Stakeholder Positions Relative to the Aquaculture Industry of the United States

An
Interactive Qualifying Project Report
Submitted to the Faculty of
WORCESTER POLYTECHNIC INSTITUTE
In Partial Fulfillment of the Requirements for the
Degree of Bachelor of Science

Project Center: Washington, D.C.
Term: B03

Sponsoring Agency: National Oceanic and Atmospheric Administration

Project Advisors: Professors Biederman and Weaver

On-Site Liaison: Dr. James McVey

By

Jeffrey Budis

Vanessa Doto

Janet Moonan

December 17, 2003

1. aquaculture
2. fish farming
3. risks and benefits

Acknowledgements

We would like to thank the following people for their contribution to the development and completion of our project:

Our Advisors:
Professor Ronald Biederman
Professor Elise Weaver

All of the Sea Grant Staff, particularly:
Dr. James McVey
Jonathan Eigen
Jamie Krauk
Mary Robinson
Dr. Ron Baird

WPI Professors (for their initial help and direction):
Jeffrey Tyler, Biology Department
Jeanine Plummer, CEE Department

Authorship Page

Executive Summary: Vanessa Doto

1. Introduction: Janet Moonan
2. Background: The entire team
3. Environmental Hazards: Janet Moonan
4. The Potential of Aquaculture: Jeffrey Budis
5. The Current Aquaculture Debate: The entire team
6. Methods: The entire team
7. Results: Vanessa Doto
8. Analysis: The entire team
9. Conclusions: The entire team
10. Recommendations: The entire team
11. Appendices:
    - A. NOAA: Janet Moonan
    - E: BMPs: Vanessa Doto
    - F: Analysis Criteria: Jeffrey Budis
    - Remaining appendices written by the entire team.

Abstract

This project was developed to provide the National Oceanic and Atmospheric Administration with an independent assessment of the stakeholder positions on U.S. aquaculture. It was found that most non-government organizations are in favor of environmentally and economically sustainable aquaculture. Stakeholders ideally want a third party to oversee all U.S. aquaculture operations. Appropriate science, guidelines, and management will allow aquaculture to alleviate pressures on wild fish stocks, create a year-round seafood supply, and be economically beneficial to the U.S.

Executive Summary

The United States seafood industry has reached a pivotal point in its history. The growing human population is demanding a large supply of seafood, but the source of wild stocks is declining. Consumers demand seafood; aquaculture may be the only way to meet demands.

Aquaculture production has been growing in the United States over the past 50 years, and has recently reached its highest levels of production. However, the increasing aquaculture production and the decreasing natural supply still can not provide a large enough source for consumers. The United States imports over $10 billion dollars of seafood annually, far more seafood that it exports. There is an ever-growing seafood trade deficit, currently reaching about $7-8 billion dollars.

United States aquaculture industry is growing so slowly due to controversy over certain issues. Many stakeholders, specifically non-government organizations, government agencies, and industry groups, are concerned with harmful environmental impacts and the inadequacy of proper science, guidelines, and management. Aquaculture production can only progress after a resolution of these conflicts.

The goal of this project was to provide the National Oceanic and Atmospheric Administration (NOAA) with an independent assessment of the positions of the various stakeholders related to U.S. aquaculture and then explain what these positions mean to the developing industry in the United States.

In order to meet this objective, we conducted archival research and interviews. We found that most of the groups we interviewed are in favor of aquaculture in the

United States, as long as it is done in an environmentally sustainable manner. All groups interviewed believe that current policy and regulation (related to aquaculture) are not sufficient to protect environmental quality. To become a more profitable industry, environmental issues need to be addressed through laws and regulations that are uniform throughout the United States.

Along with laws and regulations, best management practices should be more uniformly implemented within aquaculture practices. These best management practices should be developed by a combination of industry spokespeople (both from conventional fishing and aquaculture practices) and NGOs.

We also found that most groups agree that aquaculture is a possible way to alleviate pressures on wild stocks, but until the science proves this point, it should not be the main reason for aquaculture to occur.

Resolution of these issues requires some compromises and changes on behalf of all stakeholders. This project recommends that NOAA holds a series of focus groups, in order to better understand various industry and NGO viewpoints. One government agency should take the lead in aquaculture law proposal, and NOAA would be the obvious choice to do this. One unified NGO should be formed to work with the government law-making agency. This NGO would incorporate all views from the many NGOs involved with U.S. aquaculture. Since the public drives supply and demand, they should be better informed about the risks and benefits of aquaculture practices.

Aquaculture has a tremendous potential in the United States. Proposal of appropriate policies, along with correct science and proper management, will allow this

economically important industry to progress in a beneficial and an environmentally sustainable manner.

Table of Contents

ACKNOWLEDGEMENTS **2**

AUTHORSHIP PAGE **3**

ABSTRACT **4**

1. INTRODUCTION **10**

2. BACKGROUND **13**

2.1 INTRODUCTION 13
2.2 THE UNITED STATES 13
2.2.1 The Seafood Industry *13*
2.2.2 The Aquaculture Industry *14*

3. RISKS OF AQUACULTURE **16**

3.1 BIOLOGICAL POLLUTION AND NON-INDIGENOUS SPECIES 16
3.2 FISHMEAL 17
3.3 DISEASES AND PARASITES 17
3.4 EUTROPHICATION 18
3.4.1 Nutrient Pollution *18*
3.4.2 Antibiotics *18*
3.5 CHEMICAL POLLUTION 18
3.6 HABITAT MODIFICATION 19

4. AQUACULTURE'S POTENTIAL **20**

4.1 FOOD PRODUCTION 20
4.2 ECONOMIC BENEFITS 21
4.3 ENHANCEMENT BENEFITS 22

5. PRINCIPLES OF THE CURRENT AQUACULTURE DEBATE **23**

6. METHODS **25**

6.1 PROJECT OBJECTIVES 25
6.2 ARCHIVAL RESEARCH 25
6.3 INTERVIEWING 25
6.3.1 The Interview Process *26*

7. RESULTS **27**

7.1 INTRODUCTION 27
7.2 SUMMARY OF GROUPS INTERVIEWED 28
7.3 NON GOVERNMENT AGENCIES 29
7.3.1 American Fisheries Society *29*
7.3.2 Conservation International *30*
7.3.3 Environmental Defense *31*
7.3.4 The International Association of Fish and Wildlife Agencies *32*
7.3.5 Monterey Bay Aquarium *33*
7.3.6 National Fisheries Institute *34*
7.3.7 Pacific Coast Shellfish Growers Association *35*
7.3.8 SeaWeb *36*
7.3.9 World Wildlife Fund for Nature *37*
7.3.10 Blue Ocean Institute *38*
7.3.11 Louisiana State University Research Station *39*
7.4 GOVERNMENT AGENCIES 40
7.4.1 Environmental protection Agency *40*
7.4.2 National Marine Fisheries Service *41*

7.4.3 National Ocean Service *41*
7.4.4 United States Department of Agriculture (CSREES) *42*
7.4.5 NOAA Sea Grant College Program *42*

8. ANALYSIS **44**

8.1 INTRODUCTION 44
8.2 CHART OF RISKS AND BENEFITS BY GROUP 44
8.3 ANALYSIS BY INTERVIEW QUESTION 44
Questions #1, 2, 3: General Information *44*
Question #4: Risks and Benefits *45*
Question #5: Importance of Domestic and Foreign Aquaculture *49*
Question #6: Policy and Regulation *50*
Question # 7: Wild Stock Enhancement *51*
Question # 9: Best Management Practices *52*
Question #10: Attitude Scale *54*
Questions #11, #12: Final Information *55*

9. CONCLUSIONS **56**

10. RECOMMENDATIONS **58**

10.1 NOAA AS A KEY PLAYER 58
10.2 IMPROVEMENT OF PUBLIC AWARENESS OF AQUACULTURE 59
10.3 MORE UNIFIED POLICIES OVERSEEN BY A SINGLE, LEAD FEDERAL AGENCY 60
10.4 THIRD PARTY AGENCY TO OVERSEE ALL NGO INPUT 60
10.5 FUTURE INTERACTIVE QUALIFYING PROJECTS 61

REFERENCES **62**

11. APPENDICES **69**

Appendix A: National Oceanic and Atmospheric Administration *69*
Appendix B: Aquaculture Cage Systems *71*
Appendix C: Non-government Questions *74*
Appendix D: Government Questions *75*
Appendix E: Best Management Practices *76*
Appendix F: Analysis Criteria *77*
Appendix G: American Fisheries Society *78*
Appendix H: Blue Oceans Institute *80*
Appendix I: Conservation International *82*
Appendix J: Environmental Defense *84*
Appendix K: Environmental Protection Agency *87*
Appendix L: International Association of Fish and Wildlife Agencies *89*
Appendix M: Louisiana State University *91*
Appendix N: Monterey Bay Aquarium Seafood Watch Program *93*
Appendix O: National Fisheries Institute *96*
Appendix P: National Marine Fisheries Service *98*
Appendix Q: National Ocean Service *100*
Appendix R: Pacific Coast Shellfish Growers Association *102*
Appendix S: Sea Grant *104*
Appendix T: SeaWeb *106*
Appendix U: United States Department of Agriculture *108*
Appendix V: World Wide Fund for Nature *110*

1. Introduction

The global seafood industry is at a pivotal point in history. As the human population grows, the demand for seafood increases. However, the supply of wild fish from the ocean is constantly decreasing, leaving the world in search of new seafood provisions. In the year 2000, the Food and Agricultural Organization of the United Nations (FAO) reported that 75% of the world's major marine fisheries are either overexploited or fully exploited and cannot be expected to yield any higher productions. In the three years since this FAO report, wild fish numbers have further decreased. Aquaculture is one means to alleviate this problem.

The 1980 National Aquaculture Act defines aquaculture as "the propagation and rearing of aquatic species in controlled or selected environments, including, but not limited to, ocean ranching." Aquaculture is subdivided by its location (i.e., onshore or offshore), the type of water (i.e., saltwater, brackish water, or freshwater), and the seafood products produced (i.e., finfish, crustacean, aquatic plants, etc.). There are many combinations of these categories, and each presents various risks and different benefits. Please see Appendix B for more information on aquaculture systems.

Many countries have experimented with aquaculture and some have successfully produced the food necessary for a growing world population. For instance, China currently produces about 60% of the aquaculture products sold globally. But foreign countries do not necessarily have environmental regulations that are as safe as those in the United States.

The United States began aquaculture practices very recently in history compared to other countries. The U.S. began farming catfish in the 1950s (Murky Waters, 1997) and has only recently begun to take a substantial role in this important industry. The U.S. is currently the world's sixth largest producer of seafood from aquaculture methods, but Americans consume very little of the amount of aquaculture they produce.

The reasons why the aquaculture industry in the U.S. is growing so slowly are complex. Controversy over certain environmental issues as well as the inadequacy of laws and regulations to control this industry have caused part of the delay. The federal and state governments in the U.S. have placed strict codes and regulations on all industries that may be hazardous to the environment, like aquaculture, thus making it difficult for new aquaculture operations to be developed. Currently some government agencies, like NOAA, are attempting to pass new laws or policies that will promote future aquaculture practices that are environmentally sound, but as of December, 2003, there are no new rules in place. Non-government organizations (NGOs), government agencies, and industry spokespeople are engaged in a vigorous debate over these upcoming policies.

The United States is very concerned about the environmental impacts that the aquaculture industry creates. There are a wide range of impacts such as habitat destruction and pollution. Aquaculture operations face heavy scrutiny from environmental agencies because some types produce large amounts of waste and discharge effluents into surrounding waters. The chemicals, hormones, and antibiotics that many aquaculture facilities use can be harmful to humans and wild stocks and therefore close regulation by the Department of Agriculture (USDA), the Environmental

Protection Agency (EPA), and the Food and Drug Administration (FDA) are important to future growth.

Along with these risks, there are substantial benefits to the development of an aquaculture industry in the U.S. If the United States becomes more involved in the rapidly growing field of aquaculture, it will be able to provide employment opportunities in coastal regions where traditional fishery jobs are in decline. It will also provide a year-round seafood supply. Aquaculture systems can contribute to the development of marine biotechnology, which in turn has the potential to play a role in a number of medical and scientific advances. The many benefits that aquaculture operations can provide are of great economic importance to the United States.

At this time the future of aquaculture in the U.S. is unclear. The potential for successful growth depends on whether a number of problems and constraints can be addressed. Advances in science and technology alone cannot ensure a brighter future for this evolving industry. It is dependent upon politics and regulations at the state and federal level that realistically address environmental issues.

2. Background

2.1 Introduction

Aquaculture is one of the fastest growing food production areas in the world, but is plagued by controversy over its environmental and sociological effects. The history of the aquaculture industry and its current status in the United States and abroad in economic, environmental, and political terms is vital to understanding the future of this important global industry.

2.2 The United States

2.2.1 The Seafood Industry

The United States is currently the fifth-largest fishing nation in the world (LeBlanc, 2003). The National Marine Fisheries Service (NMFS) reported that the U.S. is both the third-largest importer and exporter of seafood, with imports reaching about $9.9 billion and exports reaching about $3.2 billion in 2001 (LeBlanc, 2003). Foreign imports currently supply seventy percent of the U.S. seafood industry (Watkins, 2002). The U.S. seafood trade deficit has grown from a level of $3.6 billion in 1996 to the current deficit level of $7-8 billion – practically double in eight years (www.noaanews.noaa.gov, 2003). At this rate, if no action is taken, the seafood trade deficit will jump to the range of $20 billion dollars by the year 2025.

2.2.2 The Aquaculture Industry

This large seafood trade deficit accumulated over many years due to the slow rate at which U.S. aquaculture production grew. Aquaculture practices began in the United States around the 1880s when oyster farming was successfully accomplished, but it was not until the 1950s that aquaculture became a major U.S. industry with the advent of catfish farming.

According to Dr. Rebecca Goldburg, "U.S. aquaculture production has increased by roughly 5 to 10 percent each year over the past decade and is projected to keep growing rapidly in the coming years" (Something Fishy, 2000). While aquaculture is currently the fastest growing segment of U.S. agriculture (Murky Waters, 1997), the United States finds itself far behind other countries in terms of production. Aquaculture is growing at a rate of ten percent annually in other countries, while growth of this industry in the U.S. is only about one percent per year.

The U.S. lag is not due to the lack of technology or funding, but rather a fragmented system of policies adopted by several state and federal agencies, with no single federal agency having primary control. The National Aquaculture Act of 1980 established the Joint Subcommittee on Aquaculture (JSA) to set aquaculture policy. However, because the JSA is comprised of a dozen federal agencies, no single group has lead control over aquaculture in the U.S. The numerous regulatory conflicts between the agencies serving on the JSA have created a disjointed regulatory framework that has not encouraged growth in this industry. NOAA, one of the agencies involved with the JSA, is working with Congress to draft a new aquaculture law that will enable the expansion of

offshore aquaculture, specifically in the Exclusive Economic Zone (EEZ), the ocean area that is generally three to 200 miles offshore the United States.

In addition to the regulatory conflicts created by the JSA model, the aquaculture industry has been slow in its U.S. development because of environmental issues. Many environmental action groups would like to see some regulations put forward to ensure that if aquaculture expands in the U.S., it would prove to be a sustainable and environmentally friendly industry. These organizations target big issues such as fishmeal and fish oil, nutrient pollution, and genetic modification. They realize that "aquaculture need not be a polluting industry" (Murky Waters, 1997), but cannot reach an agreeable solution.

3. Risks of Aquaculture

There are a variety of risks associated with aquaculture. "The main environmental effects of aquaculture can be divided into five categories: biological pollution, fish for fish feeds, organic pollution and eutrophication, chemical pollution, and habitat modification" (Goldburg, Elliot, Naylor, 2001). Risks tend to be specific to particular types of aquaculture operations, but some generalizations can be made.

3.1 Biological Pollution and Non-Indigenous Species

A serious environmental effect of aquaculture is biological pollution and the introduction of non-indigenous species. The farmed stock itself can be considered a form of pollution, because aquaculture facilities accidentally or deliberately release farmed fish into the wild. The non-indigenous species may carry diseases or parasites that are foreign to the native population. They also may compete with native organisms for existing resources or alter the food chain in that current system. Some farmed species have altered genes in their DNA; these species can introduce potentially damaging new genes into the wild. For example, interbreeding of farmed and wild fish can create transgenic fish, i.e. fish that can adversely affect the genetic makeup and decrease the fitness and survival rate of the wild populations. One way to prohibit reproduction of transgenic fish may be to farm only sterile female fish, but this technique has not yet been approved.

3.2 Fishmeal

Certain types of aquaculture, such as shrimp and salmon farming, use very large quantities of wild-caught fish as feed in the form of fishmeal or fish oil. Fishmeal is a large component of feed given to carnivorous fish. A big concern is that using fishmeal to feed farmed fish takes food away from natural stocks. One common solution is to replace fishmeal with vegetable oil substitutes or soy. However, this substitution can decrease fish growth rates, change fish flavors and colors, and reduce beneficial concentrations of healthy material.

3.3 Diseases and Parasites

Disease and parasite transmission is also a problem of major concern. Due to the high concentration of fish in an aquaculture cage or pen, diseases and parasites can be transferred between one another easily, and then be transmitted to native stocks. To reduce the transmission of disease, farms may stock certified pathogen-free fish, reduce fish stress, and filter effluents when possible. In some states, strict regulations are in place, which involve the quarantine and testing of species for diseases and parasites. Many states have also implemented disease testing and certification programs for animals that are being imported.

3.4 Eutrophication

3.4.1 Nutrient Pollution

The release of large quantities of nutrients poses a major pollution problem to the oceans' ecosystems. High nutrient concentrations result from the release of certain compounds in fish wastes from aquaculture facilities, which may adversely affect wild stocks. If these excessive nutrients spread into nearby water, they may damage the water quality and create unwanted algae or deadly organisms.

3.4.2 Antibiotics

Antibiotics are often added to fish feed to help reduce the mortality rate of the stock from bacterial diseases. Unfortunately, these antibiotics pose several environmental threats, such as accumulation of antibiotics in sediments and in fish and shellfish. These antibiotics can adversely affect human consumers. The biggest threat is the possibility that bacteria can develop a drug-resistant strain that could be passed on to humans or animals. The FDA must approve any drugs used for aquaculture. This process is expensive, time consuming, and current funding for new antibiotics is scarce.

3.5 Chemical Pollution

Chemical pollution results from the leakage or dumping of biologically disruptive chemicals into the environment. Herbicides and pesticides contribute to chemical pollution. Eventually these chemicals can work their way through the food chain, damaging many seafood populations.

3.6 Habitat Modification

Habitat modification caused by aquaculture sites also negatively impacts the environment. Over time, eutrophication (the gradual increase in the concentration of phosphorus, nitrogen, and other plant nutrients in an aging aquatic ecosystem) greatly disrupts the ecosystem and can destroy the wild stock population. Aquaculture developments sometimes change seabeds or landscapes, and result in habitat destruction. Often the newly created environment cannot sustain the natural balance, causing marine life to die out or move to new areas.

4. Aquaculture's Potential

For years, the aquaculture industry has been overshadowed by the negative effects it can have on the environment when proper precautions and procedures are not taken. Modern aquaculture also has been criticized by environmentalists because it is still in its relative infancy. It lacks the same level of support that its sister agriculture industries currently receive.

