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Wreckfish Economic and Resource Information Collection with Analysis for Management

**A report by E. J. Richardson Associates,
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Executive Summary

A study was made of the economics of wreckfish harvesting during the transition to a transferable-harvesting-rights-based (ITQ) fishery management program. The goal of the study was to establish a data baseline that could serve as a foundation for subsequent monitoring and assessment efforts. Vessel costs and returns data was assembled for thirty-seven vessels, seventeen of which provided 99.9% of wreckfish landings during the initial year of rights-based management. The data collection allowed for the measurement of the economic values generated by the harvesting sector during the transition to ITQ management, and an evaluation of the initial functioning of the markets for harvesting rights.

It was found that the transition to wreckfish ITQ management was accompanied by an effort and landings shortfall of about 33% and 40%, respectively, when compared with fishery conditions during the final year of open access. Analysis of the costs and returns data indicated that fishery rent during the initial year of ITQ management was likely about \$350,000, and may have exceeded \$400,000, with the difference depending on the values chosen for the opportunity costs of investment capital and harvesting labor. The entire fishery rent value was found attributable to the comparative advantage of some vessel owners for the low-cost production of wreckfish landings, and so the value was considered to represent "highliner" rent, and not rent due to the existence of the wreckfish resource.

The markets for wreckfish percentage shares and individual quota coupons were also analyzed. Fishery percentage shares represent freely transferable indefinite harvesting rights while individual quota represent annual harvesting rights transferable only among the owners of percentage shares. Here it was found that during the initial year of ITQ management, percentage share exchanges transferred rights for about 550,000 lbs. of wreckfish landings at an average value of \$0.51/lb., and through October of the second season of ITQ management, rights for an additional 310,000 lbs. were exchanged at an average value of \$0.61/lb. These transactions indicated a gross value for wreckfish harvesting rights of about \$920,000 during the initial year of ITQ management, and an annual rate of increase in the asset value of harvesting rights, not including lease income, of about 20%. Rights demanders were vessel owners that received percentage shares smaller than their landings during the final year of open access, and share sellers were primarily vessel owners that had left the fishery prior to the start of the ITQ program.

For the annual quota market, exchanges during the initial year of ITQ management transferred harvesting rights for about 218,000 lbs. of wreckfish, with coupon prices near \$0.25 at the beginning of the season and about \$0.10/lb. at the end. As for the percentage-share market, the annual quota market was motivated by the demands of vessel owners with initial fishery shares smaller than historic landings levels. Quota prices reached low levels at the end of the season due to the exhaustion of the harvesting capacity allocated to the fishery, and the ability of some demanders to substitute the purchase of percentage shares for quota coupons.

To evaluate the functioning of the market for percentage shares, the present value of recent vessel net revenue experience was compared with the prices paid for harvesting rights. Although the data did not support an unequivocal assessment of the market, it was concluded that most percentage share exchanges seemed rational in the sense that prices were above share-seller values calculated from recent vessel net revenue experience, and below comparable values for share-buyers. At worst, percentage share prices may have suffered slightly due to the very small number of individuals willing to invest in wreckfish harvesting capacity during the initial year of ITQ management.

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1. Introduction

Fishery economists have proposed harvest-rights based management schemes as a way to improve the management of fisheries since at least the early 1970's (Christy 1973). One reason for this is that it is possible to show using simplified analytical models that an appropriately designed harvesting-rights-based management scheme is capable of generating and valuing the full economic benefits from fishing (Maloney and Pearse 1979, Arnason 1989). Muse (1991) has provided evidence that the rate of adoption of rights-based fishery management schemes increased during the 1980's, and according to Sutinen et al. (1992) there were recently at least thirty-seven programs world-wide that made use of some form of harvesting-rights-based system to manage fisheries. As one might expect, harvester interest in rights-based management programs has also increased (Fee 1990, Brio 1992).

Given the apparent trend toward rights-based fishery management schemes, and because analytic economic models are rarely representative of even the simplest of real world systems, monitoring and assessment of the accomplishments of rights-based programs will be required before their place in the evolution of fisheries management can be established. Monitoring and assessment studies can be contrasted with descriptive analyses of rights-based program components and what can go wrong with them (Copes 1986, Muse and Schelle 1989, Muse 1991, Huppert et al. 1992), and with studies that derive conclusions about existing or potential programs primarily from programming models, optimality conditions, and pseudo data (Gilbert 1988, Lanfersieck and Squires 1992, Squires et al. 1993). Examples of recent monitoring and assessment efforts include Geen and Nayar's (1989) study of the southern bluefin tuna fishery, Linder's analyses of quota trading and rent generation in the New Zealand fisheries (Linder 1990, Linder et al. 1992), and Arnason's (1993) study of the evolution of the Icelandic individual transferable quota (ITQ) system.

The wreckfish (*Polyprion americanus*) fishery was chosen for a monitoring and assessment effort because it is a small "single-species-single-gear" fishery with little by-catch and a rights-based management program was implemented only shortly after the fishery was discovered. Although it was recognized that the simple nature of the wreckfish fishery is not typical of other fishery systems (and because of this conclusions drawn from the wreckfish program may not have wide applicability), it was also thought that the same simple features would allow a reasonably accurate assessment of the management program over time. In this regard, the fishery was thought to provide an ideal laboratory within which to measure and test the theoretical constructs which underlie the analyses of rights-based management programs that are typically provided in the academic literature.

It was also expected that monitoring and assessment of the wreckfish fishery would present unique opportunities for measuring the effects of changes in uncertainty on resource values. The reason for this is that very little is known about the natural history of wreckfish and rights-based management followed very closely after the discovery of the fishery. As a result, initial shareholders had only short histories of costs, prices, landings, and experience with scientists and fishery managers on which to base expectations of future availability of wreckfish or future profitability of wreckfish harvesting. Over time this will change, and in particular, it is almost certain that more will become known about the natural history of wreckfish. As new information becomes available, future monitoring and assessment efforts will provide opportunities to determine the payoffs, if any, which may be associated with it.

The goal of this project was to establish a data "baseline" for the wreckfish fishery that could serve as the foundation for subsequent (say every five years) monitoring and assessment efforts. The baseline data and monitoring would be of sufficient detail to allow consideration of questions such as:

Will it be possible to measure social or private benefits that may be attributed to the adoption of a rights-based fishery management program for wreckfish?

What were the sizes of the economic values that may have been preserved via the adoption of a rights-based management program?

How will calculated values for vessel net revenues from wreckfish compare with market prices for wreckfish harvesting rights?

Will investments in stock research or harvesting technology create additional wreckfish economic value over time?

Will more knowledge of wreckfish natural history or harvester experience with fishery managers change the values that private entrepreneurs place on wreckfish harvesting rights, and if so, in what way?

To achieve this goal, the following project objectives were set:

- 1) to collect costs and earnings data from a sample of wreckfish shareholders and develop estimates of the costs, earnings, and rents associated with wreckfish harvesting;
- 2) to analyze the structure of the wreckfish harvesting sector, including the vessel types and fisheries experience of the shareholders, and the extent of their participation in other southeast Atlantic fisheries;
- 3) to assess the initial functioning of the markets for wreckfish harvesting rights; and
- 4) to collect together sufficient additional information so as to allow fishery managers to better anticipate the reactions of wreckfish harvesters to adjustments in the management program.

It was also hoped that achieving the last objective might allow managers to avoid unnecessary wreckfish regulatory costs and perhaps also minimize some of the economic costs of the regulations that will certainly result if current proposals for rights-based management schemes for southeast region deep-water groupers, tilefish, amberjack, and the shallow-water snapper-grouper complex are eventually carried out (South Atlantic Fishery Management Council 1991c).

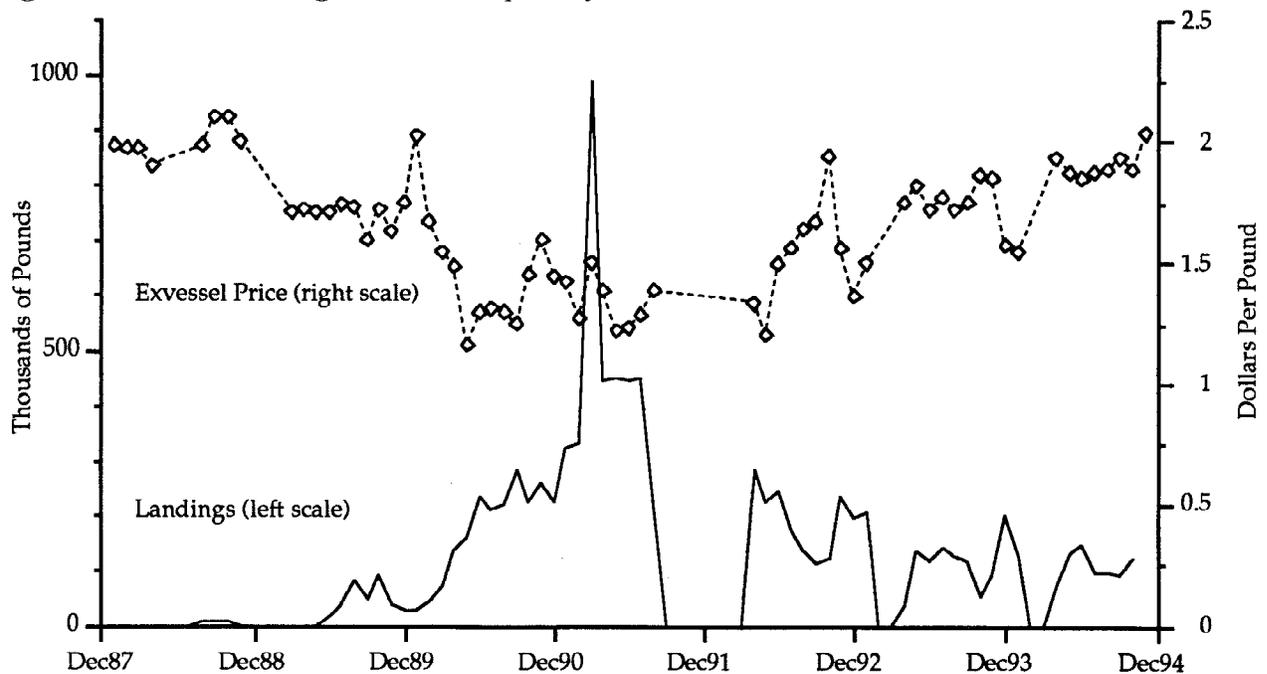
This report is organized along the lines of an academic manuscript. The remainder of the introduction is devoted to describing the development of the fishery and its management regulations. A data and methods section follows, and describes the analytical framework, survey methods, and data sources used to develop the vessel cost and returns data. Results are provided next, and these are followed by some discussion and interpretation.

Fishery Development and Regulatory History

During the mid 1980's Florida tilefish harvesters discovered commercial concentrations of wreckfish on the Blake Plateau, a deep grounds located about 120 nautical miles east of Savannah, Georgia. The initial development of the fishery is described by Sedberry et al. (in press). Wreckfish are most often caught at depths from 1,500-2,000 feet (450-600 m) and over bottom characterized by a rocky ridge system with several hundred feet of vertical relief and slopes in excess of fifteen degrees (Sedberry et al. in press). Although wreckfish can exceed two hundred lbs. in weight, most of those taken from the Blake Plateau weigh just over thirty lbs. (Vaughan et al. 1993).

The fishery was developed by harvesters with traditional southeastern snapper-grouper boats (also used to longline for swordfish and sharks) and shrimp trawlers. Wreckfish fishing gear consists of a hydraulically driven reel spooled with 3/32" steel wire and a terminal rig consisting of a 900 lb. monofilament spine, eight to twelve 600 lb. monofilament gangions with a single circle hook, and a

Figure 1. Wreckfish landings and exvessel price by month, 1987-1993.



“break-away” 20-40 lb. sinker weight. Typically, two, three, four, or five reels are installed on a single vessel and the hooks are baited with frozen squid. To fish the terminal rig in a more horizontal fashion, some harvesters attach the spine and sinker weight to an L-shaped steel rod.

Wreckfish are landed eviscerated and packed in ice. Evidently cold bottom-water temperatures and efficient on-board handling result in a landed product with an uncommonly long shelf life.¹ Eviscerated fish are filleted by secondary processors and sold throughout U.S. east coast markets as grouper or stone bass. Fillet yields from the eviscerated fish are between thirty-five and forty percent, and so wholesale prices must offset a input-to-output material cost inflation of about 2.7.² Although wreckfish fillets may be distinguished from grouper filets in retail markets by their large size, wreckfish is commonly sold as grouper and so competes for consumer seafood dollars with other domestic and imported fresh or frozen grouper.³ Figure 1 shows wreckfish landings and average prices by month since the discovery of the fishery.

In some respects, the initial phase of wreckfish fishery management was similar to other U.S. efforts to regulate commercial fisheries. The fishery developed quickly, expanding from less than five vessels in 1988 to more than forty in 1990 (Sedberry et al. in press). The most rapid increase in vessel numbers occurred during the spring of 1990, and was due to investment in wreckfish gear by the owners of about twenty shrimp trawlers. Some of these vessels entered the fishery because of a six month closure of near shore shrimp grounds caused by very cold weather during December of 1989 (United States 1990a) while others were looking for seasonal alternatives to shrimping during the late winter and spring when catch rates were traditionally very low.⁴

The rapid influx of shrimp trawlers and the concomitant deployment of longlines by many who fished previously only with vertical lines resulted in increased landings and harvester conflicts during the first portion of 1990 (South Atlantic Fishery Management Council 1990). Although a fishery management plan was approved during June of 1990, wreckfish management actually began with a set of emergency rules designed to end the 1990 fishing season as quickly as possible and so “prevent fishing that would seriously interfere with the necessary protection of the wreckfish resource” (United States 1990b,c).⁵ The emergency rules (actually a subset of the measures contained in the management plan) established an

April 16 - April 15 fishing year, a two million lb. commercial quota, and a 10,000 lb. per trip landings limit. As landings approached the two million lb. level very shortly after the effective date of the commercial quota, the fishery was closed August 8, 1990 (United States 1990c)

The initial management plan for wreckfish was approved and became effective during January of 1991.⁶ Although the 1990-1991 season lasted only four months, 3.6 million lbs. of wreckfish were landed during 1990 alone. Compared with 1989, this represented about a 75% increase in landings during an open season only two-thirds as long. Evidently conflicts among shrimp trawlers and fish boats and longliners were common during 1990 (South Atlantic Fishery Management Council 1991a,b), and the high landings rates kept prices at low levels. In addition, the ten-month closure that was ultimately required to protect the resource served to reverse previous efforts to develop reliable year-round market supply linkages for wreckfish.⁷

Management used the time available during the fishery closure to respond to industry testimony about the initial wreckfish management program. Management focus now was on harvester demands for a prohibition longline gear and some form of limited entry program, and industry concern about the possibility of a management-induced "derby" fishery during the 1991-1992 season.⁸ Management quickly announced that several alternative limited entry or "access-controlled" schemes for wreckfish would be developed for public consideration, and to discourage speculative entry into the fishery, an entry "control date" of March 28, 1990 was promulgated (United States 1990d,e).⁹ Management subsequently prohibited the use of longline gear (United States 1991b,c) and proposed a 1991-1992 commercial quota of three million lbs. to be allocated during April 15 - July 15, July 16- October 15, and October 16-January 14, 1992. The latter measure was intended to reduce the possibility of low prices during the 1991-1992 season by decreasing fishing mortality and "stretching-out" the harvest over the entire season.

During the 1991-1992 season, the spawning season closure and prohibition on longline gear yielded a reduced harvest. The expected derby fishery did not materialize, prices improved, and the commercial quota was barely reached.¹⁰ Despite the shortfall in landings, management held hearings and requested comments on a limited entry plan for wreckfish during June of 1991, and during November unveiled a preliminary version of its preferred plan (United States 1991d,f). The new plan identified excess harvesting capacity, potentially increasing levels of harvester conflicts, and low fishery conservation, regulatory compliance, and product marketing incentives as problems along with the increasing costs of management and enforcement and a regulatory spiral that had so far only served to increase fishing costs and reduce economic efficiency (United States 1991f). The preferred plan sought to limit entry by way of transferable harvesting rights.¹¹

A final version of the rights-based plan was implemented in time for the start of the 1992-1993 season (United States 1992b). The plan consisted of a series of measures which defined wreckfish harvesting rights, determined their allocation initially, and required sufficient reporting to make enforcement feasible but not burdensome.¹² Wreckfish harvest rights were conferred as percentage shares of the total allowable catch (TAC) from the fishery and were allocated to historical participants based partially on their history of landings. Percentage shares were issued for an indefinite period and were transferable without restriction. Each year share owners were to receive their harvest rights in the form of annual quota coupons equal in amount to their owned percentage share of the fishery.¹³ Quota coupons were also transferable, but only among percentage-share owners.

The new rights-based management program retained several aspects of the initial wreckfish plan. One of these was the process whereby an assessment group would advise management as to the condition of the wreckfish resource annually (United States 1991a). Management was then responsible for setting the wreckfish TAC. On the basis of the assessment group report, management set a two million lb. TAC for the initial season of ITQ management. The assessment group based its recommendations on evidence that a two million lb. harvest probably would not violate the overfishing threshold and that average size and catch per unit effort had not decreased during the development of the fishery (United

States 1992c).¹⁴ As such, the 1992-1993 season began with forty-nine vessel owners each holding a percentage share of the harvest rights for two million lbs of wreckfish.

Wreckfish landings during the initial season of ITQ management were about 1.4 million lbs. Prices were higher when compared to those during 1991, recovering in nominal terms to levels last seen during 1988. The landings were taken by twenty-one vessels, or about half as many as participated in the fishery during the final year of open access. Markets developed for both percentage shares and quota coupons, and through these markets values were established for wreckfish harvesting rights. Information collected for this study indicates that rights to about thirty percent of the fishery changed hands during the 1992-1993 season, and that the total value of wreckfish harvesting rights at the end of the season was just over \$900,000.

The condition of the resource was reassessed after the completion of the 1992-1993 season as specified by the management plan. A two million lb. TAC was again recommended, and remained in effect throughout the 1993-1994 season. The recommendation was again based on evidence that a two million lb. harvest probably would not violate the overfishing threshold and that average size and catch per unit effort had not changed. Also stated a desire to avoid altering the allowable catch and so minimize the uncertainty associated with industry adjustments to the ITQ management plan (South Atlantic Fishery Management Council 1993a).¹⁵ Through October the second season of ITQ management appeared identical to the first. Preliminary data analyzed below indicates that a nearly identical number of trips produced fishing days and landings that were about five percent higher, and values that were up by twelve percent.

As far as commercial fisheries go, the U.S. fishery for wreckfish has proved unusual in many respects. Firstly, that commercial concentrations of wreckfish were found to exist on the Blake Plateau was unusual as the species was reported previously only occasionally in the western Atlantic (Bigelow and Schroeder 1953). Also, the known grounds are relatively small, evidently about 50-75 nm², and when wreckfish are targeted, bycatch is almost nil (Sedberry et al., in press).¹⁶ These factors, and that all ports of landing are approximately equidistant from the grounds, result in the great majority of wreckfish fishing trips being of an identical nature as regards the time spent traveling to the fishing grounds and the relative share of trip income attributable to wreckfish landings. Finally, the catch of wreckfish has been and remains extraordinarily uniform in size, being made up almost entirely of mature adults within a size range of 30-45 ins. in total length. Astonishingly, mean fish lengths reported for the fishing years 1988-1992 were all between 38 and 39 inches, and mean fish weights ranged from 31.8-34.2 lbs. (Vaughan et al. 1993). This uniformity of size is all the more astonishing when one considers that annual landings during the same period have ranged from about 350,000 - 3,500,000 lbs.!

2. Data and Methods

Analytical Framework

Wreckfish shareowners are small businesses operating with investments in the harvesting sectors of the regional fisheries of the southeastern United States. Today, as with most other business activities, all that is needed to participate in the wreckfish fishery is capital, labor, and time. Capital in the form of vessels, gear, and harvesting rights; labor for management and fishing; and time from a decision about how much effort to allocate to the fishery. Vessel owners must decide how much fishing effort to allocate to wreckfish because the vessels that harvest wreckfish are also capable of supplying effort to other southeast fisheries, and wreckfish shareholders possess substantial experience with many of these other fisheries.

Fishing effort in the regional southeast fisheries consists of an annual series of fishing trips with each trip a series of fishing days or days absent (from port) due to fishing. In addition to fishing time, port time must be allocated between fishing trips to maintain the peak capacity of the vessel, gear, and crew. As a result, say, twenty-nine fishing days may require perhaps six weeks of calendar time. Because of this fundamental feature of fishing, fishing effort is measured in two dimensions — fishing days and calendar weeks allocated to a particular fishing activity. Tracking effort in calendar time is also useful from an economic and regulatory viewpoint as many fixed costs cover stretches of calendar time and many management restrictions on fishing activities refer to calendar time points (for the wreckfish fishery, an annual time maximum of approximately thirty-nine calendar weeks is provided by regulation).

Effort allocations among the multiple fisheries of the southeast region (“fishery switching”) are thought to be driven by vessel owner concerns about expected fishing profits.¹⁷ Choices among alternative effort allocations are constrained by management regulations that may interfere with or prohibit some allocations at certain times. Some general characteristics of the southeast fishing environment now faced by businesses with investments in harvesting capacity include: 1) each decision to make a trip in a particular fishery represents a commitment from a limited number of annual fishing days; 2) although fishery choice and trip duration are typically under the control of vessel management, changing government regulations may render inappropriate decisions planned too far in advance; and 3) the ability to locate a target species quickly when vulnerability is high results in shorter fishing trips, higher rewards, and more decisions about effort allocation.

As fishery shares were allocated to vessel owners, vessels are taken to be the basis of production. However, vessels must be viewed as more certain producers of effort and less certain producers of fish (Anderson 1986). Returns at the vessel level are determined from annual landings and fish prices. Annual landings can be assumed influenced by vessel design characteristics and the skills of the captain and crew, the total days fished and the proportion allocated to the alternative fisheries, and the abundance and vulnerability of southeast fisheries resources. Within this framework, vessel design and crew skill determine relative fishing power, and the product of fishing power and effort provides an index that is proportional to the fishing mortality rate. Accordingly, variation in catch rates results from the general levels of resource abundance and vulnerability and the fishing mortalities that individual vessels are able to achieve within the alternative fisheries.

Each vessel can be described by a U-shaped average total cost of effort curve for wreckfish, and one objective of the information collection was to provide an estimate of fishing costs for all vessels at one point on these curves.¹⁸ Industry-wide aggregates of fishing costs and returns are obtained by adding together the values calculated for the individual vessels. In the short run, the average level of the industry cost of effort curve is determined in part by the general state of harvest technology and in part by the characteristics of the current investment in harvesting capacity. In the longer run, investments in harvest-

ing capacity can change, although these changes may or may not embody new harvest technologies. Given constant technology, it was assumed that, over the longer term, increases in effort can be accomplished with approximately constant returns to scale. As a result, the industry long run average cost of effort could be considered independent of the level of effort.

In theory, the discovery and subsequent harvesting and consumption of the Blake Plateau population of wreckfish created economic values (fishery rents) that can be measured. One of these values, called the resource rent, can be attributed to the simple existence of commercial concentrations of wreckfish on the Blake Plateau. When costs are properly measured, wreckfish rent indicates the value to society of the existence of the resource. Another economic value, called highliner rent (Anderson 1986), arises due to the comparative advantage of some harvesters for low-cost production of wreckfish. This rent is attributable to harvesters because it results from a comparative advantage in the entrepreneurial organization of the factors of production required to bring wreckfish to consumers.¹⁹

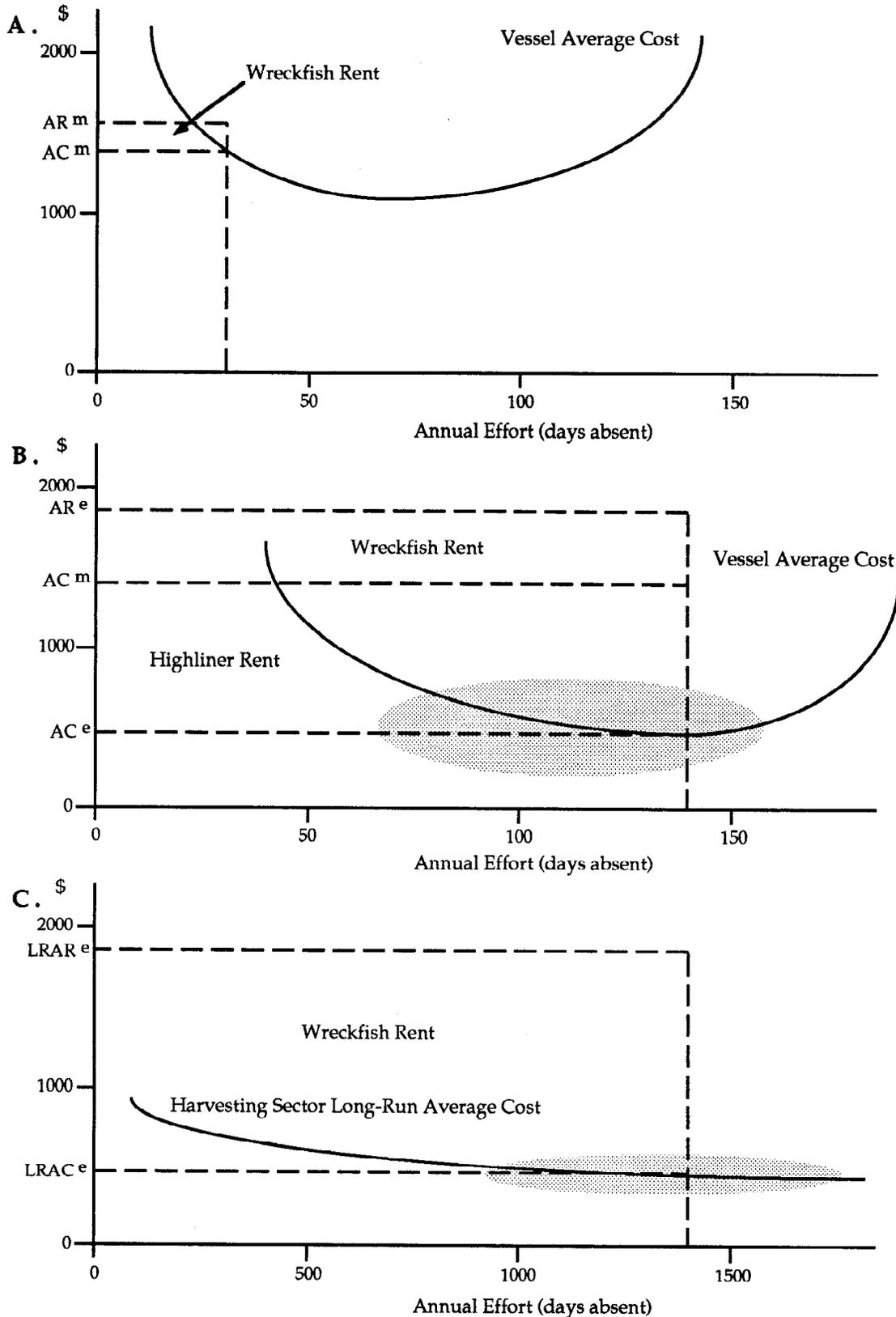
Although harvesters, fishery managers, and the public may be interested in the sizes of the economic values generated by wreckfish harvesting, the measurement of these values is not an end in itself (Anderson 1986). Resource and highliner rents are economic values that "flow" from the fishery for wreckfish. Although each vessel that lands wreckfish is responsible for a portion of these values, the relative contribution of any particular vessel depends on the efficiency levels of all vessels producing wreckfish. Higher rent values indicate that society is doing a better job of allocating its resources among wreckfish harvesting and other productive activities outside of the fishery. In practice, this is accomplished through a more "optimal" investment in vessels and gear. For the wreckfish ITQ management program, rent measurement provides a foundation for an ongoing assessment of the accomplishments of the program. In addition, information obtained to develop the rent estimates may indicate possible program adjustments that could result in larger future rents.

Figure 2 uses the vessel cost profiles and average returns for hypothetical marginal and efficient wreckfish harvesters to illustrate the concepts of resource and highliner rents discussed above. The average cost of the marginal vessel (AC^m) is the reference point for determining the relative sizes of the resource and harvester rents generated by the activities of any particular vessel in the fishery. Resource rents are represented by the rectangular boxes that lie above the horizontal lines labeled AC^m and below the average return lines AR^m and AR^e . Highliner rent is the rectangular box that lies below the AC^m line of Figure 2(B).

As illustrated by Figure 2(A), the hypothetical marginal vessel supplies less than forty days of nominal fishing effort at very high average cost. The average return for a day of effort is relatively low, but above average cost, and so economic value is generated, and this value becomes a portion of the resource rent. Depending on the investment and regulatory history and cost structure of the harvesting sector, the amount of resource rent generated by the marginal harvester may be very small or even negative. The marginal harvester will not produce any highliner rent because by definition highliner rents occur due to vessel comparative cost advantages with reference to the marginal harvester. In other words, highliner rents are generated only by vessels that produce wreckfish at lower cost than the marginal vessel.²⁰

Figure 2(B) shows the cost profile and average returns of the hypothetical efficient wreckfish harvester. As pictured, this vessel supplies in excess of 140 fishing days, produces effort at relatively low cost, and generates relatively high average returns per fishing day. The resource rent produced by the efficient harvester is greater than that of the marginal harvester because more effort is supplied and the average returns from effort are higher. As the efficient vessel lands wreckfish at a lower average cost than the marginal vessel, it generates a highliner rent as well as a resource rent. The size of the highliner rent depends on the amount of effort supplied and its average cost when compared to that of the marginal harvester.

Figure 2. Resource and harvester rents for hypothetical (A) marginal and (B) efficient harvesters, and (C) theoretical harvesting sector long-run average cost.



An important theoretical expectation of ITQ management is that efficient harvesters will eventually purchase the harvesting rights of the less efficient (Maloney and Pearse 1979). Through this process, harvesting rights are expected to migrate to ever more efficient harvesters and, as new investments in harvesting capacity occur, the average cost of the marginal harvester should approach that of the most efficient vessels. As a result, over time vessel cost profiles with regard to wreckfish harvesting activities are expected to become more similar, and may even eventually approach the theoretically convenient fiction of a harvesting sector composed of identical fishing vessels.

Although an eventual progression to largely identical vessels is clearly possible for the wreckfish fishery, it appears unlikely that all vessels that chose to participate in the fishery would supply equal amounts of effort. The reason for this is that, barring regulations designed to prevent part-time harvesting, many vessels harvesting wreckfish would also find it profitable to participate in other fisheries within the southeast region. Hence, over the longer term, it may be expected that the wreckfish fishery will be conducted by vessels operating at cost and effort points within the shaded ellipse of Figure 2(B). Vessels operating within the left-most portion of the ellipse will either be multifishery vessels capable of providing wreckfish effort at low cost but choosing to allocate only a small portion of annual effort to wreckfish, or otherwise efficient wreckfish vessels restricted to low effort levels by forces beyond their control. Vessels that choose to participate full-time in the fishery and are able to produce planned effort levels will operate within the right portion of the ellipse.

