



An Economic Profile Of

Florida's Marine Life Industry

Sherry L. Larkin
Charles M. Adams
Robert L. Degner
Donna J. Lee
J. Walter Milon



This technical paper was supported by the National Sea Grant College Program of the U.S. Department of Commerce's National Oceanic and Atmospheric Administration under NOAA Grant No. NA76RG-0120, and by the University of Florida's Institute of Food and Agricultural Sciences. The views expressed herein do not necessarily reflect the views of the University of Florida, NOAA or any of its sub-agencies.

Additional copies are available for \$5.00 each by contacting Florida Sea Grant, University of Florida, PO Box 110409, Gainesville, FL, 32611-0409, (352) 392-2801.

An Economic Profile of Florida's Marine Life Industry

Sherry L. Larkin
Assistant Professor, Food and Resource Economics
University of Florida

Charles M. Adams
Professor, Food and Resource Economics
Florida Sea Grant
University of Florida

Robert L. Degner
Professor, Food and Resource Economics
University of Florida

Donna J. Lee
Associate Professor, Food and Resource Economics
University of Florida

J. Walter Milon
Professor, Department of Economics
University of Central Florida

Sea Grant Technical Paper Number 113
November, 2001
Project No. R/LR-A-23

Abstract

The marine life industry in Florida is defined as the harvest of live marine specimens (fish and invertebrate species including plants, live rock and sand, and small “critters”) for commercial use, primarily aquariums. This paper summarizes data collected on the industry since 1990, including total landings, revenues, and trends over time. Regional analysis shows where the primary collecting areas are located in Florida. Seasonal analysis shows when the majority of landings occur within the year. Statistics on the number of participants by type (i.e., collector versus wholesaler) provide insight into the size of the industry. Trends are evaluated in terms of changes across the 9-year period from 1990 to 1998. In general, the number of licensed collectors has increased substantially, landings of fish and animal invertebrates peaked in 1994, angelfish dominated the fish landings, live rock dominated the invertebrate landings, and the average landings per trip have remained relatively constant.

Key Words

Aquarium fish, invertebrates, marine life landings, marine ornamental fish

An Economic Profile of Florida's Marine Life Industry

TABLE OF CONTENTS

I. Introduction	1
I.A. Industry Definition and Background	1
I.B. The Marine Life Industry in Florida	1
<i>I.B.1. Regulations and Requirements for Participation</i>	1
<i>I.B.2. General Market Channels</i>	4
<i>I.B.3. Impetus for Study</i>	4
<i>I.B.4. Outline of Analysis</i>	5
II. Data Source and Description.....	6
II.A. Number of Industry Participants	7
II.B. Product Types.....	8
III. Quantity and Value of Landings	11
III.A. Regional Statistics.....	11
III.B. Seasonal Statistics	13
III.C. Statistics by Product Type.....	15
<i>III.C.1. Fish Species Statistics</i>	16
<i>III.C.2. Invertebrate Species Statistics</i>	22
III.D. Trip-Level Statistics	28
IV. Discussion.....	30
References.....	35
Appendix A.....	37
Appendix B	41
Appendix C	47
Appendix D.....	49
Appendix E	53

LIST OF TABLES

Table 1. Number of Commercial Participants in the Florida Marine Life Industry	8
Table 2. List of Ornamental Marine Species Collected in Florida, 1990-98	10
Table 3. Summary of Total Revenue by Area, 1990-98	11
Table 4. Landings and Value of Fish and Invertebrates Collected in Florida, 1990-98	17
Table 5. Economic Importance of Top Fish Species Collected in Florida	18
Table 6. Average Annual Landings and Prices by the Top Fish Species Groups, 1990-98	19
Table 7. Annual Commercial Landings of the Ten Fish Species (grouped by common name) that Account for the Highest Average Landed Value 1990-98 in Florida	20
Table 8. Annual Dockside Prices of the Ten Fish Species (grouped by common name) that Account for the Highest Average Landed Value 1990-98 in Florida	21
Table 9. Annual Landings and Value of Invertebrates (in 1,000s) Collected in Florida by Type, 1990-98	23
Table 10. Economic Importance of Top Invertebrate Species Collected in Florida, 1990-98	24
Table 11. Average Annual Landings (in numbers for animals and pounds for the 'live' products), Unit Prices, and Change over Time by the Top Invertebrate Species Groups, 1990-98	25
Table 12. Annual Commercial Landings of the Ten Invertebrate Species (grouped by common name) that Account for the Highest Average Landed Value 1990-98 in Florida	26
Table 13. Annual Dockside Price of the Ten Invertebrate Species (grouped by common name) that Account for the Highest Average Landed Value 1990-98 in Florida	27
Table 14. Annual Landings per Trip of the Ten Fish Species (grouped by common name) that Account for the Highest Average Landed Value, 1990-98, in Florida	31
Table 15. Annual Landings per Trip of the Ten Invertebrate Species (grouped by common name) that Account for the Highest Average Landed Value, 1990-98, in Florida	32
Table 16. Annual Revenue per Trip of the Ten Fish Species (grouped by common name) that Account for the Highest Average Landed Value, 1990-98, in Florida	33
Table 17. Annual Revenue per Trip of the Ten Invertebrate Species (grouped by common name) that Account for the Highest Average Landed Value, 1990-98, in Florida	34
Table D-1. Primary Fish Species within the Top Fish Species Groups in terms of Average Value, 1990-98	50
Table D-2. Primary Invertebrate Species within the Top Invertebrate Species Groups in terms of Average Value, 1990-98	51

LIST OF FIGURES

Figure 1. Typical Distribution System for Tropical Ornamental Marine Species.....	4
Figure 2. Number of Species Landed in Florida by Type and Restricted Status, 1990-98	9
Figure 3. Quarterly Fish Revenues, 1991-98.....	13
Figure 4. Quarterly Fish Revenues for Top Species, 1990-98.....	14
Figure 5. Quarterly Invertebrate Revenues for Top Species, 1990-98	15
Figure 6. Annual Dockside Value of Commercial Marine Life Landings in Florida, 1990-98	16
Figure 7. Annual Dockside Value of Invertebrates Collected in Florida by Type, 1990-98	22
Figure 8. Annual Landings of Invertebrates Collected in Florida by Type, 1990-98 (animals and plants in number of specimens, live rock and live sand in pounds).....	23
Figure 9. Per Trip Averages for a Given Fish Species, 1990-98	28
Figure 10. Per Trip Averages for a Given Invertebrate Species, 1990-98.....	29
Figure E-1. Landings and Average Dockside Price of Angelfish, Florida, 1990-98.....	54
Figure E-2. Landings and Average Dockside Price of Hogfish, Florida, 1990-1998.....	54
Figure E-3. Landings and Average Dockside Price of Damselfish, Florida, 1990-1998	55
Figure E-4. Landings and Average Dockside Price of Jawfish, Florida, 1990-1998	55
Figure E-5. Landings and Average Dockside Price of Wrasse, Florida, 1990-1998.....	56
Figure E-6. Landings and Average Dockside Price of Butterfly, Florida, 1990-1998	56
Figure E-7. Landings and Average Dockside Price of Seahorse, Florida, 1990-1998	57
Figure E-8. Landings and Average Dockside Price of Parrotfish, Florida, 1990-1998.....	57
Figure E-9. Landings and Average Dockside Price of Surgeonfish, Florida, 1990-1998	58
Figure E-10. Landings and Average Dockside Price of Drum, Florida, 1990-1998	58
Figure E-11. Landings and Average Dockside Price of Live Rock, Florida, 1990-1998.....	59
Figure E-12. Landings and Average Dockside Price of Snail, Florida, 1990-1998	59
Figure E-13. Landings and Average Dockside Price of Anemone, Florida, 1990-1998	60
Figure E-14. Landings and Average Dockside Price of Crab, Florida, 1990-1998.....	60
Figure E-15. Landings and Average Dockside Price of Starfish, Florida, 1990-1998	61
Figure E-16. Landings and Average Dockside Price of Gorgonian, Florida, 1990-1998	61
Figure E-17. Landings and Average Dockside Price of Sand Dollar, Florida, 1990-1998	62
Figure E-18. Landings and Average Dockside Price of Urchin, Florida, 1990-1998	62
Figure E-19. Landings and Average Dockside Price of Sponge, Florida, 1990-1998.....	63
Figure E-20. Landings and Average Dockside Price of Live Sand, Florida, 1990-1998	63