However, there is a great deal of good that can come from a safe, regulated, and sustainable aquaculture industry. Because aquaculture is the fastest growing segment of U.S. agriculture, and its growth is expected to continue, it is important that its benefits be maximized, but not at the expense of the environment.

4.1 Food Production

The most prominent benefit of aquaculture is the ability to mass-produce large quantities of seafood. In many ways, aquaculture is similar to the current practice of raising terrestrial animals and agricultural crops. Seafood produced through aquaculture can be bought and sold in the United States' domestic markets and can be exported to other countries around the world.

Through aquaculture production, markets will no longer be dependent upon a seasonal seafood supply. Many, if not all, species of farm-raised seafood will be made readily available throughout the year, providing fresher seafood and cheaper prices for the consumer.

4.2 Economic Benefits

The expansion of the U.S. aquaculture industry could create jobs for many people, at aquaculture sites and beyond. A demand for labor would be expected in all the associated industries, such as packaging and processing, which would result in a diversification of the seafood industry.

Seafood importation is the second largest contributor to our nation's trade deficit, after oil. If the United States were to possess the capacity to produce large quantities of seafood through aquaculture, its seafood trade deficit could be reduced significantly. The U.S. would no longer need to rely so heavily on foreign imports.

The industry itself is very cost effective. Though a good deal of investment capital is required to get an aquaculture site operational, the industry as a whole makes very good use of its resources. In recent years, the public and scientific communities alike, have become increasingly conscious of food conversion ratios, or the amount of protein consumed versus the protein produced. However, ratios are often better for fish than for terrestrial animals such as cattle, poultry, or swine. According to Gifford, aquaculture has the lowest ratio at less than 2 lbs of fishmeal for every 1 lb of fish. Poultry is second, with a ratio of more than 2:1. The ratio for pigs is greater than 4:1. And beef sits last with a ratio that is roughly 7:1. When compared to all types of agriculture, it is obvious that the aquaculture industry is not as ineffective as formerly believed.

4.3 Enhancement Benefits

Seafood grown through aquaculture not only provides excellent sources of protein, but also enables fish species to be available for reintroduction into the wild, in lakes, rivers and streams, and into the ocean. Fish hatcheries are already using stocks raised through aquaculture to supply lakes and rivers, and occasionally for recreation.

Aquaculture complements traditional commercial fishing by reducing the market dependence on wild-caught fish. However, enhancement through aquaculture must be paired with good fishery management. It is critical to relieve pressure on wild stocks, and stabilizing or lowering the amounts of fish that can be caught creates the opportunity to naturally replenish their numbers. If commercial fishing is allowed to continue unrestricted, fishermen will continue to deplete the ocean resources causing further problems.

5. Principles of the Current Aquaculture Debate

The risks and benefits of aquaculture operations in the United States have led to a heated debate between stakeholders. Because they will gain or lose from development of this industry, every stakeholder brings an opinion to the debate. These views often lead stakeholders to misrepresent the facts to support their positions, especially on particularly heated issues such as salmon and shrimp farming. Stakeholders who favor this industry often do not understand the risks of the current aquaculture enterprise, while stakeholders who oppose this industry fail to comprehend the benefits.

The stakeholders essential to the aquaculture debate can be categorized into three main groups, each affecting the development of U.S. aquaculture in a distinct way. First there are the government agencies that are the policy and regulation makers. Second there are non-government organizations, especially environmental action groups, that most directly reach and influence the general public. There are also industry organizations representing fishermen and fish farmers.

People involved in the seafood industry possess a wide range of outlooks about aquaculture, depending upon their particular business sector. Due to personal economic concerns, most fishermen tend to oppose aquaculture operations, while fish farmers are in favor, because of their personal economic gains.

Overall, the general public knows very little about aquaculture; most people do not even distinguish whether the fish they eat are farmed or wild-caught. But it is the

public that most directly affects the demand for seafood, and therefore affects the economic standing of fishermen and fish farmers.

Before any major expansion of the U.S. aquaculture industry occurs, the undesirable effects must be resolved. Aquaculture is going to take place in the U.S., no matter what; what is important is that it continues in a sustainable and environmentally friendly manner.

6. Methods

6.1 Project Objectives

The goal of this project was to provide NOAA with an independent assessment of the positions of various stakeholders relative to U.S. aquaculture and explain the impacts of these positions on the developing aquaculture industry of the U.S. To explore the environmental issues surrounding aquaculture, the project team used two methods: archival research and interviews, the latter providing the most effective way to gain insight into the aquaculture debate.

6.2 Archival Research

Archival research was conducted prior to any interviews. It included searching websites, journals, books, and other printed materials for information about aquaculture and the organizations involved in the industry. By doing archival research first, the project team gained an initial familiarity with the agencies and organizations to be interviewed, thus enabling the interviews to be more efficient and effective.

6.3 Interviewing

The interviews were most helpful in identifying key players' viewpoints on aquaculture. Three categories of principle stakeholders interviewed were: government organizations, NGOs, and industry spokespeople (such as fishermen). To obtain interviews, the project team first sent emails or made phone calls. Personal interviews

were sought, but in cases where they were unobtainable, questions were asked via email or phone.

Two sets of interview questions were used - one for NGOs and one for government agencies. The questions, which appear and Appendices C and D, were tailored slightly to better suite particular organizations or agencies, and in some cases, to meet time constraints.

6.3.1 The Interview Process

The process of drafting and editing, the interview questions was an important step to ensure success during the interviews. Subtleties in wording were critical; each person we interviewed must completely understand the questions. The project team felt that, by expressing no opinions during the interviews, it would elicit the true attitudes of those being interviewed. To accomplish this goal, during face to face interviews team members took turns asking questions and all members took notes. One team member asked the questions and the other two took notes during telephone interviews. Emails required no note taking, only analysis. Following all personal and telephone interviews, all notes were compared and then typed up into interview transcripts. The comparison of team members' notes ensured the accurate recording of all key words and phrases from interviews. Overall, the more objective the project team was, the better its information will be for NOAA's use.

7. Results

7.1 Introduction

Twenty-five groups were contacted throughout the project. Sixteen groups were interviewed: five government agencies, nine NGOs, and two (PCSGA and LSU) that did not fit into either of these categories. Two groups (Oldways and PEW Oceans Commission) declined interviews but still provided some useful information. A detailed account of the information ascertained from the interviewing process is presented in this section. (For interview transcripts, please see Appendices G through V.)

One thing discovered after doing a number of interviews was that each person had a difficult time giving his or her agency's opinion; often times they could only provide their personal views. Each person interviewed had a substantial input into publications, policies, and activities that occur at their respective agency or organization; so to some degree what we received was a part of the organization's opinion.

7.2 Summary of Groups Interviewed

Group:	*Person Interviewed:*	*Type:*
Government Agencies:		
Environmental Protection Agency (EPA)	Marta Jordon and Marvin Rubin	Face to Face
National Marine Fishery Service (NMFS)	Susan Bunsick	Face to Face
National Ocean Service (NOS)	Cheryl Graham	Face to Face
Seagrant	Dr. Ronald Baird	Face to Face
United States Aquaculture Program (USDA, CSREES)	Max Mayeaux	Face to Face
Non Government Organizations:		
American Fisheries Society (AFS)	Jessica Geubtner	Phone
Blue Ocean Institute (BOI)	Carrie Brownstein	Phone
Conservation International (CI)	Bambi Semroc	Face to Face
Environmental Defense (EDF)	Tim Fitzgerald	Phone
International Association of Fish and Wildlife Agencies (IAFWA)	Eric Schwab	Face to Face
Louisiana State University Research Station	John A. Hargreaves	Phone
Monterey Bay Aquarium (MBA)	Jennifer Dianto	Email
National Fisheries Institute (NFI)	Dan Herman	Phone
Pacific Coast Shellfish Growers Association (PCSGA)	Robin Downey	Phone
SeaWeb	Brendan O'Neill	Phone
World Wildlife Fund (WWF)	Katherine Bostick	Face to Face
Those we contacted but did not interview:		
American Institute of Biological Sciences (AIBS)	Adrienne J. Froelich	Email
Audubon Organization		Phone
Directory of North East Regional Aquaculture Extension		Email
Fish and Agriculture Organization of the United Nations (FAO)		Phone
Greenpeace (GP)	Carol Gregory	Phone
Marine Conservation Biology Institute (MCBI)	Hannah Gillelan	Email
Oldways Preservation and Exchange Trust	K. Dun Gifford	Phone
PEW Ocean's Commission (PEW)	bakkour@seachangecenter.org	Email
Southern California Commercial Fishing Association (SCCFA)	Orlando Amoroso	Email
The Nature Conservancy		Phone

Table 1: List of Groups Interviewed

7.3 Non Government Agencies

7.3.1 American Fisheries Society

The American Fisheries Society (AFS) is the oldest non-profit organization in the United States. It is currently composed of roughly 9000 members from all around the world. These members come from government fish and wildlife agencies, academia, and the fishing industry. Its primary mission is directed at helping to establish sustainable fisheries as well as healthy environments.

The AFS supports aquaculture and its continued development. It realizes that demands for seafood are rising and views aquaculture as a solution to meeting this demand. However, AFS wants best science practice and better techniques to be researched and implemented within the industry. It wants the focus on scientific research, which will lead to better aquaculture practices, and believes that federal and state regulations must be taken further. AFS also suggests health monitoring systems and higher standards emphasizing food safety. One interesting concept mentioned in the interview, which was not heard from other organizations, was that of teaching good aquaculture curricula in the schools in order to promote better science.

The AFS views the aquaculture industry as very beneficial and one that will continue expanding. It believes that the United States is headed in the right direction to make the industry sustainable and viable, but that much work still needs to be done. To that end, it urges the government to promote consistent guidelines that incorporate input from individual states.

7.3.2 Conservation International

Bambi Semroc, who works in the Center for Leadership division of the Conservation International (CI), said CI works to protect biodiversity hot spots around the world. These hot spots dictate where they operate and conduct their research. Currently there are 30 field offices that work closely with fish farmers. CI's involvement with aspects of the aquaculture industry only occurs if a CI team is called to a hot spot that may have an aquaculture site, or be adjacent to one.

The threats that trigger CI action include environmental risks that CI associates with aquaculture. These include mangrove destruction, fishmeal and fish oil, biodiversity pollution and antibiotics. One of CI's current projects involves assisting the shrimp industry in Mexico, where it is working to buy out trawlers and to keep the industry clean and environment friendly.

CI is also conducting research at its headquarters to develop standards regarding aquaculture's "good" and "bad" aspects. CI views the risk of aquaculture to be the environmental hazards, and the benefits to be the industry's ability to provide an economical source of seafood for U.S. consumers. Cultured fish can be farmed all year long for a plentiful source of protein.

Ms. Semroc added that CI is also researching the potential for aquaculture to provide relief for wild stocks, but has yet to be form an opinion on that issue. She noted that, although aquaculture has not yet helped replenish the wild fish numbers, it plays a major role in certain areas of the industry, for example catfish raised in Mississippi's fresh ponds farming industry.

This CI representative gave the aquaculture industry a "mostly neutral" rating, but added that, with further research and more scientific investigation, aquaculture could

be extremely helpful in taking the pressure off of wild, caught fish. She also felt that imports of seafood produced through aquaculture were very important to the U.S. economy since they could supplement production from the U.S. domestic seafood industry.

7.3.3 Environmental Defense

Environmental Defense (EDF) is one of the nation's leading environmental advocacy groups. It seeks to protect the nation's resources through fair and economic means. Primarily a science-driven organization, EDF examines various environmental problems and works to develop solutions that will gain support from interested groups. Its goal is to remain as neutral as possible in order to be as fair as possible.

Tim Fitzgerald of EDF's Oceans Department told the project team that most of that department's work relates to the most prevalent items in the current seafood market, many of which come from the aquaculture industry. It examines different types of seafood produced through aquaculture processes, and measures them against EDF's criteria. EDF does not view aquaculture as entirely bad and has devoted fulltime staff to this area.

According to Fitzgerald, technological advances in the aquaculture industry are developing rapidly, but while they may be more efficient, such advances may not be better. EDF supports establishing broad, all-encompassing policies governing aquaculture, but recognizes the challenge given the many different types of aquaculture, which exist. EDF wants standards developed from input of industry and environmental groups, and then implemented by the government. Mr. Fitzgerald noted that guidelines

are not always followed by industry because they did not have a hand in their development. EDF is encouraged to see that the aquaculture industry is starting to come forward and to seek help to demonstrate that they are trying to conduct their operations in a sound environmental manner. EDF also believes that best management practices must be adopted by the industry.

EDF realizes that people are going to eat seafood, and to suggest, "don't eat these things," is a near-impossible task. Instead, EDF recommends better options and that the U.S. government focuses on its domestic seafood production and support the promotion of better practices.

7.3.4 The International Association of Fish and Wildlife Agencies

The International Association of Fish and Wildlife Agencies (IAFWA) is a member-based organization consisting of public fish and wildlife agencies throughout the United States and Canada. It represents its members, coordinates policy, and helps to promote and establish positive multi-state conservation initiatives. Most IAFWA members are in charge of hatcheries and fisheries. The organization also sits on the JSA as an adjunct member and seeks to ensure that aquaculture is conducted in an environmentally friendly manner. Though not a federal agency, its members work closely with state and local government to help establish guidelines.

As an organization directly involved with the primary managers of the nation's fish and wildlife, the IAFWA is very interested in the potential effects that aquaculture may have on natural habitats. In turn, it sees aquaculture as a possible solution to the current problem of depleted natural fish stocks, acknowledging that restoration benefits

are tremendous. However, the IAFWA also recognizes that eutrophication is a top industry concern.

The IAFWA believes the current aquaculture industry has concerns that need to be addressed, and that new policies and enforcement systems need to be considered as technology advances in this industry. It also supports establishing a partnership of state and federal agencies to bring available expertise to ensure that the industry operates in a responsible manner.

7.3.5 Monterey Bay Aquarium

The Monterey Bay Aquarium's (MBA) Seafood Watch Program mission is to "shift the buying habits of seafood consumers and purveyors to support sustainable fisheries and aquaculture options" (Jennifer Dianto. Internet Interview. 1 Dec 2003.). MBA creates awareness about the sustainability of seafood sources while developing regional and national seafood recommendations. The group also hopes to "strengthen their research base and make it more accessible to the public" (Jennifer Dianto. Internet Interview. 1 Dec 2003.).

The MBA's Seafood Watch Program wants to produce safe, sustainable, well-regulated aquaculture products. While they believe that aquaculture does have a "tremendous opportunity to maintain a supply of seafood while relieving pressure on wild fish" in an environmentally friendly way, they feel that one of the biggest problems with the U.S. aquaculture industry is its lack of "consistent standards" in regulations. They call for "smart growth" (Jennifer Dianto. Internet Interview. 1 Dec 2003). Dianto said

"any standards should be set with a window to adjust those standards to best respond to new information."

MBA's Seafood Watch Program targets the public with its informational packets on "Best Choice" seafood. These recommendations are based on the MBA's Seafood Watch Program's criteria for sustainable aquaculture.

7.3.6 National Fisheries Institute

The National Fisheries Institute (NFI) is a trade association for the fish and seafood industry. It works in conjunction with a wide variety of businesses, from as small as single-family business to as large as multinational corporations. NFI promotes an ample and sustainable industry. It helps its partners succeed in the seafood market by providing technical expertise and running seminars as well as disseminating information and literature on technological advances, industry developments and other useful reports.

NFI works primarily as a science and technology group. Its pro-aquaculture stance comes from a recognition that aquaculture has become a more prominent part of the seafood industry and will grow in importance in the years to come. NFI sees tremendous potential for the industry in the United States, but feels it is being thwarted by regulations. It believes that current policy is sufficient, but also recognizes that more needs to be done in areas like the EEZ. In NFI's opinion, aquaculture is an important way to compliment traditional commercial fishing practices, and the industry must take a leading role in the development of guidelines for it.

7.3.7 Pacific Coast Shellfish Growers Association

Shellfish aquaculture is different from other aquaculture, because shellfish are filter feeders and, therefore, are not "fed." These aquatic animals clean water by their filtering, and fertilize sea grasses with their feces. The Pacific Coast Shellfish Growers Association (PCSGA) oversees all shellfish production on the Pacific coast. The project team spoke with Robin Downey to ascertain her organization's positions and viewpoints on aquaculture.

The Pacific coast shellfish industry is comprised mostly of oysters growers, with some clam and mussel production. This industry began about 130 years ago, with the farming of the Olympia Oyster, a native species that had been critically depleted due to over-harvesting and pollution. In the 1920s, the Japanese Schick Oyster was brought over from Japan and became the new major crop.

One of the pitfalls of shellfish farming is the introduction of non-native species. Downey said that, in the past, invasive species have been a problem. The Spartina, an invasive weed from the East coast, has taken over many estuaries. At this point, regulations are quite strict and no new invasive species have been known to enter the ecosystem.

The PCSGA believes that the huge seafood trade deficit can be partially alleviated by shellfish farming. Shellfish have a high protein concentration and very low fat, and do not cause as many controversial environmental problems as other forms of aquaculture, so they are a good option for future seafood demand.

The PCSGA considers itself extremely in favor of aquaculture in the United States. Downey says, "the fact of the matter is that we need to feed people and fish are a healthy food source." She believes that there is room for improvement in the aquaculture

industry, but overall that it is pretty safe. We need to further develop safe and sustainable ways to produce seafood, which is very important to the economy of the United States. People need to realize that a broader look needs to be seen. The aquaculture industry needs to be compared to land-based farming. There is less harm to the natural environment with seafood farming, she said.

7.3.8 SeaWeb

The mission of SeaWeb is to raise awareness of environmental impacts, good and bad, and encourage a sustainable aquaculture industry. According to Brendan O'Neill of SeaWeb's clearinghouse, SeaWeb believes that there is a need for aquaculture, but the industry must be operated in an environmentally sound and sustainable manner. In order to gain this sustainable industry, SeaWeb believes that a third party needs to be brought in to help sort out the conflicting viewpoints and propose policies that will drive the industry to sustainability.

SeaWeb currently feels that U.S. regulations and policies are inadequate to preserve environmental quality. All policies point toward development of the aquaculture industry, but none take into consideration any of the environmental hazards of pollution, invasive species disease, nutrient wastes, habitat destruction, risk to the commercial industry, and a decline in coastal property.

SeaWeb also views the benefits of aquaculture to be economic ones, including an expanded and healthier seafood supply and more jobs for the public. This organization distributes material both through its website (www.seaweb.org) and through the mail to

inform the public, government, other organizations, and the commercial fishing industry about SeaWeb's positions on aquaculture in the United States.

7.3.9 World Wildlife Fund for Nature

Katherine Bostick, an aquaculture and agriculture researcher at the World Wildlife, explained that the WWF's mission is to preserve the environment's biodiversity and to promote conservation nationwide. WWF works with industry ecologists, producers of farmed aquatic animals, and consumers. Concentrating on such seafood industries as shrimp, tilapia, trout, catfish, aboline mussels, scallops, and seaweed, WWF is trying to encourage these industries in adopting certifications, such as ecolabeling, to help promote environmentally friendly seafood.

WWF believes that the risks of aquaculture vary with each of the different species. For example, from its work with the tilapia industry, WWF learned that this fish often escapes into the wild, and can become an invasive species because they can thrive in almost any quality of water. WWF has concerns about the fish feed used in the aquaculture industry, specifically shrimp and salmon production.

