

ECONOMIC ATTRIBUTES OF STAYERS AND LEAVERS IN FOUR CALIFORNIA FISHERIES

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ABSTRACT

We use a simple regulatory event study approach to evaluate hypothesized economic attributes of California commercial fishermen who remain as active fishery participants (“stayers”) following regulatory events that attenuate fishing opportunities. The attributes of greater revenue diversification from multi-fishery participation, lower interannual income variation, and higher annual gross fishing income are hypothesized to distinguish stayers from those who leave commercial fishing after a regulatory event. We find consistent and (in many but not all cases) significant associations as hypothesized between these economic attributes of commercial fishermen and their status as a stayer or a leaver, with interannual fishing income stability being the most consistently significant. In light of declining numbers of commercial fishermen in California, and the importance of multi-fishery participation in sustaining those who remain, policy makers should provide for flexible multi-fishery participation when designing fisheries regulations, where possible.

Attributes Distinguishing Stayers from Leavers

What attributes foster sustainability and resilience in the context of heightened restrictions on commercial fishing opportunities in California? As Marshall et al. (2007) note, knowledge of the properties that confer resilience can assist resource managers, communities and resource users to design and implement policies that minimize the impacts on people while maximizing the sustainability of ecosystem goods and services. Building on the seminal work of Holling (1973) on resilience in ecological systems, Marshall et al. use the term “social resilience” to refer to the flexibility with which resource users can cope and adapt to changes in resource policy.

In this paper we consider resilience in the context of persistence in commercial fishing. We use a simple regulatory event study approach to evaluate a number of hypothesized economic attributes of commercial fishers who remain as active fishery participants following regulatory events that attenuate fishing opportunities. Our focus is in evaluating economic characteristics that distinguish “stayers”—commercial fishermen who remain

as active fishery participants in a fishery following regulatory events that attenuate fishing opportunities—from “leavers” who exit a fishery under the same regulatory circumstances. These economic attributes are hypothesized to confer advantages that assist commercial fishers in coping with regulatory events and sustaining active participation in a commercial fishery.

There are many attributes of fishers and their households that can be expected to influence the decision to stay or leave as an active participant in a commercial fishery. These include fishing income diversification, stability, and level; market channel relationships that facilitate sales of multiple fish species; age, health, and disability status; educational attainment, experience, and skills that are transferable to non-fishing occupations; spousal income and employment opportunities; and the spatial location of outside work opportunities relative to household mobility. A comprehensive analysis of all these attributes would require detailed confidential household-level data, interview methods that would include measures for intangible and subjective attributes, and historical regional job market analysis. Rather, we took a narrower and more tractable approach that focused on economic attributes linked to commercial fishing data.

We empirically analyze three related economic attributes that are hypothesized to be congruent with successfully coping with attenuated fishing opportunities following a regulatory event. The first of these measurable attributes is meaningful participation in multiple fisheries, sometimes referred to as “combination fishing” (Dory Associates 2009). We hypothesize that stayers will materially participate in a larger number of fisheries than leavers. Participation in multiple fisheries is facilitated by production linkages in vessel, human capital, and gear so that fishermen can relatively easily redirect fishing effort to fisheries that employ similar gear or fishing methods (Hutchinson 2003). Multi-fishery participation may confer a number of economic benefits, including more complete utilization of vessel and other malleable fishing capital, and the capacity to apportion effort across fisheries based on abundance, prices, fishery management, and other factors. We construct a revenue diversity index (RDI), described

in greater detail in section 4 below, as a measure of income diversification from multi-fishery participation.

The second attribute we analyze is interannual variation in gross fishing income as measured by the coefficient of variation (CV), which measures the ratio of the standard deviation to the mean. We hypothesize that stayers will have a lower coefficient of variation in interannual gross annual fishing income than leavers. Fishing strategies that reduce interannual variation in income reduce dependence on credit or non-fishing work as a means of smoothing consumption in households dependent upon commercial fishing income. This second economic attribute may derive in part from multi-fishery participation that results in a more diversified portfolio of fishing income sources. Low interannual variation in gross fishing income may also derive from other, more difficult to measure intrinsic attributes of stayers. In years of reduced abundance or lower prices, for example, fishermen with more knowledge, skill, capacity, or commitment to fishing may be better able to smooth their interannual fishing income and sustain participation over time.

The third attribute we analyze is the level of gross annual income from all fishery sources. We hypothesize that stayers will have higher mean gross annual fishing income than leavers. Higher gross annual fishing income may reduce the need for fishers to exit commercial fishing for outside employment in the context of restrictive fishery regulations. As Marshall et al. (2007) note, in addition to their ability to secure outside employment and to remain competitive within the fishing industry, commercial fishermen assess their vulnerability to policy change on the basis of their financial situation. Fishermen with a larger financial buffer feel less vulnerable to policy change. This third attribute may derive in part from multi-fishery participation that provides more sources of fishing income, but (as with low interannual income variation) may also derive from other attributes of stayers.