An Economic Profile of Florida’s Marine Life Industry

I. Introduction

I.A. Industry Definition and Background

The marine life industry in Florida – as defined by the Florida Administrative Code (F.A.C.) – pertains to the non-lethal harvest of saltwater fish, invertebrates, and plants for commercial purposes (F.A.C. Rule 46-42). Products are landed live and sold to wholesalers, retailers, or direct to individual aquarium owners (foreign and domestic). Some products, such as sand dollars, are dried and destined for the shell/curio market. The vast majority of products, however, are destined for the hobby aquaria industry. According to the Pet Industry Joint Advisory Council (PIJAC 1999), tropical fish-keeping is the second most popular hobby (after photography) in the United States. Aside from fish, the successful establishment of an “artificial reef” requires colonization by invertebrates (Loiselle and Baensch 1995).

Live “tropical” aquatic products include both marine and freshwater species. In Florida, the marine component of the larger industry – for live ornamental aquatic products – is derived almost exclusively from the capture of wild specimens (exceptions include the culture of clown fish and live rock).¹ Conversely, the freshwater species (primarily fish) are cultured or “farmed.” According to the PIJAC (1995), Florida produces and supplies 95 percent of the tropical fish sold in North America. In addition, tropical fish and plants are the number one air freight commodity for the state of Florida; each week an estimated 15,000 to 20,000 boxes leave Tampa International Airport alone (PIJAC 1999). The PIJAC estimates the annual value of tropical species collected and farmed in Florida at approximately \$60 million. For comparison, the worldwide wholesale market for marine (i.e., saltwater) ornamental products – wild and farmed – is estimated at more than \$100 million (Aquaculture Development Program 1999; National Sea Grant Office 1999).

I.B. The Marine Life Industry in Florida

I.B.1. Regulations and Requirements for Participation

The collection of live tropical, ornamental, marine species – including fish, invertebrates, and plants – is regulated by Chapter 46-42 of the Florida Administrative Code (F.A.C.). This “Marine Life Rule” was implemented in 1991 and has since been amended three times (in 1992, 1993 and 1995). The major components of the current rule are summarized below.

¹ The Harbor Branch Oceanographic Institute has successfully reared six species of clownfish in captivity. The “culturing” of live rock is allowed by individuals who lease submerged lands from the State of Florida (F.A.C. 46-42.008).

Recreational harvesters – for example, individuals wishing to stock their own aquarium – are subject to daily “bag” limits on the collection of marine life species. For fish and invertebrates, the maximum daily catch equals 20 individuals (including no more than five angelfish) and no more than one gallon of plants (F.A.C. 46-42.005).² Commercial harvesters have higher daily limits for butterflyfish, angelfish, and giant Caribbean anemones (F.A.C. 46-42.006). In order to exceed the daily recreational bag limits, however, commercial collectors must have a current Saltwater Products License (SPL).

According to Florida Statute 370.06(2), every person, firm, or corporation that sells, offers for sale, barter, or exchanges for merchandise any saltwater products harvested and landed in Florida must have a valid SPL. The annual fee for an SPL ranges from \$50 to \$600 depending on residency and whether the license is issued to an individual or a vessel. In order to harvest marine life specimens in particular (e.g., tropical fish and invertebrate species including mollusks, plants, live rock and live sand), a \$75 marine life endorsement (MLE) is also required. In addition to the SPL and MLE, a restricted species endorsement (RSE) is needed to sell the majority of species (F.A.C. 46-42(2-4)).³ This endorsement is issued to individuals or firms that can certify a minimum income threshold from the sale of saltwater products in at least one of the last three years. The typical threshold is 25 percent or \$5,000 (whichever is less) from employment, entrepreneurship, pensions, retirement benefits, and social security benefits.

Aside from bag limits and permitting requirements, certain species are subject to a minimum and/or maximum size restriction (F.A.C. 46-42.004). For example, the butterflyfishes and several species of angelfish – including the Grey, French, Blue, Queen, and Rock Beauty – are currently subject to both a minimum and maximum length (i.e., individuals outside the range cannot be landed). Maximum lengths are also specified for the gobies, jawfish, and Spanish hogfish, while Spotfin hogfish are subject to a minimum length requirement for landing. The size restrictions pertain only to those species captured in Florida’s state or adjacent federal waters; they do not pertain to interstate or international commerce (e.g., individuals collected elsewhere and imported into Florida).

Not all species may be collected. The list of prohibited species includes Longspine urchins, Bahama starfish, hard and stony corals, sea fans, and fire corals (F.A.C. 46-42.009). In addition, live rock may only be harvested from submerged lands leased by the state of Florida if the individual has a state or federal permit for live rock culture (F.A.C. 46-42.008). Hence, in order to collect live rock in Florida, an individual needs (1) an SPL, (2) an MLE, (3) an RSE, (4) a submerged lands lease, and (5) a state or federal permit. State permits are issued by the Florida Department of Environmental Protection (FDEP).

Rule 46-42 of the F.A.C. also includes restrictions on allowable gears, including nets (hand held, barrier, and drop), trawls, slurp guns, and quinaldine (F.A.C. 46-42.007). Barrier nets cannot exceed

² In addition, Rule 46-44 of the F.A.C. contains an allowable species list for sharks and prohibits the take of more than one per person, or two per vessel, per day.

³ The list of “restricted” fish, invertebrates, and plants – which comprise the majority of all species landed – is reproduced in Appendix B.

60 feet in length, have a depth greater than 8 feet, and a mesh larger than $\frac{3}{4}$ inch. Drop nets are also restricted to a mesh size of $\frac{3}{4}$ inch and cannot exceed 12 feet. Trawls, which can only be used to collect dwarf seahorses, must be towed by a vessel no longer than 15 feet (and at less than idle speed) with an opening no larger than 12 inches by 48 inches. Quinaldine, a chemical used to briefly anesthetize fish and facilitate their capture, may be used only if the individual has a special \$25 activity license issued by FDEP (FDEP Rule 62R-4.004). The chemical must be diluted with seawater at no more than 2 percent concentration.

Finally, all collected marine life must be harvested live and the vessel must contain a continuously circulating live well, aeration, or oxygenation system (F.A.C. 46-42.0035). Species may be collected from all state waters, excluding the Biscayne National Park (unless permission is obtained from the park superintendent), and adjacent federal waters. Harvest limits apply to species collected from all areas.

