Journal of shellfish research.

[S.l. :National Shellfisheries Association,1981-
http://www.biodiversitylibrary.org/bibliography/2179

v. 7 (1988): http://www.biodiversitylibrary.org/item/18778
Page(s): Page 327, Page 328, Page 329, Page 330, Page 331, Page 332, Page 333, Page 334, Page 335, Page 336, Page 337, Page 338, Page 339, Page 340, Text, Text, Text, Text

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Journal of Shellfish Research, Vol. 7, No. 2, 327–340, 1988.

MUDDLING THROUGH THE CLAM BEDS: COOPERATIVE MANAGEMENT OF NEW JERSEY'S HARD CLAM SPAWNER SANCTUARIES[1]

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ABSTRACT This article describes the process whereby hard clam (*Mercenaria mercenaria*) spawner sanctuaries were created in estuarine environments along the New Jersey shore in an attempt to increase recruitment in the region. While the project was only a limited success in terms of this biological goal, this experiment in co-management involved complex and revealing socio-cultural interactions among a variety of constituencies and individuals who attempted to ''muddle through'' the problem solving process together. This article is principally concerned with analyzing and understanding what happened from an anthropological perspective. It thus hopes to contribute to our understanding of the reasons for the successes and failures of such cooperative efforts at fishery management problem solving.

KEY WORDS: *Mercenaria mercenaria*, spawner sanctuary, management

INTRODUCTION

This article is based on participation in an experiment in co-management that began in May 1985 with proposals to create hard clam spawner sanctuaries in the state of New Jersey. The argument behind co-management is that to achieve more effective and equitable systems of common-property resource[1] management, representatives of user groups, the scientific community, and government agencies should share knowledge, power, and responsibility (Pinkerton 1987, Kearney 1985, Jentoft 1988, McCay and Acheson 1987). It is very difficult to create a management program for a common-property resource that is: (a) equitable in its effects on different social groups and individuals; (b) based on knowledge and data that are adequate to the task of creating regulations that work; and (c) enforceable. Co-management should, in theory, reduce those problems by bringing the users directly into the management process rather than assigning them solely to the role of those being regulated. This assumes that users as well as scientists have knowledge and data that can help government officials better assess problems and devise solutions. It assumes that fuller involvement of users in the management process will reduce the political and equity problems that often arise from resource management efforts. Finally, it assumes that if users are more fully involved in management, they will be more likely to perceive the management system as legitimate and hence to comply with the rules and regulations developed (Jentoft 1988).

In the shellfish enhancement case to be described, co-management involved officials of the State of New Jersey's Department of Environmental Protection (DEP) in cooperation with clammers. It involved both in cooperation with scientists of different disciplines (biology, biochemistry, anthropology) and from both academic institutions (Rutgers University) and government agencies (several divisions within New Jersey DEP; the state Fisheries Development Commission; the federal National Marine Fisheries Service, Northeast Fisheries Center, Sandy Hook Laboratory). Added participants were state and local politicians, county officials, and a marine extension agent.

I describe the inception and realization of New Jersey's hard clam spawner sanctuary project and discuss its problems and accomplishments. It will be seen that the hard clam spawner sanctuary was an imperfect instance of co-management. The involvement of clammers in the project was not enough, or not done well enough, to prevent or blunt conflicts among groups of clammers. It also did little to encourage adherence to the rules and regulations of the program. However, these and other failures and disappointments in co-management cannot be adequately explained by recourse to stereotypes of the inclinations of clammers, or state bureaucrats, or biologists, or even anthropologists. The structure of relationships among the people and groups involved and the way they viewed and interpreted each others' behavior were critical factors.

Finally, the knowledge and data provided by clammers and academic scientists were inadequate to the task of shellfish enhancement, at least in the short run. The scientists, clammers, anthropologists, and state officials involved in the project were confronted with the problem of decision-making in the context of scientific uncertainty and ignorance. For that and other reasons, the decision-making approach taken was that of incrementalism, or muddling

[1]By ''common property resource'' is meant a resource that has properties such that it is difficult for one user to exclude others from it, and the activities of one user can subtract from the benefits obtainable by another (Feeny *et al.* 1988; Ostrom 1986:604). It is important to distinguish such a resource from the cultural and legal regime that is also often called ''common property.'' In fact, institutional regimes that concern such resources are comprised of variations ranging from totally open-access and unfettered use of a resource to various communal systems of controls over access and use to different levels and kinds of centralized government intervention (Ciriacy-Wantrup and Bishop 1975; Moloney and Pearse 1979; Bromley 1986). We have recently proposed the terms ''open access,'' ''communal property'' and ''state governance'' for general types of regimes (Feeny *et al.* 1988).

through (Lindblom 1969, 1979). Probably more important than the clams transplanted and the spawn they emit into New Jersey's waters is the fact that this project resulted in the creation of a position in applied hard clam biology dedicated to reducing the uncertainty and ignorance that plagued the project. I suggest, however, that the real challenge is to develop ways to respond to problems when we know mostly that we may not be able to know with certainty. Ravetz (1986) calls this "usable ignorance."

The analysis is based on an ethnography of cooperation, conflict, and decision-making among scientists, shellfishermen, and bureaucrats. It is personal because my research, done between 1985 and 1988, was based on the participant-observation method, with heavy emphasis on participation. I was a leading participant in the genesis and implementation of the project. As a full participant, I was able to gain insights and perspectives otherwise difficult for an outsider to obtain but also thereby added my own predilections, blinders, and biases to the process and to this account.

THE PROBLEM: DECLINING HARD CLAM AND LITTLE APPLIED RESEARCH

The project's focus is the hard clam (*Mercenaria mercenaria*). Hard clams are distributed throughout the bays and tidal rivers of New Jersey, as are commercial and recreational clammers. Landings have declined since the 1940s.[2] Vast areas were closed to clamming because of pollution, particularly after 1961, and roughly 50% of New Jersey's waters are so closed (not all of this water is hard clam habitat). By the 1970s or 1980s, many of the open waters of the bays and tidal rivers of the state showed signs of serious to severe depletion of hard clams and overall landings had come to depend significantly on programs that allowed the relay of clams from polluted to clean waters. Participation in the fishery also has declined.[3] There is no question that many commercial clammers have quit because of declining catches.[4]

There is also little scientific data available to help assess and do something about hard clam population decline in New Jersey. The state's oyster industry, although now smaller in landings, revenue, and participation than the hard clam industry, has long received the bulk of research and enhancement efforts from both the state and the academic community. This may have something to do with the fact that it is located in one town, dominated by several large shucking and packing firms, and has a long history of organized political effort. The hard clam industry, in contrast, is comprised of thousands of independent harvesters, summer and weekend clammers, and dozens of scattered, independent dealers, and thus has less organized clout. However, knowing that the experienced scientists and technical resources needed to address the problem of hard clam decline exist, we used the spawner sanctuary program to bring them together. We sought to renew and create interest in hard clam enhancement studies, and, with the assistance of members of the industry and politicians, create a new impetus for estuarine shellfish research and development in New Jersey.

APPROACHES TO A SOLUTION: THE SPAWNER SANCTUARY PROJECT

The basis for our project seemed obvious: the need to restore the hard clam resource. The specific approach taken was a hard clam spawner transplant and sanctuary project. Clam spawner transplants originated in the bays of Long Island, New York, in the early 1960s, as attempts to increase the length of time that clam larvae were present in the bay (Kassner and Malouf 1982).[5] The "spawner sanctuary" is a refinement of this strategy, developed in the early 1980s by the State University of New York at Stony Brook (Carter et al. 1984) and implemented by two Long Island townships at Great South Bay. Clams are moved

[2]Landings are under-reported, perhaps by as much as fifty percent (T. McCloy, personal communication), making it risky to rely on these data for stock assessment. Clammers' accounts of changes in typical catches suggest, however, that the decline is real in most areas. Landings have stabilized in the latter 1980s. Official landings of hard clam meats in 1987 were 1.54 million pounds, with an ex-vessel value of 5.86 million dollars. Landings were slightly under the 1984 level of a little over 1.6 million pounds, but the ex-vessel value was higher than the $4.9 million of 1984. The use of clam meats as a measure of success is somewhat misleading for hard clams because the smallest clams, the littlenecks are worth the most, and clammers are almost always paid by the clam.