To empirically analyze these economic attributes and their association with sustaining commercial fishermen, we apply a regulatory event study methodology to four California fisheries that allows for longitudinal analysis of stayers and leavers before and after a regulatory event. The event study approach is based on the idea that in the context of public hearings linked to proposed regulatory rule-making, fishery participants can anticipate the economic consequences of the upcoming regulation and sort themselves as either stayers or leavers. For example, Brandt (2005) looked at the Atlantic surf clam (*Spisula solidissima*) and ocean quahog (*Arctica islandica*) fishery before, during, and after imposition of individual transferable quotas in 1990, and found that participants who had a transition period to negotiate future quota shares acted strategically in anticipation of future regulatory change. And Casey et al. (1995) found substantial

evidence of adaptation by fishers and processors to an individual vessel quota system in the British Columbian halibut fishery.

This is not to say that participants will always anticipate the economic effects of regulation. Fishery regulation does not occur in a deterministic environment. Post-regulation adaptation may occur due to unanticipated regulatory impacts, fishery population dynamics, market changes, or broader economic forces.

Fisheries Analyzed

We focus on four California fisheries: Dungeness crab (*Cancer magister*), spot prawn (*Pandalus platyceros*), (California) sheephead (*Semicossyphus pulcher*), and (California) spiny lobster (*Panulirus interruptus*). All had significant restrictive regulatory events since 1980, and all employ trap gear to land live finfish or shellfish (occasionally other gear types are utilized as well, as described below). In large part all of these fisheries also feature relatively high prices per pound that are driven by the growth and development of new markets that increasingly support processing and distribution in live condition.

Hypothesized Attributes of Stayers and Leavers

- Multi-fishery participation (as measured by a revenue diversity index) is associated with a commercial fisher's status as a stayer who continues commercial fishery participation following a regulatory event that attenuates fishing opportunities.
- A lower coefficient of variation (CV) in gross annual fishing income is associated with a commercial fisher's status as a stayer who continues commercial fishery participation following a regulatory event that attenuates fishing opportunities.
- Higher gross annual fishing income is associated with a commercial fisher's status as a stayer who continues commercial fishery participation following a regulatory event that attenuates fishing opportunities.

Research Approaches

The California Department of Fish and Wildlife (CDFW) provided the authors with a time-series commercial landings data set of annual individual landings receipts for 1980 to 2012.

Regulatory events in the four study fisheries were researched for the time period of available CDFW data. Regulatory events that could change a fishermen's behavior include catch limits, restricted access, or season closures. Table A describes the regulatory events identified for each fishery to determine its effect on a fisherman's participation.

Dungeness Crab. Since 1905 the fishery has been regulated by the "3-S" principle: sex, size, and season limits. The 3-S principle allows only male crabs greater

TABLE A
 Regulatory Events by Fishery

Fishery	Regulatory Event Year	Regulatory Event Description
Dungeness Crab	1995	Restricted Access Program
Spot Prawn	2002	Restricted Access Program
Sheephead	2001	Catch Quota
Spiny Lobster	1996	Restricted Access Program

than 6.25 inches to be landed during the established season (Deweese et al. 2004). In 1995 California implemented a restricted access program and capped the number of available licenses.

Spot Prawn. This fishery began as a trawl fishery, with the trap fishery developing in the 1980s. The industry experienced modified seasonal closures in locations along the California coast in the 1990s to 2000. California implemented a restricted access program in 2002 that featured a two tier system, with the first tier allowing a number of high-performing vessel permits to be transferable with no landings limit. A second tier of permits were nontransferable, with landings restrictions, and a maximum of 150 traps/vessel.

Sheephead. Sheephead emerged as a specific targeted fishery in the 1980s. Regulations were first enacted with size limits in 1999 to address smaller-sized fish landed for the live fish market. We chose to focus on a catch quota imposed on the fishery at the beginning of 2001 that evolved into bimonthly catch limits. Currently sheephead is a restricted access fishery with catch limits.

Spiny Lobster. Spiny lobster has been fished in southern California since the late 1800s. Prior to 1996, the fishery was regulated by trap design. In 1996 a restricted access program was initiated. Operator permits were nontransferable, which allowed the state to eventually achieve a 225 permit capacity through attrition.

We use a 10-year event window to identify fishermen who stayed or left. Using a longitudinal approach, we tracked individual fishermen’s landings five years before the regulatory event, and then determined which fishermen remained or left the fishery within five years after the event (including the event year itself). This event study approach allowed us to determine who was a consistent participant prior to the event, and who dropped out after the event occurred. The study developed criteria for individual fishermen who were considered “stayers” and “leavers” (table B). In order to be considered materially active in a fishery (and thus to be either a stayer or a leaver), a fisherman must make at least \$1,000 worth of landings in a fishery in a five-year event period. The nominal \$1,000 threshold in ex-vessel landings eliminates the issue of landings of non-target catch confounding participation in one of the four study fisheries.

