Socio-Economic Organization of the California Market Squid Fishery: Assessment for Optimal Resource Management

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INTRODUCTION

In 1997, we began a study of the changing social and economic organization of the fishery for California market squid (*Loligo opalescens*). When we proposed the research in 1996, the squid fishery was one of the last open access fisheries on the U.S. west coast, and ranked first among California fisheries in tons and value landed. Events soon after we started our research, most notably the 1997-98 El Niño and the passage of a squid fishery management bill, SB 364 (Sher, 1997), led us to focus on the interaction between these events and the social and economic organization of the fishery.

This report presents initial results of our analyses. We begin with an overview of our approach and methods, then present our findings on 1) characteristics of the three fleets that comprise the fishery, 2) the changing institutional structure of the fishery, and 3) fishery participants' attitudes and opinions about management measures for the fishery. These findings constitute examples of social scientific information that can be used to evaluate and consider potential outcomes of management options for the squid fishery. We close with conclusions regarding our findings and some of the additional questions we will address as we continue to work with the information and insights gained through our research. In particular, we argue that growth in the harvest of squid does not begin with increased fishing effort but with expansion of the linkages and transactions in the real world of business, structured by the institutional goals and capabilities of squid receivers and processors themselves, and also by connections to (and disconnections from) growing global markets. Changes in these relationships are likely to have a major impact on the fishery and on the ability and willingness of these intermediary firms to participate in it.

METHODS

Using the complementary approaches of natural resource sociology and economic geography, we combined archival and field research to collect and analyze data on the social, cultural and economic aspects of the squid fishery. Archival information included landings data for the squid fleet, the grey and refereed literature on the fishery and the resource, and other materials such as newspapers and trade journals. The landings data, obtained from the Pacific States Marine Fisheries Commission's (PSMFC) Pacific Fisheries Information Network (PacFIN) database, included all California, Oregon and Washington landings made by vessels in the squid fleet from 1981 through 1999.[1] We analyzed this data to assess spatial and temporal patterns in vessel, fleet, port and

[1] Data on Alaska landings were not readily available, but would have afforded a more complete understanding of the changing spatial and social and economic organization of the squid fishery, given that many participants also fish for herring and/or salmon in Alaska.

processor activities. We analyzed other materials to understand the context of the growth of the fishery that was evident in the landings data. This archival research helped build a foundation for further field investigation of California squid fishery participants' experience, attitudes and ideas about potential changes in management of the fishery.

The field component of the study entailed extensive ethnographic research, including observation of fishing, landing and processing activities; key informant interviews with fishery participants, harbor and agency personnel, and other researchers; and a survey interview with a random sample of 36 squid skippers.[2] We developed a survey interview, tested and refined it, then interviewed skippers in the three major squid port areas (from north to south): Monterey, Port Hueneme/Ventura and San Pedro. The survey included questions about skippers' fishing history, fishing operation, family and community networks; their observations of changes in the fishery, and their opinions regarding potential management measures. Interviews lasted from 45 minutes to 3 hours; most were tape-recorded (with interviewees' permission).

FISHERY PARTICIPANTS AND PRACTICES

The commercial fishery for California market squid (*Loligo opalescens*) dates back to the 1860s in Monterey, when the Chinese used torches to attract squid and caught them using small purse seines (Dewees and Price 1983; Lydon 1985). In the early 1900s, Monterey's Italian fishermen introduced lampara nets and became active in the fishery. The fishery was centered in the Monterey Bay area until the 1960s, when economic changes in southern California fisheries and the adoption of the power block, round haul gear and other innovations led to growth of the squid fishery in the south. Interest in California market squid as an 'underutilized species' prompted biophysical research (e.g., Ally et al. 1975, Recksiek et al. 1978, Spratt 1979) and development of processing technologies and marketing strategies in the 1970s and early 1980s (e.g., Kato and Hardwick 1975, Brooks 1977, Singh and Brown 1981, Berntsen 1988). Annual squid landings nonetheless remained below about 25,000 tons until 1988 due largely to limited demand (LMR 1995). Squid landings nearly doubled from 1987 to 1988 and remained high until the low landings during the 1992 El Niño (Figure 1). The fishery recovered in 1993, and grew rapidly to become the state's largest fishery (in both tons and value landed) in 1996 and 1997. With the onset of the 1997-98 El Niño, landings dropped to just under 3,000 tons, then rebounded in 1999 to more than 100,000 tons.

The fishery consists of two temporally and geographically distinct components: the central California fishery off Monterey, and the southern California fishery around the

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[2] Interviewees were randomly selected from a subpopulation of the 90 most active vessels (out of over 600 that had at least one landing) in the fishery between 1993 and 1997. To identify this subpopulation, we ranked vessels by the number of squid landings during that period, and eliminated those vessels with the fewest landings over the period. We then interviewed individuals from each port area. As we proceeded, we learned that we had unintentionally biased the selection against light boat skippers by using landing frequency as the criterion for inclusion in our subpopulation. In reporting the results of the survey, we focus primarily on purse seine skippers (N=33), because of the very small number of light boat skippers (3) in our sample. In subsequent research on the fishery around the Channel Islands, we have corrected our sampling strategy to address this problem.

Channel Islands and along the mainland coast. The central California fishery typically occurs from May through September, while the southern California fishery occurs from October through February, with a small fishery continuing through the summer in some years, as in 1999. The southern California fishery grew through the 1970s, while the Monterey Bay fishery remained relatively constant. Southern California landings have exceeded those in central California since the early 1980s.