If ITQ management expectations are met, and harvest rights move to ever more efficient harvesters via the transfer of harvesting rights, then the changes in vessel cost profiles and average returns that result will alter the relative amounts of resource and highliner rents generated by the vessels. The difference between the sum of these rents before and after share transfers is sometimes called "gains from trade" (Lanfersieck and Squires 1992). Where share transfers eventually allow increased harvesting efficiency, fishery rents would increase and positive gains from trade would be realized. As this process continued, the comparative advantage of those with low-cost landings would be reduced, and economic values previously attributed to highliners would be "converted" to resource rents.

Figure 2(C) shows the general shape of the long run average cost curve for wreckfish effort that is predicted by economic theory and the cost of effort assumptions noted above. Within the context of Figures 2(A,B), it is assumed now that all harvest rights have migrated to equally efficient harvesters with similar vessel cost profiles, no new cost-reducing harvesting technologies are adopted, and resource productivity remains stable and unchanged. In this case, the shaded ellipse of Figure 2(C) indicates possible future points of harvesting sector operation and the rectangular box indicates the resource rent when sector-wide average returns from a day of wreckfish fishing approximate \$1900 and nominal annual effort is about 1400 fishing days.

Finally, the flow-nature of fishery rents and their dependency on the quantity of landings should be emphasized. In other words, a level of harvest effort must result in wreckfish landings and consumption for the fishery to generate a flow of value. In this regard, the ITQ program sets a limit on the maximum potential flow of rent that can be generated by the fishery each year.²¹ Within this maximum, it is the annual level of landings that determines the quantity of fishery rents that is realized from any particular average cost of effort and harvest price environment that may exist. When annual rents are less than the maximum potentially obtainable society experiences foregone economic value. Given that very little is known about wreckfish natural history, it is difficult to know now whether any such forgone value should be considered permanently lost.

Shareowner Survey

The population of wreckfish shareholders at the beginning of the ITQ management program was determined from a shareholder transaction file provided by the NMFS Southeast Region Office. As there were several instances where shares were owned or controlled by the same or related individuals, a

population of "decision-makers" with regard to the supply of effort for wreckfish was constructed from the population of initial shareholders. This population of decision-makers was sent a letter describing the nature and purpose of this study during March of 1993. A preliminary survey questionnaire was then developed with the assistance of South Atlantic Fishery Management Council and National Marine Fisheries Service economists. The preliminary questionnaire was tested on several wreckfish harvesters in Mayport, Florida during July of 1993, and a final version was used to collect information from fishery shareholders during July-November, 1993. The survey questionnaire was completed during an in-person interview that typically was of about one and one-half hours duration.

Shareholders were told, both in the contact letter and at the beginning of the interview, that the purpose of the study was to collect "baseline" economic data on the ITQ management program. During the interview, shareholders were asked to provide answers to questions about: 1) their fisheries experience and proportion of household income due to fishing; 2) the organization of their wreckfish harvesting operation and the nature of the vessels and gear used to catch wreckfish; 3) the fixed and variable costs of wreckfish harvesting; 4) their investments in fishing vessels and gear; 5) how they would allocate fishing effort if they could not go fishing for wreckfish; and 6) their activities in the markets for percentage shares and quota coupons. The survey questionnaire is attached as Appendix A.

The questions included in the survey resulted from a trade off between interview length and the collection of economic data on fishing activities for species other than wreckfish. In this regard, the survey did not include any questions about the fishing days, variable costs, or incomes associated with vessel operations in other southeast fisheries. Instead, linkages between the wreckfish fishery and other southeast fisheries were quantified by recording the calendar time allocations of the vessels to alternative southeast fisheries and through questions about shareholder fisheries experience and how vessel fishing effort would be allocated if it were not possible to go fishing for wreckfish.

Two versions of the study questionnaire were produced: one for shareholders with wreckfish landings during the initial year of ITQ management, and one for shareholders without landings during 1992-1993. For shareholders that landed wreckfish during 1992-1993, January 15, 1992 - January 15, 1993 was defined as the survey year. Survey years for shareholders without ITQ landings were defined as the comparable period during the most recent season when fishing effort was allocated to wreckfish. The different survey years allowed for the collection of cost data from a larger sample of vessels and a comparison of the revenue and cost experiences of shareowners who chose to fish for wreckfish during the initial year of the ITQ program and those who did not.

The survey versions also differed in the structure of the questions concerning effort allocations in the absence of wreckfish harvesting. In particular, to determine how shareowners with landings during 1992-1993 would reallocate effort, these shareholders were asked a series of hypothetical questions about how they might adapt to a disruption in their fishing activities (Appendix A, section 8). The main features of the hypothetical questions were taken from a study of west coast fisherman labor markets by Wilen and others (1991). As shareholders without landings during 1992-1993 actually had reallocated the time used to produce wreckfish effort, these individuals were asked questions about their fishing activities during the periods previously allocated to wreckfish harvesting.

The information obtained from the shareholder interviews was supplemented with several National Marine Fisheries Service (NMFS) data files. These were the wreckfish vessel logbook and permit data files for 1991-1993, the wreckfish dealer report and permit data files for 1992-1993, and the shareowner transaction data file. The NMFS refused to provide the quota coupon cancellation files and the landings receipts data used to determine shareholder wreckfish landings during 1987-1990. NMFS refusal to provide this data likely resulted in less accurate estimates of cost and returns experiences for shareholders who chose not to fish for wreckfish during 1992-1993 than would have been the case otherwise.

Harvesting Cost Calculations

The total cost of wreckfish effort was calculated by adding together vessel fixed costs and the variable costs of the wreckfish trips. Vessel fixed costs included those for maintenance and depreciation, insurance, dock fees, loan payments, business services and taxes, and a return on vessel equity. Trip costs included costs for fuel and oil, bait and ice, lost tackle, packing, groceries and labor.²² Because all vessel owners used some type of share system to determine labor payments, the amounts calculated for these payments depended on the amount of vessel income from wreckfish and share system used (Sutinen 1979). In just about all cases, suppliers of fishing labor were independent contractors.

Some of the analyses presented below describe economic phenomena motivated by the business decisions of private entrepreneurs while others, in contrast, calculate economic values of purely public or social interest. As a result, harvesting costs were considered both from the perspective of a private entrepreneur and from that of society. In particular, the markets for wreckfish harvesting rights were analyzed with cost information calculated from the perspective of the fishery shareholder while resource and harvester rents were calculated using costs as measured from a social perspective. The different perspectives on harvesting costs are noted here because appropriate methods for calculating fishing labor and capital assets costs depend on the cost perspective used, and these alternative cost calculations are described now.

The harvester interviews provided some insight into the investment-decision framework used by vessel owners within the southeast region, and this framework was used to guide the calculation of vessel fixed costs from a shareholder perspective. Briefly, the harvester interviews provided evidence that vessel owner-operators and managers preferred self-employment in the commercial fisheries and viewed equity positions in fishing vessels as desirable (here the term vessels includes also the fishing gear). As such, owners seemed to consider annual vessel depreciation costs as only the expenditures required to maintain the vessel in working order, and attached little economic weight to residual vessel value in any particular year. Harvesters noted that vessel values were more important when considering decisions to replace a vessel or leave commercial fishing. In the former case, residual vessel values typically formed the basis of a down payment on a new vessel, and any loss in asset value due to age and wear or the vagaries of the market for used vessels was suffered in the form of higher interest and principle payments for the replacement vessel. Extending this framework to a continuum of vessel investments, owners were seen in effect to pay for their vessel depreciation over time with maintenance expenditures and a portion of loan payments.

The important economic consequence of the investment framework described here is that, from a private perspective, vessel owners did not seem to consider depreciation in excess of maintenance expenditures as important with regard to the accounting of vessel annual fixed costs. Consequently, vessel depreciation from a private perspective was defined to include only the annual expenditures required to maintain the fishing capacity of the vessel, and these annual vessel maintenance expenditures were obtained during the shareholder interviews. To minimize the potential for upwardly biased annual cost estimates due to the chance occurrence of an infrequent event (such as an engine overhaul) during the survey period, vessel owners were asked to provide estimates of average yearly maintenance expenditures over the period during which they operated the vessel.

Vessel fixed costs also included a return to vessel equity. Vessel equity was determined from the date of vessel purchase and the terms of the loan used to finance the purchase, and this information was also obtained during the shareholder interviews. The required return to vessel equity was calculated by multiplying vessel equity by the annual percentage return on three-month government paper. Fishing vessels were assigned a "carrying cost" equal to that of liquid assets essentially because owners were seen to view vessels as preferred assets (i.e., vessel owners preferred self-employment in the commercial fisheries and vessel ownership was required to obtain this employment). Fixed costs also included vessel insurance and dock fees not accounted for in packing costs, accounting, legal, and fishing association

services, and vessel property taxes and fishing permits. The proportion of total annual vessel fixed costs allocated to wreckfish harvesting was set equal to the proportion of total vessel fishing weeks allocated to the wreckfish fishery.

As noted above, fishery rent values are measures of social welfare, and so are more appropriately calculated from the perspective of society. In this case, the switch from shareholder to social perspective requires alternative methods for calculating the costs of fishing labor and capital assets. Different measurement methods are required because, from a social perspective, resource costs are measured in value terms, and the appropriate values are those of the next-best (highest valued) use that must be "sacrificed by society" when resources are deployed in the wreckfish fishery (Anderson 1986). To emphasize the next-best nature of social cost measurement, social cost values are often referred to as "opportunity costs." For the case of labor, fishing is first-best "by definition," and it is easy to imagine that share-system-based payments could exceed labor values determined by next-best labor markets. With regard to capital costs, although the private investment framework described above "downplays" the importance of fishing vessel depreciation, from a social perspective there can be no denying the real costs of deploying capital assets that wear out before generating a value equal to replacement cost. Thus, switching to from a private to social perspective on harvesting costs requires adjustments in both vessel fixed and variable costs.

Vessel fixed costs were adjusted to reflect a social viewpoint by: 1) substituting an estimate of the social opportunity cost of investment capital for vessel-owner loan payments and return on investment equity; 2) adding to vessel maintenance an amount intended to reflect capital depreciation not forestalled by vessel maintenance expenditures; and 3) deleting vessel property tax payments from fixed costs. For this study, the opportunity cost of investment capital was set equal to ten percent of the market value of the fishing vessels and gear, and capital depreciation was set equal to five percent of the market value of these items.^{23, 24}

For harvesting labor, a social perspective on costs was obtained by substituting the labor opportunity costs of vessel management and operation for the labor payments of the shareholders. Because an examination of harvester labor markets was beyond the scope of this study, the social value per week of the next-best use of supervised crew labor was set equal to the average weekly earnings in manufacturing for Florida statewide, and that for hired captains was set equal to twice that for supervised crew labor. Values for the next-best employment opportunities of vessel managers and owner-operators were determined from shareholder responses to the set of questions included to determine how vessel owners might adapt to a disruption in their wreckfish fishing activities. The cost parameters used to develop the alternative cost calculations used for this study are listed in Appendix B.

3. Results

Vessel Logbook Data

The wreckfish logbook data consists of a set of vessel trip records which includes, among other things, a vessel identification number, the dates of departure and landing, the hours fishing and gear characteristics, and the catch in number and weight by species. Hours fishing is an estimate of the total time during the trip that was spent actively fishing the gear (National Marine Fisheries Service 1991) while gear characteristics include the number of lines deployed and the average number of hooks per line. The days absent from port during the trip is the number of trip days inclusive of the departure and landings dates.

Figures 3(A-C) show the vessel logbook data used for this study. It should be noted that the 1993-1994 data is incomplete and includes only the time period from April 15 - October 31, 1993.²⁵ From these figures, it can be seen that the 10,000 lb. trip limit in effect during the 1991-1992 season did serve to limit per trip landings and so slow the rate of harvest during the final year of open access. Figures 3(B) and 3(C) differ mainly in the frequency of trips with landings greater than 12,500 lbs., and this is likely due to fact that the 1993-1994 data do not include the late fall and early winter when catch rates are typically increased. As was noted in the introduction, the pace of landings and effort during the first two seasons of ITQ management was very similar through October (150 trips and 729,000 lbs. verses 151 trips and 764,000 lbs.). As measured by the number of trips, it appears that wreckfish effort during the initial years of ITQ management will be about two-thirds that during the final year of open access.

Wreckfish trip lengths during the final year of open access and the initial year of ITQ management were approximately normally distributed with means of 7.0 and 6.7 days, respectively, and so it can be said that average trip length did not change during the transition to ITQ management. Landings per trip during these years were found to be distributed lognormally with means of 6,274 and 5,325 lbs., respectively, and so average landings per trip were reduced during the initial year of ITQ management. If data from only April-October of the first two years of ITQ management are considered, then trip lengths and landings per trip increased by about 5% during the second year of ITQ management.

Figures 4(A-C) show the logbook data from a "per-fishing-day" perspective. The annual distributions of landings per fishing day are all lognormal in shape and similar in appearance. As trip length has remained relatively unchanged, it appears that the number of fishing days during the first two years of ITQ management will be about two-thirds of the level allocated to the fishery during the last year of open access.

Shareholder Survey

Fishery share allocations were made to the owners of forty-nine vessels based on their wreckfish landings during 1987-1990. A survey population of forty-seven wreckfish effort decision-makers was obtained from the group of initial shareholders, and attempts were made to contact each of the decision-makers during 1993. For the survey population of forty-seven, two refused to participate in the survey, four were not able to be located, six were not able to be interviewed, and thirty-five provided answers to the questions contained in the survey questionnaire. Of the four decision-makers that could not be located, three had no landings and all sold out of the fishery during the initial year of ITQ management. Of the six that could not be interviewed, five sold out of the fishery just after the start of the management program, the sixth sold out during May of 1993, and none had landings during 1992.

The thirty-five shareholders that were interviewed provided cost and earnings data for thirty-seven vessels. These vessels included thirty-six of the forty-nine vessels qualifying for a share of the wreckfish fishery initially, and seventeen with landings during the 1992-1993 season. The vessels with ITQ landings included fifteen fish boats and two shrimp trawlers, and together these vessels landed

Figure 3. Wreckfish trip length and landings per trip, (A) 1991-1992, (B) 1992-1993, and (C) 1993-1994.

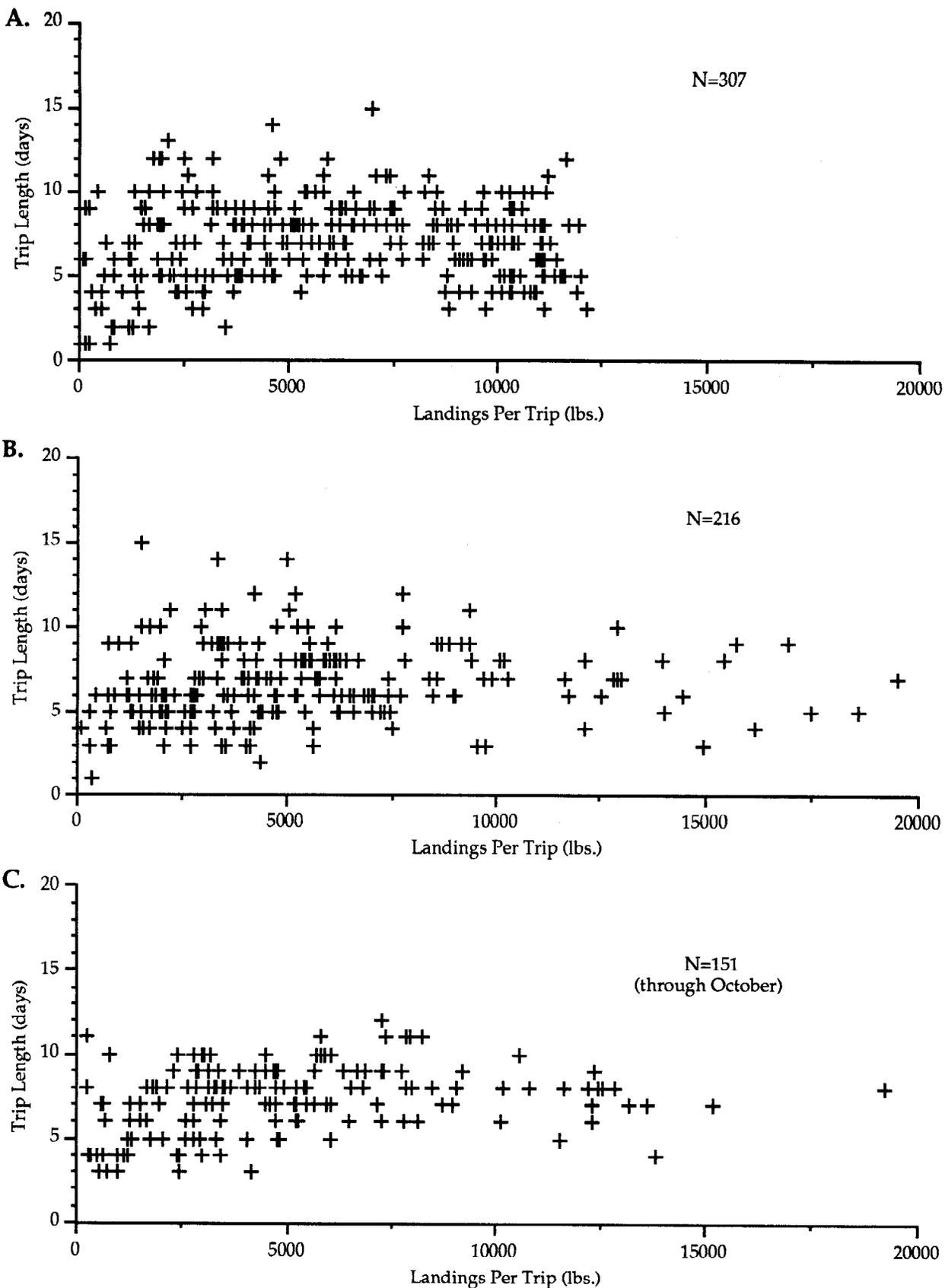
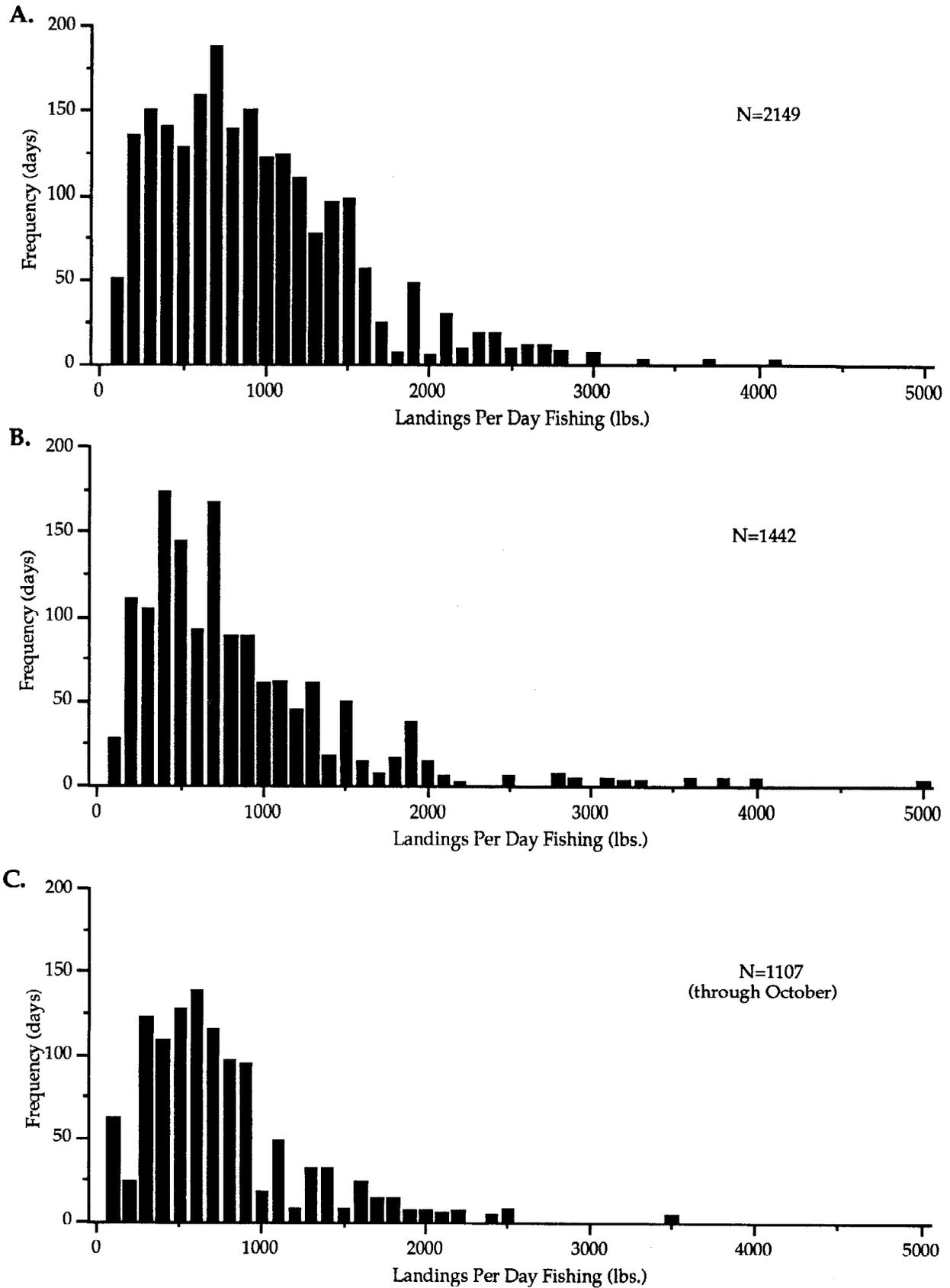


Figure 4. Wreckfish landings per day fishing, (A) 1991-1992, (B) 1992-1993, and (C) 1993-1994..



99.9% of the catch during 1992-1993. The twenty vessels which last landed wreckfish prior to 1992 included five fish boats and fifteen shrimp trawlers, and the cost and earnings data for these vessels covered various years from 1988-1991.

Shareholder Profiles

The survey results allowed the wreckfish shareholders to be classified into three groups: vessel owner-operators; vessel owner managers; and seafood distributors (dealers) that owned and managed fishing vessels. There were about half a dozen instances where vessel owner-managers and operators were family members. Of the vessels that landed wreckfish during 1992-1993, 47% were owner operated, 30% were owner managed, and 23% were owned and managed by seafood distributors. For the group of vessels that received shares initially, 57% were owner operated and the others were split evenly among owner-managers and owner-managers who were also seafood distributors.

As one purpose of this study was to describe the initial evolution of the characteristics of the wreckfish harvesting sector, many of the analyses below focus on changes in vessel characteristics among the group of vessels that landed wreckfish during the initial year of ITQ management and those that received fishery shares but decided not to allocate vessel time to wreckfish. Although cost and returns data was obtained for all vessels with landings during 1992-1993, data could not be obtained for all of the vessels included in the initial share allocation. As a result, the group of vessels with fishery shares initially but without 1992-1993 landings is represented using data from just twenty of the thirty-two vessels in this group. Based on the classification scheme above, it was found that the sampled vessels underrepresented the owner-operators without 1992-1993 landings by about 5%. These owner-operators were underrepresented because most of the decision-makers that could not be located were owner-operators who sold out of the fishery just after the start of ITQ management.

Table 1. Vessel average characteristics by shareholder group.

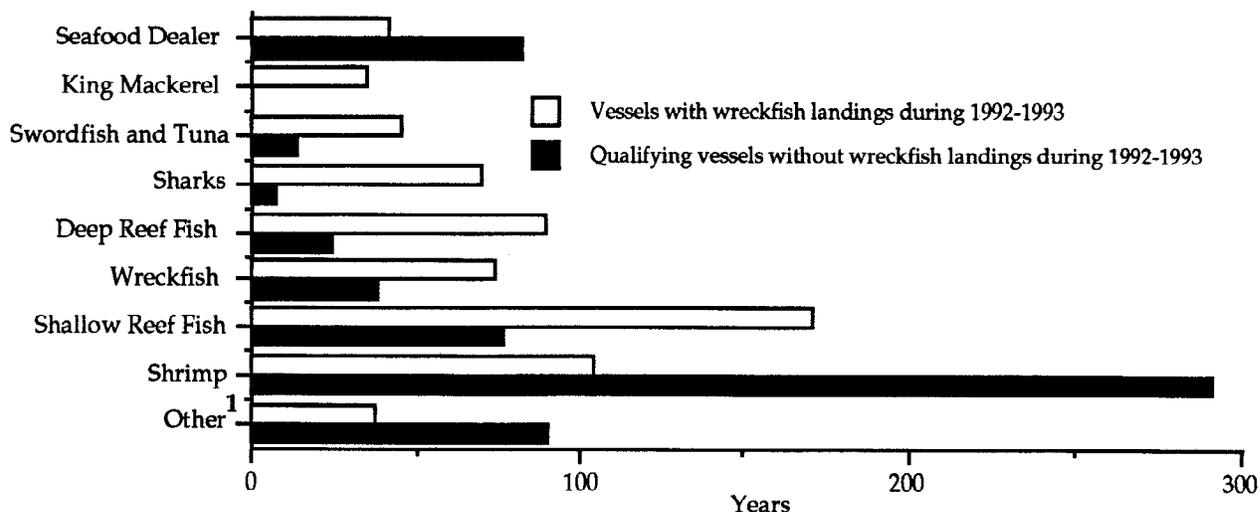
Age of owner (yr.)	Commercial fisheries experience of owner (yr.) ^a	Age of vessel (yr.)	Length of vessel (ft.)	Market value of vessel (\$)
Vessels with landings during 1992-1993				
44.8 (9.5) ^b	20.9 (8.2)	12.3 (4.0)	50.7 (10.4)	102,206 (53,171)
Vessels with harvest rights initially but no landings during 1992-1993				
48.2 (9.0)	24.0 (9.5)	11.3 (3.6)	64.3 (10.1)	137,350 (86,851)

^a Experience since age eighteen.

^b Values in parentheses are standard deviations.

Table 1 shows selected wreckfish vessel characteristics by vessel group.²⁶ The experience data indicates that, on average, wreckfish shareholders have been employed in the commercial fisheries for just about all of their adult lives. Within the southeast, these fisheries were found to include those for: 1) swordfish and tunas; 2) sharks; 3) deep reef fish (tilefish and snowy groupers); 4) shallow reef fish (snappers and groupers); and 5) shrimp as well as 6) wreckfish and some others with lower participation rates. Most of these fisheries are described elsewhere (South Atlantic Fishery Management Council 1983, 1985, Taniguchi 1987), and some have recently been the focus of increased management efforts (National Marine Fisheries Service 1993, South Atlantic Fishery Management Council 1993b). The data of Table 1

Figure 5. Commercial fisheries experience of vessel owners with wreckfish landings.

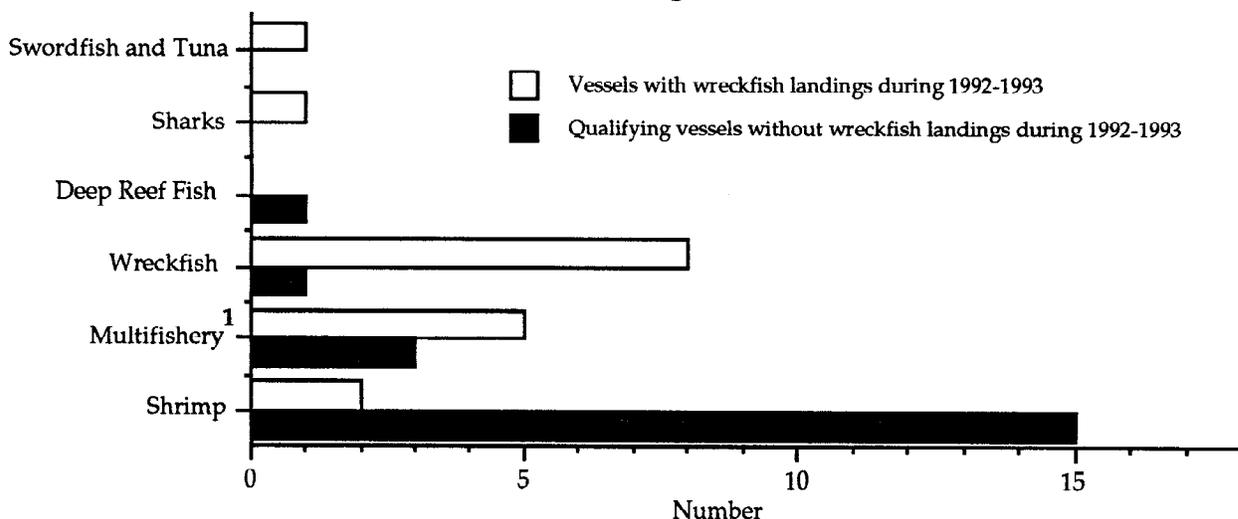


¹Includes mullet, shad and bait shrimp, spiny lobster, scallops, black sea bass, menhaden, and weakfish.

also indicates that wreckfish landings during the initial year of ITQ management were taken with vessels smaller than the average vessel qualifying for a share of the fishery initially.

Figure 5 shows the commercial fisheries experience of the vessel owners by shareholder group and southeast fishery. The experience data indicates that vessel owners harvesting wreckfish during 1992-1993 had much less experience with shrimping and seafood distribution than those who received fishery shares but decided not to allocate effort to wreckfish during 1992-1993. In fact, many shrimp trawler owners who qualified for fishery shares evidently decided not to allocate very much effort to the wreckfish fishery at the beginning of the 1991-1992 season and continued with these decisions through the 1992-1993 and 1993-1994 seasons. Figure 6, which shows the major fisheries of the two vessel groups, also indicates this “change in focus” of the owners of shrimp trawlers.

Figure 6. Major fisheries of vessels with wreckfish landings.



¹Includes various combinations of swordfish and tuna, sharks, deep and shallow reef fish, wreckfish, and king mackerel.

Vessel Numbers, Wreckfish Effort, Harvesting Practice, and Catch Per Unit of Effort

Table 2 provides summary data on wreckfish vessel characteristics and effort levels during 1991-1993. The effort levels were calculated using the vessel logbook data, and as noted above, days absent includes the trip departure and landings days and fishing hours represents the total time spent actively fishing the gear. The vessel data indicates that shrimp trawlers harvesting wreckfish were about 20 feet longer, on average, than fish boats harvesting wreckfish, and that fish boats supplied by far the largest portion of wreckfish effort during the transition to ITQ management.

For the final year of open access, twenty-six fish boats and twelve shrimp trawlers supplied 2149 fishing days of effort, with fourteen vessels fishing full time and twenty-four part time (for this study, a full-time wreckfish vessel is defined as one which made at least one wreckfish trip during seven of the ten months of the open season). Part-time vessels included twelve shrimp trawlers and twelve "multifishery" fish boats. Full-time wreckfish vessels took 75% of the landings and supplied 78% of the fishing days (shrimp trawlers provided 9% of fishing days and multifishery fish boats provided 13%). Total fishing days provided by full-time vessels ranged from 76-174 and averaged 120. Given the average effort level provided by full-time vessels, the harvesting sector supplied a nominal effort equivalent of about eighteen full-time vessels. Lastly, thirty-three of the thirty-eight vessels with landings during the final year of open access qualified for fishery shares under the ITQ management program.