TABLE B
 Criteria for Individual Fishermen Who Were Considered Stayers or Leavers in a Given Fishery:

Stayers	Leavers
<ul style="list-style-type: none"> Made at least \$1,000 from landings in the fishery in the five-year period <u>prior</u> to the regulatory event, and were active in the fishery in at least three of those five years. Made at least \$1,000 from landings in the fishery in the five-year period <u>during and after</u> the regulatory event, and were active in the fishery in at least three of those five years. 	<ul style="list-style-type: none"> Made at least \$1,000 from landings in the fishery in the five-year period <u>prior</u> to the regulatory event, and were active in the fishery in at least three of those five years. Did not make any landings in the fishery <u>during and after</u> the regulatory event.

After designating fishermen as a “stayer” or “leaver” in one of the four study fisheries, we calculated each stayer’s or leaver’s revenue diversity index (RDI). Fishermen’s landing records were first categorized into specific fisheries based on previous work done by Hackett et al. (2009) (table C). Once landing records were coded for specific fisheries, we needed to determine whether there were significant or incidental landings in a given fishery. We used \$1,000 during the five-year period before the regulatory event, or the five-year period on and after the regulatory event, as the revenue threshold for material participation in a given fishery.

TABLE C
 List of California Fisheries

California Fisheries*	
Herring	Anchovies
Salmon	Squid
Albacore	Urchin
Tuna	Sea Cucumber
Spiny Lobster	Swordfish/Shark
Pink Shrimp	Halibut
Dungeness Crab	Nearshore/Groundfish
Sardine	Spot Prawn

*Source: Hackett et al. (2009).

After longitudinal analysis to determine which fisheries individual fishermen participate in for the five-year windows before and during/after the regulatory event, we calculated a fisherman’s RDI by simply counting the number of fisheries each fisherman materially participated in. For each of the four study fisheries, the RDIs of all stayers were averaged for the five-year windows before and during/after the regulatory event (“stayers-pre” and “stayers-post,” respectively), and the RDIs of all leavers were averaged for the five-year window before the regulatory event (“leavers”). Once mean RDIs for each group of fishermen were calculated in the “pre” and “post” regulatory periods, statistical tests were applied, as described on the next page.

Analysis of Stayers and Leavers

To test whether an attribute (RDI, CV, or gross annual income) for stayers is significantly different from that of leavers, a simple two-sample *t* test procedure is employed. Two-sample *f* tests for variances provided *p* values that determine whether attribute variances between the two groups are significantly different. The outcome of the *f* tests determined whether the *t* tests were done assuming equal or unequal variances. One-tailed *t* tests are appropriate here because each of the alternative hypotheses is directional—mean RDI is larger, CV lower, and gross annual fishing income higher—for stayers relative to leavers in the period prior to regulation.

Before we turn to our results, it is worth explaining why we did not use a logit or probit regression analysis to model the probability of a fisher being a stayer or leaver as a function of various observable explanatory variables. One reason is the correlated nature of RDI, CV, and gross fishing income as explanatory variables in such a regression, which would lead to multicollinearity in the resulting model. In addition, as noted in section 1, we lack observations on other important explanatory variables such as outside (“non-fishing”) income, fishers’ and their spouses’ age, education, training, and employment experience, as well as proximity to relevant employers that presumably would contribute to a household-level understanding of the stay/leave decision. Moreover, low sample sizes for the spot prawn and sheephead fisheries would raise problems with the power of the resulting statistical tests. As a result of these issues we focused on simpler statistical analysis to identify key attributes of stayers and leavers. Results for each of the tests are provided below.

Do Stayers Have Greater Fishing Revenue Diversity?

Recall that the revenue diversity index (RDI) is a count of the number of fisheries fishermen participate in. We

evaluate this hypothesized attribute using two-sample tests for stayers and leavers for the five-year period prior to imposition of the regulatory event (these two samples are grouped as “stayers-pre” and the “leavers”). Table D summarizes the results. Note that the stayer and leaver samples draw from the five-year period prior to the regulatory event.

The mean RDIs for the two fishermen groups show a consistent pattern of stayers having larger mean RDIs than leavers. In two fisheries (Dungeness crab and sheephead) this difference in mean RDI values across stayer and leaver groups is significant at below the 1% level. In the other two fisheries (spot prawn and spiny lobster) the difference in mean RDI values across stayer and leaver groups has only marginal significance. In the case of spiny lobster, weaker significance is driven by the stayer group participating in on average only about 0.34 more fisheries than leavers in the period prior to regulation. In the case of spot prawn, weaker significance is driven more by the small sample size of the stayer and leaver groups, as the stayers participated in on average about 0.54 more fisheries than leavers prior to regulation.

