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### **Title**

Economic Evaluation of Tradable Property Rights

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### **Authors**

Brandt, Sylvia  
Hanemann, Michael

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**CALIFORNIA SEA GRANT COLLEGE PROGRAM  
FINAL TECHNICAL NARRATIVE**

**PROJECT:** E/MRE-2

**PROJECT LEADERS:**

Sylvia Brandt, Department of Resource Economics, University of Massachusetts-Amherst  
Michael Hanemann, Department of Agricultural and Resource Economics, University of California-Berkeley

**PROJECT TITLE:**

Economic Evaluation of Tradable Property Rights

**SUMMARY:**

Economists have for decades advocated transferable property rights, in which the total annual allowable catch is divided into shares, which are then tradable, as a market mechanism to decrease overcapacity. Tradable property rights, or individual transferable quotas (ITQs), are a significant departure from command-and-control regulations that impose combinations of gear restrictions, season limitations, license limitations and trip limits. While in theory tradable property rights have clear economic advantages over command and control, Federal fisheries managers face the challenge of evaluating and ranking regulatory options in a world of complexity and uncertainty.

The goal of this project is to describe the changes in the composition of the Mid-Atlantic surf clam fishery, which has been regulated with first command and control and then tradable property rights. The data analysis indicates that while there were changes in the structure of the clam industry, the introduction of tradable property rights did not lead to a redistribution of welfare across different types of participants in the industry.

## **BACKGROUND**

Command and control in fisheries have been criticized for inducing serious economic inefficiencies, safety hazards, and detriments to the ecosystems (National Marine Fishery Service, 1996; National Research Council, 1999a). According to the theoretical economic literature, tradable property rights cause the number of vessels in a fishery to decline to the minimum necessary to harvest the annual quota, with the most inefficient vessels leaving the fishery (see Moloney and Pearse, 1979; Clark, 1980, 1982).

A model of predicted production under tradable property rights compared to observed production under command and control shows potential gain in industry level efficiency (Weninger and Just, 1998). Rather than racing for a share of the total catch, ownership of ITQs guarantees a vessel the right to harvest the amount of the quota. Analyses of ex post changes in efficiency (Grafton et al., 2000; Geen and Nayar, 1988) have verified these gains in the *aggregate*. Despite these economic studies of gains in the *aggregate*, the major impediment to the adoption of tradable property rights or other regulatory changes in fisheries is a fundamental debate over how gains from increased efficiency and losses from restructuring will be *distributed across participants* in the industry.

A volatile policy issue is whether certain regulations, ITQs in particular, favor large firms over small firms, often termed "corporatization" of the fishery, thus a social concern is the equity impact of policy change (Copes, 1986). The Magnuson-Stevens Fishery Management and Conservation Act, particularly National Standards Four and Eight, (1996, Public Law 94-264, as amended through October 11, 1996; 16 US U.S.C. 1851) reflect that equity considerations that need to be incorporated in the choice of regulatory instruments ( see also, Karpoff, 1987; McCay, 1995; National Research Council, 1999a and b).

The resolution to this volatile debate will guide the direction of future policies and will have wide-reaching ramifications for resource sustainability. Current research in fishery economics, however, is inadequate to address the impact of regulation on industry composition and equity. The theoretical literature does not distinguish among different types of harvesters (processors [vertical integration], fleets [horizontal integration], and independents [no integration]), and empirical work typically models the behavior of individual *vessels*, not firms. As a result, existing research does not identify the effects of regulatory policies on different types of firms and cannot evaluate the distribution of gains and losses across these participant groups.

### **THE PROJECT**

The policy debate over tradable property rights in fisheries, therefore, centers on the issues of whether and how tradable permits significantly alter the *composition* of the industry from the prevailing structure under traditional command-and-control regulation. Using data that include seventeen years of inputs and outputs as well as firm identifiers this project addresses the central question: Does the composition of the industry over firm type (independent, fleet, or vertically integrated) change in a way that disproportionately favors one type over another? The importance of using a case study to examine this issue is that if there is evidence that ITQs do not inevitably lead to inequitable outcome, then the debate over ITQs should be refocused on how firms adapt their behavior during property rights negotiation and the implications for ITQ design. Second, this case study establishes a second way in which firms adapt their behavior, earning income by leasing their tradable rights but terminating harvesting, a vital sector of the industry that must be included in welfare analyses.