[3]From 1983 to 1987 the total number of licensed clammers, both commercial and recreational, declined 25%, from 20,550 to 15,280 (Bureau of Shellfisheries, unpublished data). The number of licensed commercial clammers was 2,875 in 1983 but only 1,935 in 1987, a 33 percent decrease.

[4]It could be argued that decline in the number of licensed clammers is due to improvements in the general economy, hence in alternatives to clamming. This is probably true, to some degree, in recent years as New Jersey's unemployment rate in the coastal counties has gone down to less than 4%. However, the parallel decline in licensed recreational clammers suggests that other factors play a role. Lack of adequate staff for enforcement of license requirements is one of those factors (G. Critchlow, personal communication). Poor catches is another. However, evidence is mostly anecdotal; catch per unit effort data are non-existent.

[5]The source suggests that baymen, rather than scientists, initiated the early transplants. I believe that the idea of spawner sanctuaries existed more widely and longer than suggested by Kassner and Malouf; New Jersey clammers and oystermen have long thought that the "chowders," for example, that they kept in protected coves or leases until the price improved had the beneficial effect, in the meantime, of increasing the amount of larvae in the waters.

from abundant to depleted waters and protected from harvest. The transplant increases the size of the breeding population. Their spawn may increase the chances of successful sets of hard clams in the depleted bays in which they are placed (COSMA 1985).

INCEPTION OF NEW JERSEY'S SPAWNER SANCTUARY PROGRAM

The idea of trying spawner sanctuaries in New Jersey was promoted by William P. (''Bill'') Jenks, a clammer and bayman who found out about the Long Island spawner sanctuaries at a meeting in 1984 at which he gave a talk about another New Jersey hard clam program (Jenks and McCay 1984). He went with me to this meeting because I hoped to show scientists and administrators on Long Island that it is indeed possible to involve clammers in constructive meetings—my first stab at ''co-management.'' I noted his reaction to such commingling: he left the meeting disgusted at the ''objectivity'' of scientists when men's lives are at stake, a not uncommon reaction of non-scientists to scientists, and one of the indicators of the sub-cultural differences that affected our project later. He also left the meeting intrigued by some things he learned, especially the idea of planting ''chowder'' clams in a protected area to repopulate the bays.

Elsewhere (McCay in press) I have described in greater detail how Bill Jenks and I worked together, with others, to stimulate interest in spawner sanctuaries in New Jersey. Bill read up on spawner sanctuaries and kept alive the idea of creating them in New Jersey. He persuaded me and others to take the idea seriously. He and I did the initial planning work in 1985. I knew how to write proposals and Bill knew a lot about clamming as well as enforcement and related issues. I prepared proposals to Sea Grant and to a new research and extension center in fisheries and aquaculture, referred to as the ''Fish Tex Center,'' in which I billed this as an experiment in low cost''intermediate technology''[6] and in cooperative research and action. Cooperation and co-management were to be realized by having numerous co-principal investigators, including Jenks; a state biologist, Tom McCloy; a federal biologist Clyde MacKenzie; a marine extension agent, Gef Flimlin. They and several other people were willing to participate as long as I did the coordination and proposal-writing and Bill Jenks did the politicking. The proposals were for the planning process: determining whether and how to use ''spawner sanctuaries'' to help restore clam populations in depleted bays.

WHY CO-MANAGEMENT? THE EXPERIENCE OF THE HARD CLAM RELAY

The idea of using ''co-management'' as our vision of the spawner sanctuary project came from our experience with New Jersey's hard clam relay program. This program, begun in northern New Jersey in 1983,[7] involves the state-supervised harvest of clams from polluted waters and their transplantation to lots leased by the individual clammers in clean waters, where, within 30 days, the clams cleanse themselves of bacterial contaminants. I was impressed by the extent to which Bill and others managed the program, both publicly, in their participation in an advisory shellfish council, and privately, in close interaction with officials of the state's shellfisheries program. In a paper co-authored with Jenks (Jenks and McCay 1984; McCay 1985), we argued that the almost ritualistic hostility and allegations of favoritism between state officials and baymen that arose at advisory council meetings and in the press were generated by a management style in which the state developed its plans without involvement of those affected by them and then presented them to advisory councils or simply implemented them on the water. Formal involvement of a few respected baymen at an early stage of planning might have prevented some of the nastier episodes.

Moreover, the involvement of baymen in the management of the relay program was forced upon the state rather than encouraged by it. This worked against rational planning, reinforced an old legacy of cat-and-mouse games between clammers and enforcement officers on the bays and seas of the state, and tended to pit groups of baymen against each other, making it difficult for them to recognize and work upon their common interests. We suggested that the clammers should be officially and directly involved in the design and running of the relay:

> A general principle of planning in general and co-management in particular is to structure the process for maximal participation by those who are most directly affected by the program and thus have both the motivation and the experience to contribute to its effectiveness. People whose livelihoods are most at stake and who know the resource, environment, and industry from experience and trial-and-error experimentation are not only valuable sources of knowledge and advice but invaluable allies of the various branches of government involved in any complex management program [McCay 1985:8].

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[6]Intermediate technology (Schumacher 1973) is an approach to development that questions the wisdom of capital-intensive, large-scale projects whose benefits are supposed to ''trickle-down'' to ordinary people; it poses instead the possibility of controlling the scale and factor-mix of technological change to be more appropriate to the resources and needs of the people who need ''development'' the most, i.e. the poor.

[7]The current program is based on one started in the early 1970s in southern New Jersey, near Atlantic City. Relays go back to the 1920s in New Jersey.

WHY AN ANTHROPOLOGIST?

There was more than serendipity behind the fact that the project was initiated by a clammer working with an anthropologist rather than with a biologist. My involvement was partly by default. State and university shellfish biologists were approached but none was willing to instigate the project (see McCay in press). Their responses were essentially the same as this, from a state biologist: "it's a good idea . . . but we have enough to do right now." No one but an anthropologist would help Bill Jenks. More than default was at work, though. The discipline of anthropology emphasizes respect for the people being studied and for the value of their knowledge. Hence an anthropologist is apt to take up the challenge to cooperate with someone like Bill Jenks.

In addition, anthropologists have a sub-discipline called applied anthropology, built on recognition of the value of not just studying people but also working with them to help them accomplish their objectives. Anthropology is also known for holism, an insistence on the interconnectedness of things and a willingness to account for rather than try to control away the complexity and diversity of human and natural communities. This may help explain why I remained with the project after its true complexity and difficulty revealed itself.

POLITICAL SUPPORT: FROM THE (EEL-)GRASSROOTS

An advantage to involving representatives of the user group, such as clammers, in a management project is that people at the grassroots are often smarter than academics about the need to obtain political support rather than rely on the goodwill and interest of state agencies or university scientists. The proposals were submitted in the summer of 1985. That summer Jenks appeared before the state's new Fisheries Development Commission to argue for its support of the hard clam industry and this proposal, and through his ability to gain the support of a coastal legislator, the spawner sanctuary concept became part of the recommendations of a legislative task force on the clam fisheries (Coastal Bay Clam Resources Task Force 1985).

We had little difficulty obtaining political support for the objective of planting hard clams in sanctuaries, especially compared with later trouble trying to gain support from the scientific community for research proposals designed to plan and evaluate the program. Contributing to our success in getting money to plant clams was the fact that the idea of transplanting shellfish and protecting them in sanctuaries to serve as a brood stock is very attractive public policy. It is simple and logical, understandable by almost anyone; and it is an example of something otherwise rare in common-property resource management: positive action instead of negative restraint.