THE THREE SQUID FLEETS: SKIPPERS AND OPERATIONS

From our analysis of vessel landing histories from the PacFIN data and information gathered through observation and interviews, we identified three "fleets" in the California squid fishery. Each has a distinct ethnic heritage and geographic base (although a few of our respondents fall outside these groups): the Monterey and San Pedro fleets are descended from fishermen from different sets of communities in Italy who settled in Monterey and San Pedro, and the Ventura fleet is comprised mainly of fishermen from Slav fishing families with historical ties to San Pedro but a current base in Washington State. Five of those we interviewed were born in Italy. For most of the 33 skippers interviewed, fishing is a family tradition: 7 of the 8 Monterey skippers, 8 of the 13 Ventura skippers, and all 12 of the San Pedro skippers had fathers who fished. Fifty percent of Monterey skippers and 75% of San Pedro fishermen reported learning to fish from their fathers. Almost all skippers reported frequent involvement of other family members in fishing and several had family in fish marketing.

Purse seine skippers had substantial depth of experience in commercial fishing (Table 1). Skippers in all three fleets reported experience in multiple fisheries and with different gear types. They differed, however, in the combinations of fisheries they pursue as part of their annual round. San Pedro skippers fish for coastal pelagic species (CPS, i.e., sardine, mackerel and anchovy) and perhaps tuna as well as squid, whereas most Monterey skippers combine CPS and squid with San Francisco Bay herring and/or Alaska salmon. Most Ventura skippers, by contrast, fish Alaska salmon or herring as a complement to squid, but do not fish for CPS. Seven of the 8 Monterey skippers had fished in Alaska; all of the Ventura skippers had fished both in Washington and Alaska. The skippers based in San Pedro were least likely to participate in out-of-state fisheries, but still half had fished in Alaska and a third had fished in Washington at some time in their careers.

The three fleets differed also on experience fishing for squid (Table 1). Monterey and San Pedro skippers had been fishing for squid, on average, 10 years more than Ventura skippers. Mobility between the central and southern California squid fisheries differed as well. All of the Monterey skippers surveyed had fished in both the southern and central California squid fisheries, while only three from Ventura and two from San Pedro had fished both fisheries.[3]

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[3] Most boats in the Ventura fleet tie up at Ventura Harbor; the remainder tie up at Channel Islands Harbor, as do vessels in the Monterey fleet when they are fishing in the southern California fishery. They deliver to five receivers at Port Hueneme and two to four receivers at Ventura Harbor.

Squid seiners use round haul gear, and usually are assisted in locating and/or attracting squid by smaller "light boats" equipped with high intensity lights (limited to 30,000 watts per vessel). Some of these light boats also scoop squid for bait operations and/or specialty markets. Most squid fishing occurs at night, with landings delivered to squid receivers (often called "markets") in the Monterey, Port Hueneme/Ventura and San Pedro/Terminal Island areas in the morning. The landed squid is pumped into totes, and trucked to packing facilities. Squid caught in Monterey Bay is landed and delivered to packing facilities within that area. The southern California catch is received at Port Hueneme, San Pedro and Ventura by processors based in the Monterey, Port Hueneme/Ventura and San Pedro/Terminal Island areas, and delivered to packing facilities from the Monterey area to Los Angeles.

Although there are elements common to most of the three fleets' purse seine operations, there are also some notable differences among them. Of the 25 skippers who reported owning their vessel, 14 co-owned it with family, 6 co-owned it with an unrelated partner (a market in some cases, an outside investor in others), and five were sole owners. Of the nine non-owner operators, six were hired skippers and three leased the vessel.
Vessel equipment varies slightly across the fleets, but the within-fleet variation is much greater (Table 2). Refrigeration is most common in the Ventura fleet; most Monterey and Ventura vessels have drums and smaller crews, while San Pedro vessels rely on larger crews and power blocks to work the gear. In terms of vessel characteristics, Monterey vessels were the most similar, with 75% having steel hulls. Among the San Pedro vessels, steel hulls were the most common, but a third of the vessels had wood hulls, a common characteristic of seiners from the traditional wetfish fleet of the 1940s and 1950s. Most of the vessels in the Ventura fleet are 58-foot "limit seiners" with fiberglass hulls, built for participation in the Alaska limited entry salmon fisheries where vessels are length-limited. The newest seiner in our sample was built in 1991, but there are newer vessels in the fleet as a whole. In addition, vessels continue to undergo modifications, including stretching and sponsening, which contribute to vessel safety, capacity or both.

Just as it is important to distinguish (and understand the relationships) among the three squid fleets, it is important to consider how light boat operations compare to purse seine operations. Although our survey included only three light boat skippers, we draw upon the information from those interviews combined with ethnographic data from the broader study, to illustrate this comparison.

Purse seine and light boat operations differ in several ways (Tables 3 and 4). Purse seine operators have more fishing experience in general, and in the squid fishery, than light boat operators (Table 3). This may be explained by the move in the past decade toward broad use of light boats to assist in the squid fishing operation. Nonetheless, some light boat operators have been involved in the fishery for many years, scooping squid for sale to bait operations and specialty markets. Whereas almost one third of the seine skippers fished squid in both central and southern California, none of the three light boat skippers interviewed did - although there are a number of Monterey-based light boats that do participate in both fisheries, many of whom we conducted non-survey interviews with. Both purse seiners and light boat skippers reported having fished in a variety of fisheries.

The two groups differed, however, in the particular sets of fisheries in which they had this experience, with light boat skippers involved in a more diverse set of in-state fisheries, and purse seiners largely involved in fisheries that use a common gear type, whether within or out-of-state.

Purse seine operations have larger crews than light boats, since they harvest as well as locate fish. Scoop or brail nets are common to both types of operation, but light boats tend not to have refrigeration, drums, fish pumps or purse seines. Purse seiners are larger than light boats to afford hold capacity and workspace, whereas light boat need to be smaller and faster to search efficiently for squid. Purse seiners averaged 57.4 net tons (NT) and 57.3 feet in length, while light boats averaged 36 NT and 36 feet in length. The two types of operation also differed in squid holding capacity reported by skippers, with purse seiners averaging 60.8 short tons (ST), and light boats averaging 10.3 ST. Moreover, purse seine vessels were older than light boats, with an average age of 28 years, compared to 7 years for light boats.