During the 1998 Session of the Florida Legislature, a moratorium on the issue of new marine life endorsements was passed effective 1 July 1998 to 1 July 2002 (Senate Bill 1506). The bill also mandated that the Marine Fisheries Commission (MFC) prepare a report of options for the establishment of a limited-entry program for the marine life fishery by 1 July 2000. The MFC consulted interested commercial fishing organizations and held three public hearings to solicit input for policy development. The resulting report to the Florida Legislature included a number of options (all with mixed support and opposition) for establishing a limited entry program for Florida's marine life industry (Division of Marine Fisheries 2000). There was general support for continuation of the moratorium, however there were those that want it coupled with "a specific goal in terms of licenses rather than an indefinite continuation." Those supporting continuation of the moratorium also proposed a number of conditions, all of which had mixed support and opposition. The conditions included (1) continuation of the moratorium until those who are not reporting landings stop paying for the license, (2) using attrition to reduce numbers of licenses, and (3) basing the ability to renew the endorsement on reported landings. There was also discussion of qualifying landings by using marine life landings only, or by using total reported landings. There was general support for raising the income threshold of fishing income from \$5,000 to \$10,000 (in any one of three previous years) in order to renew the license. A limited entry license based on reported landings had some support, but there was no clear consensus as to when to initiate a cut-off date for implementation. Tiered licenses, based upon type of equipment used for harvest was also explored. For example, one license would be required for SCUBA or chemical use, another for roller frame trawl use, and another for trap/bycatch use. Other discussions focused on the transferability of licenses, and also on the idea that a license could only be used by one or a limited number of people (Division of Marine Fisheries 2000). The Marine Fisheries Commission also considered establishing (1) bag limits for tricolor hermit crabs and turbo snails, (2) changing the bag limit for pink-tipped anemones, (3) changing the size and bag limits of Cuban and Spanish hogfish, (4) allowing the harvest of small coastal sharks, and (5) adding some grunt species to the marine life species list (Marine Fisheries Commission 1998).

I.B.2. General Market Channels

Following landing, commercial products are typically sold to a local wholesaler for distribution in Florida or export (interstate or international). Harvesters may also act as wholesalers and brokers of imported products. This primary distribution chain is depicted in Figure 1:

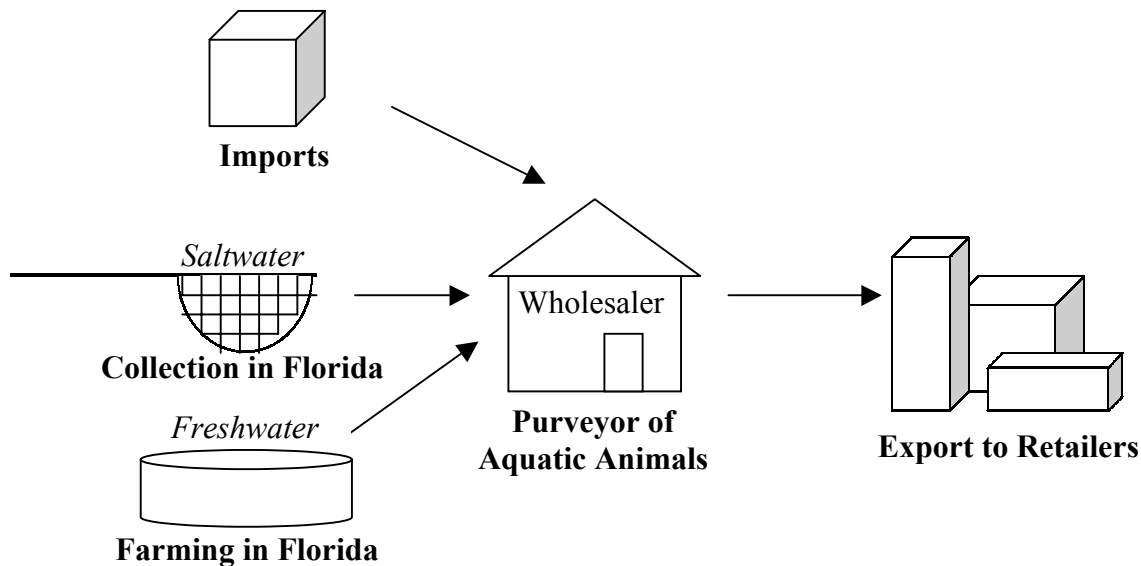


Figure 1. Typical Distribution System for Tropical Ornamental Marine Species

According to Januzzi (1991), 83 percent of collected specimens are destined for U.S. markets (48 percent remain in Florida, 35 percent are exported to other states). Of the specimens that remain in Florida, 65 percent are sold to wholesalers in South Florida. For more information on the market in Florida, see our companion report “1999 U.S. Tropical Fish Wholesalers Survey: Results and Implications”, Florida Sea Grant TP-112.

I.B.3. Impetus for Study

The tropical fish-keeping hobby is the second most popular in the United States (PIJAC 1999). More importantly, interest in home aquariums continues to grow. Industry growth has been especially prevalent for the establishment of “artificial reefs” due to recent technological advances and breakthroughs in the care of such species. Marine aquariums rely on live specimens – fish and invertebrates such as plants, rock, sand, and crustaceans – collected from the wild. In the United States, collection is concentrated in South Florida and Hawaii.

The recent awareness of the plight of coral reefs, such as the designation of 1997 as the “International Year of the Reef”, has begun to highlight the marine life collection industry. According to the World Resources Institute (WRI 2000), almost all reefs of the Florida Keys are at a moderate threat from human activities, including the over fishing of target species. In addition,

At a minimum, over fishing results in shifts in fish size, abundance, and species composition within reef communities. Evidence suggests that removal of key herbivore and predator species may ultimately affect large-scale ecosystem changes. For example, removal of triggerfish has been linked with explosions in burrowing urchin populations, their prey, who subsequently accelerate reef erosion through feeding activities. In the Caribbean, decades of over fishing has led, in many places, to very low levels of grazing fish species. Because of this, herbivorous sea urchins (a non-burrowing species) have played an increasingly important role in keeping down algae growth.

As discussed in section I.B.2, collection practices in Florida have been regulated since the early 1990s with passage of Florida Statute 46-42. However, until 1998, participation (and hence fishing effort) has been effectively unrestricted. Senate Bill 1506 placed a four-year moratorium (beginning July 1, 1998) on the issue of new “marine life endorsements,” without which marine life collected in Florida cannot be sold (Florida Statute 370.06(2)(d)2). The current moratorium (and potential future limited entry system) could produce a wide variety of economically beneficial effects by eliminating myopically driven practices that lead to a disregard for other fishers, recreational divers, reef health, fish mortality rates, and lower revenues (as smaller fish are collected and sold for a lower price). Given the diversity of species collected, however, such a generic program could neglect the protection of certain species.

The State of Florida instituted a comprehensive data collection program, the Marine Fisheries Information System, in 1990. The data resulting from this system are commonly called “Trip Ticket” data, because the program requires that all landings of saltwater fish, saltwater products, and shellfish destined for sale, barter, or trade be reported to the FDEP on a trip-by-trip basis (Rule 62R-5). The data pertaining to the tropical marine ornamental products has, however, yet to be analyzed. Past and current trends regarding the exploitation of individual species are necessary to accurately assess whether existing regulations are sufficient. Specifically, a thorough analysis of the data (Florida landings and trade statistics) would aid the Florida Marine Fisheries Commission in analyzing regulatory options. In addition, the descriptions and opinions of industry members, primarily Florida collectors and dealers, are crucial to the accurate understanding and ultimate success of future regulations.