CRISES IN CO-MANAGEMENT

Responses were much swifter than anticipated. By the early fall of 1985 the marine fisheries and shellfisheries group in New Jersey DEP's Division of Fish, Game, and Wildlife met with us and agreed to cooperate. We soon faced a crisis in co-management. In December 1985 state fisheries personnel began to design the project without including me or any of the clammers. We complained and regained central roles. In January 1986 an assistant commissioner of the DEP announced at a shellfish advisory council meeting that $10,000 would be provided for the purchase of clams for a spawner sanctuary for the spring of 1986.[8] A second crisis ensued over how that money would be spent. State biologists wanted to create a demonstration project with hatchery stock of the *notata* genetic variant of *Mercenaria* in Shark River, an enclosed and polluted estuary. The objective was to see whether a spawner sanctuary could work so that we could go to the legislature for more funds with proof in hand. However, Bill Jenks, the clammer who started the project, was upset at what he saw as misuse of scarce funds. Even though he and I had noted the possibility of using *notata* clams as a marker, he insisted that the Shark River project was a misuse of the funds. They should be used, instead, for a bona fide spawner sanctuary in open waters so that clammers could take direct advantage of the results.

For my part, I was upset that decisions about the spawner sanctuaries were still being made only by state personnel when the proposal called for planning that involved not only other shellfish scientists in the region but also baymen. After many phone calls and some politicking (including phone calls to state officials from legislators), the state agreed that the money would be used for a true spawner sanctuary, in clean and open waters, and that our original intent, of using the best possible scientific minds to advise us, would be followed.

The outcome was that there was no money for planning, just for implementing a sanctuary. Subsequently we obtained additional funding from a variety of sources,[9] most also earmarked for actual implementation of sanctuaries. But we had to plan for the immediate reality: planting clams in a spawner sanctuary in May 1986.

APPROACHES TO THE PROBLEM OF UNCERTAINTY AND IGNORANCE

By early January 1986 we knew that $10,000 was available to begin planting clams that spring. We had to abandon the idea of rational planning for the project and to

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[8]Her announcement was evidently part of an attempt to ward off mounting criticism from clammers who were dissatisfied with what they saw as little attention paid to their concerns. She accepted a challenge to attend a shellfish council meeting and brought as her gift this announcement.

[9]Sources of funding included the New Jersey DEP Bureau of Shellfisheries, the New Jersey Fisheries Development Commission, the Fish Tex Center at Rutgers University (Fisheries and Aquaculture Technology Extension Center), Ocean County Board of Freeholders, the New Jersey Agricultural Experiment Station, and the federal Coastal Zone Management Program. Legislative bills for additional funding lapsed in the legislative process.

take on a more incrementalist approach, in which major questions about goals, objectives, and methods were set aside as decisions about more immediate matters were made (see Lindblom 1969, 1979). We muddled through, and as we did some of those goals and methods emerged and many mistakes were made and lessons learned, as expected from incrementalist theory (ibid).

Not only did we lack the time and resources to engage in rational planning, but we were confronted with a situation of radical scientific uncertainty and even ignorance. Very little research on hard clams and on the relevant aspects of the ecology of their environments has been done in New Jersey in recent decades (but see Kennish and Lutz 1984; else one must go to Carriker 1961). We clearly did not have the data available to use a larval dispersion model for siting spawner sanctuaries comparable to that used, to some extent, in Long Island waters (see Carter et al. 1984).

Our approach to the problem of decision-making in a context of scientific uncertainty and ignorance became evident as we went along. It was to be very humble about what might be accomplished and to take advantage of the best available scientific advice, combined with information from baymen, in making decisions. It was also to be willing to act on the basis of very little scientific information.

I was influenced by a conversation in January 1986 with one of the shellfish biologists in New York State who had been involved in studies related to hard clam and bay scallop spawner sanctuary projects in Great South Bay, Long Island. A great deal of money had been spent to do a hydrographic model of Great South Bay, and in turn to use it to determine where to plant spawner stock in relation to patches of phytoplankton distribution and the movement of larvae. He observed that all a model such as this does is "teach us what we don't know." Moreover, given vigorous debates in ecology about equilibria vs. stochastic processes in nature, it is difficult to take a predictive model seriously. I used his observations to justify our beginning the project without hundreds of thousands of dollars worth of basic research into the physics, chemistry, and biology of the bays.

We felt that starting off with a spawner sanctuary program would help delineate and stimulate scientific research appropriate to the questions that arise from that program rather than broad-brushed and expensive large-scale studies. We also felt that this program would help initiate the restoration of applied hard clam research in New Jersey. Indeed, an important outcome of the project would be the creation of a position in applied hard clam biology, occupied by Stephen Fegley as of July 1987. From the outset and many times thereafter, we said publicly and in private that the goal of the project was hard clam enhancement, whatever that takes. We assumed that reaching this goal requires a strong applied research program in hard clam biology and management as well as genuine public commitment to the shellfisheries, and that the hard clam spawner sanctuary project should be seen in this light.

Our inclination to act without a substantial body of data began early in the project. Clyde MacKenzie, a NMFS shellfish biologist, agreed to help me and Bill Jenks with the project. He approached it with this attitude: "it sounds like a good idea; so let's do it!" When I first heard him say this, in the autumn of 1985, it was disarming; I had just written a long proposal for a year of feasibility study and planning. But it was heartwarming to Bill Jenks and other clammers, who distrust anyone who "just does a study." MacKenzie's attitude and approach turned out to be typical of the people most influential in this project. Clyde MacKenzie has worked with members of the oyster and clam industry for many decades, often on projects as applied as this (see, e.g., MacKenzie 1975, 1977, 1983) and is committed to "managing for abundance" by controlling predators and other interventions in nature (MacKenzie 1979). He is inclined more to *praxis* than to theory, and believes that clammers have much to teach biologists.

Mackenzie's attitude, the baymen's inclination to distrust scientists and feasibility studies, and the unexpected receipt of money from the state led us to accept a major change in tactic: action first, science later. The idea became to start something and trust that this would attract the scientists and science required. As the marine extension agent, Gef Flimlin, said to a reporter, "what we're doing is a whole new concept in that we're doing it first and they're studying it later. We're taking the first step, creating the situation for them to take and study" (*Ocean County Observer* May 11, 1986).

"Action now, science later" was reinforced by other participants in the process. Although some biologists who participated in our planning meetings emphasized the need for more information before planting clams, Harold Haskin, one of the most respected shellfish experts, suggested that we knew enough already, as shown in this segment of a discussion of the problems in evaluating a spawner sanctuary.

> McCay: "Do you think a Spawner Sanctuary would make any difference then?" Haskin: "Well, it can't hurt. I'm all for it because the more parents you've got in an area the greater the probability that you're going to get some sets. You can't go wrong on that." McCay: "You accept that it's an unpredictable system but you're hoping to increase the odds." H: "You're increasing the odds, . . ." (Transcript, 1/27/88 meeting)

We therefore put the proverbial cart before the horse by initiating a spawner sanctuary program in New Jersey, but by so doing we helped to redress the problem of little scientific data.

BAYMEN AND SCIENTISTS AS DECISION-MAKERS: SITE SELECTION

In the meantime, decisions about how to run the spawner sanctuary program had to be made. We used two

approaches. The first was to tap the knowledge and experience of baymen. Bill Jenks provided 113 items of advice and information based on his experience and observations. Bill and I also interviewed baymen and invited some to decision-making meetings. The second was to do the same for shellfish biologists and state administrators.