For the initial season of ITQ management, twenty-one vessels provided 1442 fishing days with nine fishing full time and thirteen part time. Full-time vessels provided 85% of the catch and 81% of total fishing days. Measured by fishing days, participation by both full-time and part-time vessels decreased by 33%. Participation by part-time vessels decreased primarily because two-thirds of the shrimp trawlers that fished during 1991-1992 chose not to allocate any effort to wreckfish during the initial year of ITQ management. Although fewer in number, the average effort level of a full-time harvester remained virtually unchanged, with total fishing days ranging from 62-162 and averaging 125. As full-time vessel effort was unchanged on average and total fishing days were lower by 33%, the harvesting sector provided a nominal effort equivalent of about twelve full-time vessels during the initial year of ITQ management.

The ITQ management plan provided for several alternative harvest-rights arrangements that vessel owners could use alone or in combination to harvest wreckfish. In broad terms, the alternatives allow for circumstances where:

- 1) a vessel owned or controlled by a shareholder could harvest a quantity of wreckfish equal to the owned percentage share of the TAC;
- 2) a vessel owned or controlled by a shareholder could harvest a quantity of wreckfish exceeding the owned percentage share of the TAC via the purchase of quota coupons from other shareholders;²⁷ and
- 3) a vessel owned or controlled by a business entity without harvest rights could associate with a shareholder and harvest an amount of wreckfish determined by business agreement(s) with the shareholder(s).²⁸

During the 1992-1993 season, there were many instances where shareholders purchased quota coupons to supplement owned shares, but only two instances where vessels landed wreckfish through associations with shareholders. These association arrangements resulted in only three wreckfish trips and less than 4,000 lbs. of landings (one of the vessels that landed wreckfish through association during 1992-1993 landed wreckfish during 1991-1992 but did not qualify for a share of the fishery).

Although incomplete, the logbook data for 1993-1994 indicates that the composition of the harvesting sector during the second year of ITQ management was very similar to that of the first. Through October of 1993, eighteen fish boats and one shrimp trawler provided wreckfish effort with ten fish boats participating full time. The share of landings and effort by full-time vessels increased slightly,

Table 2. Wreckfish vessel characteristics and nominal effort levels by vessel type and fishing year, 1991-1993.

Vessel type	Fishing year	Fishing year totals				Means and (standard deviations) by vessel type and fishing year				
		Number of vessels	Fishing trips	Days absent	Hours fishing	Vessel length (ft.)	Fishing trips	Days absent	Hours fishing	
Fish boat	1991-1992	26	281	1,964	13,315	49.3 (8.1)	10.8 (8.0)	75.5 (55.6)	512.1 (430.0)	
	1992-1993	17	206	1,395	8,306	48.2 (7.9)	12.1 (8.1)	82.1 (51.5)	488.6 (308.3)	
	1993-1994 ^a	18	150	1,104	5,716	46.5 (6.7)	8.3 (5.7)	61.3 (41.5)	317.6 (226.7)	
Shrimp trawler	1991-1992	12	26	185	1,163	69.4 (5.9)	2.2 (1.0)	15.4 (8.4)	96.9 (68.1)	
	1992-1993	4	10	47	322	65.3 (8.4)	2.5 (1.3)	11.8 (6.6)	80.5 (41.8)	
	1993-1994 ^a	1	1	3	50	73.0	1.0	3.0	50.0	

^a Through October 1993.

with full-time vessels providing 90% of landings and 85% of fishing days.

Figure 7 shows the number of wreckfish trips and fishing days by month during 1991-1993. It should be noted that the wreckfish open season extends from April 16 - January 15, and so effort levels during April and January are for half-month periods. The wreckfish trips and days absent series possess very similar seasonal patterns because trip lengths have remained approximately constant (about seven days) during the period. Figure 7 indicates that industry expectations concerning a management-induced derby fishery were self-fulfilling at least initially, as the fishery experienced very high levels of effort during the first few months of the 1991-1992 season. However, as Figure 3(A) shows, the trip landings limit did serve to constrain the rate of landings and, as can be seen from Figure 1, nominal prices during 1991 moved up to higher levels after a very soft start. Figure 7 also shows that by the halfway point of the 1991-1992 season wreckfish effort had fallen to levels that have persisted relatively unchanged through to the present.

Figures 8 and 9 allow a comparison of effort as measured by days absent with effort as measured by fishing hours and hook hours. The hook-hours variable was calculated by multiplying together the hours fishing, the number of lines fished, and the number of hooks per line. When compared with days absent, the measures of gear activity show a more rapid increase in the effort rate during the fall of 1992, and somewhat lower effort levels since the summer of 1993. One circumstance where gear activity may be expected to increase relative to days absent would be that where fish become easy to locate, perhaps due to the existence of unusually large aggregations. In contrast, when gear activity decreases relative to days absent, it may be that fish have become more difficult to locate, and so vessels must spend more time searching for concentrations of fish.²⁹

The industry-wide measures of effort shown in Figures 7-9 result from the fishing practices of individual harvesters. Harvesting practices described by owner-operators interviewed for this study were broadly similar to those reported by Johnston (1983) for New Zealand wreckfish (see pages 5-6 and Figure 5) and by Schroeder (1930) for a wreckfish fishery near the Madeira Islands of Portugal. As wreckfish evidently congregate from time to time around rock faces or along steep banks, harvesters emphasized the importance of locating these bottom features with SONAR. Harvesters also noted that maintaining high catch rates throughout the season required many alternative fishing locations, and many reported that obtaining a sufficient number of locations required extensive mapping of the bottom features of the Blake Plateau. Through the harvester interviews it was determined that very current depth sounding technology is now in use, although harvesters are not yet able to "mark" fish that may be near a bottom feature. As a result, harvesters must deploy the gear to determine whether fish are concentrated on a bottom feature.

During the interviews harvesters indicated repeatedly that "time is everything" on the grounds, and so new harvesting technologies and fishing strategies are evaluated with regard to their effect on time spent steaming to the grounds, searching for fishing locations, and checking fishing locations for the presence of fish. With regard to this latter requirement, several harvesters noted the importance of the "freewheeling" capacity of the hydraulic spool used to deploy the gear and the testing of very advanced and expensive (\$35,000) SONAR units designed to identify fish at depths of 2000 feet. When asked to compare catch rates today with those obtained previously, several harvesters reported that although catch rates seemed stable, it was their opinion that the Blake Plateau grounds were being "worked" more intensively today than in years past. In other words, harvesters today are allocating relatively more of their fishing time to locating and checking for the presence of fish on relatively minor bottom features and to prospecting for new grounds.

Figures 10 and 11 show the average values of the fishing practices that determined the aggregate effort measures described above. Figure 10 indicates that while fishing lines deployed and hooks per line have remained relatively stable on average during 1991-1993, fishing hours per day absent have decreased. Hence, the statements of harvesters concerning higher levels of prospecting activity recently are

Figure 7. Wreckfish trips and days absent from port by month, 1991-1993.

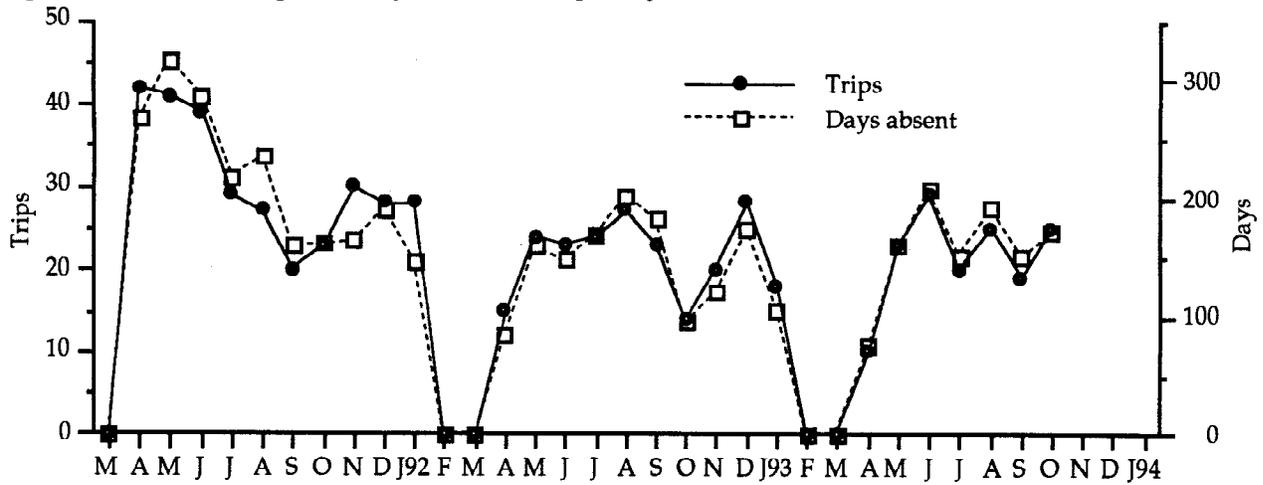


Figure 8. Wreckfish days absent and fishing hours by month, 1991-1993.

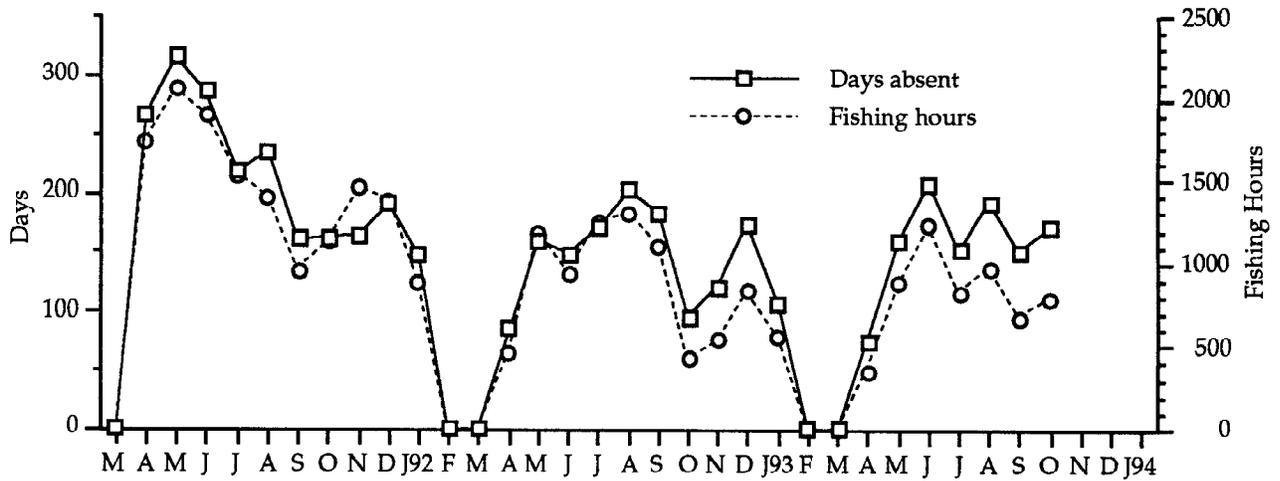


Figure 9. Wreckfish days absent and hook-hours by month, 1991-1993.

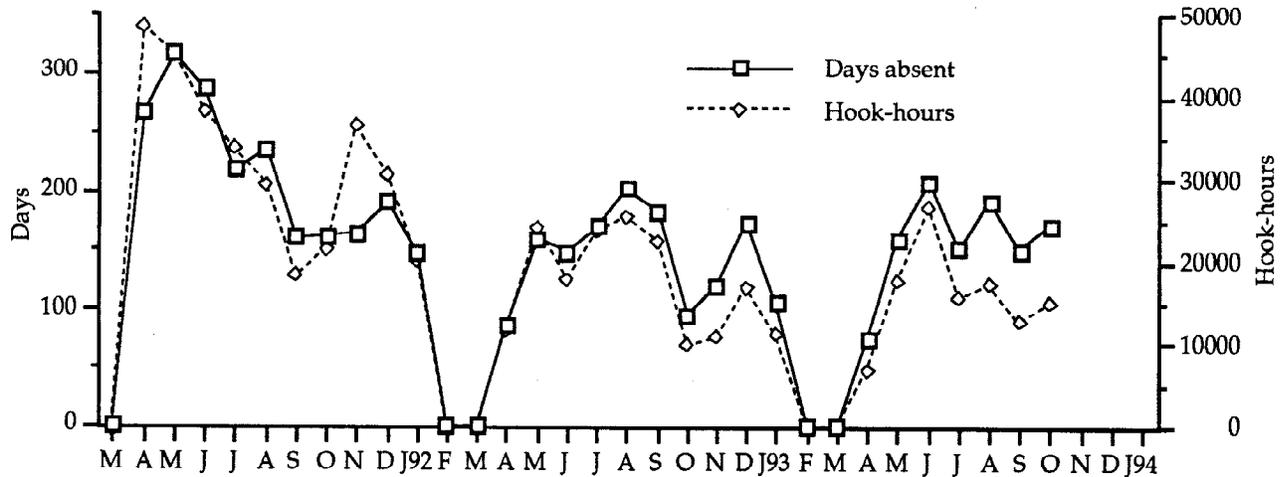
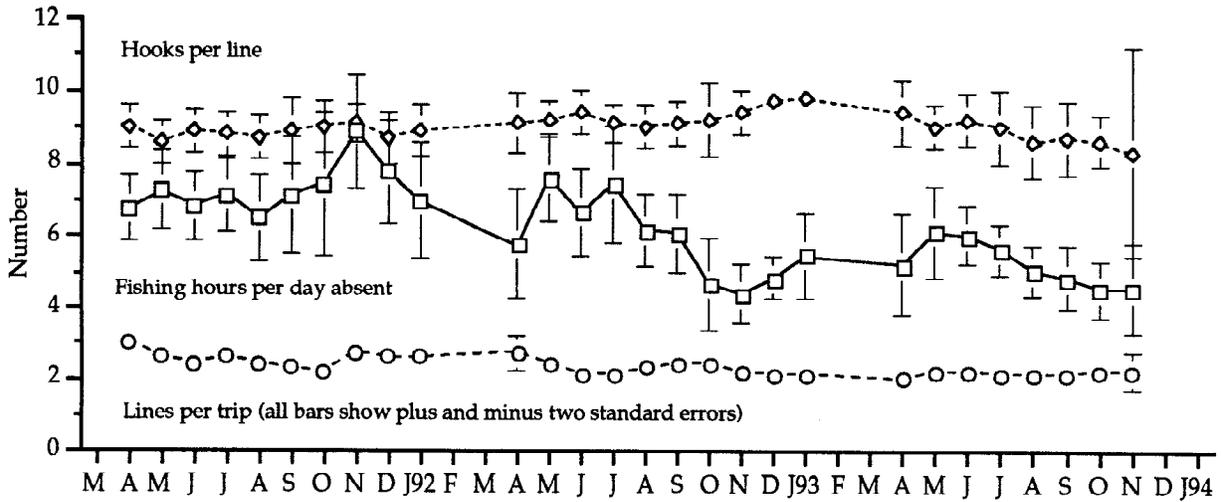


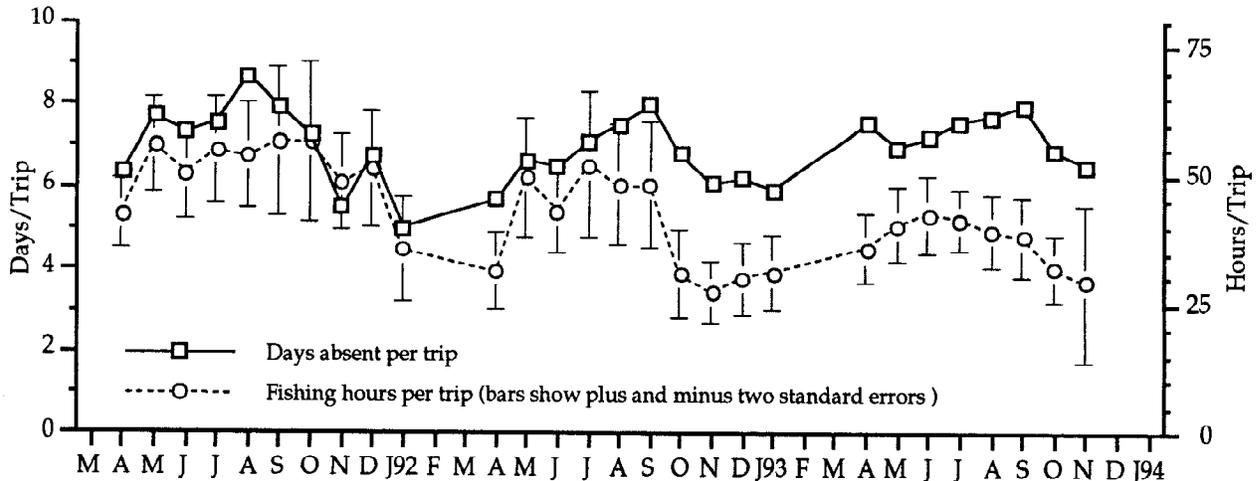
Figure 10. Mean hooks per line, lines per trip, and hours fishing per day absent, 1991-1993.



consistent with the data they reported on harvesting practices. Figure 11 shows that the decrease in fishing hours per day has resulted in a decrease in fishing hours per trip. Figure 11 also shows that, on average, days absent and fishing hours per trip increase during the summer months. This seasonal effort increase is consistent with harvester reports that fishing becomes more difficult during the summer months and so longer trips are required to obtain sufficient landings to make trips profitable.

Figure 12 shows average landings per day absent during 1991-1993. This wreckfish catch-per-unit-of-effort (CPUE) data displays a seasonal pattern about a roughly constant level, with CPUE generally higher during the months immediately preceding and following the spawning closure. Based on harvester reports about wreckfish recruitment, it seems safe to conclude that the catch per day absent data provides an index of seasonal changes in wreckfish abundance and vulnerability together.³⁰ In this regard, Figure 12 shows that the seasonal, fall increase in CPUE occurred earlier during 1991-1992 than during the initial season of ITQ management, and it is plausible that this higher CPUE was responsible for the concurrent increases in gear activity shown in Figures 8 and 9. Figure 12 also indicates that extremely low CPUE values were obtained during the initial month of ITQ management, and this is consistent with harvester reports of very poor catch rates at the start of the program serving to deter the

Figure 11. Mean days absent and fishing hours per trip by month, 1991-1993.



subsequent participation of many part-time harvesters that were on the grounds for the season opening and holding expectations for relatively high catch rates.

Figures 13 and 14 compare catch per day absent with catch per fishing hour and catch per hook hour, respectively. As these CPUE measures are of different orders of magnitude, the data are displayed using log-base-ten scales and with the gear activity scales adjusted such that their average levels appear similar to those for days absent. In this case, equal movements of the indices indicate equal percentage changes in their levels. It can be seen from these figures that the gear activity data provide "smoother" CPUE series and show slightly higher relative CPUE levels during 1992 and 1993. However, given the changes in fishing methods discussed previously, it would appear that the relatively higher CPUE levels indicated by the gear activity data recently reflect mainly these changes in fishing practices and not increases in resource abundance and or vulnerability.

Vessel Costs and Returns

Wreckfish trip incomes were taken from the monthly dealer report files. Figure 15(A) shows the distribution of wreckfish trip incomes on a per-day-absent basis during 1992-1993, and Figure 15(B) shows wreckfish per-day incomes during April-October of 1993. The income distributions are lognormal in shape, with median and average values of \$1,078/day and \$1,365/day, respectively, during the initial year of ITQ management, and \$1,059/day and \$1,313/day, respectively during 1993-1994 (through October). Hence, vessel income per day absent during the second year of ITQ management was very similar to that during the first. As dealer reports were not required during 1991-1992, the distribution of wreckfish incomes during the final year of open access could not be determined.

Table 3 provides a summary of wreckfish harvesting costs during the initial year of ITQ management. The cost data indicates that vessel fixed costs were about \$35,000 on average, and that vessel maintenance claimed about 50% of fixed costs. As nearly 80% of the vessels with wreckfish landings during 1992-1993 also allocated fishing effort to other southeast fisheries, and roughly 60% of these allocated more weeks to the alternative fisheries than to wreckfish, a rule was needed to determine the share of vessel fixed costs that could be attributed to wreckfish. The rule used here allocated fixed costs to the alternative fisheries in direct proportion to the number of total fishing weeks allocated to the alternative fisheries. Using this rule, only 43% of vessel fixed costs, or about \$15,000 on average, was considered to result from wreckfish harvesting.

Because the costs of Table 3 were calculated from the perspective of the individual shareholders, vessel labor payments were influenced by wreckfish trip incomes, whether or not the shareholder operated the vessel (i.e., payments to shareholder owner-operators were not included in the labor payments cost item and so labor payments are smaller for these vessel owners), and the particular share system used to spread the risks of fishing among the owners of capital and labor. For example, share systems commonly used by fish boats determined vessel and labor shares of trip income after the subtraction of trip expenses (fuel and oil, ice and bait, lost tackle, packing, and groceries). The labor share of income was then split among the captain and crew with captains often receiving one and a third crew shares. Shrimp trawler owners either used variants of the fish boat system just described, or systems which paid labor a percentage of gross trip income.³¹

As the primary objective of calculating vessel costs from a shareholder perspective was to use the results to evaluate the functioning of the market for percentage shares, costs and returns from rights leasing and the purchase of percentage shares were excluded from the calculations. For the same reason, no attempt was made to aggregate vessel costs and returns in those cases where shareholders used more than one vessel to harvest wreckfish. Hence, vessel harvesting costs from the shareholder perspective should be interpreted as indicators of relative shareholder vessel-cost efficiency for the production of wreckfish effort and landings.

Figure 12. Mean wreckfish landings per day absent, 1991-1993.

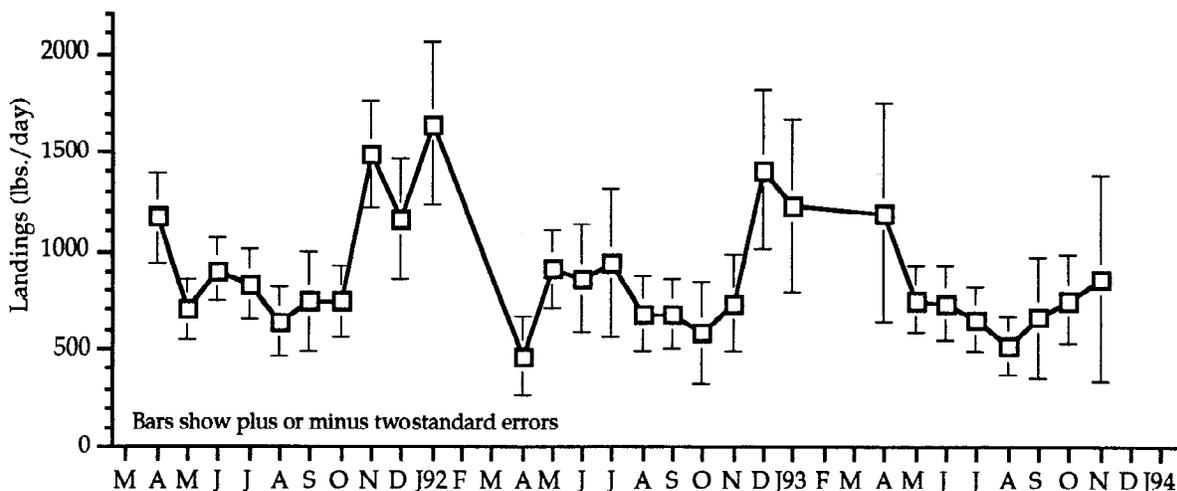


Figure 13. Mean wreckfish landings per day absent and per fishing hour, 1991-1993.

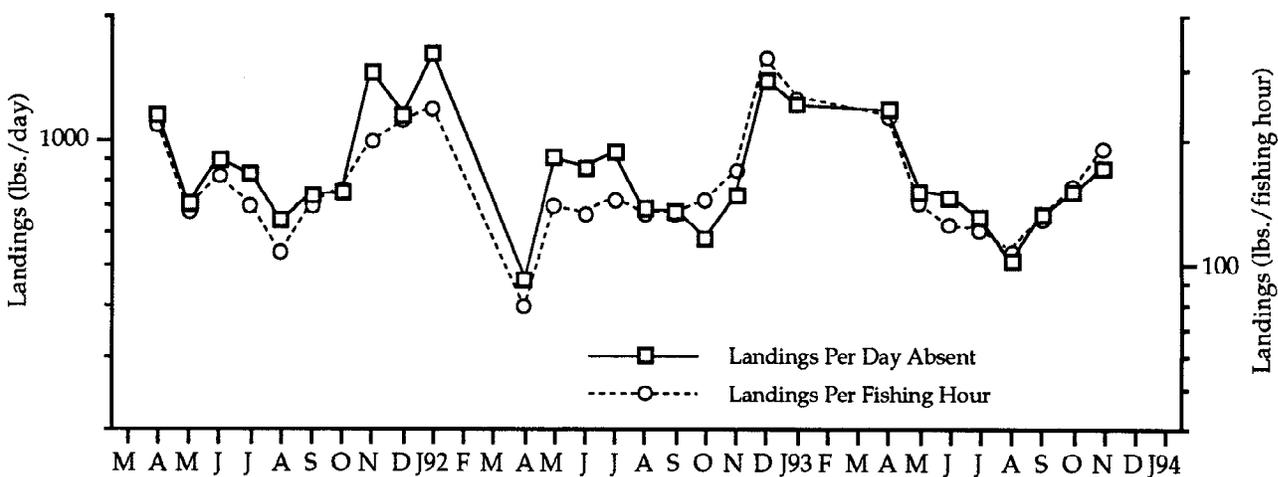


Figure 14. Mean wreckfish landings per day absent and per hook-hour, 1991-1993.

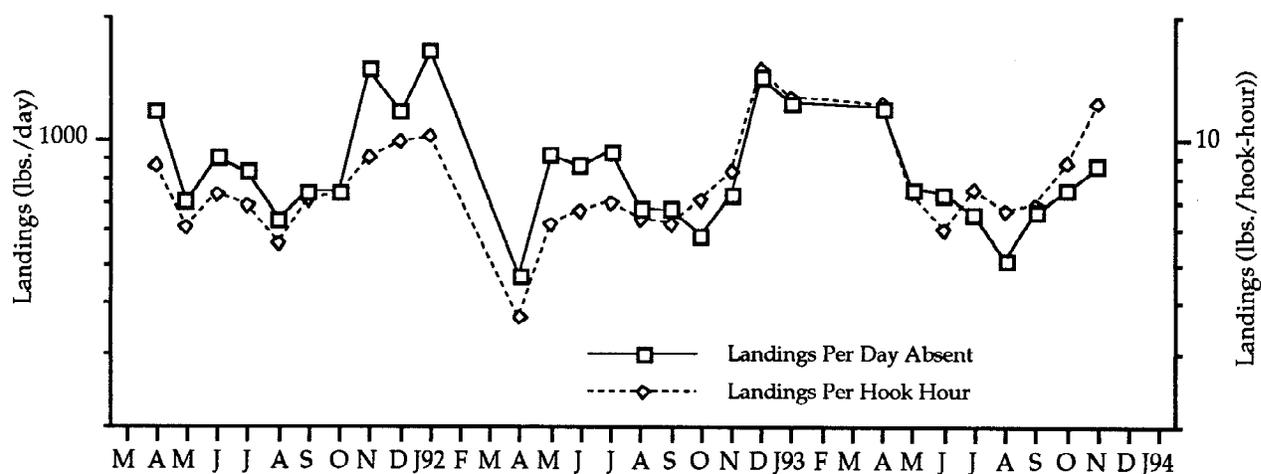
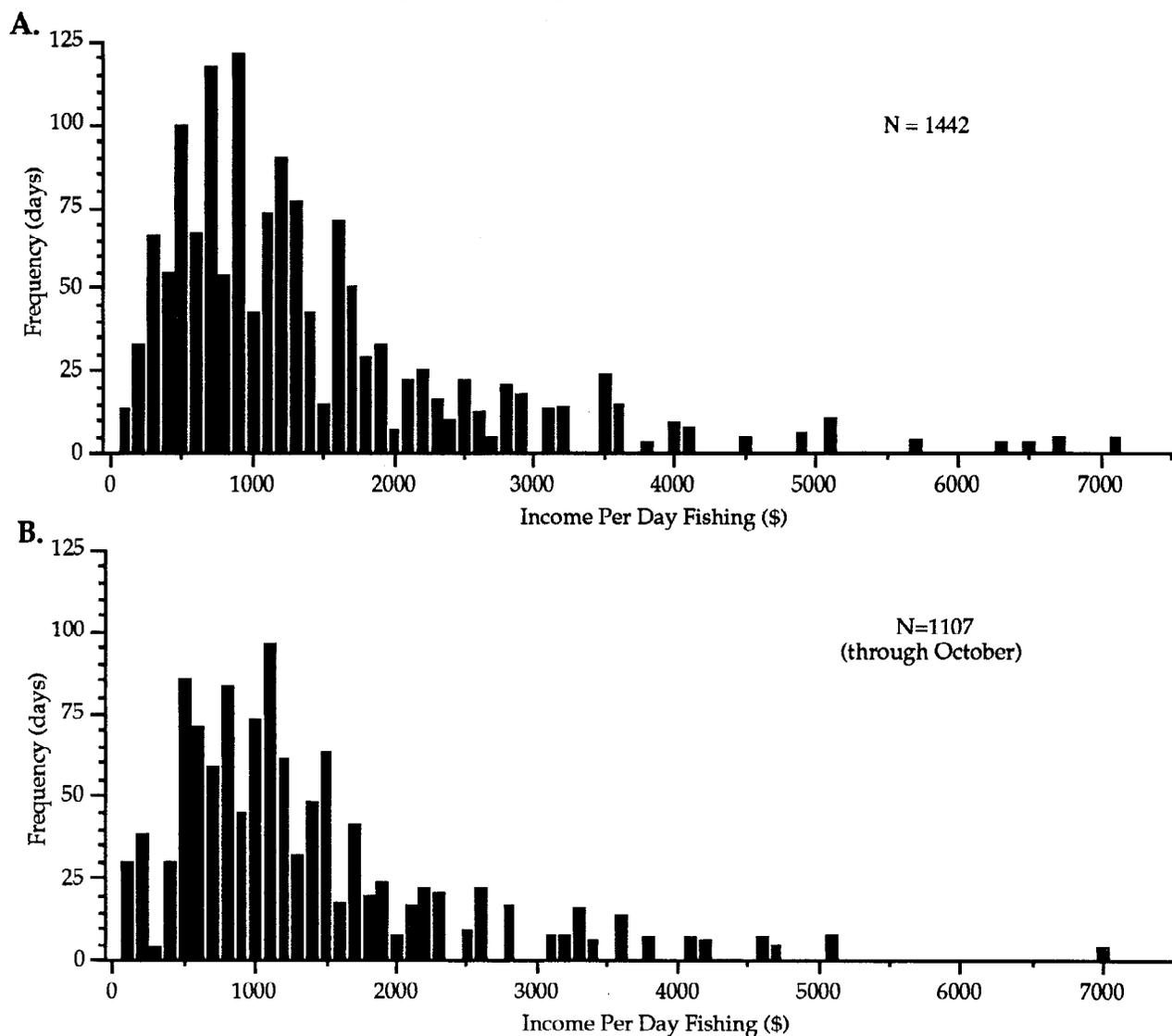


Figure 15. Vessel wreckfish income per day fishing, (A) 1992-1993 and (B) 1993-1994.