TABLE D
Tests of Hypothesized Revenue Diversity Attribute

Fishery	Groups	Sample Size	Mean RDI	<i>P</i> Value, Difference in Means*
Dungeness Crab	Stayers	363	2.71	< 1%
	Leavers	161	2.05	
Spot Prawn	Stayers	24	3.67	11.66%
	Leavers	23	3.13	
Sheephead	Stayers	59	4.80	< 1%
	Leavers	28	2.68	
Spiny Lobster	Stayers	139	2.44	9.41%
	Leavers	40	2.10	

**P* values derive from two-sample, one-tailed *t* tests. *F* tests for equality of variances (5% critical value) resulted in the use of *t* tests assuming equal variances in all four fisheries.

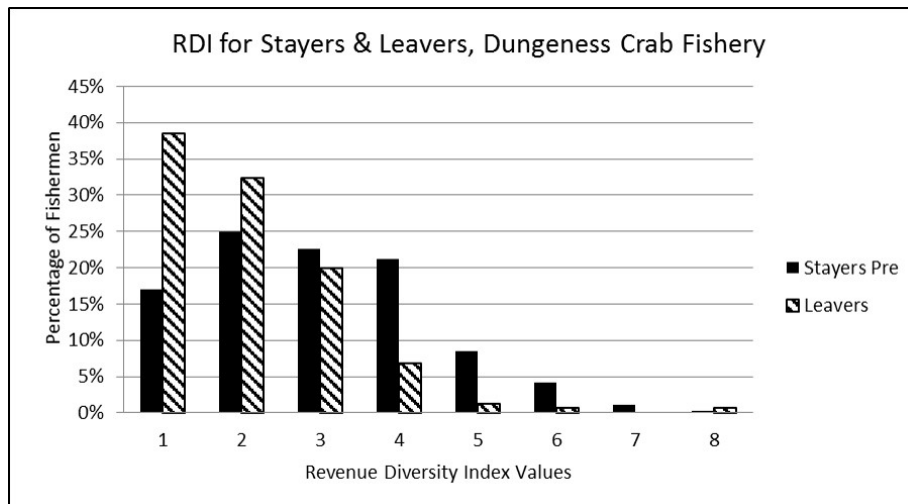


Figure 1.

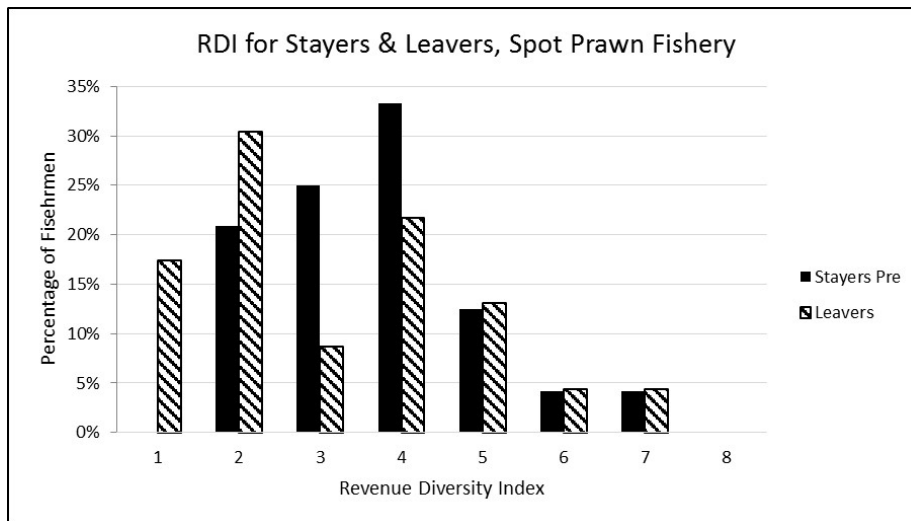


Figure 2.

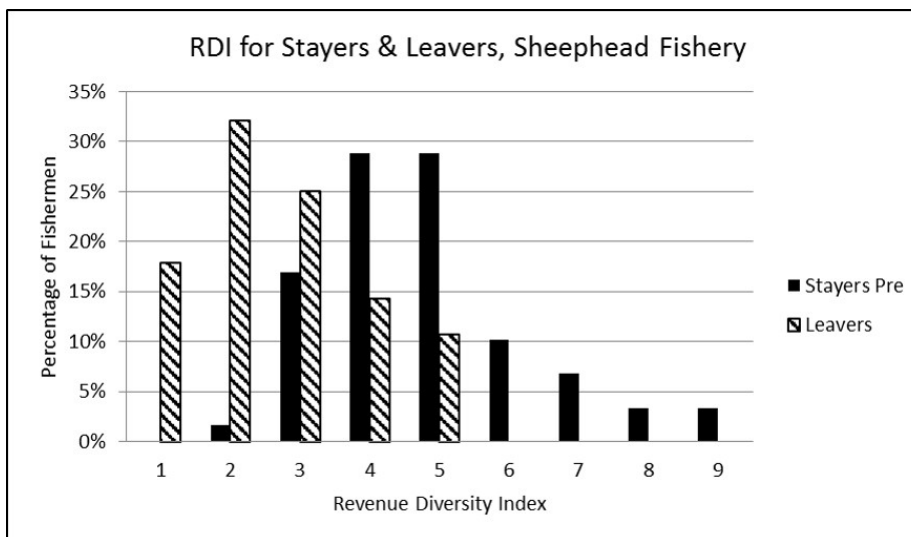


Figure 3.