The economics of the two types of operation differ notably as well (Table 4). Purse seine skippers reported that their boats had an average market value of $600,000, and an average replacement value of $960,000; light boat skippers reported $159,000 and $168,000 as market and replacement values, respectively. The five- to six-fold difference between purse seine and light boat values is not repeated in annual operating expenses, where seiners averaged $97,000 and light boats averaged $55,300. This discrepancy may be explained by light boats' greater fuel costs, incurred while scouting for squid. Another notable difference between the two types of operations is the amount paid to crew. While purse seine crew shares average 8.6% of vessel revenues after light boat, fuel and grocery expenses have been paid, light boat crew shares average 23% of the revenue to the boat after fuel and grocery costs are deducted.

DEPENDENCE ON THE SQUID FISHERY

The concept of fishery dependence is important to understanding the potential impact of both environmental and economic variability and of fishery regulation. The seasonality of most fisheries and their variability from year to year means that most fishermen participate in multiple fisheries to make use of their skills and resources throughout the year and to manage risk and uncertainty. The nature and extent of purse seine and light boat skippers' dependence on the squid fishery differs. For one indicator of dependence on the fishery, respondents were asked what proportion of their income came from squid, other fishing activities and non-fishing sources in 1993, 1996 and 1998 (Tables 5 and 6). These years were selected to include a year prior to the most recent growth spurt in the fishery, a "boom" year, and an El Niño year, which has been shown to correlate with low squid abundance (McInnis 1976, Leos 1998). Because most skippers were reluctant to report their income, these measures only show a shift in *relative* dependence on particular sources; several commented, however, that their 1996 income far exceeded that of 1993, and that of 1998 even moreso. Purse seine skippers in our sample reported that they earned, on average, just over one-third of their income from squid in 1993, more than half in 1996, and less than 10% in 1998. They consistently relied on other fisheries more than

non-fishing sources of income (e.g., investments, construction work) as a complement to income from squid fishing. Other fisheries accounted for over half of their income in 1993, then dropped to 43% in 1996, but nearly doubled (to 81%) in 1998 with the scarcity of squid during the El Niño.

As a second, and equally important, indicator of dependence on the squid fishery, we asked skippers what their most important fishery was in 1988, 1993 and 1998 (Table 7). Data on the latter two years allow comparison with the income data; information on 1988 enabled comparison over the longer term. Overall, the most important fishery for the seiners we interviewed shifted from Alaska gillnet or purse seine salmon in 1988 to squid in 1993, followed by coastal pelagic species and Alaska or San Francisco Bay herring. Both salmon and squid declined in importance in 1998, when CPS and tuna were more frequently cited as most important. The decline in the importance of squid was attributed to resource scarcity, whereas the decline in salmon's importance was attributed to both resource scarcity and poor market conditions.

We also explored mobility within the squid fishery and among fisheries with squid skippers, to understand both the spatial connection among their fishing activities and how it might have changed over time. Over time, four respondents have shifted their home port from Alaska or Washington to Ventura or San Pedro, moving away from increasingly problematic fishing conditions toward more promising opportunities in the south. All of those with out-of-state homeports in 1998 reported Port Hueneme/Ventura area ports as their main squid port. In addition, Monterey skippers have become increasingly involved in the southern California fishery over time.

THE INSTITUTIONAL STRUCTURE OF THE FISHERY: RELATIONSHIPS BETWEEN FISHERMEN AND MARKETS

The institutional structure of the fishery entails the complex relationships between fishermen and the markets to which they deliver their catch. Following Gordon (1954), most economic (and regulatory) studies of fisheries have focused on fishermen's competitive over-fishing in the absence of established property rights that would, it is argued, protect the resource in the longer term. To prevent over-fishing, most regulatory programs seek to reduce fishing effort by controlling inputs (e.g., by limiting entry, times fished or gear used) or outputs (e.g., by trip limits or quotas). It is assumed that fishermen will find a market for their fish, and that the market will expand indefinitely to accommodate increased catches (though prices paid to fishermen may also fall as supply increases). This approach, which is the basis for most fishery regulation, oversimplifies the reality of most fisheries.

Attention to the institutional structure of the fishery gives a different basis to fisheries regulation than does conventional economic analysis. Present day commercial fisheries include many necessary intermediaries between the fisherman and the consumer. The structure and function of those intermediaries strongly affect the economic and social circumstances, and therefore the behavior, of fishermen. In fisheries, as in other industries (Raikes et al. 2000; Lenz 1997, Buck et al. 1997; Friedland et al. 1981), these

intermediaries become particularly important as market chains between producers (the fishermen) and consumers lengthen in both distance and number of transactions. There is an important difference between a short market chain - as when a skipper lands fish to be sold in his uncle's market - and a long market chain - as when the skipper sells fish to a receiver who sells it to a processor who sells it to a broker who sells it to an exporter who sells it to an importer who sells it to a restaurant in China.

Since its inception, the California squid industry has shifted from local to international markets. What were primarily local and personal networks of relationships have become articulated with more formal and more commercial transactions and institutions capable of moving large tonnages of squid to markets, both domestic and international. It is in the context of this institutional change and market expansion that the extraordinary increase in squid catch has occurred.

We used the PacFIN data to identify patterns of 'market fidelity' between particular boats and processors in the squid fishery, and in certain cases for other species (e.g., wetfish, tuna).[4] We examined the activities of boats that landed squid, with particular attention to the species they caught, the ports at which they landed, and the receivers to whom they delivered their catch. Some of them fished almost exclusively for squid, at least in California waters; some included squid as one species in their fishing round, and some landed squid occasionally and opportunistically.

The roots of the market structure we discovered in the squid industry of recent times can be found in the earlier fishery in which Italian fishermen caught and sold squid for consumption by local communities of Mediterranean and Asian descent in which squid was a traditional food. Growth in demand beyond this immediate and local market required the participation of businesses that knew how to sell fish beyond these local relationships. As the industry grew, these larger processors and shippers became important to this expansion, adding squid to their product lines and reaching out to expand markets for squid that paralleled their existing markets for other California fish products. Some of these new markets were domestic, as Americans became familiar with formerly ethnic foods like "calamari"; others were international, ranging from the Mediterranean to China and Southeast Asia.

