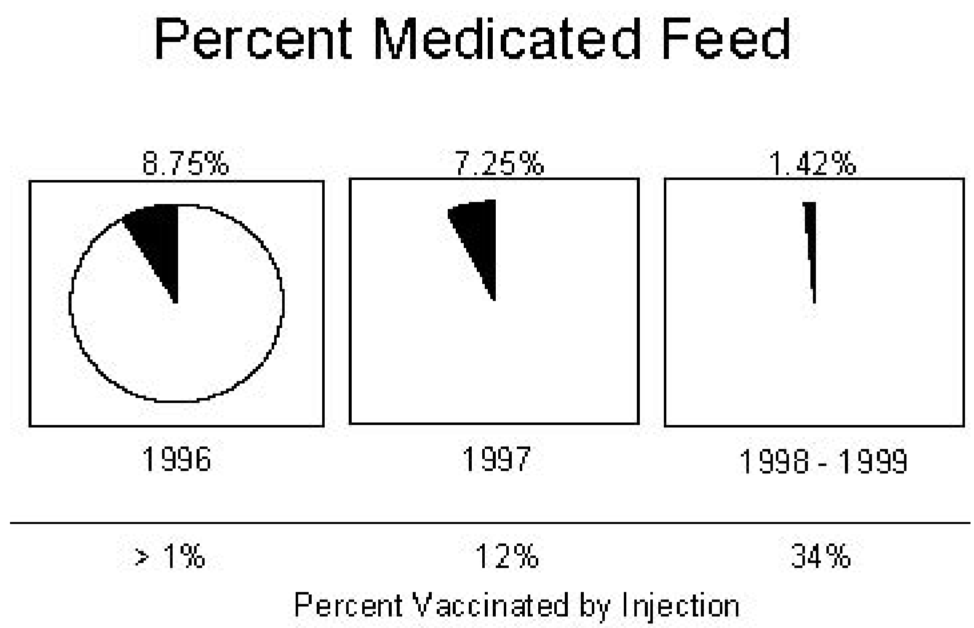

Figure 1. Medicated feed used in the North Carolina trout industry 1996-1999 as a percent of total feed fed. The percent of trout stocked each year that were vaccinated by intraperitoneal injection is shown at the bottom of the figure.

Trout Losses in North Carolina

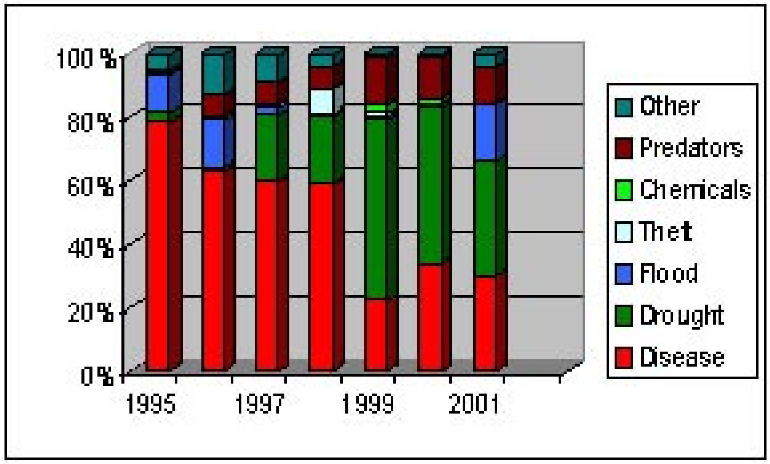

Figure 2. Reported causes of trout loss in North Carolina since 1995. All causes are presented as the percent of the total loss. Source: National Agricultural Statistics Service reports, 1996-2002.

Great Lakes Native American Involvement In Fisheries Extension Programs

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Introduction

Nearly a dozen Native American tribes in the upper Great Lakes region from Michigan, Wisconsin, and Minnesota have participated in various fisheries extension programs offered through Michigan Sea Grant Extension. These tribes, to various extents, through treaty rights are actively involved in the Great Lakes commercial fisheries. They are also involved with various aquaculture operations both for fisheries resource enhancement as well as food production.

Native Americans involved with the Great Lakes commercial fisheries have actively participated in Seafood HACCP programs, Great Lakes whitefish marketing strategies, and fish contaminant studies. Tribes with fish hatcheries have been involved with both Seafood HACCP as well as Aquatic Nuisance Species-HACCP programs, along with other educational programs related to aquaculture. This presentation will focus on our very successful Seafood HACCP program with Native Americans and will briefly review some other programs.

Approach and Outcome

The Seafood Hazard Analysis Critical Control Point (HACCP) regulation became mandatory on December 18, 1997. Commercial fish processors were required to either obtain formal training for one or more of their own employees or hire trained independent contractors to perform the HACCP functions. Formal HACCP courses began to be held around the country with registration fees ranging from $400 to $1000 and required many processors to travel great distances to get their training. To hire independent contractors to perform HACCP functions could run into the thousands of dollars. Thus Michigan Sea Grant Extension made contacts with Food and Drug Administration (FDA) officials in Detroit and Michigan Department of Agriculture (MDA) officials in Lansing indicating that Michigan Sea Grant and MSU Extension would be willing to lead the efforts to begin HACCP training in Michigan at a reasonable cost to the industry. Michigan Sea Grant Extension was aware that HACCP would also affect the tribal communities and began working with the FDA on a Partnership Grant that would help fund HACCP training in tribal communities.

The FDA Partnership Grant was funded and was used to pay travel expenses for instructors at two three-day HACCP Training Workshops at Bay Mills Indian Community and Traverse City in July of 1997. Michigan Sea Grant Extension also worked to secure instructors from both the FDA and MDA. These two workshops trained 54 tribal and non-tribal participants with a cost to each participant of only $90. The FDA also used this as an opportunity to provide an extra day of HACCP Regulator Training for tribal and MDA regulators.

After these two successful workshops Michigan Sea Grant was approached by the Keweenaw Bay Indian Community to run a similar HACCP Training Workshop on their reservation for their members involved in the Great Lakes fishery. To again help keep the costs down Michigan Sea Grant wrote a proposal to the Keweenaw Bay Indian Community Tribal Council to help subsidize the workshop. The Council agreed to supply a meeting room, pick up the registration fee for their tribal members who would be affected by the new HACCP program, and pay travel expenses for Michigan Sea Grant Extension and Michigan State University Extension personnel who would serve as instructors. Michigan Sea Grant again worked to secure additional instructors from both the FDA and MDA. In January 1998 the three-day workshop had 37 tribal and non-tribal participants. The Keweenaw Bay Indian Community Tribe was so committed to this program that they required all of their tribal licensed fishermen to attend the HACCP Training Workshop before they would be licensed to fish in Great Lakes tribal waters.

At each of these training workshops formal evaluations were conducted which showed that participants rated the training as good to excellent. These early workshops attracted participants from as far away as Pennsylvania, Ohio, Wisconsin, Florida, and Texas and included personnel from large U.S. importers/exporters of seafood and those involved with the aquaculture industry.

One of the early benefits resulting from this effort was the Grand Traverse Band of Ottawa and Chippewa Indians and the Keewenaw Bay Indian Community adopting HACCP Seafood Safety Regulations for handling fish and fish products within their tribal boundaries. Since the workshops Michigan Sea Grant Extension, at the request of many of the workshop trainees, visited their fish processing facilities to assist in developing their HACCP and Sanitation Plans. The Great Lakes Indian Fish and Wildlife Commission (GLIFWC) based in Odanah, Wisconsin witnessed the success of these workshops in Michigan and requested assistance to expand this training to many of their member tribes in Minnesota, Wisconsin, and Michigan. Michigan Sea Grant then began working with them on another FDA Partnership Grant to continue these training efforts. In addition, both tribal and federal authorities have asked Michigan Sea Grant to assist in the writing of Partnerships of Memorandums of Understanding where tribal authorities will be responsible for educating and monitoring tribal fish processors within reservation boundaries. Working with the GLIFWC Michigan Sea Grant coordinated four more HACCP Training Workshops that were held at four different Indian reservations in Michigan and Wisconsin in 1998, 1999, and 2000 using funding from a FDA Partnership Grant. These workshops attracted almost 100 participants and included tribal members from seven different reservations in Michigan, Wisconsin, and Minnesota. Other participants came from as far away as California, Texas, Maryland, New Jersey, Massachusetts, Illinois, and Ohio. Some of these participants were from medical supply companies who wanted to learn more about adapting HACCP principles into their manufacturing processes for medical equipment.

It became apparent early in the training that many tribal processors were unaware of specialized equipment used in fish processing such as calibrated thermometers, continuous recording thermometers, salometers, graduated cylinders, and sanitizer test tapes. Michigan Sea Grant worked with the GLIFWC to use moneys from the FDA Partnership Grant to purchase training equipment for demonstrations at the HACCP Training Workshops. Thus workshop participants learned first hand how to calibrate thermometers, the use of continuous recording thermometers in smoke houses, the use of salometers to make brines with the proper salt concentration, and how to develop proper sanitizing solutions. GLIFWC has since purchased this equipment for all tribal members who attended these workshops so they can now implement these practices at their own fish processing facilities. The GLIFWC has also funded Michigan Sea Grant with over $1000 dollars to purchase additional equipment for demonstrations. Tribal leaders have since informed Michigan Sea Grant that they now feel more comfortable knowing that their members now process fish under HACCP guidelines as many tourists who travel to their reservations to visit their casinos purchase processed fish and there was a real fear of potential botulism poisoning from someone who might purchase some poorly handled smoked fish.

When Michigan Sea Grant Extension started conducting the HACCP Training Workshops they developed real world models of different processing methods found in the Great Lakes region. The examples that were in the nationally developed HACCP training manuals lacked any clear examples of what really goes on in fish processing facilities in the Great Lakes region. Thus Michigan Sea Grant Extension developed models for processing various species of Great Lakes fish and also for the fish smoking process. Michigan Sea Grant also worked as a technical consultant with a University of Wisconsin food scientist to develop a video on “A Guide to Making Safe Smoked Fish” that was funded through the North Central Regional Aquaculture Center at Michigan State University. This video has been used in HACCP training workshops and has been so popular that a second order had to be produced to meet the demand. Since the HACCP regulation requires processors to keep extensive records of processing and sanitation at their facilities Michigan Sea Grant Extension developed both paper and electronic record keeping systems which have been bound into manuals by the GLIFWC and distributed to all of their tribal members. These record-keeping forms include sections on receiving, brining, smoking, cool down, temperature logs, labeling, verification, sanitation audit, and fishing vessel sanitation. The FDA and MDA investigators who visit fish processors have indicated that from their observations that most processors have adopted the record keeping system into their operations that Michigan Sea Grant Extension developed.

Since these efforts began a total of ten HACCP workshops have been conducted, including one at the $24 million St. Croix tribal food fish production aquaculture facility in Wisconsin. Three tribes have signed the Seafood HACCP Partnership Agreement with the FDA and include the Keweenaw Bay Indian Community, the Red Cliff Band of Lake Superior Chippewa Indians, and the Bad River Band of Lake Superior Tribe of Chippewa Indians. Several other tribes are currently working with the FDA and other partnership agreements will be signed in the future.

Michigan Sea Grant Extension worked with the GLIFWC on a HACCP Fish Contaminant Study where a large sample size of lake herring, lake whitefish, fat lake trout, and lean lake trout were taken from various geographic regions on Lake Superior. Michigan Sea Grant helped developed a standardized protocol based on industry standards from a data base they put together on how to smoke these various fish species and determine if a significant amount of contaminants are reduced in the finished product. Michigan Sea Grant Extension secured a fish processing facility with a state of the art computerized smoker to conduct this research. They then worked with GLIFWC scientists at this facility smoking various species of Great Lakes fish under a rigid protocol that could be developed into a HACCP program. The research results are still not complete but the GLIFWC is working on publishing five scientific papers from this project. The results will also be put in an educational brochure in a format understandable by the general public and distributed at various fish retail operations and restaurants that handle Great Lakes fish. There is also tribal involvement in our Michigan Sea Grant Great Lakes Whitefish Marketing Project to help bring the price up for lake whitefish, which makes up the bulk of the commercial fish harvest.

Enactment of the Consent Decree with several tribes and the state of Michigan resulted in a need to bring together various Great Lakes stakeholder groups to help understand the commercial fishery. Sea Grant extension led efforts to bring these groups together and they worked with state and tribal commercial fishers to produce educational materials aimed at educating boaters on recognizing commercial fishing nets in the water and how to best avoid them. A web site was also developed.

Michigan Sea Grant Extension was represented on the steering committee for the development of the NCRAC Walleye Culture Manual and recruited many tribal biologists to submit various chapters. Tribal hatchery biologists have participated in various aquaculture workshops sponsored by Michigan Sea Grant and NCRAC.

Conclusion

It is evident that working with Native American tribal communities on projects that are of a real need to their tribal members helps build strong partnerships between Native Americans and fisheries/aquaculture extension agents.

Rural Enterprise and Alternative Agricultural Development: An Illinois Initiative

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Introduction

With over one million workers employed in the food and fiber system, the State of Illinois is highly dependent on agriculture for its economic well being. In excess of nine billion dollars annually is generated by the marketing of Illinois' agricultural commodities. However, low commodity prices, along with domestic and foreign competition, have made it difficult for many Illinois farmers to remain profitable. Farm employment is decreasing and more farmers and farm families are depending on off-farm income to make ends meet.

The Rural Enterprise and Alternative Agricultural Development Initiative (READI) was conceptualized with a mission to expand income and job opportunities in rural alternative agricultural enterprises along with creating jobs and expanding income in rural Illinois. In its fifth year of funding from the Illinois Council on Food and Agricultural Research (C-FAR), the initiative is administered at the Dunn Richmond Economic Development Center at Southern Illinois University Carbondale (SIUC). C-FAR seeks to promote the economic development and management of agricultural and food systems in rural and urban communities in Illinois. The initiative pursues CFAR's mission to fund relevant and high-quality research and related outreach programs that lead to profitable, consumer-sensitive, and environmentally sound food and agricultural systems in Illinois.

Specific goals of the initiative include:

- To facilitate the expansion of sustainable aquaculture in Illinois;
- To accelerate commercialization of the viticulture/winery industry in Illinois;

- To identify alternative crops and land uses; and
- To disseminate knowledge of new opportunities and technical assistance resources to Illinois farmers, rural residents of all ages and rural organizations.

Approach

READI, utilizing the approach of Enterprise Development (Lenzi 1995), addresses the sectors of aquaculture, viticulture/wineries and alternative crops. The Enterprise Development Approach focuses on business creation or formation to add jobs and income. Lenzi's approach stresses the importance of research and technical assistance to enterprises in the areas of business planning, marketing and financial analysis.

The methodology is multifaceted, utilizing a systematic approach of research, outreach and education. Methods include business planning, feasibility studies, one-on-one technical assistance, research, demonstration extension, web dissemination, presentations, lectures, conferences, newsletters, publications and interviews. The applied research activities include field trials and field experiments. Outreach and technical assistance include the dissemination of secondary information and research findings. It includes one-on-one support such as the writing of business plans and providing support through meetings and conferences. Dissemination also involves meetings, workshops, conferences, newsletters, news releases, mailings and the web site.

Aquaculture, as an alternative form of agriculture, holds considerable economic potential in the state of Illinois. A small but growing aquaculture industry exists in Illinois, and the demand for fish as a high quality protein source and for recreational activities will continue as the population grows. The 1998 Census of Aquaculture report lists data tabulated on 20 aquaculture farms in Illinois. Total sales were $2.87 million from 603 acres of water. Food fish accounted for $1.55 million of the total, with catfish providing 705,000 pounds live weight worth $462,000. Sport and game fish accounted for $665,000, and baitfish totaled $310,000 of the total $2.87 million in 1998. However, the 705,000 pounds of catfish produced in Illinois is only a fraction of the approximate 60 million pounds (live weight) sold and consumed in Illinois. A major challenge facing READI is to develop a strategy to increase production of food fish in Illinois to better meet the demand of its residents. A related challenge is to achieve increase production while maintaining sustainability.

The goal of the aquaculture component of READI is to promote and facilitate the development and expansion of aquaculture enterprises in Illinois by providing traditional farmers and other individuals with the necessary business and technical assistance to diversify and convert resources to aquaculture. To accomplish this, READI staff utilizes a strategy of research, demonstrations, business planning, feasibility studies, technical assistance, and education via fact sheets, seminars, and workshops. An Aquaculture Specialist assists new and existing aquaculture enterprises concerning production systems, species feasibility, permits and licenses, disease control, etc. Activities also include conducting workshops, disseminating informational bulletins, as well as preparing feasibility studies, business plans, and marketing studies. During the first four years of the program (October 1998-July, 2002), 13 aquaculture business plans were generated of which five were funded for a total of $5.6 million dollars. Ten marketing plans and feasibility studies were also completed, while 12 fact sheets were authored and posted on the READI web site (www.siu.edu/~readi). Examples of fact sheet topics include: Marketing Illinois Aquaculture Products; Aeration and Water Quality: Airlift Devices; Fish of Illinois: Coho Salmon; A Production Method for Freshwater Prawns in Illinois Ponds; Freshwater Prawn Ponds and External Drains; Southern Illinois Festival Markets for Freshwater Prawns; Healthy Eating with Fish; and Wetlands and Illinois Aquaculture. A student thesis titled: The Feasibility of Raising Hybrid Striped Bass in Vertical Raceways was completed in spring 2002. An aquaculture Business Plan Template was also completed (NCRAC Technical Bulletin Series #117).

The research and demonstration component of the aquaculture sector is conducted by SIUC's Fisheries and Illinois Aquaculture Center. Research and demonstration projects are conducted in response to the needs of the aquaculture industry. Research and demonstration projects include: a) raising fish in cages in surface coal mine lakes, b) evaluation of a blue catfish/channel catfish hybrid, c) anti-fouling techniques for cage culture, d) production costs for raising fish in indoor systems, and e) a tilapia hatchery demonstration system. Researchers also provided the technical assistance to develop the first commercial hybrid striped bass fingerling nursery in Illinois and are currently constructing a freshwater prawn hatchery system.

Outcome

Overall, since inception of the READI program, acreage in aquaculture has increased 50 percent from 603 acres to 925. The number of farmers has quadrupled to 50, and 42 enterprises have started or expanded. Two emerging species, the freshwater prawn (*Macrobrachium rosenbergii*) and the hybrid striped bass (*Morone chrysops x Morone saxatilis*), were introduced to farmers by the program specialists. Success is evident by the

27 prawn farmers who produced 15,000 pounds of prawns during the 2002 growing season and the 14 farmers who raised 70,000 pounds of hybrid striped bass during the same growing season.

Conclusion

Even though the READI program addresses many of the opportunities and challenges facing farm families today, many challenges still remain. Many clients are first-time farmers with low equity positions. Many of the alternative agricultural opportunities are somewhat risky, offer delayed cash flows, and their products currently have underdeveloped markets. These challenges also adversely affect lender's perceptions and their inclinations to take risks. Despite these challenges, since inception in 1998, overall results of the Rural Enterprise and Alternative Agricultural Development Initiative across the three sectors include:

- 70 enterprises started or expanded,
- 208 jobs created/retained,
- $3.4 million in loans packaged,
- $2.2 million leveraged, and
- $9 million in capital investment.

These results indicate an improvement in the economic well being and the quality of life of farm families in Illinois, which is READI's ultimate measure of success.

References

Lenzi, R.C. 1995. The Enterprise Development Approach to Economic Development. Economic Development Review. Summer.

Aquaculture Development through Information Exchange

Cheng-Sheng Lee and Pat O'Bryen

New aquaculture technology can be developed and existing practices can be improved by research, technology transfer, or information exchange. Obtaining new technology or information through consultation with experts in the area of interest may be the most cost-effective of these methods, especially for the U.S., where aquaculture is a new industry. Learning from the experience of other major aquaculture producing countries can help to accelerate the growth of U.S. aquaculture. Also, through information exchange, it is possible for aquaculture producing countries to standardize their operations in a sustainable manner. To realize these dual benefits, the Aquaculture Interchange Program (AIP) was established in 1999 at The Oceanic Institute in Hawaii, via the funding support of the National Oceanic and Atmospheric Administration, to explore topics that address critical impediments to aquaculture development in the U.S. To date, AIP has conducted seven international workshops to exchange culture technology among experts in a wide range of areas in the field, including reproduction, hatchery management, grow-out, health, nutrition, feed, and the economics of production:

1. Reproductive Biotechnology in Finfish Aquaculture
2. Advanced Biotechnology in Hatchery Production
3. Microbial Approaches to Aquatic Nutrition within Environmentally Sound Aquaculture Production Systems
4. Aquaculture Growout Systems—Challenges and Technological Solutions
5. Biosecurity in Aquaculture Production Systems: Exclusion of Pathogens and Other Undesirables
6. Management of Aquaculture Effluents
7. Aquaculture: Retrospective and Outlook. An Aquaculture Summit

The poster presents the purpose and output from each workshop. Further information about these workshops is available through the publishers of the proceedings. In the future, the focus of AIP will continue to be on specific areas within the field of aquaculture. Two more workshops, on the culture of copepods and alternative protein sources, are planned for 2003.

