

EDUCATING  
FISHERIES  
MANAGERS

*Proceedings of a California  
Sea Grant Workshop*

EDUCATION SERIES

EDUCATION

## **CALIFORNIA SEA GRANT**

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The California Sea Grant College Program is a statewide, multiuniversity program of marine research, advisory services, and educational activities administered by the University of California Institute of Marine Resources. Through the research it sponsors, Sea Grant contributes to the growing body of knowledge about our coastal and oceanic resources and helps solve contemporary problems in the marine sphere. Through its Marine Advisory Program, Sea Grant transfers information and technology developed in its research efforts to a wide community of users in California, the Pacific region, and the nation. Sea Grant also supports a range of educational programs for students, teachers, and the general public to promote the wise use of our coastal and oceanic resources by this and future generations.

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# EDUCATING FISHERIES MANAGERS

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*Proceedings of a California  
Sea Grant Workshop*

April 3, 1986

UNIVERSITY OF CALIFORNIA, DAVIS

EDITOR,  
*Rosemary Amidei*

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## I. PREFACE

On April 3-4, 1986, the California Sea Grant College Program sponsored a comprehensive Fisheries Workshop at the University of California, Davis.

The agenda comprised three major sections:

- (1) A discussion of the status and needs of fisheries management education in California;
- (2) A review of activities and accomplishments by California Sea Grant's Marine Advisory Program; and
- (3) A discussion of the recommendation by the California Sea Grant Advisory Committee on Fisheries and Aquaculture that rockfish would make an appropriate choice for an intensive research effort by university scientists in cooperation with state and federal agencies.

This publication presents only that portion of the meeting that dealt with the first agenda item. A separate proceedings of the third section, entitled *Rockfish: A Focus for Research?* has been published as California Sea Grant Publication no. T-CSGCP-015.



## II. WELCOME

JAMES J. SULLIVAN, Program Manager, California Sea Grant College Program

There are any number of fisheries-related issues facing California today that have important economic, social, and environmental consequences. From the length of the salmon fishing season to the regulation of mixed-species fisheries, we confront problems that have no easy solution. And yet we all—consumers, fishermen, taxpayers, environmentalists, legislative and regulatory personnel, scientists, industry representatives—have a large stake in seeing that solutions are provided that are both wise and practical.

Much of the responsibility for finding solutions to these issues will fall on managers in various agencies and at various levels of government and industry. For this reason, California Sea Grant's Advisory Committee on Fisheries and Aquaculture suggested that it might be appropriate for the program to provide a forum at which the education and training of fisheries managers would be discussed from several perspectives, to see if the training being offered is sufficient for and appropriate to the complexities of the present world and to consider what the universities, industry, and government agencies can do to meet the needs of present and prospective fisheries managers.

I'm pleased to see such a large turnout and hope that this discussion, and the one to follow on rockfish, will be an important step in meeting the challenge we in the ocean community were handed by Assemblyman Larry Stirling, to come up with better coordinated planning for ocean resource use—particularly in the fisheries.

Let me now introduce Professor Wallis Clark, a member of California Sea Grant's Advisory Committee on Fisheries and Aquaculture, who will introduce the chair of today's meeting, Mary Morgan.





### III. INTRODUCTION

WALLIS CLARK, Professor, Bodega Marine Laboratory, Bodega Bay, California

Let me give you some feeling for how the education of fisheries managers came to be chosen as a topic for consideration at today's meeting.

In January 1986, California Sea Grant's Advisory Committee on Fisheries and Aquaculture met in Sausalito to discuss the direction of new research efforts.

The advisory group consists of the following people: Floyd Anders is a fisheries administrator with the the National Marine Fisheries Service in Northern California. Izadore Barrett is director of the Southwest Fisheries Center of the National Marine Fisheries Service in La Jolla. I am a professor at the Bodega Marine Laboratory. Christopher Dewees is the fisheries specialist for the California Sea Grant Marine Extension Program, based at the University of California, Davis campus. Robert Fridley is director of the Fisheries and Aquaculture Program at the University of California, Davis. Zeke Grader chairs the Pacific Coast Federation of Fishermen's Associations in Sausalito, California. Catherine Miller represents many of the sports fisheries interests in San Diego. David Ptak is with the Chesapeake Fish Company in San Diego and is in the processing and marketing business. Emil Smith is from the California Department of Fish and Game. Stephanie Thornton represents the Women's Fisheries Network and R/T Associates, which is in El Cerrito, California. Jack Van Olst is an aquaculturist from Aquatic Systems Inc. in San Diego. As you can see, this committee represents a wide range of backgrounds associated with fisheries in California and the Pacific northwest.

Although research needs in fisheries formed the focus of this committee's agenda, one of the topics that came up has been of concern for many years—the lack of well-trained people going into fisheries management in industry and in the federal and state governments. This is an unusual topic for a research advisory committee to tackle, but it appears to represent an area of such general concern that we decided it would be worthwhile to dedicate some attention to it. Thus, this first session of the Fisheries Workshop is dedicated to fisheries management education in California, its status and needs.

Let me now introduce the panel members who will lead today's discussion. Al Petrovich is chief of the Marine Resource Division of the California Department of Fish and Game. Greg Cailliet is professor of biological sciences, with a long and broad background in fisheries. He is at the Moss Landing Marine Laboratories, Moss Landing, California, a consortium laboratory of several state universities. Ted Kerstetter is a professor of zoology

and has been involved with fisheries education at Humboldt State University for many years. Merton Love, who was to have been on the program, is not here and in his place is James Willen, a professor in agricultural economics and environmental studies at the University of California, Davis. His background is primarily in fisheries management. Stephanie Thornton is the president of R/T Associates. Floyd Anders, as I previously mentioned, represents the National Marine Fisheries Service in Northern California and is based in Santa Rosa. Mary Morgan, who will chair this panel, is a consultant for the Pacific Fisheries Legislative Task Force. She is also a consultant of the Joint Committee on Fisheries and Aquaculture for the California state legislature and will shortly be joining the state Senate Office of Research.

This then is our panel for this afternoon. Mary, I will now turn the meeting over to you.

#### IV. PANEL DISCUSSION

MARY MORGAN, Consultant, Joint Committee on Fisheries and Aquaculture, Sacramento, California.

Let us first tell you a little about ourselves, so that you can judge our individual perspectives on the question. Then we will offer our observations on what we see as needs in the education of those who will enter fisheries management. After each panel member has presented his or her point of view, we will open the meeting to general discussion.

I entered fisheries in a roundabout manner. I was a social science teacher for 10 years. Half of that time was spent at a junior college, part at the secondary level, and part at the university level. I have never had any formal academic or technical training in fisheries. The fisheries-related jobs that I have held are primarily advisory positions to elected officials, including congressmen, senators, and assemblymen. These are people who make laws and appropriate money. Fisheries people then have to deal with the laws, regulations, and funding.

It is important for you to know that most of the people in my position are generalists; they are not formally trained specialists in fisheries. As a result, an adversarial relationship is sometimes established between legislative aides and people in the fisheries field that doesn't have to be there. The problem arises because the fisheries person forms a first impression that the legislative consultant doesn't know as much as he. But that's not the case. I may not have been trained in fisheries, but I know how the legislative process works. I know how the wheels turn. I know how to get money. I know how laws are made. And I know how to make sure that programs needed to enhance resources continue to get funding.

After I had been teaching for 10 years, Congressman Clausen offered me a job as his assistant on Capitol Hill, and I went to Washington to handle district issues. Because he was a north coast congressman, some of the issues were related to fisheries. Reauthorization of the Magnuson Act was coming up, and fishermen felt they had been sold a bill of goods. The Act wasn't what it had been promised to be. Suddenly I was getting a lot of complaints, which I had to field from a distance of 3000 miles. As a result, I began to learn how federal legislation works in regard to fisheries issues. While on Capitol Hill, I worked with the House Merchant Marine and Fisheries Committee and the Subcommittee on Aquaculture.