One of the arguments for co-management is that the users of a common-property resource are likely to have information and perspectives valuable to management. With inspiration from MacKenzie and from biologists like Johannes (1981) who emphasize the importance of the biological knowledge and lore of users of the marine environment, Jenks and I carried out a fact-finding expedition. In August and September of 1985 we spent three days talking to clammers, clam dealers, and aquaculturists about conditions on the bays, the concept of spawner sanctuaries, and, using charts and an ingenious system developed by Bill, where spawner sanctuaries should be located. Their responses to our questions about sites (both to plant clams and for settlement of larvae) were recorded with a straight pin on the chart; on the back of the chart each pinprick was linked to an informant, but otherwise the informants could not easily see sites chosen by others.

Our goals were several. One was to test the waters, as it were, in New Jersey coastal areas outside Bill's normal range, to see if we could count on support from very powerful clammers and oystermen there. A second was to publicize the project and generate general interest. The third goal was to use the experience and knowledge of clammers as much as possible in the project. This information would become part of the basis for making decisions about siting and other aspects of the project.

At a meeting of shellfish biologists, clammers, and state biologists and administrators on January 17, 1986 the scientists who came—six, from New Jersey and New York—reviewed the results of our survey. Jenks put our charts on the wall, showed where the pin-pricks were and revealed some of the comments made by those we interviewed. He noted criteria that should be used, in addition to those prompted by hard clam biology, in site selection, foremost among which is the need to protect the clams from poachers. Combining our findings with the biologists' own knowledge of the bays in question or similar bodies of water, we selected and ranked the more promising sites. Bill Jenks reported on what he observed and what the clammers he and I interviewed said, and scientists such as Harold Haskin and Bob Loveland of Rutgers and Bob Cerrato of State University of New York at Stony Brook discussed specific sites as well as the spawner sanctuary in general.

For example, Bill reported that a former clam dealer in Barnegat Bay recommended not planting there because of the effects of the partial closure of an inlet:

> Now, Stan Cottrell says, at this time, in Waretown there is a tide rise of only six inches and that was eighteen inches just fifteen, twenty years ago, so due to the inlet's closure or partial closure this is affected . . . In his words, he said, 'I wouldn't plant a clam in Barnegat Bay, I would go for Little Egg [Harbor] and Great Bay.' Now there's a man that lives right on the bay and was the biggest dealer in the area [Jenks, transcript 1/27/88]

Dr. Haskin responded that he and his colleagues had come to the same conclusion a long time ago, based on plantings of clams in locations from the lower end of the Delaware Bay on up to Raritan Bay:

> . . . and as I understand—this was in the late 40s and early 50s—there seemed to be an inverse relationship between the growth rate of clams and the density of clams. That's where you had your heaviest populations you also had your smallest growth rate, and . . . looking at the food conditions and what have you, we decided that it wasn't just a matter of a large population having enough food but it was rather a question of the current system. Where you've got currents that are rapid enough to . . . provide a lot of food you also were losing most of your larvae because you were tearing them out to sea with a strong tide [Haskin, transcript 1/27/88].

Accordingly, Haskin too recommended Little Egg Harbor over Barnegat Bay: ". . . Little Egg Harbor was an area which in those days had an awful lot of clams and it doesn't have a big flushing rate so that I think, just on a kind of general target area, . . . I'd look pretty closely at Little Egg" (Ibid).

Ironically, Barnegat Bay was the location of one of the sites chosen, despite recommendations of clam dealers and scientists. The sites we used—one near the town of Barnegat in the southern end of Barnegat Bay and the other in Parker Cove, Little Egg Harbor—were finally chosen after a tour of prospective sites with a member of the marine enforcement unit. Both met these criteria:

1. areas once known to have been very productive but in recent years not so;
2. deep enough to discourage treaders; and
3. close enough to roads and docks to be relatively easily monitored by enforcement officers. This consideration appeared to have been enough to rule out every alternative site except the lower Barnegat Bay one.

In retrospect, neither site was appropriate. The one chosen solely for law enforcement reasons, the Barnegat site, may have been the worst choice for the same reason, given high levels of illegal clamming in that area. The one chosen because of what seemed to be superior conditions of circulation, etc., the Little Egg Harbor site, may no longer have good environmental conditions for clam reproduction. But we probably would not have known these and other problems if we had not committed ourselves to action. Errors such as this that we made by muddling through were

costly but, one can argue, irreplaceable learning experiences.

OTHER MATTERS DISCUSSED AT THE JANUARY 17, 1988 MEETING

Similar interchange among scientists, baymen, clam dealers, and state fisheries, water quality, and enforcement personnel took place on other topics. For example, Dave Vaughn, a shellfish biologist then working for a hard clam mariculture hatchery, talked at length on the topic of the complexities of hard clam spawning behavior in different bays and the importance of timing a sanctuary transplant in relation to this. Others talked about evaluating whether a spawner sanctuary works, possible genetic techniques, and effects of predators on resulting clam seed.

The day-long meeting was also devoted to discussions over the details of actually getting, moving, planting, and protecting clams, including discussions of bidding, what kinds of gear could be used and by whom, the price of clams, how the clams would be painted and by whom, how clams from condemned waters would be monitored to ensure that they made it to the planting sites rather than consumers, and so forth. The meeting itself was a remarkable event, the first time in many years that so many shellfish scientists from different institutions, academic and government, and so many state administrators, and baymen and shellfish dealers, came together (voluntarily and without compensation beyond clam chowder, as we had no money at this point) to cooperate in planning something.

THE TRANSPLANT: TROUBLE AMONG THE RARITAN BAY CLAMMERS

As a result of the January 17, 1986 meeting and several others as well as many telephone calls, we planned the first New Jersey hard clam spawner sanctuary. Following the lessons learned in Long Island, we intended to buy only large chowders, of low market value and thus both inexpensive to purchase and less likely to be stolen from the sanctuaries, and to paint them, again to remove some of their attraction to poachers. Aware of past hostility to proposals to transplant clams from Raritan Bay, we decided that this project should involve the fishermen of the Raritan Bay area as much as possible, including paying them to harvest clams. The clammers would store the clams in trucks with locks approved by the marine enforcement unit, and after enough were accumulated the clams would be trucked to the dock at Parker Cove, LEH, the site of the first sanctuary. The state agreed to survey and stake off the site and to provide necessary enforcement manpower.

The spawner sanctuary did not work quite this way. One of the lessons we learned was not to overestimate the ability of the clammers involved to handle issues of equity and competition amongst themselves, and at the same time not to overestimate the ability of the state to make decisions that affected such issues. At first we thought that we could arrange for the harvest of clams informally, by letting out the word that we were interested and waiting for potential clammers to get in touch with us. Referring to a Jersey shore town that was once the center of clamming, Bill called the process "relying on the Tuckerton teletype" or gossip network. By this process we made arrangements with a crew from the community of Belford, on Raritan Bay, who participated in our January 17, 1986 meeting. Very soon thereafter we received angry phone calls from other fisherman in that community and clammers and dealers elsewhere who forced us to "go out for bids," through an elaborate, time-consuming bureaucratic process.

No one bid (clammers later told us that the procedure was too formidable, but fishing and lobstering were also good that season), and thus we relied on the original crew, a trio of older fisherman all of whom had experience in clamming in Raritan Bay that predated the 1961 closure of the bay because of pollution. However, they in turn refused to clam for the project.

The crew had gone to the expense and trouble of making a special dredge. We obtained for them all the permits required for them to be allowed to dredge for clams in polluted waters. They went out to get clams one day in April, with a marine enforcement officer on board, and came back with nothing. They went out again, returning again with nothing and determined to quit. They felt they had been misled about the waters open to them and could not catch enough in them to make it worth their while.

