INFORMATION NEEDS FOR EFFECTIVE MANAGEMENT OF THE CALIFORNIA MARKET SQUID FISHERY: THE ROLE OF SOCIAL SCIENCE RESEARCH

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ABSTRACT

Recent events in the fishery for California market squid (*Loligo opalescens*), especially the rapid increase in landings and participants, have raised concerns about its socioeconomic as well as its biological sustainability. As management options for the fishery are considered, it is essential to take into account the fishery's social and economic organization, including its structure; its temporal and spatial organization; the relationships among fishers, processors, and others involved in the fishery; and the informal and formal rules and strategies by which its participants operate. These factors will influence how different management options would affect—and be affected by—the fishery. We have begun to explore these aspects of the fishery in a Sea Grant–sponsored study entitled "Socio-Economic Organization of the California Market Squid Fishery: Assessment for Optimal Resource Management." This paper begins with an overview of fisheries social science and its application to fishery management elsewhere. We then provide an overview of the social, economic, and regulatory history of the fishery, followed by an introduction to our study and questions it will address toward contributing to consideration and implementation of management for the fishery.

INTRODUCTION

Since the passage of the Magnuson Act in 1976, there has been growing recognition of the importance of social and economic information to effective fishery management (Orbach 1978; Clay and McGoodwin 1994; Buck 1995). Fisheries social science entails the study of the social, cultural, and economic aspects of fisheries, to afford basic understanding of the human dimensions of fisheries and to contribute to resource management (AFS 1993). The latter goal is based on the idea that fishery management is as much people management as it is biological resource management (Fiske 1990).

Recent events in the fishery for California market squid (*Loligo opalescens*), especially the rapid increase in landings, have raised concerns about its socioeconomic and its biological sustainability, and have led to discussions of management options for this, the last major open access fishery on the West Coast. Questions have been raised about the fishery's social and economic organization, and how different management options would affect—and be affected by—the fishery. We are exploring these questions through a Sea Grant-sponsored study entitled "Socio-Economic Organization of the California Market Squid Fishery: Assessment for Optimal Resource Management."

This paper prefaces that study by providing an introduction to fisheries social science and its application to fishery management elsewhere, followed by an overview of the squid fishery, of social and economic questions relevant to its potential management, and of our plans to address those questions through our study.

FISHERIES SOCIAL SCIENCE

Overview

Several aspects of commercial fisheries interest social scientists. Chief among these are fisheries' direct dependence upon the natural environment, uncertainties associated with fishing, the common-pool nature of fishery resources, and fishers' and processors' individual and collective adaptations to contingencies created by these characteristics.

Fisheries are strongly influenced by environmental, technological, economic, and regulatory uncertainty and risk (see Acheson 1981 for an extensive review). Most marine resources are hidden from direct view; their life histories and interactions with other species are complex; and their availability in space and time is highly variable. Additional environmental uncertainty stems from changeable weather, climate, and oceanographic conditions that influence when and where fish are, and fishers' ability to find, catch, and land them safely. Technological uncertainty stems from fishers' use of heavy, potentially dangerous equipment, and fish-finding and navigation technologies (e.g., radar, sonar, loran). Even with the best gear, the sturdiest and best-equipped vessel, and the best technology, there is no guarantee that fishers will find, catch, and deliver fish to market (and do so safely). Economic uncertainty arises from unpredictable variations in supply, and the changing demand of local and global markets. Finally, changing regulatory and management structures, from the Law of the Sea and the Magnuson Fisheries Conservation and Management Act to state regulations, are an additional source of uncertainty (Maiolo and Orbach 1982; Pollnac and

Littlefield 1983). Although the implementation of standardized management institutions (e.g., the federal fishery management council system) has eliminated some aspects of regulatory uncertainty, others persist because rules change in response to changing environmental, political, economic, and social conditions. Moreover, rules have differential, and often unanticipated, social and economic implications for both harvesters and processors (Pollnac and Littlefield 1983; Hilborn 1985). For example, seasonal closures can result in idled vessels and processing facilities, temporary unemployment, accumulation of or default on debt, and conflict on the fishing grounds when fishing resumes. Similarly, regulatory changes in one fishery (e.g., gear restrictions, closed seasons, limited entry) can displace fishers, prompting them to enter or increase their effort in other fisheries.