WWF's Bostick also said that, aside from the risks, aquaculture is a great source of food production, is the only way to meet the growing U.S. demand for seafood, and can combat the diminishing sources of wild harvest fish. WWF believes that; if aquaculture methods are followed in both an environmentally- and socially-friendly manner, the industry can help bring jobs and economic prosperity to poor U.S. communities. She cited the catfish industry in Louisiana and Mississippi, which has

significantly improved the lives of underprivileged individuals by providing local jobs and a low-cost source of food.

She said WWF is aware of the controversies surrounding the aquaculture industry, but believes they all can be corrected and feels that with proper controls, aquaculture has more potential then commercial fishing to produce an environmentally friendly ecosystem.

While Ms. Bostick works abroad for WWF, and is not familiar with the specifics of legislation under development to change the aquaculture regulatory structure, she said her organization feels loopholes in the current regulatory framework should be closed. WWF supports best management practices for the aquaculture industry; and recommends that an independent entity or consultant work with other NGOs and federal agencies to update certain aquaculture policies and guidelines and to operate an improved certification process. WWF believes that the certification process should not be controlled by the aquaculture industry, as is the current situation. Ms. Bostick provided some handouts and directed the project team to the website: www.enaca.org/shrimp for some more information.

7.3.10 Blue Ocean Institute

The Blue Ocean Institute (BOI), formerly part of Audubon Society, is dedicated to developing practical solutions to our world's conservation challenges. BOI wants sustainability in the aquaculture industry.

Carrie Brownstein said BOI rates some aquaculture methods as better than others, and supports methods that are sustainable. Using criteria for sustainability developed in

cooperation with Environmental Defense, BOI evaluates aquaculture systems and then decides whether or not to support each type. While BOI believes that aquaculture is a growing industry "there is no sense in not acknowledging that," says Ms. Brownstein. (Carrie Brownstein. Phone Interview. 5 Dec 2003.) It also strives to influence the aquaculture methods used. BOI runs a seafood consumer education program that publishes a seafood mini guide. The guide advises consumers about the types of seafood that BOI feels should be purchased. Thus, BOI feels it can shift market sales for certain seafood by targeting public information to businesses and consumers, and use the changed public attitudes to force change in the aquaculture industry. Industry will not thrive on specific types of aquaculture that are not profitable, Ms. Brownstein explained.

BOI's concerns match those of other environmental groups: fish feed, impacts on wild fish stocks, chemicals, water quality, and invasive species. But it also sees aquaculture's great potential, including such benefits as relieving pressure on wild stocks, improved water quality, and economic payoffs. BOI also believes that the U.S., although ahead of the rest of the world, is still lacking a coherent federal industry regulation. Best management practices need to be applied to industry, where they will have the most impact.

7.3.11 Louisiana State University Research Station

For many years, John Hargreaves has taught aquaculture methods and conducted research studies on aquaculture in Louisiana and Mississippi. He noted that Mississippi "has the largest aquaculture industry in the U.S., which is catfish." (John Hargreaves. Phone Interview. 21 Nov 2003) He believes that the aquaculture industry in the U.S. has

a "good sense of morality and people are trying to do the right thing." He also believes that the perceptions of risk are far out of balance with reality, and need to be weighed against scientific fact.

Professor Hargreaves also said that fish tend to be more efficient than terrestrial animals at converting protein and fishmeal, which is beneficial to fish farmers and consumers. Other benefits are economically based; local communities in his area rely heavily on this industry for jobs and food. He is unsure whether farmed fish will help replenish the wild stocks.

7.4 Government Agencies

7.4.1 Environmental protection Agency

The EPA controls all ocean discharges and permits under the authority of the Clean Waters Act. Because EPA's goal is to implement "zero discharge in the waters" (Marvin Rubin. Personal Interview. 1 Dec 2003), their regulatory efforts impact the aquaculture industry. One thing that the EPA brought up that many other organizations did not was the fact that it does cost a good amount of money in order to maintain healthy and safe environmental practices. Noting that maintaining good environmental practices is costly, EPA's Marvin Rubin said, "industries should not pollute if they can afford not to." EPA works to mitigate economic stress on small businesses.

As a result of their aquaculture studies, which EPA calls Concentrated Aquatic Animal Production (CAAP), the agency feels that best management practices assist in controlling drug and chemical discharge. EPA's regulatory control of chemical usage and

disposal also relates to the aquaculture industry, but Mr. Rubin and Marta Jordan said the agency would "rather have the pollution from aquaculture then [pollution from] another toxic industry."

7.4.2 National Marine Fisheries Service

Susan Bunsick of the National Marine Fisheries Service (NMFS), another agency within NOAA, addresses NMSF policy issues. NMSF's mission includes managing the commercial and recreational fisheries within the EEZ, and its regulations apply to all living resources in that zone. Regulations include, for example, restrictions on the way fish may be caught, the numbers of fish that may be caught, and allowable sizes.

The NMSF understands that commercial fishing creates the risk of natural stock depletion, and that aquaculture can combat this effect. Replenishing natural stocks is a goal that aquaculture hopes to help attain, and thereby take pressure off of commercial fishing. She also noted that NMSF believes seafood produced through the aquaculture industry can help reduce the trade deficit and also both the economy by creating new jobs or alternative career paths for current fishermen. Considering both the risks and benefits, Ms. Bunsick said the NMSF is extremely supportive of the aquaculture industry and wants to make sure that it is managed correctly.

7.4.3 National Ocean Service

National Ocean Service is also a part of NOAA. NOS is involved in the relationship between aquaculture and its management of it in the coastal zones. Cheryl Graham, a NOS representative working on EEZ (exclusive economic zone) issues, said that there is much need for improved aquaculture legislation and regulations. Permitting is unclear and inconsistent at the national level and even at the state level.

In order to move the industry forward in a sustainable manner, a checks and balances system is needed to monitor opening and permitting of new aquaculture sties. Substantial capital needs to be invested in regulations, but the reason very little is being done is due to budget problems at NOAA. "The U.S. could take the lead but budget and organization priorities are in the way." (Cheryl Graham. Personal Interview. 19 Nov 2003).

7.4.4 United States Department of Agriculture (CSREES)

The USDA's Aquaculture Program (CSREES) plays an active role in the Joint Subcommittee on Aquaculture (JSA). Max Mayeaux said there are many benefits from the aquaculture industry, but there are also certain drawbacks. More research should be done to identify environmentally safe production methods. Noting that aquaculture production in the U.S. should be increased; Mr. Mayeaux believes that aquaculture will help meet the consumers' demand for seafood, which in turn will relieve pressure on wild stocks.

7.4.5 NOAA Sea Grant College Program

Established by Congress, Sea Grant was developed to promote the wise use of coastal and ocean resources. To strengthen the federal government's ability to address marine problems, the agency works with universities throughout the nation on coastal management issues. Sea Grant programs include research, outreach, and education ranging from K-12 environmental education to undergraduate and graduate work. Its programs often extend to the public and engage the community. Dr. Ronald Baird

explained: "We are in the business of creating new knowledge." Sea Grant supports the management of critical, location-based science. Known for its objectivity, it works with and through universities to bring information to the public.

Dr. Baird suggested that Sea Grant might want to re-assess its activities as a "message-first" organization in favor of more promotion and distribution of its message.

Sea Grant is concerned with all aspects of the aquaculture industry. The agency understands the potential harm from uncontrolled, irresponsible aquaculture practices and believes that, while a capital-intensive industry, better aquaculture technology is available and the environmental problems are manageable.

Dr. Baird joins other organizations in his view that the U.S. lacks a comprehensive aquaculture policy. Because different agencies control different aspects of the industry, and regulations are piece-meal and fragmented (both at federal and state levels), he believes a lead agency needs to be designated to assume leadership.

Sea Grant strongly supports aquaculture; it believes that the industry will grow and that a new regulatory structure will enable the U.S. to lead aquaculture development around the world.

8. Analysis

8.1 Introduction

Interview data was analyzed to give quantitative meaning to qualitative data. The analysis of the project data is divided up by interview question. Please refer to Appendices C and D for copies of the interview questions. Please refer to Appendix F for our analysis criteria.

8.2 Chart of Risks and Benefits by Group

Figure 1, on the following page, shows what each group considers to be particular risks and benefits of aquaculture.

8.3 Analysis by Interview Question

Questions #1, 2, 3: General Information

These questions were designed to gather general information from the interviews through topics such as: general mission; literature available; and positions, policy and activities relating to aquaculture. This information was used to analyze Question #10 and is reported in the Results section; it needs no further analysis.

	BENEFITS										RISKS																				
	Economic						E.	Other			Economic			Environmental																Other	
	Assistance to Poor	Lower Imports	Seafood Production	Year-round Supply	Job Creation	Trade Deficit Reduction	Wild Stock Relief	Protein, Low Fat	Medical	Recreation	Coastal Land Property Decline	Commercial Fisherman	Costs	Antibiotics	Biodiversity Pollution/Interbreeding with the Wild/GMOs	Degrading of Water Quality	Diseases, Pathogens	Escapes	Fish Oil/Fish Meal Pollution	Chemicals, Pesticides	Habitat Destruction/Impacts	Invasive species/bringing in of pests	Mangrove Destruction	Nutrient Waste/Nutrients	Overflowing	Pollution	Runoff	Sediment Loads	Absence of Regulation	Nonresponsible Aquaculture
AFS	X	X	X					X							X		X	X						X		X	X			
BOI					X	X	X							X		X			X	X	X	X				X				
CI			X	X			X							X	X	X			X				X			X				
ED							X																							
IAFWA			X				X			X					X	X	X				X	X		X			X			
LSU	X		X														X					X				X				
MBA			X				X								X	X	X			X	X	X		X		X			X	
NFI			X				X																			X				
PCSGA			X					X									X					X								
SeaWeb		X			X						X	X					X				X	X		X		X				
WWF	X		X		X		X									X		X	X											
EPA																X		X							X			X		
NMFS			X		X	X	X																							
NOS		X			X				X													X								
USDA			X										X																	
Sea Grant		X	X	X		X	X									X	X											X		

Question #4: Risks and Benefits

Question: *What do you think the risks and benefits of aquaculture are? What are your opinions regarding these issues?*

General Risks:

We found that risks associated with aquaculture were, overall, emphasized as environmental and that benefits were mostly emphasized as economic. This information was no different than what we had found in our archival research.

Of the 16 organizations and agencies interviewed, 12 described risks being environmental, one (USDA) as economic (issues of cost as primary concern), and one (EPA) emphasized other risks such as effluents. Two groups (EDF and NMFS), may feel risks exists, but did not comment on them during interviews. These results are shown in Figure 2.

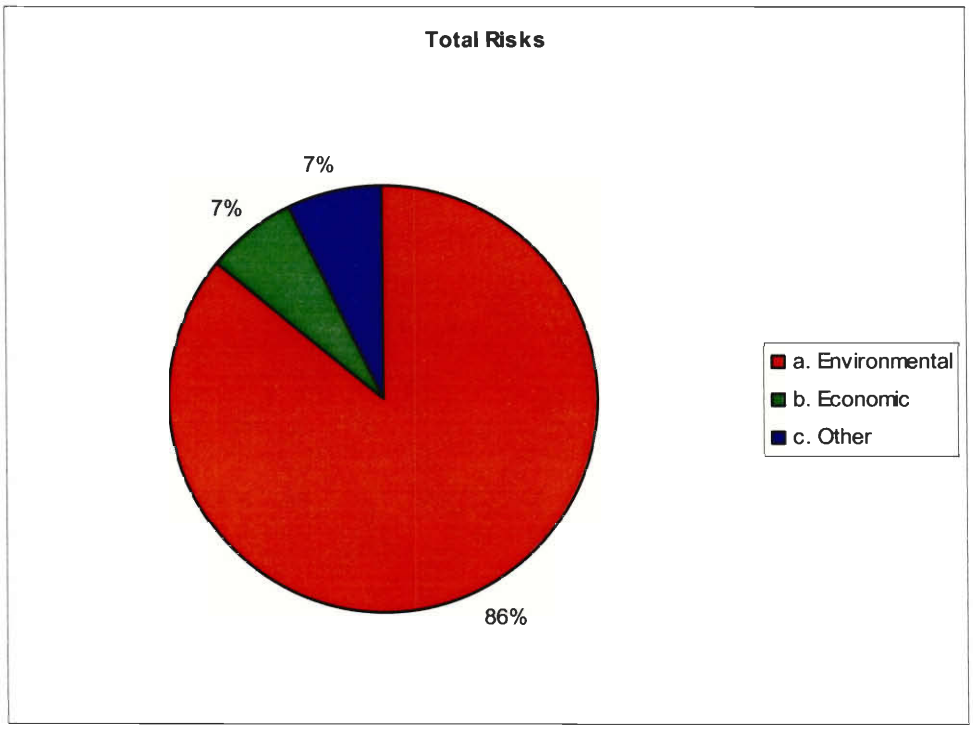

Figure 1: Generalization of Risks by Percent Response

We found that every non-government organization suggested that risks were environmental, while only 2 of 5 government agencies believed risks to be environmental. One government agency did not answer the question and the other two were split between economic risks and other risks

.

General Benefits:

Twelve of the 16 interviewees listed economic benefits, two (SeaWeb and EDF) emphasized environmental benefits such as potential for wild stock replenishment, and two groups did not answer (EPA and PCSGA). No groups categorized benefits into the "other" classification. This information is depicted in the graph below.

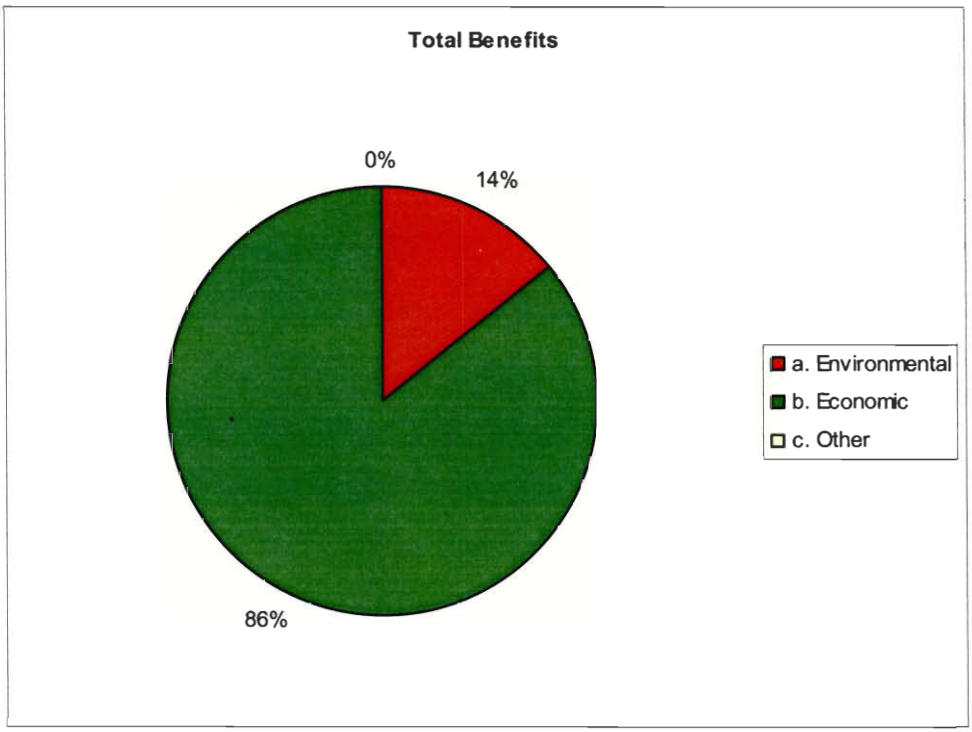

Figure 2: Generalization of Benefits by Percent Response

Specific Risks:

The risks of aquaculture are numerous. The groups interviewed recognized the following as risks associated with aquaculture:

- Coastal land property values may decline.
- Commercial fishermen may loose jobs.
- Costs of aquaculture is high.
- Antibiotics can harm the ecosystem.
- Biodiversity pollution, interbreeding with wild fish, and GMOs are all concerns of aquaculture systems.
- Water quality may degrade.
- Diseases and pathogens can be easily transferred.
- Farmed fish may escape from cages.
- Fish oil and take away from wild stock's food.
- Chemicals and pesticides can harm the environment.
- Habitats can be destroyed.
- Invasive species can enter ecosystems.
- Mangrove destruction can occur.
- Nutrient waste comes from fish excrement.
- Land systems may occasionally overflow.
- General pollution occurs.
- Runoff from land systems may affect surrounding areas.
- High sediment loads in water bodies may be harmful.
- The continuing absence of aquaculture regulations.
- The occurrence of non-responsible aquaculture.

These risks cause arguments between stakeholders. Some of these issues, like fishmeal/fish oil use, general habitat destruction, and biodiversity pollution, are the heat of the debate. Groups tend to overlook the broader perspective. They do not compare aquaculture with land based farming practices. For example, fishmeal is said to be overused in aquaculture, detracting from natural food sources for fish. But only 35% of all fishmeal is used in aquaculture, 65% is used for terrestrial animals. Many NGOs believe mangrove destruction is a big problem with aquaculture, particularly shrimp farming, but this is not an issue in the United States (since there are no mangroves).

Specific Benefits:

Many of the people interviewed identified similar benefits of aquaculture. The benefits determined from the interviews are listed below, in no particular order:

- Aquaculture is a great source of protein and a low fat food source.
- U.S. aquaculture production will help lower the amount of seafood imports.
- Aquaculture is a secure source of seafood production.
- Aquaculture may assist poor areas and third world countries.
- Aquaculture allows a year round seafood supply.
- There is a potential for aquaculture to relieve wild stocks.
- Recreation can benefit from aquaculture.
- It may create jobs.
- It may reduce the seafood trade deficit.
- Aquaculture may create medical research opportunities, which will benefit humans.

As shown in Figure 3, seafood production was the most mentioned benefit of aquaculture. Eight NGOs and three government agencies identified seafood production as a benefit. The following organizations classified seafood production as the most important benefit of aquaculture: CI, SeaWeb, IAFWA, MBA, WWF. Relief of overfishing of wild stocks was the second most mentioned benefit. However, it was repeated that science has not proved aquaculture will allow wild fish to regenerate. Only one group, NOS, suggested aquaculture as a use to benefit medical research.