Integrating Fish Culture into Public Schools in Massachusetts: a Dual-Purpose Collaboration.

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Introduction

There has been a concerted effort to integrate aquaculture into existing public and private schools in the northeast. Starting with the New England Board of Higher Education's (NEBHE) Project AQUA (funded through the NSF-ATE Program), a network of educators has been created that permits the flow of ideas and information on using aquaculture to stimulate education in math, the sciences and the humanities. Since its inception, over six years ago, the (informal) northeast aquaculture education network has contributed not only to sustaining the network but also to developing published educational materials and collaborative programs.

Recently, a problem arose relating to a bottleneck associated with fish fingerling supply for a demonstration project converting a bog within a cranberry farm into a partitioned aquaculture system (Bog/PAS) fish farm. Given the proposed grow-out season for the modified cranberry bog (April to October), it was decided that a potential strategy for achieving success with the pilot scale Bog/PAS fish farm was to stock the raceways in the spring with relatively large (5-6 inch TL) fingerlings, largemouth bass primarily, with the objective of producing marketable fish within a single growing season. The problem arose where the normal fingerling supply in the spring was either a Year 0 juvenile (2-3 inches TL) or a larger Year 1 juvenile. Year 0 fingerlings would be too small to achieve the required size after the single growing season while purchasing Year 1 fingerlings was an expensive proposition with actual supply an additional issue. Therefore, it was decided that the strategy most likely to succeed was to purchase Year 0 juveniles at the end of the first growing season (in the fall) at 2-3 inches and continue growing them through the winter in indoor recirculating aquaculture system (RAS) nurseries with temperature control.

Approach

The availability in the northeast of large-scale RAS's that could be used to test the winter nursery strategy was very limited. But, given the network of aquaculture education programs with RASs in operation, it was decided to develop an educational program centered on rearing largemouth bass fingerlings in recirculating systems. The end result would be an extended aquaculture education program with real-life links to the industry providing a supply of large bass fingerlings for deploying in the Bog/PAS fish farm in the spring.

Included in the educational program would be distribution to the schools of 2-3 inch largemouth bass fingerlings in the fall along with introductory and follow-up lectures by participants in the Bog/PAS study. The lectures would include information on fish farming and the Bog/PAS fish farm specifically. In support of the educational program, extension professionals and other participants in the program suggested procedures, protocols and educational opportunities for working with the fingerlings during the school year, based on educational materials developed during the NEBHE AQUA Project. Field trips to the demonstration Bog/PAS fish farm in the spring, ostensibly as the fingerlings are being returned for introduction into the fish farm, are also in the planning.

Outcome

Although the program is still on going, initial evaluation by the aquaculture educators and classes has been very supportive. Fish and feed have been distributed and initial survival has been excellent. Preliminary lectures have been presented and the overall discussion within the high school classes have been stimulated by issues such as open land preservation, agricultural food production and aquaculture. Currently the fish are being monitored for survival and growth where overall performance has been as anticipated (fingerlings are reaching targeted lengths on schedule). Upcoming school visits will include hands-on sessions on anaesthetizing and measuring fish to determine growth and feed conversion determinations. It is anticipated that the fish and concomitant field trips to the Bog/PAS demonstration project will take place in mid-April to mid-May , depending on progress in modifications planned for the Bog/PAS fish farm, ambient water temperatures within the system and trip schedules with the individual classes.

Conclusions

The partnership between local aquaculture extension programs, private fish growers and educational facilities has resulted in a number of measurable benefits. These include

- a multitude of “teaching moments” for using aquaculture to stimulate interest in math, the sciences and the humanities,
- many opportunities for direct interactions among aquaculture extension professionals, commercial fish/cranberry farmers and students, and
- the ability to produce large fingerlings, via RAS technology, to provide the necessary resources for spring stocking of the demonstration Bog/PAS fish farm.

Challenges in Environmental Programs and Issues: It Takes a Lot More Than Clams to Grow Clams

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Introduction

Aquaculturists in coastal United States have many obstacles to overcome in order for their industry to expand. First, they are dealing with controlled husbandry techniques in a natural environment that cannot be controlled. Second, in most cases, they operate on leased public land requiring a daunting process just to obtain the lease. And third, obtaining the lease is not the end of oversight because the public often feels it has a right to scrutinize the operation of the lease to ensure the operator is conducting his/her business in the most environmentally conscientious manner. Mechanisms are needed once the lease is granted that allows the grower to grow his/her clams, get them to the marketplace, and protect or enhance the environment in the process.

Background

To become a grower is not an easy task. It is a highly regulated industry with multiple layers of bureaucracy determining many facets of the business from the local level to the federal. Obtaining a lease is the first hurdle and it is a daunting one. For many review authorities, the potential aquaculturist must supply what seems to be an endless supply of descriptions of what he/she is going to do, where and how. They are asked to show the perimeter coordinates. They need to describe the type of gear and the number of each type of gear they intend to use over the entire lease site projected over the term of the lease for each species being considered for grow-out. They are asked to describe how high the gear will be off the bottom (for bottom culture) and describe the bottom being used. They must show the distance of the proposed site to other uses, especially channels or known boating areas. They must list other resources within the perimeter with special emphasis on any submerged aquatic vegetation present or nearby. This is merely a sampling of the long laundry list of information sought.

Once the application is submitted, it is reviewed and there may be a hearing on a local level or state level or both. At the hearing other stakeholders may give testimony. That may include recreational or commercial fishing interests, other boating enthusiasts, environmental groups or any other interested party. Often the riparian landowner is represented. The hearing authority takes all the information under advisement and either issues or denies the application. The application process is costly and there are no guarantees that the proposal will be successful. Sometimes, the lease is issued but with conditions that the leaseholder must uphold to maintain the lease.

If the grower is successful, then maintaining the lease is not easy either. The public is still watching the activity and since it is public land (or water), they feel it is their right to keep a close eye on the activity. New riparian landowners, who may not have been there when the hearings were held, may not like the "look" of the activity and begin a campaign to make life even more difficult for the grower. They may accuse the grower of causing environmental harm of some sort. Additionally, the grower has to worry about the vagaries of weather and climate conditions – ice, snow, heat, cold, rain, drought, and wind. All of them can have devastating consequences.
If he/she has weathered all this, then he/she must market the product. Sometimes a grower is competent at animal husbandry but not necessarily marketing the product, which requires a different set of skills. He/she must contend with local, inter and intra-state competition as well as global competition for some products.

This is a rather bleak picture. Who would want to enter this industry knowing these pitfalls? The answer is a group if individuals who love the life. They thrive on the hard work and on seeing healthy animals grow into food for the marketplace. They love being on the water and as much as possible, being in charge of their own destiny. They may have switched from commercial fishing, being forced out of that livelihood by regulations or circumstances or they may have been land farmers who just love to grow things. They know their business will not survive unless the water quality in the area in which they are growing their crops is the highest possible and they are among the first to know if something is amiss. But, for the most part, they are individuals, operating their own lease, trying to maximize their return for their effort. There may be an association of like-minded individuals and there may not be.

Slowly, groups of these individuals, with assistance or gentle persuasion but extension agents, are beginning to realize that developing and adhering to a suite of voluntary practices, initiated by them but with input from diverse stakeholders, enhances their position as responsible partners in the quest to maintain a healthy environment.

Codes of Practice of Best Management Practices

FAO released a document in 1995 called a Code of Conduct for Responsible Fisheries that included a section on aquaculture. It encouraged states ensure that the aquaculture industry would develop in an environmentally conscientious manner. Its approach was generic suggestions.

From that original document, others have adopted similar but different approaches, called by various names to reflect a level of specificity. A Code of Practice or Environmental Policy is a pledge that those who sign on promise to conduct themselves and their business in a certain manner. Best Management Practices are more specific and establish actions for explicit circumstances. Environmental Management Systems often contain both an Environmental Policy or Code of Practice, and explicit management actions, but often have a third-party verification scheme.

Models are beginning to appear in the United States, based on work done by the Federation of European Aquaculture Producers (FEAP), Global Aquaculture Alliance (GAA), New Zealand Mussel Council, Scottish Quality Salmon and others. They have used other industries as part of their background material like the forestry and cranberry industries and poultry farmers. The Pacific Coast Shellfish Growers Association has recently released an Environmental Management System that includes an Environmental Policy and Environmental Code of Practices. Currently out for review among its members, only the Policy is available for general readership. Massachusetts has nearly completed a Best Management Practices Manual currently under review by growers and soon to be reviewed by other stakeholders. Maine has adopted a set of Guiding Principles and is developing a Code of Practice or Environmental Management System. Their industry is even more diverse because it encompasses finfish as well as shellfish. Florida adopted Best Management Practices as regulations. Some are pleased with the program and others definitely are not in favor of BMP’s as regulations.

Clearly, growers are realizing that developing and adhering to a suite of voluntary practices, initiated by them but with input from diverse stakeholders, enhances their position as responsible partners in the quest to maintain a healthy environment. The fledgling East Coast Shellfish Growers Association has identified developing BMP’s for the entire East Coast of the United States as a high priority item. It will be a challenging effort.

Future Directions

Growers can do a lot to assuage fears of environmental degradation from their operations. They can adopt some sort of management scheme outlined above. They can accentuate the positive impacts that shellfish aquaculture provides. More than providing food, an obvious benefit, they can point out the value of shellfish as filtering organisms that help reduce the effects of eutrophication.

Nutrient loading of estuaries has become a global issue. In the last decade, scores of scientific papers have appeared in the literature regarding the increase of eutrophic estuaries as more people have moved to the coastal zone and the effects on the biota of those estuaries. Although eutrophication is a natural process, it is greatly accelerated by man's activities. Groundwater, laden with nutrients from septic systems, fertilizers, livestock and stormwater, flow into rivers that empty into estuaries or enter the estuaries directly. Denuded banks accelerate the flow as well that would be taken up by plants if the banks were vegetated. Fringe marshes may have some filtering capacity of groundwater but recent research has shown that groundwater often flows under marshes directly to the estuaries but larger marshes may utilize the nutrients. Coastal engineered structures halt the landward migration of marshes as sealevel rises, diminishing the marsh effectiveness for nutrient uptake.

Growers, who have scant time to act, must be cognizant of land uses adjacent to their lease sites or in the same general vicinity in order to be successful. Societal trends – demographics, social, political and economic policy shifts – may have a direct relationship to the success of a shellfish farm.

Role of Extension Agents

Extension Agents have their fingers on the pulse of all waterfront issues. As a result of the emerging issues of some sort of code of practice over broad geographic regions as well as societal trends, the extension agents can play a pivotal role. Extension is adept at delving into issues that cross political boundaries, disseminating information in a timely and usable fashion and acting as facilitators to bridge gaps between diverse user groups. Multiple uses of our coastal zone have produced some of the most ardent stakeholders who often do not communicate well with one another. The individuality of growers noted earlier sometimes produces the same result of poor communication among them. Extension Agents are most effective when they can communicate with a wide range of individuals from different spectra.

Extension agents know the players in their region. They build partnerships. They develop trust among diverse groups. They disseminate information in a neutral manner. They present facts. They assist anyone the best way they can. They are on the front line. They will be essential in developing trust among such diverse stakeholders as currently exists along the coastal zone and to provide the calm, yet focused attention that will be required to develop an east coast set of BMP's or similar system. They are up to the challenge.

Developing Web-Based Outreach for County Agents and the Public on Aquatic Vegetation

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Most private impoundments have multiple-uses for either livestock watering, irrigation, aquaculture, and/or recreation. Infestations of aquatic vegetation can have negative impacts on these multiple-uses by: 1) hindering feeding and harvesting operations, 2) reducing recreational access, 3) clogging irrigation systems, 4) increasing evaporation rates by as which as 30%, 5) increasing eutrophication rates by 2- to 3-fold, 6) negatively impacting water quality for fish and wildlife species, 7) shifting the balance of the fish population (e.g. stunting), and 8) increasing breeding areas for mosquitoes and other insect pests.

Aquatic vegetation identification and management in private waters, including aquaculture, is a perplexing challenge for landowners, County Extension personnel, and others attempting to assist them. Many species of native and non-indigenous aquatic plants invade and establish nuisance communities in private impoundments. Fisheries biologists, Extension personnel, and purveyors of aquatic herbicides in general have limited backgrounds in aquatic vegetation identification and control options. Yet with several million private impoundments in U.S. this is a common Extension clientele demand. County Extension personnel, landowners, and the public need expert assistance with aquatic vegetation management. Extension specialists with the Department of Wildlife and Fisheries Sciences developed a deck of aquatic plant identification cards, posters, and an web-based knowledge base (AQUAPLANT) to help identify and manage aquatic vegetation problems. The three deliverables developed by the project will be discussed and demonstrated.

Commitment to Extension's Mission: the Role of Continual Learning

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The basic tenant of the Extension mission is to provide the American public with educational programs that are timely, relevant, and provide science-based information upon which they will base personal decisions that will enhance their lives. In other words, the role of the Extension professional is to help people change. However, how we go about our jobs and how effective we are in delivering educational programs to our clientele really depends upon our own personal commitment.

We are all professionals...Extension professionals. As such, we are committed to providing the latest science-based research findings to our clientele; in our case, the aquaculture community, which includes producers, processors, marketing agencies, consumers, commodity organizations, environmental groups; policy makers, etc. The list goes on. How we go about our jobs and how effective we are in delivering Extension's mission really depends upon our own personal commitment relative to these two tenants: 1) the Extension mission; and 2) aquaculture.

Personal Commitment to the Extension Mission- In these fast-changing times, do you believe that the Extension mission and your role in that mission is more important that ever? Do you believe that, as an Extension professional, you are an agent of change? Is the extension position you are in right now just a job or is it a "passion"? Do you ask yourself "What do I get out of this?" and already know the answer or are you just working for a paycheck? Of course, making a good living is important to all of us and our families but does helping people make you feel good about yourself? Are you comfortable with your role and responsibilities as an agent of change? If not, you might want to reassess your chosen profession because the American people deserve better.

Commitment to Aquaculture- Why did you get into aquaculture? Do you believe in the future of aquaculture development? Do you believe that aquaculture will help feed the hungry of the world? Do you believe that aquaculture will help relieve some of the pressures off of threatened, wild fisheries resources? Do you believe in aquaculture? Why?

It might take a little soul searching but we need to ask ourselves these questions and answer them truthfully. In order to do the job at science-based information education and outreach that our nation deserves, it requires considerable passion for the work. It takes a commitment to keeping ourselves updated in not only the latest aquaculture science and technologies but continually learning the latest innovations and techniques in educational program content and delivery. This commitment has as much to do about continual learning for the Extension professional as well as providing information and technology transfer to and for our customers. Continual learning for the Extension professional is at the very heart of the Extension mission.

Sir Winston Churchill was once noted to say "Personally, I'm always ready to learn, although I do not always like being taught". I think we all are like him in that respect. However, as an Extension professional, we, like Sir Winston Churchill, are in a leadership role and as a leader, we are agents of change. As such, we must take the initiative to learn the newest, latest technologies and information, rework it into the proper format for our audience, and deliver it in a timely, appropriate, and professional manner. As a "leader", there are a number of leadership skills we should pursue and become skilled in. Some of these include: Team Building; Political Savvy; Flexibility; Human Resources Management; Resilience; Vision; Interpersonal Skills; Conflict Management; among others.

The one leadership skill which is an important aspect of and absolutely required for all leadership skills is Continual Learning. Ours is a changing society with changing societal values, changing and new technological innovations, changing domestic and world political climates, and changing personal views relative to a changing world around us. Some societal values require long periods of time to change; others are forced to change abruptly, such as those values changed by the tragedy of 9/11.

How do we do this?- There is no prescribed methodology; it is a personal decision. How we go about accomplishing these personal educational goals depends upon many things including time constraints, budgetary concerns, clientele, among others. However, the basic premise is: Don't just become a subject matter specialist, also become a <u>people specialist</u>. Without the necessary skills to reach the desired clientele, our educational programs can only focus upon content and we could miss the "people" component of program deliver

We are all required to be subject specialists. We are employed to deliver technical information to our clientele because of our education and expertise. We realize that the technology relating to our subject of specialization, aquaculture, is rapidly changing and we must stay current with these technological changes. This is inherently obvious. However, since we are all agents of change, we need to value continual learning. Although it takes time and energy to become more knowledgeable and skillful as an agent of change, we need to make it personal. Take courses in leadership skills if you have not already. Request from your supervisors to take classes that will enable you to do your job better. Learn how to get your clientele interested and excited about new things, new ideas, new technologies, and new paradigms. Learn how to convince your clientele that it is in their best interest to keep up with these rapidly changing times. Learn how to pull people together and avoid conflict to work on a common issue; this takes special skills. Learn how to motivate, not just educate. There are classes for this. Antoine de St. Exupery (the author of *The Little Prince)* was quoted as saying "If you want to build a ship, then don't drum up men to gather wood, give orders, and divide the work. Rather, teach them to yearn for the far and endless sea".

We should all know the basic methodology for delivering extension educational programs: 1) Analyze – define the learning objective; 2) Design – plan a strategy for developing the instruction; 3) Develop – develop instruction and materials; 4) Implement – provide the instruction; 5) Evaluate – measure the success in terms of learning outcomes. There are educational resources available to you in all of these five categories; you just have to know where to look.

Formal training can be very helpful but some of these courses can be quite expensive. There are other methods and educational materiels that do not require funding to come from our limited budgets. Listed below are a few suggestions:

- Spend time with others who are competent at a skill you are interested in acquiring
- Take on a challenging special assignment
- Recruit a mentor with skills you desire to learn
- Serve as a mentor for others
- Read books, articles, and other materials dealing with leadership skills
- Go out to lunch with someone with these skills
- Ask others around you for feedback to learn how you are doing in a particular leadership skill area
- Socialize with a goal in mind: Attend industry events or volunteer where you can network with others and take the time to have fun while you make connections
- Arrange a detail in another part of the organization or another agency or non-profit organization to gain experience
- Subscribe to a publication that covers an area with which you have not had previous exposure or experience. A good example of a free publication targeted at the Extension professional is the Journal of Extension (http://www.joe.org). This is an excellent source of the latest innovations in program content and delivery.
- Try a new skill in a volunteer organization
- Conduct interviews with professionals in unfamiliar disciplines to gain knowledge
- Work the net: Spend time looking for information pertaining to your clientele
-

Join Listservs and discussion groups

- Sign up for E-Newsletters

Why is Extension important today? Change is at the very heart of the Extension mission. As Extension professionals, it is imperative that we avoid stagnation and embrace change. Extension professionals are public servants and the American people are better-served by a knowledgeable Extension professional who is better-able to anticipate change. To embrace complacency reduces our competency as Extension professionals and our role as agents of change becomes moot. Competency in this role is imperative. Our employers expect it; our country deserves it.

National Sea Grant College Program Approaches to Industry Development

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The National Sea Grant College Program has been involved with aquaculture since the program's inception in 1968. Aquaculture was actually mentioned in the National Sea Grant Program Act when created by Congress. All of the 30 state Sea Grant programs have supported aquaculture research at one time or another and a clear majority of programs support aquaculture research, outreach and education each and every year. On average the state Sea Grant programs have funded about $5 million dollars of research each year over the 33-year period of Sea Grant's existence resulting in over $150 million dollars and close to 3,000 projects. The actual expenditures for education and outreach projects and activities is estimated to be $1.5 million per year so this brings aquaculture to a relatively constant level of about 10% of Sea Grants budget.

Sea Grant provides extension services for aquaculture in a variety of ways. Approximately 35 Sea Grant Extension agents are involved part time or full time on aquaculture topics throughout the system. Communicators, working with extension agents and educators have produced curricula for using aquaculture to teach science, handbooks for how to grow and produce aquaculture products, model business plans for those interested in entering the industry, radio show programming to deal with aquaculture issues, hatchery manuals and other "how to" literature, videos for public distribution and short articles and newsletters on the topic. Sea Grant agents and researchers have held workshops, town meetings, scientific symposia, on aquaculture topics and have helped to form professional organizations such as the World Aquaculture Society, Aquaculture Engineering Society, and regional coordination bodies such at the Pacific Aquaculture Caucus.

Sea Grant agents and researchers have provided information to the Regional Fisheries Councils around the country and have participated with NOAA on international agreements such as the US/Japan Natural Resource Panel on Aquaculture, the US/China bilateral agreement on Aquaculture and more recently the US/Korea Bilateral Agreement for Science and Technology. This has led to better international cooperation and has helped expose Sea Grant agents and researchers to aquaculture technology and management in other countries.

Outreach and extension also occurs with student fellowship programs like the Knauss Fellows or the Sea Grant Industrial fellowships. These programs bring highly motivated and educated graduate students into government and congressional offices or into industry settings to expose them to both practical and large-scale issues. Outreach goes both ways from the student to the organization and from the organization to the student.

Looking at the major successes for Sea Grant over the years the biggest outreach achievements come when Sea Grant researchers and agents work directly with industry from the very beginning of a project. Examples of this have occurred with the development of the striped bass industry, the soft shell crab industry, the development of recirculating systems and components, the creation of the new offshore aquaculture industry, the development of the West Coast use of triploid oysters and the creation of the clam and mussel industries. Here researchers and extension people worked directly with industry, often training students to become employees in the new industry. This approach brings instantaneous transfer of technology and allows the researchers and agents to see first hand the needs of the end user.