This project provides empirical evidence of the change in composition of the resource industry after transition from command and control to tradable property rights in the Mid-Atlantic surf clam

and ocean quahog fishery. The surf clam and quahog fishery has become a touchstone for debate over tradable property rights versus command and control. Management of the surf clam and quahog fishery has a long history varying from limited access, command and control and rights based management that was precipitated by a crash in the population in the mid 1970s.

The Mid-Atlantic surf clam and ocean quahog fishery was subject to command-and-control regulation from 1979 through 1989 but has been governed by ITQs since 1990. With annual production valued at over \$48 million, the Mid-Atlantic surf clam and ocean quahog fishery provides almost the entire supply for domestic processed clam products (NMFS, 1998). The outputs of the surf clam fishery include canned clam chowder, canned minced clams, canned sauces and juices, and breaded products. After the surf clam population plummeted dramatically in 1976, legislation was enacted restricting allowable fishing time and limiting access for a period of fourteen years.<sup>1</sup>

## **METHODS AND RESULTS**

The data used in this research were compiled from the confidential vessel records of every fishing trip made by every vessel during the years 1980 - 1999. These vessel records are mandated by fishery regulations and are referred to as vessel logbooks (logbook data were provided through a research agreement with the Northeast Fisheries Science Center of the National Marine Fisheries Service). Information contained in the logbooks for each trip includes:

- time spent fishing
- time spent traveling
- fishing location
- fishing port
- quantity of each species caught
- purchasing processor

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<sup>1</sup> These clams grow slowly, live on the floor of the ocean, and do not move. They are clustered in groups known as beds, whose location and density are common knowledge in the fishery, and harvested using hydraulic dredges. They are located off the shores of Virginia, Maryland, Delaware, New Jersey, New York, Rhode Island, Massachusetts, and Maine, with commercial stocks concentrated off the shore of northern New Jersey.

This information of each fishing trip was matched with vessel license records that include vessel characteristics:

- year built
- number and size of dredges
- horsepower of engine and dredge
- gross registered tonnage
- vessel's registered owner

Each registered vessel owner was then matched with its unique firm identifier using a file of true owners. True owners are the decision-making agents that own vessels and decide how to use them.

An individual true owner could own multiple vessels where each vessel could be registered under a different owning corporation. This true owner file, which maps vessels onto individual firms, is crucial to assessing the change in fleet composition over time. The file was originally created by McCay and Creed and was updated in cooperation with McCay using extensive field interviews in the spring of 2000.

### Industry Participation

This section presents empirical evidence of the differences in the surf clam and ocean quahog fishery between the two policy approaches. Overall participation by different types of firms can itself be measured using four sets of indicators: first, the absolute number of active vessels and firms in the industry; second, the distribution of active firms in the industry by type; third, the distribution of the actual harvest by type of firm; fourth, the distribution of ownership of tradable property rights.

The most striking change after the implementation of property rights was the significant reduction in the number of vessels in the industry. Economists typically interpret this rationalization as a social gain based on the assumption that less efficient producers left the industry. In contrast, other observers have portrayed this exit of vessels as evidence of a “forcing out” of industry participants and therefore as a social loss.

Because of the complex nature of vessel ownership, however, counting active vessels greatly overestimates both the number of firms that participated in the industry and the number that then exited from it. In fact, a significant portion of the reduction in active vessels is due to firms' decisions to consolidate harvesting on fewer vessels. Table 1 shows the change in participation within four time periods: command and control without property rights negotiation (1980 - 1983), command and control *with* property rights negotiation (1983 - 1986), transition from command and control to property rights (1986 - 1991), and tradable property rights and restructuring (1991-1999). Participation is measured in three ways: number of vessels active in the industry (Surf Clam Vessels), number of distinct firms harvesting surf clams (Harvesting Firms), and the number of firms involved in the industry either as firms that harvest clams or firms that own (and lease) property rights but do not harvest (All Firms).