Marketing (and the development of new markets) is not the work of the fishermen; their job is to catch squid. When squid is readily available, these relationships form the basis for managing the flow of squid through the capacity of the processing plants and freezers and on, eventually, to final outlets. Although some fishing remains opportunistic, most squid fishing is done by order from the market. The boats that fish for squid regularly tend to have established relationships with a single market from which they receive daily, weekly or ongoing orders for squid. When demand is strong, these orders may be

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[4] The data we obtained were defined only by vessels' presence in the squid fishery, and do not include landings received by squid receivers from vessels that do not land squid. As the PacFIN data does not report transactions beyond the landing of the catch, we used other sources, including interviews and industry publications, to develop a preliminary typology of squid receivers and to describe the developing structure of the industry.

unlimited or “open”. When demand, packing capacity or storage space is limited, the boats may be placed on limits, given orders of about 30 tons, about half the average vessel’s capacity, regardless of the availability of squid.

Just as a small number of the many seiners in the fishery land most of the catch, a few of the many squid receivers dominate the market (that is, they buy most of the catch). In 1981, there were 66 firms that purchased squid; in 1996 there were only 43. Over the period of this study, many buyers appear only briefly or episodically; others (like bait suppliers and local or ethnic markets) buy squid directly from the vessels regularly but in relatively small amounts.

Only a few firms buy large amounts of squid for processing, freezing, and long-distance markets (the primary growth segment of this industry). Figure 2 shows the number of firms that bought more than five percent of the squid sold in a given year. The line depicts the cumulative share of squid bought by those firms in that year. In most years, seven or eight firms fall into this category as significant receivers of squid. In every year except 1989, these few firms absorbed 70% or more of the squid landed. For most of the firms in this group, squid is one among multiple fish product lines; other products sold include both high value California species such as swordfish and albacore tuna and lower value species such as mackerel and sardines. Several of these entities also handle fish imported from other areas, nationally and internationally. Other California brokers buy processed and frozen squid (often packed under private label) for resale.

These firms benefit from maintaining multiple product lines in several ways. For those that process squid, multiple products allow them to make more efficient use of processing capacity, offsetting the problems of seasonality and day-to-day and year-to-year variations in landings. Even the more specialized squid processors will offer at least a few other species. As fish brokers or wholesalers, their multiple product lines allow them to reach out over a larger and more complex market and to maintain market position and established links with buyers over time. For some of these firms, squid was added as a new product as the market grew after 1992; others (some of the largest receivers in the squid fishery) have been marketing squid since before 1980 and followed the market as it expanded.

Particular markets have close, long-term relations with a small group of boats, but will buy fish from other vessels when they can use it (when their processing lines and markets are not fully supplied by these primary boats). The length, frequency, and magnitude of these close financial relationships can be substantial. It is difficult to illustrate the magnitude of these linkages for top boats while protecting the confidentiality of the data. However, calculation of the importance of the top five boats selling to a particular processor indicates the degree of these relationships. In many cases, these boats sell only to one processor, in some cases for all years for which we have data. Among the 15 vessels that made up the "top five" for each of the top three processors, terms of service to a single processor ranged from 4 to 17 years. Purchases from these boats comprised from 59% to 66% of these three processors' total squid purchases and ranged in total

value from $11 million to $25 million. Total numbers of transactions between the processors and their top five boats ranged from 1,088 to 2,597 in this period.

Although a small number of firms have dominated the fishery, their position relative to each other has fluctuated somewhat from year to year. A part of this fluctuation reflects conditions in the regional fisheries, since receivers in the fishery grew from their initial geographical bases and still show spatial patterns in the primary ports at which they receive fish. It also reflects the entry of new firms that became major buyers, for several years at least. Some of these persisted (in one or several corporate forms); others eventually exited the fishery. The entry of new large firms caused shifts in fishery share among processors, as occurred in 1989 (Figure 2).

These processor/wholesaler/brokers played a crucial role in the development and coordination of markets for squid during this period of remarkable growth in the industry (Figure 3). Despite the rapid growth of the fishery and the perturbations of three El Niños between 1981 and 1999, the five-firm concentration ratio in the market has remained at or well above 60% of all sales throughout most of this period.

The growth of the squid industry, therefore, has been the result of activities and innovations at each level along the market chain. Skippers and crews fished for squid and worked out ways to increase their harvests through improvements in both knowledge and technology. Markets expanded receiving, transportation, marketing and storage capabilities, and advertized and sold their products over a larger area. Markets for California squid grew as more people were able to buy it, more people learned to want it, and other sources of squid declined. *Loligo opalescens* exports from the U.S. in 1994 were valued at $23.6 million; by 1997 (before the 1998 El Niño), they had grown to $55.9 million. We did not examine the destination of these exports, but skippers and other key observers relate most of this growth to the importance of Asian markets (both China and Southeast Asia).

SKIPPERS' OPINIONS ABOUT PROSPECTIVE MANAGEMENT OF THE FISHERY

A final feature we would like to report on here, as it is particularly germane to current events in the fishery, is skippers' attitudes toward management measures that have been discussed for the fishery recently. 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. The 1987 removal of the ban on purse seine gear in the Monterey Bay fishery led not only to its near-universal adoption, but also to the subsequent increase in vessel size to accommodate the new gear. This enabled more of the Monterey fleet to venture south to participate in the winter fishery around the Channel Islands.
In 1997, the California Legislature passed SB 364, which instituted $2,500 catcher vessel and light boat permits and a 3-year moratorium on entry into the fishery. It also mandated a study of the resource and the fishery (funded by permit fees) to provide data for the development of a squid fishery management plan. With the prospect of limited entry coming to one of the last open access fisheries on the west coast, 301 vessel owners

purchased squid fishery permits for the temporary limited entry (248 catcher vessel and 53 light boat permits were issued). Permittees include both historical and prospective participants, who now seek to establish landing records in the hope of qualifying for the anticipated permanent limited entry system. This prospect is especially appealing to salmon purse seiners from Alaska and Washington, who have increasingly faced regulatory and market problems in their traditional fisheries.