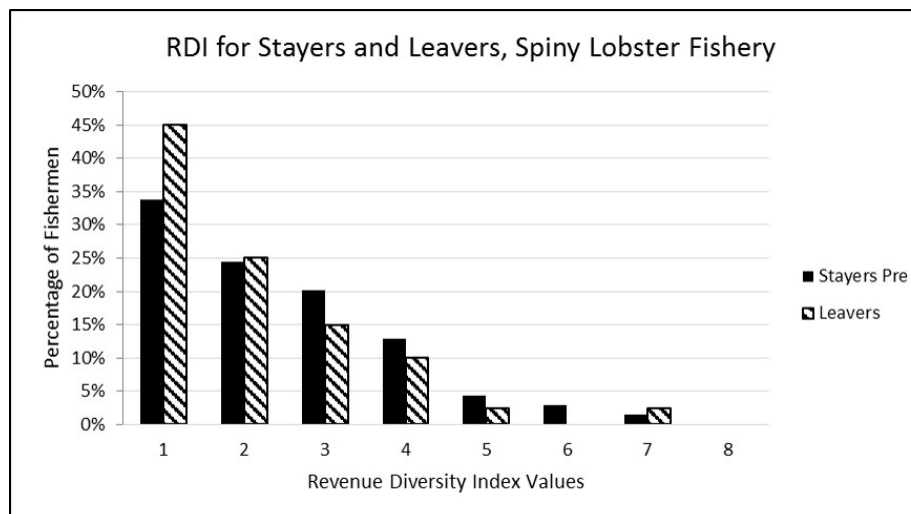


Figure 4.

We find consistent support for stayers having greater fishing revenue diversity, with mixed results for significance. Multi-fishery participation is consistently associated with stayers who persist in commercial fishery participation following a restrictive regulatory event.

Additional insight into differences in multi-fishery participation and revenue diversity across stayers and leavers can be gained by looking at RDI density plots for the two groups in the period prior to regulation. Density plots for each fishery show the distribution of RDIs for stayers and leavers in the five-year period prior to imposition of regulation (Figures 1 through 4).

From the density plots we can see that some leavers had relatively high RDI values, and some stayers had relatively low RDI values. Clearly revenue diversity is not the only attribute distinguishing stayers from leavers. Some fishermen with high revenue diversity may nevertheless exit a fishery due to age, health, or outside work opportunities, among other reasons. Likewise some stayers may focus on a single fishery due to prices, abundance, fishery-specific skills, or outside income, among other reasons. Nevertheless, in each of the four fisheries prior to the regulatory event, a higher percentage of leavers participated in either a single fishery or at most two fisheries. Moreover, in each of the four fisheries a larger percentage of stayers were diversified into three or more fisheries prior to the regulatory event. The difference in the distribution of RDI values for stayers and leavers from the density plots is strongest for the Dungeness crab and the sheephead fisheries, which is reflected in the *t* test significance levels, though this difference is clearly discernable for all four fisheries.

Do Stayers Have More Stable Fishing Income? We now turn to the hypothesized attribute that stayers will

TABLE E
 Tests of Hypothesized Revenue CV Attribute

Fishery	Groups	Sample Size	Mean Revenue CV	P Value, Difference in Means*
Dungeness Crab	Stayers	363	0.542	< 1%
	Leavers	161	0.700	
Spot Prawn	Stayers	24	0.387	< 1%
	Leavers	23	0.618	
Sheephead	Stayers	59	0.441	< 1%
	Leavers	28	0.633	
Spiny Lobster	Stayers	139	0.478	< 1%
	Leavers	40	0.767	

*P values derive from two-sample, one-tailed *t* tests. *F* tests for equality of variances (5% critical value) resulted in the use of *t* tests assuming equal variances in all but the sheephead fishery, where the *t* test assuming unequal variances was used.

have a significantly lower coefficient of variation (CV) for gross annual fishing revenue than leavers, for the five-year period prior to imposition of regulation. Results for each of the tests are shown in Table E.