Lastly, the culture of marine ornamental species is, at present, a nonviable supplement or alternative to the capture industry since – for many species – (1) information on reproduction in captivity is unknown, (2) reproduction in captivity is prohibitively expensive, and/or (3) reproduction in captivity is restricted by environmental regulations regarding release into the wild to avoid potential harm to native species.

I.B.4. Outline of Analysis

This analysis is intended to summarize the data collected by the State of Florida concerning the collection of live marine specimens (fish and invertebrate species including plants, live rock and sand, and small “critters”) for commercial use. This fishery is referred to as the “Marine Life

Industry” and the specimens are primarily intended for use in aquariums. Other outlets include shell and curio shops and niche food markets. Although all species are harvested live, and must be maintained live upon landing, sales in these other markets can involve dead specimens.

Several general statistics concerning the industry are presented including total landings, revenues, and trends over time. Regional analysis shows where the primary collecting areas are located in Florida. Seasonal analysis shows when the majority of landings occur within the year. Statistics on the number of participants by type (i.e., collector versus wholesaler) provide some insight into the size of the industry. Trends are evaluated in terms of changes across the 9-year period from 1990 to 1998.

A description of the landings involves distinguishing between fish and invertebrates and, in particular, identifying statistics for live rock and live sand (which are reported in pounds rather than numbers). In general, numbers of invertebrates landed greatly exceeds the number of fishes landed. This is because, for example, hundreds of small snails can be harvested with a single scoop of a bucket. This harvesting method contrasts with the capture of fish species, which often require diving gear and the use of slurp guns or nets. Another reason for distinguishing between fish and invertebrates is that fish prices are, in general, higher.

Within the fish and invertebrate groups, statistics are summarized by common names (discussed further below). This decision was made in order to keep the number and type of statistics to compare to a manageable number since over 320 different species have been landed. Furthermore, detailed statistics are only presented for the top 10 species (in terms of value) of fish and invertebrates, including annual landings, annual value of landings, annual average price, annual average landings per trip, and annual average revenue per trip.

For the sake of providing a comprehensive overview related to the industry, a copy of the regulations is included in an appendix. Although these regulations have since been re-numbered following the reorganization of the managing agency, the content is largely unchanged.

II. Data Source and Description

The Florida Department of Environmental Protection (FDEP) – formerly known as the Department of Natural Resources – has been collecting data on the harvest of live marine products since 1990. The FDEP requires licensed wholesale dealers (i.e., buyers) to report dealer and harvester (collector) license numbers, the location of harvest, the species and quantity purchased, and the value of each transaction by species (Chapter 62R-5). Since each transaction typically occurs immediately following the trip, these forms are referred to as “trip tickets”. Landings that are not sold, bartered, or exchanged are excluded from the data set, which is maintained by the Florida Market Research Institute (FMRI) in St. Petersburg, Florida. All data described in this report was obtained from FMRI.

Since there are size limits for some species (46-42.004), the FDEP trip tickets also allow the collector to report the size of individuals (e.g., small, medium, large). The size information is, however, not applicable for all species and is frequently unreported. Due to the main objectives of this analysis and limitations due to the magnitude of results (given the number of species, years, quarters, and areas), this information is not incorporated into this analysis. It is important to note, however, that the size of wild-caught fish will vary depending on variety, season (e.g., due to water temperature and availability of food), location, and sex of the fish. These factors can also affect specific characteristics of the fish such as color. For many species, size and color differences translate into price differences.

Prior to 1990, landings data were collected only from individuals holding quinaldine permits (Hess and Stevely 1978). Given that the corresponding data excludes invertebrate data, prices, and the harvest of fish without chemical use, these data are not analyzed in this report.

II.A. Number of Industry Participants

The number of participants in the marine life industry from 1990 to 1998 is summarized in Table 1. The number of licensed marine life dealers increased significantly in the mid-1990's, but by 1998 this number had declined to the level observed in the early 1990's. Currently, there are approximately 65 licensed dealers in the State of Florida. These dealers are legally allowed to purchase marine life species from licensed collectors and are required to submit information regarding the transaction to FMRI. This required reporting information consists of the collector's license number, species landed (quantity and unit price), area where collection occurred, and the transaction date. Individuals can be licensed as both a collector and dealer, and many are according to a recent study conducted in conjunction with this report (Larkin and Degner 2001). Information on all other permits, licenses, and endorsements are also summarized in Table 1 for the 1990-91 to 1998-99 seasons.

To collect marine life in excess of the daily bag limit of 20 specimens and one gallon of marine plants, an individual or business needs a saltwater products license (SPL) with both a restricted species endorsement and marine life endorsement (F.A.C. 46-42.006). The marine life endorsement (MLE) is the only authority that applies exclusively to the marine life industry. The total number of MLE's increased from 1990 to 1997. In 1997, approximately 800 endorsements had been issued whereas fewer than 200 were issued in 1990. The number of active marine life endorsements (i.e., endorsements with reported landings), however, has remained fewer than 230. In 1998, only 128 MLE's were active. The total number of MLE's issued declined recently due to a moratorium that will remain in effect at least until 2003. However, there continues to remain a significant amount of latent effort in the fishery. It is believed that these are commercial enterprises, individual fisherman and businesses, that are retaining permits to hedge against further restrictions in other fisheries.

Table 1. Number of Commercial Participants in the Florida Marine Life Industry

License Year	Active ^a Wholesale Dealers	Restricted Species Endorsements	Saltwater Products License		Marine Life Endorsements	
			Total	Active ^a	Total	Active ^a
1990-91	69	127	349	297	159	107
1991-92	91	265	436	289	311	164
1992-93	109	362	521	329	389	197
1993-94	114	431	572	317	477	222
1994-95	112	523	655	318	566	229
1995-96	103	589	698	273	630	205
1996-97	98	626	706	213	668	175
1997-98	105	726	844	241	801	198
1998-99	66	703	767	152	743	128

^a“Active” refers to license numbers that reported landings during the year.

II.B. Product Types

Approximately 320 marine ornamental species have been landed in Florida for commercial purposes from 1990 to 1998. The total includes 181 species of fish (57 percent) and 137 invertebrate species (43 percent), which includes live rock, live sand, and various plant species.

Slightly over 70 percent of fish species and approximately half of the invertebrate species are classified as “restricted” (Figure 2). The list of restricted species is included in Appendix A. The harvest of restricted species is subject to additional regulations. All regulations are included in Appendix B

Aside from the type of organism and restricted status, each product landed is identified by its common name, genus, species, and/or family. For the fishes, species that share a common name typically are from the same family. For example, there are nine species of parrotfish that are all members of the scaridae family. Exceptions include the blennies, sharks, and rays. Of the 181 fish species landed, there are a total of just 67 common names representing 51 families (e.g., bass, groupers, hamlets, and perch are all members of the serranidae family). The common fish names are listed in Table 2 with the corresponding list of invertebrates.