Fisheries also interest social scientists because of their common pool resource (CPR) nature.[1] Fish stocks that inhabit a large territory and thus are not easily designated as private property are best used by a group, or "in common." This poses both opportunities and challenges to resource users and managers. Without regulation, almost anyone can catch fish to eat or sell. Yet if everyone does this without restraint, the resource becomes vulnerable to overuse. The resulting tragedy of the commons (Hardin 1968) is marked by resource scarcity, social conflict, and economic hardship. These outcomes are evident, for example, in crowding on the fishing grounds, pressure to fish longer or in more dangerous conditions, and insufficient supplies of fish to keep processing plants running and staff employed.

People in fisheries have found diverse and innovative ways to deal with the uncertainties and challenges associated with CPR use, and to organize life effectively around fishing. Individual and collective adaptations are found in work organization at sea, relationships at the docks, and life on land (Acheson 1981). For example, the share system commonly used in fisheries invests the crew in the process and outcome of fishing. Other adaptations include coordination with other boats while at sea (e.g., through code groups), and other forms of information and skill management (e.g., Orbach 1977; Acheson 1981; Eales and Wilen 1986). Fishers and processors also adapt by acquiring new skills, adopting innovations, managing capital, and maintaining the flexibility to switch among fisheries as conditions and opportunities change interannually, seasonally, and even daily at sea, on the market, and in fishery management. In some cases, resource users cooperate to establish and uphold rules, norms, and strategies to coordinate the use of shared resources. These "institutions for CPR management" have attracted the attention of social scientists and resource managers as alternatives or complements to traditional, state-centered (i.e., top-down) fishery management (NRC 1986; McCay and Acheson 1987; Berkes 1989; Ostrom 1990). They may be locally generated and operated, independent of state management systems, or they may be coordinated (officially or unofficially) with state resource management, as forms of cooperative (or co-) management (Pinkerton 1989).

[1]There is an important distinction between common *pool* and common *property* resources. Whereas the former refers directly to the biophysical nature of the resource and its use, the latter pertains to the resource as the subject of the legal institution of property (Bromley 1991).

Applications to Fishery Management

Traditional fishery management tends to focus almost exclusively on the biological resource, to the exclusion of the "human dimension" (Orbach 1980). The rationale for conducting social science research on fisheries is that management decisions informed by an understanding of people's practices, values, and beliefs are more acceptable and successful, and less disruptive (Hanna and Smith 1994).

Social scientific research and the information it produces can play a critical role at various stages of fishery management. For example, social and economic impact assessment can help prepare those who will be affected by a change in the rules (ICGP 1994), and can help managers anticipate resistance or other problems associated with implementing new management policies (Orbach 1980; Fiske 1990; Orbach et al. 1990). Social science research also is useful in situations where the biological condition of the resource is unknown or not clearly an issue, but where social and economic concerns are associated with its use (e.g., where continued growth in that use could threaten both the industry and the resource). Such research can also give managers information to facilitate their work with the industry. As one California Department of Fish and Game (CDFG) biologist noted, "It's not required that we have such information to manage the fisheries, but it sure makes it a lot easier if you know who and what you're working with" (anon. pers. comm.). Social and economic information about a fishery can help those who design and implement policy by giving them a fuller understanding of how management measures will affect *and be affected by* the individuals and groups involved.

Social science disciplines, from anthropology to economics, have increasingly been applied to fisheries. However, the particular interests and approaches across the social sciences differ. In short, anthropology and sociology focus on culture and social organization, geography on the spatial and temporal organization of social and economic life, political science on politics and policy processes, and economics on the costs, benefits, motivations, and behaviors associated with fishing. While

political scientists and economists work principally with public data sets and then argue from theory to explain their results, anthropologists, sociologists, and geographers often conduct fieldwork—involving interviews, observation, and archival research—in an effort to understand how, why, and what people are doing. Systematic collection and analysis of this information then enables the detailed descriptive, explanatory, and perhaps predictive characterization of fisheries as a human endeavor.[2]