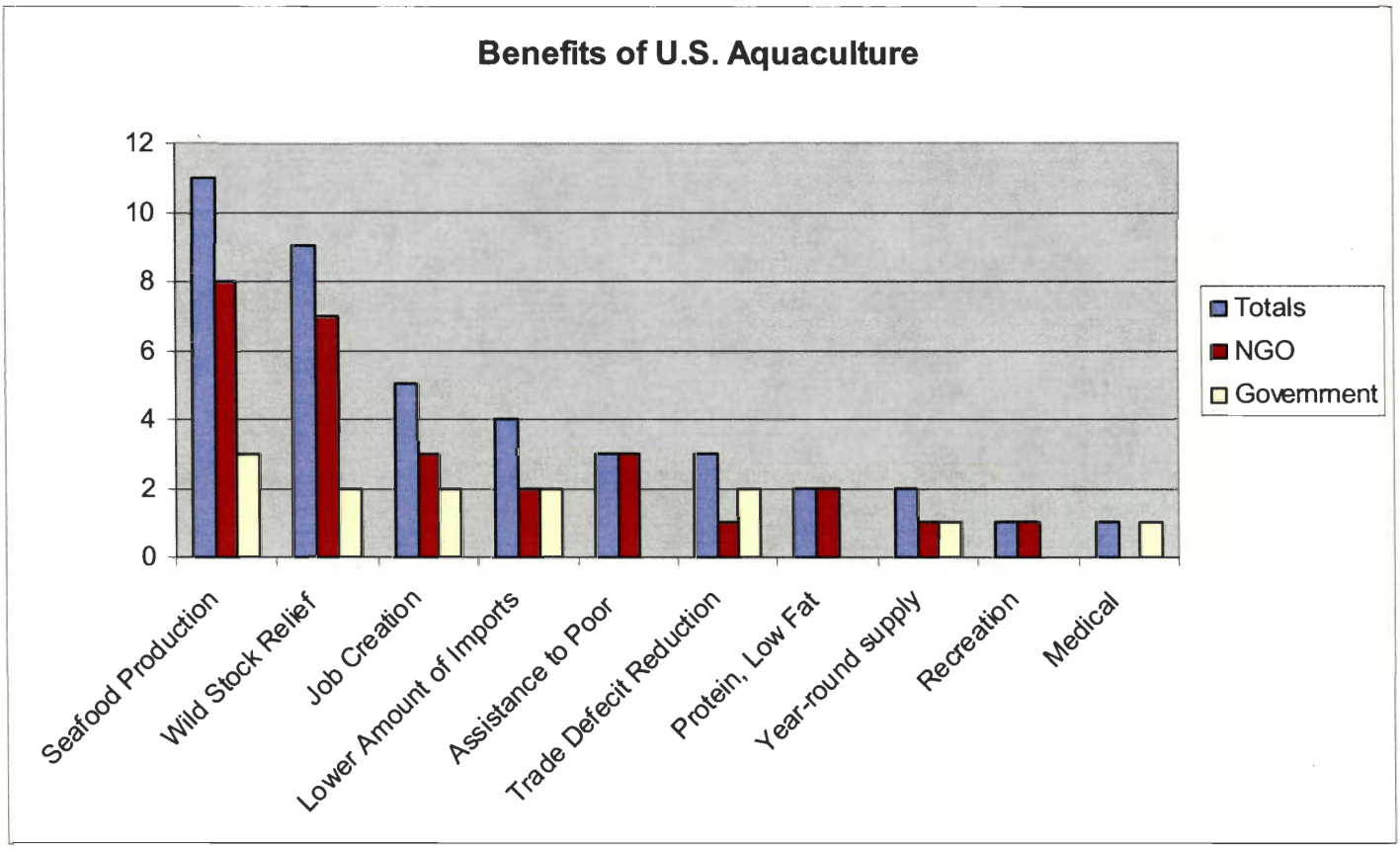

Figure 3: Benefits of United States Aquaculture

Question #5: Importance of Domestic and Foreign Aquaculture

Question: *The supply of seafood comes from a combination of fisheries and aquaculture. The United States imports more than $10B worth of seafood annually, the majority of which comes from aquaculture. How important do you think domestic aquaculture is to the U.S. seafood market? What about foreign aquaculture?*

This question originally was intended for use in categorization, but there was such a variety of answers to this question that we decided to use it as qualitative data. Groups said that domestic aquaculture production is limited and does not make up a large part of the seafood industry in the United States; foreign aquaculture imports play a much larger role. Aquaculture production will increase worldwide in the future.

Question #6: Policy and Regulation

Question: *Do you feel that current U.S. regulation and policy (relating to aquaculture) are adequate to preserve environmental quality in the U.S.? (Please explain.)*

Half of the NGO responses said that aquaculture regulations and policies were inadequate at this point in time; the other half was spread equally between the feelings of adequacy or a viewpoint different from the aforementioned two. What is important to note is that 75% felt current policy is in someway inadequate or insufficient. On the government end of the spectrum, there were no responses that adequate policy exits. It is interesting to note that two groups (IAFWA and NFI) believe that adequate policy exists. Most felt that current policy has yet to be all inclusive and comprehensive. Regulations fail to adequately represent or govern all of the numerous types of aquaculture that exist. When examined, the results lend further support to the inadequacy of current policy. It is obvious that much more work is needed before any policy will be fully accepted.

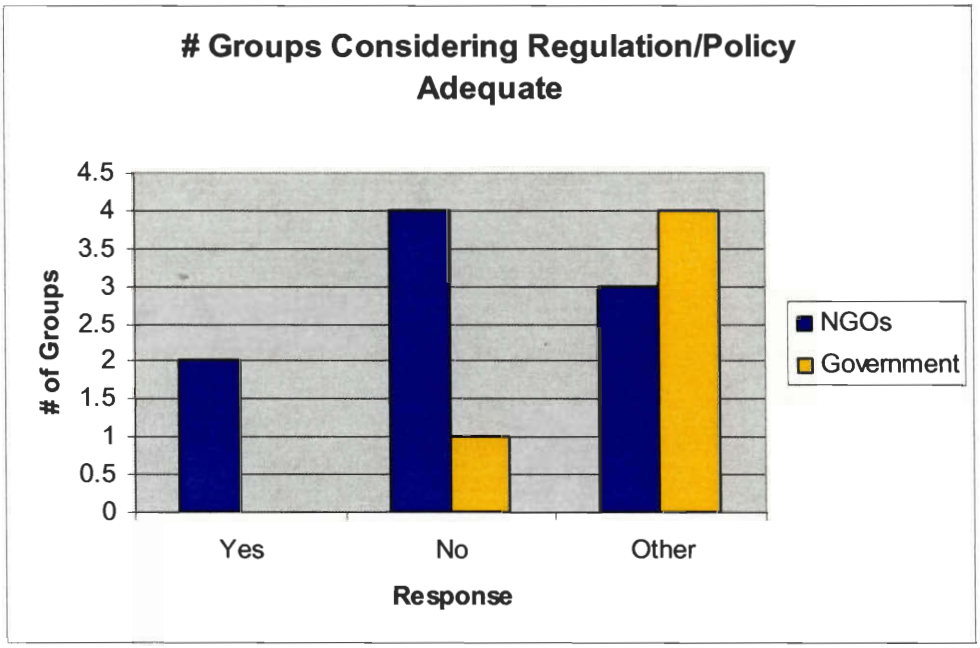

Figure 4: Groups that Consider Current Regulation and Policy Adequate

Question # 7: Wild Stock Enhancement

Question: *Over fishing of wild stocks has become a serious concern. Does your organization see a role for aquaculture in alleviating this problem? (Please explain)*

A huge concern facing the world is the depletion of our natural wild fish stocks. Aquaculture has the potential to be an answer to this problem. The project team sought to learn whether those organizations interviewed felt the same way. Not a single response said that renewal was impossible, as shown in Figure 5.

Organizations that were not entirely supportive of this concept felt this way for several reasons. CI believes that reestablishing wild stocks through aquaculture is a possibility. However, the science has not yet come far enough to confirm this assumption. Studies must be conducted over a long period of time to prove whether or not such a program would be truly effective. The NOS feels that restoration should not be the sole reason for the development of the industry, commenting that it would not hurt, but it would not be particularly helpful either. Those at SeaWeb are concerned about the pressure the aquaculture industry will place on wild stocks if carnivorous species are raised.

Aside from these few, most groups interviewed see aquaculture as not only a benefit to the seafood supply, but an answer to reviving the depletion of wild stocks in our oceans.

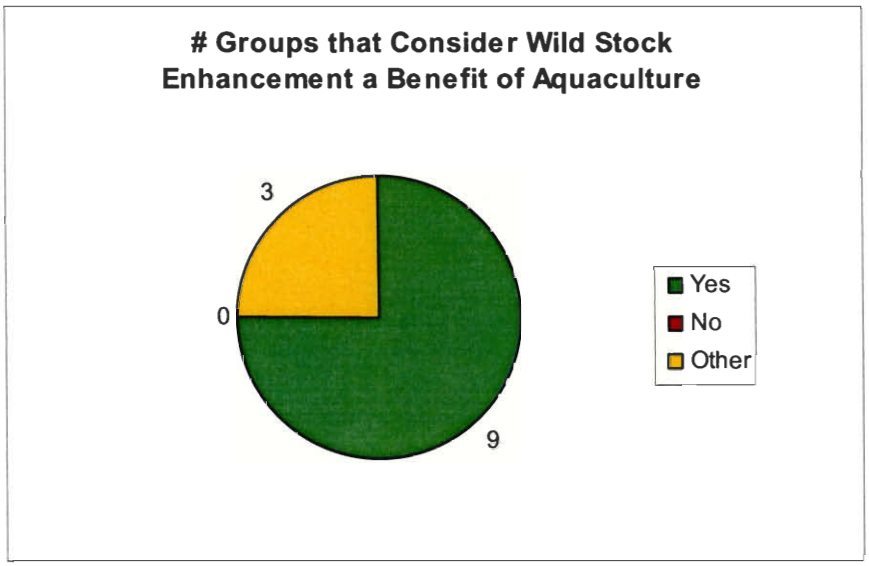

Figure 5: Number of Groups that Consider Wild Stock Enhancement Beneficial

Question # 9: Best Management Practices

Question: *Do you think development of best management practices is important to the general acceptance of aquaculture in the U.S.? If so, who should develop these guidelines?*

Best Management Practices (BMPs) are guidelines for the manner in which the aquaculture industry ought to be conducted. In our interviews, we discovered that most groups felt that BMPs were important in some manner. This response is shown in Figure 6. Whether or not they are specifically important to the acceptance of aquaculture in the United States could not be determined. The CI spokesperson mentioned that BMPs, though important, are designed more for the industry itself. The public does not often concern itself with where seafood is coming from, which allows aquaculture to be more

widely accepted. The AFI feels that BMPs should be used to develop consistencies within the industry.

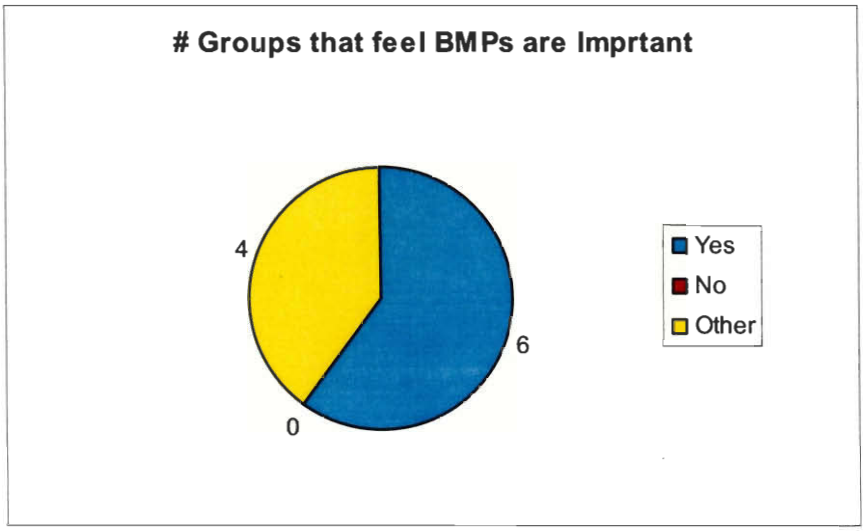

Figure 6: Number of Groups that feel BMPs are Important to General Acceptance

A misunderstanding occurred in our questioning process due to two questions. "Do you feel that current U.S. regulation and policy [related to aquaculture] are adequate to preserve environmental quality?" and "Do you think the development of best management practices is important to the general acceptance of aquaculture in the U.S.? If so, who should develop these guidelines?" (questions #6 and #9 on the NGO interview question set.) These questions caused the interviewees to give answers to two topics: who should develop U.S. regulation and policy [related to aquaculture] and who should develop BMPs. U.S. regulation and policy should be developed by the federal and local governments. BMPs should be developed by the industry, with NGO input.

Question #10: Attitude Scale

Question: *Please rate your organization (agency) on a scale from 1 to 5, 1 being completely opposed to aquaculture in the U.S., 5 being extremely in favor of it, and 3 being neutral. Then briefly explain why you chose this position.*

Group:	*Attitude Scale:*
Government Agencies:	
Environmental Protection Agency (EPA)	3 – 4
National Marine Fishery Service (NMFS)	4.5
National Ocean Service (NOS)	3 – 4
Seagrant	5
United States Aquaculture Program (USDA, CSREES)	0
Non Government Organizations:	
American Fisheries Society (AFS)	4
Blue Ocean Institute (BOI)	3
Conservation International (CI)	3 – 4
Environmental Defense (EDF)	3 – 4
International Association of Fish and Wildlife Agencies (IAFWA)	4 – 5
Louisiana State University Research Station	0
Monterey Bay Aquarium (MBA)	3
National Fisheries Institute (NFI)	4 – 5
Pacific Coast Shellfish Growers Association (PCSGA)	5
SeaWeb	0
World Wildlife Fund (WWF)	5

Table 2: The Placement of Groups on an Attitude Scale

All groups that answered this question were between neutral (3) and extremely in favor of aquaculture (5). We were surprised to find that WWF rated itself as a 5 and that NOS rated itself between 3 and 4. We would have expected to see WWF around 4 and NOS more towards 4 or 5.

Questions #11, #12: Final Information

These questions were developed to find other organizations and agencies to interview and to make sure we covered all important and relevant information during the interview. We found that many groups suggested interviewing people with whom we had already spoken. This enabled us to make sure we were on target. In regards to question #12, groups interviewed generally asked us for more details on our project and had nothing else to say.

9. Conclusions

Aquaculture is going to occur regardless of any opposition it faces. If the United States does not begin to take a leading role in aquaculture production, other countries' aquaculture products will continue to dominate the U.S. seafood market.

The growing human population results in an ever-increasing need for seafood. Aquaculture can provide this necessary food source. However, there are various environmental hazards, economic issues, and political views that are preventing the industry from reaching its full potential. These views inhibit the industry by not allowing more updated policies to be agreed upon.

Many environmental organizations are not as opposed to aquaculture as in the past. There are a few reasons for this. Some groups have realized that the benefits of aquaculture outweigh the risks. Aquaculture, on a large scale, has the potential to positively affect our country in many ways. It can lead to economic development, provide employment opportunities and income, lower the seafood trade deficit, and can possibly help minimize over-fishing while providing a sustainable year-round food supply. The project team found that, in general, the NGOs interviewed were in favor of aquaculture provided that it is done in a sustainable and environmentally friendly manner.

Some NGOs were against aquaculture practices because their members were people directly part of the commercial fishing industry. Attitudes are changing, however, because these individuals, primarily concerned with their own livelihoods, recently have realized that profits due to commercial fishing practices are decreasing along with the

source of wild fish stocks, and other sources of income and seafood is necessary. Employment in aquaculture may be an option for them.

While a few obstacles currently remain, we are confident that most aquaculture stakeholders will unite and work through the environmental hazards and policy issues associated with aquaculture. With the proper science, guidelines, and management, aquaculture will successfully become an environmentally sustainable and economically beneficial industry to the United States.

10. Recommendations

The research conducted throughout this project has provided great insight into the aquaculture debate and the industry's future in the United States. Our analysis led us to a number of conclusions about the current state of the aquaculture industry, and enabled us to develop steps for the future. These recommendations are targeted at all key stakeholders in the debate as well as for future IQPs.

10.1 NOAA as a Key Player

This project used interviews to identify viewpoints on certain aquaculture issues. From the interviews, we discovered that many organizations favor aquaculture with some stipulations. Much of these relate to policy regarding, specifically, the perception of unsafe environmental impacts. The project team recommends that NOAA take the lead role in bringing together all stakeholders for a series of focus groups. If the environmental groups are hesitant to participate, NOAA should contract with an independent third-party who would run the focus group sessions, record comments, and bring the group together to form agreeable solutions.

These sessions, which should continue over a period of several months to enable the groups to become familiar with each other and build a "trust" that does not currently exist, would allow every organization to have some a say in the development of solutions.

10.2 Improvement of Public Awareness of Aquaculture

One interesting point that emerged during the project work was how the general public is misinformed, if not completely lacking in information about aquaculture. We learned that much of the scientific research on aquaculture stays within the scientific community. We feel that the public needs to be better informed, and therefore recommendation some improved mechanism to accomplish this. For example, the JSA should work with the aquaculture industry in the development and distribution to food stores and restaurants of simple, basic information (in the form of a pamphlet). This pamphlet would include information about products produced through aquaculture and the need to save diminishing wild seafood stocks.

Television commercials are the best method to reach many consumers, but funding for such an undertaking is unrealistic.

NOAA should publish more literature to help inform the general public about the benefits of aquaculture. Because the general public is important to the economic standing of the industry in the U.S., the more knowledge the public has, the more positively they will influence the industry. This could be done through sponsorship of projects (IQPs), but funding may be an issue.

10.3 More unified policies overseen by a single, lead federal agency

In the recent years, a standardized and updated policy has been one of the missing ingredients to establishing a safe and sustainable industry in the United States. Many of the organizations and government agencies that we interviewed felt the U.S. is in dire need of set policies that establish environmental regulations. Most of the policy making is still done on the state level. The federal government needs to produce a unified policy that is very thorough and inclusive, while at the same time, is easy to update and amend, so that it can evolve as needed.

Because the current JSA is comprised of a dozen or more federal agencies, coordination and cooperation can be difficult to achieve. Therefore, we recommend that the legislation currently under development by NOAA include provisions for NOAA to assume the lead federal role for aquaculture in the U.S.

10.4 Third party agency to oversee all NGO input

There was a strong feeling from many of the NGOs interviewed that in order to properly assimilate data and viewpoints and regulate the aquaculture industry, a third-party agency or organization should be developed, tasked with the sole mission of overseeing all NGO input to government agencies. They felt that this group would provide a more objective stance and incorporate all points most effectively. This idea is reasonable, but not likely to happen.

10.5 Future Interactive Qualifying Projects

The debate over aquaculture is far from over. It is our recommendation that future IQP groups work with NOAA to lay the groundwork for successful focus group meetings. While the stakeholders will not be as interested in meetings with WPI (or any university) students as they will in meeting with governmental agency officials, an IQP project can be an excellent tool to bring groups together for initial meetings. Those first meetings, to be held before an official focus group is formed, can begin to build the trust necessary for focus sessions to be successful. For example, such IQP-sponsored meetings could closely examine some of the aquaculture issues, such as what specific BMPs should be considered in uniform guidelines, or what aquaculture operations in the U.S. are models for demonstrating environmental sustainability.

References

American Institute of Biological Science. Mission Statement. [Online] http://www.aibs.org/about-aibs/mission_statement.html 4 Nov. 2003.

Aquaculture. [Online] http://www.epa.gov/owow/oceans/yoto/oceanrpt/aquacult.html 5 Nov. 2003.

Aquaculture and Fishing. March 2000 [Online] http://www.nalms.org/bclss/aquaculture.html 15 Dec. 2003

Aquaculture Operations-Best Management Practices. 12 July 2002. Environmental Protection Agency. [Online] http://www.epa.gov/agriculture/anaqubmp.html 15 Dec. 2003

Aquaculture: The Choice is Ours. SeaWeb Aquaculture Clearinghouse.