We asked skippers whether they would favor, be neutral toward, or oppose several management measures: one or two-day closures, limited entry, light limits, an annual quota, closed areas, and fishing seasons (Table 8). Limited entry received the greatest support from purse seiners, with 81.82% in favor, and only 12.12% opposed. Other measures supported by at least half of those interviewed were one- or two-day closures, which were in place in Monterey at the time of the interview and were subsequently adopted for the fishery statewide. The prospect of weekend closures statewide was of some concern because it might lead to skippers to fish on days that remained open, even if weather conditions were hazardous. But overall weekend closures were supported because they would give skippers and crew a rest after being on the water (if not actively fishing) around-the-clock on weekdays. Some skippers also noted that such closures would give the squid a chance to spawn unhindered by squid lights and fishing activity. Limits on the amount of wattage used to light for squid was also favored by well over half of the skippers interviewed. Several skippers discussed the recent increase in the number and intensity of lights used to attract squid, and felt it had become excessive and counterproductive for the fishery. Nearly 85% of those interviewed opposed the use of closed areas to manage the fishery. Both survey respondents and other fishermen we spoke with were very concerned about this prospect. Their reasons for opposing closed areas centered on their observations of the extreme variability in the spatial distribution of the squid intra- and inter-seasonally, and the increased concentration of boats in more limited areas, which could lead to both conflict on the fishing grounds and reduced catches. In addition, several expressed concern about potential safety hazards that could arise from fishing areas that remain open but are more exposed to severe weather, or that are more distant from safe anchorages, where they take refuge during such times.

CONCLUSION

This report summarizes initial results from our study of the changing social and economic organization of the fishery for California market squid. They suggest that successful management of this fishery to sustain its participants, as well as the squid itself, will require attention to a number of factors identified in this report. First, the community of fishermen itself is diverse and segmented. The notable differences among the three fleets we identified, and their participants' histories, circumstances and goals, suggest that management actions will affect fishery participants differentially. These differences must be recognized to generate regulations that are equitable, and that do not have undesired effects on fishery participants, the resource or the ecosystem.

Second, we have demonstrated that changes in the institutional structure have been critically important in the development and coordination of markets in this and other

California fisheries. Growth in the harvest of squid does not begin with increased fishing effort, but with expansion of the linkages and transactions in the real world of business. These are structured by the institutional goals and capabilities of intermediary firms themselves, and also by connections to (and disconnections from) growing global markets. Changes in these relationships are likely to have a major impact on the fishery and on the ability and willingness of such firms to participate in it.

Third, the opinions of the fishermen themselves are important to successful regulation of the fishery. Not only are they most directly affected by proposed fishery regulations; they also have played a prominent role in raising questions and engaging managers in discussion directed toward management of the fishery. Their extensive knowledge about the resource, the fishery, its global market context, and the relationship among these, can be brought to bear as choices are made among alternative regulatory measures. Moreover, they are problem solvers, whose ideas have already contributed to the development and management of the fishery, and could be useful as management proceeds. We hope that this information will be useful to the deliberations of the fishery policy community as debate about regulation of the fishery for California market squid continues.

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LITERATURE CITED

Ally, J. R. Raymond, R.G. Evans, and T.W. Thompson. 1975. The results of an exploratory fishing cruise for Loligo opalescens in southern and central California, June 5-25, 1974. Moss Landing, CA: Moss Landing Marine Laboratories. Series title: (CASUC-MLML-TP-75-02)

Berntsen, S.E. 1988. Development of a restructured seafood product from squid (Loligo opalescens). M.S. Thesis, Oregon State University.

Brooks, L.A. 1977. Development and testing of a device to automatically clean California market squid (Loligo opalescens). Dissertation, University of California, Davis.

Buck, D., C. Getz, and J. Guthman. 1997. From farm to table: the organic vegetable commodity chain of Northern California. Sociologia Ruralis 37(1).

Dewees, C.M. and R.J. Price. 1983. The California squid fishery. Berkeley: Cooperative Extension, Division of Agricultural Sciences, University of California. University of California, Cooperative Extension Leaflet No. 21330.

Evans, R.G. 1976. Aspects of the population biology of the California Market Squid (*Loligo opalescens*, Berry). Dissertation, Moss Landing Marine Laboratory.

Fields, W.G. 1965. The structure, development, food relations, reproduction, and life history of the squid *Loligo opalescens* Berry. Sacramento: CA Dept Fish and Game. Series title: California. Dept. of Fish and Game. Fish bulletin 131.

Friedland, W.H., A.E. Barton and R.J. Thomas. 1981. Manufacturing green gold: Capital, labor and technology in the lettuce industry. Cambridge: Cambridge University Press.

Gordon, H.S. 1954. The economic theory of a common-property resource: The fishery. Journal of Political Economy 62:124- 142.

Kato, S. and J.E. Hardwick. 1975. The California Squid Fishery. Pp.107-27 in Expert Consultation on Fishing for Squid and Other Cephalopods, Tokyo and Hakodate, Japan, 9-13 September 1975. Fisheries Report 170 Suppl. Rome: FAO.

Leet, W.S., C.M. Dewees, and C.W. Haugen, eds. 1992. California's living marine resources and their utilization. Davis: Sea Grant Extension Program, University of California. UCSGEP 92-12.

Lenz, B. 1997. The filiere concept as an heuristic instrument for analysing the organizational and spatial patterns of production and its distribution. Geographische Zeitschrift. 85(1): 20-33.