Then I came back out to the West Coast. Barry Keene, Chairman of the Joint Fisheries and Aquaculture Committee and also the Senate Majority Leader in the California Legislature, needed someone to act as consultant for that committee. At that

point I knew about federal fisheries, but not a lot about inland fisheries. However, I took that job and started working with state agencies.

Over the years I've worked with a multitude of fisheries people, both managers and line staff. I've seen how programs are implemented and evaluated and where problems are.

I got a very different perspective when I became the consultant to the Pacific Fisheries Legislative Task Force. The task force is made up of elected officials from four states: Oregon, California, Idaho, and Alaska. Legislators from Washington and Hawaii participate but may not vote, as their state legislatures have yet to pass formal membership resolutions. Members try to determine how they can best deal as a region with the federal government on fisheries, aquaculture, and seafood issues.

As I mentioned, the important thing for fisheries people to realize is that government workers may not be specialists, but if you work with them it will be better than if you work apart. I need people with technical information to advise me. They need my know-how. Together we can create quite a team.

What I've found is that fisheries managers (in particular those right out of school) tend to be book-smart. . .to have a lot of theoretical knowledge, but not much practical knowledge. They don't understand how things get done. In law making, the important things to know are how a bill becomes law and how to compromise. For example, if some benefit is proposed for the salmon fishery on the north coast, Los Angeles legislators are going to ask, what's in it for us? If you want a fishery restoration program, you had better be in a bargaining position to give those legislators from the southern part of the state something that will benefit them.

I strongly believe that prospective fisheries managers need internships. An internship would probably be the most valuable learning experience that students could have. It would get them working with a variety of professionals so they could see how the process works and how to apply their knowledge. Moreover, it would be good for the "hosts" because interns still have enthusiasm, and many of the folks in the field are worn out. If matched correctly, interns could be an effective part of a team. They could work in government—federal, state, or county—or in the legislative arena or a regulatory agency. In any case, the interns would see firsthand what they would otherwise only read about in books. Formal education is an excellent and necessary foundation, but until a new manager gets practical experience, he

or she may only be capable of building a house of cards.

Internship programs do not have to be long term. Interns could be given university credit, stipends, or fellowships; students could also attend weekend seminars put on by professionals in the field.

I don't look for the legislative system to change. Elected government officials are not going to surround themselves with specialists, but with generalists. We can bridge that gap if generalists learn more subject content and work more closely with technically trained fisheries managers and if fisheries managers learn in the broadest sense how the process works. Internships could help to make managers more effective by giving them experience early on with how things really work.

FLOYD ANDERS, Fishery Program Administrator, National Marine Fisheries Service, Santa Rosa, California

I was a zoology major because there was no fisheries curriculum at UC Berkeley. I also took minors in speech and history, and in some cases those subjects have served me better than has zoology. I worked for the California Department of Fish and Game for about 3 years, and I eventually ended up joining the Fish and Wildlife Service and moving to Boise, Idaho to work on the Snake, Salmon, and Clearwater rivers.

After that I worked in Portland and Seattle in research and management on restoration of salmon runs and on sturgeon. Then I went to Washington, D.C. where I held a variety of jobs. Environmental programs at that time were nearly nonexistent in our agency, The Bureau of Commercial Fisheries in the Department of the Interior. We managed to get that started. For a while I was responsible for the research functions of the centers and laboratories, and then I switched over and was in charge of things like environmental programs, fish facilities, sealing on the Pribilof Islands, enforcement, and of a number of other activities. In the process, I got exposed to what we now call OMB, the Office of Management and Budget, which at that time was the federal Bureau of the Budget, and also got involved with legislative matters.

I was listening very carefully to what Mary said, and what she said is true. In management, there's a lot to knowing how to play the game: what you have to deal with and how you have to trade.

From Washington I came out to Southern California, where I

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became the deputy regional director of the National Marine Fisheries Service. I was heavily involved with highly migratory species of fish, particularly the tunas, and got involved in going to places like Costa Rica, Nicaragua, Mexico, and the central and western Pacific. I then had the opportunity to come to Northern California where I opened an office and became what you could call a senior "hand holder" for want of a better term. I now work with the commercial fishing industry, recreationists, educational institutions, environmentalists, and others.

There are a number of things that bother me in looking at the business of fishery management today. Part of the problem began with the development of complex technologies in fisheries, such as improved gear, improved methods of finding fish, and improved methods of harvesting fish, which have increased competition both domestically and by foreigners.

The advent of the Magnuson Fishery Conservation Management Act changed the complexion of management once more and thrust us into the role of managing, in large part, by committee action. It can be frustrating, particularly for professional fisheries managers, to work with committees and councils. I find that these days a great deal of time is taken up with management, considerations of management, and arguing about management. Managers are often caught in the middle among the commercial fishermen, the recreationists, the environmentalists, the general public, and special interest groups.

Today's managers require a greater breadth of training and experience than was previously necessary. The present 4-year curriculum is just not sufficient, no matter how you look at it. If you were building the ideal fisheries manager, you would want someone who was in part a mathematician, a chemist, a physicist, a geologist, a soils expert, a botanist, an ecologist, an engineer, a geneticist, a pathologist, a nutritionist—the list is endless.

And although these technical fields are important, there are certain other aspects of management which I now consider essential. These include knowledge of economics, communications (both oral and written), group dynamics, and negotiating skills.

You may ask, why these skills? The Magnuson Act states that in developing management plans, we must, among other things, take into account the sociological and economic aspects of fisheries. We have to know something about existing fisheries and the impacts of actions on both fishermen and communities. Every time we go to a meeting, we are dealing with a diversity of

interests. Negotiation is a constant fact of life, and where group dynamics are in effect, methods of achieving effectiveness must be understood. There may be a lot of stress involved.

Anybody who goes into fishery management should have a good knowledge of existing programs and problems. Economic and community stability are prime considerations these days in managerial affairs. That applies not only to commercial fishing but also to recreational fishing. For example, I can tell you about a little town whose dependence on the tourist trade, especially on recreational fishing, is so great (accounting for perhaps 80% of its annual income) that if the fishing season is very short, or if there is no season, it faces financial disaster.

I'm also talking about environmental considerations when I talk about community and economic stability. You all realize what happens when the habitat that fish are dependent upon no longer exists in a suitable form. . . when it's been degraded, when it's been shipped off to some other locale, when it has had things dumped into it.

I think there are some possible solutions to be considered for strengthening the education and training of prospective fishery managers. We might want to look at revising the curriculum to extend study to a longer term. The basic 4-year curriculum leaves us with someone who doesn't have many of those other skills that I mentioned, and it certainly leaves the students without experience.

Internships have been talked about before, and many of us think it's a valid idea. Internships might be part of a graduate program that would lead to a degree in fisheries management. I don't think you can give a degree in fisheries management to somebody who has gone to college for only 4 years.

I would like to see a professional seminar series developed. By that I mean bringing fisheries managers into our schools on a regular basis and having them deliver lectures with case histories concerning the problems of managing halibut or highly migratory species.

I would also like to see us encourage faculty to spend time at fishery management council meetings or at other negotiation sessions. I realize it may be difficult because of scheduling, but nevertheless I think it would help if faculty could see some of the actual problems that exist in fisheries management.

I was thinking recently of a series of negotiations involving the Klamath River in Northern California. Several different groups were involved, including Native Americans, recreational fishermen

on the river, recreational ocean fishermen, and commercial ocean fishermen, among all of whom there was disagreement. There were also a few county supervisors who didn't agree either. We put them all together in a series of meetings, and over time they achieved some agreement about the management of salmon stocks. There have been ups and downs in that agreement, but I think it's going to hold up. This, for example, would make an excellent case history for a faculty member to relate to a class.

In summary, I believe that the process for training and educating professional fisheries managers can be strengthened by implementing programs that embody internships and professional seminar series and by providing greater faculty exposure to ongoing management problems. Curriculum additions should require basic economics, group dynamics and negotiation skills, and communication skills. Degrees in fisheries management should require graduate level work.