Recently aquaculture policy and regulations have been on the forefront of industry concerns. Sea Grant lawyers and scientists have worked with decision makers around the country to analyze the needs of the industry and state and federal managers. Sea Grant researchers have held regional and national workshops on the subject in order to bring the viewpoint of the constituents into the debate. Several draft policy documents have been developed to serve as discussion points and many of these have been used by governmental organizations to set the guidelines and regulations for the future of the aquaculture community.

Sea Grant also supports the AquaNIC electronic information service as a part of the NOAA/DOC aquaculture initiative. This is coordinated through the NOAA Central Library and AquaNIC is a major vehicle for dissemination of educational and technical material on aquaculture. The NOAA Library and the National Sea Grant Library coordinate with AquaNIC to provide constituents and Sea Grant and USDA aquaculture agents with needed information services. The NOAA Central library maintains web sites on aquaculture, both national and international, for access by all users and the Sea Grant Library will provide loans on articles and other printed materials that have resulted from Sea Grant research over the years.

Regional Aquaculture Centers Approach to Industry Development

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Introduction

Five Regional Aquaculture Centers (RAC) were established by Congress in Title XIV of the Agriculture & Food Act of 1980 and the Food Security Act of 1985 (Subtitle L, Section 1475[d]). The RAC program encourages cooperative and collaborative research, and extension education programs in aquaculture having regional or national application. Center programs complement and strengthen existing aquaculture research and extension education programs supported by the U.S. Department of Agriculture, the National Sea Grant College Program, and other public institutions. The five RACs are: Center for Subtropical and Tropical Aquaculture (CTSA), Southern Regional Aquaculture Center (SRAC), Northeastern Regional Aquaculture Center (NRAC), North Central Regional Aquaculture Center (NCRAC), and Western Regional Aquaculture Center (WRAC).

The RAC mission is to support aquaculture research, development, demonstration, and extension education to enhance viable and profitable U.S. aquaculture production to benefit consumers, producers, service industries, and the American economy. RAC projects are based on industry needs and are designed to directly impact commercial aquaculture development in all states and territories. The Centers are organized to engage the best aquaculture science, education programs, and facilities in the United States. Center programs insure effective coordination and a region-wide team approach to project planning and implementation by research, extension, government, and industry collaboration. Inter-agency cooperation and shared funding of priority projects are strongly encouraged.

The Board of Directors (BOD), the policy-making body for the RACs, incorporate recommendations from an Industry Advisory Council (IAC) and a Technical Committee (TC) to determine funding amounts for new and continuing high-priority aquaculture research and extension projects for each region. IAC members represent different sectors of the aquaculture industry in a region and thus provide an open forum for input and program direction from private and public sectors. The TC consists of research and extension scientists from essentially all states and territories within each region and identifies priorities from a technical perspective. These groups provide valuable input into the RAC program planning process by identifying and developing priority research and extension education needs for the advancement of U.S. aquaculture. Using recommendations from these two groups, the RAC Board of Directors selects priority categories for project development and funding. Upon undergoing a peer-review process, selected project proposals are then sent to the USDA-Cooperative State Research, Education, and Extension Service administrative staff for approval.

Approach

There are regional differences in the aquaculture industry as well as aquaculture extension programs. To address these differences, the RAC program has used different approaches relevant to state and regional extension programming. The commonality in extension programming by all five Centers is to promote a strong connection between the research and extension communities to allow for timely dissemination of information.

The CTSA has provided funds to support regional extension programming through salary and operational support. In addition, funds have been used to support the Pacific Regional Aquaculture Information Service for Education (PRAISE). The purposes of PRAISE are: 1) make scientific information more accessible to the aquaculture community; 2) develop database for culture species in the region, and 3) compile grey literature from the region.

The SRAC has funded a project entitled, Publications, Videos, and Computer Software, since 1995. To date, SRAC has published 154 fact sheets, 16 research publications, and 19 videos. One hundred twenty-one authors from across the United States have contributed to SRAC's publication project (Publications, Videos, and Computer Software).

In the NRAC, the following projects are being pursued: 1) aquaculture extension agent professional development; 2) targeted aquaculture extension projects; 3) workshops and trainings for the general public, extension community and industry; 4) state aquaculture association leadership, education and marketing program assistance; and 5) administrative support. To date, 18 fact sheets have been developed by NRAC.

Although there is an extensive Cooperative Extension Service and Sea Grant Network, there are a limited number of individual aquaculture specialists in the North Central Region. The NCRAC approach to extension programming has been to fund special projects, e.g., publications and workshops, as well as provide funds to allow for networking of the regional extension community. In addition, funds have been provided to help support the AquaNIC web site.

Information outreach from WRAC research is often delivered by direct contact with industry or more recently regulatory agencies. A number of WRAC research projects are initiated because of critical regulatory compliance requirements or developing regulations that could severely impact aquaculture development, i.e., effluent discharge, endangered species, essential fish habitat; and the results of the projects have direct conduit to the regulatory agencies.

National Profile: Roles and Challenges of Aquaculture Extension in a New Century

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Introduction

The 21st century marks another period in history whereby dramatic changes will occur that affect peoples' daily lives and how business of any type is conducted (Extension Committee on Organization and Policy, 2002). The currents of change can be expected to remain dynamically driven in part by shifting demographics, sociopolitical environment, science and technology advancements, consolidations and mergers, globalization impacts, and ever-changing lifestyles that influence attitudes towards food production systems and preferences for products and services. Additionally, the economic, environmental, and social demands on our coastal oceans and shorelines will be unparalleled in human history (National Sea Grant Extension Review Panel, 2000). In response, extension programs must be more flexible and adaptable than ever before and more engaged with outside constituents at all levels (NASULGC, 2002).

Universities are also undergoing changes as priorities and resources shift to new programs and institutional aspirations, and teaching curricula align with new and emerging fields of employment. These change factors can marginalize the traditional agricultural mission functions within the overall university community (Kellogg Commission, 1998). The combined forces of technological, economic, political, social and regulatory changes are impacting the landscape of agriculture and its related sub-sectors, including aquaculture.

The fast pace of growth in aquaculture has been recently tempered by a slowdown in the national economy and increasing pressures from high valued imported aquatic food products. With the U.S. having one of the world's strongest economies and high food purchasing power, exporters of aquatic products are targeting U.S. markets for profits and foreign revenue generation. Today's realities of global competition, emerging species and technologies, and acceptable integration of aquaculture production systems into diverse aquatic ecosystems require strategic approaches, leveraging of resources, and more attention to the timely solution of constraints and problems that will determine, in part, the future growth in the aquaculture sector.

Aquaculture extension is but a small subset within our Nation's university-supported extension and outreach system yet is expected to address the myriad complexities of challenges associated with aquaculture characterized by wide diversities in species, systems, issues, environments, policies, programs, and more. Unlike, many researchers, extension professionals are more likely to work on multiple issues on a daily basis (Economic Research Service, 2002). Extension educators work on the frontlines of changing issues, and today, are making significant contributions to the further development of an environmentally sound and socially responsible aquaculture industry in the United States. Pressures from shrinking budgets on extension programs across the nation linked to increasing constraints on advancement of the aquaculture sector warrant new ideas, innovative approaches and partnerships to develop and deliver timely, critical extension programs. Extension FTEs in aquaculture-related fields are very limiting in some regions and states (Swann and Morris, 2001); new collaborative approaches can broaden constituent benefits by making available more educational resources, tools and expertise.

The National Sea Grant College Program of the National Oceanic and Atmospheric Administration (NOAA) and the Cooperative State Research, Education and Extension Service (CSREES) of U.S. Department of Agriculture (USDA) recognize the value and importance of collaboration and sharing of resources exemplified by the co-sponsorship of the Third National Aquaculture Extension Conference. Extension programs within CSREES and National Sea Grant College Program partnerships develop and execute a variety of county, state, regional, and national aquaculture educational programs and activities that are critical to the success of a viable and healthy aquaculture industry.

Extension has contributed in large part to the huge productivity derived from the engagement of campus-based science with the realities of agricultural problems at the farm level (McDowell, 2002). To remain on the cutting edge of information systems, practical applications of scientific discoveries, and educational program delivery options, this national network of extension educators must be provided the tools, knowledge and resources to excel in their profession and duties. Advancement of logic models are also providing methods for cooperative extension programs to evaluate and justify public investments in extension linked to potential short-term, medium-term, and long-term outcomes and impacts in targeted areas, such as aquaculture (GAO, 2002)

Both USDA and NOAA are seeking ways to improve the support role of federally- funded programs in the federal-state extension partnerships that will best serve the educational needs of our diverse aquaculture constituency. The joint initiative of employing a national questionnaire to solicit input and suggestions from extension professionals across the nation is meant to strengthen this critical partnership. USDA and NOAA developed the comprehensive National Extension Questionnaire to evaluate, and ultimately, to enhance the collective roles of extension associated with the U.S. aquaculture industry. The objectives of the national questionnaire are:

1) Develop a profile of current roles and functions of extension personnel
2) Identify uses of technologies and tools for applications in extension
3) Gather suggestions, options and ideas that can be implemented to benefit the extension system associated with aquaculture
4) Identify the current status of client issues, challenges, and constraints from an extension perspective
5) Determine mechanisms to foster collaboration and strengthen cross-disciplinary networks among all parts of the extension system and relevant agencies
6) Share findings and results with extension professionals for purposes of self-evaluation and professional growth

Approach

Federal agency managers for extension programs related to aquaculture in USDA-CSREES and NOAA-Sea Grant prepared a draft 22-page questionnaire. The draft questionnaire was circulated to thirteen extension professionals with diverse duties, for pre-testing and validation. The questionnaire was also reviewed by several social scientists in CSREES. The questionnaire was revised based upon suggestions received from the pre-testing exercise. USDA-CSREES maintains an electronic mail group (aqua-ext) consisting of about

300 extension educators, many of whom have responsibilities in areas relating to aquaculture. Areas of specialization include production, marketing, economics, engineering, processing, food safety, and more. The questionnaire was distributed electronically to the email addresses subscribed to the CSREES aqua-ext mail group. The mail group was updated with input from the NOAA National Sea Grant College Program, and other information sources; the CSREES five Regional Aquaculture Centers and members of the steering committee for the National Aquaculture Extension Conference. The period of comment solicitation was 2003 January 7 to March 7. Completed questionnaires were returned via electronic submission (email).

The questionnaire is organized under numerous headings each with a series of related questions. Many of the questions were formatted using a Likerd-like scale (Taylor-Powell, 1998) to facilitate the reporting of findings whereas others involved short narrative responses. The heading titles and number of questions (in parenthesis) for each heading were: Position Related (14); Career Related (8); Professional Growth and Development (11); Extension Related (20); Information and Technology (21); Research Related (15); Regional and Multi-State Activities (9); National Activities (3); International Activities (5); Clientele Issues (21); Accomplishment Reporting (2); Extramural Funding (7); and Future and Emerging Issues (6).

The questionnaire is aimed at diverse extension educators, from state specialists to country agents to solicit suggestions and information that can be used by each agency to improve leadership and coordinating roles in collaboration with state partners. Many questions were formulated to identify actions and initiatives that can be taken by the various parts in our national extension and outreach community to strengthen efforts and capacity at all levels in the system.

The analysis and review of the responses in the section on research will be shared with various research agencies and programs to identify areas where new opportunities can be sought to gain more value to clientele through integrated research-extension partnerships and communication efforts.

Outcome

The deadline for submission of completed questionnaires was March 7 which occurred after the deadline for completion and submission of expanded abstracts for the proceedings of the Third National Aquaculture Extension Conference, thus findings and summaries of responses to the questionnaire are not reported in this abstract. However, the oral presentation at the conference will address selected topics. Selected findings and results will be submitted for publication in the Journal of Extension and the Journal of Applied Aquaculture to reach diverse audiences. Additionally, a White Paper will be developed for broad distribution in the aquaculture extension community. Approximately 90 returned questionnaires will form the basis of analysis, reporting of findings, and subsequent follow-up actions planned and implemented in consultation with the aquaculture extension community and other interested parties.

Conclusions

When the Cooperative Extension Service and Sea Grant extension programs were established, rural inland and coastal communities were thriving based upon traditional agriculture and fisheries sectors. Aquaculture was an emerging sector and only reached a level of federal government recognition and regulatory oversight beginning in the late 1980s to early 1990s. Today, the need for unbiased, research-based educational programs is more important than ever. Decisions made by farmers, managers, policy-makers, and the public should include the best scientific knowledge available. The evolution of computer-based technologies, improved communication systems, industry-wide consolidations, profound social changes, and the melding of national policies and economies driven by intertwined global factors have dramatically changed the landscape of rural inland and coastal communities, and likewise, opportunities for aquaculture development.

Information systems and technologies will continue to provide new opportunities to become valuable tools for novel and effective applications and approaches to deliver extension curricula using state-of-the-art technologies, methodologies and research. The gap between scientific discoveries and applications to food production and processing systems, and public policy development and public opinion can be reduced by sound, reliable and credible education in plain language – extension education. It is both the challenge and opportunity for extension to evolve, remain flexible and excel in its role of educator, facilitator, coordinator, catalyzer, and leader to stimulate active learning, critical thinking, and problem solving. The findings and results from the joint USDA-NOAA National Extension Questionnaire; Aquaculture and Related Disciplines will provide options and suggestions that can be addressed to further strengthen extension's role and function within the family of CSREES 1862, 1890 and 1994 partner institutions and Sea Grant College programs to support aquaculture development during a period of dramatic change and evolution.

References

Economic Research Service. 2002. Trends in Extension Staffing. U.S. Department of Agriculture. http://www.ers.usda.gov/data/extension/

Extension Committee on Organization and Policy. 2002. The Extension System: A Vision for the 21st Century. NASULGC Office of Public Affairs, pp.10.

GAO. 2002. Program Evaluation: Strategies for Assessing How Information Dissemination Contributes to Agency Goals. Report to Congressional Committees. GAO-02-923, pp. 39.

Kellogg Commission. 1998. Returning to Our Roots: The Engaged Institution. Kellogg Commission on the Future of State and Land-Grant Universities, Washington, DC, NASULGC.

McDowell, G.R. 2002. Land-Grant Universities and Extension into the 21st Century: Renewing the Covenant. Contributed Paper, Washington State University Cooperative Extension Conference, Pullman, WA, October 14-16, pp. 18.

NASULGC. 2002. Extension Panel Cites New Challenges for Programs in the 21st Century. NASULGC Newsline (March):11.

National Sea Grant Extension Review Panel. 2000. A Mandate to Engage Coastal Users: A Review of the National Sea Grant College Extension Program and A Call for Greater National Commitment to Engagement. Publication No. ORESU-Q-01-001, Oregon Sea Grant, Corvallis, OR, pp. 46.

Swann, L. and J. Morris. 2001. A White Paper on the Status and Needs of Aquaculture Extension Outreach for the North Central Region, pp. 12. (http://ag.ansc.purdue.edu/aquanic/ncrac/wpapers/ext0901.htm)

Taylor-Powell, E. 1998. Questionnaire Design: Asking Questions with a Purpose. Publication G3658-2, Program and Evaluation, University of Wisconsin Cooperative Extension, pp. 18.

Success of the Pearl and Giant Clam Industry in the Republic of the Marshall Islands, A result of Cooperation of U.S.D.A., C.T.S.A Research and Extension, the Government and the Industry Stake Holders

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The Republic of Marshall Islands (RMI) is bestowed with a rich marine biodiversity of shell fish and finfish. Among these the most important ones from the commercial point of view are the black lip pearl oyster *Pinctada margaritifera* and the Giant clam *Tridacna* sp. is also available in some of the selected atolls of the RMI where they are being exploited for commercial purposes. Due to the sustained extension and research and development the RMI currently boasts 2 profitable commercial clam farms one by the Robert Reimers Enterprises (RRE) and the other by the Government which also includes a hatchery and 4 successful private pearl farms belonging to RRE and Black Pearls of Micronesia Inc. (BPOM) who also have a pearl hatchery

These successful ventures have been due to the support of Centre for Tropical and SubTropical Aquaculture (CTSA) and USDA through its Land Grant Cooperative Research and Extension (CRE) programme first operating through the College of Microneisa (COM) and at present through the College of the Marshall Islands (CMI). Successive Extension agents of CTSA and research and development through the support of USDA (CTSA sponsored research projects or the direct USDA sponsored Hatch projects (with half local matching) have resulted in the transition of these projects from lab to land and a successful industry.

Off late a working group has been set up with various stakeholders which would benefit the U.S. Pacific Islands of RMI, Federated States of Micronesia and Hawaii State of U.S. like the CTSA research project investigators from University of Hawaii at Hilo, The Land Grant (CRE) and Marine Science Programmes of CMI and COM, Pohnpei Agricultural Trade School (PATS), Government departments like Marshall Islands Marine Resources Authority(MIMRA), private companies like RRE and BPOM and several NGO's. This unique cooperation of the working group in the Western and Central Pacific Islands has resulted in the open sharing of scarce funds through joint projects and dissemination of research findings to the industry and could be a model for several other nations in this region.

Web Based Linkage:
Producer - Grower Association – Buyer

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Introduction

Agricultural marketing is often an area in which a farmer is unable or unwilling to devote sufficient time or money. This is true for aquacultural producers, especially our limited resource fish farmer clients in Virginia, who do not have sufficient production to interest wholesale buyers or to supply outlets on a continuous basis. A marketing tool that can be helpful in linking customers and farmers is the use of the Internet. Cooperative Extension can provide the education to make farmers aware of this option, link them with an existing website host and educate the website host of the needs of the aquacultural producer.

The development of an Internet based e-market is appropriate at this time for aquaculture products. Consumers are concerned with product quality and freshness, and local family farm based producers can supply such products. Buying directly from the producer or from farmers' markets would satisfy this demand. Most households are connected via a computer to the Internet, as are many farmers. Limits exist for traditional direct marketing efforts such as word of mouth, local advertising, person to person (producer to client), local telephone calls and mailings. These techniques are expensive in both time and money. In addition, they only provide promotion for a short time period.

A lack of markets was faced by Virginia farmers who initiated the warmwater aquaculture industry in the late 1980s, and continues today with a large number of family farms seeking to diversify from traditional crops such as tobacco and peanuts. The Virginia Fish Farmers Association (VFFA) was formed in the early 1990s to provide the opportunity for group purchases and sales. The Virginia Aquaculture Association (VAA), which evolved from the VFFA, faces a similar dilemma. Demand for their product exists. Farmers have product to sell. An efficient marketing process needs to be established to link this demand with the supply. Internet sales, in effect, become a digital farmers' market in which product is available 24 hours per day, seven days per week.

Approach

Virginia aquaculture market needs will be used as an example. A commercial web host, which specializes in small business development for local agricultural producers, was contacted by the VAA and a plan developed to assist the association's member farmers. The VAA would be provided with a free web site with the paid establishment of five individual producer web sites. An initial charge (minimal) for the participating farmers would be made for establishing the uniform individual web sites. A monthly service charge billed on a quarterly basis would be the profit incentive for the host. The host provides firewall security and back-up server protection from remote units.

Responsibility for upkeep of the established site is with the producer. Access by the producer to the site is made via a password. The web site can be modified using common word processing software and does not require any special programming languages. This user-friendly aspect allows for real-time modifications of product availability, prices, specials, etc. from any remote site. These changes can be done as needed at the convenience of the farmer.

Another option open to the producers through the web site is the use of various secure means of transferring money on-line. These real-time payment services require membership at no cost and have a very small handling fee. License requirements for these services differ from state to state.

Necessary for the success of Internet marketing of aquaculture products is the ability of consumers to be aware of product availability. Search engines are cumbersome and may not direct the customer quickly to the appropriate site. It is important to publicize the web site name so people know where to look. Proven ways of advertising this location are by placing the web site address on product packages, window stickers, banners displayed at meeting and fairs, member business cards and stationery.

Easy access is the most important component. A key aspect of the web page is to limit the amount of special effects or "glitz". This requires excess time to download. The maximum time that that a web page should take to load is 15 seconds. Any additional time would discourage customers. Loading speed is based on several factors including the type of phone line connecting the buyer's computer to server, and the capacity of the buyer's computer. Therefore, few pictures, which require time to load, are placed on the initial page.

The farmers' market site will direct buyers to those farmers offering the identified products. Standardized individual web pages contain listings of available product and photos. Contact information (name, address, phone number, e-mail address) as well as a map of how to reach the farm should be included. A separate link is provided for fee-fishing operations, one of the main outlets for fresh warm water fish in Virginia. An example of a simple home page design is represented in Figure 1. An example of the marketing link (AQUACULTURE FARMERS MARKET) found on the home page is represented in Figure 2.

Outcome

The establishment of a marketing portal associated with the producer organization is the start. The producer association can initially serve as a clearinghouse for those producers without individual web pages. Expansion may lead to voluntary buyer lists with e-mail notifications of discounts, and mail-order products or specialty items. These can easily be adopted into the Web Based Linkage: Producer - Grower Association – Buyer.