Fisheries social scientists focus first on elements common to most or all fisheries—direct dependence on a natural resource system, uncertainty, the use of a shared resource, and adaptation. These elements taken together in context have led to the identification of a "subculture of fishing," with reference to the people involved, the work, the communities where fishing is based, and the organization of life around fishing (Poggie and Gersuny 1974). Researchers have examined the occupational, social, and cultural identities of fishers and fishing communities and how these influence perceptions, attitudes, and behavior (Poggie and Gersuny 1974; Orbach and Beckwith 1980; Miller and Van Maanen 1982). The particular values associated with work, family life, and community are found to be common among fishing communities and yet distinct from the larger culture. Even as fisheries have much in common, however, each is unique, owing to the particular life histories, habitats, and ecologies of the species involved, and to the distinct historical, social, and cultural context of the fishery. Fisheries differ also in the nature and extent of their markets, and the ways they have been managed and regulated, both informally (through local institutions) and formally (by state and federal governments).

A growing number of research programs provide social scientific information useful to fishery management (AFS 1993). Notable among these are James Acheson and others' work on the Maine lobster fishery, and Susan Hanna, Courtland Smith, and others' work on Oregon coastal fisheries. Acheson's research on the practices and social organization within the Maine lobster fishery led to the identification of "harbor gangs," port-based groups of lobster fishers along the coast who have a system of shared norms and rules about who fishes, where and how (Acheson 1988). Membership in a harbor gang is contingent upon one's ethnic identity and community ties. Group members set their lobster traps in areas adjacent to their home port, and defend those areas from intrusion by "outsiders." Within this territorial system, Acheson distinguishes between "nucleated" and "perimeter-defended" areas. In nucleated areas, the sense of territoriality is strong close to the harbor mouth (and the core of individual territories), but diminishes with distance from it. Perimeter-defended areas are characterized by a strong sense of territoriality, with sharply drawn boundaries both within and among groups (Acheson 1987).

Ecological and economic analysis of these arrangements showed that perimeter-defended lobster territories had higher catch per unit of effort, larger lobsters, and higher densities of lobsters compared to nucleated areas (Acheson 1975). Acheson argues that "perimeter-defended territories . . . serve both to restrict entry into the fishery in these areas and enable the enactment of local conservation measures" (Acheson 1987:48).[3] Contrary to many observers' expectations, the lobster fishery has remained biologically and economically robust, governed by the local institutional arrangements first described by Acheson in 1975 (Wilson, pers. comm.). In 1995, the Maine Department of Marine Resources recognized those arrangements with a plan to transfer resource management responsibility for the lobster fishery to the local level through the establishment of experimental "lobster zone management councils" (Lobster Institute 1997).

Hanna and Smith's (1994; Smith and Hanna 1993) recent survey of Oregon trawl captains' attitudes about work, resource use, and fishery management challenges key assumptions that underlie much of fishery management. It is often assumed that fishers from a single-gear fleet are homogeneous in their views and practices, and that they have myopic, short-term views of the resource and do not recognize the collective effects of fishing on the resource. Hanna and Smith (1994) found, however, that trawl captains were heterogeneous. Differences in individuals' experience, family associations, education, age, and place of residence contribute to differences in their views on work, environmental and economic risk, and the environment. Individuals differed also in their fishing practices. Whereas some captains make shorter trips in the interest of landing quality, others take longer trips to land quantity. Such differences are important, for example, when considering trip limits and the differential effects they would have on the fleet (Hanna and Smith 1994). Hanna and Smith (1994) also argue that because assumptions of homogeneity among trawl captains and their operations do not hold, the use of landings data (assuming homogeneous links between a fishing

[2]Although informative, this work is also difficult because of the ethical issues associated with conducting research on human beings. Interviews and observation are intrusive; people feel uncomfortable being studied. Yet the local knowledge they have is important, and can (and should) be brought together with information from other sources and situations to help inform efforts to solve problems both locally and elsewhere.

[3]Fishers have devised and implemented rules such as trap limits, closed seasons, and prohibitions against keeping berried (egg-bearing, i.e., reproductive) females.

trip and fishing effort) may be inappropriate and lead to dangerous results for both the resource and the fishery (see also Hilborn 1985; Smith and Hanna 1990). Hanna and Smith argue that acknowledging these differences when designing management strategies can lead to more appropriate and successful management; failure to do so often leads to unpredictable (and often negative) results.