LMR Fisheries Research, Inc. 1995. A review of the market squid industry of California. Prepared for the California Seafood Council. San Diego: LMR Fisheries Research.

Leos, R.1996. The Mysterious Lights on Monterey Bay - and the Fishery Beneath Them. Outdoor California. 57(1):19-22.

Lydon, S. 1985. Chinese Gold: The Chinese in the Monterey Bay Region. Capitola, CA: Capitola Book Co.

McInnis, R.R. 1976. Correlations between the squid fishery and environmental factors in Monterey Bay, California Dissertation, San Francisco State University.

Raikes, P., M.F. Jensen, and S. Ponte. 2000. Global commodity chain analysis and the French filiere approach: Comparison and critique. Economy and Society 29(3): 390-417.

Recksiek, C.W. and H.W. Frey, eds. 1978. Biological, oceanographic, and acoustic aspects of the market squid, *Loligo opalescens* Berry. Sacramento: California State Resources Agency, Dept. of Fish and Game. Fish Bulletin 169.

Singh, R.P., and D.E. Brown. 1981. Automatic squid cleaning machine. California Agriculture, July-August: 4-6.

Spratt, J.D. 1979. Age and growth of the market squid, *Loligo opalescens* Berry, from statoliths. CalCOFI Reports 20:58-64.

Figure 1. Tons of squid landed at major ports and elsewhere in California, 1981-99. (Source: PacFIN data.)

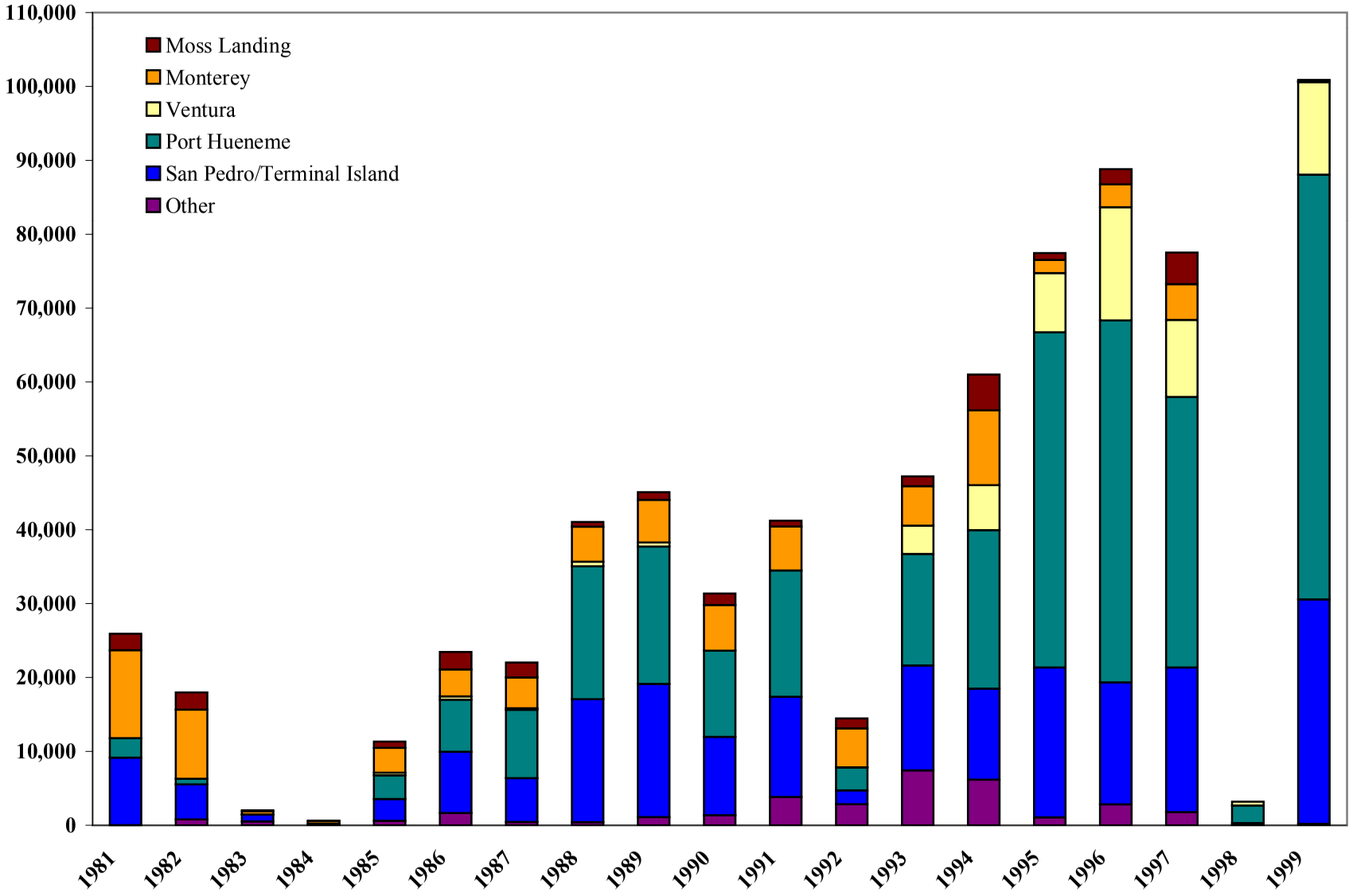

Figure 2. "Major" squid markets, 1981-96. (Source: PacFIN data.)