Figure 1.

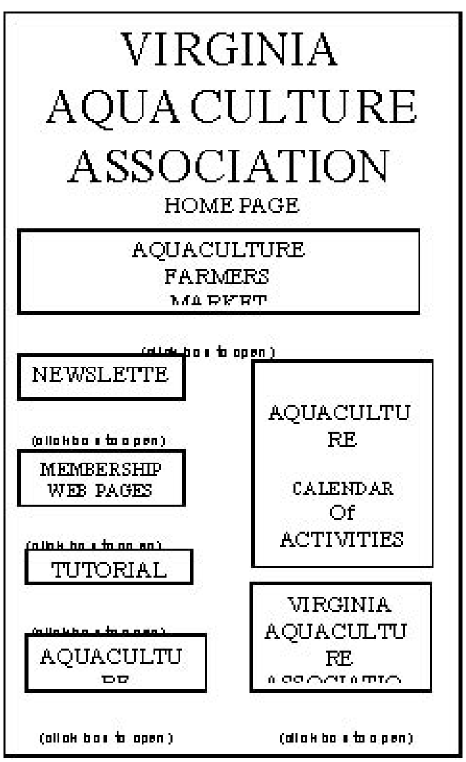
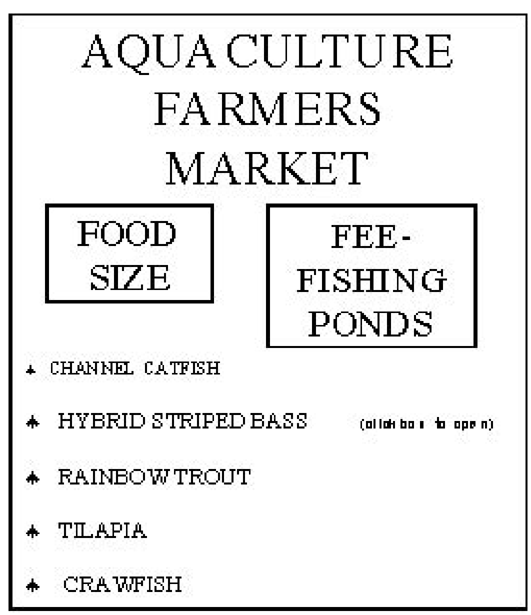


Figure 2.



Genetically Modified Aquatic Organisms and the California Legislature

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Introduction

There are concerns among some segments of society about the safety of genetically modified (GM) foods and their potential to adversely impact the environment. These concerns have been greatly allayed concerning GM corn, grain and soybeans, which have been in the market place for many years and been shown to be safe and nutritious. In contrast, these concerns are heightened when discussing consumption of genetically modified animals. This issue is currently focussed on fish because Aqua Bounty Farms, a Massachusetts based biotechnology firm, is the first company in the U.S. to petition the Food and Drug Administration (FDA) for approval to market a genetically modified Atlantic salmon. If approved, this would be the first genetically modified animal intended for human consumption to enter the market place in the U.S. In California, concerns over the potential use of GM fish on the part of some fishing industry and opposition groups resulted in the introduction of legislation, SB 1525, to prohibit their importation or possession by registered aquaculturists. Associated legislation would have required labeling of any GM fish in the market place, and another bill called for a California Senate resolution asking the FDA to deny the petition submitted on the part of Aqua Bounty Farms to market their GM salmon.

This legislation was supported by the following organizations:

- Natural Resources Defense Council
- Pacific Coast Federation of Fishermen's Associations
- A Home Away From Homelessness
- California Public Interest Research Group
- CalTrout
- Defenders of Wildlife
- Environmental Defense

- Friends of the Earth
- Greenpeace
- Institute for Fisheries Resources
- Salmon Protection and Watershed Network
- Save Our Shores
- Sierra Club
- The Ocean Conservancy
- The Sea Turtle Restoration Project
- Union of Concerned Scientists

In arguing for the ban on GM fish the Natural Resources Defense Council (NRDC) stated that the great diversity of native marine life in California is placed at risk by live transgenic fish and that approximately 35 species of fish have been genetically engineered. According to NRDC, farmed Atlantic salmon grown in British Columbia have escaped, and are found in 77 streams in that province. NRDC also holds the view that the federal regulatory structure used by the FDA evaluates genetically engineered fish only in terms of the chemicals used in the engineering process and their pharmaceutical effects, and not for possible ecological effects.

The numerous conservation groups supporting this legislation highlight the perceived peril posed to native salmon, many of which are listed as threatened or endangered species. They question whether the actual or potential risk to native salmon through the use of transgenic salmon is warranted.

This proposed legislation was not based on science demonstrating that consumption of GM fish posed any health risks, or that their regulated use would present any unacceptable environmental risks. In light of this, the legislation was opposed by a number of aquaculture, agriculture and biotechnology firms, which held the position that future research and commercial opportunities using GM fish should not be eliminated due to concerns about potential negative impacts.

The legislative opponents included the following:

- BIOCOM/San Diego

- Biotechnology Industry Organization
- California Aquaculture Association (unless amended)
- California Chamber of Commerce
- California Farm Bureau Federation
- California Fisheries and Seafood Institute
- California Grain and Feed Association
- California Grocers Association
- California Plant Health Association
- California Retailers Association
- California Seed Association
- Grocery Manufacturers of America
- National Food Processors Association

Biocom/San Diego is an umbrella organization of companies in the biotechnology field and they argued that current and future biotechnology research could offer the same benefits for improved aquaculture production as observed in agriculture. Federal agencies and independent scientific organizations have found the use of biotech foods to be appropriate and effective. In contrast to the bill's supporters, opponents feel that the federal government strictly regulates biotechnology. They argued that potential impacts of GM fish on natural resources are assessed as part of the FDA review process, and this process is subject to federal environmental statutes and regulations.

Aqua Bounty Farms argued that the legislation was premature, because FDA research on the Aqua Bounty proposal to raise and market GM salmon had not been completed, and no transgenic fish products are on the market anywhere in the world. The company argued further, that there are no salmon farms in state waters and none are likely to be located in California because of unfavorable climatic conditions. It was pointed out that the farmed salmon that have escaped in British Columbia have a survival rate of less than one percent and none have become established. The company waived FDA confidentiality so the review process would be transparent, they agreed to label GM fish if they reach market, and stated that the fish it raises will be sterilized females.

Approach

Cooperative Extension and Sea Grant Extension Program staff contributed science based information to this process in collaboration with the University of California's Legislative Director for agriculture and environment in the Office of State Governmental Relations. It was pointed out that federal regulation of transgenic fish is governed by the Food, Drug and Cosmetics Act, under which jurisdiction for GM products falls to the U.S. Food and Drug Administration. In reviewing petitions for GM fish the FDA insures the relative safety of the products, and also includes environmental review that addresses the potential for environmental toxicity and also for lasting effects on ecological community dynamics.

Further information was provided to the Department of Fish and Game as they subsequently developed regulations to manage transgenic fish in the state. Cooperative Extension and Sea Grant Extension Program staff worked with groups on each side of the issue to facilitate adoption of sound regulations based on the best available science.

Outcome

SB 1525 did not pass in the 2002 legislative session. Following the Bill's defeat, supporters undertook to "gut and amend" an unrelated bill, SB 307, which was being held in committee. This amended bill, now containing the content of SB1525, was also held in Committee and died. The original authors then filed a petition with the Fish and Game Commission to ban the importation of transgenic fish into California. The Fish and Game Commission responded by directing the Department of Fish and Game to develop regulations to manage GM fish in the state. The Department worked with a broad range of constituencies on all sides of the issue to draft regulations that were ultimately approved by the Fish and Game Commission.

Conclusions

Through concerted efforts on the part of all parties involved a system to responsibly manage the use of GM fish for research and commercial production exists in California. That this occurred, rather than a prohibition on their use, resulted from the input of science based information in the development of a reasonable regulatory framework that addressed the concerns of all parties.

Minority Outreach: Abstract

Albert Reid and Brian Nerrie

There are approximately 1000 minority farmers in Virginia and the number is steadily declining. Finding ways to diversify and sustain minority farmers while preserving the vitality of their rural communities is essential to Southside Virginia's tobacco growing region. In the spring of 1996 cage culture and pen culture systems were established with the assistance of the aquaculture office of Virginia State University's Cooperative Extension. Pen culture was established first in 1996 when it was observed that a shallow .125-hectare peninsula shaped part of a farmer's 6-hectare pond could be sectioned off with plastic mesh. One year old channel catfish were stocked that spring at 2000 fish per hectare of water and harvested the following year (fall). Processed channel catfish were sold to local residents and civic organizations. A bridge was built over this sectioned – off part of the pond and a bubble gum machine was mounted and filled with feed so that camp visitors could pay to feed the fish and help supplement feed cost. Rainbow trout were later stocked and placed in circular cages the following fall. Rainbow trout were harvested and sold in the spring to the local annual shad planking fish festival. Fee fishing also proved to be a profitable enterprise. This feature was added after the second year of fish production and complimented the camp and park experience. Numerous urban youth were also exposed to the fishing experience for the very first time. Church activities, camping trips, school outings, family reunions, car shows, and horseback riding participants were all consumers of aquacultured related products.

Planning Aquaculture Development to Avoid Controversy
The New Alaskan Effort to Develop a Shellfish Farming Industry

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Introduction

Oyster farming in Alaska began in the 1930's with the seeding beaches with Pacific oyster (*Crassostrea gigas*) spat imported from Japan, but the due to the cold water conditions shellfish failed to reproduce and survival was low. These efforts were abandoned shortly after World War II. In the late 1970s residents in the Wrangell, Alaska area initiated a rebirth of the industry with the introduction of suspended culture techniques (Yancey 1966). About a dozen of these small cottage industry oyster farms operated in the 1980s, however, surface culture techniques proved inefficient, labor requirements arduous, and little demand for the product emerged. State of Alaska permit application and renewal procedures were vague and burdensome. Collectively, these constraints caused many business failures, however, the area proved very productive and capable of producing high quality oysters.

The Aquatic Farm Act of 1988 official legalized shellfish and seaweed farming and improved the permit application procedure that has resulted in the state now having 63 farms. Most of the farms remain small providing minimal economic impact to the local community, but demand for Alaskan grown oysters far exceeds the supply. It is not unusual for a single buyer to request weekly oysters deliveries equal to the entire yearly production of the entire state. Transforming the industry to meet market demand requires a dramatic increase in production, but any response is fraught with socio-economic obstacles that have effectively stifled industry expansion to its current level.

A predominate constraint to shellfish aquaculture expansion is Alaska's noteworthy public stance against finfish aquaculture. It is ironic that Alaska has the most productive salmon enhancement program in the United

States, releasing an average of 1.5 billion salmon smolts annually into the ocean, but prohibits salmon farming (ADF&G 2001). The nearly twenty years of debate coupled with the current depression in salmon prices blamed on farmed salmon production, renders expanding aquaculture difficult to advocate (Knapp 2002). Public presentations explaining that shellfish do not have fins may generate laughter from the audience, but shellfish aquaculture is nonetheless viewed with a certain degree of suspicion (Alaska Sea Grant 1996).

Advocates of marine resources management and development initiatives fully realize that Alaska is viewed as America's last frontier and that environmental policy is often not controlled by local citizens or even residents of the state. Controversy generated by applying for a tidelands permit often leads to the perception that every square foot of tidelands in Alaska's 33,000 miles of coastline is being used for some priority purpose. Effective media presentations about the perceived environmental problems associated with aquaculture raise the alarm that shellfish farming is a dire assault on our coastal ecosystems (Bendell-Young 2002).

Collectively, the finfish farming issue, conflicts with coastal resource users, environmental impact concerns, and suspicions about the future intentions of shellfish aquaculture have resulted in an agonizingly slow and cumbersome permit processing, burdensome farm operation regulations, and often very confrontational public reviews of permit applications. In such an atmosphere of controversy, how does one pursue a shellfish aquaculture development program? With ten years of effort in this area, the approach we are now using that has an enormous potential for success is to plan shellfish aquaculture as a locally initiated economic development program.

The unfortunate downward spiraling in the Southeastern Alaska economy caused primarily by reduced timber harvest and low salmon prices is a major reason for renewed interest in shellfish farming (Knapp 2002). New technology, regulatory reform, and strong market demand effectively solve some of the problems encountered by pioneering shellfish farmers. Other barriers such as difficult logistics, poor communications and high transportation and production costs can be addressed by working cooperatively with other farmers or area processors and other businesses.

Shellfish aquaculture as economic development

Historical attempts to develop shellfish aquaculture through the standard permitting process have not worked.

As a result, a new approach to industry development has adopted a design modeled after the Cedar Keys, Florida clam aquaculture program that transformed unemployed commercial fishermen into clam farmers through the cooperative efforts of the State of Florida, University of Florida, and the local community (Philippakos etal. 2001). In the fall of 2001, a similar working consortium composed of the University of Alaska, Southeast Conference, and several state agencies administering the aquaculture programs was assembled.

The concept that shellfish aquaculture provides local communities economic opportunity provided the rationale for accelerating development of the industry. In Southeastern Alaska, communities have implemented a number of economic programs to attract businesses and provide local employment; however, these new enterprises deliver limited economic impact and the prospects of further development is questionable (ISER 2001). For example, development of a tourism industry is often the first response initiated by communities only to find that tourism jobs are seasonal and often filled by out-of-state residents. Economists speculate that only one in three dollars remains in the local community, and after an initial spurt of growth tourism in many communities is now leveling off (Colt and Huntington 2002). Aquaculture development portrays and entirely different economic prospectus. In a survey of farm expenditures, the results show that over 50% of the income generated by farmers remains in the local community, 72% in the region (e.g. S.E. Alaska) and 95% remains in the State of Alaska. In addition to the local retention of economic impact, aquaculture increases the frequency of air transit that has side benefits to the community, provides year around employment, stabilized communities populations that have been declining, and provides natural resource jobs rather than intrusive tourism enterprises that are not welcome in many rural communities.

Locally initiated development

Early in the program development stage, the decision was made by the aquaculture development team to promote the program through the regional economic development district, the Southeast Conference. The Southeast Conference is composed of representatives of all the communities in the southeast Alaska and serves as an umbrella organization to coordinate the economic development program. Southeast Conference served an essential function by extending invitations to multiple agencies, private citizens, and government to participate in the planning the process. Initial meetings of the aquaculture committee formed under Southeast Conference made the decision to inform communities of the opportunity, but did not pursue aquaculture planning if the community rejected the concept. Following presentations in seven communities, Naukati, Wrangell, and Ketchikan overwhelmingly embraced the program (Figure 1).

The objectives of planning

The emphasis or the program begins at the local level by consultation with community members providing information about potential shellfish farming sites. Once potential sites are identified as acceptable to the community, additional ancillary information necessary for the Alaska Department of Natural Resources (ADNR) review process is used for assessing the feasibility of the site for development and sites that pass the initial inquiry are incorporated into a plan.

1. Amore comprehensive approach better assesses the total aquaculture potential for the area
2. The environmental impact of site development is examined before any permits have been submitted for review.
3. Users of the marine resources of the area are consulted and informed regularly about the results of the planning efforts.
4. Surprises about locations of potential farm sites that have lead to confrontation during past reviews can be avoided with an open planning process.
5. Cumulative impacts can be controlled by recommending the number of farm sites allowed at each proposed location before development.
6. Regulatory requirements that would normally be used to review a single farm site are now used to permit a number of farms occupying a larger area.
7. Cooperative instead of confrontational relationships between participants and interested parties are developed.

8. Planning enables rapid industry growth with the prospect that a number of site leases will be issued during a short timeframe.

Funding acquisition and program results

Following initial interest in aquaculture development, and successful acquisition of over $150,000 in funding, the program began in the Naukiti area. Word of the project reached the Alaska legislature, which was in session during the winter of 2002, and the program team was invited to make a presentation to the joint House/Senate Fisheries Subcommittee. The positive impression of the presentation lead to development for legislation, HB

208, which required the State of Alaska to identify and put up for lease 90 news shellfish farm sites by January 2004. In support of HB 208 $470,000 was appropriated by the legislature for states agencies to assist with the planning and fund the site review process. Additional support came from an $81,000 grant through the Alaska Sea Grant Program. Adequate funding is now available to expand the program to the other interested communities with some assurance that identification of suitable farm sites for 2004 could be realized, and all sites have been nominated for consideration and leasing under stipulations of HB 208.

Beyond site identification, the purpose of intensive site studies was to nominate locations for consideration under HB 208 that had a high likelihood of passing the ADNR review process and be issued for lease. To accomplish this goal, an interdisciplinary data collection approach was used that essentially collected as much of the information as was readily available that ADNR would normally review in order to assess the suitability of the site for lease. The data collection process included maps and data on marine uses, tidelands and uplands use and planning documents, surveys of fish and wildlife use of the area, human impacts, Alaska Native subsistence and culture uses, logistical and economic feasibility of developing the farm site, and any local knowledge of the sites.

The three communities identified for the program assembled local advisory panels to assist in locating potential sites for on-bottom intertidal littleneck clam (*Protothaca staminea*) and suspended oyster and scallop (*Crassadoma giganteus*) farming. Subtidal geoduck clam (*Panopea abrupta*) farm sites were nominated by the Southeast Alaska Regional Dive Fishery Association. Following identification of potential sites by the community advisory panels, reconnaissance surveys examined the approximate 9,440 square kilometers of potential sites. Upon consideration of readily known ancillary information about the sites, the total area of submitted for nomination was reduced to 3,903 hectares encompassing 104 sites.

The data was entered into a Geographical Information System (GIS), the 104 site nomination applications were complete, and the entire application was submitted to ADNR on a DC-ROM by the deadline of December 13, 2002. The ADNR has assembled and interdisciplinary committee comprised of state agencies, the University of Alaska Marine Advisory Program, citizens, and industry representative to review the suitability of nominated sites for eventual leasing. To date, after three review sessions, only a single site has been rejected. Following committee review additional on-site investigations will ensue during the summer of 2003, and public meetings are scheduled to obtain additional input.

Summary

The more comprehensive approach to aquaculture siting has worked well thus far. Local citizens have been incorporated into the process of site identification and selection from the inception of the planning process, governmental agencies have been active in supplying information, and multidisciplinary review panel has worked cooperatively to review the site nominations. Important to the process was the time spend at the planning phase has reduced the level of confrontation by involving the local community in identifying sites with minimal use conflicts, conducting a thorough initial review of the site, and discarding sites that could lead to unnecessary controversy. The results have been an atmosphere of good will on all parties. The review process will continue for the remainder of 2003, but the result has already been pre-determined by the Alaska legislature, 90 sites will be available for lease early in 2004.

References

Alaska Department of Fish and Game (ADF&G). 2001. Alaska salmon enhancement program: 2001 annual report. Division of Commercial Fisheries and Enhancement Division. Regional Information Report No 5J02-04

Alaska Sea Grant. 1997. Alaska groundfish fisherman survey results 1996. University of Alaska Sea Grant College Program. AK-admin 1997. Fairbanks, Alaska.

Bendell-Young, L., 2002. *Some issues facing the expanding British Columbia shellfish industry*. Conference presentation, Ocean Management Research Network National Conference (October 25-27, 2002), Ottawa, Ontario.

Colt, S. and H. Huntington. 2002. Oceans, watersheds, and people; Facts, myths, and realities. Presentation at the conference on Oceans and Watershed. June 18, 2002. Anchorage Alaska.

Institute of Social and Economic Research (ISER). 2001. Trends in Alaska's people and economy. Prepared for the Alaska 20/20 partnership bringing Alaskans together to chart our future. Alaska Humanities Forum. University of Alaska Anchorage. Anchorage, Alaska.

Knapp, G. 2002. Challenges and strategies for the Alaska salmon industry. Presentation of the Institute of Social and Economic Research. University of Alaska Anchorage. Anchorage, Alaska.

Philippakos, E; C. Adams; A. Hodges; D. Mulkey; D. Comer; L. Sturmer. 2001. Economic impact of the Florida cultured hard clam industry. Florida Sea Grant Program. SGR 123.

Yancey, R.M. 1966. Review of oyster culture in Alaska, 1910-1961. Proceedings of the National Shellfisheries Association. Volume 56.