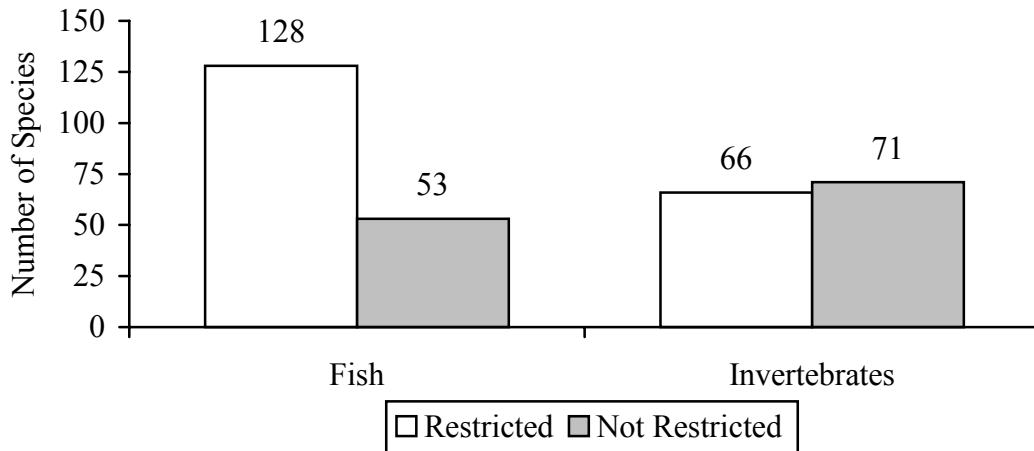


Figure 2. Number of Species Landed in Florida by Type and Restricted Status, 1990-98

For the invertebrate species, common names do not match specific families as closely as the fish species. For example, the 26 “snails” represent 21 different families and the 15 “crabs” represent 10 families. When grouped by common name, however, the 137 species are reduced to just 32 distinct groups. For clarity and comparison with other studies, it is possible to further distinguish the invertebrate species as sessile or mobile. Sessile invertebrates are completely immobile and include such species as plants, live rock, and live sand. Slow moving invertebrates – such as anemones, corals, sponges, and marine worms – are frequently included in this category. The mobile invertebrates can also be categorized by whether they are segmented. For example, unsegmented mobile invertebrates would include the molluscs (i.e., marine snails, nudibranches, bivalves, and octopi). Segmented mobile invertebrates (arthropoda, class crustacea) include shrimps, prawns, lobsters, and crabs. Lastly, the echinodermatas or “spiny skinned ones”, are characterized by radial symmetry and include sand dollars, sea urchins, starfish, brittlestars, and sea cucumbers. In this analysis, live rock and live sand are usually distinguished from the remaining invertebrates, which are not further divided.

Table 2. List of Ornamental Marine Species Collected in Florida, 1990-98

Fishes		Invertebrates
Angelfish (6)	Moray (5)	Anemone (6)
Balloonfish	Parrotfish (9)	Bryozoa
Barracuda	Perch	Chiton
Bass (8)	Pilotfish	Clam (4)
Batfish	Pipefish	Conch (7)
Bigeye	Porgy	Cowrie (2)
Blenny (8)	Puffer (3)	Crab (15)
Brotula	Ray (4)	Fileclam (2)
Burrfish	Razorfish	Gorgonian (3)
Butterflyfish (6)	Remora (2)	Jellyfish (2)
Cardinalfish (3)	Scorpionfish (2)	Isopod
Catfish	Seahorse (3)	Live Rock (6)
Chub	Searobin	Live Sand
Clingfish	Shark (3)	Lobster (3)
Coronetfish (3)	Sheephead	Nudibranch (3)
Cowfish (3)	Skate	Octopus (4)
Cusk-eel	Snapper (3)	Oyster
Damselfish (14)	Soapfish	Penshell
Drum (4)	Soldierfish	Plant (4)
Filefish (6)	Spadefish	Polychaete (5)
Flounder	Squirrelfish (3)	Sand Dollar (4)
Frogfish (2)	Stargazer (2)	Scallop (2)
Goatfish (2)	Stingray (2)	Sea Biscuit (3)
Goby (3)	Surgeonfish	Sea Cucumber (2)
Grouper (5)	Sweeper	Sea Hare
Grunt (5)	Tang (3)	Shrimp (8)
Hamlet (6)	Tilefish	Snail (26)
Hawkfish	Toadfish	Sponge (4)
Hogfish (3)	Triggerfish (3)	Starfish (8)
Jack (2)	Tripletail	Tunicates
Jawfish (4)	Trumpetfish	Urchin (5)
Lizardfish	Trunkfish (2)	Whelk (2)
Minnow	Wrasse (8)	
Mojarra		

Note: Common names reflect biological family, number in parentheses corresponds to the number of different genus and species combinations related to the family. Names are listed in alphabetical order.

III. Quantity and Value of Landings

III.A. Regional Statistics

The Marine Fisheries Information System – the data collection program maintained by the FDEP – has divided the fishing areas in Florida into 17 distinct sections. Each of the 17 primary areas is further subdivided into distinct subregions. In addition, separate fishing area codes have been defined for Georgia, Barbados, the Virgin Islands, and Puerto Rico. These codes are presented in Appendix C, Figure C-1.

Only eight of the 17 primary areas were reported as sources of marine life collected for commercial purposes from 1990 through 1996. However, nine additional areas reported landings in 1997 and 1998. Because most of the landings were relatively small, the nine areas are included in the “all others” category. The identified collecting regions ranged from the Crystal River - Tarpon Springs area on Florida’s West Coast down to the Miami area on Florida’s southern East Coast. Overall, the Marathon area (748.0, 748.1, and 748.9) accounted for the highest value of landings (31.1 percent or \$7.2 million) and most number of trips (39.4 percent or nearly 181,000) (Table 3). The areas reported represented approximately 75 percent of the total number of trips taken and 76.8 percent value of marine life landed. The source region was not reported for 15.8 percent of trips that accounted for 15.2 percent of landed value. Also, the total value of landings over all areas does not exactly match the total value of landings reported in other sections because some observations were excluded to maintain confidentiality.

Table 3. Summary of Total Revenue by Area, 1990-98

Area Name	Area Code	1990-96 (1,000\$)	1997-98 (1,000\$)	Total (1,000\$)	Total Percent
Crystal River-Tarpon Springs					
Offshore Waters	6.0	302			
St. Joseph Sound	6.1	7			
Other Inland Waters	6.2	13			
Federal Waters	6.9	2,301			
Total	6.0	2,623	213	2,836	12.3%
Tampa					
Offshore Waters	5.0	155			
Tampa Bay	5.1	98			
Sarasota Bay	5.3	10			
Federal Waters	5.9	1,371			
Total	5.0	1,634	124	1,758	7.6%
Fort Myers					
Offshore Waters	4.0	192			
Charlotte Harbor	4.1	61			

Table 3. continued

Area Name	Area Code	1990-96 (1,000\$)	1997-98 (1,000\$)	Total (1,000\$)	Total Percent
Pine Is. Snd. & San C. Bay	4.3	183			
Federal Waters	4.9	64			
Total	4.0	500	54	554	2.4%
Everglades					
Offshore Waters	3.0	1			
Whitewater Bay	3.1	5			
All Other Inland Waters	3.2	6			
Federal Waters	3.9	33			
Total	3.0	45	5	50	0.2%
Tortugas					
All Waters	2.0	5			
Federal Waters	2.9	4			
Total	2.0	9	51	60	0.3%
Key West					
North of US 1	1.0	667			
South of US 1(FL Bay)	1.1	835			
Federal Waters	1.9	813			
Total	1.0	2,315	656	2,971	12.9%
Marathon					
South of US 1	748.0	2,663			
North of US 1(FL Bay)	748.1	241			
Federal Waters	748.9	3,587			
Total	748.0	6,491	668	7,159	31.1%
Miami					
Offshore Waters	744.0	1,054			
Florida Bay	744.1	97			
Bis. Bay, Card & Barnes S.	744.2	84			
Federal Waters	744.9	915			
Total	744.0	2,150	137	2,287	9.9%
All Other Areas					
Total			1,851	1,851	8.0%
Unspecified Areas					
Total		3,464	30	3,494	15.2%
Grand Total		19,231	3,789	23,020	100.0%

^a Detailed codes were not available for 1997 and 1998 data.