As shown in Table 1, there was a notable reversal in trends in the number of active vessels. In the early 1980s, during command and control, there was a contraction in the industry and the number of vessels fell almost 8 percent between 1980 and 1983. This downward trend in number of vessels reversed during the negotiation of property rights in the mid-1980s. Between 1983 and 1986 there was a dramatic increase of 23 percent in the number of vessels. The initial increase in active vessels was a direct result of firms utilizing previously inactive vessels in order to establish a claim under the property rights system. After implementation of property rights, the property right was no longer embedded in the vessel and there was then a dramatic 48 percent reduction of capital in the fishery (from a peak of 146 vessels in 1986 to only 42 in 1999). Over the nine years of tradable property rights, there was a continued decline in the number of vessels harvesting surf clams, declining in total 63 percent from 1991 to 1999.

**Table 1: Change in Participation in Surf Clam Fishery Within Four Time Periods**

	Participation of Vessels	Participation of Firms	
	Surf Clam Vessels	Harvesting Firms	All Firms
1980 - 1983 (C and C, no negotiation)	-7.87%		
1983 - 1986 (C and C, with negotiation)	23.10%	19.05%	
1986 - 1991 (implementation of TPR)	-47.92%	-26%	4%
1991 - 1999 (TPR)	-62.70%	-43.24%	5.77%

Source: National Marine Fishery Surf Clam and Ocean Quahog Logbooks and True Owners file.

From a social equity perspective, however, it is not the number of vessels per se that is of interest, but rather the number of participants in the industry - that is, firms. Measuring the change in the number of vessels shows us how firms change their utilization of capital - for example, increasing capital to gain property rights - but not the social impact on those people for whom the fishery is a business investment. We can see in Table 1 that while many vessels exited the industry after property rights, the total number of firms in the industry reveals a more complex story.

Under command-and-control regulation, vessel owners could participate in the industry only as harvesters. The change in the number of harvesting firms is shown in the second column of Table 1. Between 1983 and 1986 there was a 19 percent increase in number of firms harvesting surf clams, as vessel owners used this opportunity to gain property rights. The number of firms that participated in the industry fell 26 percent from 1986 to 1991 and 43 percent from 1991 to 1999. Although this decrease in number of firms is far less than the decrease in number of vessels, it, too, overstates the exit of firms from the industry.



Since the implementation of property rights, some firms have made a transition from harvesting clams to a new business model where they no longer harvest but instead generate revenue by leasing property rights to harvesting firms. Thus, the decrease in the number of harvesting firms has not resulted in a significant decline in the total number of firms in the industry. As the last column of Table 1 shows, there has actually been an increase of almost 6 percent in the number of distinct participants in the industry, including both harvesters (who may own property rights) and property rights owners who do not harvest.

Analyses examining only the change in the number of harvesting vessels miss important shifts in the way firms participate in the industry. Using just the number of vessels - without matching those vessels to their owners - estimates only the change in capital in the industry, not the change in the number of participants. Such analyses not only ignore the question of fairness of alternative policies, but also produce social welfare estimates that are likely to be misleading.

#### Composition of Industry by Firm Type

Firm type is critical for understanding the impact of regulatory change on industry structure. Firms that own one or two vessels and are not vertically integrated with the processing sector are defined as independents; firms with three or more boats that are not vertically integrated are defined as fleets; and firms that harvest clams and are vertically integrated are defined as processors.<sup>2</sup> The impact of regulatory change on the type of firms in the industry is illustrated in Figure 1, which shows the change in the distribution of firms over time. The solid gray area is the number of independent harvesting firms, which increases in the mid-1980 and rapidly decline after 1990. The white area is the number of firms that are horizontally integrated harvester (fleet). The number of vertically integrated harvesters (processors) is represented by the solid black area. The annual total number of harvesting firms is then the total of these three areas for the respective year. The figure

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<sup>2</sup>Conflicts among types of harvesters existed in almost every management discussion (McCay and Creed, 1990).

shows an upward trend in the number of harvesting firms during property rights negotiations and a decline after actual implementation of property rights. In 1983, 74% of harvesting firms were independents, 10% were fleet owners, and 16% were vertically integrated firms. By 1999, this distribution of *harvesting firms* had shifted to 57% independents, 19% fleet owners, and 24% vertically integrated firms – giving the appearance that independent firms had been “forced out” of the industry by fleet owners and vertically integrated processors. Looking at the composition of all firms in the industry (including both harvesters and former harvesters who now leased their allocations), however, yields a different picture.