We find strong and consistent support for the hypothesized attribute that stayers will have a lower CV for their fishing income. From Table E, one can see substantially lower CVs for gross annual fishing income for stayers relative to leavers in all four fisheries for the five-year period prior to imposition of regulation. All test results were significant at below the 1% level. These findings are consistent with the idea that low interannual fishing income variation reduces economic stress on the households of commercial fishers, and thus would be associated with economically resilient stayers capable of sustaining participation in a commercial fishery following a regulatory event that attenuates fishing opportunities.

Figure 5 shows mean coefficients of variation (CV) in gross annual fishing income for stayers-pre, stayers-post, and leavers. The mean CV for gross annual fish-

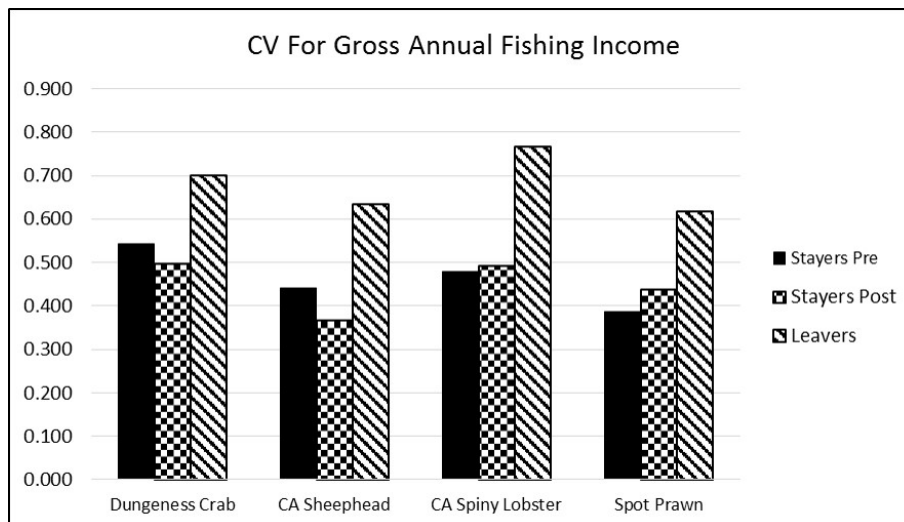


Figure 5.

TABLE F
Tests of Hypothesized Gross Annual Fishing Income Attribute

Fishery	Groups	Sample Size	Mean Gross Annual Fishing Income	P Value, Difference in Means*
Dungeness Crab	Stayers	363	\$52,223	< 1%
	Leavers	161	\$16,239	
Spot Prawn	Stayers	24	\$111,751	11.9%
	Leavers	23	\$86,134	
Sheephead	Stayers	59	\$61,042	< 1%
	Leavers	28	\$27,875	
Spiny Lobster	Stayers	139	\$32,407	21.47%
	Leavers	40	\$26,379	

*P values derive from two-sample, one-tailed *t* tests. *F* tests for equality of variances (5% critical value) resulted in the use of *t* tests assuming unequal variances in all but the spot prawn fishery, where the *t* test assuming equal variances was used.

ing income for leavers consistently exceeds that of both stayer groups in all four fisheries.

It is also notable that there is no consistent longitudinal pattern to changes in mean CV for gross annual fishing income for stayers before and after the regulatory event. Post-event mean CV of stayers declines for the Dungeness crab and sheephead fisheries (paired two-sample *t* test for difference in means is significant at the 5% level), but increases for the spiny lobster and spot prawn fisheries (though these slight increases are not significant at even the 10% level).

Do Stayers Have Higher Gross Annual Fishing Income? We now turn to our last hypothesis, which is that stayers will have significantly higher gross annual fishing income than leavers. Gross annual fishing income is calculated by summing ex-vessel revenue from all landings receipts for a given fisherman in a particular year. Results are given in Table F. Note that as with the

earlier analysis, the stayer and leaver samples draw from the five-year period prior to the regulatory event.

We find a consistent pattern of stayers having a larger mean gross annual fishing income than leavers. Moreover, as with the fishing revenue diversity attribute, the significance of these differences in mean gross annual fishing income is mixed. In two fisheries (Dungeness crab and sheephead) this difference in mean gross annual fishing income across stayer and leaver groups is significant at below the 1% level. In the other two fisheries (spot prawn and spiny lobster), the difference in mean gross annual fishing income across stayer and leaver groups is not significant at the usual 5% level.

Figure 6 shows mean gross annual fishing income for stayers (pre- and post-event) and leavers. One can see that mean gross annual fishing income for stayers consistently exceeds that of leavers in all four fisheries. It is also notable that there is a consistent longitudinal pattern of higher mean annual gross fishing income for stayers during and after the regulatory event relative to before the regulatory event. Paired two-sample *t* tests for difference in mean gross annual fishing income for stayers before and on/after the regulatory event are significant at the 5% level in all four fisheries. Consolidation of commercial fishing activity following exit of leavers resulted in higher mean gross annual fishing income for the stayers who were more resilient to regulatory change and were able to sustain active fishery participation.