These and other research programs' attention to the social and economic organization, institutional arrangements, and diversity within fisheries, as well as to their implications for resource management, have informed our approach to the fishery for California market squid. In the remaining sections of this paper, we provide a brief history of the squid fishery, describe recent changes in its social and economic organization and regulatory status, and conclude with an overview of the study we are undertaking.[4]

THE FISHERY FOR CALIFORNIA MARKET SQUID

History

The fishery for California market squid was started in the 1860s at Monterey by the Chinese, who used torches to attract squid and caught them with small purse seines (Dewees and Price 1983; Lydon 1985). In the early 1900s, Monterey's Italian fishers introduced lampara nets into the fishery. The fishery was centered in the Monterey Bay area until the 1960s, when the southern California fishery developed on spawning aggregations near the Channel Islands (Dewees and Price 1983). Since then, landings in southern California have been on the rise, while those at Monterey have remained about the same (LMR 1995).

Through the early 1980s, annual squid landings remained below about 25,000 metric tons (t), largely because of limited demand (LMR 1995). Following record low catches associated with the 1982–83 El Niño, however, landings increased greatly. By 1996, squid ranked first among California fisheries in both volume and value, with landings of more than 86,000 t, worth over $32 million (Vojkovich 1998).

This phenomenal growth in the squid fishery is the result of developments in markets, processing, and fishing strategies over the past 10 to 15 years.[5] Domestic markets have grown as consumers have come to value the nutritional benefits of seafood in general (NMFS 1996), and have developed a taste for squid products marketed under the more appealing name of "calamari." Declines in other squid fisheries (e.g., Falkland Islands) and the opening of new markets have prompted growth in international demand from both traditional consumers such as Greece and Italy and new ones, most notably China (Redmayne 1996). In addition, fluctuating supply and demand in other domestic fisheries have contributed to growing demand for squid.

This growing demand has spurred changes in fishing practices that have resulted in increased catch and in fundamental alterations in the structure and spatial distribution of the fishery. Purse seiners using round haul gear are now the dominant type of operation, although a number of lampara boats still operate in southern California. Some squid fishers use spotter planes, as well as depth sounders and sonar, to locate fishable aggregations of squid. The use of light boats—small vessels that scout for fishable aggregations, and use halogen lamps to attract and hold the squid for a seiner to catch—has become widespread (although they are prohibited in District 10).[6] These innovations have greatly increased the efficiency and scope of squid fishing operations. The central California fishery has spread from the inner waters of Monterey Bay to outer bay waters, while the southern California fishery has expanded its coverage of Channel Islands fishing sites.

The fleet's capacity has increased as well. The CDFG estimates the fleet's maximum capacity in 1995 at 4,520 net tons, compared to 3,640 net tons in 1982 (M. Vojkovich, pers. comm.).[7] Both CDFG and fishers' records show an increase in the number of out-of-state vessels participating in the southern California fishery. Of the 137 vessels that landed squid in 1982, 6 were from out of state and landed 6% of the catch; by 1995, 22 of 117 vessels in the fishery were from out of state, and accounted for 27% of landings (M. Vojkovich, pers. comm.). A list compiled recently by fishers shows that the number of vessels fishing squid on the southern California grounds doubled between 1994 and

[4]The following is based on preliminary research on the fishery (literature review, informational interviews, and observation) that we conducted in preparation for submitting the proposal to California Sea Grant and in anticipation of receiving funding.

[5]Research on squid biology, processing, and marketing in the 1960s and 1970s stimulated many of these developments (e.g., Fields 1965; Recksiek and Frey 1978; Kato 1970; Brooks 1977; Brown and Singh 1981; Berntsen 1988).

[6]Light boats, as discussed here, are registered vessels, distinct from purse seiners and seine skiffs, that are equipped with lights and are used primarily to scout for, attract, and hold aggregations of squid for capture by the purse seine vessel. Light boats are owned or contracted by a seiner operation, or operate as freelancers, and receive a percentage of the catch for their services.

District 10 includes the ocean waters and tidelands between the southern boundary of Mendocino County and a line extending west from Pigeon Point Lighthouse in San Mateo County, including Tomales Bay, to a line drawn from the mouth of an unnamed creek about 1,500 feet north of Tomasini Point to the mouth of an unnamed creek at Shell Beach; excluding Bodega Lagoon, that portion of Bolinas Bay inside of Bolinas Bar, that portion of San Francisco Bay east of a line drawn from Point Bonita to Point Lobos, and all rivers, streams and lagoons (CDFG 1998).