III.B. Seasonal Statistics

To examine seasonal differences, landings statistics are summarized by quarter (January-March, April-June, July-September, October-December) in this section. First seasonal differences are examined by total per quarter for fish and invertebrates. To facilitate comparisons, only the total values (i.e., revenues) are presented. Figure 3 depicts the distribution of landings in value by quarter.⁴

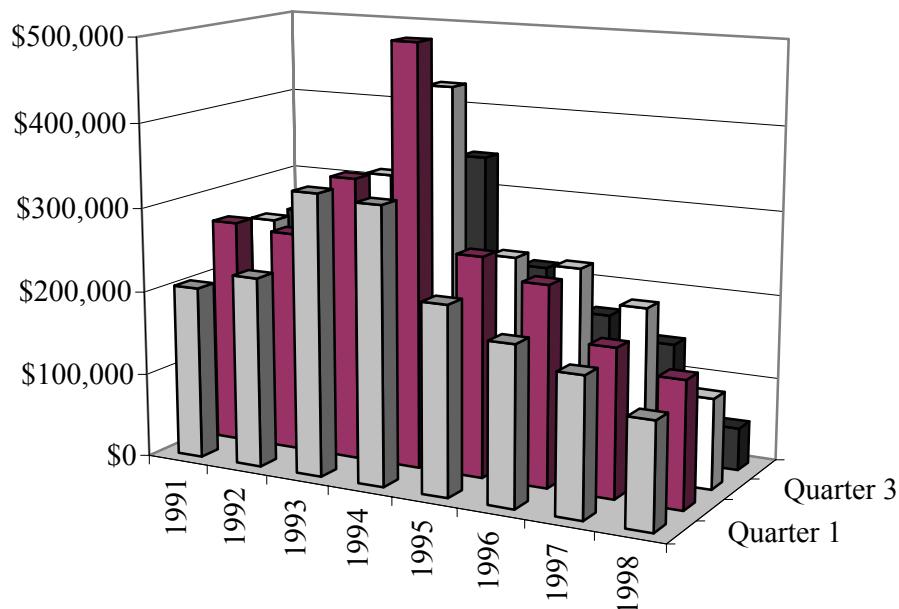


Figure 3. Quarterly Fish Revenues, 1991-98

In general, fish landings have been roughly equally distributed during the season in terms of value. When fish revenues were highest in 1994, the second quarter accounted for a relatively larger share. On average, the value of fish landings were highest during the second quarter and lowest during the fourth quarter at \$274,387 (accounting for 28 percent) and \$208,958 (accounting for 22 percent), respectively.

When the revenues are examined by top 10 revenue-generating groups of fish species, some seasonal patterns emerge. Figure 4 shows the quarterly revenue shares for each of the top fish species. For the top 2 fish species (in terms of value), landings are roughly equally distributed throughout the year. This even distribution reflects either constant demand or constant effort for angelfishes and hogfishes. Jawfish and drum are primarily caught in the third quarter and each have relatively small landings in the first quarter. Conversely, the value of parrotfish and surgeonfish landings have been highest (in other words, have experienced the heaviest fishing pressure) in the first quarter.

⁴ The quarterly data set was incomplete for the first quarter of 1990 so that year was not included in this analysis.

Seahorses are the only species group for which the relative harvest falls in the final (i.e., fourth) quarter.

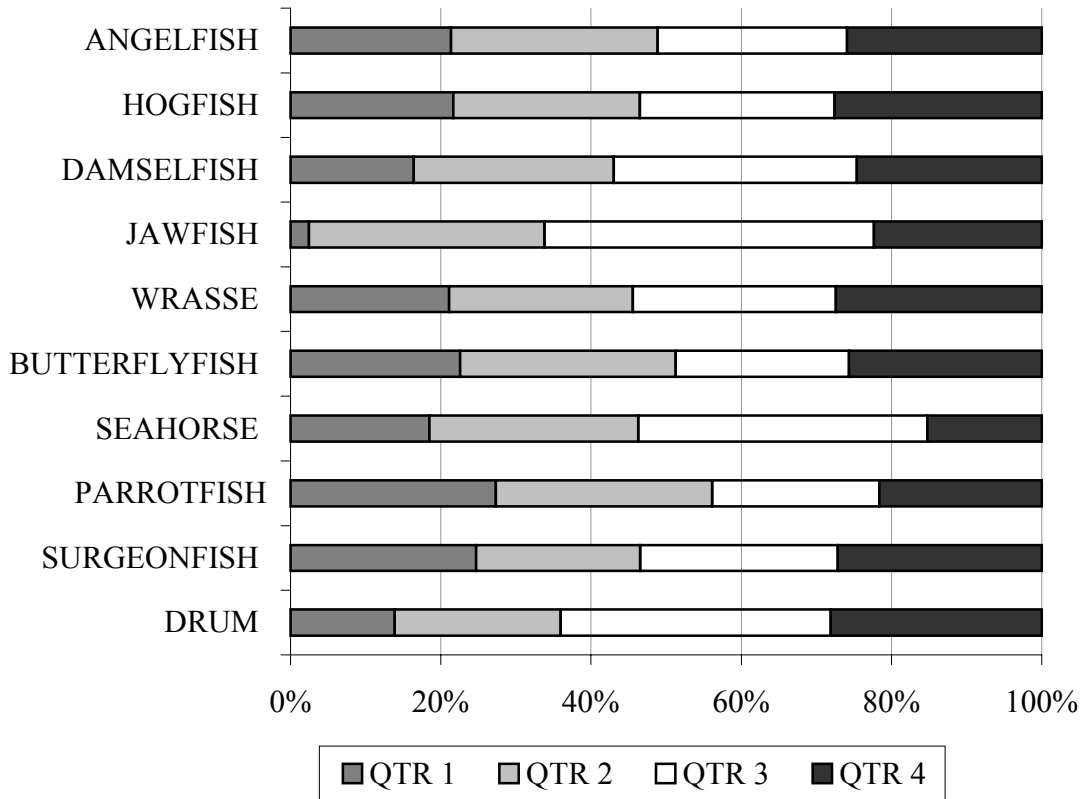


Figure 4. Quarterly Fish Revenues for Top Species, 1990-98

The quarterly total statistics for the value of invertebrates ranged from \$404,072 (accounting for 24 percent) to \$456,746 (accounting for 26 percent) and corresponded to the first and third quarters, respectively (Figure 5). There was no noticeable trend in landings distribution over time and, thus, we have not included this information.

When comparing the fish landings distribution with the invertebrates shown in Table 6, note that among the invertebrate species more product (i.e., total revenue) was caught in the first quarter and less in the second and third quarters. The share of product caught in the fourth quarter was above 20 percent for all species. Sand dollars were primarily collected from July through September. Over 40 percent of live sand was collected from April through June. With the exception of sand dollars, in general it appears that landings are lowest July through August.