Vessel average wreckfish trip costs were determined to be nearly \$6,000 during the initial year of ITQ management, with yearly trip costs contributing on average 80% of total harvesting costs. It also appears that during this time about \$55,000 worth of wreckfish gear was lost. Crew payments showed large variation and represented the largest portion of trip costs, claiming roughly 35%. As one might expect, the largest labor payments were made by shareholders with hired captains that produced high levels of landings, and the smallest by shareholders who operated their vessels but landed only small amounts of wreckfish. Shareholder total wreckfish trip costs and harvesting costs also showed large variation, and this was due both to the choice of some to allocate fishing effort to alternative fisheries, and of others to operate their vessels instead of hiring a captain.³²

Although not shown as a cost item in Table 3, several vessel owners used share systems which included "ITQ fees" as an additional "off-the-top" trip expense (i.e., ITQ fees were accounted just like fuel and packing). In effect, share systems with ITQ fees served to reduce payments to fishing labor. Interestingly, vessel owners employing share systems with ITQ fees were in every case owners who had purchased wreckfish harvesting rights. Hence, it may be safely assumed that the occurrence of share-system ITQ fees was motivated by a market-driven recognition of the value and cost of harvest rights ownership.³³

Table 3. Average harvesting costs for seventeen vessels landing wreckfish during 1992-1993.

Item	Mean (\$)	Minimum (\$)	Maximum (\$)
Annual fixed costs			
Maintenance ^a	18,555	4,950	44,500
Loan payments	8,011	0	31,200
Return on vessel value	2,952	1,530	6,800
Insurance and dock fees	4,103	0	16,800
Services ^b	1,004	0	6,269
Taxes ^c	583	277	754
Vessel total fixed cost	35,209	9,259	90,831
Total wreckfish fixed cost	15,171	2,884	53,986
Costs per wreckfish trip			
Labor payments ^d	2176	26	5195
Fuel and oil	771	415	1500
Ice and bait	556	300	1200
Lost tackle	268	105	850
Packing	365	0	2360
Groceries	291	200	550
Average wreckfish trip cost	5,721	2,592	11,709
Total wreckfish trip costs	59,745	10,074	227,032
Total wreckfish costs	74,916	12,958	281,018

^a Includes annual vessel maintenance, gear storage, and support vehicle costs.

^b Includes accounting, legal, and fishing association services.

^c Includes vessel registration, property taxes, and fishing permits.

^d Includes payments to hired captains and deck hands only.

Average vessel incomes from wreckfish during 1992-1993 are summarized in Table 4. As shown, gross wreckfish incomes ranged from about \$17,000 to more than \$500,000. The wide variation in vessel incomes was due primarily to differences in the amount of effort allocated to wreckfish and the relative fishing power of the effort. Vessel incomes exceeded total trip costs by about \$55,000 on average, and total harvesting costs by about \$40,000 on average. Due to the method used to tabulate harvesting costs, vessel incomes above harvesting costs represent returns to vessel management for those cases where shareholders hired captains, and returns to vessel management and operation in those cases where shareholders chose to operate their vessels. As for harvesting costs, the great variation in the calculated net incomes resulted in part because some shareholders chose to allocate large amounts of vessel time to alternative southeast fisheries, and because in some cases returns above costs rewarded both vessel management and operation. Wreckfish income above total harvesting costs was calculated to be negative for four vessels.

Table 5 allows a comparison of the average costs of wreckfish effort by vessel type and fishery preference. Fishery preference was defined as wreckfish for vessels satisfying the full-time criterion noted previously, and as multifishery otherwise. Analysis of the cost group means by vessel type indicated that, accepting the method used to allocate fixed costs, the cost of a day absent was about 40%

higher for shrimp trawlers than for fish boats. However, it should be noted that the number of shrimp trawlers was small and economic theory predicts that those vessels which choose to allocate effort to wreckfish will be relatively cost-efficient effort producers. With regard to fishing hours, costs for shrimp trawlers exceeded those for fish boats by only about 20%, and implies that shrimp trawlers spent relatively more trip time actively fishing than did fish boats. The effort cost group means by fishery preference indicated that the cost of a day absent was about 20% higher for wreckfish vessels than for multifishery vessels, and the cost of a fishing hour about 40% higher. Although hook-hour costs for fish boats were higher than for shrimp trawlers, and for wreckfish vessels as opposed to multifishery vessels, these results appear to have little meaning with regard to relative cost efficiency, indicating instead a move to fewer hooks per line by full-time wreckfish harvesters.

Table 4. Average vessel incomes from wreckfish during 1992-1993.

Item	Mean (\$)	Minimum (\$)	Maximum (\$)
Gross income	114,869	17,415	514,518
Trip costs	59,745	10,074	227,032
Income above variable costs	55,123	4,216	287,486
Fixed costs	15,171	2,884	53,986
Income above total costs	39,953	-5,607	233,500

Figure 16 illustrates on a per-day basis and by fishery preference the vessel gross income data summarized in Table 4 and the vessel effort allocations made to obtain the income. Income-per-day group means for the vessels shown in Figure 16 were \$1,510/day and \$900/day for wreckfish and multifishery vessels, respectively. Figure 17 illustrates the average cost per day absent data summarized in the second portion of Table 5 along with the effort data. Figure 18 shows wreckfish harvesting costs per pound of landings, the wreckfish effort allocations, and the average exvessel price of wreckfish during the 1992-1993 season. Many of the shareholders interviewed for this study noted the importance of per-pound harvesting cost experience both for analyzing the harvest of wreckfish from a business perspective and for judging the value of wreckfish harvesting rights. Economic theory also recognizes the importance of average harvesting cost as a primary index of economic efficiency (Clark 1976), and as such the vertical distance between per-pound harvesting cost and exvessel price provides a rough indication of relative vessel economic efficiency in the production of wreckfish during the initial season of ITQ management. With regard to whether shareholders that decided to operate their vessels full-time for wreckfish may have "perceived" lower per-pound harvesting costs on average, the cost-per-pound group means were calculated to be \$1.12/lb. and \$1.47/lb. for wreckfish and multifishery vessels, respectively.³⁴

Table 5. Average cost of wreckfish fishing effort by vessel type and fishery preference, 1992-1993.

	Number	Average total cost (\$)a			
		Fishing trip	Day absent	Fishing hour	Hook-hour
<u>Vessel type</u>					
Fish boat	15	5,726 (589)	841 (113)	146 (22)	7.11 (0.88)
Shrimp trawler	2	5,681 (888)	1,161 (153)	172 (25)	4.41 (0.72)
<u>Fishery Preference</u>					
Wreckfish	9	6,133 (842)	956 (170)	174 (31)	8.37 (1.14)
Multifishery	8	5,258 (600)	792 (113)	121 (18)	5.02 (0.77)

^a Values in parentheses are standard errors.

Wreckfish Economic Values

Wreckfish economic values were calculated using the trip incomes data and vessel harvesting costs as measured from a social perspective. As was noted, labor opportunity costs for hired captains and crew were taken from regional manufacturing earnings data while those for vessel managers and owner-operators were determined from shareholder responses to a series of hypothetical questions about how time planned for managing and operating vessels in the wreckfish fishery would be reallocated in the event of an unavoidable disruption in wreckfish fishing activities. In particular, shareholders were asked about how they would adapt to a short-term fishery disruption caused by a violation of the ITQ management plan rules, and a longer-term disruption caused by the unexplained disappearance of commercial concentrations of wreckfish on the Blake Plateau. Before describing the hypothetical disruption scenarios, shareholders were asked to indicate how many wreckfish trips were planned for the 1993-1994 and 1994-1995 seasons and how many weeks of work time they thought would be required to supply the trips. After describing the scenarios, shareholders were asked how they would use the time they indicated was planned for managing and or operating their vessels in the wreckfish fishery, and what they expected to receive as before-tax earnings from this alternative activity.

Shareholder responses to the expected income questions are summarized in Table 6. Opportunity incomes for vessel owner-manager and owner-manager-operator labor reported by shareholders averaged about \$1,000/week, with owner-manager-operators reporting slightly higher values than owner-managers. These values were about two and a half times the average regional manufacturing wage used to value deck labor. As shareholder responses to the disruption scenarios were thought to comprise the best available information about shareholder first-best alternatives to wreckfish harvesting activities, opportunity cost values for management and owner-operator labor were set equal to the expected income values provided. For the 40% of cases where shareholders were not able to provide an expected income value, labor opportunity costs were set equal to the averages of the values provided by managers and owner-operators with landings during 1992-1993.

Figure 16. Vessel income per day absent and days absent, 1992-1993.

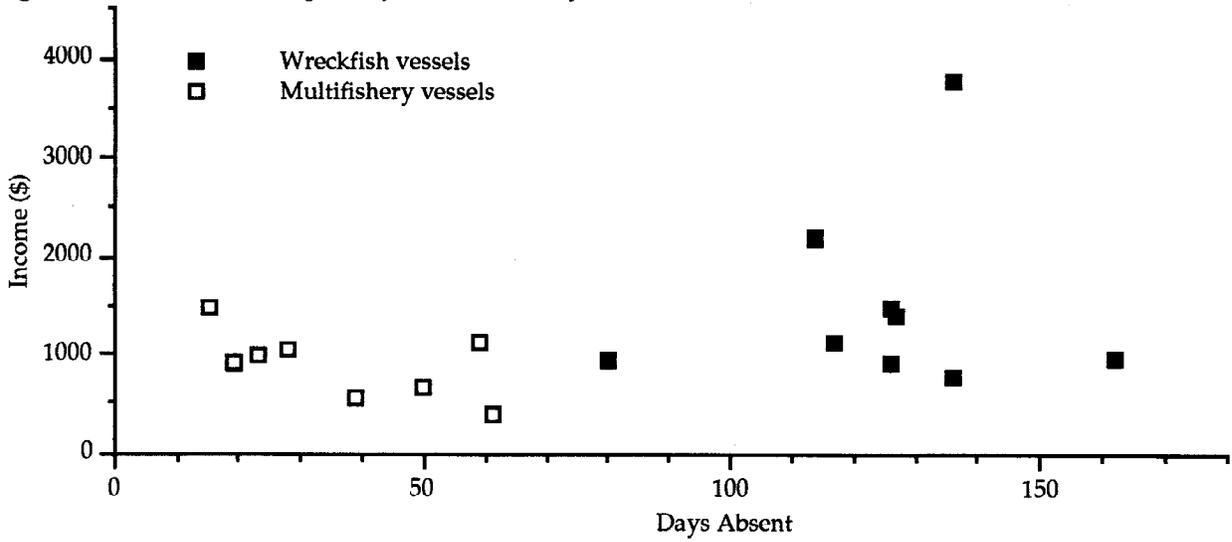


Figure 17. Vessel total cost per day absent and days absent, 1992-1993.

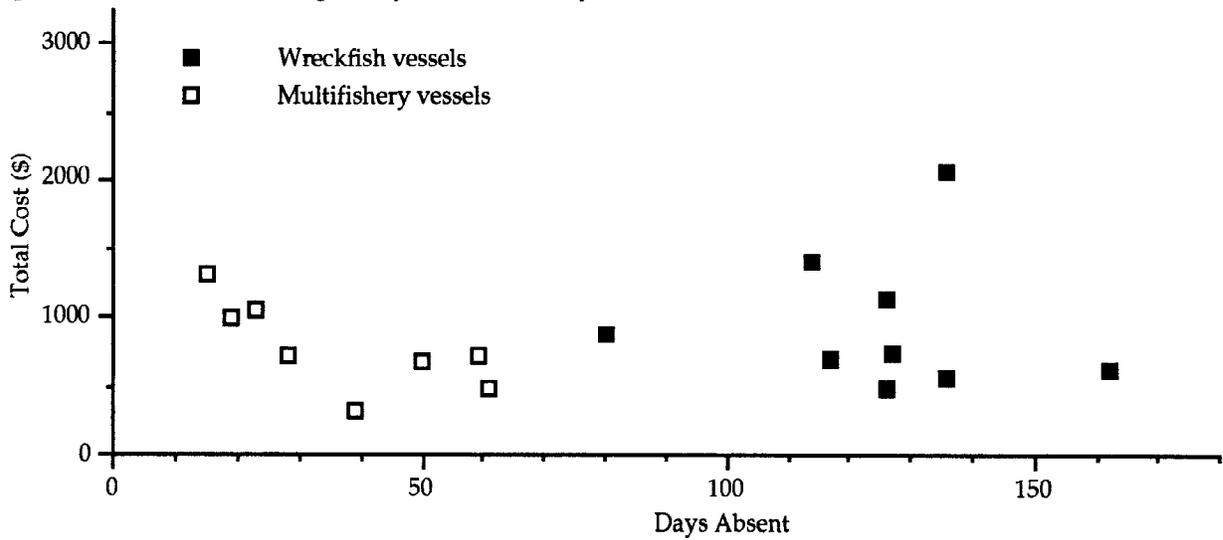


Figure 18. Vessel total cost per pound of landings, days absent, and average exvessel price, 1992-1993.

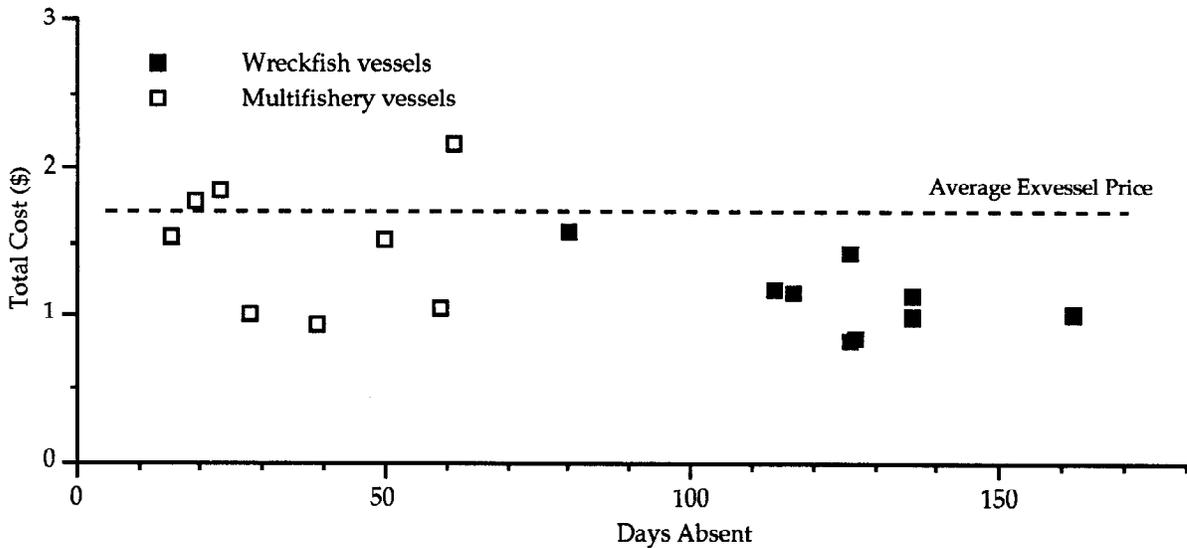


Table 6. Vessel weekly labor opportunity costs by labor type and vessel group.

Labor type and vessel group	Number	Mean (\$)	Minimum (\$)	Maximum (\$)
Vessels with wreckfish landings during 1992-1993				
Manager	3	967	575	1,175
Manager and operator	7	988	480	1,540
Vessels with harvest rights initially but without wreckfish landings during 1992-1993 ^a				
Manager	8	726	0	1,175
Manager and operator	16	930	250	1,925

^a Opportunity earnings provided for various years 1988-1991.

Table 7 shows the aggregate wreckfish gross value, harvesting cost, and fishery rent values calculated for the seventeen vessels that provided 99.9% of wreckfish landings during the initial year of ITQ management. Because the costs of Table 7 were calculated from a social perspective, vessel fixed costs include capital opportunity and depreciation costs equal to 15% of the market value of vessel capital investment in lieu of actual vessel loan payments and a return to vessel and gear equity based on yields from three-month government paper.³⁵ Given the proportion of fishing weeks rule used to allocate vessel fixed costs and the values chosen to measure the opportunity costs of capital and labor, the cost calculations indicate that the social cost of providing the effort required to obtain the landings was about \$1.6 million and fishery rent was about \$350,000. Of total harvesting costs, fixed costs claimed roughly 20% and labor opportunity costs claimed about 50%.

Table 7. Wreckfish gross value, harvesting costs, and fishery rents during 1992-1993.

Item	Total (\$)	Minimum (\$)	Maximum (\$)
Wreckfish gross value	1,952,766	17,415	514,518
Vessel total fixed costs ^a	331,087	3,121	77,186
Vessel total variable costs	1,267,004	14,706	249,222
Opportunity cost of labor ^b	825,849	6,156	122,981
Vessel total costs	1,598,092	17,827	326,408
Fishery rents	354,675	-27,544	188,110

^a Includes capital opportunity cost and depreciation equal to fifteen percent of the market value of capital investment.

^b Labor opportunity costs are a portion of vessel variable costs and include values for vessel management and operation (managers, captains, and deck hands).

The approximately \$350,000 of economic value calculated as generated by the wreckfish fishery during 1992-1993 corresponds to a value of \$0.31/lb. of landings, or about 18% of the average exvessel price. Fishery rent plus vessel fixed costs was calculated to be \$0.60/lb., or 35% of the average price. As labor opportunity costs comprised the largest portion of harvesting costs, the rent value is relatively more sensitive to alternative social values for labor than to, say, fuel prices or vessel insurance. Judging from the interview experience, regional manufacturing wages may overestimate the true social cost of deck labor, but probably by no more than a third. Reducing the opportunity cost of deck labor to \$300/week from \$393/week yielded an increase in the fishery rent value of just over 22%. Of course the rent value is also influenced by the rate of return that society requires of capital resources, and in this regard adding a percentage point to the 15% rate used to account for investment costs and capital depreciation decreases fishery rent by 2.5%.

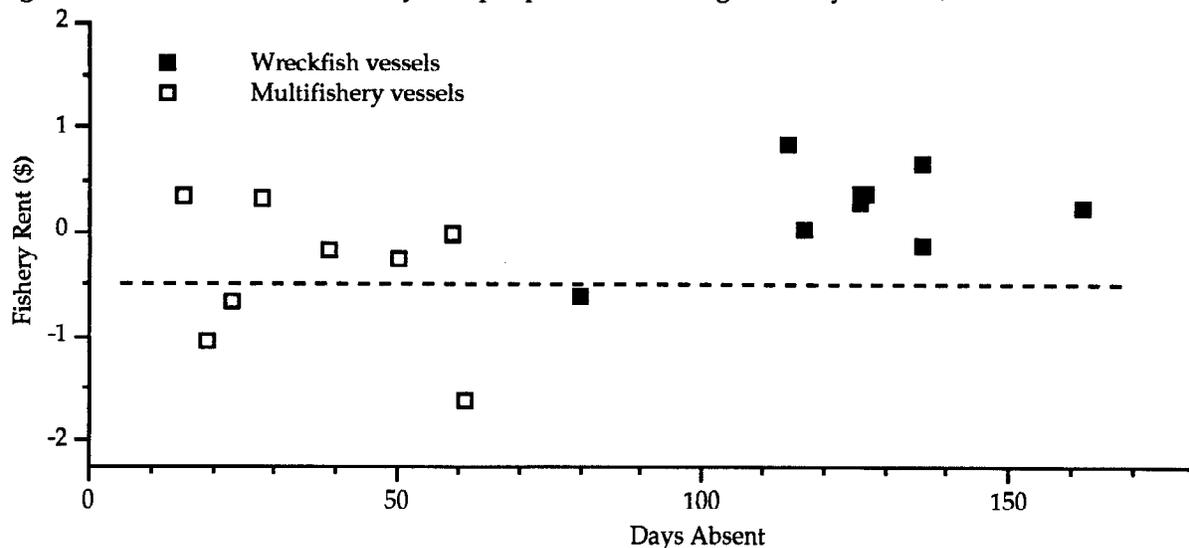
Figure 19 shows the vessel rent values summarized in Table 7 on a "per-pound" basis. Group means for wreckfish and multifishery vessels were \$0.23/lb. and negative \$0.39/lb., respectively. Hence, multifishery vessels were found to generate lower per-pound rent values than wreckfish vessels. Using negative \$0.50/lb. as a cutoff point for nonmarginal vessels, there were four marginal vessels with wreckfish landings during 1992-1993. These marginal vessels together provided 183 fishing days and 57 weeks of vessel time, and from the perspective of society, generated negative fishery rents of nearly \$70,000. The marginal vessels were also calculated to have lost money from a shareholder perspective, but the amounts were much smaller — only about \$14,000 in total, and with the exception of one vessel, losses were each less than \$2,000.

The fishing activities of the marginal vessels of 1992-1993 were checked during the 1993-1994 season. Here it was found that through October three of the four had supplied effort to the fishery, with total effort for the vessels equal to 66 days absent and 16 weeks of fishing time. Hence, it appears that the marginal vessels of 1992-1993 reduced their wreckfish effort during the 1993-1994 season. Interestingly, the vessel which chose not to supply effort was that with the most negative per-pound rent value and the highest private loss value, but not the largest negative total rent value. As the marginal vessels all generated negative fishery rents, the entire economic value generated by the wreckfish fishery during 1992-1993 may be attributed to the comparative advantage of some vessel owners for the production of low-cost wreckfish landings.

The fishery rent values measured here represent only one component of the value that society might place on the wreckfish resource. This is because obtaining the rent evidently requires a fishery management program and stock research and these require social resources, and because wreckfish consumers also receive economic value through consumption of wreckfish. Thus to arrive at a more complete estimate of the value to society of the wreckfish resource, management and stock research costs must be subtracted from the fishery rent value and consumer benefits must be added in. In this regard, it was estimated during 1991 that the cost of the ITQ management program without enforcement and stock research would be about \$47,500 (South Atlantic Fishery Management Council 1991b).

Figures 20 and 21 allow a comparison of per-pound harvesting costs and fishery rent values during 1992-1993 with those experienced by the vessels which qualified for a share of the fishery but did not fish for wreckfish during 1992-1993. Historic vessel costs and rents for these vessels were calculated as for those that landed wreckfish during 1992-1993, but using the cost values of Appendix B, and so represent nominal dollar values over various years. The values are displayed by vessel group, with vessels divided into three groups depending on the year of most recent participation in the wreckfish fishery and whether or not the vessel owner decided to "sell out" of the fishery prior to October 1993. The figures indicate that most of the vessels which qualified for a share of the fishery but did not fish during 1992-1993 supplied less than 60 days of wreckfish effort during their most recent year of fishery participation.

Figure 19. Vessel wreckfish fishery rent per pound of landings and days absent, 1992-1993.



While the historic cost and rent values are provided to illustrate the variation in the harvesting cost experiences of those vessels which qualified for a share of the wreckfish fishery initially, it should be noted that a direct comparison of the inter-year values is complicated by 1) unknown changes in resource abundance during 1988-1990 and 2) harvesting cost and wreckfish price changes due to inflation and the various management measures implemented to protect the wreckfish resource. For example, about half of the historic values represent the fishing activities of vessels during 1990. As was noted in the introduction, fishery managers closed the fishery somewhat unexpectedly during August of 1990 for what was initially an unspecified time period. In addition, about 60% of the observations represent activities of vessels during their initial year in the fishery. Based on the shareholders interviews, it appears that both of these factors served to reduce the number of trips per week of fishing time from that which these vessels would have been able to supply otherwise, and this in turn resulted in relatively higher fixed costs per pound of landings than would have been the case otherwise.³⁶

Figure 20 shows that while many of the vessels which decided not allocate effort to wreckfish during 1992-1993 did experience relatively high per-pound harvesting costs, others experienced costs equal to or lower than vessels which landed wreckfish during 1992-1993.³⁷ Based on information obtained during the shareholder interviews, this result appeared due primarily to the large degree of individual variation in business circumstances that can be said to characterize small fishing firms generally. Figure 21 shows that, from the perspective of society, many of the vessels that did not allocate effort to wreckfish during 1992-1993 were vessels which achieved only marginal results during their last season in the fishery. However, it again must be stressed that half of the observations resulted from activities during 1990 when managers abruptly curtailed the fishery and wreckfish prices were very low. Given these circumstances, it is probably more accurate to interpret the data in these cases as indicating not the activities of inherently marginal wreckfish vessels, but instead fishing activities whose social value was marginalized by the rapid pace of fishery expansion and the timing of their decision to enter the wreckfish fishery.

Fishery Switching

The shareholder survey included the mapping of vessel fishing effort allocations among the southeast fisheries during the survey year, and results of these mappings are presented here. As noted previously, these effort allocations, or fishery switching behaviors, were viewed as motivated by expected vessel profits, although it was observed that some vessel owners seemed to consider relatively longer time frames than others.

Figure 20. Vessel total wreckfish harvesting cost per pound of landings and days absent, 1988-1993.

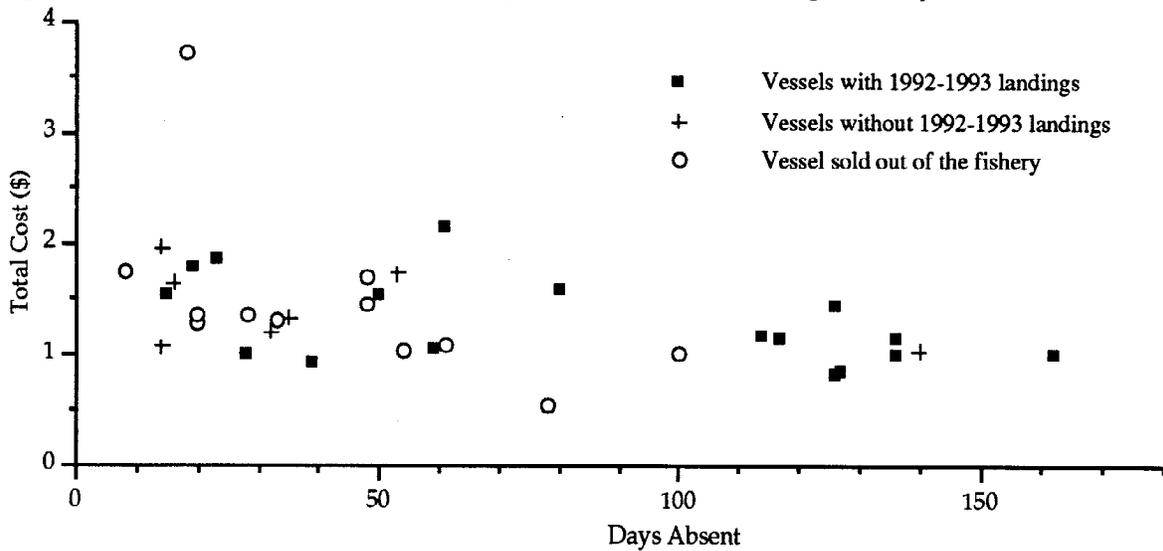


Figure 21. Vessel wreckfish rent per pound of landings and days absent, 1988-1993.

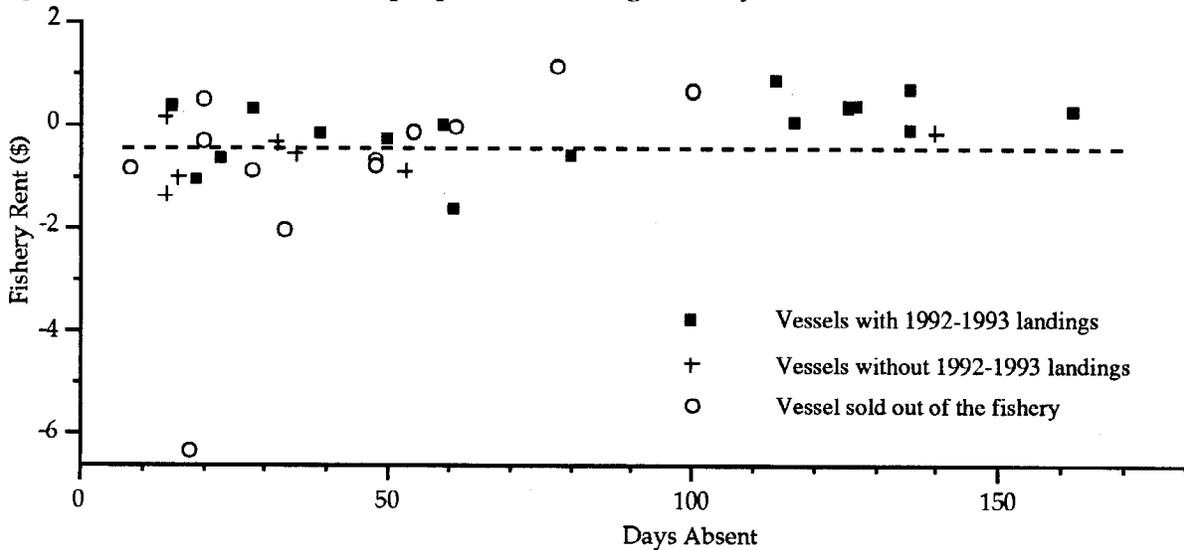
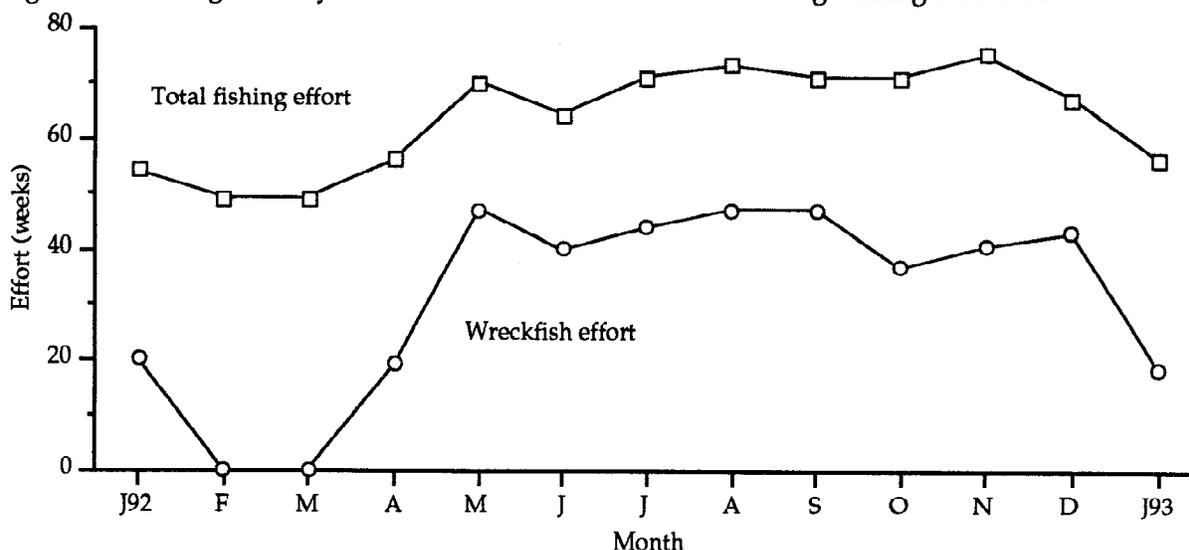


Figure 22 shows the fishing efforts by month for the vessels with wreckfish landings during 1992-1993. Total fishing effort represented 89% of the total time available, with the other 11% allocated to vessel maintenance or other non-fishing activities. Total fishing activities were reduced during the winter because annual vessel maintenance or nonfishing activities occurred more often during these months. Of total fishing time, 50% was allocated to wreckfish, 18% to sharks, 12% to shrimp, 7% to swordfish and tunas, and 8% and 5% to shallow and deep reef fish, respectively.