The Challenge of Participating in Multiple Fisheries

There are a number of factors that may affect a fisher’s capacity for participation in multiple fisheries. One

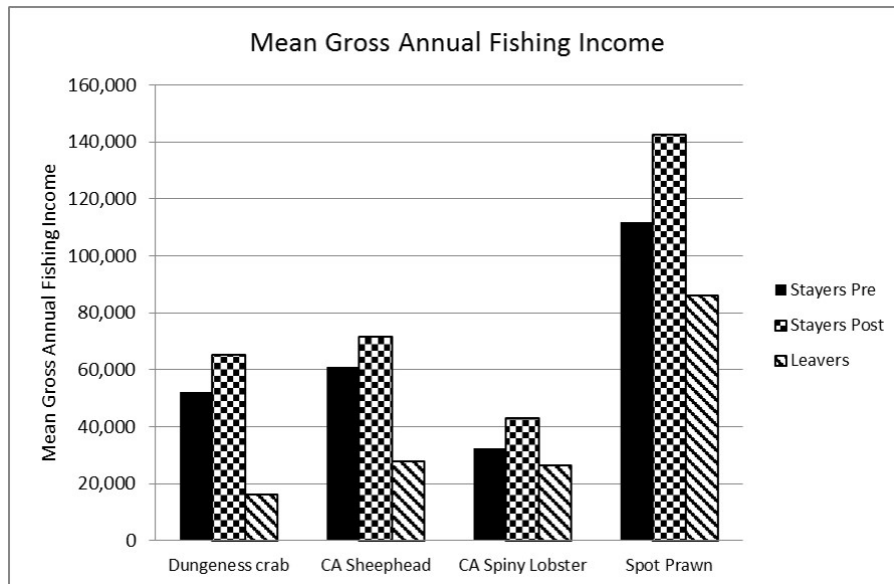


Figure 6.

of these is the extent to which capital (vessel, gear, and human capital) is transferable from one fishery to another. Hutchinson (2003) notes that similar fishing inputs (e.g., gear, vessel, and crew), along with complementary fishing seasons, allowed fishers to participate in multiple fisheries. All four of the fisheries analyzed in this paper are trap fisheries. It should be noted, however, that Dungeness crab, CA sheephead, CA spiny lobster, and spot prawn require different trap configurations in terms of mesh size, escape and entry port size, and location in order to reduce the incidence of bycatch (NOAA 2012). As a result, trap inputs from one fishery cannot be repurposed for another fishery. Although fishery gear is not amenable to transferability, a given vessel configuration can facilitate participation in a variety of live trap fisheries. Stayers who participate in multiple trap fisheries own trap gear unique to each fishery, and simply swap one type of gear out for another (pers. comm. Lia Protopapadakis 2014).

Transferable human capital—skills and experience associated with deploying different types of trap gear and handling different types of live fish and crustaceans—is another important factor associated with participation in multiple fisheries. Durrenberger and Palsson (1983) describe how success can be attributed to a fisherman's expert knowledge gained from experience and active engagement with the environment (Palsson 1994). This would extend beyond fishing into market channel relationships, as reflected by ready access to receiver/processors, direct-to-consumer, fisherman's markets, restaurant accounts, and other channels that can absorb a variety of live species of fish and crustaceans.

Though a substantial proportion of the study's fishermen participate in multiple fisheries, it is not as simple as swapping out one gear configuration for another to meet other target fisheries needs. Many fisheries are under a restricted access, or limited entry, program. Such programs restrict the number of participants by limiting number and size of vessels, necessitating permits, requiring specific gear, or imposing harvest rights such as a quota system. Responding to an upcoming regulatory event by participating in additional fisheries may thus require access to financial capital to acquire limited access permits. Therefore restricted access programs may make it difficult for fishermen to participate in multiple fisheries and can prevent fishermen from making the best strategic choices (Dory Associates 2009).

Participation in multiple fisheries may also be affected by the timing of fishing seasons (Dory Associates 2009). While the Dungeness crab season extends into July, the great majority of landings occur in the first four to six weeks of the season opening (Deweese et al. 2004). Consequently, fisheries with derby characteristics and with temporally conflicting season openings can make multi-

fishery participation difficult. The CA spiny lobster fishery has a long closure period. Fishers participating in the spot prawn or CA sheephead fisheries can enter and exit the CA spiny lobster fishery and thereby enhance annual fishing revenue and more fully utilize vessel and related capital.