The number of allocation firms is the shaded area between the lines beginning in 1990. Allocation only firms are those firms that own allocation but do not harvest. These allocation only firms consist mainly of independent firms that discontinued harvesting after receiving tradable property rights (gray patterned area). A smaller segment of allocation only firms are processors that own property right but do not harvest (black patterned). The allocation-only firm is reflects a new sector in the fishery after 1990, and the number of independent allocation only firms grew substantially from 1990 through 1999. Thus the decline in the number of independent harvesting firms (gray area) is significantly offset by the growth in independent allocation-only firms (gray patterned area). In 1999, the distribution of *all firms* in the industry was 80% independents, 7% fleet owners, and 13% vertically integrated firms.

Under tradable property rights, firms participate in the industry both as harvesters and as allocation owners; looking only at the number of active vessels overstates the exit of firms from the industry and gives a distorted picture of the effect of regulatory change on industry structure. Figure 1 illustrates that this institutional change was particularly important to the independent firms. The allocation only firms, which are dominated by formerly independent harvesters, are a crucial

component of the entire fishery and policy evaluations must incorporate this sector for a complete picture.

One of the arguments made against ITQs has been that catch and revenues would become concentrated in the hands of the largest harvesters. Analysis of the surf clam fishery shows that this has not been the case. The distribution of the annual harvest across firm type demonstrates that for both clam species, the share harvested by independents has actually grown under ITQs (Figure 2). Central to the equity issue is the change in the distribution across firm types. Figure 3 shows the distribution of property rights ownership across firm types when first allocated (1990) and the last year for which data are available (1999). The four categories of ownership are: independent harvesters who own quota, fleet owners (horizontally integrated), processors, and allocation only (firms that own quota but do not harvest). First, the share owned by processors has significantly decreased from 42 percent to 29 percent. Likewise, the share owned by independent harvesters has declined, from 26 percent to 13 percent.

Of particular interest is the increase in the property rights owned by allocation-only firms (consisting of independents firms and vertically integrated firms that that discontinued harvesting but retained property rights). The change in the distribution of ownership of property rights from 1990 to 1999 is primarily due to the dramatic shift of independent harvesters to this sector. In fact, it is this class of firms that grew the most from 1990 to 1999, increasing its share from 6 percent in 1990 to 39 percent. Any analysis of the impact of regulatory change must incorporate this new sector or risk mischaracterizing the transitions in the industry.

## **CONCLUSION**

The objective of this project was to explore a critical question at the heart of the current debate over tradable property rights: Are the economic gains from property rights unfairly

redistributed from one group to another? To explore this question, there is no better place to look than the surf clam industry, which was the first U.S. marine fishery to undergo the transition from command-and-control regulation to individual transferable quotas. On balance, the claim that ITQs unfairly harm “small” fishermen, forcing them out of the fishery to the benefit of larger fleets and vertically integrated processors, is not borne out by the evidence.

Empirical analysis yields insight into the aspects of the industry that differed between command and control and ITQs. First, the pronounced decline in the number of active vessels in the fishery masks the fact that far fewer *firms* actually exited the industry; focusing on the actual economic actors involved shows considerably less socioeconomic dislocation than is implied by vessel-level observations. Second, the share of harvesting firms that were independents, as well as the share of actual harvests taken by those independents, were not adversely affected by the change in regulatory policy, providing more evidence that small fishermen were able to maintain or even expand their economic importance in the fishery. Third, while property rights owned by independent harvesting firms have decreased over the 1990 – 1999 period, this decrease is due to the emergence of the allocation-only firms, largely consisting of previously independent harvesters. Finally, analysis of firms that exited the fishery entirely shows that the *type* of firm choosing to exit did not change from the period of command-and-control regulation to the period of ITQs. Together, these results demonstrate that the introduction of tradable property rights did not lead to a redistribution of welfare across different types of participants in the industry.

It is a long way from economic theory to economic results, and this is especially true when the mechanisms of regulatory policy necessarily intervene. The strategic actions of well-informed economic actors play a major role in dictating whether, how, and for whom the benefits envisioned by economists, politicians, and regulators are achieved. The experience of the surf clam and ocean

quahog fishery shows that tradable property rights can ultimately achieve their goals of efficiency without sacrificing equity, but how these goals are reached depends crucially on the way in which property rights are implemented, interpreted, and exploited by the various parties involved.