The Belford crew pressured us to get regulations changed to open other Raritan Bay waters to them. This placed us in a terrible bind. The beds they wanted to dredge were in an area marked on the official chart as available to participants in the state's hard clam relay and depuration program. The men who work in that program use tongs and rakes, not dredges (which are illegal in New Jersey's clam fisheries). The Belford men with whom we contracted had special permission to use a mechanical dredge from a large vessel. The relay and depuration clammers were angry about Belford fishermen dredging in 'their" waters. They let us know through phone calls and rumor of a petition or even law-suit. To make matters worse, Bill Jenks, the representative of clammers on our project, was a relay clammer and so too his sons, and thus could not allow anything that would offend the relay clammers. The state shellfisheries officials, recognizing a familiar political storm brewing, refused to make any of the changes demanded by the Belford clammers. We were stalemated.

Although Bill Jenks and I, from our separate experiences, he as a clammer and shellfish enforcement officer for some years, I as an anthropologist, felt we knew the people of the area well enough to be able to hire a crew to

catch clams, we failed.[10] Cooperation, experience, sensitivity to social and cultural differences, all of these may not be enough.

We then turned to the relay and depuration clammers who worked out of the community of Highlands, hoping that if the chowders were thick in "their" area of Raritan Bay, as the Belford men said they were, we could get them —more slowly and with more logistical problems—from tongers and rakers. Phone calls, meetings with the owner of a clam depuration plant in Highlands, meetings and calls with state water quality and shellfisheries officials, led to nothing. Regulations for the relay and depuration program forbade the direct sale of clams to anyone for any purpose. None of the state officials involved in the project was willing to go to the trouble required to get the regulation changed.

Our underestimation of the effects of long-term factionalism within the shellfisheries of the region and our overestimation of the willingness or ability of state "co-managers" to cooperate led to weeks of fruitless negotiating. Finally, we changed our plans. Clams had to be planted soon. The state money had to be spent by October, and we wanted to give the transplanted clams a chance to spawn in their new home before summer began. So we were forced to engage in what at times seemed both the sublime and the ridiculous: buying from dealers chowder clams, many of which came from the same bay into which we would plant them. It was, however, suggested that creating a dense aggregation of clams into one area might help induce spawning and a higher rate of fertilization of eggs. Then we misjudged the chowder market. We expected that local dealers would be interested in selling chowders to us because of a traditionally poor market for clams in late spring. In fact we had difficulty obtaining enough chowders for our sanctuaries. This was, we were told by one of the dealers, partly because we were competing with the managers of the Long Island spawner sanctuaries for New Jersey chowder clams. Knowledge of this helped restore at least my faith in the project: we were paying clammers to keep local chowders in the bay!

CREATION OF THE 1986 SPAWNER SANCTUARIES

Finally, in May and June and then October, 1986, we bought, painted and then dropped overboard 218,700 hard clams into the two "spawner sanctuary" sites in Barnegat and Little Egg Harbor bays. Biologists in the state's Bureau of Shellfisheries surveyed and staked the sites and, with the state's Division of Water Resources (all within DEP) had them formally designated as "condemned" waters. Clams for the Parker Cove site came from local dealers. Some of the clams for the Barnegat site came from clammers who harvested, under special permit, clams from condemned waters in Raritan Bay. We paid clammers and dealers for the clams at roughly the local market rate.

The clams were painted red with rollers on an ingenious rack by groups of county prisoners on a work-release program. The paint was to discourage poaching. It was chosen to minimize known toxic hazards while providing acceptable drying speeds. The clams were spread over one-acre plots within five-acre lots that had been surveyed, staked, and designated as sanctuaries. The sanctuaries are classified as polluted waters by the state so that theft of the clams is a very serious offense. We paid local clammers to spread the clams for us. At a later phase of the project, some of the Raritan Bay clams were painted yellow and planted in the Barnegat sanctuary in discrete areas for ease of discrimination in future research.

In the fall of 1986 we were able to return to our original plan. We found a pair of young clammers who were willing to dredge clams at our price in Raritan Bay and, most important, to paint them on board, allowing them more flexibility in the timing of their deliveries to the planting site and reducing our hassles in painting the clams. They received a special permit, through our program, to dredge clams in highly polluted waters just for the spawner sanctuary. Marine enforcement officers had to watch them carefully. Because they had never dredged for clams before their level of production was low and erratic. So we also set up two days of buying clams from dealers and using the prisoners to paint them.

CO-MANAGERS AND CO-MANAGEMENT

The spawner sanctuary program has been full of administrative and socio-economic challenges. Among these are finding ways to fairly compensate and coordinate the activities of the harvesters and transplanters and to deal with competition among different interest groups, coordinating the research activities of the scientists involved, searching for funding for the purchase of clams for the sanctuaries, and sustaining the notion that industry, academia, and state and federal governments can indeed cooperate.

Many of these tasks were done by a small team. In January 1986 Gale Critchlow, Chief of the Bureau of Shellfisheries, and I agreed to be official co-directors of the project. She called upon other state personnel as necessary and helped create and maintain public commitment to and minimize bureaucratic interference with the program. I managed the money, planned and held meetings, wrote up bid specifications, and spent many hours on the telephone

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[10]There may have been more at issue in our difficulty in getting Raritan Bay clammers to work for the project, including their enduring suspicion of any program designed to move "their clams" from local waters to other waters. This harkens to an ancient "north/south" conflict among shellfishermen in New Jersey, but also bespeaks continuing bitterness over the failure of the state to do anything to help the large numbers of clammers forced out of business when pollution resulted in closure of most shellfish beds in northern New Jersey in 1961.

with Gale, Bill Jenks, Clyde MacKenzie, and others on the project, working on the details and general approach.

The participants in the program, besides biologists and other scientists who attended planning meetings and helped define new research agendas, comprised a number of state officials with direct mandates concerning shellfish and water quality and a more motley band of assorted scientists, clammers, and administrators. The success of the project depended very much on the nature and talents of the individuals involved, particularly those who were able to bridge social boundaries, to work in more than one cultural world.

PROBLEMS WITH THE STATE

The state officials involved in the project showed enthusiasm and willingness to cooperate in the early phases, and Gale Critchlow continued support for it into a second year of funding from DEP. Elsewhere (McCay in press) I describe her and others in the state, emphasizing the extent to which they shared qualities observed in other key actors in this experiment in co-management, especially the ability to work closely with people in other roles. I also there note the emergence of a disturbing distinction between ''the real workers'' and, by default, the state participants in the program.

The state personnel avoided any direct involvement in the project beyond helping with regulations and, at first, putting up stakes. We needed help. For example, who was to plant the clams on the site? State personnel claimed not to have the boat or time to do the work, but on the first day of planting two state biologists showed up with a new, very substantial boat, and stood around observing the work and the attention we were getting from the press, while a clammer we hired to plant the clams went back and forth with bags of painted clams in his tiny clam boat. That was a major source of aggravation to other cooperators, as was the more pervasive ''no-show'' response of state personnel who had otherwise pledged themselves to the project.

Among the important problems we experienced were;

1. getting rapid action on critical matters (i.e. permits), a problem understandable given busy schedules and normal inter-agency fragmentation and administrative and legal complexities; and
2. the ''no-show'' problem alluded to above, a social relations gaff that reinforced perceptions of strong social boundaries and subcultural differences between ''the state'' and others.

In addition, despite great concern over the fate of clams transplanted from condemned waters of Raritan Bay, supervision of that transplant was negligible, a fact that may have contributed to our later difficulty finding any Raritan Bay clams in the Barnegat sanctuary. Further, the state participants in the project continued to aggravate the others in 1987 and again in 1988 by their failure to act rapidly to re-stake the sanctuary sites after ice, baymen, or other conditions destroyed the stakes.

As understandable and defensible as they or the delays in changing them are, state rules and regulations and personnel and budget limitations were viewed by the non-state co-managers as troublesome every step of the way. The people involved tried to minimize the damage and to cooperate when they could, but the definition of ''when they could'' was probably different for them than for other participants in the project. Among features of their bureaucratic situation that appear to have constrained their ability to cooperate was the tendency of individuals working for the state to minimize any action that will cause a reaction. It was put this way, in a different context, by one of the state employees: ''I didn't want to aggravate them because they would just turn around and aggravate me.''