Figure 23 shows the vessel effort allocations by month and fishery. From Figure 23 it can be seen that shrimp trawlers allocated their effort to wreckfish during the initial months of the season, and so contributed to the rapid increase in wreckfish effort during this period. Due to the different vessel designs, fish boats would always switch to fisheries other than shrimp when not in the wreckfish fishery and shrimp trawlers would always switch back to shrimp. Fish boats with wreckfish landings were found to have supplied effort to sharks and swordfish and tunas throughout the year but allocated effort to shallow and deep reef fish only seasonally. In this regard, sharks received two to three times more effort than swordfish and tunas and the fisheries for shallow and deep reef fish received the largest effort increases during the wreckfish spawning closure. The data also shows that vessels from the wreckfish

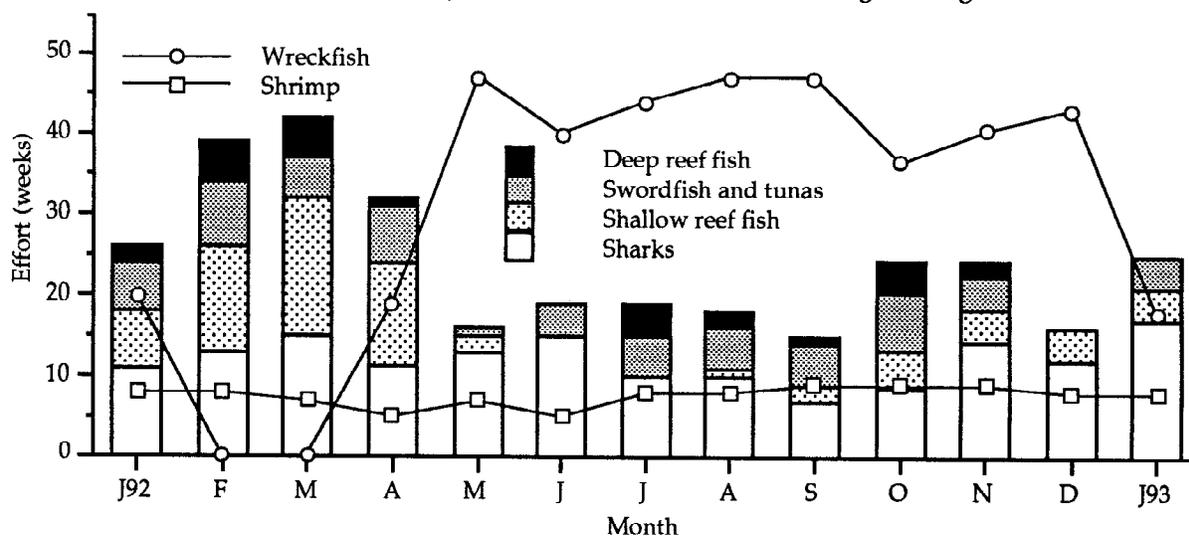
Figure 22. Fishing effort by month for vessels with wreckfish landings during 1992-1993.



fishery allocated effort to the shallow and deep reef fish during the summer and fall, with allocations to the deep reef fish complex coming a month or two prior to those for shallow reef fish.

If a mapping of vessel effort allocations were available for 1993-1994, it is virtually certain that the pattern of vessel effort allocations would be different from that shown in Figure 23. This is true because the NMFS began to manage the federal-waters shark fishery during 1993, and the initial plan resulted in a three month closure during the first half of the year, and closure for all but one month during the second (United States 1993a,b). As NMFS described their management plan at public hearings throughout the southeast during 1992 (United States 1992a), it was found that the shark plan also influenced vessel wreckfish effort allocations during the initial year of wreckfish ITQ management.³⁸ Based on information from the shareholder interviews, it was determined that about 20% of the vessels with wreckfish landings during 1992-1993 altered their fishing effort allocations due to regulation changes for fisheries other than wreckfish. For the 1993-1994 season, the comparable number was 50%. In the first instance, the majority of reallocations were motivated by knowledge of pending shark management regulations, and in the second, most cited the closure of the commercial shark fishery.³⁹

Figure 23. Effort by month and fishery for vessels with wreckfish landings during 1992-1993.



It now appears that the southeast fisheries which provide income alternatives for vessel owners with wreckfish harvesting rights — in particular those for sharks and reef fish — have reached a point in their evolution where significant changes in management regulations can be expected for several years hence. As a result, it is likely that some wreckfish effort allocations will continue to be influenced by regulation changes in these alternative fisheries. A practical implication of these developments in the context of wreckfish management program evaluation is that the changing fisheries regulatory environment will probably slow the transfer of wreckfish harvesting rights and so extend the period required to achieve minimum-cost wreckfish harvests from that which would have occurred otherwise. Accepting that the dynamic southeast fisheries regulatory environment will continue to influence wreckfish effort allocations, it should of course also be expected that these circumstances will influence the quantity of wreckfish landings, although the expected effects of the changing regulations on annual effort and landings will likely depend on the particular actions of management. For example, future closures of the federal-waters shark fishery could be expected to increase wreckfish effort and landings, all else constant, while in contrast, industry awareness of management proposals to manage shallow-water reef fish via a system of harvesting rights could be expected to reduce wreckfish effort and landings.

Harvesting Rights Ownership

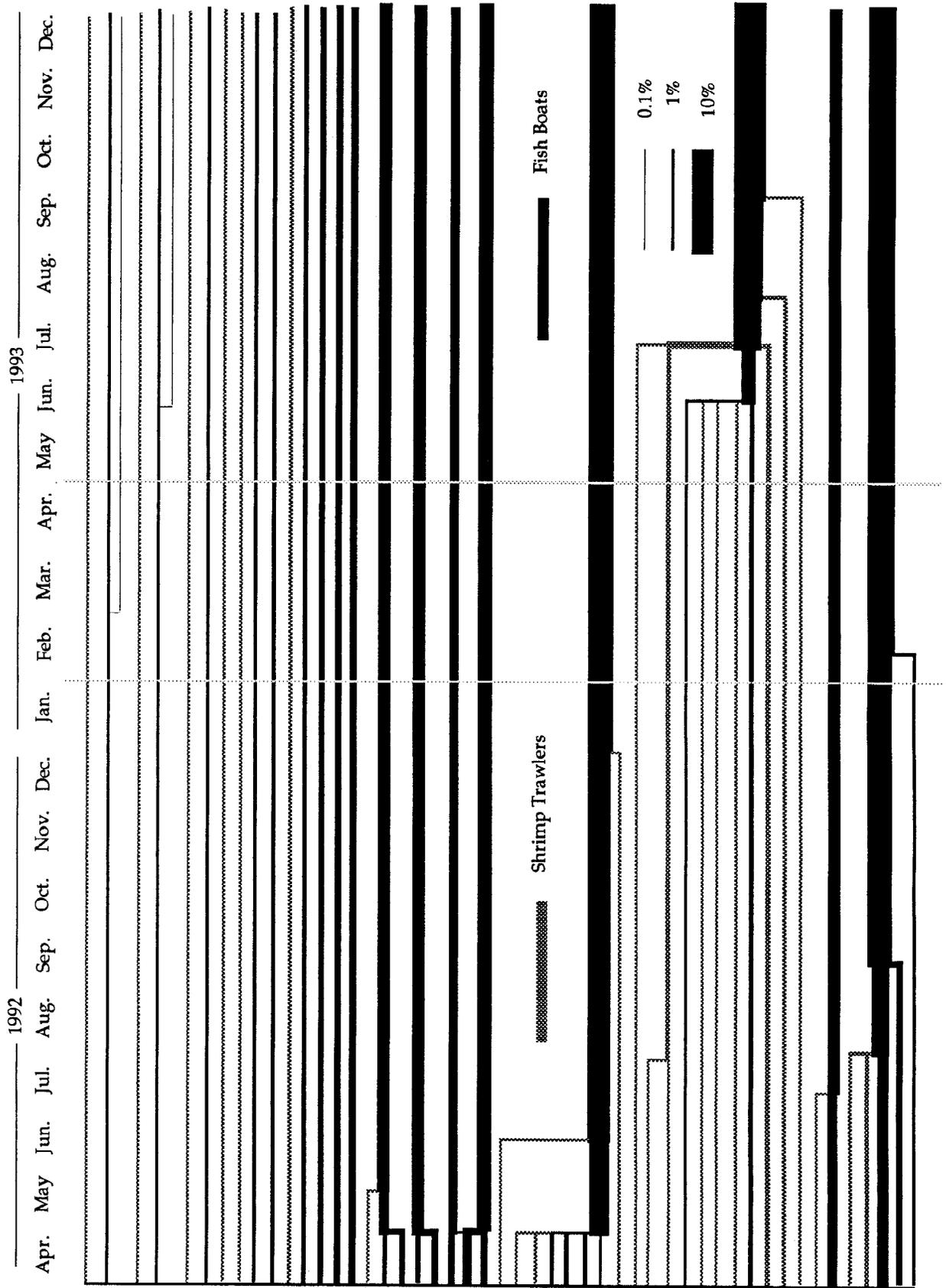
The initial share allocation distributed harvest rights to forty-nine vessel owners based on fishing activities during 1987-1990. As noted previously, harvesting rights were denominated in lbs., conferred to vessel owners in amounts equal to a percentage share of the wreckfish TAC, and freely transferable. The initial vessel group included twenty-five fish boats and twenty-four shrimp trawlers, with 57% owner-managed and operated, 20% owner-managed, and 22% owner-managed by individuals with business interests in seafood distribution. Measured in percentage shares, fish boats and shrimp trawlers initially received 64% and 36%, respectively, of the wreckfish harvesting rights.

Share exchanges since the initial allocation served to establish a market value for wreckfish harvesting rights. Figure 24 shows a time line of these wreckfish share exchanges by month and vessel type from the start of ITQ management through October of 1993. Transfers during the initial season of the ITQ program were motivated by the demands of the owners of about a dozen vessels, ten of which received initial shares smaller than their landings during the final year of open access. Share supplies were provided by six vessel owners who sold harvesting rights just prior to the start of the 1992-1993 season, and eight more who decided to sell before the end of the season.

The sixteen share exchanges during the initial season of ITQ management resulted in the transfer of the harvesting rights for nearly 550,000 lbs. of wreckfish at a total value of just over \$280,000. The average size of the shares exchanged during 1992 was 1.9%, with exchange quantities coming from fish boats and shrimp trawlers in the same proportion as given above for the initial share allocation. The 1992 sales produced an average value for rights of \$0.51/lb., and given the two million lb. TAC, indicated a gross value for all wreckfish harvesting rights of about \$920,000.

About 65% (by weight) of the rights exchanges during 1992 represented the "on paper" completion of fishing effort allocation decisions made prior to the final season of open access. That is to say, most of the exchanges during the initial year of ITQ management reflected the actions of the owners of ten vessels (seven shrimp trawlers and three fish boats) that did not allocate effort to wreckfish during the 1991-1992 season, and probably would not have provided any during the 1992-1993 season regardless of the actions of fishery managers. The remaining 35% of rights exchanges involved two shrimp trawlers and two fish boats that made thirty-two wreckfish trips during the 1991-1992 season. As these vessels continued to allocate effort to wreckfish during the final year of open access, these exchanges may more legitimately be said to represent fishing effort allocation decisions made within the context of the ITQ management environment.

Figure 24. Wreckfish percentage share exchanges by month and vessel type, April 1992 - October 1993.



Share transfers during 1993 were motivated by the addition of three new vessels and a vessel replacement (one of the new vessels was "sold out" of the fishery during 1992-1993). Share supplies during 1993 were provided by the owners of eight shrimp vessels and three fish boats. About 30% of the share transfers during 1993 were from vessels which last allocated effort to wreckfish prior to the 1991-1992 season. Although the remaining eight vessels did land wreckfish during the final year of open access, effort levels for many were very low (the eight vessels together made only seventeen wreckfish trips). Hence it appears that many vessel owners that chose to allocate only small amounts of effort to wreckfish during the transition to ITQ management also chose to postpone for a period their decisions to leave the wreckfish fishery. This may have been due to a lack of familiarity with the workings of the market for harvesting rights and or the relatively low cost of carrying harvest rights. In the latter regard, the annual "carrying cost" for a 2% share of the fishery was calculated to be about \$650 given the average share value observed during 1992 and the 3.4% short-term interest rate used to value preferred fishing assets.

Share sales reported through October during the second year of ITQ management totaled 310,000 lbs. and were valued at just over \$190,000. As a result, the average value of wreckfish harvest rights was \$0.61/lb. during 1993, and this represented a 20% increase over the average value observed during 1992. From program start through October, 1993, the percentage of harvest rights owned by vessel owner-operators decreased to 41% from 57%, the percentage held by owner-managers increased to 25% from 20%, and the percentage held by owner-managers who were also seafood dealers increased to 34% from 22%. Compared with the group of vessels that landed wreckfish during the final year of open access, the net effect of the implementation of the ITQ management program and the share transfers through October, 1993 was to remove nine fish boats and eight shrimp vessels from the harvesting sector. At the same time, nominal effort and landings were reduced by about 33% and 40%, respectively.

Figure 24 also shows that during 1993 the owners of two fish boats purchased fractional 0.1% wreckfish shares. Given the constructs of the management program, it can be safely assumed that these purchases were made solely to obtain the right to purchase additional harvest rights via the future purchase of annual quota coupons. As these sales were made by vessel owners who chose not to participate in the information collection, no information about the value of these exchanges was obtained.

To assess whether the market for wreckfish harvesting rights could be considered to have functioned according to expectations, observed exchange prices were compared with those that may have been expected given economic theory and the shareholder data on wreckfish revenue and cost experiences. In this regard, Maloney and Pearse (1979) assert that vessel owners should demand or offer harvest rights depending upon whether the net revenue that is expected from the catch, at the margin, exceeds or falls short of the market price. For the wreckfish ITQ program, harvest rights were issued indefinitely. In this case, it may be more appropriate to anticipate that vessel owners would demand or offer rights depending on whether the present value of the expected time-stream of net revenue from wreckfish landings exceeds or falls short of the price for harvest rights. Where rights holders contemplate selling out of the fishery, the situation would appear somewhat analogous to that where a firm must endure a forced shutdown (i.e., by selling all wreckfish shares a vessel owner implicitly accepts that no further wreckfish effort may be produced). For this case, producer willingness to pay to remain in production is more properly measured as profit plus unavoidable fixed costs (Just, Hueth and Schmitz 1983). As all shareholders had experience with multiple southeast fisheries and only one indicated a likelihood of leaving commercial fishing if wreckfish fishing activities were unavoidably disrupted, it seems that vessel owners would judge the existence of unavoidable fixed costs within the context of expected differences in the amount of vessel annual fixed costs that could be covered "on average" from wreckfish revenues as opposed to revenues from other southeast fisheries.

While a comparison of exchange prices with seller and buyer experiences with wreckfish net revenues and fixed costs would seem straightforward, such comparisons are clouded by the real-world complexity of multibusiness ownership, the different wreckfish harvest regulations in effect during the

periods for which cost and revenue experience were recorded and presently, and the lack of data on shareholder expectations about fixed cost coverage by fishery. For example, most vessel owners with business interests in seafood distribution also had business interests in the provision of fishing inputs such as fuel, ice and bait. To the extent that some portion of the profits and perhaps unavoidable fixed cost coverage of shareholder synergistic business interests are viewed as dependent on wreckfish share ownership, it is plausible that such shareholders would consider expectations about some portion of the results from these businesses activities when contemplating the purchase or sale of wreckfish harvesting rights.

Given the analytical complexities and data concerns noted above, it was concluded that an unequivocal assessment of the market for wreckfish harvesting rights was beyond the limits of the data collected for this study, and that the best that could be provided was a rough characterization of the functioning of the rights market based on an ad hoc comparison of the observed exchange values and the net revenue experiences of the buyers and sellers.⁴⁰ However, it must be kept in mind when reviewing these comparisons that strictly comparing share values and net revenue experiences in this way does not consider any synergistic business values which may be associated with wreckfish share ownership and implicitly assumes that vessel owners which decide to sell out of the wreckfish fishery do not face any unavoidable fixed costs.⁴¹

The shareholder surveys provided information on the net revenue experiences of share buyers and sellers for thirteen of the twenty-nine wreckfish rights exchanges that occurred through October of 1993. In all cases share-buyer net revenue experience was for the 1992-1993 season while share-seller experiences were for various years during 1988-1991. To make the comparisons, the share exchange values and vessel net revenue results were calculated on a per-pound basis. As two share suppliers had decided to sell their vessels and leave commercial fishing before the wreckfish ITQ program was implemented, these exchanges were excluded from the comparison. Of the eleven remaining exchanges, six involved share sellers calculated to have generated negative vessel net revenues from wreckfish during their most recent year of harvesting experience. Hence, in each of these cases it can be said that share sellers received prices for harvesting rights that probably exceeded the present value of a uniform future income stream equal to the wreckfish net revenues obtained during their most recent year of harvesting experience. For the remaining five cases, the prices obtained by share sellers ranged from 10%-50% and averaged 25% of the present value of a constant income stream equal to calculated vessel net revenues from wreckfish during the most recent year fishing.

From a buyer perspective, the prices paid for wreckfish shares in some cases exceeded vessel annual net revenue but for all but one case were less than the present value of a constant income stream equal to this value.⁴² For most share buyers, exchange values ranged from 13%-25% of the calculated present value of vessel net revenue experience. Interestingly, the exchange prices obtained by share buyers would have represented smaller proportions of calculated share values were it not that high risky interest rates were recorded for most share buyers.⁴³

In summary, the market for wreckfish harvesting rights during the initial year of ITQ management involved the exchange of novel property by a very small number of market participants. The market was motivated almost exclusively by the demands of vessel owners that received percentage shares smaller than their landings during the final year of open access. If it can be accepted that vessel owners are able to calculate the vessel profit share from wreckfish effort and value harvesting rights based on a future projection of recent profit experience, then most share exchanges appeared rational in the sense that prices were above share values calculated for sellers and below those calculated for buyers. At worst, it appears that the value of wreckfish harvesting rights may have suffered due to the small number of individuals willing to invest in the ownership of wreckfish harvesting capacity.

Quota Coupon Values

The design of the wreckfish ITQ management plan provided for the annual distribution of harvest rights as an amount of individual quota coupons. For permitted vessels, individual quota coupons confer the right to possess and land a corresponding quantity of wreckfish during the April 15 - January 15 open season. As such, quota coupons provide harvest rights for a defined time period. Quota coupons are distributed just before the start of the open season with each shareholder of record receiving an amount equal in weight to the owned percentage of the current TAC. Once distributed, quota coupons are freely transferable, but only among the owners of fishery percentage shares.

During the initial year of ITQ management, the population of effort decision-makers holding wreckfish percentage shares was initially forty-one and by way of percentage share exchanges was subsequently reduced to thirty-two. The shareholder survey allowed information about coupon market activities and quota coupon values to be obtained from thirty-two of these decision-makers. Although the NMFS refused to provide this study with the quota coupon cancellation files, it is believed that information was obtained for all coupon exchanges during the 1992-1993 season. All those interviewed appeared to understand correctly that quota coupons were valid only for one year and could only be purchased from, or sold to, other percentage-share owners.

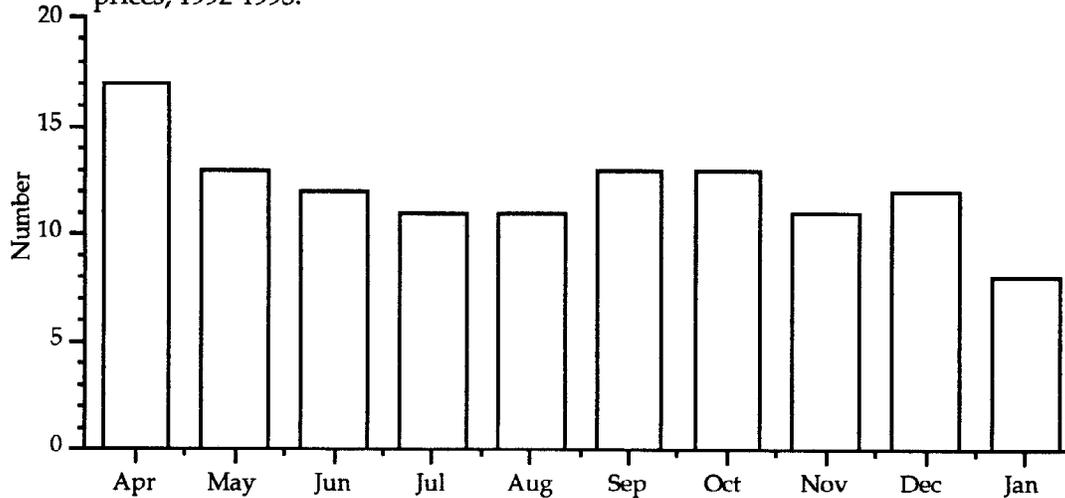
To assess the functioning of the quota coupon market, shareholders were first asked about their expectations for wreckfish fishing activities at the start of the 1992-1993 season. The shareholder responses indicated that 72% had planned to use or rent all of their coupons during the open season, and that 15% had planned to purchase quota coupons. As it turned out, 43% of those that planned to use or rent all of their coupons were not able to do so while the remaining 57% were able to cancel or rent percentages of their coupons ranging from 86%-94%. All who planned at the start of the season to rent coupons eventually did so.

The shareholder survey also included questions designed to determine shareholder awareness of coupon price levels during the open season and, in particular, whether coupon price levels changed during the open season. Here, 65% of shareholders indicated they possessed good information about coupon prices during at least one month of the open season, and 34% indicated they possessed such information for six or more months of the open season. Figure 25 shows by month the number of interviewed shareholders indicating they possessed good information about coupon prices. With regard to methods used to obtain coupon price information, 78% of shareholders indicated they relied on word of mouth or "the grape vine" to obtain their price information and 22% indicated systematic telephone surveys were used to discover coupon price levels. Interestingly, just over half (56%) of those indicating they possessed good information about coupon prices during six or more months of the open season were able to describe accurately the evolution of coupon prices during the 1992-1993 season.

Shareholders also were asked about their activities in the coupon market and, for those involved in coupon exchanges, about the relative importance of a list of factors that were thought likely, based on simple vessel economics, to have been important for coupon purchase and sale decisions. With regard to market activity, 56% of those interviewed considered selling quota coupons during 1992-1993 and of these individuals, 27% contacted other shareholders to promote their interests, 57% received inquiries from others regarding their willingness to sell coupons, and 45% were able to sell some or all of their coupons. On the demand side of the market, 19% of the interviewed shareholders considered purchasing coupons at some time during 1992-1993, all contacted other shareholders to promote their interests, and 83% of those that considered purchasing coupons eventually did so.⁴⁴

Table 8 shows the importance ratings assigned by coupon sellers and buyers to the list of factors presented as possibly influencing their quota coupon buying and selling decisions. As the responses summarized in Table 8 indicate, coupon sellers viewed the harvesting costs that would be required to use their coupons and the prices bid for their coupons as the factors most often important for their decision

Figure 25. Number of shareholders indicating they possessed good information about coupon prices, 1992-1993.



making. For coupon sellers, the importance ratings reflect the thinking of vessel owners who had very little intention of fishing for wreckfish during the 1992-1993 season and instead planned in advance to sell their coupons. For coupon buyers, the factors most often important for their purchasing decisions were the quantity of unused coupons in their possession and the boat price expected for wreckfish. Coupon offer prices and wreckfish catchability were indicated to be of importance less often. Coupon buyers viewed the quantity of uncanceled coupons most often important and the cost to use the coupons least often important because buyers were vessel owners who planned to allocate full-time effort levels to wreckfish, had received percentage shares smaller than their landings during previous years, and were unable or unwilling to purchase percentage shares large enough to allow the harvest of all of the wreckfish they planned to catch. All who eventually purchased quota coupons indicated they planned at the start of the season to purchase coupons.

Figures 26 (A,B) show the average coupon prices and exchange quantities by month during the initial year of ITQ management. These coupon exchanges resulted in the transfer of harvesting rights for just over 218,000 lbs. of wreckfish at a total value of about \$43,500. Coupon prices and quantities are distinguished by transaction type because, in practice, the different harvesting rights ownership arrangements conferred different levels of business independence. That is to say, prices for outright sales represent exchanges among the owners of percentage shares while those for vessel associations represent exchanges among shareholders and a vessel owner whose right to participate in the fishery remains contingent upon the maintenance of a satisfactory business relationship with a shareholder.

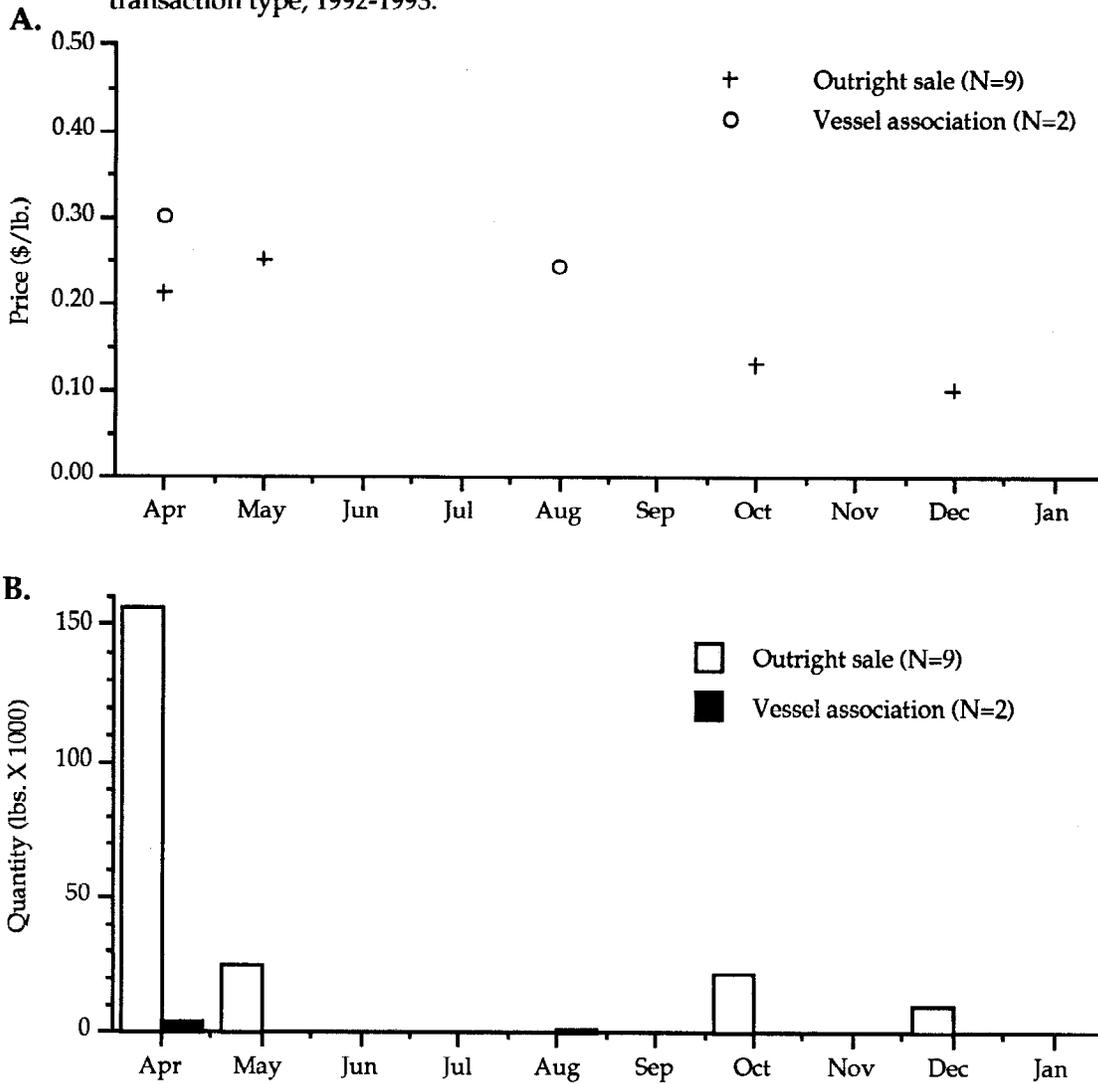
Figure 26(A) shows that coupon prices were about \$0.25 at the beginning of the season and about \$0.10/lb. at the end. Figure 26(B) shows that most coupon exchanges occurred at the beginning of the season when prices were high, and that exchanges from vessel associations accounted for a very small portion of the coupon exchanges. The annual pattern of coupon prices corresponds to the stylized pattern suggested by Linder (1990) as appropriate for annual harvest rights during a "bad season" (i.e., a season where catch rates are lower than average).⁴⁵ As described by Linder, prices at the beginning of a bad season should reflect a level determined by the initial state of expectations concerning catch rates, and during the season, should trend toward a level that reflects an "option premium," or value associated with avoiding the risk of not being able to land and sell wreckfish that have been caught. While the annual quota market for wreckfish exhibited some features in common with those described by Linder for a bad season (namely that catches fell short of the TAC and demands for quota coupons fell off to option-premium levels by the end of the season), there is little evidence to support characterizing the initial year of ITQ management as a bad season for wreckfish harvesters. Especially with regard to catch rates and exvessel prices, the data indicates that economic conditions within the wreckfish fishery improved during the transition to ITQ management.

Table 8. Relative importance of quota coupon seller and buyer decision factors.

Average importance rating of coupon-exchange decision factors by coupon sellers (N = 8)				
Wreckfish catchability	Wreckfish price	Quantity of unused coupons in possession	Harvesting costs required to use coupons	Bid price of coupons
1.7 a	2.4	2.4	3.4	3.6
Average importance rating of coupon-exchange decision factors by coupon buyers (N = 5)				
Wreckfish catchability	Wreckfish price	Quantity of unused coupons in possession	Harvesting costs required to use coupons	Offer price of coupons
2.6	4.0	4.4	1.8	3.4

a Range of 1 to 5 with 5 almost always important, 3 sometimes important, and 1 almost never important.

Figure 26. (A) Average quota coupon prices and (B) coupon exchange quantities by month and transaction type, 1992-1993.



It appears that the most important difference between the annual quota market for wreckfish and those described by Linder for snapper in New Zealand would concern the level of fishery harvesting capacity. In contrast to the New Zealand snapper fishery, which evidently was encumbered by chronic overcapacity during the transition to ITQ management, it appears that the wreckfish fishery sustained a fishing effort "deficit" during the transition to ITQ management. This effort deficit was attributed to the decisions of some multifishery vessels to allocate only small amounts of effort to wreckfish during 1992-1993, and to the decisions of some shareholders to leave the wreckfish fishery. As noted previously, the decisions of some multifishery vessels to allocate only small amounts of effort to wreckfish were sometimes influenced by management actions proposed for other southeast fisheries.