## **PRESENTATIONS AND MANUSCRIPTS**

Results from this project were presented at the Second World Congress of Environmental and resource Economists in June 2002, Annual Conference of European Association of Environmental and Resource Economists in June 2003 and the American Agricultural Economics Association Meetings in July 2003.

Manuscripts under review include:

Sylvia Brandt. "Evaluating Tradable Property Rights for Natural Resources: The Role of Strategic Entry and Exit."

Sylvia Brandt. "Equity Versus Efficiency: A Comparison of Two Regulatory Approaches to Natural Resources"

Sylvia Brandt. "A Tale of Two Clams: Policy Anticipation and Industry Productivity"

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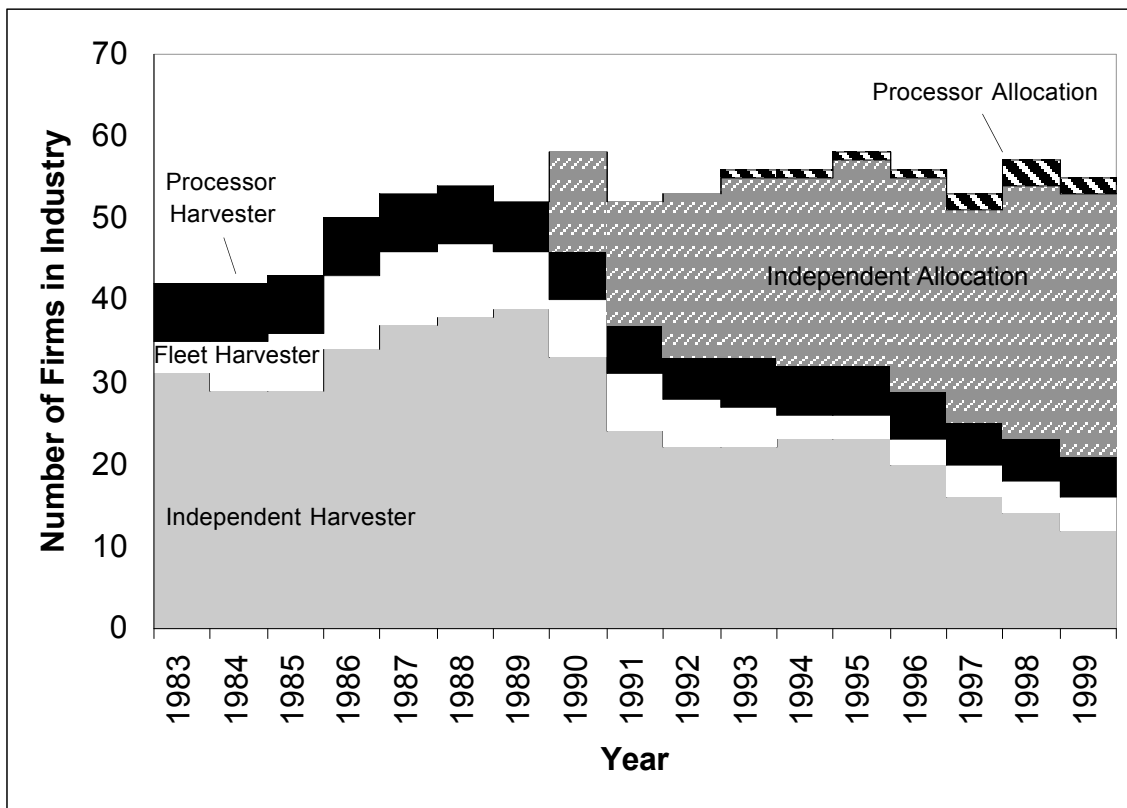
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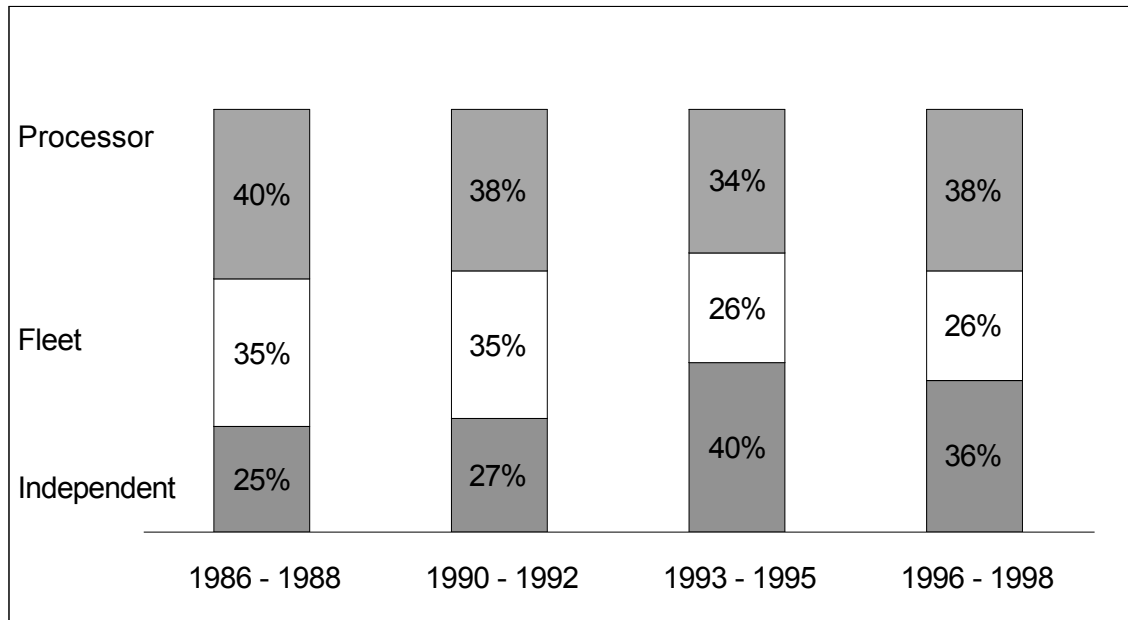
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**Figure 1: Total Participation in Industry by Firm Type**