**JAMES WILEN**, Agricultural Economics Department, University of California, Davis

My background is in economics. I'm an associate professor in the Agricultural Economics Department here at Davis, and I've taught at the Universities of British Columbia and Washington. I have had quite a bit of experience dealing with management agencies along the Pacific Coast and in British Columbia, Alaska, New England, New Zealand, and other areas. I have formed some opinions that I would like to share with you today. They have to do with what we ought to be thinking about if we're concerned with developing an educational or research program that is to be of some use to fisheries management.

My conclusion from working with fisheries managers is that they're just barely hanging on. As most of you know, the task of managing real world fisheries is complicated. The stakes are high in the sense that the potential values involved are large and the consequences of making mistakes are serious. Most agencies are underfunded and understaffed, and I think that in most cases they are staffed with people who, at least when they begin the job, are ill-equipped to handle the sorts of problems that they will face. My overall conclusion in watching what goes on is that much of management is basically muddling through from day to day or, at best, from season to season.



You might ask why this is happening. In my opinion, it's because fisheries management has evolved into an adversarial process. Fisheries managers and fishermen have the same long-term interests—they both are interested in preserving the species. But the fact is that there is basically a fixed, limited resource out there. Fishermen are competing among themselves for a share of this resource, and managers' actions are designed to constrain the activities of fishermen. So it shouldn't be surprising that the situation is one of conflict.

Louis Botsford and I once had a chance to talk with a person involved in salmon management who was, in my mind, incredibly talented. He knew fisheries biology, fisheries technology, and fisheries management, and he understood fishermen and their motivations. But he told us that he was getting out of the process because the personal costs were too high. His life had been threatened by angry and desperate fishermen, and his management career just wasn't worth continuing at that level of personal risk.

This case is not isolated. If you look at what's happened in fisheries management over the past 80 years, the intensity of adversarial actions has increased over time in almost every case. Let me give you some case studies as examples.

The halibut fishery is interesting because it's one of the first situations where we actively got involved, back in the 1920s and 1930s, in trying to manage the biology of a fishery. The fishery had begun in the 1880s and 1890s and was very profitable to begin with. It attracted a lot of fishermen, markets expanded, and times were good. Then the fishery began its inevitable decline, and the catch began to fall off.

By the 1920s there was a move underway to convince both the Canadians and the Americans to get together and try to come up with a management plan, and in 1930 those countries finally decided on a joint management plan and established the Halibut Commission. Good staffs of biologists were hired, and they came up with proposals that basically involved setting an aggregate quota on U.S. and Canadian fleets in an attempt to build the fishery back up. Canada and the United States implemented the plan, and it turned out that the biological stock assessments were correct—the fishery began to build up and stocks appeared to improve.

But this success drew in more fishermen and by 1950 the fleet had doubled. There was a targeted catch that the commission wanted to maintain, and so managers began to cut down on the season length. That, at times, met with resistance. Fishermen

didn't want the season length cut and proposed all sorts of alternatives, such as trip limits in which they would voluntarily agree to lay over a certain number of days. This, in turn, evolved into a situation where fishermen were supposedly volunteering to bring back not more than a certain catch per trip. That sounded good in theory, but what happened in practice is that fishermen began to cheat. They began to land fish but not record them, and so the action that was intended to maintain biological controls in the fishery began to distort the information base which itself was being used to manage the fishery.

There are many other interesting aspects to the management of the halibut fishery that have to do with this connection between fishermen's incentives and management actions and information. One of these is that during this period managers were using a measure of catch per unit effort to assess the abundance of halibut, and fishermen at one point in the 1950s changed the spacing of their hooks. There were adjustments made in the catch per unit effort measures, but these were made incorrectly because the efficiency of fishing increased per hook as the spacing increased. Because this change in efficiency wasn't taken into account properly, the stock assessments led to overestimates of the actual abundance. The fishery went through another decline, and it has gone through more ups and downs since the 1950s.

The really ironic outcome is that the season is presently limited to only 5 days per year. We've gone from a situation where fishermen were fishing for 300 days out of the year to one where they are fishing for only 5 days. From the fishermen's perspective, that is a precarious situation. Their whole livelihood in this fishery depends on their having everything worked out over this five-day period. Fishermen work furiously for 24-hour stretches at a time and if something happens to their engines, they lose a whole year's revenues. From a management point of view, the situation is also one of high risk. Managers are basically trying to monitor the fishery and ensure that the target isn't exceeded in a 5-day stretch, which is a lot more difficult than over a 300-day stretch.

That is just one example of the consequences of not accounting for some of the interactions on the human side of the picture. It's not an isolated case. The British Columbia herring fishery provides another interesting example. In the early 1970s it was a relatively low-value, reduction-based fishery. Then, when the Japanese roe herring fishery collapsed in the early 1970s,

there was suddenly a huge demand for roe herring here in North America. The price went up to over \$3500 a ton and created a gold rush atmosphere in British Columbia and along the rest of the coast as well. Overnight the situation changed from one where there was a relatively small fleet spread out geographically over the whole province to one where the fleet increased enormously in capacity and mobility. It was not long before the whole fleet converged on each opening. Fisheries managers began "sitting" on the openings so they could manage the fishery. In some cases they could only open the fishery for 15 minutes, in other cases they had to completely forego opening it because there was too much fleet capacity on the grounds and even one net set would have exceeded the target.

Why are these examples important? The central thread that runs through them and others that you can think of is that management does not so much focus purely on biology, but rather on the the system as a whole, the system being not only the biology but also the fishing community and fishermen. In both of these cases, ignoring fishermen's reactions has led to severe problems, to situations that are absurd, such as fishing seasons that are 15 minutes or 5 days long and huge fleet build-ups that fish for only a short period of time. When these fishermen are not fishing on one fishery, their capacity spills over to other fisheries creating management problems there too. A lot of capital is used for only a short amount of time, and most of the fish have to be processed and frozen instead of being marketed fresh, thus lowering the value. Finally, the primary goal of protecting the stock is itself endangered by the very structure that has been set up to preserve it.

All of these things suggest to me something important about what sort of training we ought to be thinking about if we are serious about training people to go into fisheries management. This may sound like heresy, but to me it seems that we don't need people who are heavily oriented toward the laboratory sciences or biology. What we need are people who are systems oriented and who understand something about population biology, modeling, forecasting, sampling, and monitoring. They should have an understanding of the social sciences, have an ability to predict, and know how fishermen are going to be affected by and will respond to regulations and how their actions will affect management strategies. We need people who are wise enough to come up with institutional designs for reducing the level of tension between groups. To me that's a major reorientation in the way we typically think of fisheries programs.

I'm saying that it's probably more important to think about managing people than it is to think about managing fish. That's a fairly strong statement, and maybe I ought to qualify it by saying that managing people is certainly as important as managing fish. Thus, the sort of training that I would propose is something different from the standard fish biology curriculum.

I guess we should ask whether we have the capabilities to meet these needs in our university and college structures. I think in California, particularly in the University of California system and the state colleges, we have an enormous pool of talent. For example, at UC Davis we have people who are well trained in a technical sense but who are also primarily interested in policy issues. They are interested in providing scientific input to help management and improve management strategies. We've got good students and we've got the raw talent. Like many things, what it boils down to is a commitment of funds. I would personally love to teach courses in fisheries economics, but my department would have to be relieved of the courses that I would otherwise teach. If we are serious about trying to improve the quality of people who are going into management positions from the educational structure, then we need a financial commitment. The raw resources are already there, but somebody—the fishermen or the state or the federal government—has to decide to commit something to form an institute, for example, and to set up the formal structure.