A rough appreciation for the relative influence of the factors which brought about the effort deficit during the transition to ITQ management can be obtained by comparing 1992-1993 landings with those of the final year of open access. In this regard, the 1991-1992 landings of vessels owned by those allocated harvest rights initially was about 1.8 million lbs. while total 1991-1992 landings were just over 1.9 million lbs. (the difference in these amounts was found to be attributable mainly to the time period

chosen for judging whether vessels qualified for harvesting rights). Hence, if the group of vessels with rights initially and landings during the final year of open access had made the same effort allocations and achieved the same results during the initial year of ITQ management, then the entire TAC would have been landed (i.e., 1.8 million lbs. of eviscerated landings provides a whole weight equivalent of 2 million lbs.). Further, for the group of vessels that decided to make at least one wreckfish trip during the initial year of ITQ management, 1991-1992 landings were about 1.4 million lbs. while those during 1992-1993 were about 1.1 million lbs. Although these vessel owners were allocated harvesting rights for only about 825,000 lbs., purchases of percentage shares and quota coupons eventually allowed the group to increase its ownership of harvesting rights to about 1.55 million lbs. Hence, about 60% (400,00 lbs.) of the landings shortfall during the initial year of ITQ management may be attributed to the decisions of some vessel owners to leave the fishery, and about 40% (300,000 lbs.) may be attributed to the decisions of some shareholders to allocate only small amounts of effort to wreckfish.

The annual pattern of annual quota prices may also be viewed within a "supply and demand curve for quota coupons" framework. Within such a framework, it may be expected that shareholders would offer coupons in those cases where coupon prices exceed the expected profits and perhaps unavoidable fixed costs associated with wreckfish harvesting, and would purchase coupons in those cases where prices were less than expected profits. While in theory it would be possible using the logbook and cost data to calculate such a supply curve for quota coupons, in practice a more difficult problem would be that associated with measuring the location of the corresponding demand curve for annual quota coupons.⁴⁶ The reason for this is that the monthly quota demand curve will be influenced by changes in the ownership of substitute rights (i.e., percentage shares) as well as random events such vessel breakdowns and technology changes. For the present transition phase to ITQ management, the annual quota market was in no doubt characterized by shrinking demands for quota coupons as the season progressed. However, these changes were motivated not by changes in expected profits from wreckfish harvesting, but by the exhaustion of the harvesting capacity allocated to the fishery and the ability of some rights demanders to substitute the purchase of percentage shares for quota coupons. Although percentage shares were more costly than quota coupons, many vessel owners were interested primarily in purchasing these rights because they received percentage-share allocations smaller than their previous catch levels.

In summary, the market for annual quota coupons was similar to that for percentage shares in that transactions involved the exchange of novel property by a very small number of market participants. Based on the responses of shareholders, it did not seem that the availability of market information was perceived as a constraint to obtaining mutually satisfactory quota coupon exchange prices. Market activities during the initial year of ITQ management were motivated primarily by the initial allocation of wreckfish percentage shares and were, in turn, influenced by the percentage-share exchanges that occurred. These factors stand in contrast to the uncertain and unexpected events that would be expected to motivate market transactions in circumstances where harvesting sector effort allocations routinely result in a harvesting capacity that closely matches allowable catch levels.⁴⁷

4. Discussion

The primary goal of this project was to establish a data baseline for the wreckfish fishery that could serve as a foundation for subsequent monitoring and assessment efforts, and this was achieved. The data collection effort also allowed other near-term project goals to be reached, and in particular these included measurement of the economic values generated by the wreckfish harvesters during the transition to ITQ management, and a comparison of vessel net revenues from wreckfish and market prices for harvesting rights. The longer-term project goals (i.e., the consideration of questions such as whether additional stock research or changes in harvesting technology will yield increased fishery rents, and how market prices for harvesting rights may respond to changes in these factors) must await future wreckfish monitoring and assessment efforts.

At the outset, a determination as to whether any of the wreckfish economic values that might be measured during 1992-1993 could be attributed to the adoption of the rights-based management plan was also included as a project goal. However, given hindsight and the complex and dynamic regulatory environment of southeast fisheries, this goal now appears overly simplistic at best and naive at worst. This is because the wreckfish ITQ program comprised only a portion of the continuum of fishery regulations that were implemented to manage southeast fisheries, and many of these other regulations also influenced the wreckfish economic values measured by this project. Of these regulations, perhaps the most important were the wreckfish spawning closure and prohibition on longline gear, and the federal-waters shark management plan.

Although many of the fishery regulations that impacted the wreckfish fishery occurred at different times, all seemed to share one characteristic, and this was that all worked to slow down and ultimately reverse the rapid effort and landings increases that occurred during the initial development of the fishery. As a result, it is very likely that wreckfish fishery benefits during the initial year of ITQ management were smaller than, say, those during the final year of open access, with the reduction caused by the smaller level of landings. The implication here is that the portion of wreckfish management regulations that implemented the ITQ program probably caused an economic loss due to the reduced economic value generated by wreckfish harvesters during 1992-1993. Whether the economic loss that accompanied the transition to ITQ management will be only short-term, or transitory, depends on whether or not wreckfish landings return to levels near the total allowable catch. And of course, whether these economic changes will eventually be viewed simply as short-term decreases in fishery economic performance due to the imposition of a novel management program, or alternatively as sacrifices necessary to avoid a much larger and more serious longer term economic loss, depends on what becomes known about wreckfish natural history.

The uncertainty surrounding wreckfish natural history is mentioned now because it requires the adoption of an important analytical caveat, and this caveat must be kept in mind throughout the discussion presented here. That is to say, all that follows was written with the implicit assumption that the two million lb. TAC set by managers represents a level of catch that can be sustained from the Blake Plateau on average over the long term. Yet, wreckfish natural history is poorly known and the biological information so far collected really provides little direct support for the notion that a two million lb. TAC will be sustainable over the long term. On the other hand, there is little information available that would support higher or lower values either. What is known now is that perhaps ten years will be required for any U.S. fishery-induced changes in wreckfish recruitment to become apparent, that recently measured spawning stock biomass ratios are right at the overfishing threshold, and that the SSBR measurements contain the implicit assumption that catches of Blake Plateau wreckfish represent the only removals from a very localized stock. While this assumption concerning the extent of the wreckfish stock was required to carry forward the SSBR calculations, it is also known that wreckfish are taken by other fisheries within the North Atlantic. The implication here is that the methods used to calculate the SSBR cannot be characterized as conservative, just the best available.

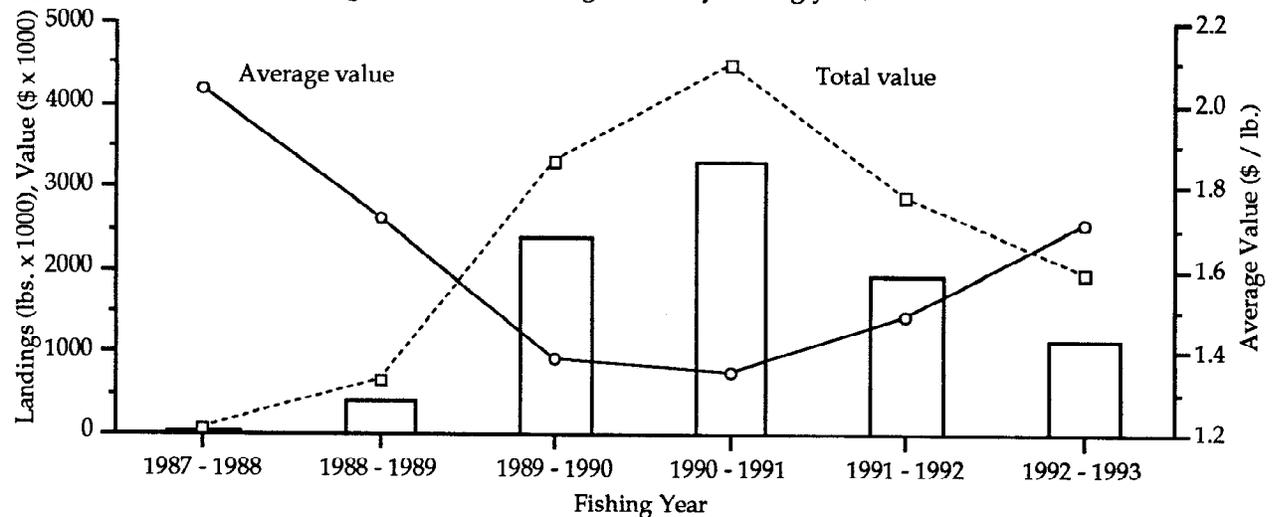
A second reason why a focus on attributing economic benefits to the implementation of the ITQ management program now appears misplaced is that the implementation of the wreckfish ITQ program was justified with reference to costs, and not benefits. In particular, the program explicitly stated that its primary objective was to reduce or eliminate the potential for future growth in fishing and regulatory costs and harvester conflicts. Again, depending on what becomes known about wreckfish natural history, it may turn out that the reduction in landings caused by the transition to ITQ management was simply a short-run social cost associated with avoiding unknown but probably higher longer-term costs. However, if it can eventually be demonstrated that wreckfish reproductive security was threatened by the rapid pace of fishery expansion, and so substantially reduced harvest rates were appropriate and indeed required, then the results obtained from the management program would seem very different. Obviously, achieving consensus about the correct interpretation of the economic effects brought about by the ITQ management program will require further study and information about wreckfish natural history.

Summary of Results

Figure 27 shows annual wreckfish landings and total and average wreckfish values from the discovery of the fishery through the initial year of ITQ management. Compared to the final year of open access, nominal effort and total landings during the initial year of ITQ management were smaller by 33% and 40%, respectively, and the average value of landings was higher by 15%. These factors together produced a total value of landings about 30%, or nearly \$900,000, less than was obtained during the final year of open access. If the entire total allowable catch were to have been taken and wreckfish prices remained unchanged during 1992-1993, then the total value of landings would have been about \$1.4 million higher, and highliner rents perhaps \$250,000 larger. On the other hand, no studies to quantify the dependence of wreckfish prices on wreckfish landings or substitute seafoods have been conducted, and so the possibility that 1.8 million lbs. of landings during 1992-1993 would have produced average values comparable to those during the previous year cannot be ruled out. Thus, the values noted here represent upper-bounds for the revenue and rent decreases that accompanied the transition to ITQ management.

The shareholder survey provided vessel cost and effort allocation data for thirty-seven vessels including the seventeen vessels that provided 99.9% of wreckfish landings during the initial year of ITQ management. These same vessels also provided 70% of wreckfish landings during the final year of open access. The survey data indicated that the group of vessels qualifying for percentage shares initially was about half owner-managed and operated, and about half owner-managed. Further, about 40% of owner-managed vessels were owned by individuals with business interests in seafood distribution. The survey

Figure 27. Wreckfish landings, value, and average value by fishing year, 1987-1993.



data also revealed that the group of vessel owners receiving percentage shares initially possessed many years of commercial experience, both with seafood distribution and with the alternative southeast fisheries for shrimp, sharks, shallow and deep reef fish, and swordfish and tunas. As it turned out, shareholders that decided to allocate effort to wreckfish during the initial year of ITQ management had significantly less experience with seafood distribution and shrimping than those who received shares but chose not to allocate effort to wreckfish.

While just about all of the vessels that allocated effort to wreckfish during the initial year of ITQ management also allocated effort to other southeast fisheries, the shareholder interviews revealed clear differences in the fishery emphasis of the shareholders. In this regard, shareholders fell primarily into two groups: vessel owners with a focus on the wreckfish fishery and vessel owners with a multifishery focus. Analysis of the vessel logbook data indicated that these groups could be separated according to the number of months during which wreckfish trips were made. As it turned out, full-time wreckfish vessels were found to have made wreckfish trips during seven or more months of the open season, with multifishery vessels making wreckfish trips during at most six months of the open season.

The vessel logbook data also provided information on the dynamics of wreckfish effort, fishing practices, and catch per unit of effort during the transition to ITQ management. Analysis of the logbook data confirmed that the derby fishery expected during the final year of open access was a "nonevent," and that by the halfway point of the season nominal effort had fallen to levels that have remained virtually unchanged through to the present. The logbook data also indicated that most of the vessels which allocated effort to wreckfish during the initial year of ITQ management had allocated similar levels of effort to the fishery during the final year of open access, and that fish boats as opposed to shrimp trawlers supplied the largest portion of wreckfish effort during the transition period. It was also determined that five vessels with landings during the final year of open access were not able to qualify for a percentage share of the fishery.

The logbook data also showed that the seasonal pattern of nominal effort did not change very much during 1991-1993, with effort levels always higher during the spring, summer and winter, and lower during the fall. The average effort levels supplied by full-time vessels also did not change during the transition to ITQ management, and based on these average values, the entire harvesting sector supplied the nominal effort equivalent of about a dozen full-time vessels during 1992-1993.

With regard to fishing practices, the decrease in fishing hours per day absent recorded during 1991-1994 was consistent with shareholder reports that fishing practices are changing, and in particular, that vessel operators are now allocating more time to both mapping the bottom features of the established grounds and prospecting for new grounds. Further, harvesters are currently testing SONAR gear thought capable of identifying wreckfish concentrations on the Blake Plateau. Although it is not clear that these behavioral changes can be attributed solely to the transition to ITQ management, it can be said that the testing of advanced SONAR carries implications for future harvesting practices. That is to say, if new SONAR technology allows harvesters to establish whether wreckfish are concentrated on bottom features without deploying the fishing gear, then the cost of exploratory fishing would be reduced and, all else constant, harvesters would be expected to allocate more time to it. In this regard, many shareholders indicated a belief that undiscovered fishable concentrations of wreckfish exist in the western Atlantic.

Analysis of the logbook data and information from the shareholder interviews together indicated that landings-per-day-absent probably provides the best index of wreckfish abundance and or vulnerability. The within-year levels of landings-per-day-absent showed a well-defined seasonal pattern, with levels about twice as high just prior to and after the winter spawning closure as for during the summer and fall. Although aggregate annual landings per day absent were found to have decreased by about 15% during the initial year of ITQ management, average monthly levels were very similar throughout the transition period. The slightly smaller annual average recorded during the initial year of ITQ manage-

ment was largely the result of relatively poor fishing during April and November. As these months are transition months between the periods of low and high CPUE levels which result from changes in spawning activity and perhaps also recruitment, the decrease appears attributable to random variability in the seasonal timing of these natural history factors.

The vessel costs and returns analysis indicated that, on average, vessel wreckfish incomes were \$115,000, harvesting costs were nearly \$75,000, and incomes above total cost were about \$40,000. It was also determined that average vessel income per day absent was the same through October of the second ITQ season as it was during the first. The shareholder interviews provided evidence that the share systems employed to spread the risks of fishing among the owners of capital and labor are changing, and this change can be attributed to the implementation of the ITQ management program. In particular, several vessel share systems now include ITQ fees as an additional trip expense, and this has served to reduce the income share of vessel labor. As noted, this was predicted for the case where harvesting rights are allocated to vessel owners, and follows because the ITQ program limits the number of vessels that may operate in the fishery. Lower share rates are accepted because employment in the wreckfish fishery is viewed as first-best by more labor than is required by the number of vessels with harvesting rights, and so share rates are bid down by crew members anxious for work (Anderson 1986, p. 233).

The costs and returns analysis also provided some results concerning the relative cost efficiency of wreckfish and multifishery vessels. Here it was found that while effort costs were higher for wreckfish vessels than for multifishery vessels, wreckfish vessels were able to achieve lower costs per pound of landings. In particular, average vessel cost was found to be \$1.12/lb. for wreckfish vessels and \$1.47/lb. for multifishery vessels. The reason for this was that average catch rates for wreckfish vessels, at 870 lbs./day, were about 56% higher than those of multifishery vessels. As one would expect, the higher catch rates yielded higher average incomes, and average daily income for wreckfish vessels was two-thirds again as large as was obtained by multifishery vessels.

The economic value calculations indicated that, given all the assumptions made to carry the calculations forward, wreckfish fishery rent during the initial season of ITQ management was about \$350,000, and it may have approximated \$435,000 were the opportunity cost of supervised deck labor in reality only 75% of regional manufacturing wages. Put in perspective, the annual rent value is similar to the value of a coastal home within the southeast region. As was noted, a more complete assessment of the social benefits from wreckfish harvesting would require the subtraction of the costs of management (including enforcement and stock research costs) and the addition of benefits due to wreckfish consumption. With regard to consumer benefits, it is likely that the annual economic value obtained from wreckfish consumption would equal or exceed the \$0.31/lb. value calculated for fishery rent. If the \$47,500 cost estimate of the wreckfish ITQ management program less enforcement and stock research can be taken at face value, then it appears that perhaps as much as \$300,000-\$400,000 could be expended on enforcement and or stock research annually with the fishery still providing positive value for society.

The costs and returns calculations also indicated that all of the fishery rents generated by the wreckfish fishery during the initial year of ITQ management were highliner rents. As noted, these rents are viewed as attributable to the comparative advantage of some harvesters for the low-cost production of wreckfish. Given the only very recent discovery of fishable concentrations of Blake Plateau wreckfish and their location more than one hundred miles offshore and under 1,500-2,000 ft. of sea water, this result does not seem unreasonable. Although managers have indicated their support for a policy of recovering all or a portion of fishery management and administrative costs from percentage-share owners should it become legal to do so, managers have not indicated whether government appropriation of some portion of the annual resource rent would be appropriate (South Atlantic Fishery Management Council 1991a). This is mentioned here because some ITQ management programs, notably those implemented by the government of New Zealand, contain provisions for government collection of resource rents via "royalties" payable by the holders of fishing rights (Clark et al. 1989, Linder et al. 1992).⁴⁸ Policies of this type are typically justified in the context of compensating the original owners of common property resources (i.e., U.S. society and the government treasury) for their willingness to accept a restriction on access.

It appears safe to say the New Zealand experience with fishery rent collection has been more complicated than expected (see Linder et al. 1992). Much uncertainty has surrounded the setting of appropriate royalty payments, and this appears to have resulted from relying on observed market values for annual quota to guide appraisals of resource rent values (Clark et al. 1989). One objective of carrying out the cost calculations from both the perspective of shareholders and society was to emphasize the fact that these values are determined using different concepts of economic value, and so there is really little reason to believe *a priori* that annual quota prices and resource rent values will correspond in any given year. Current ITQ management feasibility assessments suggest that fishery managers should not attempt to collect all of the resource rent, especially in those cases where its value cannot be determined (Sutinen et al. 1992). Others have noted that where resource use charges are justified as compensating resource owners for accepting use restrictions, they should be aimed at the collection of resource rents, and highliner rents should not be touched because claiming these rents would likely interfere with efficient longer-term investments in harvesting capacity (Anderson 1989).

For the case of wreckfish during the transition to ITQ management, resource rents appear to have been slightly negative even though both percentage-shares and annual quota coupons exchanged at positive prices. This can be explained by noting that highliner rents were positive in the aggregate and relatively large for some shareowners. It can be safely assumed that the prospects for these rents served to motivate the actions of those who purchased harvesting rights. Given the very recent discovery of fishable concentrations of wreckfish, their location offshore and at great depth, the rapid expansion of the harvesting sector initially, and the information obtained during the shareowner interviews, it is conjectured that the wreckfish fishery has yet to generate very much rent that could be attributed solely to the existence of the resource. However, this is not to say that the fishery will not generate resource rents sometime in the future, although the if and when remain highly uncertain. As noted previously, resource rents will develop when marginal vessels are able to earn income over and above the costs that *society* incurs to obtain the landings. In practical terms, this will require marginal vessels with harvesting cost profiles much nearer to those of the most efficient vessels operating today.

Resource rents and highliner rents are thought to reward *unique* factors in the production of wreckfish. Resource rents reward the existence of fishable concentrations of wreckfish and highliner rents reward the entrepreneurial skills of low-cost wreckfish producers. Similarly, the commercial fishing pier is another unique factor in the production of wreckfish, and packing fees reward this factor. As was noted, packing fees were \$0.20/lb. throughout the region during 1992-1993, and thus vessel income from wreckfish provided commercial fishing piers with about \$230,000 in rental payments during 1992-1993. Further, it should be appreciated that these rental payments compensated both the fishing services provided and the real property required to provide the services. These factor payments are mentioned now to emphasize the linkage between the quantity of commercial landings and the many culturally unique fishing ports that also serve as factors in the production of tourism and other "scenic amenity" services.

With regard to fishery switching, it was found that nearly 80% of the vessels with wreckfish landings during 1992-1993 also allocated fishing effort to other southeast fisheries, and roughly 60% of these vessels allocated more weeks to the alternative fisheries than to wreckfish. Because of this, the fishing effort allocation decisions of many wreckfish shareholders were influenced by regulation changes in these other fisheries. It was noted that regulation changes for other southeast fisheries can be expected for several years hence, and so it should also be expected that wreckfish effort allocations will continue to be influenced by regulation changes for other fisheries. The practical implications of these circumstances are thought to be that: 1) wreckfish landings and rents produced by multifishery vessels will be smaller than they would otherwise; and 2) the exchange of wreckfish harvesting rights will be slowed down, and so the period required to achieve minimum-cost wreckfish harvests will be extended.

Shareholders also provided information about their activities in the markets for wreckfish harvesting rights. This data indicated that percentage-share exchanges during the initial year of ITQ

management transferred harvesting rights for nearly 550,000 lbs. of wreckfish at an average value of \$0.51/lb., and through October of the second season of management, rights to land an additional 310,000 lbs. of wreckfish were transferred at an average value of \$0.61/lb. Hence, the annual return on asset value for wreckfish rights not including lease income seems to have exceeded 20%. One reason for the relatively high rate of asset appreciation may be that most share exchanges during the initial year of management involved share sellers that had already made decisions to leave the wreckfish fishery. On the other hand, although most share sellers during year two had allocated some effort to wreckfish recently, the effort levels were very low. It was also noted that two percentage-share exchanges during year two involved the sale of fractional 0.1% shares designed to transfer only the right to purchase individual quota coupons. Although defining the factors that would be considered to determine a value for this right presents a particularly challenging problem for the study of fisheries ITQ markets, no data on the values of these exchanges was obtained.

The costs and returns data and share exchange prices were used as a basis for evaluating the initial functioning of the market for wreckfish harvesting rights. Here it was found that, from the perspective of share buyers, virtually all exchanges were at prices less than the present value of recent vessel wreckfish net revenue experience. From the perspective of share sellers, prices exceeded this value for about half of the observed exchanges, and ranged from 10%-50% of recent vessel net revenue experience for the others. As noted previously, share-seller net revenue experiences were measured for various years during 1988-1991, and in some cases were from periods when wreckfish management regulations and abundance and or vulnerability were different than exist presently. For these shareholders especially, it may not have been realistic to expect that percentage-share valuations were based solely on the most recent vessel net-revenue experience from wreckfish. Also in this regard, it was noted that some shareholders may consider unavoidable vessel fixed costs and synergistic business incomes as important codeterminants of the price levels at which they are willing to part with wreckfish harvesting rights, and these items were not considered by the comparisons.

While it was admitted that the available data could not support an unequivocal assessment of the functioning of the market for harvesting rights, most of the share exchanges appeared rational given the individual circumstances of the fishing businesses concerned. In fact, most if not all of the several share exchanges that were calculated to have transferred harvesting rights to higher-cost vessels could be explained either by random factors such as difficulties with tax payments, family life, and business arrangements that, alone or in combination, can be seen to disrupt the activities of all types of small businesses, or by instances where vessel net revenue experience was calculated from an early stage of fishery development when management regulations and or wreckfish abundance were different and average catch rates probably higher.

It was also found that initial exchanges within the markets for wreckfish harvesting rights were motivated almost exclusively by the demands of vessel owners that received percentage-shares smaller than their wreckfish landings during the final year of open access, and that the number of individuals that eventually indicated a willingness to invest in wreckfish harvesting capacity was very small. Because of this, the value of harvesting rights that was established may have been on the low side. Although the rate of appreciation for wreckfish harvesting rights would not be considered disappointing, through the first two years of ITQ management the fishery has not attracted investment from outside the initial group of vessel owners and their immediate families. Factors that may account for this are that the wreckfish fishery is small and poorly known about outside the of southeast region, and that the financial environment for investment in commercial fisheries harvesting capacity within the southeast now appears very poor.

These circumstances are cited here to highlight the important role of the financial environment for investment in harvesting capacity when fishery management plans involve transferable harvesting rights and efficiency gains depend on the abilities of some harvesters to purchase the harvesting capacity of others. For the present case, it has been known for some time that limited-entry management plans

which feature ITQs and a TAC limit provide lower incentives for investment in harvesting capacity when compared to similar programs without these features (Clark 1985). The depressing effect on investment follows from the asymmetric effect on landings that the allocated TAC limit produces. That is to say, when resource abundance is high and catches would otherwise exceed TAC levels, total landings are constrained to equal the TAC. In contrast, when catch rates are poor and landings less than the TAC, no similar effect is produced. This leads to a situation where expected catches are less for any given level of fishery investment, and similarly, to a reduced incentive for investment in harvesting capacity. Low incentives for investment in harvesting capacity would seem to have at least two implications for wreckfish fishery management. For the short term, it would seem that the financial ability of existing shareholders to harvest the additional 400,000 lbs. needed to satisfy the TAC should not be taken for granted. For the longer term, if landings remain substantially below the TAC, then managers might consider the development of program components designed to boost incentives for investment in harvesting capacity.

Lastly, analysis of shareholder activities in the market for individual quota coupons indicated that 56% of the those interviewed considered selling quota coupons during the initial season of ITQ management but only 19% considered purchasing coupons. Coupon sales eventually transferred harvesting rights for about 220,000 lbs. of wreckfish, with prices initially about \$0.25/lb. and declining to near \$0.10/lb. by the end of the season. Although not all shareholders that considered purchasing coupons during the season were found to have purchased coupons, all who planned at the beginning of the season to purchase coupons eventually did so. Here, the market for annual quota coupons was similar to that for percentage shares in that the level of demand in the market was primarily the result of the distribution of harvesting rights that managers chose to begin the management program. Activities within the quota coupon market were heavily influenced by transactions in the percentage share market because percentage shares confer harvesting rights that are "substitutes" for the rights obtained when quota coupons are purchased. As the initial distribution of percentage shares was thus found to be the single most important factor motivating the establishment of wreckfish harvesting rights values initially, it was thought useful to add a section to the discussion which analyzed the rights distribution in more detail.

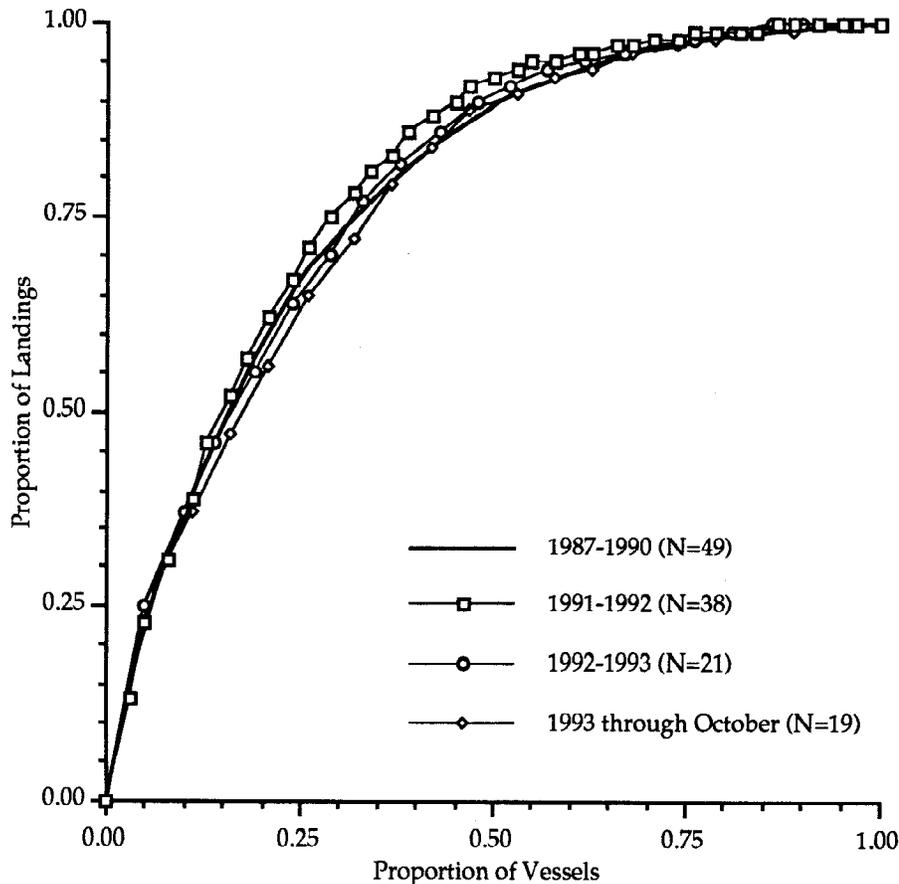
The Distribution of Wreckfish Harvesting Rights

It has been suggested that the initial distribution of harvesting rights has little implication for the efficiency of an ITQ management program (Maloney and Pearce 1979, Sutinen et al. 1992). However, these authors refer to theoretical "equilibrium" economic performance, and not economic performance along the transition path toward the "expected" equilibrium. To understand some of the economic effects of the wreckfish rights distribution during the transition to ITQ management, the features of the distribution were analyzed. The objective here was not to judge the equity of the distribution, but instead to describe what seem to have been the consequences of the distribution in economic terms. For wreckfish, the analysis indicates that the particular rights distribution chosen by managers probably had little effect on the short-term economic performance of the management program.

The allocation formula chosen by fishery managers distributed wreckfish harvesting rights according to recent fishery participation and historic landings levels, with no share allowed larger than ten percent initially. Managers noted that the formula was designed to balance the rewards provided to long-time active participants against providing more recent participants with a fair chance to remain in the fishery (South Atlantic Fishery Management Council 1991a). This balance was struck by distributing one half of the available shares equally among all qualifying vessel owners with landings during 1989-1990, and the remaining half according to total landings during 1987-1990 (the "fifty-fifty" distribution).

As vessel landings histories determined the distribution of percentage shares, the economic effects of the distribution were examined by making reference to vessel landings during the development of the fishery. Concentration profiles (Hilborn 1985) provide a way to examine the distribution of landings among wreckfish vessels over time, and Figure 28 shows the wreckfish landings concentration

Figure 28. Vessel wreckfish landings concentration profiles, 1987-1993.