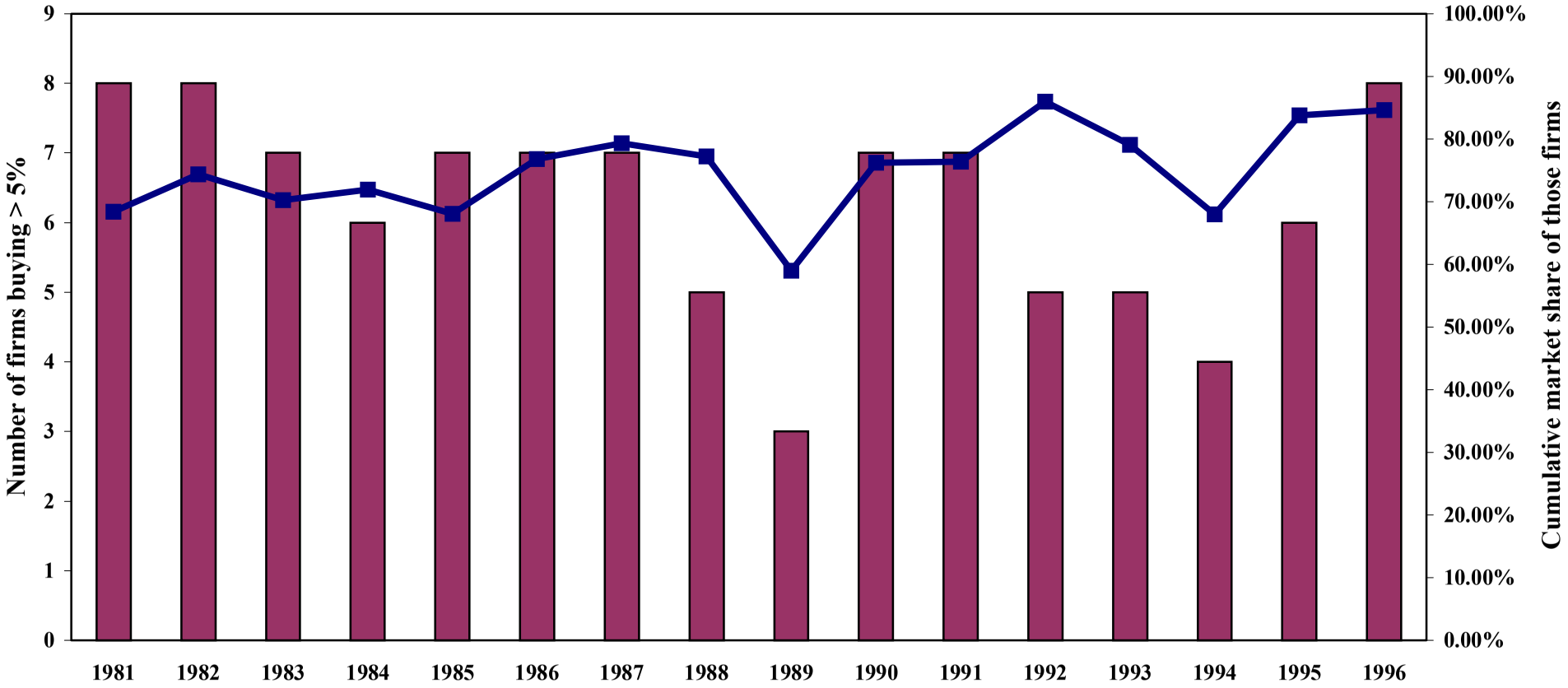

Figure 3. Markets in a growing fishery. (Source: PacFIN data.)