However, Gale Critchlow, co-director of the project, continued her interest in and commitment to it. It had the potential of being one of the few positive things she, as a regulator, could do for the shellfish industry. She found $10,000 for another spawner sanctuary, and she successfully brought in a federal coastal resources grant for another $20,000 in 1987.

THE ''REAL WORKERS''

The stalwart band of workers found with bags of clams and cans of red paint on the docks of Parkertown or Barnegat, New Jersey, in May and June 1986 comprised a retired clammer and his wife (Bill and Vivian Jenks), a marine extension agent (Gef Flimlin), the assistant director of the Fisheries Development Commission (Hal Bickings, Jr.), and from time to time an anthropologist (McCay). They were joined by a group of prisoners from a county jail and their warden, Officer Jim Davis. On an experimental work-release program, the prisoners did the actual painting and helped out with jobs like bagging and hauling bags of clams for planting. There were others, i.e. clammers who planted the bags of clams for us in the designated ''sanctuary,'' and dealers who made special efforts to fill our needs when they had other markets for ''chowders.'' My department secretary did her best to make sure the dealers were paid. We were a media event, celebrated in one newspaper heading as ''Convicts and Clams,'' and as such attracted local and state politicians who gave press conferences at our planting sites.

The people who consistently showed up at the painting/planting sites, the ''real workers,'' almost all shared practical, action-oriented approaches to problems. The scientists and state administrators who from time to time ''really worked'' are unusual in their commitment to ''grassroots'' approaches to problems. They and the clammers and others who worked on this project had special skills in bridging boundaries between scientists and industry, which are described elsewhere (McCay, in press). Most, like Jenks, are politically savvy, experienced on the water, respectful of

the knowledge of both scientists and baymen, and inclined to action.

EVALUATION

Unmet Goals and Responses

These are some of our disappointments and how we are dealing with them:

1. We were unable to carry out the original plan of using clams from polluted waters in Raritan Bay to help restore productivity elsewhere. Factionalism, based on real differences in situation among different groups of clammers, made this next to impossible. More generally, the clamming industry's enthusiasm and support for the project faded rapidly after the early phase of it, and by late 1986 even south Jersey clammers were publicly expressing skepticism about the project.

   If more clammers from different regions and segments of the industry had been involved from the start, their support might have been more enduring. Accordingly, in 1987 we designed the composition of a new Hard Clam Research Committee of the Fisheries Development Commission to have broader representation. Another possible factor was the improvement of clamming in the bays to the south of our target area which reduced perception of the need for the project. In addition, clammers, like scientists, are skeptical although hopeful about interventions in nature such as this.
2. The clams we transplanted did not seem to fare very well. Those planted at the Barnegat site, both from Raritan Bay and from local dealers, seemed scarce not long after planting (Fegley, personal communication). Clams may have dug deep (MacKenzie, personal communication). Some participants feel that few of the clams were actually planted (because of lack of enforcement at that end during the Raritan Bay transplant) or that poaching took place soon after the planting.

   It was difficult to communicate the idea of "co-management," especially with its implication of shared responsibility, to members of the clam industry. Clammers and dealers were inclined to see this as a state project. The state is perceived either as a meddling bureaucracy or as an abstract source of largess. Whichever, putting hundreds of thousands of clams in a small area of the bay, then labeling them Property of the State of New Jersey, is tantamount to saying, "here they are, come and poach 'em." This was worsened by the difficulty we had persuading the state to keep the sites staked.[11] Because of the poaching problem, the Long Island spawner sanctuaries have been redesigned as small, scattered plantings without visible markers (Kassner, personal communication), and our new, small-scale experimental ones are being done the same way (Fegley, personal communication).

   Many of the clams planted at the Parker Cove site, in Little Egg Harbor, appear to have stayed there, but their health was poor. I obtained funds from the Fisheries Development Commission for analyses of fecundity and survivorship of planted clams in comparison to native clams. Between May and October 1987 Steve Fegley and Bruce Barber collected spawner clams, and found that survival during the first year (estimated at 73%) was lower than what could be expected by more careful handling and placement. More seriously, they found that gamete production was suppressed in Parker Cove clams, suggesting that environmental or nutritional conditions are not favorable for clams there (Barber et al 1988). It is possible although still not proven that environmental changes caused the scarcity of clams in Parker Cove that led us to select this as a site, and those same environmental conditions make it a poor place for clam spawner sanctuaries.

   Attempts to evaluate the first major spawner sanctuaries continue. Moreover, Fegley has begun to develop small spawner sanctuary experiments with some controls and to focus on the critical question of what happens to juvenile hard clams in the wild.
3. An outcome of one of our meetings was the idea of exploring whether genetic differences between clams from different areas would be useful as a way of evaluating whether a spawner sanctuary works. Beyond chronological coincidence—a set following the planting of clams—there is no known way to accurately determine whether a spawner sanctuary increases the likelihood of a set. We persuaded the evolutionary geneticist Robert Vrijenhoek and his student to investigate the potential of using genetic variability to distinguish clams. This seemed appropriate at the outset of the project, when we still believed that we would be able to obtain most of our spawners from Raritan Bay. Raritan Bay and the planting site in Little Egg Harbor are over seventy miles, and many other obstacles, apart. If we planted Raritan Bay clams in Little Egg Harbor then when a new set occurred it may be possible to distinguish descendants of Raritan Bay clams from descendants of native clams. Sadly, genetic discrimination techniques have revealed no geography-based variability (Vrijenhoek, personal communication).[12]

[11] Lack of proper staking is yet another sign that the state is bumbling, and hence to be taken advantage of. It is also a signal that poaching is all right because even if caught, one would not be convicted for want of evidence.

[12] Geographic isolation is probably more the exception than the rule. When we began negotiating with Vrijenhoek to research the possibility of ge-

4. Our hopes for a scientific breakthrough in techniques for evaluating a spawner sanctuary were dashed. More seriously, however, it seems that participants in the project, particularly the scientists (including peer reviewers of proposals), came rapidly to the conclusion that creating spawner sanctuaries was not worthwhile. The lack of a technique for measuring their effectiveness was a major reason. There are other reasons for being skeptical about hard clam spawner sanctuaries, and certainly about specific sites. This one, however, seems to reflect our tendency to confuse technique with truth: if I can't measure it, then it is not there.

Accordingly, we were unable to obtain funding from the Office of Sea Grant, a federal government agency for scientific research related to the objectives of the spawner sanctuary project. I received a small amount for administration and analysis of the project, but our attempts to put together a truly multi-disciplinary, multi-institutional problem-focused research program did not make it through peer review and Sea Grant muster. This partly reflected widespread skepticism in the scientific community about hard clam spawner sanctuaries. The project is barely kept going by small grants from the Fisheries Development Commission and the DEP and support for Fegley from the Fish Tex Center.

DEALING WITH SCIENTIFIC UNCERTAINTY

Three summary points can be made about New Jersey's hard clam spawner sanctuary project. First, whether by design or happenstance, it was an example of the style of decision-making known as incrementalism, or "muddling through" (Lindblom 1969). Our policy of "action first, science later" was an example of incrementalism, as opposed to a "rational-comprehensive" approach to decision-making in which decisions and actions are based on complete and scientifically valid comparisons of all alternatives with reference to predetermined goals. We had little choice: our funding was for planting clams, and the information based required for a rational-comprehensive approach was not available to us. However, by basing our decisions on the advice of scientists working from very limited data, we were able to establish a program. We "muddled through" without clear ideas of exactly what we wished to accomplish or how we would do it, just trying at the outset to get something going, and then forced to hurriedly plan a spawner sanctuary. Nonetheless, as Lindblom (1969, 1979) would predict, we were thereby able to stimulate consideration of both goals and means of achieving them that will enable a more rational approach or at least better-informed incrementalism in the future.