There was a program in British Columbia which I would consider to be an ideal model. Unfortunately, it has been closed down now by the province as support has been withdrawn from higher education in general. The program was called the Institute for Animal Resource Ecology, and it had permanent funding from the province that provided for a staff of six or more people who both trained students and also worked on real fisheries management problems. The group was involved in all sorts of issues that had to do with stock prediction, stock recruitment relationships, statistical analysis, monitoring programs, analysis of fleet dynamics, and analysis of the impacts of policies on fishermen. In my view, this is something close to what we ought to be shooting for if we want to develop something ourselves. The institute had a particularly good symbiotic relationship between the people involved actively in management and the university, and it was very much an applied program.

In addition, institute personnel went out in the field and brought together fishermen and fisheries managers. Institute

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modelers would present a model that they thought was an accurate representation of a particular fishery. They then "experimented" with some hypothetical policies and asked the fishermen to suggest policies and look at the implications. The basic idea was to break down the barriers that existed between fishermen and managers and allow people to test differences of opinions. There is always going to be some uncertainty in a particular system, and one way to improve communication is to bring people together and help them understand the implications of this uncertainty. If one group believes one thing, try it; if another group believes another thing, try it. Sometimes choosing one course of action over another doesn't make any difference, but sometimes it makes a big difference.

I'm suggesting the concept of an institute as an example of something that we might try to aim for. I see the need to develop something like this in a committed way if we are seriously interested in improving the quality of today's fisheries managers.

STEPHANIE THORNTON, President, R/T Associates, El Cerrito, California

I grew up in a commercial fishing family in San Diego and lived as a youngster on a fishing boat for 10 years. From there I went on to Humboldt State University, where I completed my degree in fisheries biology. At Humboldt State, I received comprehensive training in fisheries. During that time I was president of the American Fisheries Society, which had a chapter on campus largely composed of students. During the summers, I worked in various research programs, 2 years with the California Department of Fish and Game and with Ocean Salmon Research, and then 2 years with the National Marine Fisheries Service in its albacore research and tagging program in San Diego.

After graduation, I went to work for the Humboldt Fishermen's Marketing Association in Eureka. It is a 350-member organization of commercial fishermen who participate in the salmon, crab, shrimp, albacore, and Dungeness crab fisheries. My responsibilities were to speak on their behalf at various organizations and to look after their needs regarding pricing and marketing of their products. This is where I began to get in touch with fishery management. I often attended Pacific Fishery Management Council meetings, though I felt unprepared and insecure. During this time, I was appointed by then Governor

Brown to the Pacific Marine Fisheries Commission. The Commission is a five-state interpack which addresses fisheries issues that are relevant to those states.

In the early 1980s, during the El Niño, the Humboldt Fishermen's Marketing Association was faced with a crunch when revenues from fish landings began to decline seriously. I went to work with the Pacific Coast Federation of Fishermen's Associations, assisting Zeke Grader with some of the management and policy issues that he's involved in at a statewide level. Unfortunately, PCFFA too soon found itself in financial trouble, so I was again looking for another fishery job.

I next went to work for Producer Seafood, a fish processing company in Oakland, California that buys and sells fish that are caught in the San Francisco area and off the coast. As my odyssey may illustrate, you don't know where you're going to end up in fisheries.

At Producers Seafood I got quite a good background in marketing, which was something that I did not have. I found myself looking forward to and anticipating changes in my career. During that time, I founded a chapter of the Women's Fisheries Network, a nationwide organization whose purpose is to educate people in fisheries on various aspects of the industry. Our membership comprises biologists, managers, people who own businesses in fisheries (such as retailers), legislators, people working in legislation, and agency people (such as the Coastal Commission).

While I was at Producers, I was looking for new directions. Subsequently, I developed a fisheries consulting firm with my husband, which is called R/T Associates. The firm is pursuing fishery marketing and development programs and is involved with establishing and administering the Coastal Fisheries Foundation.

I share many of the concerns voiced by Floyd Anders regarding the quality of education for fishery managers. I would like to offer four recommendations for developing a more comprehensive educational background for future managers—one that will prepare them to work in any aspect of the industry. Fisheries jobs are limited and the field is very small. Many times you may think you're going to move in a particular career direction, but find yourself going in a completely different one.

I would first like to suggest that we develop a curriculum advisory committee composed of people in academic and nonacademic fields, including industry. Together they might be able to offer recommendations and directions for developing good

programs that will address some of the needs that are current and immediate. I think that Sea Grant could play a vital role in helping to coordinate this type of advisory committee.

My second recommendation, and this reinforces what Mary Morgan suggested, is to create internships. I cannot stress how important it would be to have students participate in fisheries management while still engaged in their academic studies.

Third, I believe we should encourage students to participate in professional societies, fisheries organizations, and other public organizations associated with fisheries. Affiliation would expose students to professionals in the field and thus would enhance their future career development. I also think it's important, when appropriate, to have not only faculty but also students participate in fisheries management meetings, and possibly to build curriculum around attendance at some of these meetings. For example, the Pacific Fishery Management Council will be meeting shortly. I think it would be appropriate to have some students and faculty attend that meeting to gain first-hand experience. Also, it would be helpful for students to attend board meetings of private fisheries organizations, such as Pacific Coast Federation of Fishermen's Associations or United Anglers.

My fourth recommendation is to initiate a speaker's network to bring managers in to talk to students and faculty.

I think that there's a major role for Sea Grant in career development. I would like to see it happen. Better career preparation could really help to minimize some of the adversarial relationships that exist today.

**THEODORE KERSTETTER, Professor of Zoology, Humboldt State University**

As the first of the educators on the panel to speak, my work is cut out for me.

A little bit about myself first. I am not actually a member of the fisheries department at Humboldt State University. I am a member of the biology department and my speciality is physiology. My research is on fish, and I teach a course for the fisheries department on fish physiology. I've been involved in the Sea Grant program for a number of years; I'm on the California Sea Grant Committee.

I will be talking about our fisheries program both from the outside and as a participant but not as one who helped develop

the philosophy behind the curriculum as it exists today. I'm not trying to take myself off the hook by saying that. I just want you to know that there may be some questions that I may not be able to answer.

I think I would best serve the informational needs today if I talk about what the Humboldt State fisheries program does, since the other panel participants have so far talked about the needs as they see them and the deficiencies that we all recognize are there.

The Humboldt State fisheries program has existed for about 30 years, and, like fisheries programs everywhere, it's largely technical. By the time a student's science training is completed (not only basic science, but also applied fisheries science), he or she simply doesn't have time for many of the things that are being suggested by the panel today.

For example, our fishery students take basic biology, chemistry, and physics, as well as mathematics, calculus, and statistics before they even get into their fisheries classes. Then they need to fulfill the general education requirements for the California State University system, which require a significant amount of work and time out of the total amount that the student has available. What's left over doesn't amount to very much. Beginning next year, when we go on the semester system, an undergraduate going through the fisheries curriculum will have a total of nine semester units available for approved electives, that is, electives that relate to the fisheries degree. Nine semester hours equal about three courses over and above the standard science and fisheries courses that the student must take.

What are some of these fisheries courses? Maybe we should lay them out and talk later about their value. Maybe some of these courses could be eliminated. There are subjects such as ichthyology, or fish physiology. That's the course that I teach, by the way, and I won't defend it right now. Another one is population dynamics, which I would defend. Field techniques is our attempt to show students what fishery scientists do and what equipment they use to do it with. There is another course in management strategies, but this does not really include what we've been talking about here; it covers biological management, not people management. There are other courses as well. Students going through our curriculum can specialize in either marine or freshwater fisheries by selecting appropriate additional courses. They can choose, for example, between freshwater and marine ecology, or among different invertebrate biology topics.



But the bottom line is that the program leaves a total of only nine semester units for approved electives—the kinds of subjects that would appear to be most important in a management context. This includes additional communication skills (over and above the basic English and public speaking requirements that every university has) as well as sociology, anthropology, and economics.