Arsenault, Mark, Tom Beigbeder, Nathan Johnson, and Kevin Pearce. Current and Future Regulation of Marine Aquaculture. 2002.

Baird, Ron. Interview. Sea Grant, Washington D.C. Personal Interview, 4 Dec. 2003.

Baker, Beth. Keeping aquaculture environmentally friendly. [Online] http://www.aibs.org/bioscience/bioscience-archive/vol48/aug.98.ww.html 4 Nov. 2003

Benjamin, Natasha. "Aquaculture's Next Wave Threatens to Swamp Commercial Fisheries: Moving Offshore, Out of Sight and Free of Scrutiny." Fishermen's News Dec. 2002. [Online] http://www.pcffa.org/fn-dec02.htm. 30 Oct. 2003.

Benn, Joanna. The Rising Tide of Fish Farming. 12 Aug. 2003. World Wide Fund for Nature. http://panda.org/news_facts/newsroom/features/news.cfm?uNewsID=8281 15 Sep. 2003.

Berg, U. C. "Guidelines for the production of environmental management of coastal aquaculture development." FAO Fisheries Technical Paper. No. 328. Rome; FAO, 1992.

Betts, Kellyn. "Will fish farms feed the world?" Environmental Science & Technology Dec. 2003: 429-430.

Black, Kenneth D., ed. Environmental Impacts of Aquaculture. Boca Raton: Sheffield Academic Press, 2001.

Bostick, Katherine. World Wildlife Fund for Nature, Washington D.C. Personal Interview, 14 Nov. 2003.

Brownstein, Carrie. Interview. Blue Oceans Institute. Phone Interview, 5 Dec. 2003.

Bunsick, Susan. Interview. National Marine Fisheries Service, Washington D.C. Personal Interview, 19 Nov. 2003.

Coastal America Website. [Online] http://www.coastalamerica.gov

Coastal Services. NOAA Coastal Services Center. Vol. 4, Issue 5. Sep./Oct. 2001

Dianto, Jennifer. Monterey Bay Aquarium, California. Phone Interview, 1 Dec. 2003.

Downey, Robin. Pacific Coast Shellfish Growers Association. Phone Interview, 2 Dec. 2003.

Ecological Society of America. Issues in Ecology. Washington, D.C.: Ecological Society of America, 2001.

Environmental Defense. EDF Report Details Environmental Impacts of Aquaculture Industry. [Online] http://www.environmental defense.org/pressrelease 3 Nov. 2003.

Environmental Defense. Practicing Science with a Conscience. [Online] http://www.environmentaldefense.org 3 Nov. 2003.

"Factory Farms of the Sea." World Watch Magazine September/October 2003. [Online] http://www.worldwatch.org/press/news/2003/08/18/ 15 Sep. 2003.

Fitzgerald, Tim, Environmental Defense, New York
Phone Interview, 2 Dec. 2003.

Froelich, Adrienne. Washington Watch: A Sea Change for US Ocean Policy? [Online] http://www.aibs.org/washington-watch/washington_watch_2002_03.html 4 Nov. 2003.

Garrett, E. Spencer, Carlos Limo dos Santos, and Michael L. Jahncke. "Public, Animal, and Environmental Health Implications of Aquaculture." Emerging Infectious Diseases 3 (1997): 453-457.

Geubtner, Jessica, American Fisheries Society.
Phone Interview, 2 Dec. 2003.

Gifford, K.Dun. Water Farming Initiative: Researching for Solutions. Oldways Preservation & Exchange Trust. [PowerPoint Presentation.] Boston: 11-13 Jan. 2001.

Goldburg, Rebecca and Tracy Triplett. Murky Waters: Environmental Effects of Aquaculture in the U.S. 1997.

"Governing Offshore Aquaculture Issues and Policies." [Online] http://www.pacaqua.org/Offshore_Mariculture_Brochure.pdf 12 Sep. 2003

Graham, Cheryl. National Ocean Service, Washington D.C.
Personal Interview, 19 Nov. 2003

Hagler, Mike. Shrimp: the Devastating Delicacy. May 1997. [Online] http://www.greenpeaceusa.org/reports/biodiversity/shrimp/shrmp03.html 15 Sep. 2003.

Hargreaves, John. Interview. Louisiana State University. Phone Interview, 21 Nov. 2003.

Harmony, Anne Marie. The Need for Rapid Development of US Aquaculture Industry-Polyculture and Integrated Fish-Seaweed Farming that Promotes Waste Recycling. 8 May 2002. [Online] http://home.san.rr.com/aharmony/marinepoll.html

Herman, Dan. National Fisheries Institute. Phone Interview, 2 Dec. 2003.

Johnson, Howard M, and Ian Doré. 1994 Annual Report on the United States Seafood Industry. Bellevue: H.M. Johnson and Associates, 2003.

Jordan, Marta, and Marvin Rubin, EPA: Oceans Department, Washington D.C. Personal Interview, 1 Dec. 2003

Kay, Jane. "Suits challenge labeling of farmed salmon: Chemical pigments make fish pink." 24 April 2003.

Khan, Stephen. "High Hopes for Scottish 'fish ranch.'" The Observer. 2 Feb 2003. [Online] http://politics.guardian.co.uk/scotland/story/0,9061,887403,00.html 16 Sep. 2003.

LeBlanc, Justin. "The Global Fish Market and the Need for Multilateral Fishing Disciplines." Economic Perspectives Jan 2003. [Online] http://usinfo.state.gov/journals/ites/0103/ijee/leblanc.htm. 4 Nov 2003.

Manning, Peter. The Role of NGOs in the governance of fisheries. 11 Dec. 2003. http://E:/html\issues\sustain\roleengo\default.htm.

Marine Aquaculture Zoning: A Sustainable Approach in the Growth of Offshore Aquaculture. Mississippi Alabama Sea Grant Legal Program. 11 Sep 2003. http://www.olemiss.edu/orgs/masglp/zoning.htm

Mayeaux, Max, USDA, Washington D.C.
Personal Interview, 1 Dec. 2003

Monterey Bay Aquarium Seafood Watch. Developing Sustainable Seafood Recommendations. Sep. 2003.

Monterey Bay Aquarium Seafood Watch. Aquaculture: Is Fish Farming the Answer? [Online] http://www.mbayaq.org/cr/cr_seafoodwatch/sfw_ac.asp 3 Nov. 2003.

Monterey Bay Aquarium. Sustainable Farmed Shrimp, Fair-Trade Organic Coffee Put Conservation on the Menu at Aquarium Café. [Online] http://www.mbayaq.org 21 Nov. 2002.

National Aquaculture Act of 1980. Act of September 26, 1980. Public Law 96-362.

National Marine Fisheries Service. Fisheries of the United States, 2002. Washington D.C.: U.S. Government Printing Office, 2003.

National Oceanographic and Atmospheric Association. Chinese Aquaculture Industry. [Online] http://www.lib.noaa.gov/china/aquaculture.htm#areaoutput 16 Sep. 2003.

Naylor, Rosamond L, et al. Effects of Aquaculture on World Fish Supplies. [Online] http://www.epa.gov/watertrain/step8aabstr.html 5 Nov 2003.

NGO Statement Concerning Unsustainable Aquaculture To The United Nations Commission On Sustainable Development, May 1996. [Online] http://darwin.bio.uci.edu/~sustain/shrimpecos/declare2.html 28 Oct. 2003.

NOAA Office of Legislative Affairs. Coastal Zone Management Act. [Online] http://www.legislative.noaa.gov/Legislation/czma.html 7 Nov. 2003.

Oldways Website. [Online] http://www.oldwayspt.org

O'Neill, Brendan. SeaWeb, Rhode Island.
Phone Interview, 14, Nov. 2003.

Planning and Management for Sustainable Coastal Aquaculture Development. [Online]
http://www.seaweb.org/resources/sac/sustainable.html

Rieser, Alison and Susan Bunsick. "Offshore Marine Aquaculture in the U.S. Exclusive Economic Zone (EEZ): Legal and Regulatory Concerns."

Schiermeier, Quirin. "Fish farms' threat to salmon stocks exposed." Nature 425 (Oct. 2003): 753.

Schwaab, Eric. International Association of Fish and Wildlife Agencies.
Phone Interview, 21 Nov. 2003.

Semroc, Bambi, Conservation International, Washington D.C.
Personal Interview, 12 Nov. 2003

Shipley, J. Brook. "United States Ocean Commission Declares Oceans Are In Trouble." Fisheries July 2003: 26-27.

Stephens, Francine. Seafood Solutions: A Chef's Guide to Ecologically Responsible Fish Procurement.

Stickney, R.R. and J.P. McVey, eds. Responsible Marine Aquaculture. New York: CABI publishing, 2002.

Testimony of Rebecca Goldburg, Ph.D., Environmental Defense Concerning Marine Aquaculture Before the U.S. Commission on Ocean Policy. Boston: 23 July 2002.

"The Promise of a Blue Revolution." The Economist 7 Aug. 2003. [Online] http://www.economist.com/business/displayStory.cfm?story_id=1974103 15 Sep. 2003.

The State of World Fisheries and Aquaculture. Food and Agriculture Organization of the United Nations. [Online] http://www.fao.org/docrep/005/y7300e/y7300e00.htm 6 Sep. 2003.

United States. Marine Board. Marine Aquaculture: Opportunities for Growth. Committee on Assessment of Technology and Opportunities for Marine Aquaculture for the United States. National Academy Press. Washington, D.C., 1992.

Wijkström, U., A. Gumy, and R. Grainger. State of the World Fisheries and Aquaculture. 2002. FAO Fisheries Department. 15 Sep 2002. [Online] http://www.fao.org/docrep/005/y7300e/y7300e00.htm

World Aquaculture Outlook 2002. [Online] http://www.aquaculturemag.com/siteenglish/printed/buyers/web-worldoutlook.pdf 14 Sep. 2003.

11. Appendices

Appendix A: National Oceanic and Atmospheric Administration

The National Oceanic and Atmospheric Administration (NOAA) is a government agency whose mission is "to describe and predict changes in the Earth's environment, and conserve and manage wisely the Nation's coastal and marine resources to ensure sustainable economic opportunities" (http://www.noaanews.noaa.gov/stories/iq.htm). NOAA has evolved over the years from various other agencies, beginning in 1807 with the Survey of the Coast which was started by President Thomas Jefferson. The Survey of the Coast proposed surveying the United States coastal area in order to promote future commerce (http://www.history.noaa.gov/cgsact.html).

The current NOAA was developed by President Nixon in October of 1970. This agency was created "...for better protection of life and property from natural hazards...for a better understanding of the total environment...[and] for exploration and development leading to the intelligent use of our marine resources..." (http://www.history.noaa.gov/noaahistory.html).

NOAA's organizational structure is quite complex. NOAA is overseen by the Department of Commerce. From here, the structure spreads out to a large array of groups and people. The NOAA can be grouped into six organizations; National Weather Service, Satellites and Information, Fisheries, Ocean Service, Research, and Marine & Aviation Operations (http://www.noaa.org/index.html).

The Research division of NOAA includes the National Sea Grant College Program. Sea Grant was established by Congress to "promote the wise use of coastal and

ocean resources" (Ron Baird, Personal Interview, 4 Dec 2003). This office engages the nation's universities in coastal management issues, hopefully leading to the capacity in the U.S. to deal with related problems. They use K-12, undergraduate, and graduate students to create new knowledge as a mechanism to enhance economic growth. Sea Grant realizes that "aquaculture is a place based science with large social and cultural problems."

From weather, water, and climate forecasting and to monitoring the environment, fisheries, and coastline, the National Oceanic and Atmospheric Administration is a vital agency in keeping the United States running (http://www.history.noaa.gov/noaahistory.html).

Appendix B: Aquaculture Cage Systems

There are three main categories of culturing facilities; onshore, offshore, and nearshore. Nearshore systems are located along the coast in shallow waters and are visible from the coast. These systems are the most economically feasible and until new technology makes relocation possible they will remain to be the most common type of facility. Therefore it is in the companies' best interest to make them appear aesthetically acceptable and environmentally sound. Typical nearshore culture systems are cages or net pens which are supported by a floating structure. Natural currents and tidal flow provide water flow. Pollution from unused food and feces is sometimes a problem with nearshore systems, due to overfeeding and massive amounts of stock in a small area. Human fecal contamination also poses a threat in coastal waters and results in elevated risk due to the fact that fish can be carriers for disease.

Onshore culture systems allow the facility to move off the coast, which would enable other recreational activities to take place. However, there are more limiting factors associated with onshore systems. It is not as economically viable to build an onshore facility due to the fact that you must pump water from a nearby marine source and an aeration unit is also needed. The cost of high-quality water is expensive because the water must be pumped and, if needed, must be cooled, heated, or treated. This system may be less profitable than others due to the high cost of equipment needed.

Offshore systems may be the best possible solution. They can alleviate many of the problems associated with coastal marine aquaculture activities, since the system would be moved off the coast to less sensitive areas. There are drawbacks to this system, which make it less appealing though. The facility must be built out of expensive

materials that can endure harsh conditions and unpredictable weather. Also, receiving approval to use the waters offshore may be time consuming and expensive. The operating costs, safety of workers, and the reliability of systems in the absence of continuous monitoring rule out this system as most viable.

All three of these systems usually involve the use of cages or nets. The cages must be made out of materials that are strong, durable, and non-toxic, but also must be made so that there is a sufficient circulation of water through it. Adequate water flow is critical to the health of the fish. It allows oxygen to enter the cage and it removes wastes at the same time. The size of the cage depends on the accessibility of space, the method of harvest, and the availability of aeration. The frame of the cage must be coated with a water-resistant substance to maintain durability. The cage itself usually is constructed out of plastic coated welded wire, solid plastic mesh, or nylon netting. Lids are placed on top of the cage to prevent fish from escaping, predators from entering, and to prevent people from having access to the cage. A lot of planning and development must go into each cage to ensure that the maximum amount of healthy and safe product can be manufactured without damaging effects on the environment.

The use of high-density cage systems is one of the most intense forms of aquaculture in the industry. Due to the excessive amounts of fish in a small area it is also one of the most problematic systems. One problem that faces these systems is that the fish are difficult to observe, due to turbid water and the simple fact that fish are generally shy and attempt to hide from people. This makes it hard see whether the fish are stressed or diseased. Feeding is the only time when the fish come to the surface, so it is critical to observe the fish during this time and to note any behavioral changes. If

disease or parasites are present, it may be because the water itself is stressed due to an accumulation of nutrients, from overfeeding, or from excessive waste accumulation. Excessive plankton blooms, surface scum, strong odors, excessive weed growth, or a change in watercolor, all are signs of water stress. If fish farming is continued in an area that is stressed, it can cause major harm to the environment that may be irreversible.

Appendix C: Non-government Questions

Please keep in mind that we are looking for the best representation of your organization's opinions.

1. Please describe the mission and environmental vision of your organization.

2. Do you have any literature explaining your organization's stance on aquaculture? If so, can you provide us with a copy or access to it?

3. Briefly explain your organization's position/policy and activities related to aquaculture.

4. What do you think the risks and benefits of aquaculture are? What are your opinions concerning them?

5. The supply of seafood comes from a combination of fisheries and aquaculture. The United States imports more than $10B worth of seafood annually, the majority of which comes from aquaculture. How important do you think domestic aquaculture is to the U.S. seafood market? What about foreign aquaculture?

6. Do you feel that current U.S. regulation and policy (related to aquaculture) are adequate to preserve environmental quality? (Please explain)

7. Over fishing of wild stocks has become a serious concern. Does your organization see a role for aquaculture in alleviating this problem? Can you please explain?

8. What is your organization's vision for the U.S. aquaculture industry?

9. Do you think development of best management practices is important to the general acceptance of aquaculture in the U.S.? If so, who should develop these guidelines?

10. Please rate your organization on a scale from 1 to 5, 1 being completely opposed to aquaculture in the U.S. and 5 being strongly in favor of it, and 3 being neutral, and then briefly explain why you chose this position.

11. What other organizations would you recommend we contact on this issue?

12. Do you have additional thoughts or comments that we did not already discuss?

Appendix D: Government Questions

Please keep in mind that we are looking for the best representation of your agency's opinions.

1. Please describe the general mission of your agency and any positions/stances/activities you have regarding aquaculture.

2. Do you have any literature explaining your agency's stance on aquaculture? If so, can you provide us with a copy or access to it?

3. What role does your agency play in regards to the aquaculture industry?

4. What does your agency think the risks and benefits of aquaculture are? What is your agency's opinion regarding these issues?

5. The supply of seafood comes from a combination of fisheries and aquaculture. The United States imports more than $10B worth of seafood annually, the majority of which comes from aquaculture. How important do you think domestic aquaculture is to the U.S. seafood market? What about foreign aquaculture?

6. Do you feel that current U.S. regulation and policy (related to aquaculture) are adequate to preserve environmental quality? (Please explain)

7. Are there any polices related to aquaculture that your agency is currently working on or plans to propose? (Please explain).

8. Over fishing of wild stocks has become a serious concern. Does your organization feel that aquaculture will play a role in alleviating this problem? (Please explain)

9. What is your vision for the U.S. aquaculture industry?

10. Please rate yourself on a scale from 1 to 5, 1 being completely opposed to aquaculture in the U.S. and 5 being strongly in favor of it, and 3 being neutral, and then briefly explain why you chose this position.

11. What other agencies would you recommend we contact on this issue?

12. Do you have additional thoughts or comments that we did not already discuss?

Appendix E: Best Management Practices

Best management practices are written to address nutrient assessment and over-enrichment. They are a set of guidelines intended to provide a common sense and cost effective suggestions for achieving a basic level of environmental protection of water quality. They also attempt to protect water quality from non-point source pollution (http://www.epa.gov/agriculture/anaqubmp.html).

Qualified Engineers and Biologists are required to decide what an acceptable practice for a given specific situation, in this case aquaculture. Ten principles are kept in mind when writing these BMPs. They are certainty, communication, consultation, cost-effectiveness, efficiency, flexibility, integrity, practicality, responsibility and transparency (http://www.nalms.org/bclss/aquaculture.html, 2003). BMPs vary with each industry and most often with each state. They are not yet standardized for the whole nation.

It is the responsibility of commercial or industrial operators to follow these guidelines. For many BMPs there exist legislation, policy, rules, regulations and other legal requirements, which take precedence over Best Management Practices. BMPs are more suggestions then rules. Some examples of them are; avoiding usage of drugs or pesticides unless an outbreak; holding treated water until drug has degraded fully, using hatchery stock where possible; using non-native species only where escape is impossible; using feed appropriate for the size of the stock, and not over-feeding the stock.

Appendix F: Analysis Criteria

In order to quantify and better analyze the data collected from our interviews, a set of criteria was developed. This allowed us to categorize the data by the type of response for further analysis. Questions 1-3, 5, 8, and 11-12 were not used in our quantitative analysis.

Question #4, the risks and benefits associated with aquaculture, was divided into two parts. The first described the general risks and benefits, and the second part reported the specific risks and benefits.

For the first part (general risks and benefits), we gave an overall rating of environmental, economic, or other, based on the frequency of listed benefits of each category. The specific risks and benefits were collected from the interviews and then listed. The project team realizes that this is a very subjective way to analyze our data, but our interpretation of the data is what was important. For questions 6, 7, and 9, the responses were categorized by yes, no, or other.