[7]Although CDFG data show little change in the number of boats, there have been changes in vessel size, gear, and practices such as the use of light boats, all of which influence the fleet's fishing power and capacity. Spratt and Ferry (1993) have documented such changes in the Monterey fleet.

1996, from 18 to 36.[8] These increases in fleet capacity and in numbers of out-of-state vessels participating in the fishery are attributed to strong demand and good prices for squid, and to limited entry and/or declines in other fisheries in California, Oregon, Washington, and Alaska.

These changes reflect a blurring of territorial distinctions between the Monterey and southern California fleets and fisheries. Many vessels from the Monterey fleet now also fish in southern California, and the central California processors they work with have invested in receiving, transporting, and (in some cases) processing capabilities in southern California to receive catch at those locations. A smaller number of vessels and processors from southern California also participate in the central California fishery.

The fishery's growth notwithstanding, it remains constrained by environmental, technological, and economic uncertainties. It is particularly vulnerable to changing oceanographic conditions (especially temperature), which play an important role in the spawning, distribution, and abundance of squid (Hixon 1983). Declines in the availability of squid appear to be correlated with El Niño events, including the 1997–98 event (Leos 1998). As of early 1998, the southern California fishery had landed reduced numbers of squid, and some fishers were concerned that the same would happen at Monterey in the spring. Technological uncertainty is associated with squid fishers' reliance on fish-finding devices, light boats, and spotter planes to locate fishable aggregations.[9] In addition, once caught, squid is highly perishable, so vessels must have reliable refrigeration systems or be able to deliver the catch within hours of capture, and processors must have dependable squid pumping, cleaning, packing, storage, and transport technologies. Economic uncertainties affect both supply and demand in the fishery. For example, according to one squid processor, the growth in international demand for squid has been dampened by recent downturns in Asian markets.[10]

It is even more important, perhaps, that heterogeneity within the fishery persists, and includes fundamental social, cultural, and economic differences within and among ports. The San Pedro fleet consists primarily of traditional Slav, Italian, and Portuguese skippers; older, wooden-hull seiners and gear; and large (about 8-person) crews.[11] The Ventura/Channel Islands/Port Hueneme fleet is more ethnically diverse, and primarily uses fiberglass or steel-hull vessels, newer gear, and smaller crews. The Monterey fleet is dominated by Italian skippers and increasingly nontraditional crews, which now include many Vietnamese (Spratt and Ferry 1993). The Washington-based fleet, which operates out of several California ports (except San Pedro), consists primarily of Scandinavians and Slavs who run well-equipped steel-hull vessels. In addition, while the San Pedro fleet depends primarily on squid and other coastal pelagic species, many fishers from other ports participate in other nonlocal fisheries (e.g., Alaska salmon, San Francisco Bay herring). Processors also vary in their social and cultural backgrounds, the nature and extent of vertical and horizontal integration, and the relative importance of squid and other fisheries to their operations. These differences underscore the need for detailed understanding of the squid fishery's participants, their social and economic relationships, values, perceptions, and attitudes, and how all of these influence their behavior.

Management

Historically, squid fishing has been regulated by the state with legislative measures that restrict the use of lights to attract squid, limit days or times when fishing is allowed, and for several years prohibited the use of purse seines in Monterey Bay (see Dewees and Price 1983). Current regulation includes a prohibition on the use of light boats in District 10 (Half Moon Bay) and a closure of the fishery from noon Friday until noon Sunday north of Point Conception (California Fish and Game Code Sec. 8399.1 and 8420.5). Many of these regulations have been prompted by harvesters or processors.

The squid fishery has not been regulated under a federal fishery management plan (FMP), but it was taken into consideration in the development of the 1994 Coastal Pelagic Species (CPS, i.e., northern anchovy, Pacific sardine, and Pacific and jack mackerel) FMP. Specifically, the FMP would have allowed squid landings to count toward vessel landings requirements for qualification to participate in the CPS fishery. The rationale for doing this was linked to the fishery's close ecological, economic, and social ties to the CPS fisheries (CPS FMP Development Team 1993a, b; Thomson et al. 1994). Although the CPS FMP was canceled in early 1996, it has been revived as of early 1998.