Source: National Marine Fishery Surf Clam and Ocean Quahog Logbooks and True Owners file.

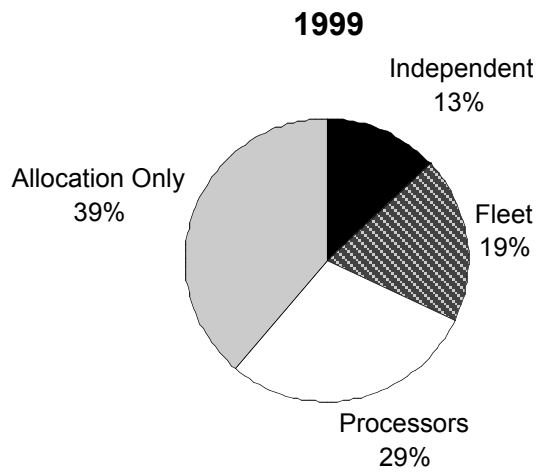
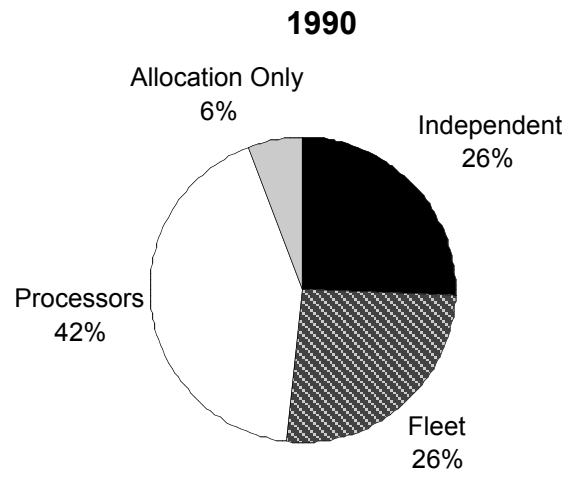
**Figure 2: Share of Surf Clam Catch by Firm Type**



Source: National Marine Fishery Surf Clam and Ocean Quahog Logbooks and True Owners file.



**Figure 3: Distribution of Property Right Ownership Across Firm Type, 1990 and 1999**



Source: Mid-Atlantic Fishery Management Council Surf Clams and Ocean Quahog Allocation Annual Records and True Owners