Upon establishing the criteria, a spreadsheet was created to log all the data. The number one was assigned to a positive response and zero for a negative. Responses were then totaled and analyzed. This spreadsheet of criteria can be found on the accompanying CD.

Appendix G: American Fisheries Society

Jessica Geubtner
Policy and Development Coordinator
301/897.8616 x215
Tuesday 2 Dec 2003

AFS
www.fisheries.org

jgeubtner@fisheries.org
1:00 PM

1. **Please describe the mission and environmental vision of your organization.**

   AFS is the oldest non-profit fishing organization in the United States. It has about 9000 members from the U.S. and other countries consisting of government fish and wildlife agencies, academia, fishermen. Its mission is to provide sustainable fisheries and a healthy environment. Conservation is a small part of that.

2. **Do you have any literature explaining your organization's stance on aquaculture? If so, can you provide us with a copy or access to it?**

   www.fisheries.org Look at the AFS policy statement on aquaculture.

3. **Briefly explain your organization's position/policy and activities related to aquaculture.**

   In summary, position is absolutely in support of it. Demands for seafood are increasing. Best Science Practices (BSPs), better techniques. They feel that much more scientific research and federal and state regulation need to be put in place. Their stance is that they are in support but with a focus on scientific research and making better aquaculture practices. They suggest health monitoring of systems and better standards. Food safety legislation. They also want a good curriculum to be taught in schools, which will help promote future science.

4. **What do you think the risks and benefits of aquaculture are? What are your opinions concerning them?**

   RISKS: diseases from genetics, pollution, escape, interbreeding in wild, waste problems, run off, eutrophication.

   BENEFITS: Great source of protein in food. Economics: Lower amount of imports, source of food production and will help minimize imports. Improvement in practices will help third world countries.

5. **The supply of seafood comes from a combination of fisheries and aquaculture. The United States imports more than $10B worth of seafood annually, the majority of which comes from aquaculture. What role do you think domestic aquaculture plays in the U.S. seafood market? What about foreign aquaculture?**

   The U.S. is behind Asia. Ultimately the U.S. needs to run their aquaculture sites in the best environmental and economic manner. There are effects on fishermen and we need to be aware of this. She doesn't know enough about foreign aquaculture.

6. **Do you feel that current U.S. regulation and policy are adequate to preserve environmental quality? (Please explain)**

We are headed in the right direction as aquaculture grows...but now, no. These regulations aren't static. Science and research is being done and will continue. Regulations need to be put in place before the industry really takes off.

7. **Over fishing of wild stocks has become a serious concern. Does your organization see a role for aquaculture in alleviating this problem? Can you please explain?**

   Definitely.

8. **What is your organization's vision for the U.S. aquaculture industry?**

   Wants to see it grow; it is growing and will continue to do so. They are in support of the industry.

9. **Do you think development of best management practices is important to the general acceptance of aquaculture in the U.S.? If so, who should develop these guidelines?**

   We feel that it should be done ultimately by federal government. Need guidelines to promote consistencies but with state input.

10. **Please rate your organization on a scale from 1 to 5, 1 being completely opposed to aquaculture in the U.S. and 5 being extremely in favor of it, and then briefly explain why you chose this position.**

    4

11. **What other organizations would you recommend we contact on this issue?**

    World Aquaculture Society. Oceania.

12. **Do you have additional thoughts or comments that we did not already discuss?**

Appendix H: Blue Oceans Institute

Carrie Brownstein
Research and Outreach Coordinator
631/367.0041
Friday 5 Dec 2003

Blue Oceans Institute
www.blueoceansinstitute.org
cbrowstein@blueoceaninstitute.org
10:30 AM

1. **Please describe the mission and environmental vision of your organizing.**

   Mission statement on web. They have a seafood consumer education program and put out a seafood mini guide.

2. **Do you have any literature explaining your organization's stance on aquaculture? If so, can you provide us with a copy or access to it?**

   Seafood mini guide, a paper on conservation and practices, and the Seafood researcher almanac. (Provided us with through web and email.)

3. **Briefly explain your organization's position/policy and activities related to aquaculture.**

   No longer work on policy. When at Audubon they did. They support sustainable aquaculture and realize that some ways are better than others and they support sustainable methods. They use a set of criteria to evaluate aquaculture systems and support those that meet these criteria. Industry is here and growing. There is "no sense in not acknowledging that." What matters is how it is done. They target sustainable practice knowledge at certain people in attempt to shift the market. Chefs, supermarkets, etc. Don't deal with industry. They have an active partnership with Environmental Defense on research and evaluation. EDF (farmed research) and Blue Oceans (wild research). Criteria a joint effort.

4. **What do you think the risks and benefits of aquaculture are? What are your opinions concerning them?**

   RISKS: Feed. Fishmeal and oil. Wild/ocean impact. Antibiotics. Waste water. Quality in natural systems. Pollution. Chemicals. Pesticides. Ecological impact from non-native species.

   BENEFITS: Lower pressure on wild stocks. Replace wild capture (?) Improve quality through filter feeders, etc. Economic gains

5. **The supply of seafood comes from a combination of fisheries and aquaculture. The United States imports more than $10B worth of seafood annually, the majority of which comes from aquaculture. What role do you think domestic aquaculture plays in the U.S. seafood market? What about foreign aquaculture?**

   Foreign aquaculture is huge. Tilapia, shrimp, salmon.

6. **Do you fell that current U.S. regulation and policy are adequate to preserve environmental quality? (please explain)**

   Impression is we have better regulations than the rest of the world. Currently done on a state by state basis. Need more specific federal policy.

7. **Over fishing of wild stocks has become a serious concern. Does your organization see a role for aquaculture in alleviating this problem? (please explain)**

   Yes (see question 4)

8. **What is your organization's vision for the U.S. aquaculture industry?**

   Dependent upon the consumer demand and the market. If there is a movement for safe sustainable aquaculture seafood, industry will take off.

9. **Do you think development of best management practices is important to the general acceptance of aquaculture in the U.S.? If so, who should develop these guidelines?**

   BMPs are important for healthy ecosystems. Acceptance is in the environmental community, not so much general acceptance. So far away from general consumers knowing what's going on. Seafood Choices Alliance

10. **Please rate your organization on a scale from 1 to 5, 1 being completely opposed to aquaculture in the U.S. and 5 being extremely in favor of it, then briefly explain why you chose this position.**

    In favor of sustainable aquaculture. 3

11. **What other organizations would you recommend we contact on this issue?**

    Seafood Choices Alliance byway of www.seaweb.org

12. **Do you have additional thoughts or comments that we did not already discuss?**

    (We noticed she was cautious, reluctant to answer questions.)

Appendix I: Conservation International

Bambi Semroc
Manager, Agriculture and Fisheries
202/912.1554
Friday 14 Nov 2003

Conservation International
www.conservation.org

bsemroc@conservation.org
12:00 PM

1. **Please describe the mission and environmental vision of your organization.**

   The protection of biodiversity in hot spots around the world. The hot spots dictate where they work. She works at the Center for Leadership with industry to find solutions to problems (www.celb.org).

2. **Do you have any literature explaining your organization's stance on aquaculture? If so, can you provide us with a copy or access to it?**

   Aquaculture is new to them, so not a lot of literature exists. Shrimp, catfish, tilapia, salmon. Industry exhausting alternative species.

3. **Briefly explain your organization's position/policy and activities related to aquaculture.**

   30 field offices which work closer with farmers and industry. Basically only work with aquaculture if it is a threat to hotspots. In Mexico, shrimp industry is bad. They work to buy out trawlers and keep industry clean. At headquarters they do research of what consists of good/bad aquaculture.

4. **What do you think the risks and benefits of aquaculture are? What are your opinions concerning them?**

   RISKS: Mangrove destruction, and fish oil, effluent, bio-diversity pollution, antibiotics, fungicides.

   BENEFITS: Secure food sources, year round supply. Potential for it to relieve wild stocks, but this needs to be proven first.

5. **The supply of seafood comes from a combination of fisheries and aquaculture. The United States imports more than $10B worth of seafood annually, the majority of which comes from aquaculture. What role do you think domestic aquaculture plays in the U.S. seafood market? What about foreign aquaculture?**

   Domestic: catfish is a huge part of industry in Mississippi, freshwater ponds. Domestic is shrimp, salmon.

6. **Do you feel that current U.S. regulation and policy are adequate to preserve environmental quality? (Please explain)**

   Developing effluent standards in draft form, which is a good step forward. The EPA is doing this. Conservation International does no lobbying.

7. **Over fishing of wild stocks has become a serious concern. Does your organization see a role for aquaculture in alleviating this problem? Can you please explain?**

Fisheries project looks at wild stocks. One of the caveats: if supply is more from aquaculture, science must be better. Potential is there but the science isn't quite there.

8. **What is your organization's vision for the U.S. aquaculture industry?**

   Most of their work is international.

9. **Do you think development of best management practices is important to the general acceptance of aquaculture in the U.S.? If so, who should develop these guidelines?**

   She thinks aquaculture is widely accepted because most people don't think about where their seafood comes from. There is a role for BMPs, to raise awareness of companies buying a lot of fish. BMPs are really more for the industry side.

10. **Please rate your organization on a scale from 1 to 5, 1 being completely opposed to aquaculture in the U.S. and 5 being extremely in favor of it, and then briefly explain why you chose this position.**

    Mostly neutral. 3-4. See it as a way to take the pressure off of wild fish.

11. **What other organizations would you recommend we contact on this issue?**

    WWF, EDF+, Seattle?, Natural Resource Defense Council (NRDC), Greenpeace

12. **Do you have additional thoughts or comments that we did not already discuss?**

    Importance to economy in U.S: Greater imports, domestic just won't cut it.

    In general, they are working on a report for next year that will get out general knowledge. They also want a copy of our final report.

Appendix J: Environmental Defense

Tim Fitzgerald	Environmental Defense
	www.environmentaldefense.org
212/616.1230	timfitzgerald@environmentaldefense.org
Tuesday 2 Dec 2003	10:00 AM

1. **Please describe the mission and environmental vision of your organization.**

   See website for this information.

2. **Do you have any literature explaining your organization's stance on aquaculture? If so, can you provide us with a copy or access to it?**

   He emailed us stuff

3. **Briefly explain your organization's position/policy and activities related to aquaculture.**

   Currently most of it is related to the seafood of which there are a few different parts. They are trying to do research on many prevalent seafood items in the U.S. seafood market. Many of these items come from aquaculture production. Not all aquaculture is bad. They realize if it is done right, it could relieve pressures on wild fisheries. He and Rebecca Goldburg work fulltime on the seafood project. They analyze items that have aquaculture processes and try to have separate criteria (standards). Vanessa asked question and answer was that there are more wild caught than aquaculture, but it is shifting the percent towards aquaculture. About ¾ of U.S. seafood comes from imports. China is the biggest aquaculture producer. We import most of our seafood but it isn't a majority. At the moment wild dominates.

4. **What do you think the risks and benefits of aquaculture are? What are your opinions concerning them?**

   BENEFITS: possibility to relieve pressure on wild fisheries. Aquaculture technology is going forward at a rapid rate. A big factor is that they are getting more efficient but not necessarily better. In general, shrimp in the U.S. is better than Southeast Asia. In the U.S., shrimp is done in closed ponds. The industry is really trying in the U.S. For example, Maine will probably have better environmental regulations and worker safety than Chile.

   J's Question: Growing certification in seafood in general is a good idea, but not sure about individual programs. However, there is a growing trend for that kind of stuff, but again, he's not sure. There is a new regulation in the U.S. called "country of origin" labeling which is trying to tell consumers where their seafood comes from. EDF could be in support of any kind of certification effort done properly. Any certification system is not going to happen globally. It's a utopian dream that just really won't happen. 80-90 percent of salmon is farmed.

5. **The supply of seafood comes from a combination of fisheries and aquaculture. The United States imports more than $10B worth of seafood annually, the majority of which comes from aquaculture. What role do you think domestic aquaculture plays in the U.S. seafood market? What about foreign aquaculture?**

Foreign aquaculture plays a bigger role in the U.S. Tilapia is in top 10 most consumed. 70-80 percent is found in Asia. Tilapia is the fish of the future, the fish that will satisfy the protein demand. They grow fast in any kind of water and are a low fat, white fish. But they are native to Africa and can be destructive when they escape. Tilapia is the "aquaculture poster fish."

6. **Do you feel that current U.S. regulation and policy are adequate to preserve environmental quality? (Please explain)**

   Not really. There are no broad or all encompassing policies and it would be hard to do that. Regulations for all types are hard because there are such a wide variety of practices and it would be difficult to do that. This doesn't mean they shouldn't try to implement some kind of standards. Nationwide it has to be government and development of any policy or regulation needs to have input from various stakeholders and from the industry themselves. A lot of times people don't follow any national guidelines because those people weren't involved in making them. There really is an emphasis on local and specific industries.

7. **Over fishing of wild stocks has become a serious concern. Does your organization see a role for aquaculture in alleviating this problem? Can you please explain?**

   Yes, see question 1.

8. **What is your organization's vision for the U.S. aquaculture industry?**

   "A lot of aquaculture operations are definitely headed in the right direction." Salmon and shrimp farming are pretty poor. EDF supports efforts to do things better in the United States. Regional offices work to improve practices. For example, the Texas office works with shrimp farmers. The industry is coming forward looking for help to get the work to people so they know "hey, we're trying here."

9. **Do you think development of best management practices is important to the general acceptance of aquaculture in the U.S.? If so, who should develop these guidelines?**

   Absolutely. But there aren't too many around. There are only a few BMPs in a few states like Florida, Washington or Oregon. Definitely important and definitely something that has to have input from every possible entity in one way or another. Aquaculture operations are so diverse and the industry has to come forward.

10. **Please rate your organization on a scale from 1 to 5, 1 being completely opposed to aquaculture in the U.S. and 5 being extremely in favor of it, and then briefly explain why you chose this position.**

    Say 3.5, 4. "We at the seafood program realize that people are going to eat clams, shrimp, and salmon and that we can't just say, don't eat these things. We recommend better options." By-catch, etc is bad. There are farms that are environmentally invisible and don't impact the bottom. There are instances where aquaculture is superior to wild fishing in regards to ecological impacts. Should focus on domestic imports. Shrimp is a very popular item that we urge people to avoid. EDF is in support of promoting better practices.

11. **What other organizations would you recommend we contact on this issue?**

    Brendan O'Neill – SeaWeb

The Blue Ocean Institute – Carrie Brownstein
Farmedanddangerous.com

12. Do you have additional thoughts or comments that we did not already discuss?

Appendix K: Environmental Protection Agency

Marta Jordan and Marvin Rubin	EPA: Oceans Department. www.epa.gov/ost/guide/aquaculture
202/566.1049	Jordan.marta@epa.gov
Monday 1 Dec 2003	3:30 PM

1. **Please describe the general mission of your agency and any position/stances/activities you have regarding aquaculture.**

   Deal with the Clean Water Act involving all discharges and permits. Based on affordable technology, or Best Available Technology (BAT). Effluent Guidelines must be met by the industry. If industry chooses not to follow effluent guidelines, a permit writer must follow BPJ and BEJ. Water quality is done at the state level. They call aquaculture "Concentrated Aquatic Animal Production" (CAAP). The EPA protects surface and ground water. Goal is to implement zero discharge in the waters, which is covered by the Ocean Dumping Act, Clean Water Act, Safe Drinking. EPA's administrator has no other influence except to deal with all policies/laws. They get passed by administrator, with a small influence from OMB (Office of Management and Budget) and an interagency review, involves USDA, EDFA, NOAA, Department of the Interior (Fisheries and Wildlife).

2. **Do you have any literature explaining your agency's stance on aquaculture? If so, can you provide us with a copy or access to it?**

   We received a copy of the draft guidance for aquatic animal production: Development for proposed Effluent Limitations Guidelines and Standards for the AAP. We were also referred to their website and JSA website's FAQ.

3. **What role does your agency play in regards to the aquaculture industry?**

   Position involves Clean Water Acts and Effluent Guidelines propositions. They are trying to prevent pollution of the waters. People "should not pollute if they can afford not too." They try to mitigate economic stress on the businesses. Aquaculture has the potential for impacting large amounts of small businesses. The Regulatory Flexibility Act tries to help protect small businesses; goes through the OMB. If there is a significant impact on the business, then proposals must go thru congress.

4. **What does your agency think the risks and benefits of aquaculture are? What is your agency's opinions regarding these issues?**

   RISKS: They weigh out the problems and the benefits, which are still being examined. Much has to do with the suspended solids in water. They have been looking into the risks, but they are very difficult to quantify. EPA has tried to provide a balance. Many unstoppable events come into play like storms, overflowing facilities, which can lead to escape and inappropriate but unavoidable discharge.

5. **The supply of seafood comes from a combination of fisheries and aquaculture. The United States imports more than $10B worth of seafood annually, the majority of which comes from aquaculture. How important do you think domestic aquaculture plays is to the U.S. seafood market? What about foreign aquaculture?**

6. **Do you feel that current U.S. regulation and policy (regarding aquaculture) are adequate to preserve environmental quality? (Please explain)**

   BMPs allow more control over drug and chemical discharge, with possible reduction. The control of suspended solids and invasive/non-native species has a lot to do with sites and species. States often handle this, but the EPA has authority over chemicals. Aquaculture facilities use drugs. The EPA is working with the RDA in hopes of making effluent guidelines realistic.

7. **Are there any policies related to aquaculture that your agency is currently working on or plans to propose?**

8. **Over fishing of wild stocks has become a serious concern. Does your agency see a role for aquaculture in alleviating this problem? Can you please explain?**

9. **What is your agency's vision for the U.S. aquaculture industry?**

10. **Please rate your organization on a scale from 1 to 5, 1 being completely opposed to aquaculture in the U.S. and 5 being extremely in favor of it, and then briefly explain why you chose this position.**

    3-4

11. **What other organizations would you recommend we contact on this issue?**
    JSA, Seaweb, PEW, USDA

12. **Do you have additional thoughts or comments that we did not already discuss?**
    Started CAAP when there was a choice to pick from 4 new areas of research. They needed new guidelines for aquatic animals industry anyways. Each of the 4 new topics all dealt with nutrient discharge.

    They deal with industrial sources in terms of aquaculture, which is much better off then many other industries and their toxic discharge. We would "rather have aquaculture then another toxic industry."

Appendix L: International Association of Fish and Wildlife Agencies

Eric Schwaab
Resource Director
202/624.7890
Friday 21 Nov 2003

International Association of Fish and Wildlife Agencies
www.sso.org/iafwa
eschwaab@sso.org
10:00 AM

1. **Please describe the general mission of your organization.**

   It's a member organization; public fish and wildlife agencies are members in all 50 states, also in provinces of Canada. They represent the members, coordinate policy, positive multi-state conservation initiatives. Interested in potential effects of aquaculture on natural habitats. Members run hatcheries and IAFWA is an adjunct member of the Joint Subcommittee on Aquaculture.

   Official interaction with federal agencies. They are not a federal agency but they comment on proposals. No official stance on aquaculture. Active by making sure that it happens in a way that is friendly as possible to the environment.