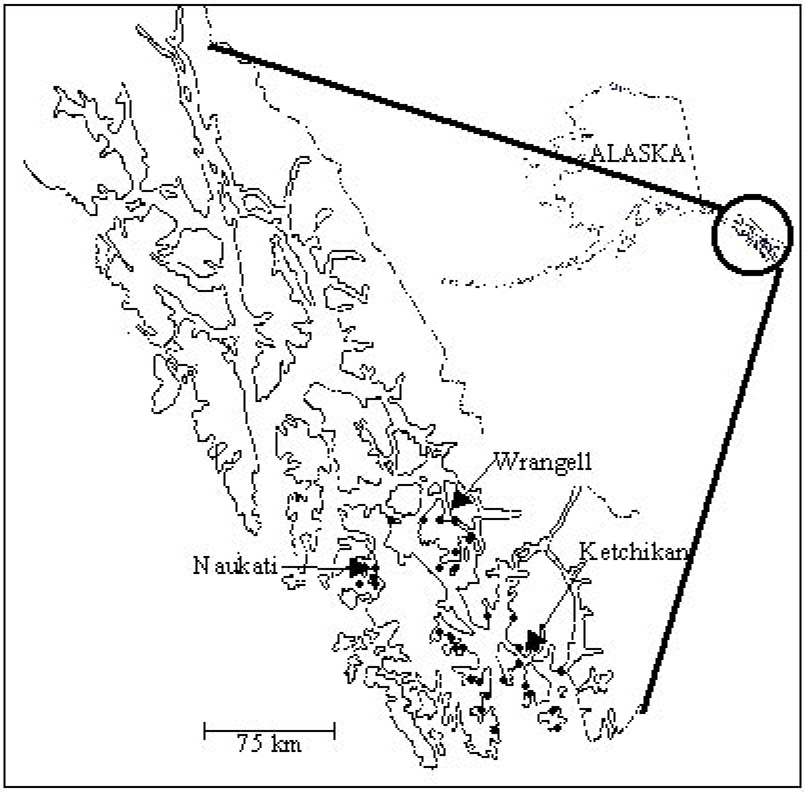

Figure 1. *Site nominations for the Southeast shellfish aquaculture development program*

An Overhaul of the Aquaculture Laws in Rhode Island

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In the late 19th and early 20th centuries, Rhode Island was one of the major producers of aquacultured oysters, *Crassostrea virginica*. In the peak production year, 1911, about 1.4 million bushels of live oysters were sold in addition to about 1.3 million gallons of shucked oyster meats (Rhode Island Commissioners of Shellfisheries, 1912) all produced on 20,846 acres of leased oyster grounds in Narragansett Bay and coastal barrier beach estuaries (*Figure 1*).

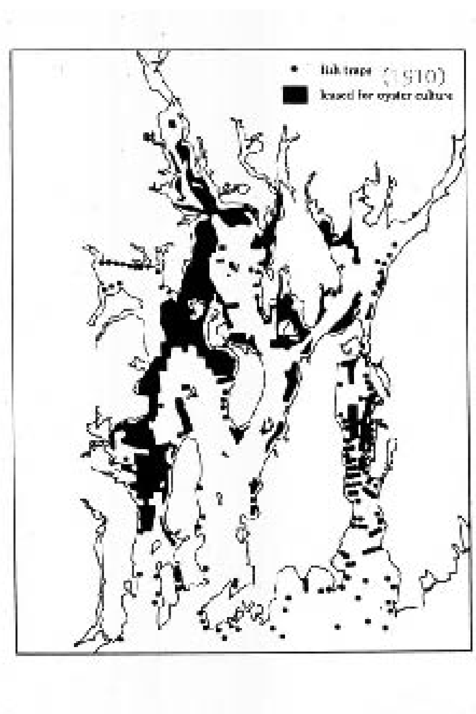

Figure 1. *A map of Narragansett Bay, Rhode Island showing the location of leased oyster farms (blackened tracts) and location of leased locations for fish traps and pound nets (filled circles). Source: Rhode Island Commissioners of Shellfisheries, 1911.*

One of the key factors contributing to the rise of such robust aquaculture industry in the state was the 1864 Rhode Island Oyster Act that first established a mechanism for leasing of publicly held estuarine bottom and establishment of the Commissioners of Shellfisheries (the direct predecessor of the Rhode Island Division of Fish and Wildlife) to regulate and manage the aquacultural activities (reviewed by Nixon, 1992). The oyster aquaculture industry flourished until the 1930s when several factors including siltation of the grounds, effluents from metal plating and a hurricane in 1938 devastated the industry. A frequently overlooked reason for aquaculture's decline was the radical political change toward populist political policies in 1935. Aquaculture became politically very unpopular in Rhode Island in the post-World War II era. By 1952, the last of the old oyster lease (Warren Oyster Company) was revoked by the state, and by the 1970s, the aquaculture laws (General Laws of Rhode Island 20-10-1) were rewritten such that permitting was spread among multiple new agencies including the Coastal Resources Management Council (Olsen and Seavy, 1983) and various divisions of the RI Department of Environmental Management and the RI Department of Health, with federal review coordinated by the U.S. Army Corps of Engineers Region 1.

In an effort to educate potential aquaculturists about the procedures for obtaining aquaculture leases in coastal waters Rice and Ganz (1994) produced an aquaculture permitting resource manual closely based on a document produced by Alaska Sea Grant (Ralonde and Paust, 1993) that provided flow charts of the aquaculture permitting process and key contacts to prospective aquaculturists. Also in 1994, RI Sea Grant and Cooperative Extension provided some limited logistical support for the formation of the Ocean State Aquaculture Association (OSAA), Rhode Island's aquaculture trade organization. A series of aquaculture workshops for fishermen was established in 1995 (Rice and DeAlteris, 1996), and these extension workshops continue to be offered annually. A combination of the recently published aquaculture 'permitting manual' with the flowcharts with Byzantine complexity and periodic newsletters from the OSAA, prompted the 1995 Rhode Island House of Representatives to pass Resolution 95-H 5615 authored by Rep. Eileen Slattery Naughton forming a thirteen-member legislative commission with a charge to, "promote, protect, and stimulate aquacultural commerce in Rhode Island." The output of the Commission included co-sponsorship of annual aquaculture conferences (along with the aquaculture extension agencies and other sponsors), and three documents of note; initial Aquaculture Legislation (96-H 8276 Substitute A "An Aquaculture Act") that became public law and began the consolidation of the permitting process under a single state agency, a strategic plan (Anderson et al., 1998) and an omnibus aquaculture bill (98-H 8816) that closely followed recommendations in the strategic plan. The bill proposed a variety of measures designed to grow the aquaculture industry, these included: a greatly streamlined the permitting process, recognition of aquacultural crops as agricultural and therefore not subject to wildlife regulation, agricultural tax breaks, 'right to farm' protections, creation of position of Aquaculture Coordinator to be an advocate within the state governmental structure, and boosting the state capabilities in public fishery restoration aquaculture.

In the intervening years virtually all of the provisions of this original omnibus bill have become law or regulation in piecemeal fashion. For example most recently, considerable controversy surrounding the management of traditional capture fisheries has led to a process of restructuring the entire fishing licensing structure within RI. In 2001, an Intergovernmental (Governor, House, and Senate) Working Group (IWG) for Fisheries Management has requested that the University of Rhode Island Coastal Institute serve as a neutral venue where the fishing industry, resource managers, academic experts, political leadership, and the public could meet to discuss the status and future of commercial fisheries management. The aquaculture industry actively participated in these discussions and with the passage of the Fishing Licensing Act of 2002 (02-S 2771) principally sponsored by Sen. Susan V. Sosnowski and signed into law by Governor Lincoln Almond on June 10, 2002 aquaculture livestock has been exempted from all fisheries management regulation.

Table 1. **Recent Rhode Island Aquaculture Statistics**
(data courtesy of RICRMC)

Year	Number of farms	Total Acres	*Farmgate value of crops in U.S. $*
1995	6	9	$83,518
1996	6	9	$91,499
1997	6	17	$275,946
1998	10	26	$296,980
1999	14	28	$213,861
2000	12	30	$314,977
2001	18	51.5	$299,998

The annual reports from the state aquaculture coordinator (e.g. Alves, 2001) show an increase in aquacultural crop production of about 40% per year on average over the time period 1995 to 2001 and a five-fold increase in aquacultural lease acreage during that same time period (Table 1). Although the aquaculture industry in Rhode Island no longer has the production and economic significance it had near the early part of the last century, its growth has been healthy in the last few years by strategic partnering among aquaculture industry, university extension professionals and legislators with a keen interest in aquaculture as a geographically appropriate and an environmentally sound form of economic development for the state.

Acknowledgements

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References

Alves, D. 2001. Aquaculture in Rhode Island: 2001 Yearly Status Report. Rhode Island Coastal Resources Management Council, Wakefield. 21pp.

Anderson, J.L., R.T. Johnston, S. Jancart, M.T. Carroll, J. Martinez, and B.S. Gardiner. 1998. A Strategic Plan for Rhode Island Aquaculture. Rhode Island Legislative Commission on Aquaculture, Suite 07B Statehouse, Providence. 170pp.

Nixon, D.W. 1992. A legal history of shellfish regulation in Rhode Island. Pp. 19-22. In: M.A. Rice and D. Grossman-Garber eds., Proceedings of the Second Rhode Island Industry Conference. Rhode Island Sea Grant, University of Rhode Island, Narragansett.

Olsen, S. and G.L. Seavy. 1983. The State of Rhode Island Coastal Resources Management Program as Amended. Rhode Island Coastal Resources Management Council, Wakefield, RI.

Ralonde, R. and B. Paust. 1993. Developing a Mariculture Business in Alaska: Information and Resources. Alaska Sea Grant Publication AN-15, Alaska Sea Grant, University of Alaska, Fairbanks.

Rhode Island Commissioners of Shellfisheries. 1911. Annual Report of the Commissioners of Shellfisheries. Made to the Rhode Island General Assembly. E.L. Freeman & Company, Providence.

Rhode Island Commissioners of Shellfisheries. 1912. Annual Report of the Commissioners of Shellfisheries. Made to the Rhode Island General Assembly. E.L. Freeman & Company, Providence.

Rice, M.A. and J.T. DeAlteris. 1996. Changing times for Rhode Island shellfisheries: URI's shellfish aquaculture training program for shellfishermen. Journal of Shellfish Research 15:459-460.

Rice, M.A. and A.R. Ganz. 1994. Planning an Aquaculture Business in Rhode Island: Getting Started. Rhode Island Sea Grant, University of Rhode Island, Narragansett. 39pp.

Recirculating Aquaculture Systems: Foodfish Production?

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Introduction

Most of the world's commercial fisheries are either on the verge of overexploitation, or declining due to the world's expanding population putting pressure on the ocean's animal and plant resources (Jahncke and Schwarz, 2002). World fisheries production dropped from a combined tonnage of 93.6 million metric tons in 1997 to 86.3 million metric tons in 1998, a decrease of 7.8%, and appear to have now stabilized at approximately 80 million metric tons. However, projected demand for seafood is 110 to 120 million metric tons by 2010. In response, major financial efforts as well as legislation has encouraged fishery gear optimization, efficiency, and expanded traditional fishing areas. The result is even more pressure on fish stocks allowing for fewer areas for stock recruitment (Tidwell and Allen, 2001). In this same time interval, fisheries production in the United States (US) dropped from 4.98 million metric tons to 4.7 million metric tons, a decline of 5.6%. In the US, these trends have resulted in ever increasing economic hardships to coastal communities with rich historic and economic ties to the fishing industry. These trends have also helped generate what has grown to a staggering $7 billion US seafood trade deficit, a doubling since 1995, the largest for any agricultural commodity, and the second only to petroleum for any natural product (Personal communication, ASDA ARS). As the upward trend for seafood demand increases, the US must develop alternative seafood supplies or suffer increasing trade imbalances in fishery products (Garrett et al., 2000).

Aquaculture has the potential to offset decreases in wild fisheries production, decrease the growing US seafood trade deficit, and provide a safe and wholesome food product enhancing food security issues in the US. Over the past several years aquaculture has represented the fastest growing segment of agriculture in the US. Given inherent production costs associated with any form of industry in the US, compounded by multiple user resource conflicts associated with aquaculture and a climate generally noncondusive to extensive warm and coolwater fish production, aquaculture production in Recirculating Aquaculture Systems (RAS) have received significant interest. RAS decrease required limited land and water resources as compared to conventional aquaculture production techniques such as net pen, pond, and flow-through raceway production systems, produce concentrated waste streams amenable to municipal waste treatment techniques, and effectively facilitate control and biosecurity of production aspects. However, the greatest significant trade-off for these benefits is an inherently high infrastructure and operating cost, as well as elevated production risks associated with increased animal densities in combination with potential system failures. These detriments are directly transferred to increased production costs, a significant factor when compared to conventional aquaculture production techniques.

Given the inherently elevated production costs associated with RAS, combined with a relative low value associated with "aquaculturable" food fish available to date, successful RAS applications in foodfish production in the US has been minimal at best. RAS production systems as a whole have become sequentially more expensive to build and operate as technological applications are continually maximized to increase biomass and control. Compounding production issues in RAS has been a relative stagnation in the market values of producible species.

Nonetheless, several RAS applications for the production of foodfish in the US have begun to demonstrate economical viability. A commonality to many of these facilities has been a trend toward reduced technological applications, combined with a proportional decrease in standing biomass and associated parameters and risks. These systems are being operated at densities less than 0.5 pounds/gallon (0.227grams/L), and thus are able to eliminate the necessity of utilizing pure oxygen and its associated detriments. These systems focus on high efficiency/low head pumps and airdrive components, and are thus designed for low-energy inputs. Treatment streams for solids control are a sidestream from main flow patterns for biofiltration, and high system turnovers are achievable and applied due to low head requirements. These factors simultaneously increase natural reareation and CO_2 stripping. Given reduced loading rates of these systems, higher water quality parameters are maintained at a nominal cost, resulting in reduced stress levels upon the fish. This directly transfers to improved health, growth, food conversions, and other desirable aspects of production conducive to lower production costs.

References:

Garrett, E.S., M.L. Jahncke, and R.E. Martin. (2000). “Applications of HACCP principles to address food safety and other issues in aquaculture: An overview.” *Journal of Aquatic Food Production Technology*.

Jahncke, M.L. and M. H. Schwarz. 2002. Public, animal, and environmental aquaculture health issues in industrialized countries. Chapter 3. In Public, Animal and Environmental Aquaculture Health Issues. (Jahncke, M.L., E.S. Garrett, A. Reilly, and R.E. Martin, Eds.). John Wiley & Sons, Inc. 605 Third Avenue. New York, NY 10158-0012. (Pg 67-102).

Tidwell, J.H., and G.L. Allan. 2001. Fish as food: aquaculture’s contribution. European Molecular Biology Organization, vol. 21, no. 11958-963

USDA/ARS Aquaculture Action Plan
www.nps.ars.usda.gov/programs/programs.html?npnumber =106Idocid=278

The Effect of Aerator Placement on Pond Circulation

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Commercial channel catfish ponds can experience episodes of low dissolved oxygen. These episodes can lead to fish kills or reduced growth, and as a result can limit production. Electric paddle wheel aerators are typically used in emergencies to add oxygen when dissolved oxygen levels fall to critical levels. Water circulation created by the movement of the paddle wheels helps maintain high oxygen-transfer efficiency because freshly oxygenated water is propelled away from the aerator and replaced by water with a lower dissolved oxygen concentration. Water circulation tests have shown that aerators mix water throughout pond and that aerator placement affects the efficiency of the mixing. This has impacts on the delivery of oxygenated water to fish. Research in small experimental ponds (typically 1 acre or less) have shown that to maximize pond circulation, the aerator should be placed midway down the long axis of a rectangular pond and point across the short axis of the pond (parallel to the short side). The effect that aerator placement has on water circulation has not been tested in production sized catfish ponds.

Three ponds on the Cain Fish Farm were used, each possessing a different paddle wheel aerator location. Water circulation was examined using plastic bottles, which floated with only their top ends exposed. The direction and speed of their movements indicated the water circulation pattern created by the aerator. Water circulation was also examined using small gypsum (Plaster of Paris) blocks. These were suspended below the pond surface throughout the test ponds, and allowed to dissolve for a period of time while the aerators operated. Weight loss was compared to that of a control block. The amount of weight lost was used as an indicator of water current strength.

Both of these methods indicate that the recommendations that were derived from studying small experimental ponds apply to larger production ponds. The most efficient water circulation patterns result from placing an emergency electric aerator along the long axis so that it directs water parallel to the short sides of the pond.

Verifying Yield at Two West Virginia Trout Farms

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Production in representative units at two commercial farms growing rainbow trout (*Oncorhynchus mykiss)* was measured. Though both farms grew fish in gravity fed flowing water systems, there were different production designs, management strategies, and market objectives.

The tank based system captured ground water as it flowed from a coal mine. Fish were grown in round tanks holding 1658 or 4163 ft^3 of water supplied with a flow rate of 67 and 100 gallons/minute respectively. Average exchange rates were 0.19 and 0.32 exchanges/hour. Oxygen was supplemented to the system to maintain at least 6 mg/l at all times. Production at this farm was destined for a processing plant. Management focused on growing as many pounds of fish as possible. As such, water quality (oxygen, Carbon dioxide, and ammonia) had potential to limit fish growth.

The raceway based system captured spring water as it flowed from the base of a mountain. Fish were grown in concrete raceways holding approximately 190 ft^3 of water supplied with a flow rate between 120 and 300 gallons/minute depending on water availability. Average exchange rates were between 6 and 10 exchanges/hour. There was no oxygen supplementation. Water quality (oxygen, carbon dioxide, ammonia) did not reach levels expected to limit fish growth. Production from this farm was destined primarily to the recreational market. Labor was a limiting commodity. Management focused on growing adequate volume to fill orders while minimizing the required labor.

Without replication, it was impossible to make conclusions regarding statistically significant differences among production units receiving specific management strategies. Data from the tank based system did suggest, however, that feeding a high energy diet (42% protein, 18% fat) resulted in a lower feed conversion and higher yield than feeding a standard diet (38% protein and 11% fat). It also suggested that fish (136g at stocking) fed to satiation during the production cycle would result in a lower feed conversion and higher yield than feeding 2% body weight/day through a 180 day production cycle. Data from the raceway system suggested that grading did not influence feed conversion or yield.

Fish in the raceway system were harvested or split when density approached 4 lb/cubic foot, whereas fish in the tank system were harvested as density approached 2 lb/cubic foot. Average production was 107 and 5.8 lb/gpm/yr for tank and raceway systems, respectively. If equal production were obtain on all five levels of the raceway system, average annual production would be about 29 lb/gpm. To equal production of the tank system given current management practices, would therefore require 18.5 uses of water in the raceway format. Clearly the production rates were higher in the tank based system. This is consistent with management objectives at the two facilities.

Comparison of Multiple-batch and “Modular” Catfish Production Systems

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Introduction

Multiple-batch production systems have been the norm for channel catfish, *Ictalurus punctatus*, production in Alabama, Arkansas, Louisiana, and Mississippi for many years. Under this system 5” fingerlings are restocked annually at a rate that takes into account average mortality over the next 18 months needed to grow out these fish. This system produces 1.0 - 1.5 pound fish fairly efficiently to an average yield of 4-5,000 lb/acre. However, two things have changed in the past few years. First, the farm-bank price of catfish has decreased from $0.70 - 0.75 /lb to $0.52 - 0.58/lb. The cost of producing catfish is thought to range from $0.60 - 0.70/lb and farmers are losing money and some operations are going out of business. Second, the size of catfish desired by processors has increased to the 1.5 to 2.0 pound range.

Catfish producers are faced with management schemes that no longer accomplish growth at a consistently profitable level. The extra time and inputs required to produce this larger size food fish has reduced the profitability of the multiple-batch production system. A better way to produce this larger-sized fish is needed. Engle (2001) estimates there is a 99% probability of producing fish at less than $0.60/lb when 7” fingerlings are stocked into growout ponds. Given that most fish producers have ready access to a 5” fingerling supply and fingerlings >6” are typically hard to find and transport great distances; a production system utilizing the 5” seed stock to reliably grow food fish to larger sizes was needed.

The goal of this project is to evaluate and compare a "modular" production system to the multiple-batch catfish production systems currently in use in the delta region of Mississippi. Physical production and economic evaluation of the two systems, as well as a discussion of the advantages and disadvantages of the two systems are presented.

Methods

Production parameters come from enterprise budget preparations stemming from long-term analysis of catfish production systems in the delta. Modular production system results come from farmers presently using this system. For the economic and production analysis and comparisons between the two systems, farm size, production (fingerlings stocked, pounds harvested, feed fed, labor, chemicals, other variable) and fixed costs, machinery and equipment were taken into account. Enterprise budgets were constructed for each scenario and compared. Breakeven analysis was conducted to determine the cost of production for each system. The breakeven cost can be compared to current farm bank prices to determine each systems profitability.

Results

Total farm acreage for the two compared systems did not vary, though acreage usage by specific production phases did differ, Table 1. While overall acreage for each system was not different, there were 1,050 grow-out acres in the multiple-batch production system compared to 900 grow-out acres in the modular production system, i.e., a 200-acre reduction in grow-out acres for the modular system. This poses the question whether the modular system can increase production to make up for this reduction in grow-out acreage. Additionally, in this analysis, all costs involved in 200-acres of 'fingerling-to-stocker' production were accounted for in the economic analysis. The top portion of Table 2 presents the change in fingerlings stocking rates for each system and the associated costs. The lower portion of Table 2 presents the differences in production of food-size catfish produced by each production system.

Other variable costs were estimated for each system. Feed requirements for the two systems differed with the multiple-batch system requiring 5.96 ton/ac/yr compared to 5.91 ton/ac/yr for the modular system, a decrease of 0.05 ton/acre/yr and a $12 per ton/ac/yr decrease in feed costs. The modular production system required an additional four seining crew employees over the multiple-batch production system, or an additional $72,000 per year in labor and management costs. Fewer acres required salt and diuron applications for the modular system and these costs were reduced. Copper sulfate was applied to 50 more acres in the modular system resulting in a higher charge for this chemical. Overall, chemical costs were $10 acre/year higher for the multiple-batch system over the modular system.