Second, co-management worked, at least to the point of creating two hard clam spawner sanctuaries, largely because of the strong commitment of a handful of people who were willing to try to communicate across social boundaries with the goal of getting something done. Distinctions between "ordinary knowledge" and "scientific knowledge" and the ways people perceive these forms of understanding are essential to understanding the difficulties that lay people and scientists have in working together. It may be that, as Lindblom and Cohen (1979) have suggested, we must ask about "usable knowledge." The people who made this project work are those who were able to cast scientific knowledge not only into ordinary language but also into the practical concerns of ordinary people; they are people who, whether scientist or bureaucrat or clammer, seemed to care little about competing claims for legitimacy but instead to be most concerned about what the social scientists call "praxis" or "social action," and what others might describe as "getting something done." However, the perceptions the activists held of those who were more cautious or participated less overtly contributed to the social fracture points of this experiment in cooperation (see McCay in press).

Third, the project was disappointing in terms of the goal of a sustained and co-managed spawner sanctuary program in New Jersey. The cooperative, multi-disciplinary team of 1986–87 was by 1988 truncated to a small handful of people, and no more large spawner sanctuaries were planned. One reason was increasing awareness of high levels of uncertainty and risk about hard clam spawner sanctuaries, which led to skepticism about the project.

The project is fraught with skepticism and uncertainty, indeed with ignorance. As the philosopher of science J. R. Ravetz recently argued (1986), the world is increasingly faced with ecological and social problems with which science is hard pressed to deal because there is so little known about them. Scientists are very uncomfortable dealing with questions such as "What's going to happen to the biosphere," and especially with answers such as "We don't have any way to know." He offers the concept of "usable ignorance," as an adjunct to "usable knowledge." Scientists increasingly must be able to interact with others, of different disciplines, and of different professional and social backgrounds, to adequately cope with ignorance and in so doing make it useful. They must also be able to appreciate the points of views of others, which include different criteria of quality and truth.

The hard clam spawner sanctuary project—and the larger questions of what causes variation in hard clam abundance and what can be done to affect that—are apt examples of the kinds of problems to which Ravetz refers.

netic markers in hard clams, Bill Jenks wrote down the occasions he knew of since ca. 1950 when large quantities of clams were moved by clammers from one bay to another in New Jersey. In particular, a few explosive sets of hard clams, when beds were dense with small juveniles, led clammers and dealers to gather great quantities of undersized clams and plant them in leases elsewhere or sell them to others in and out-of-state.

Very little is known, and what we have found so far is that we don't (yet) have a way to know, for sure. Transplanting "spawners" to increase clam production is not proven to be effective. As noted earlier, methods have not yet been found to evaluate spawner sanctuaries, i.e., to distinguish the offspring of the transplanted spawners from the offspring of native clams. Moreover, the project rests upon several unproven and questionable assumptions, including (a) that one could ever realistically plant enough clams in a large estuary or bay to make a measurable difference (Kassner and Malouf 1982); (b) that the number of spawning clams in one generation affects the numbers of survivors of the next generation (the stock/recruitment relationship); and (c) that decline of clams in an area is due to depletion of spawning stock rather than environmental changes, Fegley, personal communication), changes in the intensity of predation (MacKenzie, personal communication), or other factors affecting clam reproduction and survivorship.

Our recognition of the nature and extent of the problem of decision-making given scientific uncertainty and ignorance developed with the project, as did our approach to it. It was to be very humble about what might be accomplished, to take advantage of the best available scientific advice, to recognize that baymen, too, might have "usable knowledge," and to hope that starting off with a spawner sanctuary program would help delineate and stimulate applied scientific research on hard clams.

I have used terms such as "our approach" in this article, but do not mean that every one involved in New Jersey's hard clam spawner sanctuary project was aware of or in agreement with what I said. A multi-disciplinary, co-operative project such as this involves negotiation among many, sometimes conflicting, approaches. Clark and Majone (1985) identify five major roles in policy-relevant science: scientist, peer group, program manager or sponsor, policy-maker, and public interest groups. They identify differences in what they do, the questions they ask and criteria and processes by which they choose and make decisions. In this case, the critical roles are somewhat different: academic scientist, government (applied) scientist, peer group (in reference to proposal review), program manager, government regulators, public interest group (the clammers). The approaches we took to the problem of uncertainty and ignorance arose out of competition and tension among the approaches of representatives of those groups.

For example, clammers who participated and were interviewed did their best to simplify the problem and solution: "we need action now." They also were very skeptical about the value of scientific research and suspicious if not hostile to any move that would place scientific research before practical action.

As regulators, officials and employees of DEP were concerned about law enforcement more than science. For example, the siting of the spawner transplants would be determined as much by relative ease in watching the sites from a patrol car as by suitability for clam spawning and larval circulation. As government agents, they were also concerned about political ramifications of the project. Because of the tremendous political support garnered by Bill Jenks,—and the inherent appeal of the project—state officials such as Gale Critchlow, Chief of Shellfisheries, gave us enthusiastic support. But her concern, and the concern of most others in the state, was to find out whether it worked as quickly as possible so that they could have evidence to use in asking legislators to appropriate more money for the project. Hence, the emphasis was on quick-and-dirty science, but uncertainty and ignorance about whether the spawner sanctuary worked was unacceptable. There had to be answers. Once they found out there were no quick answers, they tended to lose interest. The politicians involved shared that perspective to some extent, but also tended to support whatever their constituents, i.e., the clammers, wanted.

The role of scientist must be more precisely delineated. The academic scientists concerned about data quality, validation, and such as well as professional recognition maintained strong pessimism and emphasized the need to find ways to evaluate spawner sanctuaries, such as genetic discrimination. Their peers reinforced those messages in evaluating proposals for research support. The biologist Fegley's major task is to satisfy the skeptics by determining whether spawner sanctuaries can work, and he is engaged in controlled experimentation to this end, but he must do so in a way that will enhance his credentials as a scientist.

Government scientists by and large have different peers and pressures. Bureaucratized scientists, who must deal with limited budgets and many and conflicting demands from the public and policy-makers, share many concerns and ideals with academic scientists, but they are strongly concerned to minimize involvement in new projects of any kind and to cover their flanks against possible challenges from the public and politicians.[13] In this case, state shellfish biologists said they were too busy to be actively engaged in the project, although they eventually did essential tasks such as surveying and staking out the sanctuary sites and they came to our numerous meetings.

But there are applied scientists who work for government but are more insulated from the public and policy-makers as well as much of the professional system of the academics. They have more freedom to explore new projects fraught with scientific uncertainty. Our example

[13]Moreover, possibly because many of the government biologists work for regulatory agencies and are therefore often in antagonistic relationships with clammers, they tend to denigrate the value of the clammers' knowledge and experience. The clammers are the ones who are raping the resource, and the biologists have the lonely, often thankless, role of trying to protect the resource for long-term and public interest.

of this type was Clyde MacKenzie, of the National Marine Fisheries Service, who from the outset took a very optimistic stance about spawner sanctuaries and engaged in small-scale, very practical research, much of it on his own, during and after the transplants.

There are also applied scientists from academia who by virtue of position or stature in the profession are also more willing to offer advice and make decisions even when there is a great deal of uncertainty and ignorance about the facts. Harold Haskin, Professor Emeritus of Oyster Culture at Rutgers University, is an example of the latter, a shellfish biologist with decades of applied research experience, who agreed with MacKenzie early on that this project was worth doing, that it ''makes sense'' even if we can't readily find out whether and to what extent it works.