That's what is being done at present. How might we change it? How could the requirements be changed appropriately within the regular 4-year fisheries curriculum that we now offer? The conclusion one comes to immediately is that some of the technical courses would have to be eliminated to make more room for the social sciences courses. That's one topic that fisheries educators need to address seriously. It is time to look at the undergraduate curriculum to see if some of the technical course material can be eliminated.

What could be done to change things even more; that is, to change the philosophy behind the degree? What if we could change the time requirements, or the nature of the graduate degree? Are there some greater changes that could be made that would go along with the thinking that is being expressed here this afternoon? I think so. These are topics that we've just barely begun to discuss at Humboldt State, and perhaps this panel will be a stimulus to much deeper discussion in the future.

I can tell you that we are actively considering a nonthesis graduate degree. We've had a master's degree for as long as the fisheries program existed. The nonthesis option would lend itself admirably to the kind of management training that we're talking about here. The thesis option is centered around a research project, and I'm sure that you're all very familiar with what a master's or doctoral candidate typically does in the fisheries science field. The nonthesis option would point the student more into areas such as economics, communications, and interpersonal relationships.

Another recent development that may be of interest to the group is this. Our College of Natural Resources has recently created what is termed a Natural Resources Institute whose purpose is to create and hold short courses for professionals. It was started about a year ago. To date it has offered two- to three-day short courses designed for professionals in natural resources. They've not discussed the possibility of doing this in a fisheries context yet—I think the major effort so far has gone into forestry and range management—but certainly the possibility of an intensive short course taught by professionals actively working

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in fisheries would be well worth discussion and possibly extremely useful in the context of building up the skills of a potential manager.

It occurs to me that fisheries education has remained relatively constant over the years, and what has changed is the job. The job has gotten much more complex over the years. As an educator, I must say it's time we stepped back and looked at our product. The students are just as bright. In fact, I honestly believe that the older I get, the brighter they get, so there's no fault with the raw material. It's the educators who need to look at themselves.

An analogy one might draw is with the medical profession. A student goes to medical school for 4 years after finishing a four-year undergraduate curriculum, and none of us would want to be treated by a raw graduate from medical school. Medicine has simply gotten too complex. I don't think I would trust a neurosurgeon who got his degree last month from medical school. Years and years of additional training are required. The field of fisheries science is looking at that kind of situation today.

GREG CAILLIET, Professor of Biological Sciences, Moss Landing Marine Laboratory, California State University

I've done Sea Grant-funded research on a variety of fishes including squid, sablefish, sturgeon, and elasmobranchs. Some of the data that have been generated by my research have been used, or at least could have been used, in managing these fisheries. I have a few opinions that are different from those of other people on the panel, and in some cases they are a bit more positive than are those that have been stated.

I like to consider myself an ichthyologist. I should explain that I've never taken a course in fisheries in my life, but I teach one. I've never taken a course in population dynamics, but I teach one. I have taken courses in ichthyology, and I do teach courses in marine ecology.

As I mentioned, a lot of my research has involved fishes that are important to fisheries, and as a result I've interacted (quite enjoyably in most cases) with people who are fishery managers. I've been involved with the California Department of Fish and Game, the U.S. Fish and Wildlife Service, and the National Marine Fisheries Service. I think that the experience that my students

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and I have had has been very valuable because it has allowed us to relate our research-oriented activities to the reality of what fishery managers do. Another link that my students and I have forged (mainly to collect specimens for our research) is with individuals in the fishing industry. It has been valuable to find out about personalities, lifestyles, and different problems that people in the industry have.

Two programs for college students, both undergraduate and graduate, that are very valuable and probably ought to be considered for enhancement or at least retention, are the trainee program and things like the California Department of Fish and Game's seasonal aide programs. In these two activities, students get an incredible amount of experience—some good, some not so good—with the fishes, the fisheries, the people involved with the fisheries (i.e., the people who are harvesting these products), and the managers.

In my experience, those people who are now managing, especially those with the California Department of Fish and Game (with which I have the most experience) were trained as biologists. Very few of them were trained in subjects such as sociology, political science, and economics.

One factor that hasn't been mentioned today is that the hiring policies of this agency, and of all the other agencies, probably are not going to change much. I think that the Department of Fish and Game will continue to hire people who have a decent academic background, usually in biology and sometimes in mathematics. Seldom have they or will they hire people with backgrounds in the softer sciences such as fisheries management, sociology, and economics. Hiring practices would have to be changed for graduates of any proposed new programs to have a chance of competing. In a lot of cases, hiring practices do not stress graduate education. I think that might be a problem, although some of the best managers I know do not even have a master's degree and they are doing as good a job as you could possibly expect.

Another problem is that management decisions, even those made by people who were trained as biologists, are often made in an ecological vacuum. That is, despite all the energy devoted to developing demographic analyses, life history tables, mortality tables, age and growth patterns, and reproductive characteristics, this information often doesn't even get reconsidered. For example, if you asked managers why the drift gillnet mesh size is the way it is, most would admit they don't know. Or if you want to find out

what an acceptable biological catch (ABC) is, many people at the Pacific Fishery Management Council meetings can't tell you how it was mathematically generated. I think this is a problem. I think it's the main reason we are here today.

Another problem is that management decisions are often made in reaction to situations that have gotten out of hand. I don't know if sound management education would help that. I think most of the politically motivated rules and regulations at the state and federal levels, as well as most council decisions, are made in response to strong social, economic, and political pressures. This may be one of the main reasons why these decisions are made in an ecological vacuum.

We haven't thought enough about the fact that people look at things with entirely different perspectives. I, as an academician, look at fish first and people second. Students of mine tend to do that too unless they've had a lot of first-hand experience, which some of them have had with the sturgeon and elasmobranch fisheries. Fishermen look at fish as being a dollar bill because fish represent their livelihood. Fishermen don't often consider the biology of the fish. More recently, though, I think this has changed, perhaps because fishermen today are a much better educated breed. They have seen the problems of the past, and they would like to plan ahead rather than see management react to new problems. I have had good luck with every fisherman I've dealt with in my research, and I think it's because I promised I would never get involved in a discussion like this one.

The perspective of a manager is also different. The manager is torn, primarily because he or she was trained as a biologist but ends up being pressured by colleagues and biological concerns and at the same time by the fishing industry. And, of course, the ultimate decision-making process is from a fourth perspective. This final perspective is political motivation to get votes and to acquire power. Perhaps there are even more perspectives that I'm not aware of.

I don't know what if anything Sea Grant should do. I do know that several schools in California have fishery management programs. Humboldt State has an excellent one and so does UC Davis. Oregon State ranks even higher than those two in terms of the number of courses that mention fishery management in their curriculum description. And, of course, the University of Washington has page after page of relevant courses listed in its catalogs. Maybe the courses ought to be changed a bit to get more case study information or more actual experience in them. I

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have designed the courses I teach to try to get my students hired. I've aimed them toward what I think the Department of Fish and Game, the National Marine Fisheries Service, etc., will look for. And my students do well on tests. One of my students who took a test in Washington recently scored the top grade; they just couldn't believe that she didn't come from UW.

I take students to the managers and to the fishermen. We walk around Moss Landing all the time, we go to Monterey, we go to San Francisco. I have my students visit the Monterey office of Fish and Game, and they come away puzzled. Sometimes they have good responses to the individuals they talk to, and sometimes they don't. But at least they know the problems.

I don't think we need many new courses. I do think we need a slightly different approach to these courses which doesn't just teach maximum sustainable yield and yield models and parent-stock recruitment relationships. We need those, but I think that the students ought to be getting more experience about what it's like at each of those four levels of perspective that I've discussed. Once when the Pacific Fishery Management Council was meeting in Monterey, I took my whole marine fisheries class there. They came away confused and asking, how do they calculate A,B,C? I didn't know, and nobody I talked to could tell me. But the point is that the students learned a lot and saw how management decisions are being made.