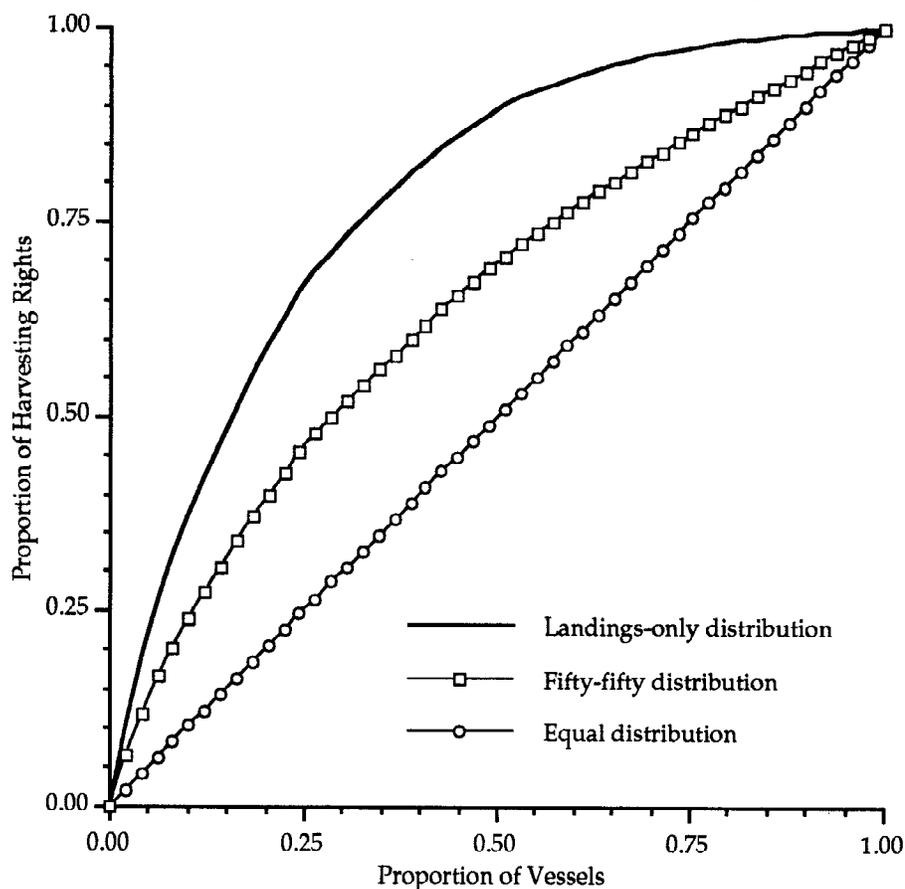


profiles for 1987-1993. Figure 28 includes the landings profiles for each fishing season during 1991-1993, and for the landings amounts of the forty-nine vessels that qualified for harvest rights. The profiles show that during the development of the fishery the proportion of vessels taking any given proportion of the landings changed very little. Interestingly, of the British Columbia salmon fishery profiles shown by Hilborn, the wreckfish profiles more closely resemble the relatively more concentrated sport fishery profile than the relatively less concentrated commercial purse-seine fishery profile.⁴⁹

Figure 29 shows the rights concentration profile for the distribution of wreckfish rights that was made to start the ITQ program, and also for the two principal alternatives that were considered and rejected by managers during plan development. These "bounding" alternatives were the equal distribution and a distribution based solely on historic landings amounts. As can be seen from Figure 29, if vessel owners had actually landed wreckfish in amounts equal to their rights initially, then the landings profile that resulted would have been considerably "flatter" than any produced by the fishery during its development. Hence in hindsight, there was little chance that vessel landings during the initial year of ITQ management would approximate the amounts distributed to vessel owners. Instead, the artificial "resetting" of the landings distribution mandated by the rights allocation catalyzed activity in the markets for wreckfish harvesting rights.

Figure 30 shows the fifty-fifty rights distribution and the landings-only alternative in term of vessel individual quota. As Figure 30 shows, compared with the landings-only alternative, the decision of managers to distribute half of the available shares equally among all who qualified to participate served to pivot the quota allocation about a locus of seven vessels that would have received similar quota amounts under either scenario. As such, the chosen alternative transferred about 385,000 lbs. (21%) of individual quota from the owners of the sixteen vessels with the largest historic landings amounts to the

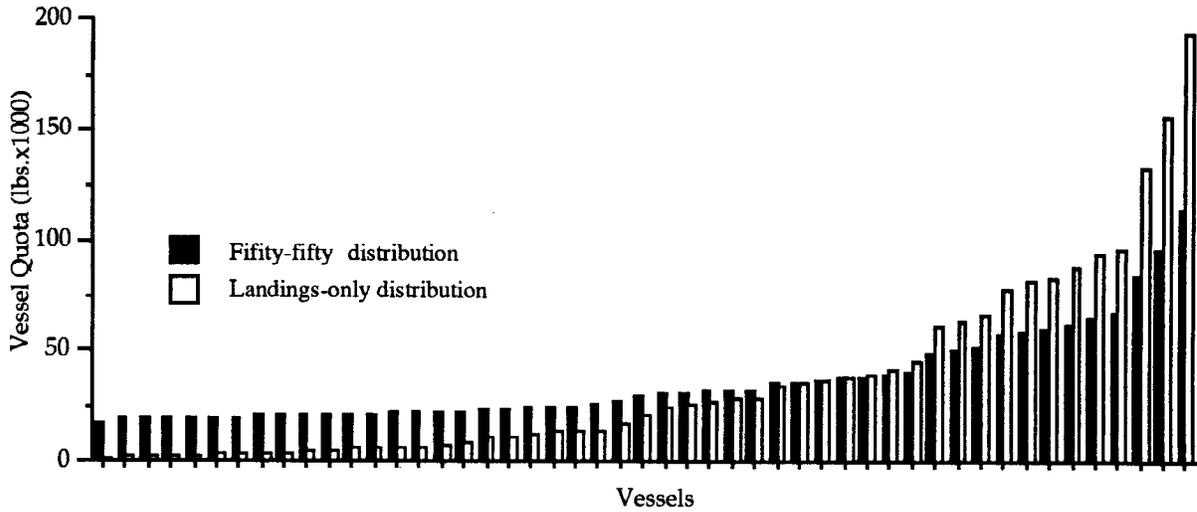
Figure 29. Alternative vessel wreckfish harvesting rights concentration profiles.



owners of the thirty-two vessels with the smallest historic landings amounts. If the equal-shares alternative had been selected, then the transfer would have been twice as large, or about 775,000 lbs. Given the average percentage-share price of \$0.51/lb. observed during the initial year of ITQ management, the fifty-fifty distribution could be viewed as transferring about \$200,000 of fishing rights from long-time active to more recent fishery participants.

Also along these lines, fishery managers indicated during ITQ program development that sufficient information was not available to determine in advance whether any particular rights distribution would result in a large number of instances where percentage-shares would exceed or fall short of the landings required for efficient vessel operation (South Atlantic Fishery Management Council 1991a). In fact, the primary rationale for awarding half of the shares equally to all was partly intended to eliminate instances of grossly insufficient initial awards and so achieve the objective of providing a fair chance for recent participants to remain in the fishery (Gauvin et al. in press). However, while managers knew the direction in which the fifty-fifty distribution would move initial share amounts, managers remained unsure about the economic consequences that would result, and in this regard justified proposals for transferable harvesting rights in part as necessary to allow the industry to rectify the "mismatch" among harvesting rights and historic landings that managers expected would be produced by the rights distribution. These equity issues are mentioned here because a few vessel owners testified during plan development that a gear compensation fund, designed to compensate the gear investments of any recent participants excluded from the fishery, might be warranted (South Atlantic Fishery Management Council 1991b). Although these comments seemed to engender support among industry participants, no version of the ITQ program contained such a fund.

Figure 30. Vessel individual quota for fifty-fifty and landings-only distribution formulas.



Given industry concerns that issues of equity might require those excluded from the fishery to be compensated for gear investment, and that fishery managers seem by design to have chosen a rights distribution that would achieve some of the same economic consequences as those which might have resulted from the establishment of a gear investment compensation fund, it was thought useful to assess the economic consequences of the rights distribution from the perspective of whether or not those who sold their percentage shares were able to retrieve a significant portion of their investment in wreckfish gear.⁵⁰ Information on recent vessel purchases and investments in wreckfish fishing gear was obtained during the shareholder interviews, and Figure 31 shows this wreckfish investment data. In Figure 31, the values represent investments in wreckfish gear installed on vessels that entered the wreckfish fishery from other southeast fisheries.

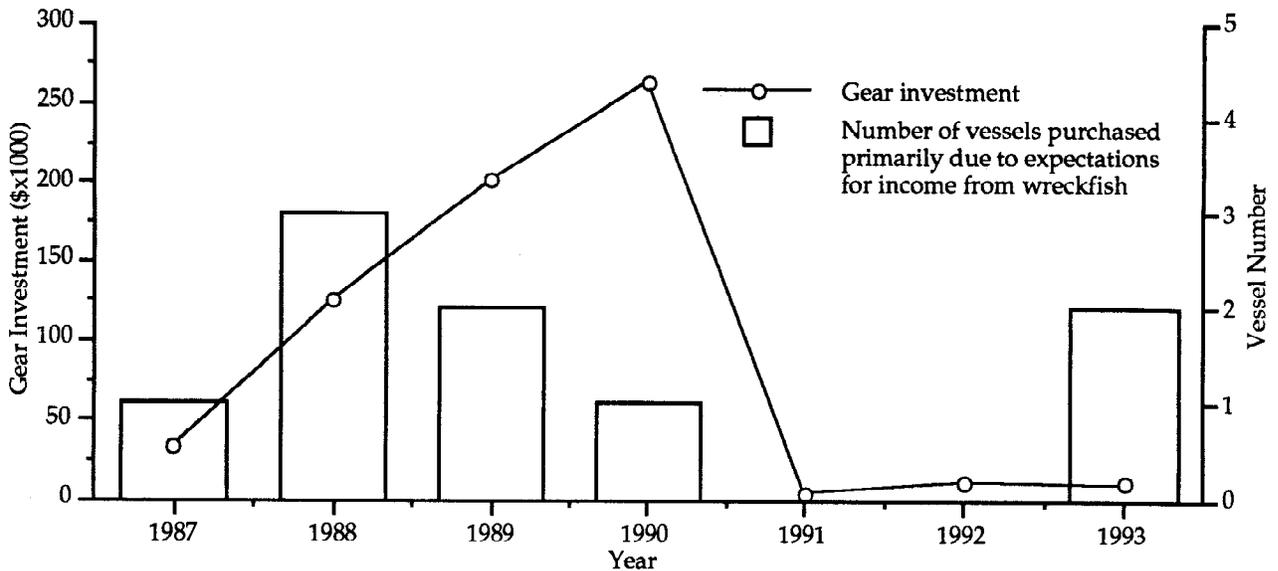
The gear investment and percentage-share sales data allowed a comparison of gear investment costs and share sales payments for fifteen vessel owners, thirteen of which were among those that received larger percentage shares due to the decision to distribute half of the shares equally among all qualifying owners. For these fifteen owners, the median value received from percentage-share sales was found to equal 117% of wreckfish gear investment costs while values for individual vessel owners ranged from 26%-474% of gear costs. Also, none of these owners indicated any vessel purchase decisions were made based primarily on expectations for income from wreckfish.

It was concluded that the particular formula chosen to distribute wreckfish harvesting rights probably had little effect on fishery performance because it was found that just about all of the vessels that allocated effort to wreckfish during the initial year of management had allocated similar levels of effort to the fishery during the final season of open-access entry, and while this group of vessel owners eventually purchased the rights to nearly 1.6 million lbs. of landings, only 1.1 million lbs. were taken. These circumstances imply that similar effort allocations and landings would have occurred during 1992-1993 regardless of whether the equal allocation or landings-only formula, or some other "in between" formula were to have been selected.

Suggestions for Management

The results summary was intended to illustrate the many economic themes that fishery managers might keep in mind as the evolution of the wreckfish ITQ program is monitored and limited entry management programs for other southeast fisheries are developed. Of these, perhaps the most important is the financial environment for investment in harvesting capacity. As noted, most southeast harvesters

Figure 31. Investment in wreckfish vessels and gear, 1987-1993.



are small business where objectives include the provision of self-employment and the building of equity in fishing vessels. At the level of the individual harvester, the investment environment is influenced by the residual values of fishing vessels.

As the objective of this project was to collect baseline data during the transition to ITQ management, no specific suggestions for management changes are made at this time.⁵¹ Instead, the following guidelines are suggested as likely to reward those who entrust fishery managers to obtain high value:

- 1) avoid fishery management regulations designed solely to discourage or prohibit vessel owners with wreckfish percentage shares from participating in other southeast fisheries;
- 2) if wreckfish landings remain below the TAC and noncompetitive control of landings quantities can be ruled out, then consider adding program components designed to boost investment in harvesting capacity;
- 3) if it is decided that resource protection requires the adoption of limited entry regulations for most other southeast fisheries, then complete the regulations as quickly as possible while avoiding to the greatest extent possible regulations and rights distributions that knock down vessel values.

With regard to the economic values that now appear forgone but available for capture by wreckfish harvesters, distributors, and consumers, these would include about \$250,000 of fishery rents, perhaps \$150,000 of rental payments to commercial fishing piers, and consumer benefits that likely exceed \$500,000. These foregone values result from the sustainable two million lb. TAC, current wreckfish prices and harvesting costs, and the current shortfall in landings.

It is suggested that managers avoid regulations designed solely to discourage or prohibit vessel owners from participating in other southeast fisheries because, from the perspective of society, it is preferable to extract the highest value possible from the capital and labor resources that are "tied up" in the southeast fisheries. Multifishery harvesters are for managers somewhat like the traditional part-timer problem (Crutchfield 1979). However, while these vessel owners may be considered part-time wreckfish harvesters, they are full-time fishing people that are capable providing wreckfish as efficiently as those vessels which have focused on wreckfish. Hence, there is the very real possibility that an effort mix that includes a large portion of multifishery vessels would produce higher rents than one which included only full-time vessels. This seems especially likely when one realizes that wreckfish harvesting rights are now

imbedded in the U.S. system of social justice, and this is likely to produce "rigidities" in the free transfer of rights. For example, it was realized during the shareholder interviews that fishery managers will almost certainly encounter future situations where the use of harvesting rights will be restricted due to court action. In this regard, multifishery harvesters can be seen as fairly flexible suppliers of additional harvesting capacity while fishing rights stuck in probate court will act against the smooth transfers of harvesting capacity.

Two program components thought capable of increasing incentives for investment in wreckfish harvesting rights, while at the same time retaining the relative simplicity of the present program, are: 1) the annual advertisement, in industry trade publications, of the economic conditions and harvesting rights values for wreckfish; and 2) the allocation, at nominal cost, of additional fractional 0.1% shares to individuals that meet some general skill and experience criteria such as might be found in industry apprenticeship programs. With regard to making the economic opportunities in the wreckfish fishery more widely known, as additional U.S. fisheries come under ITQ management, it would seem beneficial to include the circumstances of the wreckfish fishery with those of other ITQ fisheries in the form of a government "situation and outlook" report for investment in fisheries harvesting rights.

The allocation of additional fractional shares is suggested as a way to boost investment incentives for several reasons, although the "if it ain't broke, don't fix it" approach would appear to be best here (i.e., the measure would be considered only when it can be determined that fishery economic performance suffers from low incentives for investment in harvesting capacity). The allocation of fractional shares would seem to fit in with the multifishery nature of southeast fisheries and the dynamic year-to-year fishing effort allocations that result, and also with objectives for providing an avenue for individuals not initially included in the wreckfish ITQ program to enter it (United States 1991f).

Suggestions for Additional Research

It is suggested that management of the wreckfish fishery and perhaps other southeast fisheries may benefit from additional fisheries economic research such as:

- 1) a study of the dependence of wreckfish prices on wreckfish landings and available quantities of plausible substitute seafoods within the southeast region;
- 2) a study of the supply and demand for wreckfish individual quota coupons; and
- 3) a follow-up wreckfish monitoring and assessment study, say perhaps in five years, with objectives similar to those of this project.

Here, fisheries management is interpreted broadly and refers to the efficient (low-cost) capture of economic value by harvesters, distributors, and consumers of wreckfish.

A study of the seafood market that includes wreckfish could be justified on several grounds. Perhaps the most obvious would be that if the relationship between wreckfish prices and competing seafood quantities were known, then a better estimate of the economic value potentially obtainable from wreckfish could be made, and this, in turn, would allow better judgments as regards the success of the ITQ management program. A study of wreckfish demand would also provide an estimate of consumer benefits from wreckfish consumption, and this, along with better documentation of enforcement and stock research costs, would allow a more complete calculation of the economic value generated by the wreckfish fishery.

Another reason why a demand study might prove useful is that informed judgments could then be made about the possibility of wreckfish suppliers influencing vessel incomes via the manipulation of aggregate landings levels. In theory, this would be possible if the price of wreckfish were largely independent of the quantities of other seafoods in the market area. Further, it can be expected that those distributing wreckfish will attempt to "niche market" wreckfish because products that can be marketed narrowly generally command higher prices than "commodity" products. But if the industry achieves

success marketing wreckfish narrowly, then its linkages with competing seafoods will be less pronounced, and wreckfish suppliers might eventually face market demands that "slope downward" (i.e., where smaller annual landings would result in higher average prices). In this case, it would seem that chronic landings shortfalls would be need to be evaluated in the context of the ability of suppliers to control aggregate landings.

A study of the supply and demand for wreckfish individual quota coupons could be justified on the grounds that the workings of real-world fisheries ITQ markets are now only poorly understood, and any experience that could be gained or conclusions that could be drawn would likely have implications for the pace and direction of transferable-rights-based fishery management programs nationwide. Also, assuming that a follow-on assessment program is carried out, additional study of the quota market may yield insights as regards the co-evolution of fishery rents and market prices for annual harvesting rights. Lastly, as with the market for wreckfish, it is possible that the market for annual wreckfish quota could be influenced negatively by less than competitive exchange conditions, and this might result in a harvesting sector less efficient than would otherwise be the case (Huppert et al. 1992). Without a better understanding of the factors motivating exchange values, circumstances such as these would be very difficult to discern and or evaluate.⁵²

A follow-up wreckfish monitoring and assessment study is suggested for many of the same reasons used to justify the present analysis. In particular, now that a baseline has been established, a follow-on assessment may allow consideration of questions such as whether additional knowledge of wreckfish natural history or alternative harvesting technologies will yield increased fishery rents, and how will market prices for wreckfish percentage shares respond to shareholder expectations for these factors.⁵³

5. Notes

1. Personal communication, Dee Pack, Miss Becky's Seafood, Mayport, Florida, July 1993.
2. Personal communication, William Bryan, Island Seafood, Fernandina Beach, Florida, July 1993.
3. Personal communications: William Bryan, Island Seafood, Fernandina Beach, Florida, July 1993; Charles Phillips, Phillips Seafood, Darien, Georgia, July 1993; James Freeman, King's Seafood, Port Orange, Florida, October 1993.
4. Wreckfish shareholder interviews, this study.
5. Management indicated that concern over the status of the wreckfish resource justified the use of emergency rules. When the emergency regulations were promulgated, wreckfish natural history was largely unknown. Initial stock assessments were based on very limited data on fish sizes and weights and the results of several research cruises made largely to confirm the locations of commercial fishing (Ulrich and Sedberry 1990). As catch rates continued to increase during 1989 and 1990, managers feared that pending management programs for swordfish and sharks might result in enough additional wreckfish effort to cause a resource collapse (United States 1990b,d).
6. The wreckfish management plan was set forth in Amendment 3 to the Snapper-grouper Fishery Management Plan and became effective January 31, 1991 (United States 1991a). In addition to the measures adopted by emergency rule, the plan required fishing permits and the completion of vessel log-books, provided a definition for overfishing, and established a seasonal spawning closure from January 15 - April 15. The plan also specified a process whereby adjustments could be made annually to the maximum sustainable yield, total allowable catch, quota, spawning-season closure, trip landings limit, fishing year, and permit requirements.
7. Personal communications: William Bryan, Island Seafood, Fernandina Beach, Florida, July 1993; James Freeman, King's Seafood, Port Orange, Florida, October 1993.
8. While it appears that most who attended the management hearings wanted some form of limited entry management program as quickly as possible, many had reservations about the prospect of limited entry only for wreckfish (South Atlantic Fishery Management Council 1991b). Hearing testimony indicates that a number of harvesters preferred a limited entry program that would include wreckfish with other species such as deep water groupers and tilefish. In this case, a fairness argument centered around the situation where harvesters with wreckfish rights would enjoy protection from new entry while, at the same time, would not be prohibited from participating in other fisheries.
9. Management defined the control date as the point in time after which initial fishery participation would not guarantee access to the resource should a management program that limited the number of participants be implemented. Although the March 28 control date was included in the management plan approved during June, 1990, its date of publication in the Federal Register (September 24, 1990) was eventually adopted as the effective control date (United States 1991d).
10. Although managers reduced the 1991-1992 commercial quota to two million lbs. from three million lbs. and provided notice during October that the fishery would close when the two million lb. quota was reached, catch projections made at the time indicated that landings during the 1991-1992 season would not likely exceed two million lbs. (United States 1991e).
11. As stated, program objectives included: 1) the creation of high incentives for conservation and regulatory compliance through the vesting of harvesters in efforts to conserve and wisely manage the resource; 2) the promotion of a stable management regime that would not require in the future more

stringent management measures or high management costs; 3) a reduction in harvest overcapacity and harvester conflicts; 4) harvest strategies and product forms motivated by the marketplace; and 5) the provision of a reasonable opportunity for harvesters to make adequate returns from commercial fishing and an avenue for harvesters not initially included in the program to enter it if they wish (United States 1991f).

12. Elements of the program that defined the harvesting rights included:

- harvesting rights would be of indefinite duration and could be revoked or modified for non-compliance or by the FMP amendment process;
- harvesting rights would be in the form of a percentage share of the TAC, issued annually as an amount of individual quota coupons equal in lbs. to the percentage share of the TAC;
- percentage shares would be freely transferable, but individual quota coupons would be transferable only among share holders;
- percentage-share owners would not be required to harvest wreckfish, and the 10,000 lb. trip limit in force before the ITQ program would be rescinded;
- future wreckfish TACs, whether larger or smaller than the initial two million lb. TAC, would be allocated to the shareholders according to the percentage shares owned at the start of each fishing season.

Program elements that determined the initial share allocation included:

- shares would be allocated to vessel owners who qualified for inclusion in the fishery;
- the criteria for inclusion in the fishery was proof of wreckfish landings between January 1, 1989 and August 8, 1990 and proof of at least during 5,000 lbs. of wreckfish landings between January 1, 1987 and August 8, 1990;
- one half of the shares would be divided equally among those who qualified and one half of the shares would be divided among those who qualified based on their relative share of the total wreckfish landings documented by the qualifying vessels during January 1, 1987 and August 8, 1990;
- the vessel landings data used to determine the initial share allocation would be submitted by vessel owners and supported with fish house receipts or other dealer records (i.e., government landings statistics would not be used);
- no initial share would be greater than ten percent;
- an appeals board would be available to settle disputes over eligibility and the initial allocation of percentage shares.

Program elements concerned with enforcement included:

- a requirement that dealers possess permits and a physical facility, provide enforcement a twenty-four hour advance notice of any off loading away from the facility, and maintain a list of wreckfish purchases to be provided to management monthly along with all canceled quota coupons;
- a requirement that harvesters with wreckfish in their possession also have in their possession a wreckfish harvesting permit, a wreckfish logbook, and a quantity of quota coupons that equals or exceeds the amount of wreckfish in their possession
- a requirement that harvesters forward logbook data and canceled coupons to management after each trip, with unused coupons to be returned at the end of the fishing year;
- a requirement that wreckfish be off loaded only between 8:00 AM and 5:00 PM;
- that buying and selling of percentage shares and quota coupons would be recorded by management;
- a management statement that gross violations of the program should result in permit sanctions or forfeiture of percentage shares.

13. Each season percentage-share owners receive a set of 500 and 100 lb. coupons equal in weight to the eviscerated-weight-equivalent of the product of the TAC and their percentage share at the beginning of the season. The eviscerated weight equivalent of the TAC is calculated by multiplying the TAC amount by 0.901.

14. By the end of the 1991-1992 season fishery researchers possessed sufficient fish length distributions and age-at-length information to produce estimates of natural and fishing mortalities for Blake Plateau wreckfish. The age and growth studies also indicated that it would likely require ten or more years before fishery-induced changes in recruitment would affect the "local population" of Blake Plateau wreckfish. It was also known that wreckfish landings from other locations in the eastern Atlantic ranged from 500,000 - 1 million lbs. during 1975-1989 (South Atlantic Fishery Management Council 1992b). However, wreckfish stock structure within the North Atlantic was unknown and maturity estimates were based on data from New Zealand.

15. By the end of the 1992-1993 season the number of wreckfish length distributions available for analysis had increased and maturity measurements from Blake Plateau wreckfish had allowed the development of a maturity schedule based on data from the local population. The new data showed that 50% of females could be expected to be mature at age six, or two years younger than was shown for wreckfish from New Zealand (South Atlantic Fishery Management Council 1993a). Although natural mortality estimates remained unchanged, fishing mortality estimates were about 20% higher than those of the previous assessment. The younger age at maturity and the higher fishing mortality were offsetting factors in the updated calculations of spawning potentials, and the new estimates ranged from 30%-37% of the unfished stock. As the average of the values calculated for 1989-1992 was higher than the 30% value specified in the overfishing definition, a continuation of the two million lb. TAC was not considered to violate the overfishing criterion (South Atlantic Fishery Management Council 1993a). As for previous assessments, an important caveat concerned the validity of the implicit assumption that wreckfish constituted a single stock on the Blake Plateau.

16. Evidently the small size of the grounds was responsible in large part for the high levels of harvester conflicts during the spring of 1990 (South Atlantic Fisheries Management Council 1990).

17. It is acknowledged that the time frames over which expectations are considered would likely be found to vary quite a bit among vessel owners. In particular, some vessel owners may focus on maximizing net returns during the current fishing season while others will allocate fishing effort after anticipating events and considering future profit potentials.

18. Because the wreckfish fishery is a relatively new fishery and management regulations have changed throughout its development, there is little reason to believe that any of the vessels are operating at the minimum of their average total cost of effort curves.

19. The term rent is used to emphasize the cost-of-inputs-to-production-perspective of value. As the existence of fishery rents are of interest to society, rent values are calculated using costs as measured from the perspective of society.

20. With complete and accurate costs and returns information it would in theory be possible to identify the marginal vessel. However, given that real-world measurement of costs and returns is limited by many social and institutional factors, it often becomes useful to consider the marginal vessel as a set of vessels with similar harvesting costs.

21. The TAC for wreckfish is considered and set annually. Current regulations require that the selected value not exceed eight million lbs. (United States 1991a).

22. It is established practice generally for southeast harvesters to pay for vessel storage costs (dock fees) in the form of a packing fee. Packing fees are paid by harvesters who operate their vessels from piers owned by seafood dealers, and may actually purchase an array of fishing related services in addition to the use of a functioning pier (i.e., short-term credit for trip expenses, settlement accounting services, seafood price information, etc.). Although packing fees and the services they reward are known to exist among both dealers and harvesters, their explicit accounting within vessel settlement sheets is a matter of

local practice. That is to say, in some ports the packing charge can be seen as an explicit input cost and in others it takes the form of a lower exvessel price. Packing costs here include only those actually paid and were tabulated as an average-per-trip variable cost.

23. While there is agreement among economists about what the social opportunity cost of capital should measure, a first-best estimate of its value has so far escaped the profession. One reason for this is that many believe that the appropriate rate is a weighted average of observable market rates such as the consumer interest rate and the pre-tax rate of return on corporate investment, and as such is not directly observable (Baumol 1968, Ramsey 1970). Others would calculate the value from the set of unfunded government projects and a government budget constraint (Quirk and Terasawa 1991). Plausible values appear to range from five to fifteen percent, or perhaps higher. Linder et al. (1989) used 9.7% for a study of fishery rent generation in New Zealand when corporate tax rates were about 80% of the rate for the U.S. today. A value of ten percent value was used here simply because it is the rate that has been mandated by OMB Circular A-94 as appropriate for most government projects.

24. A vessel useful life of thirty years and a declining balance depreciation schedule yields a depreciation rate of about five percent per year (Linder et al. 1992, p. 236).

25. According to NMFS personnel, the 1991-1992 logbook program was voluntary and so this data may also be incomplete.

26. Where vessels were owned by business entities, the age and experience data refer to the business representative (typically the managing partner) that participated in the survey.

27. Shareholders planning to harvest more wreckfish than their owned percentage shares include those with shares just slightly below planned landings and fractional shareholders who must purchase harvest rights to justify even a single trip.

28. Vessel owners associate with shareholders by arranging for the shareholder to endorse the vessel fishing permit application. While in theory the alternative harvesting-rights arrangements allowed by the management program provide almost unlimited flexibility with regard to the structuring of an efficient harvesting sector, the amount of business independence the alternatives provide for vessel owners depends on the particular alternative(s) employed. For example, suppose that a vessel owner without harvest rights wishes to enter the fishery but has limited capital resources. In this case, prior to investing in wreckfish gear, the vessel owner would either seek to associate with a shareholder or purchase a fractional percentage share (i.e., perhaps 0.1%) and sufficient quota coupons to justify the gear investment. Although in each case the vessel owner would be required to purchase gear and quota coupons, given the changing circumstances of business relationships, a vessel owner with a fractional share would have more control over harvesting activities than one with only a shareholder association. This is because ownership of the fractional share conveys the right to purchase individual quota coupons from all percentage-share owners. Of course, the price of this increased control would be the cost of the fractional share.

29. As the wreckfish grounds are relatively small, it is possible that a few skilled or innovative vessel captains could alter the efficiency of the entire harvesting sector fairly quickly. This seemed to be the case for the adoption of motor-fishing techniques during 1989 (South Atlantic Fishery Management Council 1990). In addition, a close examination of the trip records during the fall of 1991 indicated that about half of the vessels were locating large concentrations of wreckfish trip after trip while the other half were not.

30. In general, increases in the catch per unit of effort may indicate that fish have become more abundant, or more vulnerable to the gear, or that a nominal unit of effort has become more "powerful," or that the size of the fishing grounds has changed, or that some combination of these has occurred. Effort may become more powerful either through harvester learning or through the adoption of new fishing strate-

gies or harvesting technologies. As such, the potential for changes in the average power of effort can only be determined through close observation of fishing strategies and harvest technologies. In the absence of "fishery-independent" information about resource abundance, it is generally not possible to separate the relative influences of changes in resource abundance and vulnerability on catch rates. For the case of wreckfish, it seems safe to conclude that the catch per day absent data of 1991-1993 measures changes in resource abundance and vulnerability together. This conclusion is based primarily on the seasonal pattern exhibited by the CPUE data, and harvester reports that "new" fish of shiny skin color arrive on the Blake Plateau during the fall and that wreckfish appear to become more aggressive and eager to take baits during the spawning period.

31. Shrimp trawlers used a wide variety of share systems. Compared with fish boats, perhaps the only valid generalization would be that crew shares paid for groceries more often than did income from fish. In this regard, it should be noted that groceries paid for with crew shares were not included in shareholder vessel trip costs.

32. Of the seventeen vessels described, eight were operated by shareholders and five of these individuals chose not to fish for wreckfish full time.

33. Share-system ITQ fees were not included in harvesting costs because they are not costs per say. However, the fees were included in the calculations made to determine crew payments. The reduction in crew payments caused by the ITQ fees was predicted for the case where harvesting rights are distributed to vessel owners and crew opportunity earnings are low (Anderson 1986, p. 233). In this case, vessel owners are able to capture a portion of the fishery rents earned previously (i.e., under open-access entry conditions) by crew members.

34. The present study differs from most other studies of vessel economics in that virtually the entire population of vessels with wreckfish landings during 1992-1993 was sampled. Hence, statistical inference is not required to judge differences among sample group means during 1992-1993. However, vessels landed wreckfish prior to the 1992-1993 season, and vessels will presumably harvest wreckfish in future years, perhaps under very similar conditions. As such, the cost data may alternatively be viewed as a small sample from a large number of past and future vessel seasons. Within this framework, statistical inference may be used to provide some additional information about the nature of the distributions of the vessel average values that determined the group means. Analysis of the vessel group means using standard methods of statistical inference indicated that no significant differences could be said to exist among shrimp trawlers or fish boats, or among wreckfish and multifishery vessels, as regards the average cost of a day absent or a fishing hour when judged using the 95% significance convention. The same result was also found for the income-per-day and cost-per-pound group means for wreckfish and multifishery vessels, although the null hypothesis of equal income-per-day group means was rejected for these vessel groups using a 90% significance level.