A major challenge is to find ways to evaluate and justify projects such as this one that may not ever be amenable to scientific testing. Nature is complex, various, and illusive. Experimentation outside the laboratory is difficult, often impossible. Our team's attempts to develop experimental means of evaluating spawner sanctuaries ''in the wild,'' led by Fegley, continue, but there is persistent trouble convincing peer reviewers that they are scientific enough. Yet research of that kind is essential if science is to affect shellfish enhancement policy. New ways to communicate and interact, as suggested by Ravetz (1986), perhaps based on the co-management experience, may help us to become more discriminating in reaching the conclusion offered by biologists at the outset of our spawner sanctuary project: Just do it. It makes sense.

ACCOMPLISHMENTS

I have dwelt at length on the disappointments and failures of the project because of what they reveal about the social reality of very different people trying to work together. Our accomplishments should not be underestimated. They were many, and they were the outcome of the cooperation of these very different people, trying to cope with each other, the lack of knowledge, and themselves.

Our accomplishments included these:

1. two large spawner sanctuaries were created in 1986, and several small, experimental ones were created in subsequent years;
2. scientific research to evalute the success and rationale for spawner sanctuaries was begun in 1986 and received more support in 1987 and 1988;
3. a position in applied hard clam research was created by the Fisheries Technology and Aquaculture Extension Center in 1987.
4. Because of involvement in this project, MacKenzie established an ongoing study to control hard clam predators.
5. the Fisheries Development Commission created a Hard Clam Research Committee in 1987; headed by myself, it is a forum for continued cooperation among clammers, state officials, and scientists in identifying problems, exploring possible solutions, and planning for hard clam enhancement;
6. recognizing limitations of spawner sanctuaries, participants in the project have explored and become involved in alternatives, including small-scale, ''intermediate technology'' mariculture, ranging from hatchery operations to simple ''growing-out'' ventures.

I think we also,

7. showed ourselves and others that it is indeed possible, if not always pleasant or productive, for members of the industry, academic scientists, government scientists, and administrators to cooperate.

The last word belongs to Bill Jenks. Before he left the project, upset about the state's seeming neglect of their responsibilities and by what he saw as the over-objectivity and skepticism of the scientists, Bill Jenks agreed to evaluate the program (pers. comm. 10/26/86):

> ''So, what have we done in the last two years? We have completed two ''hard clam spawner sanctuaries'' and have started a new trend towards biological enhancement! Many people are thinking CLAM. We changed the thinking of many people in State government through dogged determination. We attended many meetings to try to cut through the red tape and succeeded . . . We aided the shellfish industry and gave them new ideas and guidelines. The word ''hard clam spawner sanctuary'' is now a word being used daily along the entire N.J. coast. And who knows? It might work!''

ACKNOWLEDGEMENTS

This work is the result of research sponsored by NOAA, Office of Sea Grant, Department of Commerce, under Grant No. NA85AA-DI-SG084 (Project No. R/F-19). The U.S. Government is authorized to produce and distribute reprints for governmental purpose notwithstanding any copyright notation that may appear hereon. It is also the result of support from the Fisheries and Aquaculture Technology Extension Center (Fish Tex Center) at Rutgers University; the Fisheries Development Commission of New Jersey; the New Jersey Department of Environmental Protection, Marine Fisheries Administration, Bureau of Shellfisheries; and the New Jersey Agricultural Experiment Station. This article is publication number J-26418-2-88 of the Agricultural Experiment Station. It is based on papers given at the annual meetings of the Society for Applied Anthropology, Oaxaca, Mexico, April 8–12, 1987 and the Conference on Coastal Resource Management and Shellfishing: A Global Perspective, Hofstra University, Hempstead, N.Y. August 19–21, 1987. My thanks also to Bill Jenks, Clyde MacKenzie, and Len Spiegel for critical review of this paper.

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JOURNAL OF SHELLFISH RESEARCH

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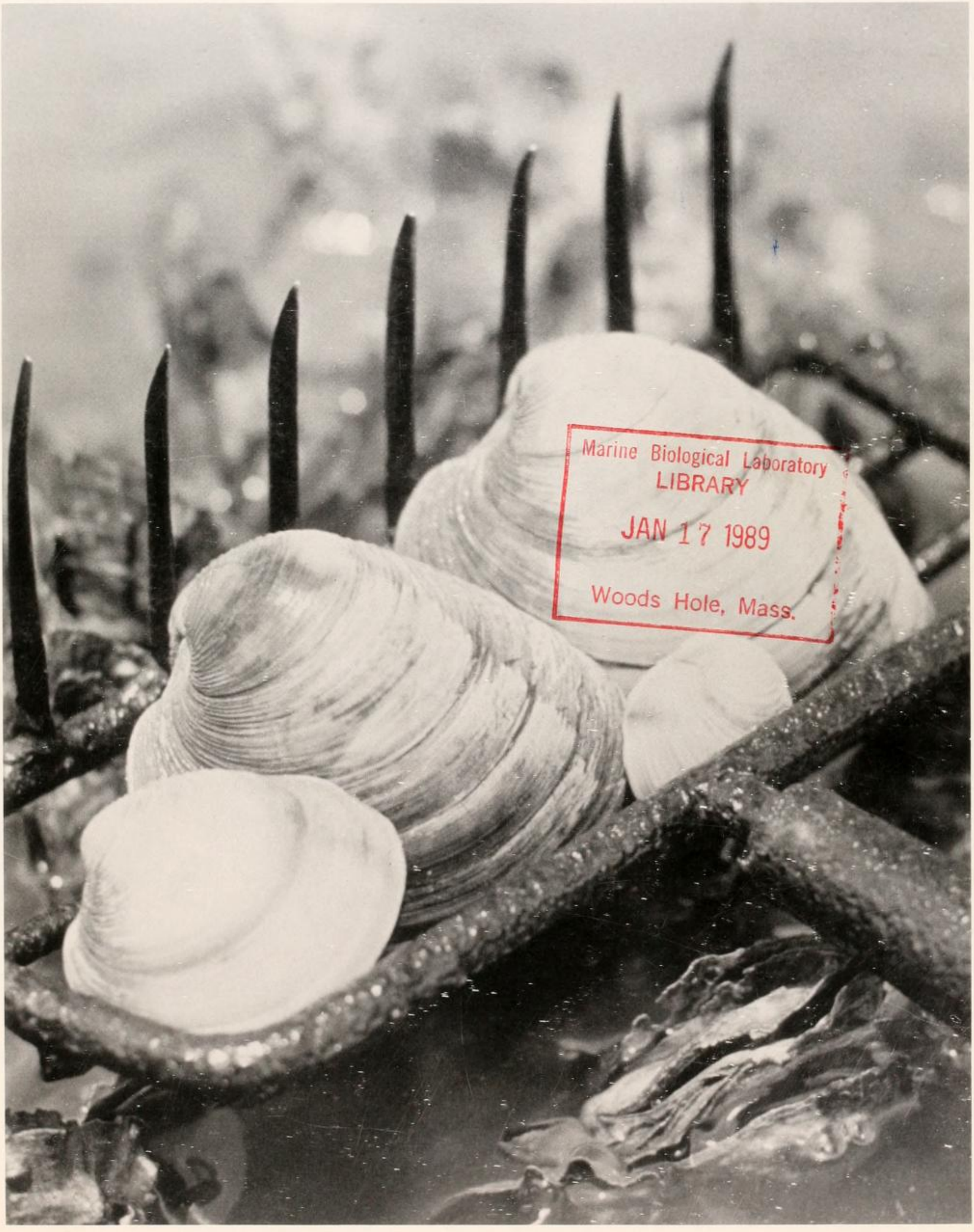

The *Journal of Shellfish Research* (formerly *Proceedings of the National Shellfisheries Association*) is the official publication of the National Shellfisheries Association

Journal of Shellfish Research
Volume 7, Number 3
ISSN: 00775711
December 1988