Where do we go from here? I think changing the training program would be a big mistake. It would be better to enhance training programs to include internships, whether they're strictly at the manager's level or represent a broad array of field experiences. I think Sea Grant ought to try to support trainees who can later get hired, because it would be of no use to educate students who bounce around from job to job and never get in a position where they act as a manager. Most people who are managers weren't trained to be managers. Changing the orientation of courses would be quite valuable. There are several other ideas that were brought up by previous speakers that I would support, and I'll do that in the discussion.

**AL PETROVICH, Chief, Marine Resources Division, California Department of Fish and Game**

I have a little trouble talking about educational needs when I know that there are more graduates coming out of the colleges and universities now than there are jobs available.

By way of introduction, I have a Bachelor of Science and a Master of Science degree in fisheries management from Humboldt State College. I use the term "college" because it was only a college at that time. I have worked with the California Department of Fish and Game for over 20 years in a variety of assignments, most in the marine area, but I have spent a good deal of time working on anadromous species. In recent years my primary experience has been administrative in nature. I served as an assistant executive secretary for the Fish and Game Commission, which is a policy-setting body for the Department. Following that I served as chief of the Marine Resources Branch where I had responsibility for all the marine research activities of the department. I am presently chief of the Marine Resources Division and have responsibility for all the research and management endeavors of the department. We have about 20 people working in the division, most of them marine biologists.

You will have to realize that my comments are those of an administrator of a management agency, and that I may be expressing some of my frustrations as a manager rather than assessing the actual needs of the education system as regards fisheries management.

Obviously, transferring basic theoretical principles and concepts is important in the educational process and is appropriate to the role of the college and the university. Also I realize that there are efforts by some educational institutions to provide a more practical approach. However, I still feel that fisheries graduates are not being prepared for what they encounter in the real world. Fisheries management has changed markedly in the last 20 years from resource management to conflict resolution. User group competition for dwindling fishery resources has increased markedly.

There is a difference between resource protection and fisheries management, and both are important to the manager. In California, for example, the legislature basically has control over commercial fisheries. User groups have recognized that fact and have increasingly sought resolution of conflicts and differences in the political arena. The name of the game today appears to be compromise, given that the resource is not jeopardized.

This concept has been difficult for incoming or fledgling biologists to understand, especially if they come into the

department with a research-oriented background. The results of a study by our department might clearly indicate a biologically sound course of action, and recommendations for that course of action might flow through the organizational hierarchy. However, what actually comes out of the legislative process is often a watered-down version of what was originally submitted, a compromise if you will, a judgment-call based on other considerations. This is sometimes difficult for a new biologist to understand or rationalize.

Should there be greater emphasis placed on biopolitics and socio-economics in the educational process? Should courses such as conflict resolution, personal interactions, principles of human behavior, and the legislative process be offered? I do not know but rather offer the concept as food for thought. This may indeed go beyond the responsibility of the educational system, and perhaps should rest more properly with the management agency as on-the-job training.

In closing, another area where I see a real need for fisheries managers to improve is communication. Effective communication is critical to the efficient functioning of the department or any other management agency. I will be quite candid with you. There are biologists working for the department who cannot write or communicate effectively. These individuals are capable biologists in all other respects, but they have trouble communicating.

This problem is complicated by the fact that communication needs have also changed with the times. There is as great a need today to be able to converse with the public as with one's peers. Most of our communication activities today involve laymen—fishermen, conservationists, environmentalists, legislators, commissioners. If we cannot communicate with these individuals effectively, our chances of achieving our management goals are markedly reduced. Any means by which the educational system can improve students' communication skills—including writing, public speaking, multimedia training, etc.—can go a long way in making a more complete and effective fisheries manager.

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## V. DISCUSSION

*Morgan:* At this time I would like to open the discussion to questions or comments from the audience.

*Participant:* One of the problems I face as an educator is that I don't want to train students to be fisheries managers because there aren't that many jobs out there. Students are much better off being broadly trained so they have a number of alternatives. Do you agree?

*Anders:* We all tend to become somewhat myopic when we look at job opportunities. We think about, for example, the National Marine Fisheries Service or the California Department of Fish and Game—that is, about the formal structures. However, I see more and more people who have been in fisheries management going into other areas. They are working with processors or brokers or fishermen's organizations or with United Anglers or PCFFA. The list is beginning to grow considerably. And while we don't have an abundance of jobs, there are certainly more opportunities than there used to be. I think that there are more opportunities than we recognize.

On the other hand, I don't think that students ought to be going into management directly out of school with just a bachelor's degree. Students need a good basic background in an appropriate discipline, and then additional graduate training beyond that. This additional training should involve what several people have described today, communication skills, for example. I agree with Al Petrovich. I've had people work for me who were brilliant in their technical specialties, but who could not prepare a report or address a public meeting. Communication skills these days, in the kind of atmosphere we operate in, are essential.

*Thornton:* You would be surprised at how many jobs are available in fisheries today, especially in the growing fields of marketing and fishery development—it's just exploding. Also, there is a growing demand by the public to learn more about seafood and fisheries; thus the need for consumer education is growing rapidly. I agree that technical background should be learned first, and maybe at the graduate level. And the student should get some good solid communication skills to be able to go into any field within fisheries, including those in the private sector.

*Participant:* Very few of the graduates from UC Davis are finding jobs in the public sector right now. That's why I'm reluctant to recommend specialized training, because a broad training gives them lots of other things to look at.

*Costa:* I am Dan Costa with the Long Marine Lab at the



University of California, Santa Cruz. It seems to me that the term "fisheries management" is creating some confusion. I've been involved in a number of studies that relate to human interactions with the fisheries, and the thing that always strikes me is that biology does not dictate management. Management reflects sociological and economic concerns. We do not in fact train fisheries managers, but fisheries biologists. Fisheries managers and fisheries biologists are two very different people, and we need both of them.

At the Santa Cruz campus we have a degree program in environmental studies that includes biology, sociology, and economics. Graduates of that program are more appropriate for management; they are generalists. The program does not train biologists. I think this might be an important distinction.

*Toole:* I'm Chris Toole with the Marine Advisory Program. My experience has been that the people in the agencies who make important decisions are in the upper levels; they are not people just out of school with Bachelor's degrees. Newer people get input, collect technical data, and perhaps start to learn the procedures that will eventually enable them to manage. Because there is the opportunity for on-the-job training, it seems more appropriate to me to have ongoing training programs available that are apart from the degree programs. For someone who is coming back for additional training, perhaps something similar to the Natural Resources Institute should exist. Maybe there should be separate institutions to do this kind of training.

*Anders:* A person who makes a career in fisheries must have some basic understanding of both the critters and the constituents they work with. If not, they are not going to do a very good job. That's why I was advocating that we concentrate on the basics in the first part of the educational process and then look later on to further training in the form of practical experience or internships to broaden the students' horizons.

One of the good things about the University of California and State University systems is that there are certain basic requirements to be met. Engineers are forced to take English and history, for example. A person in the biological sciences ends up fulfilling certain broad requirements, too. There needs to be some rethinking and expansion of this type of broader education, perhaps at the graduate level. This is especially true for the fisheries area. The point is well taken that it is the upper levels of people making management decisions. Maybe the quality of management today would have been improved had they been

more aware of the circumstances that they were going to encounter as they were moving up in their careers.

*Participant:* I suspect one of the areas where we as educators fall in our mission of working with undergraduates is that we don't give them very good advice. Students are faced not only with requirements for their specialty degree but also with requirements in general education. There is a wealth of courses that would provide some of the broader skills we have been discussing, but students avoid them because they don't know about them or think them relevant to their careers, or because they would rather take easier courses. If we are trying to steer these students early on into those programs we think will give them valuable undergraduate training before they go on into fisheries management, then we must look carefully at what counsel we give.

*Cailliet:* It's my experience that at the undergraduate level there are many students who really want to be biologists and deal with fisheries. They are the ones who get jobs as seasonal aides for very little money. Many of them end up coming back to graduate school and continue with a strong interest. However, after they graduate, you discover they are jobless. Nonetheless, that experience as an aide is invaluable and serves them well if they do end up in management agencies.