35. The aggregate market value of wreckfish fishing vessels inclusive of all fishing gear but exclusive of harvesting rights was estimated by shareholders to be \$1,735,500 during 1992-1993. Only vessel and gear values were included because no vessel owners indicated that shore-side facilities were required to support the harvesting operations of their vessels. Although a few vessel owners rented storage space, most indicated that shore-side facilities provided by dealers in return for packing fees allowed them to operate their vessels without purchasing land or buildings.

36. From a social perspective, average vessel fixed and variable costs were calculated to be \$0.38/lb. and \$1.35/lb., respectively, for vessels with wreckfish landings during the initial year of ITQ management, and \$0.51/lb. and \$1.46/lb., respectively, for vessels which last fished for wreckfish prior to 1992-1993.

37. The lowest of these values was produced by a vessel which last fished during 1988 when resource abundance and or vulnerability was undoubtedly very high.

38. Several wreckfish shareholders were found to have allocated additional effort to the shark fishery based in part on hunches that federal-waters shark management would quickly evolve into some form of harvesting-rights-based system where the allocation of the rights would depend in part on historic landings. Interestingly, this type of share-focused behavior (see Wilen [1976] for other types) was predicted by those harvesters who during the development of the wreckfish management program indicated their preference for a broader plan that included other fisheries such as that for deep reef fish.

39. It is interesting to note that the NMFS shark plan stated that the proposed management measures were not expected to have an impact on commercial or recreational fisheries or divert fishermen to other fisheries (National Marine Fisheries Service 1993, appendix I, p.44). This was the case even though the proposed measures included commercial quotas and stated explicitly that the fishery would be closed should the quotas be reached.

40. For each shareholder, the present value of wreckfish harvest rights was set equal to the discounted value of a uniform income stream equal to vessel wreckfish net revenue as calculated from the survey data. The net revenue stream was discounted over thirty years using a risky rate of interest supplied by the shareholders. The shareholder risky rate equaled the minimum rate of interest that shareholders indicated would have been accepted to hold a mortgage on their fishing business for most of the purchase amount and for the hypothetical circumstance where the business was purchased by an individual considered to be as capable as they at fishing and business management (see the survey, Appendix A, section 8). For those cases where shareholders indicated they could not determine an interest rate for these circumstances, the shareholder-reported average of 10% was used. For those cases where shareholders indicated they would not consider holding a mortgage on their fishing business for most of the purchase amount, a 30% rate was used.

41. The shareholder interviews indicated that synergistic business values are likely to exist for some shareholders. With regard to vessel unavoidable fixed costs, many of those who sold their wreckfish shares left the wreckfish fishery voluntarily before the start of the ITQ management program but continued to operate in the commercial fisheries. It seems that this behavior would provide prima facie evidence that these shareholders held expectations that vessel fixed costs could be covered with income from other fisheries, and so for these shareholders unavoidable vessel fixed costs may not have been an important consideration.

42. The only share buyer to pay more than the calculated present value of vessel net revenue experience was a multifishery vessel owner who received a percentage share smaller than 1991-1992 landings but allocated only a very small amount of effort to wreckfish during 1992-1993.

43. Most share purchases were made by vessel owners who indicated they would not hold a mortgage on their fishing businesses given the hypothetical circumstances described during the survey, and so were assigned a risky rate of interest of 30%. All else constant, a high risky rate of interest reduces the present value of a future projection of vessel net revenues. In addition, most harvest rights purchases through October of 1993 were made by vessel owners with interests in seafood distribution, and so for these vessels owners it is likely that the present value of vessel net revenues would underestimate perceived share values.

44. Shareholder coupon market activity percentages represent shareholder contacts which involved the discussion of specific coupon price levels.

45. Linder suggests that for cases where harvesting capacity is chronically excessive or has adjusted to appropriate longer-term levels, annual quota prices will evolve over the course of a "bad season" (i.e., a season where catch rates are lower than average) to the level of an option premium, and will evolve over the course of a "bumper season" (i.e., a season where catch rates are higher than average) to a level approaching the exvessel price.

46. It may be of some interest to note that for the case of annual quota, which provides harvesting rights only during a defined period of time, the quota supply curve during the relevant period must shift up and to the left as landings are recorded, coupons are canceled, and harvesting rights are extinguished. It is conjectured that this shifting feature may assist with identification of the demand curve for annual quota.
47. It seems safe to assume that the designers of the wreckfish ITQ management plan envisioned that the exchange of quota coupons would provide the flexibility required to ensure that allowable catch levels could be harvested notwithstanding the uncertain and variable business circumstances that characterize small fishing firms. For example, the exchange of quota coupons, either through outright sales or via vessel associations, provides a mechanism for the fishery to obtain substitute effort in cases where a vessel owner plans to allocate full-time effort to wreckfish but may be prevented from doing so by a vessel breakdown or sinking or other factor equally beyond direct control. Obviously, quota coupon exchanges would also provide for substitute effort in those cases where it may be in the economic interest of a multifishery vessel owner to allocate only small amount of effort to wreckfish in any particular year. However, the important point to remember with regard to these circumstances is that they more appropriately pertain to a future period in the evolution of the wreckfish fishery when harvesting capacity and effort allocations have adjusted to better match "on average" allowable catch levels.
48. Evidently only token royalty payments were set by the New Zealand government when ITQ management was introduced, but the government also stated its intention to eventually capture most if not all of the economic rent from the fisheries.
49. Hilborn attributed the relatively more concentrated sport fishery profile to variations in individual effort levels.
50. When asked about the factors thought important for determining a value for their wreckfish percentage shares, many of those who sold out of the fishery indicated that a primary consideration was to retrieve their investment in wreckfish gear and use the money to support current fishing activities.
51. The shareholder survey did not seek to uncover in any systematic way the program changes that vessel owners thought would benefit their industry. However, as these concerns were discussed during most interviews, the management suggestions that were provided are noted here. These were:
- 1) don't use fishery regulations to force vessel owners to choose among mutually exclusive alternative fisheries;
 - 2) add a "use it or lose it" provision to the wreckfish plan;
 - 3) create a program component that allows vessels to possess small quantities of wreckfish during the spawning closure but outside of the established grounds so as to increase possibilities for exploratory fishing.
52. The quota coupon monitoring system as presently conceived does not seem fully capable of documenting the prices and quantities of all coupon exchanges. If this can be changed, then a study of the market for quota coupons would be less costly.
53. To keep the analysis presented here as simple and straightforward as possible, direct consideration of shareholder expectations about future harvesting profitability and or TAC levels, and in particular the ways in which shareholder expectations about TAC level are likely to enter assessments of share values, was purposely avoided. However, the present ITQ management plan provides that future TAC amounts, whether larger or smaller than those presently in effect, will be allocated to shareholders according to their percentage share amounts. This provision implies that TACs may vary and so percentage shares may confer rights to variable quantities of wreckfish, and this in turn implies that values for harvesting rights will be fundamentally influenced by shareholder expectations for TAC amounts. In this regard, trial measurement of harvester expectations for TAC amounts was attempted during the survey pretest,

but shareholder responses to test questions about expectations were variable and inconsistent. While this result may have been due to unfamiliarity with the management program and the only short period of time within which it would have been possible for shareholders to develop expectations, it is conjectured that the measurement of shareholder expectations will present greater challenges than did the measurement of fishery rents.

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Appendix A. 1992 Wreckfish Fishery Economic and Resource Information Collection.

1. Survey purpose and data confidentiality statement

As you may know, E.J. Richardson Associates recently received a Marine Fisheries Initiative grant award from the U.S. Department of Commerce to conduct a Wreckfish Economic and Resource Information Collection. This project was selected for funding through a competitive process, and will allow the collection of "baseline" economic data on the wreckfish individual transferable quota management system that was implemented recently through the combined efforts of the industry and the South Atlantic Fishery Management Council.

This baseline data collection will gather information mainly about fishing activities during the 1992 fishing season, which is defined as the period from January 15, 1992 to January 15, 1993. The questions will focus on your fisheries background and the organization of your wreckfish harvesting operation, the costs of catching wreckfish, your level of capital investment in the fisheries, the relative importance to you of fisheries income as compared to income from non-fishing activities, and your knowledge and opinions concerning how the markets for wreckfish share exchanges and coupon sales are functioning.

I want to emphasize that your participation is voluntary, and that all of your responses will remain strictly confidential. However, if you would rather not answer a particular question, or if do not know the answer to a question, just say so.

I also want to emphasize that your willingness to assist with this study is very important. The reason for this is that the wreckfish fishery will be managed with or without complete and up-to-date economic information even though this information is needed to assess accurately any changes in the economics of wreckfish harvesting that may be due to the ITQ management program. Because assessments of economic factors may influence judgments about whether the wreckfish ITQ management program is meeting its objectives, it is important that a picture of the economic circumstances of the harvesting sector be developed using input from all wreckfish harvesters. In this regard, the baseline economic data that you provide will support an important component of the fishery management process. In my experience, the better the data, the better the fishery management program.

Any questions so far?

2. Background

How old are you? _____ How many years of experience, since age 18, do you have fishing commercially? _____

Based on your fisheries experience and background, do you consider yourself to be primarily a:

- _____ seafood packer or dealer;
- _____ shrimp harvester;
- _____ wreckfish harvester;
- _____ reef fish (snapper and grouper) harvester;
- _____ swordfish and tuna harvester;
- _____ shark harvester;
- _____ tilefish and snowy grouper (deep reef fish) harvester;
- _____ combination _____, _____, and _____ harvester;
- _____ other _____.

How many years of experience do you have fishing for: _____ wreckfish _____ shrimp _____ shallow reef fish (snapper-grouper)
 _____ swordfish and tuna _____ sharks _____ deep reef fish (tilefish or snowy grouper)
 _____ other _____.

or working as a seafood packer or dealer? _____

Do you belong to any fishing-related organizations? _____ (If yes) Which ones?

3. Organization of the harvesting operation

Now I'd like to ask some questions about the organization of your wreckfish harvesting operation during the 1992 season. According to the NMFS vessel permit records, during the 1992 wreckfish season, F/V(s) _____, _____, _____ were associated with share certificate # _____ for the purpose of harvesting wreckfish. The permit records also indicate that the vessel(s) ((WERE , WERE NOT)) owned by the same business or individual as was the share certificate. Are these records correct?

During the 1992 fishing season, how was the wreckfish harvesting operation of _____ organized?

- _____ share certificate owner owned and operated the vessel(s)
- _____ share certificate owner owned the vessel(s) but hired the captain(s)
- _____ share certificate owner did not own the vessel but was associated with one or more owner-operated vessels
- _____ share certificate owner did not own the vessels but was associated with one or more vessels operated by hired captain(s)
- _____ other _____

As far as you know, did any of the vessels associated with your certificate work for hire as recreational fishing charter vessels during the 1992 wreckfish season? _____

On wreckfish trips during the 1992 season, what was the average crew size of F/V(s) _____, _____, _____ ?

On wreckfish trips during the 1992 season, did the crew size(s) change from trip to trip, or was it just about always the same? #1 _____ #2 _____ #3 _____

(If crew changed) How did the crew size(s) change during the year?

On wreckfish trips during the 1992 season, how did you pay for the services of the captain and crew of F/V(s) _____, _____, _____ ? (Was a fixed wage or fixed rental arrangement used, or were the vessel owner(s), captain(s), and crew(s) paid according to an agreed upon share of the landed value of the wreckfish that was caught?)

F/V #1 _____ F/V #2 _____ F/V #3 _____ fixed wage or rental payments F/V #1 _____ F/V #2 _____ F/V #3 _____ share of landed value

(If more than one vessel) Were the arrangements the same for all of the vessels? _____ (If no please explain)

(If fixed wage or vessel rental agreements) What were the fixed wages or rental agreement(s) that were used?

#1 _____ fixed vessel rental fee (\$/ _____) #2 _____ fixed vessel rental fee (\$/ _____) #3 _____ fixed vessel rental fee (\$/ _____)

#1 _____ fixed captain wage (\$/ _____) #2 _____ fixed captain wage (\$/ _____) #3 _____ fixed captain wage (\$/ _____)

#1 _____ fixed crew wage (\$/ _____) #2 _____ fixed crew wage (\$/ _____) #3 _____ fixed crew wage (\$/ _____)

(If share arrangements) Were any expenses, such as those for fuel or groceries, deducted from the value of the landings before calculating the shares?
 (If yes) Which expenses were deducted?

F/V #1 _____

F/V #2 _____

F/V #3 _____

(If yes) Who paid for the expenses that were deducted?

F/V #1 _____

F/V #2 _____

F/V #3 _____

What were the share arrangements for the vessel owner, the captain, and the crew?

#1 vessel share of landed value was _____ % #2 vessel share of landed value was _____ % #3 vessel share of landed value was _____ %

#1 captain share of landed value was _____ % #2 captain share of landed value was _____ % #3 captain share of landed value was _____ %

#1 crew share of landed value was _____ % #2 crew share of landed value was _____ % #3 crew share of landed value was _____ %

During the 1992 wreckfish season, did the captain receive a crew share in addition to the captain's share? F/V #1 _____ F/V #2 _____ F/V #3 _____

(Do the share percentages add to 100?)

Did you make quarterly state unemployment compensation payments for your captain and crew during the 1992 season?

F/V #1 _____ F/V #2 _____ F/V #3 _____

(If yes) As far as you know, are you paying the minimum percentage (or do you have any past crew members drawing)?

The next set of questions concerns the costs of catching the wreckfish that were landed by vessels associated with your share certificate during the 1992 season. The purpose of these questions is to determine the costs of the harvesting operation that you chose to use during 1992 to bring wreckfish to U.S. consumers.

(If more than one vessel)

If your harvesting operation included more than one vessel, or if any of the vessels also participated in other fisheries besides wreckfish, then determining these costs will require some extra effort. For example, if more than one vessel was associated with your share certificate and landed wreckfish during 1992, then I'll need to get some idea of the costs of each vessel. If any of the vessels participated in more than one fishery, then determining the costs of wreckfishing will require that some appropriate portion of the annual upkeep costs of these vessel(s) be allocated back to wreckfish. To do this, I will need to ask questions about both "trip" costs, where the total depends on how often the vessel(s) went fishing for wreckfish, and "fixed" costs which would have been paid regardless of the particular fishing activities of the vessel during 1992. I also want to map out the fishing activities of the vessel during 1992 and to get some idea of the before tax incomes that resulted from the alternative fishing activities. This time and income information will be used to determine how much of the annual vessel upkeep to allocate to wreckfishing. Any questions so far?

So the first question is do you have pretty good knowledge of the activities and the costs of operating the vessels that were associated with your share certificate during the 1992 season? _____

(If no, check to see who is the person that is most familiar with the activities and costs of operating the vessel during 1992. Is the share owner at least somewhat familiar with the costs and activities of the vessels? Should I ask the operator of the vessel the cost and activity questions?)

I'd like to start out by developing a picture of the vessel's fishing activities during 1992. So please take a moment to think about the fishing activities during the 1992 season (and fishing activities include any time that you or your adult household partner may have spent maintaining this vessel and its gear or managing its operation). Next, I'd like to work with you to complete this worksheet, and to block-out, as best we can, a month by month profile of the vessel's fishing activities during 1992. I realize that it may be difficult to remember exactly the time periods and before-tax incomes of the alternatives throughout the entire year right away, so simply estimate as best you can. Lets start by blocking out all of the non-fishing periods.

F/V _____

4. Monthly time profile of fishing activities during the 1992 fishing season — F/V _____

_____ vessel	No Fishing _____	Fishing _____
breakdown, maintenance, vacations	wreckfish business management	Shrimp/finfish trawling
	Wreckfish fishing	Tilefish and Snowy Grouper fishing
		Snapper/Grouper reef fishing
		Swordfish/tuna fishing
		Shark fishing
		other fishing (Sea Bass Pots?) (Charter?)

—15
 JAN (1992)
 —15
 FEB
 —15
 MAR
 —15
 APR
 —15
 MAY
 —15
 JUN
 —15
 JUL
 —15
 AUG
 —15
 SEP
 —15
 OCT
 —15
 NOV
 —15
 DEC
 —15
 JAN (1993)
 —15

Total Weeks _____
 Before Tax Income (\$K) _____
 Gear Used _____

5. 1992 trip costs — F/V _____

Now let's move to the trip costs. According to the NMFS logbook data, F/V _____ made _____ wreckfish trips during the 1992 season, and during these trips fished on average _____ reels. It was also reported that during the 1992 season each trip lasted about _____ days for a total of _____ days fished. Does this sound correct when you think about the fishing activities of F/V _____ during 1992? (If no) Please explain?

In your opinion, did the F/V _____ fish at capacity during 1992 (i.e., given the 275 day wreckfish season and the weather, were the number of trips and total fishing days of 1992 roughly the most that could have been provided by F/V _____ ?

(If no) What is the maximum number of trips and or fishing days that could be provided by F/V _____ on average during a season? _____ trips _____ days

What were the costs of any or all of the following items that may have been required for each wreckfish trip that was made by F/V _____ during the 1992 season? The items are:

Item	Cost / tri p?	Quantit y / tri p?	Did cost vary with length of trip? (If <u>yes</u> , <u>how</u> ?)
Fuel and oil	_____	_____	_____
Bait	_____	_____	_____
Ice or boxes	_____	_____	_____
Unloading the catch	_____	_____	_____
Repairing or replacing damaged or lost gear (cable, hooks, leaders, weights, etc.)	_____	_____	_____
Repairing or maintaining the vessel	_____	_____	_____
Groceries	_____	_____	_____

Were there any other expenses that were paid regularly each time that F/V _____ went fishing for wreckfish during the 1992 season? (If yes, list items and amounts)

During the 1992 season, were you able to develop any "rule of thumb" concerning the minimum income from wreckfish landings that was required to make a wreckfish trip by F/V _____ break even? (If yes) How much income did you figure was required? \$ _____

6. 1992 fixed costs — F/V _____

And lastly, the fixed costs. What were the costs of any or all of the following items that may have been required for the annual upkeep of F/V _____ during the 1992 season? The items are:

	Amount (\$)	Frequency or Time Period
1) Annual vessel overhaul/rehab with paint and/or engine work	_____	_____
2) Annual fishing electronics overhaul/rehab/replacement	_____	_____
3) Annual wreckfish gear overhaul/rehab/replacement (includes cables and hydraulic lines)	_____	_____
4) Monthly loan payments on the fishing vessel, gear, equipment, share purchases, or other fishing business debt (And please also include second mortgage payments on your home if these payments are for funds that were used to capitalize your fishing business)	_____	_____
5) Hull, liability, or other fishing business insurance	_____	_____
6) Property taxes on fishing business capital equipment (vehicles, docks, docking rights, storage or repair facilities, etc.)	_____	_____
7) Docking or storing the fishing vessel	_____	_____
(If none) Were vessel docking or storage costs a part of any agreements to sell your catch to a particular packer or dealer? (If yes) If this arrangement had not existed, what do you estimate that it would have cost to keep the vessel at a dock for the year? \$ _____		
During 1992, did you also pay any annual fees for:		
8) Fishing business accounting and tax preparation services	_____	_____
9) Fishing business legal services (incorporation, maintaining a corporation, etc.)	_____	_____
10) Fishing business vehicle(s) (business vehicles only)	_____	_____
11) Fishing association dues	_____	_____
12) State and federal commercial fishing permits	_____	_____
13) State fishing vessel registration	_____	_____

7. Vessel and gear characteristics — F/V _____

What is the length _____ and hull material _____ of F/V _____ ?

Do you know when (which year) it was built _____ and the engine type _____ ?

What types and how many pieces of electronic fishing equipment were aboard the vessel during the 1992 season?

_____ Radar	_____ LORAN	_____ GPS system	_____ Paper Plotter	_____ Video Plotter	_____ VHF Radio	_____ CB Radio
_____ Fish Finder (color scope)	_____ Fathometer	_____ Single-Side-Band Radio	_____ 406 EPIRB	_____ Hailer		

Was any of the electronic fishing equipment aboard during 1992 purchased and used solely for wreckfish harvesting (a very narrow beam sonar, for example)? (If yes but not all) Which items, when (which year) were they purchased, and what was their approximate cost with installation?

_____	_____	\$ _____
_____	_____	\$ _____

What types and how much wreckfish fishing gear was aboard the vessel when you went fishing for wreckfish during the 1992 season?

_____ commercially produced reel(s) (mylar or colgan) _____ home-made reel(s) _____ weights (lbs.)

_____ spare cable (feet) _____ bottom rigs (hooks and leaders) _____ purpose-built wreckfish anchor(s)

other (describe) _____

Was the wreckfish fishing gear on the vessel throughout the entire 1992 season?

(If no) Was the wreckfish gear installed and removed for each wreckfish trip that was made during 1992?

(If no) How many times was the wreckfish gear installed and removed during 1992?

How much did it cost to remove or install the wreckfish gear? \$ _____

Are the wreckfish reels that are now on the vessel the same reels as those that were on the vessel during the 1992 season?

(If not explain changes)

During which year(s) did you purchase or build the reels that were used during the 1992 season and how much did it cost to obtain and install them? (If homemade, what was the cost of materials and time)

#1 _____ \$ _____ #3 _____ \$ _____
 #2 _____ \$ _____ #4 _____ \$ _____

When (during which year) do you estimate that you will have to replace these reels (i.e., when will it no longer be worthwhile to simply maintain them)?

#1 _____ #3 _____
 #2 _____ #4 _____

Do you know when the F/V _____ was last purchased and how much was paid for it? _____ yr. \$ _____

At the time it was purchased, was the F/V _____ equipped to go fishing for wreckfish?

(If no) Were there any special costs associated with equipping the vessel to go fishing for wreckfish? (For example, costs for different electronics, the wreckfish reels, modifications to the hydraulic system, etc.)?

(If yes) Please list the items and their approximate cost.

- 1) Modify hydraulic system \$ _____ 4) Sinker weights \$ _____ 7) _____ \$ _____
- 2) Fabricate reel mountings \$ _____ 5) Miscellaneous sea gear \$ _____ 8) _____ \$ _____
- 3) Mono leaders, swivels, hooks \$ _____ 6) Tackle crimping tools \$ _____ 9) _____ \$ _____

How much equity do you have now in the F/V _____ (i.e., what percentage of the vessel does your business own outright now)? _____ %

What, in your estimate, was the market value of F/V _____ during the 1992 season, with all of its electronics and fishing gear? (If you were to have put the vessel with all of the electronics and gear on the market during the 1992 season, how much would it have sold for?) \$ _____

If you were to purchase a new vessel today, built and equipped just like the vessel you have, approximately how much would it cost for:

the vessel and engines with all associated equipment such as generators and hydraulics: \$ _____
 the electronic fishing gear: \$ _____
 all of the other fishing gear: \$ _____

8. Wreckfish harvesting managers and vessel owner/operators opportunity costs

The next series of questions concerns how you might adapt to a disruption in your fishing activities, for example a disruption such as was caused by the recent oil spill in Alaska. Many of the questions are hypothetical. To answer the questions, you will need to consider what you would do if you could not go fishing for wreckfish. When thinking about how you might adapt to the disruption, you should suppose that all of the other fisheries are relatively unaffected and remain as currently regulated (i.e., the same seasons, gear restrictions, etc.). When answering the questions, you should select the alternative that you think is the mostly likely given your circumstances today. Any questions so far?

To start, I need to know how many wreckfish trips you plan to make this year (and if more than one vessel is associated with your certificate, please add up the trips you plan for all of the vessels)? _____ trips

And about how many weeks in total of your work time do you expect that these trips will require? _____ weeks
(Please include only the time you expect to devote to operating the vessel and/or managing the wreckfish harvesting operation. Do not include time devoted to finding markets for wreckfish or managing the operation of the vessel when it is participating in other fisheries besides wreckfish.)

Right now, do you expect to make about ((THE SAME, MORE, or LESS)) wreckfish trips during the 1994 season?

About how many weeks in total of your work time do you expect that the 1994 trips will require? _____ weeks
(And again, please include only the time you expect to devote to operating the vessel and/or managing the wreckfish harvesting operation. Do not include time devoted to finding markets for wreckfish or managing the operation of the vessel when it is participating in other fisheries besides wreckfish.)

Now, for the first question, suppose that your health or personal circumstances change, and for some reason, you are no longer able to operate a fishing vessel and/or manage a fishing business. You decide to sell your fishing business, the vessel, the gear, your wreckfish shares, and everything else, to another person whom you consider to be as capable at fishing and business management as you are. To close the deal, you agree to hold paper (a mortgage) on most of the purchase amount. In this circumstance, what is the minimum rate of interest that you would accept to hold the mortgage on your business?

_____ %

Now for the next set of questions, I'd like you to suppose that during December a vessel associated with your share certificate is caught violating the rules of the wreckfish ITQ management program. After a hearing, the violation is substantiated and the NMFS imposes an administrative sanction on your share certificate and the fishing vessel. As a penalty, the sanction invalidates the 1994 wreckfish coupons of the share owner and the vessel is prohibited from obtaining a 1994 wreckfish permit. However, the sanction affects only your 1994 wreckfish coupons and only the wreckfish harvesting operations of the vessel during 1994.

Remembering that during this period all other southeast fisheries are unchanged and remain as presently regulated, and that you are now planning to allocate about _____ weeks of vessel and management time to wreckfishing during the 1994 season, what is your best guess about how you would adapt to the TEMPORARY fishery disruption described above? Would you:

- (1) Stop operating or managing the vessel(s), take the time off, work on the vessel, or do other unpaid work;
- (2) Stop operating or managing the vessel(s), devote the time to a paid job in another aspect of fisheries; (for example, selling seafood or managing a fishing vessel repair shop);
- (3) Stop operating or managing the vessel(s), switch to a paid non-fishing job;
- (4) Continue to operate or manage the fishing vessel(s), but switch the vessel(s) to another fishery.

(If #3) What is your best guess about the specific non-fishing occupation you would switch to? _____
Can you provide a best guess as to how long you think it would take you to switch to this occupation? _____

Can you provide a best guess as to where you would find this occupation? _____
Would you have to move from your current residence to obtain this occupation? _____

(If #4) How many weeks do you think you might spend in which fisheries?
_____ fishery _____ weeks
_____ fishery _____ weeks
_____ fishery _____ weeks

(If #2, #3, or #4) What is your best guess as to how much your before-tax earnings would be in this alternative fishery or job?
Estimated earnings: _____ (\$K) per WEEK/MONTH/YEAR

NOTE: a rough estimate, rounded to thousands, is sufficient here

Lastly, suppose that next May, because of some poorly understood change in environmental factors, just about all of the Blake Plateau population of wreckfish suddenly moves off the grounds. Although the 2 million pound TAC remains in effect, catch rates are so poor that no more than 200 lbs. of wreckfish are landed from any trip. After about one month, the South Atlantic Fishery Management Council uses emergency regulatory authority and closes the fishery, and the National Marine Fisheries Service begins an experimental fishing program to monitor wreckfish abundance on the Blake Plateau grounds. However, for unknown reasons, large numbers of wreckfish do not reappear on the Blake Plateau and catch rates never exceed a few fish per day after year. Because the fishery ceases to exist, the Council cancels the wreckfish ITQ management program.

Remembering that during this period all other southeast fisheries are unchanged and remain as presently regulated, and that you are now planning to allocate about _____ weeks of vessel and management time to wreckfishing during the 1994 season, what is your best guess about how you would adapt to the LONG-TERM fishery disruption described above? Would you:

- (1) Stop operating or managing the vessel(s), take the time off, work on the vessel, or do other unpaid work;
- (2) Stop operating or managing the vessel(s), devote the time to a paid job in another aspect of fisheries; (for example, selling seafood or managing a fishing vessel repair shop);
- (3) Stop operating or managing the vessel(s), switch to a paid non-fishing job;
- (4) Continue to operate or manage the fishing vessel(s), but switch the vessel(s) to another fishery.

(If #3) What is your best guess about the specific non-fishing occupation you would switch to? _____

Can you provide a best guess as to how long you think it would take you to switch to this occupation? _____

Can you provide a best guess as to where you would find this occupation? _____

Would you have to move from your current residence to obtain this occupation? _____

(If #4) How many weeks do you think you might spend in which fisheries each year?

_____	fishery	_____	weeks
_____	fishery	_____	weeks
_____	fishery	_____	weeks

(If #2, #3, or #4) What is your best guess as to how much your before-tax earnings would be in this alternative fishery or job?

Estimated earnings: _____ (\$K) per WEEK/MONTH/YEAR

NOTE: a rough estimate, rounded to thousands, is sufficient here

10. Value of fishing and non-fishing activities during the 1992 fishing season

The purpose of the following questions and worksheet is to determine how important commercial fishing is to you and your family or household, both in terms of time commitment and in terms of contribution to household or family income. To do this, information about your family or household income from all sources is required, and so the next several questions are about your household income during the 1992 fishing season (and again, the 1992 fishing season is defined as the period from January 15, 1992 to January 15, 1993).

The first question is: Did you or your spouse or adult household partner hold any non-fishing jobs during the 1992 fishing season? _____

(If yes) What was the before-tax income, rounded to thousands of dollars, that was earned by you and/or your spouse or adult household partner from non-fishing employment activities during the 1992 fishing season, and the time commitment in weeks that was required to obtain this income.

Non-Fishing Income and Time Allocation

	Before-Tax Income (\$K)	Total Weeks
1) <u>Income from Employment Activities</u>		
Yourself	_____ (\$K)	_____ weeks
Your Spouse or Household Partner	_____ (\$K)	_____ weeks

What was the amount of before-tax household income due to household savings, investments, ownership of rental property, etc.

2) Other Household Income

(interest from savings and investments, rental income, etc.) _____ (\$K)

What was the total before-tax income, rounded to thousands of dollars, that was earned by you and/or your spouse or adult household partner from fishing employment activities during the 1992 fishing season, and the time commitment in weeks that was required to obtain this income.

Fishing Income and Time Allocation

	Before-Tax Income (\$K)	Total Weeks
Yourself	_____ (\$K)	_____ weeks
Your Spouse or Household Partner	_____ (\$K)	_____ weeks

Appendix B. Vessel cost parameters.

Table 9. Vessel cost parameters by year, 1988-1993.

Item	1988	1989	1990	1991	1992	1993	1988
Fuel price (\$/gal.) ^a	0.61	0.72	0.91	0.80	0.76	0.72	0.61
Yield on U.S. government three month bills (%) ^b	6.7	8.1	7.5	5.4	3.4		6.7
Prime rate on short-term business loans (%) ^b	9.3	10.9	10.0	8.5	6.2		9.3
Average weekly manufacturing earnings, Florida statewide (\$) ^c	341	355	365	378	393		341

^a Fuel prices for 1993-1991 obtained from area dealers, prices during 1988-1990 calculated from 1991-1993 prices using the #2 diesel fuel price index (commodity code 057303), Table 4. Producer price indices for commodity groups, subgroups, product classes, and individual items, Supplement to Producer Price Indexes Data for 1988-1990, U.S. Department of Labor, Bureau of Labor Statistics, August 1991.

^b Business Statistics, 1963-1991, U.S. Department of Commerce, Bureau of Economic Analysis, 1992.

^c Establishment, Hours, and Earnings States and Areas, Data for 1987-1992, Bulletin 2411, U.S. Department of Labor, Bureau of Labor Statistics, August 1992 (1992 estimated from monthly data).