2. **Do you have any literature explaining your organization's stance on aquaculture? If so, can you provide us with a copy or access to it?**

3. **Briefly explain your organization's position/policy and activities related to aquaculture.**

   a. Primary managers of fish and wildlife. Interested in potential effects of aquaculture on natural habitats. On one hand they run facility, on the other, concerned with habitats.
   b. Many members are involved in aquaculture. Activities include fish stocking and restoration

4. **What do you think the risks and benefits of aquaculture are? What are your opinions concerning them?**

   Benefits: food, can alleviate pressure on native species, as population goes up, and demand goes up, the stock goes down. This is why restoration is important. It is very effective. Tremendous restoration benefits. Recreational value.

   Risks: degrading of water quality, sediment loads, nutrient loads, potential for habitat impact, structure can impact naturally occurring bottom. Disease transmission, concentration, to native populations. Unintentional introduction of non-native species, or genetically changed species.

5. **The supply of seafood comes from a combination of fisheries and aquaculture. The United States imports more than $10B worth of seafood annually, the majority of which comes from aquaculture. What role do you think domestic aquaculture plays in the U.S. seafood market? What about foreign aquaculture?**

   Aquaculture in U.S. now is significant but not dominant, but it will become more and more important. Trying to bring it back home, which is difficult. Domestic and foreign aquacultures are both going to increase.

6. **Do you feel that current U.S. regulation and policy are adequate to preserve environmental quality? (Please explain)**

   Yes, for the most part. There are a few areas in need of development. Technology is advancing allowing growth and potential impacts. Evolving technology requires constant evolution of policy enforcement issues associated with this. Compliance isn't always adequate. Effective education and enforcement go hand in hand.

7. **Over fishing of wild stocks has become a serious concern. Does your organization see a role for aquaculture in alleviating this problem? Can you please explain?**
   Yes.

8. **What is your organization's vision for the U.S. aquaculture industry?**
   Not really a vision, aquaculture is a healthy part of economy. Stock restoration is important.

9. **Do you think development of best management practices is important to the general acceptance of aquaculture in the U.S.? If so, who should develop these guidelines?**

   Yes, BMPs are important. Federal and State water quality. Responsible for nutrient and sediment management and flow manage. Management of species has to be a partnership of state and federal fish and wildlife agencies. Placement has to be right. Need to put expertise to use.
   Ex of Chesapeake bay oysters.

10. **Please rate your organization on a scale from 1 to 5, 1 being completely opposed to aquaculture in the U.S. and 5 being extremely in favor of it, and then briefly explain why you chose this position.**

    In favor, 4 or 5, stipulations with adequate safeguards for environmental protection.

11. **What other organizations would you recommend we contact on this issue?**

    USDA Gary Jenson. gjensen@reeusda.gov
    EPA Marta Jordon

12. **Do you have additional thoughts or comments that we did not already discuss?**

    Should the U.S. take a leading role? Yes, should be a positive influence. We should set the example. We have a long history with environment protection, food safety. There is leadership in our past.

Appendix M: Louisiana State University

John A. Hargreaves
Associate Professor at
Aquaculture Research Station
225/765.2848
Friday 21 Nov 2003

Louisiana State University

jhargreaves@agcenter.lsu.edu
2:30 PM

1. **Please describe the mission and environmental vision of your organization.**

   Aquaculture industry? (He's being rhetorical.) There is none. Aquaculture is scattered, diverse, localized. The industry term hides that diversity. He works at LSU and before that at MSU. Mississippi has the largest aquaculture industry in the United States; the catfish farming industry. He is involved in doing work on this, and more recently interested in policy and environmental advocacy.

2. **Do you have any literature explaining your organization's stance on aquaculture? If so, can you provide us with a copy or access to it?**

   There is a website with his publications. At the research station he is working on genetics and water quality with research extension scientists.

   www.aquanic.com
   www.was.org

3. **Briefly explain your organization's position/policy and activities related to aquaculture.**

4. **What do you think the risks and benefits of aquaculture are? What are your opinions concerning them?**

   In New England, probably the most important industry is shellfish. Each type of aquaculture has its own benefits and risks. Salmon are getting picked on.

   BENEFITS: Example, catfish. In a historically depressed area, this has brought economic growth and jobs. Local economies would suffer without it. Money tends to cycle locally, and therefore the industry can have a greater impact locally. Money is earned locally and spent locally. Also, seafood production is good. Fish are going to have to come from somewhere.

   RISKS: invasive species, pathogens, farming impacts in general. Perception of risks is way out of balance. It needs to be weighed with what is being done by scientists. If science is done objectively, it is better. A risk is usually some kind of hazard. It is vital to look at magnitude, frequency, and probability.

5. **The supply of seafood comes from a combination of fisheries and aquaculture. The United States imports more than $10B worth of seafood annually, the majority of which comes from aquaculture. What role do you think domestic aquaculture plays in the U.S. seafood market? What about foreign aquaculture?**

   The yield from the oceans is maxed out. Do we want to produce? Fish tend to my more efficient than terrestrial animals at converting protein/.

6. **Do you feel that current U.S. regulation and policy are adequate to preserve environmental quality? (Please explain)**

   Effluent limitation guidelines. NRDC sued EPA for not enforcing the Clean Water Act. They had a consent agreement out of court. EPA agreed to look at different industries and apply effluent guidelines, to things like aquaculture. The size, diversity, and scale of industry all influence guidelines. They are only chipping around the edges. As a national problem, it is way overblown. Relative to other activities, aquaculture is a dead player. Certain locations may impact quality, but it is way overblown.

7. **Over fishing of wild stocks has become a serious concern. Does your organization see a role for aquaculture in alleviating this problem? Can you please explain?**

   In general, true, but not sure it is an either/or type of equation. It is true we need to rebuilt stocks and expand on aquaculture. Both will contribute to the increasing supply of seafood. The question assumes that total mass of protein is fish; we have to think about other forms of protein. Look at the overall protein supply of the U.S.

8. **What is your organization's vision for the U.S. aquaculture industry?**

   A lot of people saw them as the heroes. Most people have idealistic notions. He has seen that the industries of the U.S. have grown and will continue to grow sufficiently large that they move from the local/regional market to the global market. Shrimp imports impact the U.S. shrimp industry. Salmon industry is completing worldwide. Technology in the U.S. will lead the way, at least for a while. They will target domestic producers. U.S. has taken the lead in safe environmental practices but it is not important that we do so. Overall there is a good morality, and people are trying to do the right thing. We can take the lead by farms setting examples and other countries can show us the way. It's a little tough to regulate but the U.S. is pretty good so far.

9. **Do you think development of best management practices is important to the general acceptance of aquaculture in the U.S.? If so, who should develop these guidelines?**

10. **Please rate your organization on a scale from 1 to 5, 1 being completely opposed to aquaculture in the U.S. and 5 being extremely in favor of it, and then briefly explain why you chose this position.**

11. **What other organizations would you recommend we contact on this issue?**

12. **Do you have additional thoughts or comments that we did not already discuss?**

    Environmental action groups' principle concerns are to advocate their position, not science.

Appendix N: Monterey Bay Aquarium Seafood Watch Program

Jennifer Dianto
Seafood Watch Program Manager
831/647.6872
Monday 1 Dec 2003

Monterey Bay Aquarium
www.mbayaq.org
jdianto@mbayaq.org
3:30 PM

1. **Please describe the mission and environmental vision of your organization.**

   The mission of Monterey Bay Aquarium's Seafood Watch program is to shift the buying habits of seafood consumers and purveyors to support sustainable fisheries and aquaculture operations. Our three main goals are to (1.) Generate awareness about the sustainability of seafood sources, (2.) Develop regional and national seafood recommendations and distribute them via convenient pocket guides and other venues, and (3.) Strengthen our research base and make it more accessible to the public.

2. **Do you have any literature explaining your organization's stance on aquaculture? If so, can you provide us with a copy or access to it?**

   Yes. I have attached our document entitled, "Developing Sustainable Seafood Recommendations" which includes an overview of our aquaculture criteria.

3. **Briefly explain your organization's position/policy and activities related to aquaculture.**

   We evaluate types of aquaculture operations against our criteria for sustainability. Therefore, our position - whether we recommend that a certain aquaculture product is a "Best Choice" or something that consumers should "Avoid" depends on how that operation evaluates against our criteria. The only hard position we have on aquaculture is our definition of sustainable aquaculture.
   Sustainable Aquaculture:
   - minimizes the use of wild caught fish,
   - eliminates or reduces, to acceptable levels, the risk of deleterious effects on wild fish stocks,
   - eliminates or reduces, to acceptable levels, the risk of disease transfer to wild fish stocks,
   - conserves the structure, function, biodiversity and productivity of the surrounding ecosystem,
   - employs methods to reduce organic waste discharge and the resulting discharge is deemed to not adversely affect the surrounding ecosystem,
   - minimizes the use of chemicals including, but not limited to, antibiotics, pesticides, herbicides, algaecides, and insecticides, and their release to the environment, and
   - respects all local, national and international laws and utilizes a precautionary approach (which favors the conservation of the environment) for daily operations and industry expansion.

4. **What do you think the risks and benefits of aquaculture are? What are you opinions concerning them?**

   Aquaculture has a tremendous opportunity to maintain a supply of seafood while relieving pressure on wild fish. Many aquaculture operations are meeting this need in an

environmentally responsible way. Others are not. A risk of aquaculture is that of rapid expansion or continued operation in the absence of regulation, understanding or monitoring of environmental impact(s).

5. **The supply of seafood comes from a combination of fisheries and aquaculture. The United States imports more than $10B worth of seafood annually, the majority of which comes from aquaculture. What role do you think domestic aquaculture plays in the U.S. seafood market? What about foreign aquaculture?**

   Both domestic and international aquaculture have a place in the market. Domestic aquaculture can help provide not only a desirable supply of seafood, but can stimulate local economies and provide jobs. The same can be said for foreign aquaculture - which can help shape a new, healthy commodity for international trade.

6. **Do you feel that current U.S. regulation and policy are adequate to preserve environmental quality? (Please explain)**

   No - current U.S. regulation lacks consistent standards among the various governing local, state and federal agencies. The standards must also adhere to the precautionary principle. Since aquaculture is a relatively new industry in this country, its impacts (including an analysis of growth potential and impact over time) should be monitored closely. Any standards should be set with a window to adjust those standards to best respond to new information.

7. **Over fishing of wild stocks has become a serious concern. Does your organization see a role for aquaculture in alleviating this problem? Can you please explain?**

   Yes. With a growing global population coupled with an increased understanding of health benefits - people will want and need more seafood. Wild stocks simply cannot keep up with the demand without enduring poorly understood ecosystem impacts. Aquaculture provides the opportunity to meet demand, while maintaining the integrity of the ecosystem in which the product was reared.

8. **What is your organization's vision for the U.S. aquaculture industry?**

   Smart growth. We can learn from so many other agriculture and animal rearing industries that stocking density, treatment of effluent, use of antibiotics and other factors must be strategically addressed to avoid both a negative reputation and a negative impact on the environment. Standard Best Management Practices should be mandatory, implemented, monitored and enforced.

9. **Do you think development of best management practices is important to the general acceptance of aquaculture in the U.S.? If so, who should develop these guidelines?**

   Ah, I swear I didn't read question nine before I answered question eight! Seriously, yes, they are important, but they need more teeth. The term "best management practices" has unfortunately become a fluffy one in and of itself. Like the ISO accreditations, the industry needs something more sophisticated that should be developed by a committee not only of industry reps., but academic scientists, government regulators, and other stakeholders who understand the reality of running an aquaculture operation, the significance of maintaining a healthy environment, and the challenges to monitoring and enforcing such standards.

10. **Please rate your organization on a scale from 1 to 5, 1 being completely opposed to aquaculture in the U.S. and 5 being extremely in favor of it, and then briefly explain why you chose this position.**

    Overall we are neutral (3). When evaluating an aquaculture operation, we attempt to do so based on fact - and not inject a bias in either direction.

11. **What other organizations would you recommend we contact on this issue?**

    The Seafood Choices Alliance (www.seafoodchoices.com), Environmental Defense (www.environmentaldefense.org)

12. **Do you have additional thoughts or comments that we did not already discuss?**

    <<Recommendation Process 952003.doc>>

Appendix O: National Fisheries Institute

Dan Herman — NFI
www.nfi.org
703/524.8883
Tuesday 2 Dec 2003 — 3:30 PM

1. **Please describe the general mission of your organization.**

   They deal with everything from industry to restaurants and stores. They want an ample and sustainable industry.

2. **Do you have any literature explaining your organization's stance on aquaculture? If so, can you provide us with a copy or access to it?**

   Website.

3. **Briefly explain your organization's position/policy and activities related to aquaculture.**

   They are a science and technology group that is generally pro-aquaculture. They are made up of an executive board and committees. There were set up by a committee about 20-25 years ago. They propose policy and hold seminars and meetings and forums.

4. **What do you think the risks and benefits of aquaculture are? What are your opinions concerning them?**

   BENEFITS: Look at Howard Johnson's projection for 2020. There is an international exploitation of wild stocks and aquaculture needs to increase to meet need for food.
   RISKS: Environmental impacts

5. **The supply of seafood comes from a combination of fisheries and aquaculture. The United States imports more than $10B worth of seafood annually, the majority of which comes from aquaculture. What role do you think domestic aquaculture plays in the U.S. seafood market? What about foreign aquaculture?**

   Most seafood consumed is shrimp (1), tuna (2), and salmon (3), the majority of which is foreign imports. The importation of seafood causes a $7B trade deficit, which is 3rd after oil and cars. For the future, domestic production needs to gear up. The U.S. is an ideal location but regulations are holding the industry back. Marine aquaculture needs to "get on the stick." If it doesn't, the U.S. will be for the most part all import.

6. **Do you feel that current U.S. regulation and policy are adequate to preserve environmental quality? (Please explain)**

   Yes, adequate to preserve quality, though the EEZ and other areas are still developing; they have not been addressed yet.

7. **Over fishing of wild stocks has become a serious concern. Does your organization see a role for aquaculture in alleviating this problem? Can you please explain?**

Most definitely.

8. **What is your organization's vision for the U.S. aquaculture industry?**

9. **Do you think development of best management practices is important to the general acceptance of aquaculture in the U.S.? If so, who should develop these guidelines?**

   Industry should be making the policies and guidelines. "Keep EPA off our backs." BMPs are a way to address….

10. **Please rate your organization on a scale from 1 to 5, 1 being completely opposed to aquaculture in the U.S. and 5 being extremely in favor of it, and then briefly explain why you chose this position.**

    4 or 5. NFI is for aquaculture. They foresee it as the coming thing; a way to compliment fishing. However there is a conflict between the "old guard traditional fishermen" and fish farmers.

11. **What other organizations would you recommend we contact on this issue?**

    Talk to Howard Johnson

12. **Do you have additional thoughts or comments that we did not already discuss?**

Appendix P: National Marine Fisheries Service

Susan Bunsick
Marine Policy Consultant
301/713.2334 x102
Wednesday 19 Nov 2003

National Marine Fisheries Service
www.nmfs.noaa.gov
Susan.bunsick@noaa.gov
11:00 AM

1. **Please describe the general mission of your agency and any positions/stances/activities you have regarding aquaculture.**

   NOAA fisheries managing living resources in the EEZ. Commercial and recreational fishery manage management plans. Restrict number of fish, size, how they are caught. Aquaculture labs in regions. Milford CT, shellfish, hatcheries, how spawn, grow out. Galveston, TX, sea turtles. Manchester, Washington, salmon, trout, seaweed. Her slant is policy.

2. **Do you have any literature explaining your organization's stance on aquaculture? If so, can you provide us with a copy or access to it?**

   1998 NOAA developed aquaculture policy
   1999 became Dept. of Commerce Policy, it was research and now economic development comes into play.
   Recently, trying to clarify the role of NOAA vs. other agencies in aquaculture
   Laws don't say how to DO aquaculture. There was a regulatory gap and it's not clear who was in charge. At the end of 2001, Bill Hoagarth, head of NOAA Fisheries, created the NOAA fish aquaculture council. There is the" white paper" on aquaculture, a code of conduct for aquaculture, and the old legislation that is trying to be pushed through.
   NOAA now has aquaculture program, managed by Conrad Mahnken.

3. **Briefly explain your organization's position/policy and activities related to aquaculture.**

   See previous. Been drafting legislation for a few years. Their three goals are to develop legal and regulatory structure, develop research side (new species for commercial, species for boots of natural stocks), and develop responsible aquaculture (siting, impacts on environment, etc). They are working with EPA, Army Corps, and Coastal states.

   Join Subcommittee on aquaculture – chairman Meryl Broussard. (USDA).

4. **What does your agency think the risks and benefits of aquaculture are? What is your agency's opinion regarding these issues?**

   Economic and social benefits. Reduce trade deficit, domestic production, jobs, alternative career paths for fishermen, pressure off wild stocks.

5. **What role do you think domestic aquaculture plays in the U.S. seafood market? What about foreign aquaculture?**

6. **Do you feel that current U.S. regulation and policy are adequate to preserve environmental quality? (Please explain)**

   See above.

7. **Are there any policies related to aquaculture that your agency is currently working on or plans to propose? (Please explain.)**

8. **Over fishing of wild stocks has become a serious concern. Does your organization see a role for aquaculture in alleviating this problem? Can you please explain?**

   Yes, takes pressure off, provides alternative sources, year round supply

9. **What is your organization's vision for the U.S. aquaculture industry?**

   Essentially an environmentally safe sustainable industry. (see above)

10. **Please rate your organization on a scale from 1 to 5, 1 being completely opposed to aquaculture in the U.S. and 5 being extremely in favor of it, and then briefly explain why you chose this position.**

    Officially, they are supportive. 4, borderline 5. There is a great deal of internal opposition because people are responsible for environment. Aquaculture has to be done right.

11. **What other organizations would you recommend we contact on this issue?**

    Pietro Parravano, Pacific Associate of Professional Fishermen
    Dan Herman, National Fisheries Institute.
    Marta Jordan, EPA Effluent Limitations.
    John Colt (john.colt@noaa.gov) with NOAA fisheries
    Kevin Amos, Aquatic Animal Health Plans
    K. Dun Gifford – Oldways

12. **Do you have additional thoughts or comments that we did not already discuss?**

Appendix Q: National Ocean Service

Cheryl Graham	NOS
Evaluation team leader	www.nos.noaa.gov
301/713.3155 x106	Cheryl.Graham@noaa.gov
Wednesday 19 Nov 2003	11:00 AM

1. **Please describe the general mission of your agency and any positions/stances/activities you have regarding aquaculture.**

   NOS does coastal zone management and conduct research and evaluation of coastal programs at CZMA. Their interest in aquaculture is for NOS to have a role in coastal zone management. States currently can take federal funds to investigate aquaculture. Graham is on a matrix team representing NOS (possibly JSA?). NOS looks at the EEZ and stock enhancement. NCCOS would like nearshore GIS mapping.

2. **Do you have any literature explaining your agency's stance on aquaculture? If so, can you provide us with a copy or access to it?**

3. **What role does your agency play in regards to the aquaculture industry?**

4. **What your agency think the risks and benefits of aquaculture are? What is your agency's opinion regarding these issues?**

   BENEFITS: jobs, less imports, environmentally sound aquaculture, fear of invasive species, and medical and biomedical opportunities.

5. **How important is domestic aquaculture to the U.S. seafood market? What about foreign aquaculture?**

   (Personal opinion) Currently the U.S. is not doing that much aquaculture, because it is still so experimental. People (aquaculturalists) are trying to get through regulations; it is all such a mishmash. In various states, it does not make sense who is giving permits. Who is going to regulate it? There currently is no consistent policy or procedure.