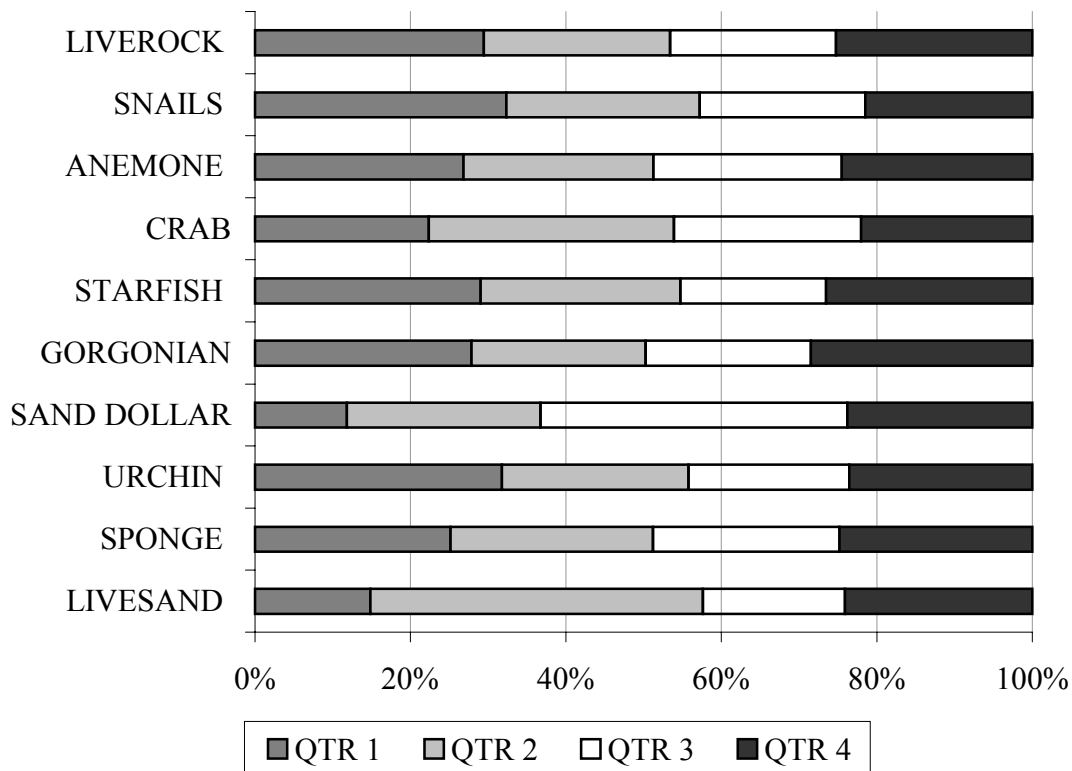


Figure 5. Quarterly Invertebrate Revenues for Top Species, 1990-98

III.C. Statistics by Product Type

At this point it bears repeating that the “marine life” fishery in Florida is defined in the regulations and legislation to include only saltwater species that are collected live and intended for the aquarium industry (i.e., commercial purposes). The total dockside value of marine life landings (i.e., specimens harvested, collected, or caught) in Florida increased from \$1.4 million in 1990 to approximately \$4.3 million in 1992 (Figure 6, Table 4). The total value of this fishery then decreased to about \$3.5 million in 1995 and can be accounted for by decrease in the landings of live rock and sand, which fell from approximately 1.2 million pounds in 1995 to 166,000 pounds in 1998. The reason for the dramatic decrease was the prohibition of all commercial harvest of live rock and sand, in both Atlantic and Gulf of Mexico waters adjacent to Florida. The only exception is the harvest of live rock from permitted commercial culture sites approved by the appropriate state and federal agencies. By 1998, there were seven commercial live rock culture leases off the coast of Florida, but total production was relatively low (Florida Marine Research Institute 1999).

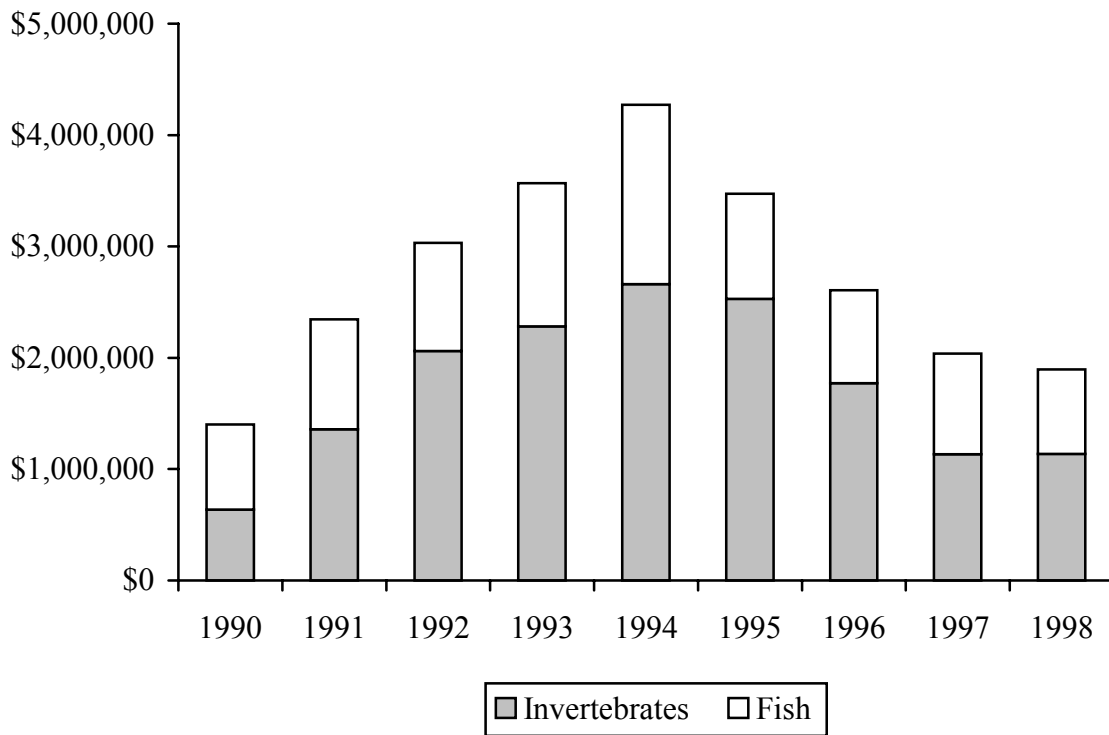


Figure 6. Annual Dockside Value of Commercial Marine Life Landings in Florida, 1990-98

III.C.1. Fish Species Statistics

Landings and value of marine ornamental finfish increased to peak levels in 1994, then decreased through 1998. Reported landings increased from 245,000 individual fish in 1990 to 426,000 in 1994, then declined to approximately 200,000 in 1998. Dockside value followed the same general pattern, increasing from \$766,000 in 1990 to \$1.6 million in 1994, then declining to \$759,000 in 1998 (Figure 6, Table 4). Note that in 1992, landings increased 35 percent while the total value of landings declined slightly. The increased landings were due specifically to a five-fold increase in the collection of seahorses (from approximately 14,000 harvested in 1991 to 83,700 harvested in 1992), primarily *Hippocampus zosterae* (i.e., Dwarf seahorses). In addition, the increased landings of seahorses lowered market prices; the average price paid by dealers for seahorses fell from \$1.10 in 1991 to only \$0.17 in 1992, a decline of nearly 84 percent.