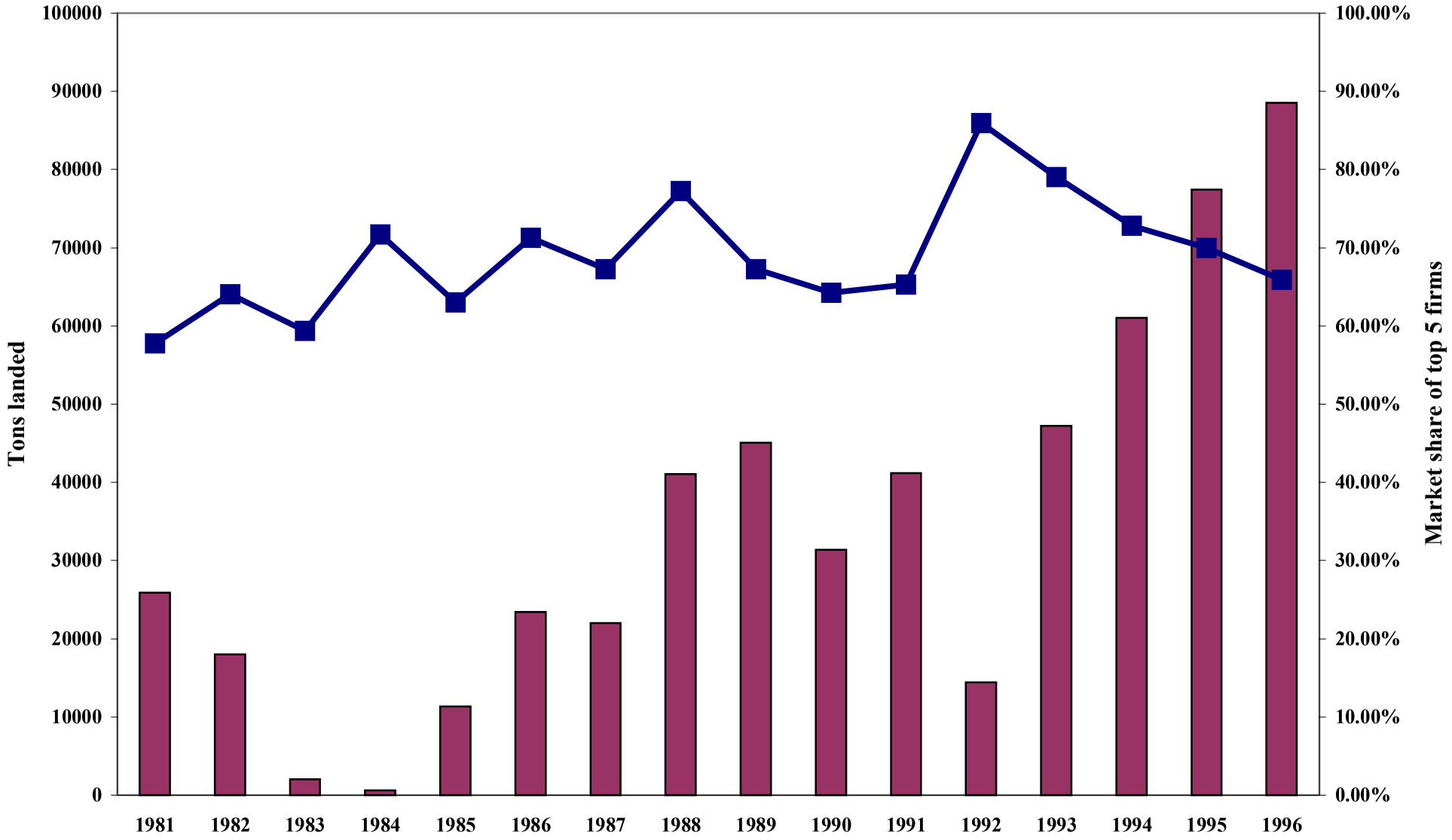

Table 1. Fishing experience of interviewed squid purse seine skippers, by fleet ([a] N=2).						
	Monterey (N = 8)		Ventura (N=13)		San Pedro (N=12)	
	Mean	Range	Mean	Range	Mean	Range
Years commercial fishing	21.50	11-39	24.31	14-39	32.92	20-58
Number of places fished	4.88	3-9	4.69	2-10	4.92	2-8
Number of fisheries fished	5.75	4-10	6.62	3-13	6.5	4-10
Number of gear types fished	4.63	3-7	3.38	1-7	3.17	1-6
Year first fished squid	1980	1974-91	1991	1975-99	1977	1941-90
Year became squid skipper	1985	1970-95	1993	1975-99	1983	1960-98
Year started fishing squid statewide	1989	1984-97	1985[a]	1978-92	n/a	n/a

Table 2. Percent of purse seine vessels with types of equipment, by fleet.				
	Monterey (N=8)	Ventura (N=13)	San Pedro (N=12)	Overall (N=33)
Drum	62.50	61.54	33.33	51.52
Pump	100.00	100.00	91.67	96.97
Refrigeration	87.50	92.31	83.33	87.88
Hull type				
Fiberglass	12.5	61.5	16.7	33.33
Steel	75	15.4	41.7	39.39
Wood	12.5	15.4	33.3	21.21
Other	0	7.7	8.3	6.06

Table 3. Fishing experience of interviewed squid skippers ([a] N=10).				
	Purse seiners (N=33)		Light boats (N=3)	
	Mean	Range	Mean	Range
Years commercial fishing	26.76	11-58	20	17-24
Number of places fished	4.82	2-10	3.67	3-4
Number of fisheries fished	6.36	3-13	5.33	4-6
Number of gear types fished	3.61	1-7	3.33	3-4
Year first fished squid	1983	1941-1999	1985	1982-1988
Year became squid skipper	1987	1960-1999	1990	1984-1995
Year started fishing squid statewide	1989[a]	1978-1997	n/a	n/a

Table 4. Selected characteristics of respondents' squid fishing operations ([a] N=32, [b] N=30).				
	Purse seiners (N=33)		Light boats (N=3)	
	Mean	Range	Mean	Range
Crew size	4.55	3-8	0.67	0-1
Squid boat capacity (tons)	60.8	12-130	10.33	5-14
Market value of vessel ($)	605,469[a]	125,000-1,800,000	159,333	70,000-250,000
Replacement value of vessel ($)	960,333[b]	250,000-2,100,000	168,333	125,000-250,000
Total operating expenses ($)	97,464[a]	7,236-279,000	55,300	45,700-64,900
Boat share of revenue (%)	53.13[a]	30-70	60	50-70
Crewman's share of revenue (%)	8.62[a]	5.5-11.25	23.33	10-50

Table 5. Respondents' proportion of income from squid, other fisheries and non-fishing sources, 1993, 1996 and 1998.

	Purse seiners (N=33)			Light boats (N=3)		
	1993	1996	1998	1993	1996	1998
Squid	37	51	9	37.5	39.5	39.5
Other fisheries	54	43	81	62.5	57.5	57.5
Non-fishing sources	9	5	10	0	2.5	2.5

Table 6. Respondents' dependence on squid, other fisheries and non-fishing sources, 1993, 1996 and 1998, by fleet ([a] N=5, [b] N=13, [c] N=11, [d] N=7, [e] N=6).

	1993			1996			1998		
	Monterey[a]	Ventura[b]	San Pedro[c]	Monterey[d]	Ventura[b]	San Pedro[c]	Monterey[e]	Ventura[b]	San Pedro[c]
Squid	56	26.15	41.36	57.57	43.62	56.82	7.14	11.92	3.45
Other fisheries	42	54.62	58.18	40.14	45.62	42.73	88.33	64.23	94.18
Non-fishing sources	2	19.23	0	2.29	10.77	0	3.33	16.15	2.91

Table 7. Purse seiner skippers' most important fishery 1988, 1993 and 1998 (N=33).			
	1988	1993	1998
Squid	28.79	42.42	36.36
Tuna	3.03	3.03	6.06
Salmon	45.45	39.39	33.33
Coastal Pelagic Species	10.61	6.06	15.15
Herring	9.09	9.09	-
Other	3.03	-	3.03

Table 8. Purse seine skippers' opinions regarding selected management options ([a] N=22)						
	Strongly favor	Favor	Neutral	Oppose	Strongly oppose	No response
One or two-day closures	48.48	3.03	9.09	-	39.39	-
Limited entry	72.73	9.09	6.06	3.03	9.09	-
Light Limits	39.39	18.18	18.18	3.03	18.18	3.03
Annual quota	-	6.06	21.21	18.18	48.48	6.06
Closed areas	3.03	-	9.09	12.12	72.73	3.03
Fishing seasons[a]	18.18	9.09	9.09	13.64	50.00	-