Equipment usage for the two production systems followed the same rule, i.e., one tractor and PTO emergency aerator for every three ponds; two 10-hp electric aerators per 10-acre pond and the modular system required two boom-loading trucks whereas the multiple-batch system required only one. When all receipts and costs were totaled the modular system had a net return of $250/acre/yr compared to the multiple-batch system's net return of $158/acre/yr, a net increase of $92/acre, Table 3. The breakeven price of production is presented in Table 4 and the modular production system had a $0.01 lower cost than the multiple-batch system when variable costs only are considered. When variable and fixed costs are included the modular system had a $0.02/lb lower breakeven cost.

Discussion

Modular catfish production systems are currently in use on a small number of farms. The economic analysis showed an increased net return for the modular system. All growers contacted that use the system are very satisfied with the level of production realized when using this system. Other 'non-cash' but important reasons to pursue the modular production system include the additional control over catfish at all stages; the reduced risk of over- or under-stocked ponds; becoming aware of dead fish sooner in the production cycle; and a more efficient use of foodfish pond space and size control. The advent of genetically improved catfish strains that show improved growth over traditional catfish may still result in further modification of this system. Changes in the size of fish required by processors may also change stocking practices.

Given the current size of catfish fingerlings that are widely available and needs of processors this system has proven to work well by those using it. Growth of 5" fingerlings to stockers in their second year takes advantage of the natural competitive nature of fish at this size. Fish feed very aggressively when stocked appropriately for the second year of growth. Due to transport requirements of the stocker size fish as they are distributed to food fish ponds they should be produced in as close a proximity to the food fish ponds as practicable.

Conclusion

In changing economic times and times of changes in fish size required by processors alternative production systems need to be considered. Farm simulations can assist farmers in determining if another production system, such as the modular system, may be right for them. In the delta region of MS farmers have a few producers who are already using this production system successfully. Extension presentations comparing these two systems can provide some evidence but farmers should be encouraged to also check with current users.

References

Engle, C.R. 2001. The economics of producing and understocking different sizes of catfish fingerlings on growout farms. University of Arkansas at Pine Bluff, Pine Bluff, Arkansas, Bulletin ETB255 AFC-01-1, 18pp.

Table 1. Acre requirements for each phase of production by production system.

Phase of Production	Production System: Multiple-batch	Production System: Modular
Grow-out	1,050	900
Fingerling to stocker	--	200
Fry to fingerlings	150	100
Broodstock	50	50
TOTAL	1,250	1,250

Table 2. Change and cost of fingerling stockings and change in grow-out catfish production by production system.

Multiple-batch Fingerling Phase	Modular Fingerling Phase	Change in Fingerling Phase
1,050 acres x 7,500 5" fingerlings/acre	200 acres x 50,000 5" fingerlings/acre	+2.13 million 5" fingerlings
= $393,750	= $500,000	+ $106,250
$375/acre	$455/acre	+$ 80/acre
Multiple-batch Grow-out Phase (1,050 acres)	**Modular Grow-out Phase (900 acres)**	**Change in Grow-out Phase**
8.21 million pounds	8.85 million pounds	+0.64 million pounds
4,961 lb/ac/yr	6,500 lb/ac/yr	+ 1,539 lb/ac/yr

Table 3. Enterprise budgets for the two production systems.

Item	Multiple-batch (1,050 acres)	Modular (1,100 acres)
1. Gross receipts[a]	$3,473	$3,723
2. Variable Costs		
Fingerlings	375	455
Feed	2,166	2,075
Labor and management	362	411
Chemicals	659	739
Total Variable Costs	2,814	2,984
3. Net Returns Above Variable Costs	659	739
4. Fixed Costs	501	489
5. Net Returns Above ALL Costs	$158	$250

[a] Receipts were calculated using $0.70/lb, which is much higher than is presently being received by farmers.

Table 4. Breakeven price for the two production systems.

	Multiple-batch (1,050 acres)	Modular (1,100 acres)
Price Required to Cover:		
- All Variable Costs	$0.57	$0.56
- Variable and Fixed Costs	$0.67	$0.65

Recent Developments in Baitfish Production Techniques

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Introduction

Farm-gate sales of baitfish were $37.5 million in 1998 (NASS 2000). The retail value of all baitfish sold in North America (U.S. and Canada, wild-caught and farm-raised) is many times greater, approximately $1 billion (Litvak and Mandrak 1993). Baitfish farming provides an alternative to the capture of minnows from the wild. Use of wild-caught minnows for bait has raised ecological concerns over the potential for accidentally spreading exotic species as well as the inter-basin transfer of fish species (Goodchild 1999, Litvak and Mandrak 1999). The primary species raised for bait are the golden shiner (*Notemigonus crysoleucas*), fathead minnow (*Pimephales promelas*), and goldfish (*Carassius auratus*). Goldfish are also sold as 'feeders', live food for the pet trade and zoos. Baitfish production differs from foodfish aquaculture in several ways, including the vast numbers of fry required. It has been estimated that Arkansas alone sells some six billion baitfish annually (Stone et al. 1997a). Marketing and distribution networks are critical to the success of a baitfish farm, and in most years many more pounds of fish are raised than can be sold.

Recent Developments

To remain competitive, the baitfish industry in Arkansas has been undergoing numerous changes in culture techniques (Stone et al. 1997b). Recent developments include the adoption of tank spawning for goldfish and tank hatching systems for goldfish and golden shiners (Morrison and Burtle 1989, Rowan and Stone 1996, Stone et al. 1998b). Pond preparation methods also have been refined (Ludwig et al. 1998, Stone et al. 1998a) although additional work is needed on appropriate larval feeds and pH control. Baitfish producers have made many other innovative improvements to their operations, including the use of liquid oxygen in holding vats. Research has also improved our knowledge of the nutritional requirements for baitfish species (Lochmann and Phillips 2001, 2002). Broodstock nutrition is another important area for research, especially given the prolonged spawning season and impressive fecundity of bait species. Clemment (2002) determined that a kg of golden shiners produced in excess of one million eggs over a 111-day spawning period. Egg production peaked at 22°C and was significantly correlated with water temperature ($P < 0.05$).

Another striking difference between baitfish culture and food fish production is in the need to control fish growth to meet market size requirements. Control of fish growth is accomplished through adjusting stocking and feeding rates. Work on stocking and feeding rates for feeder goldfish production (Stone et al. in press) determined that fish growth could be slowed but condition maintained by stocking at 2 ½ -5 million/ha (1-2 million/acre) and feeding at a rate of 1% body weight/day.

Recent Issues

New issues of importance to baitfish farmers have emerged within the past several years. Pending EPA regulation of aquaculture discharges prompted the Arkansas Bait and Ornamental Fish Growers Association (ABOFGA) to examine their farming operations and to adopt a set of Best Management Practices for members to follow (ABOFGA n.d. a). The discovery of spring viremia of carp virus in North Carolina (Goodwin 2002a) and Wisconsin has made farmers aware of the importance of biosecurity on their farms (Goodwin 2002b). Following the lead of Gunderson and Kinnunen (2001), baitfish farmers proactively developed a Hazard Analysis Critical Control Point (HACCP) approach to farm biosecurity, focusing on exotic diseases and aquatic nuisance species (ABOFGA n.d. b).

Conclusion

Changing economic conditions and markets have encouraged baitfish producers to seek and implement new production technologies. Emerging issues have also led members of the baitfish farmers association to voluntarily adopt measures to ensure the quality of their product and to minimize the environmental impact of their farms.

References

ABOFGA (Arkansas Bait and Ornamental Fish Growers Association). (no date)a. Best management practices (BMP's) for bait and ornamental fish farms. ABOFGA, Lonoke, Arkansas.

ABOFGA (Arkansas Bait and Ornamental Fish Growers Association). (no date)b. Using the HACCP approach for the biosecurity of your farm. ABOFGA, Lonoke, Arkansas.

Clemment, T. 2002. Egg production of golden shiners (*Notemigonus crysoleucas*) and effects of weather, lunar phase, and water temperature on spawning. M.S. thesis, Univ. of Arkansas at Pine Bluff.

Goodchild, C. D. 1999. Ecological impacts of introductions associated with the use of live baitfish. In: R.

Claudi and J. H. Leach, editors. Nonindigenous Freshwater Organisms, Vectors, Biology, and Impacts, Lewis Publishers, Boca Raton, Florida, pp. 181-200.
Goodwin, A. 2002a. First report of Spring Viremia of Carp Virus (SVCV) in North America. J. Aqua. An. Health. 14:161-164.
Goodwin, A. 2002b. Biosecurity of Fish Farms. Arkansas Aquafarming 19(2):1-3.
Gunderson, J. L., and R. E. Kinnunen (eds). 2001. Aquatic nuisance species – hazard analysis and critical control point training curriculum. Minnesota Sea Grant Publication MN SG-F11, Michigan Sea Grant Publication MSG-00-400.
Litvak, M. K., and N. E. Mandrak. 1993. Ecology of freshwater baitfish use in Canada and the United States. Fisheries 18(12):6-13.
Litvak, M. K., and N. E. Mandrak. 1999. Baitfish trade as a vector of aquatic introductions. In: R. Claudi and J. H. Leach (eds), Nonindigenous Freshwater Organisms, Vectors, Biology, and Impacts, Lewis Publishers, Boca Raton, Florida, pp. 163-180.
Lochmann, R., and H. Phillips. 2001. Nutritional aspects of health and related components of baitfish performance. In: C. Lim and C. Webster, (eds), Nutrition and Fish Health, Food Products Press Press, Binghamton, New York, pp. 119-127.
Lochmann, R., and H. Phillips. 2002. Nutrition and feeding of baitfish. ETB256, Cooperative Extension Program, Univ. of Arkansas at Pine Bluff.
Ludwig, G.W., N. M. Stone and C. Collins. 1998. Fertilization of fish fry ponds. Southern Regional Aquaculture Center Publication No. 469, Stoneville, Mississippi.
Morrison, J. R., and G. J. Burtle. 1989. Hatching of golden shiner eggs in hatchery tanks and subsequent fry survival in rearing ponds. Prog. Fish-Cult. 51:229-231.
NASS (National Agricultural Statistics Service). 2000. Census of aquaculture (1998). Volume 3, Special Studies, Part 3. AC97-SP-3.National Agricultural Statistics Service, United States Department of Agriculture, Washington, D.C.
Rowan, M., and N. Stone. 1996. Off-season spawning of golden shiners. Prog. Fish-Cult. 58:62-64.

Stone, N., S. Lochmann and E. Park, 1998a. Preparing and stocking golden shiner fry ponds. Fact Sheet FSA9080, Cooperative Extension Program, Univ. of Arkansas at Pine Bluff.
Stone, N., E. McNulty and E. Park. 1998b. Tank spawning and hatching of golden shiners. Fact Sheet FSA9081, Cooperative Extension Program, Univ. of Arkansas at Pine Bluff.
Stone, N., E. McNulty and E. Park. in press. The effect of stocking and feeding rates on growth and production of feeder goldfish in pools. N. Am. J. Aqua.
Stone, N., E. Park, L. Dorman and H. Thomforde. 1997a. Baitfish culture in Arkansas. World Aqua. 28(4):5-13.
Stone, N., E. Park, L. Dorman and H. Thomforde. 1997b. Baitfish culture in Arkansas: golden shiners, goldfish and fathead minnows. MP 386, Cooperative Extension Program, Univ. of Arkansas at Pine Bluff.

Working with New Partners:
Extension Experiences with USDA's Risk Management Agency

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Introduction

The idea of crop insurance is as old as the country, but it only became a reality in the last century. First authorized by Congress in the 1930s, federal crop insurance helped agriculture recover from the Great Depression and Dust Bowl. The Federal Crop Insurance Corporation (FCIC) was created in 1938 to carry out the program. Initially, the program started as an experiment with activities limited to major crops in the main producing areas. The Federal Crop Insurance Act of 1980 expanded the program to more crops and regions of the country. Further, the Act authorized a subsidy of the crop insurance premium. In 1996, the Risk Management Agency (RMA) was created in the U.S. Department of Agriculture (USDA) to administer the FCIC program, as well as risk management and education programs, to help support agriculture. RMA regional offices work with local producers, growers groups, universities, and other government agencies in these efforts. Today, more than 76 crops are insurable against unavoidable losses.

In 1996, the RMA was also authorized to investigate offering aquaculture insurance. The Regional Service Offices (RSOs) conducted listening sessions and identified several industries interested in working with the agency on pilot products. Hard clams were identified as a primary candidate because of the strong interest shown by the producers, the availability of producer records, and the crop's resistance to diseases and other perils. Further, the RMA was in need of regional experts willing to work with them in devising and establishing the pilot program. The clam industry provided this support through extension specialists and agents. The first pilot aquatic crop insurance product, the Cultivated Clam Crop Insurance Program, was initiated during the crop year 2000. Clam farmers were the first aquaculturists in the U.S. to become eligible for affordable insurance protection - the same type of financial protection made available to land farmers over the past century.

Approach

The cultured clam crop insurance program brought together the expertise of extension faculty from the four states, Massachusetts, Virginia, South Carolina, and Florida, where the pilot program was being considered. The USDA Cooperative State Research, Education, and Extension Service (CSREES) created a network in the participating states by hosting an electronic mail group. This facilitated an exchange of information and ideas among agents, along with RMA insurance specialists at regional and headquarter levels. The involvement of extension in the program, agents' concerns, and program outcomes were recounted at a national aquaculture conference in 2000 (Rheault 2000). The development and implementation of aquatic crop insurance programs, such as the cultivated clam program, can offer people with extension appointments varied educational opportunities and outreach activities, as well as interactions with new clientele and stakeholders.

The following relates experiences of the University of Florida (UF) Shellfish Aquaculture Extension Program in assisting the RMA during the early phases of the pilot clam program development in Florida. During 1998-99, focus workshops were organized in which growers interacted with RMA insurance staff from the Valdosta RSO. Information shared during these meetings included 1) understanding of crop insurance, 2) determining risks involved with clam production, 3) obtaining data on crop value and production techniques, and 4) determining what type of insurance growers want. Follow-up workshops were conducted so RMA staff could review crop provisions of the draft insurance policy with growers. Assistance was provided to the RMA in obtaining growers' production records from which the actuarial documents were based and the premium schedule determined. The resulting program provisions and actuarial documents were also reviewed during sessions with representatives of reinsured companies. Additional assistance was necessary to establish appraisal methods for assessing crop losses, which were then incorporated in the loss adjustment manual. Tours provided in conjunction with workshops allowed new user groups to gain an understanding of clam farming. Once the pilot program policy was approved by the FCIC in 1999, workshops were held for RMA staff to provide eligible clam growers in four counties in Florida with information on policy provisions, reporting requirements, types of coverage, examples of indemnity payments and premium costs, and insurable causes of crop loss.

During the evaluation of the pilot program in 2000-03, emphasis shifted from educating growers, to informing insurance agents and loss adjusters about the complex biological issues involved in implementing the program. A clam crop insurance school was held in conjunction with the National Crop Insurance Association, a trade organization that provides training to private crop insurance companies. Representatives were introduced to clam aquaculture technology and production risks. A roundtable forum with shellfish experts in the fields of biology, physiology, and pathology, provided the audience with information on tolerances and susceptibility of clams to the losses covered in the policy. Updates on the policy and proposed improvements were the focus of subsequent workshops, which also allowed growers to comment to RMA staff on the performance of the program. Other extension activities included: 1) maintaining a list of insurance agents who sold the policy and distributed to eligible growers, 2) keeping clam growers informed of important final dates regarding when to purchase the policy or file an inventory report, 3) instructing new clam growers in eligible counties on the provisions and benefits of the program, and 4) consulting with growers, insurance providers, loss adjusters, and compliance officers on crop losses.

Outcome

A summary of the number of clam growers participating nationwide in the pilot crop insurance program during 2000-02, based on policies sold, is presented in Table 1. Information on crop liabilities, premiums, and indemnity (loss) payments over this period is also summarized. In Florida, program participation increased from about 75% in the first crop year to over 90% in the third year. Negative effects on clam production related to elevated salinities due to droughts, as well as hurricane and tropical storm damages, affirmed that the pilot insurance program could provide important financial protection to the clam aquaculture industry. During the 3-year evaluation of the pilot program, improvements to the policy were hindered by Congress's passage of the Agricultural Risk Protection Act in 2000. Initial interpretation of the ARPA legislation prohibited the research and development of any new policies, including maintenance of pilot programs, by the RMA. Instead, funding was provided for the RMA to enter into partnerships for research and development. At the request of the Valdosta RSO, risk management and extension faculty at the UF and Clemson University formed a regional team to make recommendations, develop a course of action, and conduct subsequent tasks as determined by the RMA to the pilot clam crop insurance program. Funding for the partnership was not approved in 2001, although new guidelines released by the FCIC in 2002 allowed the RMA to begin implementing revisions to ongoing pilot programs.

Other funding opportunities and partnership agreements have become available to aquaculture extension agents in their new role with the RMA. During 2000-01, a series of educational seminars targeting management of risks by clam producers was conducted in Florida with financial support from the Valdosta RSO. Specialists were invited to address a number of topics including genetics in seed production, species diversification, product quality, and marketing. Additional project funding in that time period came from the RMA headquarters office through the USDA-CSREES. This funding allowed for the development of a simplified spreadsheet software program, which is specific to the management practices employed by the Florida's clam aquaculture industry.

C.L.A.M., Computer Logbook and Management, was published as a business tool for clam growers to facilitate record keeping required of producers who participate in the pilot crop insurance program. Since 2002, several federal announcements by the FCIC have provided for educational and research partnerships with the RMA. For example, funding recently procured under the Targeted Commodity Partnerships for Risk Management Education allows for development of a curriculum addressing organizational structures and strategies for the clam aquaculture industry in Florida. More recently, the USDA-CREES, as required through ARPA, has established regional educational centers and competitive grants programs for the purpose of educating producers on risk management activities.

Conclusion

Extension provided the necessary educational support and technical expertise to the USDA-RMA in the development and implementation of a pilot crop insurance program for the clam aquaculture industry. This breakthrough program can have a significant economic impact on the $38 million a year industry by minimizing environmental and catastrophic risks that are beyond the control of the clam farmer. Further, this new partnership will help to ensure the program will be continued beyond the pilot phase and expanded to other geographical areas.

References

Rheault, A.K. 2000. Federal clam crop insurance update. Fish Farming News 18(2):18-19.

Table 1. Summary of participation in the pilot cultivated clam crop insurance program for four eligible states during the evaluation period of 2000-2002.

Crop Year	Policies Sold	Crop Liabilities ($)	Total Premiums ($)	Indemnity Payments ($)	Loss Ratio*
2000	347	36,120,804	1,125,780	2,045903	1.82
2001	429	41,215,268	1,401,005	2,218,156	1.58
2002	553	59,522,977	2,158,051	3,133,982	1.45

*Ratio of indemnity payments to total premium costs

Current Status and Future Directions of the Aquaculture Network Information Center

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Situation

Aquaculture is one of the fastest growing forms of animal agriculture. Production increased from 308 million pounds in 1992 to 768 million pounds in 1997, while farm-gate value increased from $261 million to $978 million during the same period (National Marine Fisheries Service, 1999 and National Agriculture Statistics Service, 1998). However, little coordination of the delivery of Internet-based aquaculture information by the Cooperative Extension Service or Sea Grant existed prior to 1994. Practicing or prospective aquaculturists relied on direct contact with either state Extension or Sea Grant educators as their primary source of university aquaculture research and Extension information. As national interest in aquaculture information grew, aquaculture educators were faced with the challenge of increasing educational programs for a growing audience without a concomitant increase in program funding.

In addition, there was no single source for locating aquaculture information by the world aquaculture community. As Internet access and use extended beyond educational institutions and governmental agencies, a clear need was identified to use the Internet to reach a broader audience. It was clear that, in the age of an Internet "information overload," a centralized gateway to the world's electronic resources for aquaculture would be beneficial to the Extension community.

Response

The Aquaculture Network Information Center (AquaNIC) was established in 1994 through grants from the USDA CSREES and the Sea Grant College Program. Annual funding for AquaNIC is provided by the Department of Commerce Aquaculture Information Center and the North Central Regional Aquaculture Center. Additional matching support is provided by the Mississippi-Alabama Sea Grant Consortium, Auburn University's Department of Fisheries and Allied Aquacultures and the Illinois-Indiana Sea Grant College Program. Land Grant institutions, Sea Grant Colleges, the USDA Regional Aquaculture Centers Program, and others with an expertise in aquaculture provide significant oversight and contribute to the resource base. AquaNIC houses or provides links to thousands of state, national, and international aquaculture publications, newsletters, visual media, calendars, job services, directories and specialty sections for species and production systems.

Mission

AquaNIC will be the gateway to the world's electronic resources
for aquaculture information and education.