Another way to introduce the more practical aspects of fisheries management into courses is to do what Jim Wilen suggested: use case histories. In this way you can bring in the perspective of the fisherman, the academic, the manager, and the legislator or other person who makes the political decisions. If you can do that, either from a biological or a socioeconomic perspective, students benefit because they realize that situations are not all black and white.

*Spless:* I'm Fred Spless, director of the Institute of Marine Resources of the University of California. I grew up as a nuclear physicist and shifted over and became some kind of a general marine scientist. I'd like to make two comments. The first is that the problems we are talking about here are not really just fisheries management problems, they are education problems. There have been two big areas mentioned here that really should be part of the basic requirements in the various universities in which we are involved. One is communication and the other is knowledge of the real world. Fisheries is not the only place where you have to cut a deal. In fact, you need to know enough so that you can cut a favorable deal in fisheries with some kind of trade

that doesn't even involve fisheries because that's the way the real world is.

Second, I would like to comment on the difficulty of establishing new programs. This year I am chair of the faculty on the UC San Diego campus, so I know that the process for establishing a new institute or graduate course in the University of California system is long and complex. One of the things that you start with is demonstrating need. It would seem that a good activity for Sea Grant or some other unit would be to try to pull together statistics that would help to prove that need. We've heard from many different people that there is a need for broadly trained managers out there, and yet we also hear that there are people who don't have jobs. If we are going to do anything practical about new courses or new degrees, then a demonstration of need is a fundamental input parameter that we must have in the hands of the academics among us who would have to fight all this through. It is as complicated a process as getting a bill through the legislature, except that it takes a different kind of expertise about how to do it.

*Morgan:* I would like to respond to that. I used to be a program coordinator for extended education at Humboldt State University. One of the ways that you can start that process is by running a program first through the extension education department. It's generally easier. You can hire the staff, recruit the students and offer courses as an elective. This way courses are run on a trial-and-error basis to see how well they are received. You can then determine if it's something that you later want to make a policy decision on and whether or not to incorporate it into a formal curriculum.

*Cailliet:* It appears that Humboldt State University has fairly decent course offerings, but, as far as I know, no degree in marine fisheries management. So it would be valuable to pursue the suggestion that Ted Kerstetter made of creating a nonthesis master's degree for someone who is solidly grounded in an academic subject like biology, and then enhancing that with more case history involvement or an internship. It could be done more easily at Humboldt than at any of the other state campuses that I know of. At Fresno, we have one undergraduate course in fisheries biology management. I teach the marine fisheries class at Moss Landing. There's no core there. There's no way I can teach economics and sociology. In order for this to be an effective program, it has to be centralized. In Washington, the curriculum is all within the University of Washington system, and

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that's an impressive program on paper. I wonder if it would be better to consider building programs elsewhere or to build up programs that already exist.

*Participant:* This is where you get back to the question of need. Do you really need more than two or three institutions in the state doing this kind of thing?

I was asked at one time to give a course for the people at Fish and Game at Monterey, but I felt insecure about teaching such experienced people. I think, however, that would be an important thing to do, in addition to initiating a speaker's bureau. The problem, again, is that there are few places where professionals can get a course offering in a short time to enhance their career and their ability to make decisions. People who are already in positions of power, but who may be a bit rusty in areas outside of their specialty, might benefit from update courses, speakers' groups, and seminar series.

*Wilen:* I wonder what would happen if there were a program that trained five or six people a year in a radically restructured way. I'm not simply talking about taking a biology program and tacking on a few courses in communications, economics, and sociology, but teaching people with a curriculum devoted to actual management case studies and discussing some "real world" problems. It seems to me that the management game has changed enough so that it won't be adequate to take traditional programs and add a few extra courses from the social sciences. Today's managers need to know something about the details of decision-making institutions and what's going on in the real world. I suspect there probably is a market for properly trained, management-oriented fisheries people. I don't know how big it is, but I suspect there is a market for something that is very different from what we've got.

*Kerstetter:* I think the market is in the replacement of people who are in management positions now. What we are looking for is a way to supply a cadre of better trained people to replace existing managers. Ideally, I think, the cadre would come from technically trained graduates who have worked in the field for two or more years, and possibly then gone back for either a structured graduate degree or a series of courses designed specifically to enhance their management skills. I don't think a case could be made for putting a program like this in place based on the number of positions that are waiting for its graduates. You simply couldn't make economic sense out of trying to do it that way.

*Thornton:* At a time when finances are a major consideration

for everybody, any attempt to develop new curricula or programs scares people. We do not have the money right now to do that. Maybe we do need to take a good hard look at what we have right now. I'm thinking about what Dr. Kerstetter said earlier about the possibility of eliminating a course if it's no longer practical. Maybe we don't need to eliminate it, but rather to look at its content and decide whether it is really applicable and whether it's helping students to be better prepared to get jobs in fisheries.

*Barrett:* My name is Iz Barrett from the Southwest Fisheries Center. One of the things we do is to provide advice to fisheries managers. Our world has changed in the last 10 years since the Fisheries Management Conservation Act came into place. We are not getting the kind of people we should have in this business. I agree fully with Jim Wilen. My ideal in presenting advice to the regional fishery management councils (I'm not talking about the states now) or to regional management offices is to provide them with a series of alternatives. . .there are different things we can do and there are different consequences for each. If I were doing that 10 or 15 years ago, I would just have talked biology and said, "Well you can't fish. . .you're going to go over the MSY. . .too bad, you'd better not do it." Now we're advised to talk optimum yield and to take into account sociological and economic factors. It's people with that kind of knowledge that we're not getting—people who can synthesize and look at the broad problem. Speaking as a person who hires, I would still prefer someone with a strong area of specialization, such as economics, population dynamics, or sociology. But I would want that person to have an understanding of other elements of the field. If a person has a population dynamics degree, I'd like him or her to have taken a course in resource economics and perhaps in sociology. I would certainly want that person to have an understanding of how to make things work, how decisions can be "forced," how to plan so you don't wander around in the wilderness, how to run a meeting, things like that. Those are the practical skills that really make the difference.

The gentleman in the back is quite right: biologists don't make management decisions. The way it works now in the fisheries council is that decisions are made by lay people from business and industry. I think it's only proper that we educate new people who can help these decision-makers come to the right decisions or at least understand the consequences of a variety of decisions.

As a strong recommendation, I think it would be useful if Sea Grant set up a fact-finding committee and probably even went

further and tried to set up a draft curriculum. It might be useful. I don't think we are talking about a lot of work.

**Wyatt:** I'm Bruce Wyatt, a marine advisor in Santa Rosa. I like the intern idea. It would seem that the Pacific Fishery Management Council might even use an intern. Is there anyone who can give us some information about internships and what's happening in this area?

**Nagata:** I'm Lindy Nagata with California Sea Grant. There is a National Intern Program sponsored by the National Sea Grant College Program. Graduate students are placed either on Capitol Hill in legislative committees or in the agencies. It's a relatively small program. We've had one or two students from California each year for the last three or four years. I think the program offers about 20 positions overall each year. We at California Sea Grant have discussed the possibility of having an intern program at the state legislature, but at this point it's just an item of discussion.

**Spieß:** In intern programs there's always the question of who pays. The Sea Grant program pays for its national internships, and it doesn't have very many. If there's a feeling on the management side that internships are a good idea, then it would be incumbent on the National Marine Fisheries Service or the Department of Fish and Game, for example, to establish some lines in their budgets for bringing in interns. I know that the big Navy in-house laboratories have major programs every summer by which they bring young physicists or other scientists into their laboratories.

Supporting graduate students is another line of attack in which you have a kind of continuous internship. A student who is working for an advanced degree becomes an employee and is supported by one of the agencies or laboratories.

**Anders:** The term "intern" probably hasn't been used correctly here, at least by me. The Department of Fish and Game's seasonal aide program is actually an intern program as far as I'm concerned. Graduate students working at the center are, in essence, interns. Practical experience is what we are really talking about, no matter what you call it, and I think it has tremendous value.