6. **Do you feel that current U.S. regulation and policy are adequate to preserve environmental quality? (Please explain)**

   There is a need for legislation and regulations, and they must be environmentally sound. Checks and balances are important to anything proposed. The question is who is going to take the lead. [Someone needs to] "take a strong stand and move forward." NOAA should have a strong position or at least be player. The thing is, aquaculture isn't the only thing in the ocean. There is fisheries management, non-point source pollution, and coastal growth.

7. **Are there any policies related to aquaculture that your agency is currently working on or plans to propose? (Please explain)**

8. **Over fishing of wild stocks has become a serious concern. Does your agency see a role for aquaculture in alleviating this problem? Can you please explain?**

Aquaculture won't hurt but is not particularly helpful. It shouldn't be the sole reason to do aquaculture.

9. **What is your agency's vision for the U.S. aquaculture industry?**

10. **Please rate your organization on a scale from 1 to 5, 1 being completely opposed to aquaculture in the U.S. and 5 being extremely in favor of it, and 3 being neutral, and then briefly explain why you chose this position.**

    Probably a 3, leaning towards 4. Aquaculture is worthwhile if done by science.

11. **What other organizations would you recommend we contact on this issue?**

    Susan Snow-Cotter, CZM program. Call individual states. Fisheries of Chesapeake Bay, Paton Robertson, Dep. Dir.

12. **Do you have additional thoughts or comments that we did not already discuss?**

    NOAA hasn't stepped up to the table because of budget problems. "The reality is budget and budget priorities." There are also a lot of other ecosystem issues. Aquaculture isn't taking a front seat due to other agendas.

    The U.S. should take a lead and showing other nations that aquaculture can be done safely but budget and organization priorities are in the way.

Appendix R: Pacific Coast Shellfish Growers Association

Robin Downey
Executive Director
360/754.2744
Tuesday 2 Dec 2003

Pacific Coast Shellfish Growers Association
www.psca.org
RobinDowney@pcsga.org
12:00 PM

1. **Please describe the mission and environmental vision of your organization.**

   She initially wanted to mention that shellfish aquaculture is really different from other aquaculture because they don't feed the shellfish; the shellfish biofilter the water (cleanse the water) and that the feces and pseudo-feces become fertilizer for the sea grasses.

2. **Do you have any literature explaining your organization's stance on aquaculture? If so, can you provide us with a copy or access to it?**

3. **Briefly explain your organization's position/policy and activities related to aquaculture.**

   Methods: they grow oysters mostly, on the ground like they naturally would. Do have some other methods depending on what the shellfish is marketed for. Long lining system is PVC poles with a line between them that the oyster clutch (babies, essentially) hangs on to. This is the second most common method. The third is growing the shellfish in bags on the beach. In Alaska, the alternative is suspending in the water column, primarily sub tidal. Clams are grown on the ground 99 percent of the time, and hand raked up. Just a few growers use bags for clams.

   They don't currently do a good job of getting information out to the public. They are developing brochures, posters, and talking to chefs etc, and writing lots of letters. Basically baby steps.

4. **What do you think the risks and benefits of aquaculture are? What are your opinions concerning them?**

   Risks of shellfish farming: It has been done on the West coast for 130 years. They originally worked with the native oyster (Olympia oyster) but that became over-harvested due to pollution from mills so enterprising Japanese Americans brought over the Japanese oyster. The Japanese Schick oyster has been harvested on the west coast since about the 1920s. Some "piggy backers" like the Manila clam, a non-native species, came over with them and are now farmed. One of the pitfalls of shellfish farming is the bringing in of pests to the oysters like spartina, an invasive weed. This is not native and takes over estuastaries. They believe it came in from east coast oysters. At this point though, there are extremely strict programs in place that regulate all of the shellfish industry. They develop their own seeds in labs that are disease free and they get the proper permits.

5. **The supply of seafood comes from a combination of fisheries and aquaculture. The United States imports more than $10B worth of seafood annually, the majority of which comes from aquaculture. What role do you think domestic (shellfish) aquaculture plays in the U.S. seafood market? What about foreign aquaculture?**

There is a huge trade deficit and the west coast is positioned quite well to help offset this. They have no wild harvest for commerciality on the west coast, but do have naturally producing stocks on beaches for recreation.

6. **Do you feel that current U.S. regulation and policy are adequate to preserve environmental quality? (Please explain)**

7. **Over fishing of wild stocks has become a serious concern. Does your organization see a role for aquaculture in alleviating this problem? Can you please explain?**

8. **What is your organization's vision for the U.S. aquaculture industry?**

   Hope to grow the market and get people interested. Shellfish have an incredibly high amount of protein and very low fat. They hope to share information with consumers, but it really depends on the area of the country.

9. **Do you think development of best management practices is important to the general acceptance of aquaculture in the U.S.? If so, who should develop these guidelines?**

10. **Please rate your organization on a scale from 1 to 5, 1 being completely opposed to aquaculture in the U.S. and 5 being extremely in favor of it, and then briefly explain why you chose this position.**

    Far end – 5. The fact of the matter is that we need to feed people and fish are a healthy food source. Seafood is losing its edge in the U.S. and since other countries don't have healthy systems, the U.S. should take the lead. There is room for improvement of the industry, but overall it is pretty safe. We do need to come up with safe and sustainable ways to produce seafood. This is very important to the United States. But we need technology to improve. We need to look at the inputs of food and compare it to land based agriculture. There is less of a load (harm) to the natural environment with seafood farming.

11. **What other organizations would you recommend we contact on this issue?**

    East Coast Shellfish Growers Association – Bob Rhault or Ann Payne Roe (401) 783-6007 (she's his wife and editor with commercial fisheries news)

    Dan Swecker – director of the Washington Fish growers. Also a senator. (360) 273-5890 (H) and (360) 786-7638 (W)

12. **Do you have additional thoughts or comments that we did not already discuss?**

Appendix S: Sea Grant

Ron Baird
Director, Sea Grant
301/713.2448
Thursday 4 Dec 2003

NOAA Sea Grant
www.oar.noaa.gov/oceans-nsgo.html
Ronald.Baird@noaa.gov
2:30 PM

1. **Please describe the mission and environmental vision of your organizing.**

   Seagrant was established by Congress to promote wise use of coastal and ocean resources. They engage nations' universities in coastal management issues and build capacity in country to deal with problems. Involved with environmental literacy K-12, undergraduate and graduate work. They have programs of research, outreach, and education. Basically they want to create new knowledge. They support management of critical location based science. Information transfer (bringing info to the user). Inform public of policy. They use universities as a mechanism to enhance economic growth. "Venture capital" is distributed in every state. Aquaculture is a place based science, social, cultural problems. They engage their constituents.

Q. How do you engage the public?

Advisory board for every program. Leaders on issues, scientists, Congress. Every program has extension capability. Engage community. Communication office. We press to publication. Objective unbiased reputation. Job is to provide information.

Q. How successful is public education?

Message is received. Do they do enough? Nature of promotion? "Message first" organization. Story first, glory later.

2. **Do you have any literature explaining your organization's stance on aquaculture? If so, can you provide us with a copy or access to it?**

3. **Briefly explain your organization's position/policy and activities related to aquaculture.**

4. **What do you think the risks and benefits of aquaculture are? What are your opinions concerning them?**

   RISKS: 50% is policy. Realize "aquaculture is a capital intensive industry." Equipment, siting, raising difficulty, lots of risk. Disease related issues are catastrophic. Organism health is a concern.

   Technology is there. Need for permitting and licensing. Problems are manageable. Water quality as well.

5. **The supply of seafood comes from a combination of fisheries and aquaculture. The United States imports more than $10B worth of seafood annually, the majority of which comes from aquaculture. What role do you think domestic aquaculture plays in the U.S. seafood market? What about foreign aquaculture?**

6. **Do you fell that current U.S. regulation and policy are adequate to preserve environmental quality? (please explain)**

   The U.S. doesn't have comprehensive policy. Environmental protection falls to legal system. Bits and pieces from different groups. Some states are pretty comprehensive but it varies state-to-state. Multiple jurisdiction. USDA governs inland. NOAA oversees oceans. Need a lead agency. Aquaculture is going to happen in other countries and the U.S. could set the pace for the industry.

7. **Over fishing of wild stocks has become a serious concern. Does your organization see a role for aquaculture in alleviating this problem? (please explain)**

8. **What is your organization's vision for the U.S. aquaculture industry?**

9. **Do you think development of best management practices is important to the general acceptance of aquaculture in the U.S.? If so, who should develop these guidelines?**

10. **Please rate your organization on a scale from 1 to 5, 1 being completely opposed to aquaculture in the U.S. and 5 being extremely in favor of it, then briefly explain why you chose this position.**

    5 all the way. Sea Grant is the leader in marine aquaculture and technology development.

11. **What other organizations would you recommend we contact on this issue?**

12. **Do you have additional thoughts or comments that we did not already discuss?**

Appendix T: SeaWeb

Brendan O'Neill	SeaWeb
SeaWeb Clearinghouse	www.seaweb.org
401/272.8822	boneill@seaweb.org
Friday 14 Nov 2003	10:00 AM

1. **Please describe the mission and environmental vision of your organization.**

   Raise awareness of environmental impacts, good and bad, and encourage a sustainable industry

2. **Do you have any literature explaining your organization's stance on aquaculture? If so, can you provide us with a copy or access to it?**

   Brochures and reports available on website

3. **Briefly explain your organization's position/policy and activities related to aquaculture.**

   Position – need for aquaculture in the future but must be done right and sustainable
   Activities – create awareness. Distribute material (website, mail). Inform public, government, other organizations, and commercial fishing industry

4. **What do you think the risks and benefits of aquaculture are? What are your opinions concerning them?**

   Tough to generalize.
   BENEFITS: some provide more and healthier seafood; jobs; filter feeders
   RISKS (again generalized): pollution, invasive species, disease, nutrient waste, habitat destruction, risk to commercial industry, coastal land property value decline

5. **The supply of seafood comes from a combination of fisheries and aquaculture. The United States imports more than $10B worth of seafood annually, the majority of which comes from aquaculture. What role do you think domestic aquaculture plays in the U.S. seafood market? What about foreign aquaculture?**

   Is it a majority? Shrimp and domestic catfish. Domestic plays a small role. Foreign plays a much larger role and is increasing.

6. **Do you feel that current U.S. regulation and policy are adequate to preserve environmental quality? (Please explain)**

   Inadequate. Policy is pro-development and doesn't consider environmental aspects. Effluent discharge policy draft. Weak compared to other industries. Offshore "develop at all costs." Environment takes a backseat to development.

7. **Over fishing of wild stocks has become a serious concern. Does your organization see a role for aquaculture in alleviating this problem? Can you please explain?**

   Possibly. Too many forms. Many dependent on wild fisheries (salmon). Increased pressure. "Tuna 'fattening'" Needs to be independent of wild fisheries. Price drop if aquaculture is a type caught in domestic industry. Traditional fishermen increase efforts, and in turn pressure, to compensate and cut their losses.

8. **What is your organization's vision for the U.S. aquaculture industry?**

   Sustainable industry that benefits coastal communities with no damage to the environment.

9. **Do you think development of best management practices is important to the general acceptance of aquaculture in the U.S.? If so, who should develop these guidelines?**

   BMP good! Question is who develops. Third party needed. Comprised of all stakeholders. Outside the conflicting sides.

10. **Please rate your organization on a scale from 1 to 5, 1 being completely opposed to aquaculture in the U.S. and 5 being extremely in favor of it, and then briefly explain why you chose this position.**

    Too general for a single number. Salmon – 1. Filter feeders – 4. Perhaps a breakdown?

11. **What other organizations would you recommend we contact on this issue?**

    Institute for Agriculture and Trade Policy (MN). Friends of Bluehill Bay (ME). Contact will be coming in email

12. **Do you have additional thoughts or comments that we did not already discuss?**

    Question about project itself and purpose.

Appendix U: United States Department of Agriculture

Max Mayeaux
Aquaculture Program Specialist
202/401.3352
Monday 1 Dec 2003

USDA, CREES
www.reeusda.gov
mmayeaux@csrees.usda.gov
2:00 PM

1. **Please describe the general mission of your agency and any positions/stances/activities you have regarding aquaculture.**

   Refer to the website. He plays a lead role in the JSA. Meryl Broussard is the head chairman. This committee was developed in the Aquaculture Act of 1980.

2. **Do you have any literature explaining your agency's stance on aquaculture? If so, can you provide us with a copy or access to it?**

   http://ag.ansc.purdue.edu/aquanic/jsa/index.htm
   http://www.reeusda.gov
   http://www.reeusda.gov/1700/about.htm
   http://www.nass.usda.gov/census/census97/aquaculture/aquaculture.htm

3. **What role does your agency play in regards to the aquaculture industry?**

   They have a role in the JSA, which is the intercommunication between agencies. Currently Max is working on the effluent task force.

4. **What does your agency think the risks and benefits of aquaculture are? What is your agency's opinions regarding these issues?**

   BENEFITS: Food and fiber, though it comes at a cost.

   RISKS: Costs, but can be mitigated by researching for environmentally safe new ways of production.

5. **The supply of seafood comes from a combination of fisheries and aquaculture. The United States imports more than $10B worth of seafood annually, the majority of which comes from aquaculture. How important do you think domestic aquaculture is to the U.S. seafood market? What about foreign aquaculture?**

   There is a very low percentage of aquaculture in the U.S., except for the catfish industry. It is the largest in the U.S., about 98% or production. Louisiana crawfish, gulf coast oyster industry, NE salmon, and shrimp all are going through tough times due to the cheap foreign imports
   Foreign imported seafood in the number two import next to oil. Seafood plays a major role in the U.S. trade deficit (about 7 billion, 3 billion of just in shrimp). The U.S. shouldn't necessarily take the lead. Other countries are addressing the issue of environmentally sound aquaculture.

6. **Do you feel that current U.S. regulation and policy are adequate to preserve environmental quality? (Please explain)**

   This is a whole other issue surrounding aquaculture. Talk to the EPA.

7. **Are there any policies related to aquaculture that your agency is currently working on or plans to propose?**

8. **Over fishing of wild stocks has become a serious concern. Does your organization see a role for aquaculture in alleviating this problem? Can you please explain?**

   Yes, meeting the consumer demand for seafood will relieve pressure on wild stocks, helping to replenish natural supply of seafood.

9. **What is your organization's vision for the U.S. aquaculture industry?**

   Cheap but the best production. JSA's vision is on their website. If the U.S. can't provide seafood cheap enough it will be bought somewhere else, just like any other world market.

10. **Please rate your organization on a scale from 1 to 5, 1 being completely opposed to aquaculture in the U.S. and 5 being extremely in favor of it, and 3 being neutral, and then briefly explain why you chose this position.**

    He could not rate the organization because he is only able to give his personal viewpoint.

11. **What other organizations would you recommend we contact on this issue?**

12. **Do you have additional thoughts or comments that we did not already discuss?**

Appendix V: World Wide Fund for Nature

Katherine Bostick
Aquaculture/Agriculture Researcher
202/822.3470
Friday 14 Nov 2003

World Wildlife Fund
www.wwfus.org

Katherine.bostick@wwfus.org
10:00 AM

1. **Please describe the general mission of your organization.**

   Broad mission is to preserve the environment's biodiversity, conservation. Very global.

2. **Do you have any literature explaining your organization's stance on aquaculture? If so, can you provide us with a copy or access to it?**

   She gave us handouts and directed us to www.enaca.org/shrimp

3. **Briefly explain your organization's position/policy and activities related to aquaculture.**

   Most of work is on shrimp, salmon, tilapia, trout, catfish, abalone mussels, scallops, seaweed. Goal of work is to come up with certifications. (ecolabeling) Certified environmentally friendly seafood. Identify BMPS. Need to develop a certification body, an independent third party. Global aquaculture alliance has a certification program for shrimp that is too industry driven. WWF works with industry ecologists, producers, and consumers. Current certification is not independent of industry.

4. **What do you think the risks and benefits of aquaculture are? What are your opinions concerning them?**

   RISK: Varies with species. Tilapia escapes into the wild and they thrive anywhere. FAO used them in programs but they escaped. Shrimp, effluent, fish oil and in shrimp and salmon feed.
   BENEFITS: can be done on small scale or sustenance food for local community. Puts seafood into market. Food production. Pressure off world stocks is a possibility but has not been proven yet. Aquaculture is the only way to meet the growing seafood demand. If done in an environmentally and socially manner can help. Jobs all around. Catfish farming in Louisiana and Mississippi has done a lot for some poor communities Catfish in AL, MS very different. AL has better environmental standards.

5. **The supply of seafood comes from a combination of fisheries and aquaculture. The United States imports more than $10B worth of seafood annually, the majority of which comes from aquaculture. What role do you think domestic aquaculture plays in the U.S. seafood market? What about foreign aquaculture?**

   One of the main problems is whether it is economically viable. Catfish is, but are shrimp farmers? Percent wise, aquaculture production doesn't do a lot. Foreign trade provides greater percent of seafood. The highest percent of shrimp comes from Brazil. 1/3 of salmon production comes from Norway and Chile. Generally, aquaculture in foreign countries is U.S. companies. We have to proceed with caution. Land and labor is more expensive here. Regulations are stronger so it becomes a less economically viable operation. Industry in U.S. should be taking a leading research role (science.)

6. **Do you feel that current U.S. regulation and policy are adequate to preserve environmental quality? (Please explain)**

   Don't know specifics of U.S. legislation. She works abroad. She feels that there are loopholes in the current framework. A close look needs to be taken at regulations. Because some things are outdated, technology has changed and that makes some stuff irrelevant. It's not up to date. There are water issues, like Catfish in MS, AL. MS uses groundwater and AL doesn't.

7. **Over fishing of wild stocks has become a serious concern. Does your organization see a role for aquaculture in alleviating this problem? Can you please explain?**

   Definitely. The way our work on aquaculture began was Jason Clay report in 1998. Aquaculture has lots of issues but they are fixable. Aquaculture is so controlled that it has more potential that commercial fishing to produce environmentally friendly systems. So will it relieve pressure? Demand is growing so it will have to occur.

8. **What is your organization's vision for the U.S. aquaculture industry?**

   Vision is to have the industry become focused on development and growing in a way that is environmentally sustainable. There is an incentive for them because they depend on clean water and cleanliness to operate.

9. **Do you think development of best management practices is important to the general acceptance of aquaculture in the U.S.? If so, who should develop these guidelines?**

   BMPs are critical to develop the industry. All producers need access to the information. BMPs are win-win. Who should develop them? Industry hast to play role but also NGOs and government. Perhaps funds, analysis, and collaboration. Find BMPs are technology. BMPs in certification program. There must be a way to easily update them; it's harder to change Government laws and policy.

10. **Please rate your organization on a scale from 1 to 5, 1 being completely opposed to aquaculture in the U.S. and 5 being extremely in favor of it, and then briefly explain why you chose this position.**

    Global scale, 5. In favor assuming its development and industry is environmentally friendly.

11. **What other organizations would you recommend we contact on this issue?**

    Howard Johnson annual seafood market report. Conservation International, NOAA, Monterey Bay, Sea Web.

12. **Do you have additional thoughts or comments that we did not already discuss?**

    Talked about the project a little.