Objectives

1. Provide access to all electronic aquaculture information at the national and international level.
2. Increase the quantity and quality of electronic information available to the aquaculture industry.
3. Provide self-paced aquaculture instruction to the aquaculture industry.
4. Obtain user input in directing AquaNIC services.

DOC/NOAA

AquaNIC is a member of the Department of Commerce/National Oceanic and Atmospheric Administration

Sea Grant Network of Aquaculture Information Services (NAIS). NAIS collaborators included Delaware Sea Grant, Maryland Sea Grant, Illinois-Indiana Sea Grant College Program, the Mississippi-Alabama Sea Grant Consortium, the National Sea Grant Library, and the DOC/NOAA Aquaculture Information Center.

AgNIC

The Agriculture Network Information Center (AgNIC) is a voluntary alliance of the National Agricultural Library (NAL), land-grant universities and other agricultural organizations, in cooperation with citizen groups and government agencies. AgNIC <http://agnic.org> is a discipline-specific distributed network where lead and collaborating institutions rely on networked search capabilities. AquaNIC is an AgNIC member along with 13 Land Grant/Sea Grant Institutions and the NAL's Alternative Farming Systems Information Center (AFSIC). The guiding concept for multiple collaborating institutions is the ability to utilize the regional expertise developed as a result of the diversity of species produced and the production systems used. Member institutions participating in the AgNIC Alliance for aquaculture are collectively referred to as AquaNIC. These members include:

1. Mississippi-Alabama Sea Grant Consortium
2. Auburn University Department of Fisheries and Allied Aquacultures
3. Illinois-Indiana Sea Grant College Program
4. Kentucky State University
5. Maine Sea Grant/Cooperative Extension
6. University of Arizona
7. University of Arkansas at Pine Bluff
8. University of California Davis
9. University of Florida Tropical Aquaculture Center
10. University of Idaho Cooperative Extension Service
11. Texas A&M University
12. Thad Cochran National Warmwater Aquaculture Center
13. Virginia State University

At the Federal level, the Alternative Farming Systems Information Center (AFSIC) serves as a NAL collaborator and continues their involvement in the distribution of electronic aquaculture information.

Each AquaNIC participant serves as the lead institution for a narrowly focused subject matter category within AquaNIC. The lead institution is charged with locating, entering, and maintaining a sub-Web for each subject category. A single database provides users with the capability of using one search to locate documents/services regardless of location.

Results

Connection with Users

AquaNIC was the first U.S. aquaculture Web site and is globally one of the most widely accessed and cited aquaculture Web sites. AquaNIC staff monitors monthly user statistics. Data reported are a one-year average for 2002.

1. In 2002 1.2 million visitors from more than 140 countries used AquaNIC 11.5 million times. In addition, more than 1,000 individual, educational, commercial, and governmental, Web sites link to AquaNIC.
2. AquaNIC had approximately 5,000 pages viewed per day by 2,800 daily visitors, with 1500 unique visitors per day. Visitors using AquaNIC more than twice per month comprised 17% of the total unique visitors. Average session length was approximately 10 minutes. Visitor sessions from the U.S. comprised 63% of the total with 14% international visitors. The remaining 23% were of unknown origin.
3. AquaNIC maintains more than 10,000 files and links contained within 11 public root directories: beginner's section, discussion groups, publications, Internet sites, jobs, resumes, newsletters, contacts directory, multimedia, news flashes, and educator information. Of these, the five most commonly accessed directories were discussion groups (41%), publications (15%), multimedia (11%), jobs (10%), and beginners sections (9%).
4. When AquaNIC was established in 1994, more than 75% of visitors accessed AquaNIC through an educational (.edu) domain, with less than 10% using a commercial (.com) domain. In 2002, the top five domain types used were commercial (.com, 33%), network (.net, 48%), education (.edu, 14%), organizations (.org, 2.7%), and government (.gov, 1.4%). If you assume that commercial and network domains are composed of private individuals/companies, then more approximately 80% of AquaNIC users are from the private sector.

Partnerships

The NAIS partnership has provided AquaNIC the opportunity to serve as the primary conduit for aquaculture information for the NOAA Aquaculture Information Center within the NOAA Library. In addition, the World Aquaculture's Society's Job Services is coordinated by the Delaware Sea Grant's Aquaculture Resource Center and maintained on AquaNIC.

Future Directions

Based on the user information collected, there is data supporting the use of the Web by educators to provide educational and industry support information to a global audience for a specific agriculture subject area such as aquaculture. We suggest that if the past was a time of providing electronic versions of hard-copy information on the Internet, then the future will be a time for the development of on-line educational programs responsive to the needs of the U.S. and global aquaculture community.

While Web sites providing solely electronic copies of Extension publications have been and still are useful, future Web sites should take a more holistic approach in support of the aquaculture industry. For example, the Internet is already being used to provide in-service training within Extension.

The future success of AquaNIC depends on continuing improvements in delivery of existing information services provided and an increased emphasis on on-line instruction for adult learners. To achieve the goal of increased educational programming on the Internet, there must be increased collaboration across state, regional, and national boundaries using the collective, worldwide expertise of aquaculture specialists.

Non-formal courses, specialized training, and workshops targeting existing and prospective aquaculturists and other educators are the new initiatives AquaNIC proposes to address the needs of aquaculture stakeholders. These Internet teaching resources must be designed, developed, and implemented to allow maximum interaction between the "teacher" and the "student." Teaching resources will include combinations of media such as narrated slide sets, streaming audio and video, chat rooms, discussion groups, one- and two-way video, virtual reality, electronic mail, and other means of interaction to address industry needs.

Through collaboration between educators and the use of interactive media outreach, educators specializing in aquaculture will be able to convert the Web from a source of information to a source of instruction.

References

National Agriculture Statistics Service. 1998. 1997 Census of Agriculture. U.S. Department of Agriculture, National Agricultural Statistics Service 3 (3).

National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce. 1998. Fisheries of the United States, 1998 [On-line]. Available: http://www.st.nmfs.gov/st1/fus/fus98/index.html [November 17, 1999].

Pfiesteria, Agriculture and Water Quality in the Chesapeake

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Introduction

The Chesapeake Bay and associated tributaries are highly enriched as a consequence of a variety of anthropogenic sources including increasing population in urban centers and agricultural activity. The ecological impacts of nutrient enrichment are a result of increased phytoplankton production and include anoxia, hypoxia and decline of submersed aquatic vegetation (D'Elia et al. 1992). In response, The Chesapeake Bay Program, a combined State and Federal program, has addressed the nutrient problem through nutrient reduction at the point and non-point source levels for several decades. Public education has been a key component in the Chesapeake restoration effort including the activities of the Chesapeake Bay Program, and various advocacy (e.g. Chesapeake Bay Foundation) and non-advocacy (e.g. Sea Grant) organizations. As a result, public awareness of the role of nutrients and their sources in the decline of the Chesapeake is high. Increased awareness of the sources of nutrients combined with increasing urbanization has resulted in the negative perception of agriculture as a source of nutrients. To combat agriculturally derived nutrients, Maryland initiated a voluntary Nutrient Management Program in 1989 using Extension consultants funded through the Maryland Department of Agriculture and Maryland Department of the Environment (Perkinson, 1994). Although increasingly adopted by the agricultural community, frustration due to delays in reaching the 40% nutrient reduction goals established by the Chesapeake Bay Program resulted in growing perceptions of the environmental community that the voluntary nutrient management programs were not effective.

Public concern about water quality in the Chesapeake increased dramatically during the"*Pfiesteria* hysteria" of 1997. Concerns about human health and the possible association of *Pfiesteria* with agricultural nutrients resulted in polarization of the agricultural and environmental communities. The Nationally publicized co-occurrence of the dinoflagellate *Pfiesteria piscicida* with lesions and fish mortalities in the Chesapeake in 1997 was preceded by:

1) Peer reviewed publications describing an unusually complex life history including over 20 stages, toxic effects on fish, human health impacts, and connections with agriculturally derived nutrients.
2) A popular account of the discovery and impacts of *Pfiesteria* "And the Waters turned to Blood" by Rodney Barker that increased public concern.
3) A large fish kill in an estuarine aquaculture facility using water from a tributary of the Chesapeake with a low cell density of *Pfiesteria* and suspiciously high cell density of *Gyrodinium galatheanum* (=*Karladinium micrum*) (Terlizzi et al. 2000)

Previous exposure to *Pfiesteria* media coverage potentiated the public and intense coverage during the summer of 1997 heightened public concern and altered consumer behavior in Maryland toward seafood and recreational use of the Bay (Strand, 1999). This consumer reaction resulted in a $43 million loss in Seafood sales (Lipton, 1999) The description of health impacts among Maryland Commercial fishermen and others with high exposure levels (Grattan et al. 1998) led to the conclusion that the *Pfiesteria* "outbreak was a clear linkage between Chesapeake Bay water quality and human health. The fish lesion and mortality events associated with *Pfiesteria* or "*Pfiesteria*-like" dinoflagellates ocurred in Bay tributaries of the lower eastern shore of Maryland which had developed high soil phosphorous levels as a consequence of N- based fertilizer recommendations and the use of poultry litter from the large poultry industry centered there (Coale, 1999). This resulted in the conclusion that agriculturally derived nutrients were responsible for *Pfiesteria*, fish lesions and fish mortality. Legislation "the Water Quality Improvement Act" of 1998 was enacted that required mandatory nutrient management planning in place of voluntary programs.

Approach

During the media frenzy that occurred during the fish lesion and mortality events of 1997 and prior to the passage of the Water Quality Improvement Act (WQIA) of 1998 over 50 presentations were made to committees of the Chesapeake Bay program, Resource agency personnel, Agricultural groups, Environmental groups and concerned citizens. The goal was to provide current technical information on the nature of harmful algal blooms including *Pfiesteria* to educate clientele on the role of nutrients and environmental factors in algal blooms and to reduce public fear. This approach was based conceptually on the relationship between hazard and public outrage that results in public perception of risk (Sandman, 1987). In the case of *Pfiesteria* in the Chesapeake, the hazard may be relatively small so outrage determines the perception of risk. During the *Pfiesteria* "hysteria" of 1997 educational approaches from some environmental interests were designed to increase outrage and perception of risk. For example one Bay advocacy group released a flyer displaying fish with lesions and raised the question—is this the future of the Bay? The non-advocacy approach was based on outrage reduction through presentation of the science and weaknesses in some of the information being used. The following points were incorporated into presentations:

1) Dinoflagellates are normal components of the Bay phytoplankton community and although a number of species were present in the Bay that are known to be toxic elsewhere (Marshall, 1996) this was the first apparent toxic event in the Bay which accounted for some of the concern.
2) Nutrients are one factor thought to be involved in the increased appearance of harmful algal blooms (Hallegraeff, 1993). However, the linkages of Harmful algal blooms to nutrients are not always clear (Anderson et al. 2002).
3) Dinoflagellates other than *Pfiesteria* may be involved in the fish health issues observed. For example an aquaculture fish kill was dominated by *G. galatheanum* (*K. micrum*) (Terlizzi et al. 2000) although it was reported that this kill was a consequence of *Pfiesteria* (Burkholder and Glasgow, 1997).
4) The association of dinoflagellates other than *Pfiesteria* but of similar size resulted in the use of the term *Pfiesteria*-like which is misleading because the published descriptions of the life history and ecology of *Pfiesteria* claim that it is unique.

Outcomes

The WQIA was adopted in 1998. The Agricultural community was resistant feeling that additional work to clarify the link between nutrients and *Pfiesteria* was necessary. The concerns about human health led Environmentalists to argue in favor of the WQIA This event contributed to the polarity of environmentalists and the agriculture community who felt that their role in improvement of the environment was overlooked (Paolisso and Maloney, 2000). One serious long-term consequence of the passage of the WQIA in response the health concerns of *Pfiesteria* is the alienation of the agricultural community. Since the passage of the WQIA the following has occurred:

1) The complex, unique life history of *Pfiesteria*, its ability to cause lesions and the presence of a toxin has been challenged by various investigators (Blazer, et al., 1999, Litaker, 2002, Berry et al. 2002)
2) *Gyrodinium galatheanum* (=*K.micrum*) a dinoflagellate associated with the 1996 aquaculture fish kills and some of the events in the Chesapeake Bay has been shown to be toxic. (Deeds et al. 2002).

3) Although *Pfiesteria* is widely distributed in the Bay and may correlated with nutrients there have been no fish health or human health consequences on the scale of those reported in 1997.
4) There are increasing reports that *G. galatheanum* (*K. micrum*) is a possible cause of fish mortality in the Chesapeake. (Goshorn et al., 2002)

The comprehensive, stringent control of nitrogen and phosphorous through the WQIA would be justified by the concerns about anoxia, hypoxia and decline of submersed aquatic vegetation. However, the impetus for this legislation, *Pfiesteria piscicida,* may not be as serious a concern as was thought during the panic of 1997. Therefore the WQIA may be as some have described "the right law for the wrong reasons".

References

Anderson, D.M. Glibert, P.M, and Burkholder, J.M. 2002. Harmful algal blooms and eutrophication: Nutrient Sources, Composition, and Consequences. Estuaries. Vol. 25:4b, 704-726.

Berry, JP; Reece, KS; Rein, KS; Baden, DG; Haas, LW; Ribeiro, WL; Shields, JD; Snyder, RV; Vogelbein, WK; Gawley, RE. 2002. Are *Pfiesteria* species toxicogenic? Evidence against production of ichthyotoxins by *Pfiesteria shumwayae*. Proceedings of the National Academy of Sciences, USA. 99:17, 10970-10975.

Blazer, V.S., Vogelbein, W.K., Densmore, C.L. May, E.B., Lilley, J.H. and Zwerner, D.E. 1999. *Apanomyces* as a cause of ulcerative skin lesions of Menhaden from Chesapeake Bay tributaries. Journal of Aquatic Animal Health. 11:340-349.

Burkholder, J.M. and Glasgow, H.G. 1997. The ichthyotoxic dinoflagellate *Pfiesteria piscicida:* behavior, impacts and environmental controls. Limnology and Oceanography 42: 1052-1075.

Coale, F.J. 1999. Phosphorous from Agriculture Entering the Chesapeake Bay. In: Economics of policy options for nutrient management and *Pfiesteria.* Pp.3-12. Proceedings of the Conference. 11/16/98. Gardner, B.L. and Koch L. Eds.

Deeds , J.R., Terlizzi, D.E., Adolf, J.E. Stoecker, D.K. and Place A.R. 2002. Toxic activity from cultures of *Karladinium micrum* (=*Gyrodinium galatheanum*) (Dinophyceae)—A dinoflagellate associated with fish mortalities in an estuarine aquaculture facility. Harmful Algae. 1:2 169-189.

D'Elia, CF, Harding, LW, Leffler, M and Mackiernan, GB. 1992. The role and control of nutrients in Chesapeake Bay. Water Sci. Tech. 26:12, 2635-2644.

Goshorn, D., Deeds, J. Tango, P. Place, A. Butler,W., Magnien,R. 2002. Occurence of *Karladinium micrum* and its association with fish kills in Maryland estuaries. Abstract. Xth International Conference on Harmful Algae Oct. 21-25. St Pete Beach, Fla.

Hallegraeff, G.M.1993. A review of harmful algal blooms and their apparent global increase. Phycologia. 32: 79-99.

Grattan, L.M., Oldach, D., Perl, T.M., Lowitt, M.H., Matuszak, D.L., Dickson, C., Parrott, C., Shoemaker, R.C. Kauffman, L.C., Wasserman, M.P., Hebel, R.J., Characher P. and Morris, J.G. Jr. 1998. Learning and memory difficulties after environmental exposure to waterways containing toxin-producing *Pfiesteria* or *Pfiesteria*-like Dinoflagellates. The Lancet 352:532-539.

Litaker,R.W., Vandersea, M.W., Kibler, S.R., Madden V.J. ,Noga, E.J. and Tester, P.A. 2002. life cycle of the heterotrophic dinoflagellate *Pfiesteria piscicida* (Dinophyceae). Journal of Phycology. 38:442-463.

Marshall, H.G. 1996. Toxin producing phytoplankton in Chesapeake Bay. Virginia Journal of Science. 47:1,29-37.

Paolisso and Maloney 2000. Recognizing farmer environmentalism: nutrient runoff and toxic dinoflagellate blooms in the Chesapeake Bay region. Human Organization, 59:2,209-221.

Perkinson, R. 1994. Evolution of nutrient management in the Chesapeake Bay region. Journal of Soil and Water Conservation. Nutrient Management Special Supplement. 49:2,87-88.

Sandman, P.M. 1987. Risk communication: facing public outrage. EPA Journal. 13:21-22

Strand I, 1999. *Pfiesteria* concerns and human behavior. In: Economics of policy options for nutrient management and *Pfiesteria.* Pp.19-34. Proceedings of the Conference. 11/16/98. Gardner, B.L. and Koch L. Eds.

Terlizzi, D.E., Stoecker, D.K. and Glibert, P.M. 2000. *Gyrodinium galatheanum*: A threat to estuarine aquaculture waters. In Flos, R. Creswell,L., (Eds), Abstracts of Contributions Presented at the International Conference AQUA 2000, Responsible Aquaculture in the New Millenium , Nice, France, 2-6 May, 2000. European Aquaculture Society Special Publication 28, Ostende, Belgium, p.700.

On Farm Demonstration of Freshwater Shrimp Culture in Southern Ohio

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Introduction

Extension specialists in many states are increasingly being asked about the feasibility of culturing freshwater shrimp (Macrobrachium rosenbergii). Research on temperate culture of freshwater shrimp in the U.S. was initiated at Kentucky State University in 1990 and the results have led to the establishment of several freshwater shrimp operations in Kentucky, Tennessee, Illinois and Indiana. In 2001, a few producers raised the first crops of freshwater shrimp in Ohio. This, in turn, led to an increase in requests for information on this particular aquaculture species.

Freshwater shrimp are believed to have great potential for diversification of Ohio farms. They have a short growing season (June 1st-September 15th) that fits in well with other farm activities, require little labor (20 minutes/day feeding and one long harvest day), and can occupy underutilized existing water resources. Cost and return estimates developed by the University of Kentucky's Department of Agricultural Economics (Woods, Murdock and Riggins 1998), show per acre returns to land, capital and management to range from $0 to $9000 with an average of around $3,000 per acre. Further evaluation of on-farm production of this species is necessary in order to evaluate its potential as a cash crop for Ohio. The objectives of this study and demonstration are:

1. To determine the applicability of freshwater shrimp production research from Kentucky and other states to southern Ohio.
2. To evaluate the potential of freshwater shrimp as a cash crop for southern Ohio farmers by determining production potential and exploring market opportunities.
3. To develop a framework for future on-farm demonstrations of non-traditional agricultural enterprises in southern Ohio utilizing a total team approach, which incorporates applied research and Extension education.
4. Provide cooperators with the assistance that they need to establish sustainable profitable enterprise.

Approach

An Ohio Shrimp Team was organized in January 2002. The team consisted of Aquaculture Specialists at the Ohio State University (OSU) South Centers, an Extension Specialist for Natural Resources and eight County Agriculture and Natural Resources Extension Agents. The goal was to use a team approach to conduct an on farm demonstration of freshwater shrimp culture in Southern Ohio. Agents from each of eight counties in Southern Ohio were encouraged to identify a potential cooperator from their county based on the criteria necessary for successful shrimp production. Ideally, cooperators would have a ¼ to ½ acre drainable pond with accessible electricity. The OSU South Centers at Piketon Aquaculture Research Center (Pike County) would serve as the ninth demonstration site. Proposals were written and funds were awarded (Ohio Sea Grant, Ohio Agricultural Research and Development Center) to support the project.

An introductory workshop was held in March 2002 for people interested in growing shrimp. Participants listened to lectures on shrimp culture and pond building, watched a shrimp marketing video produced by the Kentucky State University Aquaculture Program (2002) and were able to ask questions of an experienced shrimp farmer from Kentucky. The Aquaculture Specialists provided each member of the group with a notebook containing pertinent fact sheets and information on the culture of freshwater shrimp. Five cooperators agreed to participate in the project. One cooperator had two ponds and three ponds at the OSU Aquaculture Research Center were utilized for a total of nine ponds.

Ponds were assigned one of three treatments in conjunction with the wishes of the cooperator. Three ponds were stocked at a density of 16,000 shrimp/acre, three at 24,000 shrimp/acre and three at 24,000 shrimp/acre with the installation of artificial substrate (fence poles and construction netting) to increase available habitat area in the pond. Juvenile shrimp were purchased from a hatchery in Kentucky ($0.10/each) and ponds were stocked the week of June 13, 2002. No liming or fertilization of ponds was conducted due to the lack of preparation time.

Each cooperator was provided with the use of a surface aerator (Air-O-Lator Corp., Kansas City, MO) for the duration of the demonstration. Aeration was supplied 24 hours a day, seven days a week for the entire production cycle. Feed (Melick Aquafeed, Catawissa, PA) was purchased in bulk ($0.24/lb) and farmers fed twice a day according to the recommendations in the Kentucky State University Aquaculture Program Prawn

Production Manual (2002). Soil samples were collected at stocking, mid- season and at harvest while water samples were collected every two weeks.