I started out working as a seasonal aide for Fish and Game when I was a zoology major at UC Berkeley and got experience at Moss Landing and at Point Reyes and Fort Bragg working on the docks with the fishermen, working at the processing houses, and at a number of other jobs. It certainly changed the direction in which I went.

**Clegg:** My name is Jim Clegg and I am with the Bodega Marine Laboratory. It seems to me that trying to train students to become fisheries managers is a somewhat schizophrenic objective. On the one hand, you are training people as scientists, but on the other hand, you are telling them not to act that way. One simply has to say, if you want to find out about the universe become a scientist. Let's not sully that one, please. Be very clear that if we give up this approach, we're going to lose. It may take a while, but we're going to lose, no matter how well we manage. It seems to me that fisheries managers have to be trained differently from scientists. I tend to agree with Jim Wilen that fisheries managers should work at managing. Presumably, if a manager is good at it, he or she will learn enough about fishes and things like that to converse with scientists. You ought to keep scientists where they belong, doing what they know best.

**Anders:** I disagree with you. I submit respectfully that someone who doesn't know anything about fisheries is going to have a hard time in the fishery management business. But because the fishery manager is confronted with the public every day, he has to be able to communicate about the subject matter in somewhat intelligent terms. A biologist who doesn't want to pursue research has a real role to play if he or she can work with the general public (with constituents, if you want to call them that). . . can tell them what the business is all about in terms they can understand and try to influence their decisions. Too often we don't see that happening, and what we end up with is a lack of communication.

**Cailliet:** It seems to me that there are different levels of decision making that go on in terms of who takes what courses and what good it does them. University systems offer a comprehensive array of courses. Students can choose to take specific courses whether or not these are in their main area of study. I took immunology and I'm not an immunologist. I took parasitology and occasionally I see a parasite. I took ichthyology and here I am. Students can choose from among the courses that the university offers and decide what careers they want to pursue, and they can do this knowing what's available and what is going to help them get hired. The people who do the hiring have to make decisions too—about what cluster of knowledge and skills is going to be most valuable to them. So there are many factors involved in the game. When it gets right down to it, no matter what school one goes to, it's still the individual who gets the job and convinces the employer that he or she is good and should be hired. It's up to students to decide what mix of courses is going

to get them hired into positions where they can ultimately become managers.

*Morgan:* It might be a worthwhile project to use a videotape player to have various professional people discuss things they wish they knew when they started. Students could check out the videotapes or professors could show them during classes. Hindsight is 20/20, and often students don't know what they need to know unless someone else brings it up.

*Costa:* I have a comment on a sociological phenomenon that occurs in at least the University of California system. As a product of three different campuses, I have recognized a certain amount of what you could call academic snobbery toward applied research. When I was young and naive, starting out as a biology student at UCLA, I wanted to be a resource manager, but I ended up an academician, for better or worse. My point is that professors often press their own values onto students. And, unfortunately, another reality is that there aren't very many places for academicians to work. Some of our best students may be better off doing applied research.

*Dewees:* I'm Chris Dewees from the Marine Advisory Program. One observation I have is that although students vary from generation to generation, they all look at the job market and decide what classes to take based on what they think will help them to be hired. I think the people doing the hiring need to give clearer signals about what they want. If they want people who have management skills, they need to make that clear. If they want technicians who have biological skills, that also needs to be made clear. I have seen very few job descriptions that call for management or communications skills. If these requirements were made clear, then we could have some hope of our students fitting the job market better.

*Reid:* I'm David Reid of the the Food Science Department at UC Davis. One of the problems is that we are trying to teach too many people too many specific things with too many specific degrees. It is more important to teach people how to do things, why to do them, how to learn, and how to communicate. Basic curricula should be offered. Rather than forcing students to take so many courses in marine biology or in fisheries management, for example, we should allow them to find out what kind of job appeals to them and select specific courses toward that end. It's the trend today to specialize, but if that job market vanishes, then you've got to be flexible.

*Cech:* I'm Joe Cech from the Department of Wildlife and



Fisheries Biology at the University of California, Davis. I'd like to back up the previous speaker. At UC Davis, we're very fortunate in having a broad spectrum of hard sciences and social sciences available to students. They can major in fisheries biology, food science and technology, economics, genetics, and many other fields according to their own preference. Once these choices have been made, a student has both basic skills and a specialty area. Right now we're trying to develop a masters-level fisheries program within the Ecology Graduate Group that would take into account economics and sociology as well as biology. I'm not sure that's the right forum for this particular program, but administratively, it makes some sense to put it into an existing graduate program.

*Participant:* Making sure that students have good writing, speaking, and communication skills isn't just specific to a fisheries management curriculum. The best academician or sociologist needs these skills. As educators, at all levels, we should be striving to incorporate these skills in with the requirements of our courses.

*Cech:* I'd like to caution that there is the danger here of throwing the baby out with the bathwater, so to speak—with the baby representing what's good in our present curriculum. If we shift over strictly to a systems approach or to people-based decisions rather than fish-based decisions, we run the risk of ignoring the resource-related real world. For example, to talk about recruitment in a model, one needs to know something about the process of reproduction in the fishes. I think we need to generate more specific information about how these biological processes work before we can really manipulate them and utilize them to the best of our ability for the fishermen and for society.

## **VI. SUMMARY**

**MARY MORGAN**, Consultant, Joint Committee on Fisheries and Aquaculture, Sacramento, California

Our consideration of what constitutes appropriate training for a fisheries manager in today's world has opened several lines of discussion.

There seems to be broad agreement that the nature of the job has changed in some fundamental way in the past decade or two, reflecting among other things changes in legislation, changes in technology, and changes in the intensity of competition for the resource. To be effective, today's managers must be expert communicators and negotiators, and skilled in conflict resolution. They must understand the political process, how things "really work," economics, and human dynamics.

These demands suggest to some people that the manager is necessarily a very different person from the scientist, and that the scientist cannot and perhaps should not be expected to "grow" into the manager. Others feel strongly that a basic scientific background is an important prerequisite for the fisheries manager and indeed that it should be strengthened so that the manager is able fully to understand the ecological and broader systems implications of his or her decisions.

In any event, there is general agreement that four years of college education is not sufficient for the prospective fisheries manager, although there are certainly actions that could be taken to strengthen undergraduate fisheries education. We should, for example, examine very closely what courses are presently being offered and their content. And we could make these courses more practical by incorporating case studies of important management decisions, by inviting speakers into our classrooms, and by getting students into the field to meet fishermen, industry people, legislators, representatives of professional associations, industry people, and the like.

All of this can also be done at the graduate level, which seems to be where most of us would place relevant management and social science courses. We have heard, for example, that Humboldt State is considering the institution of a nonthesis master's degree in fisheries, which would present opportunities for the broad training we are considering. We have also heard described as a kind of model a separate institute where management training of the broadest kind could be conducted. Many of our panelists spoke of the need to give students practical experience, and a number of them suggested that internships in government and in management and regulatory agencies would be of incalculable value to prospective managers.

There is considerable opinion that much could be done to help

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those persons who have already entered government and the agencies. A need exists for all kinds of broadening short courses and seminars in communications and the social sciences, as well as in more scientific subjects.

There is some concern about the job possibilities awaiting graduates, and, again, the belief that broad training gives students most options. Although there are not positions open at present in the major fisheries institutions to absorb new graduates of the type we envision, it is thought that these are the kinds of people who will be needed to succeed present managers. The observation was also made that we are seeing new kinds of positions, in consumer education and marketing, for example, that we have not seen before.

In summary, it appears that there are many lines of attack to the problem. By your participation here today, you have helped to place the concern in broad perspective and to suggest any number of possible solutions to which the universities, the agencies, and a variety of other groups can contribute. My thanks to all of you for being here today and to California Sea Grant for providing a forum for our discussion.

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