[8]Industry members expect many new entrants in 1998 following the passage of SB 364.

[9]According to some squid fishers, seining for squid can be especially dangerous for those accustomed to seining for finfish. Squid respond differently in the net and can shift a vessel's balance quickly, thereby increasing the risk of capsizing.

[10]The nature, extent, and seriousness of recent downturns in Asian markets for California market squid will be explored as part of our Sea Grant–sponsored study of the fishery. See Moo (1998) and Ess (1998) for discussions of international markets for squid and other marine species caught by U.S. fishers.

[11]Jacobson and Thomson (1993) note the changing ethnic composition of crews in their analysis of ethnicity, opportunity cost, and decisions to fish for northern anchovy. They highlight fundamental social and cultural differences between "traditional" European-American and increasingly ethnically mixed crews, and the implications of these differences and changes for the organization and conduct of the fishery.

As the fishery continued to grow, members of the industry called for scientific, regulatory, and managerial attention to the fishery, citing concerns about its biological and economic sustainability. Opponents argued that there was no evidence of a resource problem, and therefore there was no need for regulating the fishery. The CDFG agreed that a resource problem was not evident, but noted that it had insufficient information to make a clear determination. (These positions and arguments are more complex, but are beyond the scope of this paper.) In 1997, the California Legislature passed SB 364 (Sher), instituting a $2,500 permit requirement for fishing vessels and light boats to participate in the squid fishery, with the funds to be used to support a three-year program of research on the resource and the fishery (CFG Code Sec. 8420-8429).

Social and Economic Information Needs

Fishery management in the form of regulations governing human use of fishery resources is often directed toward fisheries in biological crisis or subject to multiple-use conflict. With a lack of clear evidence of biological crisis or multiple-use conflict in the squid fishery, why think about regulating squid now? From a social science perspective, the interest emerges from local knowledge of the observed rapid changes in the fishery, placed in comparative perspective with recollections of other cases where such rapid change led to resource decline or economic hardship (e.g., the sardine fishery; PCFFA 1996). It is not clear that squid can reasonably be compared to other fisheries. What is more important is the articulation of concerns about the social and economic, as well as biological, sustainability of the fishery. The suggestion that squid receive regulatory consideration now—before apparent biological or socioeconomic crisis—is unusual in fisheries, and may provide a rare opportunity to develop management that is more appropriate and workable than it would be if action were deferred until a time of crisis.

In addition to the biological and ecological questions about squid, industry participants and resource managers have articulated many questions about the fishery's social and economic organization. For example: What are the vessel, crew, and work configurations in the squid fishery? What are the social, cultural, and economic relationships between harvesters and processors? How and why have these characteristics, configurations, relationships, and institutions changed over time? For which or what types of vessel configurations, processing operations, or individuals is the squid fishery the (or a) primary fishery in both economic and social terms? What other fisheries do fishers and processors participate in? How is participation in these fisheries coordinated in time and space? What strategies have fishers and processors used to adapt to changing conditions in the fishery? Where are vessels, fishers, and processors based? What is the nature and extent of their geographical mobility in terms of the squid fishery and in terms of other fisheries? How have these spatial factors and relationships changed over time?

We will address these questions in our recently initiated study of the California market squid fishery. The study's objectives are (1) to characterize the changing practices and institutions in the California market squid fishery; (2) to determine the relationship between fishers' and processors' dependence on the fishery and their fishing and processing strategies; and (3) to ascertain the spatial patterns, linkages, and developing relationships between the central and southern California fisheries.

In the two-year project, we will examine the changing (social, cultural, and economic) relations of production, adaptation, and flexibility within the industry, as well as resource dependence. We will collect and analyze data through a combination of archival (background documentary) research; observation of fishing, processing, and other industry activities; and interviews with industry participants and others knowledgeable about the fishery. Using this information, we will compare the present fishery with that of the past; the social and economic institutions which organize the fishery within and among fishing areas and landing ports; and this fishery with other fisheries. The proposed research will give resource managers and industry participants systematic documentation of the fishery as a human enterprise. This information can be integrated with existing and new information on the nature and condition of the resource to contribute to the design and implementation of effective resource management.

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