Throughout the production cycle, cooperators were encouraged to contact their county agents for advice and guidance. In turn, the county agents contacted the aquaculture specialists for support and information. Each farmer also worked with their agent and the shrimp team to develop a successful marketing plan for their shrimp. Cooperators were able to keep all profits from the sale of shrimp.

Outcome

All ponds were harvested in September 2002. Production data is summarized in Table 1. There was a lot of variability in the production from each pond. Although stocking density seemed to have some impact, it was not possible to isolate it as the variable responsible for the wide range of results. In fact, general observation points to pond fertility as having a bigger impact on production. Older, more established ponds tended to have better production and better water quality than the newly constructed ponds.

The biggest concern of the cooperators throughout the study was the inability to see their crop. This made them all very nervous. In addition, since none of our cooperators had the capability of measuring their own water quality, they were concerned about that as well. Many were also concerned about the economics. After figuring their costs, most would have lost money due to the small scale of their pilot operations.

Marketing strategies varied from producer to producer. One producer placed ads in local newspapers and took pre-orders. Another produced small shrimp and marketed them as bait at a pay lake. A third rented a booth at a farmers market and sold 500 pounds in two hours. Another sold to friends for $8.00 per pound. Some of the shrimp were sold to another farmer holding a shrimp festival. Overall, due to the fact that there was limited competition and this was a new, exotic product, marketing was not a problem for this small group.

Conclusions

The freshwater shrimp production technology from Kentucky transferred well to southern Ohio. We were able to successfully raise freshwater shrimp in Ohio using methods outlined in the Kentucky State University Aquaculture Program Prawn Production Manual (2002). The cooperators in the study had little trouble marketing their product and received a good price. Unfortunately, due to the small size of many of the ponds, without the support from the grant, the pilot would not have been profitable. Ultimately, however, three of five cooperators plan to continue to raise shrimp.

The team approach, using county agents, district specialists and aquaculture specialists worked well in this case. Relationships between farmers and county agents were developed and contact between agents and aquaculture specialists was enhanced. The team was able to provide cooperators with the assistance that they needed to explore the feasibility and profitability of adding a new crop to their existing enterprise. Both of the agents involved on the Shrimp Team in 2002 are planning on participating again in 2003.

The Shrimp Team is planning on expanding this project in 2003. Many farmers in northern Ohio are curious as to whether they are capable of growing shrimp. We are currently seeking funding to explore the impact of latitude on the culture of freshwater shrimp in Ohio. This year, spring workshops will include pond liming and fertilization instructions. In addition, farmers will be encouraged to buy water quality kits so that they may monitor their own ponds. A relationship with a local incubator kitchen is being developed to begin work on exploring value-added products.

Additional results and pictures from this study are posted on the web at http://southcenters.osu.edu/aqua/OSUSII.htm. A FAQ fact sheet is also available at http://southcenters.osu.edu/aqua/pdfs/shrimpfaq.pdf.

Table 1*: Production parameters for a nine-pond on farm demonstration of freshwater shrimp culture in southern Ohio.*

Pond	Pond Size (acre)	Stocking Density (shrimp/acre)	Additional Substrate	Production (lbs/acre)	Average Individual Weight (g)	Survival (%)
1	0.25	16,000	No	292	15	55
2	0.25	16,000	No	1021	36	81
3	0.40	16,000	No	850	44	55
4	0.25	24,000	No	618	18	65
5	0.25	24,000	No	343	17	39
6	0.25	24,000	No	744	26	66
7	0.33	24,000	Yes	22	7	6
8	0.10	24,000	Yes	991	20	95
9	0.25	24,000	Yes	1010	28	67

References

Kentucky State University Aquaculture Program. 2002. Growout of freshwater prawns in Kentucky ponds: Prawn production manual. 44p. Available online: http://www.ksuaquaculture.org/index.htm

Kentucky State University Aquaculture Program. 2002. Freshwater shrimp: A new crop for Kentucky. Video 59:00 minutes. Available online: http://www.ksuaquaculture.org/index.htm

Woods, T., Murdock, J. and S. Riggins. 1998. Freshwater shrimp enterprise cost and return estimates for Kentucky. Ag Economics Extension Publication 98-05. Available online: http://www.uky.edu/Ag/AgEcon/publications/aec_ext98-05.pdf

Starting an International/4-H Aquaculture Club: Investing in our Future

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Successful and sustainable aquaculture depends on efficient collaboration with organization, agencies, industry, and individuals. It is also of paramount importance that we not forget to educate, inspire, and connect the future generation of fish farmers and aquaculturalists namely, our youth, to the myriad of career opportunities around the "world of aquaculture." Most young people in the U.S. never have an opportunity to travel to another country, or even be exposed to, electronically and in person, similarly mind young people from other countries. The Jasper County Extension Agent recently started an International 4-H Aquaculture Club, based in central Georgia, to help accomplish these objects. Since it's inception two years ago, there has been great interest in the club itself and offers of partnership/sponsorship from several foreign countries' aquaculture educators and industry representatives (i.e. Costa Rica, Honduras, Panama, Ecuador, Venezuela, and Great Britain). The poster will illustrate the steps taken to start and promote the club, international contacts made, their plan of work and goals, and highlights of some of the 2000-02 activities including "exchange tours."

Recycle (low water usage) Aquaculture For The Future: A Muddy Crystal Ball

Dallas Weaver, Ph.D.
ScientificHatcheries

Over 25 years ago, recycle aquaculture was called “the wave of the future”. It is still being called “the wave of the future”. However, the questions of water usage by aquaculture have become even more pressing during this time period. The reasons for the lack of commercial success of recycle aquaculture outside of niche markets will be examined. Possible future technology changes, ranging from partitioned aquaculture systems (PAS) to C/N ratio heterotrophic systems to theoretical microbiological control system will be examined relative to conventional pond culture, flow through raceways or net pen culture technology. The theoretical minimum cost structure will be used for the analysis with all the system/recycle costs normalized as a cost/kg of feed fed.

Development of Eastern United States Interstate Shellfish Seed Transport

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There has been a long history of interstate transport of shellfish seed along the east coast of North America. Initial efforts targetted transplantation of large quantities of oyster (Crassostrea virginica) seed. While Recently, interstate commerce in seed clams (Mercenaria mercenaria) has evolved throughout the eastern seaboard. The success of hard clam culture has created new field grow-out techniques, a robust industry and a plethora of state regulations pertaining to importation of shellfish. Importing and exporting states have developed different disease and genetic entry requirements, often originating from livestock or non-marine fishery guidelines. A review of Southeastern states' hard clam seed importation requirements illustrates both disparities and similarities in state protocols. In addition to the difficulty of identifying and communicating with the appropriate state agency official, divergent certification requirements have plagued the industry and the testing laboratories. Several industry members and state regulators have stated that a workshop addressing these and other issues was long overdue.

As a result of these circumstances, a workshop was held at the South Carolina Marine Resources Center, Charleston, SC to provide a forum for the exchange of information concerning the need to protect state resource interests, reduce risks associated with shellfish importation and facilitate interstate commerce of aquaculture products. Three discussion panels were convened during the day and a half workshop:

(1) disease testing and shellfish pathology issues

(2) state regulatory requirement issues

(3) shellfish industry issues.

The agenda included presentations and panel discussions in sequential sessions. A publication was developed which provides a summary of the three panel discussions, identification of research needs, development of a spreadsheet containing all fourteen east coast state regulations and points of contacts within each state, and recommendations for developing a uniform set of criteria for shipment of bivalves between jurisdictions. The workshop did not intend to address public health issues associated with clams or oysters, but focused on shellfish diseases specific to the bivalves imported and exported.

The publication is available from the SC Sea Grant Consortium, free of charge, or on the internet at: http://scseagrant.org/pdf_files/shellfish_abstracts.pdf

Extension’s Role in Creating BMP’s for Alabama’s Catfish Industry

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Catfish production in Alabama achieved industry status twenty years ago. Given the importance of this industry to the agricultural sector of the state, any issues that may have an impact are addressed by the State Catfish Committee. This committee is composed of elected representatives of the state’s catfish producers. The committee is under the direction of the Alabama Farmers Federation, a large and potent political force in state politics. When the book, “Murky waters: environmental effects of aquaculture in the United States” was first circulated in 1997 by the Environmental Defense Fund, catfish production was mentioned briefly but adequately enough to warrant attention from the committee. Reacting proactively, the committee enlisted Auburn University’s Department of Fisheries and Allied Aquacultures to conduct a study on the actual environmental impact of the catfish industry in Alabama. With feed check-off funds, the committee funded this project to the tune of $50,000. Dr. Claude Boyd, a world renowned expert in water quality and shrimp production, was appointed as the lead researcher.

Since over 90% of the catfish production occurs in west Alabama, the Extension Aquaculturist at the Alabama Fish Farming Center coordinated efforts between Auburn University, which is located on the east side of the state, with the field data collection, producers’ interviews and BMP development. This comprehensive study, Environmental Assessment of Channel Catfish Farming in Alabama, was completed and published in the winter of 2000.

The Extension Aquaculturist also set up a tour in west Alabama in the spring of 2001 for Environmental Protection Agency personnel. The thoroughness, site selection, and timing of this tour revealed very important aspects of the industry which played a large part in the EPA’s overall assessment of the industry and shed critical light on the possible ramifications of impractical effluent regulations.

In the fall of 2001, all the state’s known producers were invited to a meeting for the purpose of discussing a list of BMPs that were recommended by Auburn’s research team and this author. After much discussion including some adverse and heated sentiments to "unnecessary regulation" of the industry by the government, the BMPs were eventually adopted. After further revision by the state' s office of Natural Resources and Conservation Service (NRCS), the BMPs were disseminated in a final form on the NRCS web site.

During this entire process, the author coordinated numerous interviews with producers about their particular farm situation, effluents and possible regulations of the EPA. From these interviews and field data collection, the BMPs that were developed represent a practical method for lessening the impact on the environment by Alabama's catfish industry.

References

Goldberg, R. and T. Triplett. 1997. Murky waters: environmental effects of aquaculture in the United States. Environmental Defense Fund, Washington, D.C., USA. 196 pp 100% recycled.

Boyd, C.E., J. Queiroz, J. Lee, M. Rowan, G.N Whitis, and A.Gross. 2000. Environmental Assessment of channel catfish *Ictalurus punctatus* farming in Alabama. Journal of the World Aquaculture Society 31: 511-544.

Plankton Harvest: Recycling Waste Nutrients to Improve Yield and Sustainability

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Polyculture is practiced throughout the world. Several species of aquatic animals are stocked simultaneously to take advantage of the different food niches available in the pond environment. In many systems, the primary culture species is fed a prepared diet. The resultant wastes stimulate large phytoplankton populations, which in turn support several species of zooplankton. On a dry weight basis, plankton can account for almost half of the standing biomass in a culture pond (900-1000 kg/ha). Phytoplankton and zooplankton represent the largest niches of surplus food available in commercial production ponds. As such, filter feeding animals, or planktivores, are stocked as additional species in polyculture ponds. This increases production efficiency overall and minimizes the loss of waste nutrients.

Each of the filter feeding species stocked is permitted to graze simultaneously on the same plankton populations. Essentially, these animals feed parallel to one another. Filter feeders screen planktonic plants and animals non-selectively from the water column on the basis of particle size. These planktivores consume phytoplankton and/or zooplankton. By filtering small particles, such as phytoplankton and minute zooplankton, herbivorous planktivores would remove larger plankton as well and would negatively impact the numbers of large-size zooplankton, decreasing zooplankton populations overall (total productivity and standing biomass). The filtering activity of animals that rely primarily on phytoplankton for subsistence would reduce the harvest biomass of planktivores that depend solely on intermediate and large plankton (particles) for food.

To improve the efficiency of plankton harvest, filter feeders should be placed in a series arrangement, flowing plankton rich waters past animals that feed on the largest plankton first and to those that consume the smallest plankton last. Each of the different planktivores should be compartmentalized according to the size of the particles they filter. Pond water could be pumped, from one enclosure into the next, through a series of floating or land-based chambers. Removing plankton sequentially, big particles first and small particles last, would improve net filtration efficiency and increase the (potential) biomass of planktivores at harvest. Careful selection and segregation of filter feeders for an aquaculture system could, in theory, double the harvest biomass in a production pond without significant deterioration of water quality. Waste nutrients would be recycled indirectly through the planktivores.

Stabilizing Water Quality for Production of Freshwater Shrimp *Machrobrachium rosenbergii*.

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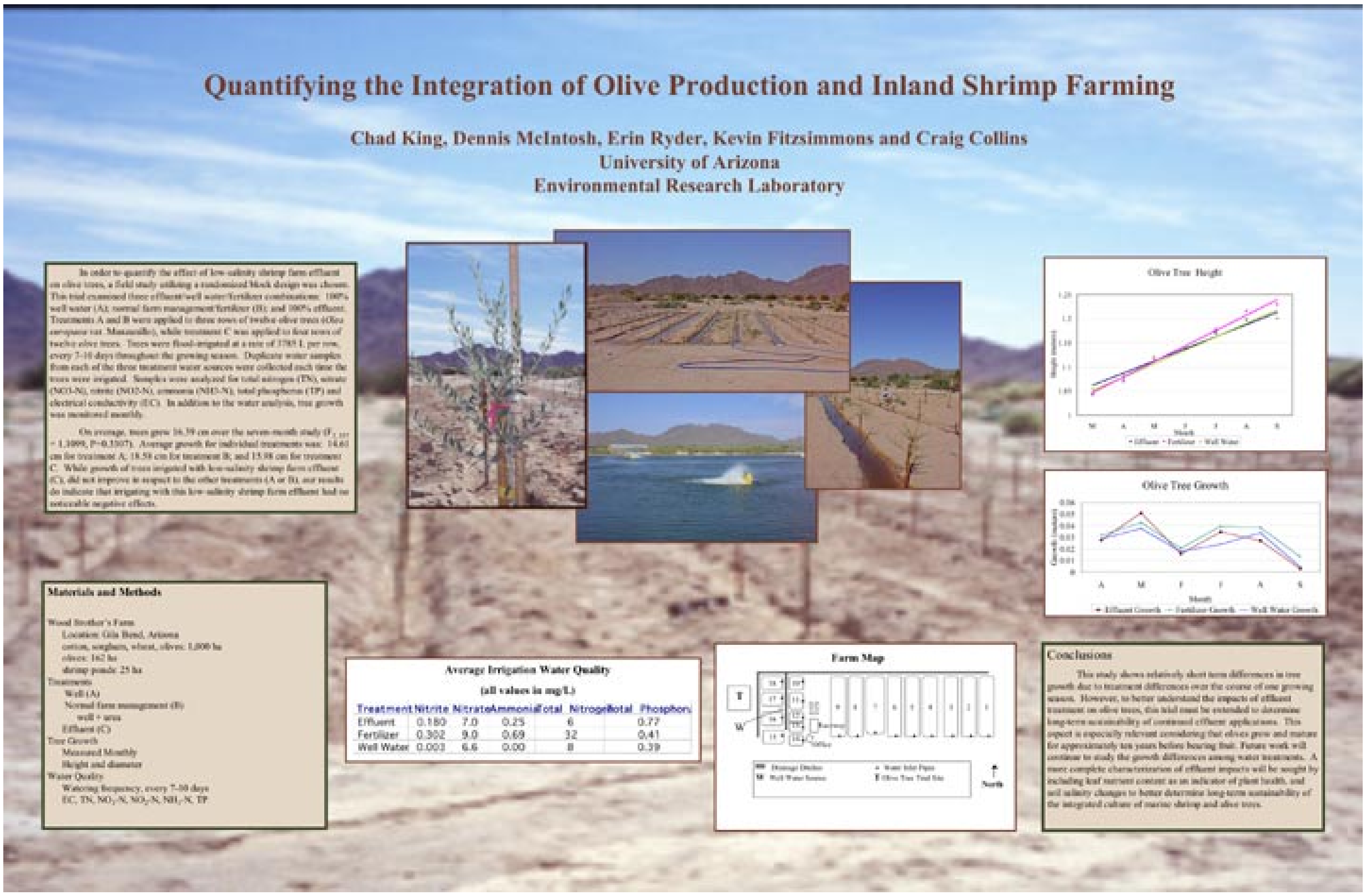
Over the past few years, the interest in farming freshwater shrimp in Kentucky has risen significantly. There has been considerable expansion in shrimp-pond construction, from 50 to approximately 150 acres, because of the increased popularity. Many of the producers have begun farming shrimp intensively in “recently constructed ponds.” Perhaps the most commonly reported challenge has been poor water quality. Large swings in pH and dissolved oxygen have been most prevalent. The problems appear to be related to intensive production practices, the use of new ponds, and imbalances of calcium hardness and alkalinity. Several management practices have been employed to remedy the situation. A practice combining the addition of agricultural limestone and gypsum and the use of organic fertilization has been used to help stabilize water quality in shrimp ponds.

Posters

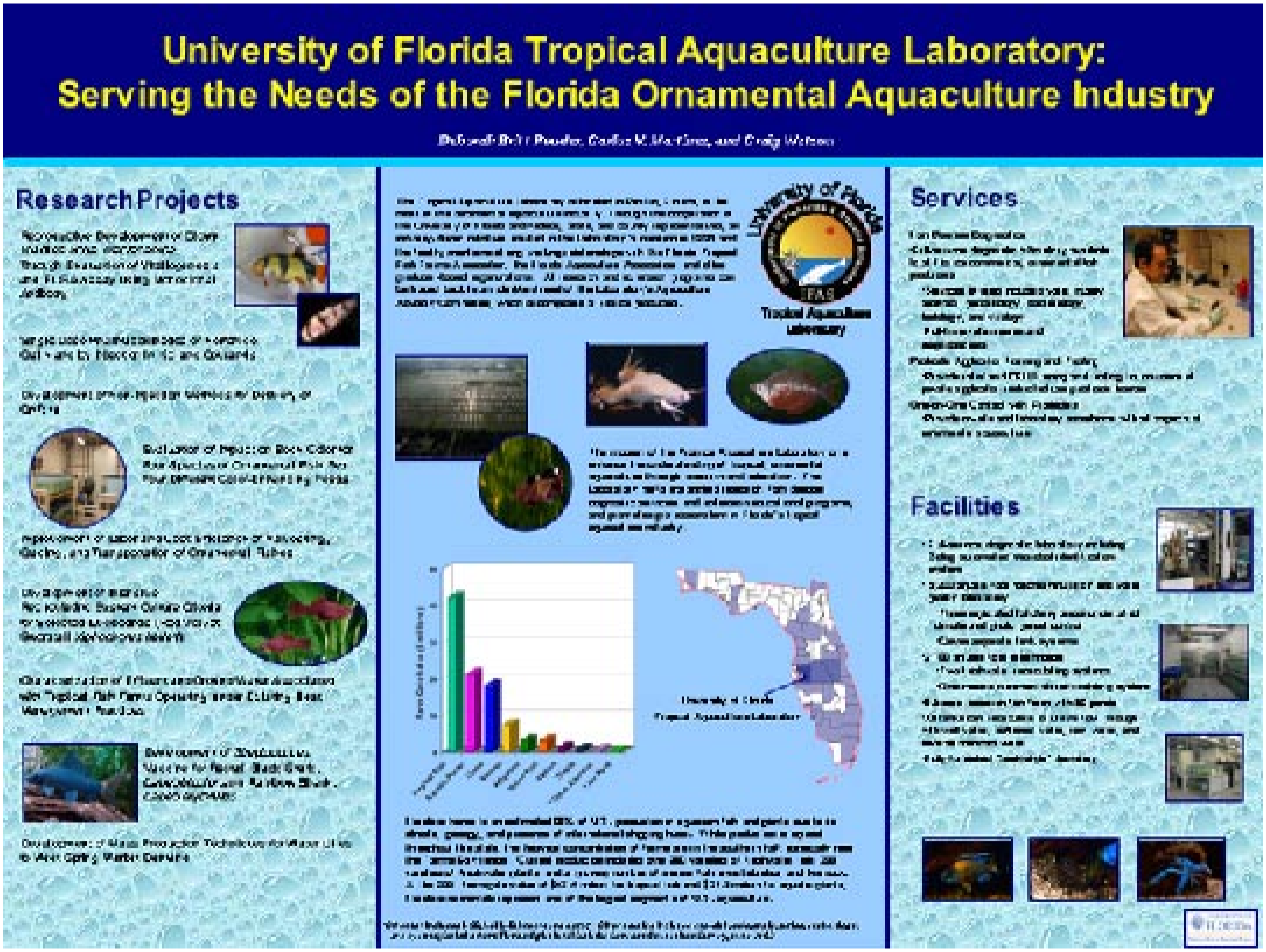
Poster - Identifying the Integration of Olive Production and Inland Shrimp Farming

Chad King, Dennis McIntosh, Erin Ryder, Kevin Fitzsimmons and Craig Collins



Poster - University of Florida Tropical Aquaculture Laboratory

Deborah Britt Powder, Carlos V. Martinez, and Craig Watson



Poster - Aquaculture Extension in Hawaii

James P. Szyper, Clyde S. Tamaru, Robert Howerton, Maria Haws, Kathleen McGovern-Hopkins