Spatial considerations are another factor associated with participation in multiple fisheries. For example California's commercial Dungeness crab fishery is located primarily in northern California (and to a limited degree central California). As a result fishers targeting Dungeness crab tend to have home ports in northern California and face considerable transit and other costs if they seek to participate in the more southern California fisheries of CA sheephead, CA spiny lobster, and spot prawn. Instead, fishers targeting Dungeness crab traditionally fish other northern California fisheries that have complementary seasons such as salmon and groundfish. The southern California CA sheephead, CA spiny lobster, and spot prawn fisheries are spatially proximate and share compatible production linkages such as vessel and captain/crew inputs that allow those fishermen to participate across those fisheries (Hutchinson 2003).

The California Marine Life Management Act (MLMA) has as one of its goals to provide for the long-term interests of fishing-dependent individuals, minimizing adverse impacts through regulatory actions. Our findings point to multi-fishery participation as one potential approach to complying with this goal, as diversity in fishery participation and diversity in marketing arrangements and strategies may be the best solutions to weathering reduced fishing opportunities and other shocks to income. The problem that arises from this is that regulatory hurdles are high, attention to factors with regard to the resource may not be considered, and cooperative efforts among fishermen may not be sustainable. Additionally, the strategies are not always adaptable in certain environmental contexts (Tough 1999).

In spite of the complexities associated with a multi-fishery approach to minimizing negative impacts to fishermen, there are several options that the state of California could take in order to comply with the goal of the MLMA outlined above. It could be effective for managers to promote a more collaborative approach, wherein regularly held meetings would be convened with fisheries participants that would take into account needs linked to multi-fishery participation. There is evidence that such a collaborative management approach with practical input provided by fishers may have fruitful outcomes (Cinner et al. 2012). Through this process, deficiencies of information flow could be determined, as well as concerns regarding permits, access, and opportunities that may otherwise be largely unknown. A centralized web-based location clearly outlining regulations

for both market-integration (e.g., direct sale) and fisheries permits throughout the state, perhaps with a specific focus on typical multi-fishery combinations, would help consolidate information and eliminate confusion that often leads to frustration and inertia.

Ethnographic data gathered as a different component of our research revealed that as a result of the many regulatory, environmental, and market-based challenges faced by the commercial fishing sector, and the perceived subsequent decline in job satisfaction and general well-being, many fishermen indicate they are unlikely to promote entering the industry to their children, and new entrants are decreasing. State management could alleviate the pressures associated with an aging fleet through establishing financial incentives and educational opportunities for those wishing to enter commercial fishing. While the California Fisheries Fund is helpful in providing loan assistance to fishermen for permits and gear, a model more akin to that of the Nature Conservancy and the Morro Bay, California, commercial fishermen puts less of a financial burden on fishermen and serves as a longer-term investment in the overall health of not just the fishermen and their communities, but the ecosystem on which they depend.

The Morro Bay model originated when the Nature Conservancy purchased permits for fisheries that were near collapse from Morro Bay fishermen who no longer wished to remain in the fishery. They leased the quota back to the fishermen under the condition that they worked collaboratively to innovate sustainable practices. Given the success of this program (e.g., lowering bycatch, increasing catch of target species), the Nature Conservancy ultimately transferred fishing rights back to the Morro Bay Community Quota Fund that now regulates the quota of groundfish among its members and its collaborative scientific board. These types of “community quota entities” are being tested in various locations in the west, though the initial capital outlay and subsequent management of such models requires participation from people other than the fishermen themselves in order to finance and effectively and sustainably manage activities. When successful, as in the case of Morro Bay, this model has the potential to sustain local fishery access to a consortium of community members. The state of California could contribute to the financing of such a program instead of relying on a private entity to finance these programs that directly benefit the state.

Another approach that could be more widely promoted and financed by the state to facilitate multi-fisheries participation is the cooperative model developed by the San Francisco Community Fishing Association. Here, members of the association who may be permitted to fish for different species individually, collectively benefit in revenue sharing, in effect creating multi-fisheries

participation through cooperative efforts. Due to the fact that many of the high value California commercial fisheries are now limited entry, and that opening these fisheries to more entrants is not a viable option, it appears as though the collaborative models outlined above may have better potential for success.

The goal of this research was to assess the variables that kept fishermen in the industry in spite of shocks to their fishery after a major regulatory event. These types of events occur regularly throughout the country, as new science emerges, access becomes restricted, or fisheries decline. Since many states, including California, have mandates to minimize the adverse effects of such regulatory events on fishermen, managers will be seeking proven alternative models to integrate into the regulatory process. We have explored the importance of multi-fisheries participation as a means for long-term success in the commercial fishing industry, and explained the challenges associated with the realities of such an approach. While there are successful models engaging this multi-fisheries approach operating throughout the state, they have all required collaborative assistance from state and nongovernmental organizations in terms of financing, technology, and operations in varying degrees. With a goal of the MLMA to insure the long-term sustainability of commercial fishing communities, the state would benefit from creating a streamlined process through which individual fishermen and their communities could locate information related to the models outlined here and related regulatory information. In addition, the state could develop partnerships with organizations experienced in implementing these models and actively promote their integration into the current paradigm.

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