Table 4. Landings and Value of Fish and Invertebrates Collected in Florida, 1990-98

Year	Fish			Invertebrates ^a		Total Value (\$)
	Number Landed	Value (\$)	Percent Total Value	Value (\$)	Percent Total Value	
1990	245,401	\$ 766,868	55%	\$ 635,950	45%	\$1,401,818
1991	291,311	986,885	42%	1,357,720	58%	2,344,605
1992	393,497	971,115	32%	2,061,135	68%	3,032,250
1993	355,017	1,283,871	36%	2,282,590	64%	3,566,461
1994	425,781	1,612,597	38%	2,660,887	62%	4,273,484
1995	259,387	944,172	27%	2,528,508	73%	3,472,680
1996	205,832	832,603	32%	1,773,081	68%	2,605,684
1997	278,105	903,923	44%	1,134,274	56%	2,038,197
1998	201,212	759,363	40%	1,136,385	60%	1,895,748
Totals	2,656,643	9,060,397	37%	15,570,530	63%	24,630,927

^a The absolute level of landings were not included since live rock and live sand are measured in pounds versus by the piece.

During the 1990-98 period, 181 individual species of finfish were harvested. For simplicity, these species were grouped into 67 categories using their common name as defined by the Florida Marine Research Institute. The Institute uses a three digit code for each species and associated with this code are: (1) a common name, (2) genus and species, and (3) family. The common name is most closely associated with the family. For example, the data set contains three genus and species of “cowfish” including *Lactophrys polygonia*, *Lactophrys quadricornis*, and family *ostraciidae*, which are listed (in common name field), respectively, as honeycomb cowfish, scrawled cowfish, and other cowfish. Although each species has its own unique code, each is a member of the *ostraciidae* family, and data from all three are aggregated and included under the common name “cowfish”. Note that not all codes are associated with a unique genus and species and, thus, fall into an “other” category. Consequently, the number of individual species should be considered as conservative.

The 67 aggregate finfish groups were listed in Table 2. If a group consists of multiple species, parentheses were used to indicate the number of individual species that are included in the common-name groupings. Of these groups, ten accounted for nearly 84 percent of the total dockside value (Table 5). The most important species group was angelfish, which represented 54 percent of the total

value. Hogfish accounted for 7.5 percent of the total, while the other eight groups accounted for approximately 22 percent of the total dockside value of live marine finfish collected from 1990 to 1998. Since each species group contains multiple species, it may be helpful to know how important any single species may be, especially when regulations can be enacted at the species level. The primary species within each group is shown in Appendix D, Table D-1.

Table 5. Economic Importance of Top Fish Species Collected in Florida

	Total Value 1990-98	Percent of Total Fish Value	Cumulative Percent
1. Angelfish	\$4,891,917	54.0%	54.0%
2. Hogfish	676,696	7.5	61.5
3. Damselfish	316,368	3.5	65.0
4. Jawfish	293,857	3.2	68.2
5. Wrasse	289,019	3.2	71.4
6. Butterflyfish	273,876	3.0	74.4
7. Seahorses	238,631	2.6	77.0
8. Parrotfish	233,147	2.6	79.6
9. Surgeons	201,162	2.2	81.8
10. Drum	174,865	1.9	83.7

With the exception of seahorses and surgeonfish, all species groups exhibited a decline in landings volumes from 1990 to 1998 (Tables 6 and 7). The largest species group decline was reported to be the butterflyfish (48 percent), while seahorses were the species group with the largest increase (184 percent). Trends in landings for each of the top 10 species groups are shown in Appendix E, Figures E-1 through E-10.

Table 6. Average Annual Landings and Prices by the Top Fish Species Groups, 1990–98

Species Group	Average Annual Landings (Number)	Change in Landings 1990-1998 (Percent)	Average Annual Price (\$/fish)	Change in Price 1990-98 (Percent)	Average Annual Value (\$)
1. Angelfish	71,793	-31.6%	\$7.60	44.5%	\$543,546
2. Hogfish	9,911	-13.1	7.55	13.6	75,189
3. Damselfish	26,408	-34.0	1.33	-10.5	35,152
4. Jawfish	12,901	-6.8	2.42	17.4	32,651
5. Wrasse	19,735	-42.4	1.64	13.5	32,113
6. Butterflyfish	11,029	-48.3	2.86	26.4	30,431
7. Seahorse	48,426	+184.4	0.77	-29.2	26,515
8. Parrotfish	5,308	-39.5	4.87	97.9	25,905
9. Surgeonfish	7,317	+18.3	3.09	3.9	22,351
10. Drum	9,230	-43.0	2.11	15.3	19,429

Average per unit prices varied considerably across species. For example, in 1998 the average unit price for angelfish and hogfish both exceeded \$8 per fish, while the unit price for damselfish, jawfish, wrasse, butterflyfish, and drum were less than \$3 (Table 8). The average price for seahorses was less than \$1. With the exception of angelfish, the species exhibiting the highest landings volume (i.e., damselfish, wrasse, and seahorses) also showed the lowest average unit price. The average unit price for angelfish varied considerably during the 1990-98 period (Figure 4), increasing from \$5.62 in 1990 to \$9.13 in 1993, before declining to \$6.92 in 1995. The unit average price for angelfish then increased to \$8.12 in 1998. Price trends for each of the top 10 species groups are also found in Appendix E, Figures E-1 through E-10.

Table 7. Annual Commercial Landings of the Ten Fish Species (grouped by common name) that Account for the Highest Average Landed Value 1990-98 in Florida

Species Group	Number of Specimens Landed Annually										Average
	1990	1991	1992	1993	1994	1995	1996	1997	1998		
1. Angelfish	71,459	82,589	86,711	79,782	82,668	73,666	60,602	59,817	48,839		71,793
2. Hogfish	8,535	8,794	9,888	10,112	13,494	12,451	10,633	7,869	7,419		9,911
3. Damselfish	32,150	31,702	38,337	21,558	29,387	27,504	14,102	21,703	21,225		26,408
4. Jawfish	6,325	4,995	16,624	22,151	28,267	13,596	9,285	8,976	5,894		12,901
5. Wrasse	23,440	25,032	27,227	20,686	21,713	16,920	12,453	16,633	13,512		19,735
6. Butterflyfish	12,667	15,266	15,479	13,213	12,949	9,420	6,941	6,772	6,551		11,029
7. Seahorse	5,969	13,982	83,715	71,815	110,948	23,341	19,037	90,049	16,977		48,426
8. Parrotfish	4,953	5,760	8,374	6,212	8,728	3,876	2,866	4,004	2,998		5,308
9. Surgeonfish	6,511	6,881	8,930	9,342	8,378	6,791	5,359	5,961	7,702		7,317
10. Drum	11,891	9,816	9,505	10,569	11,526	9,086	7,233	6,661	6,781		9,230

Table 8. Annual Dockside Prices of the Ten Fish Species (grouped by common name) that Account for the Highest Average Landed Value 1990-98 in Florida

Species Group	Average Dockside Price (\$ each)										Total Value
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1998	
1. Angelfish	5.62	7.00	6.61	9.13	8.85	6.92	7.61	8.54	8.12	8.12	543,546
2. Hogfish	7.43	6.56	4.01	8.84	9.23	7.28	7.89	8.23	8.44	8.44	75,189
3. Damselfish	1.33	1.20	1.08	1.53	2.01	1.30	1.22	1.12	1.19	1.19	35,152
4. Jawfish	2.01	2.19	2.17	2.38	3.07	2.44	2.60	2.58	2.36	2.36	32,651
5. Wrasse	1.48	1.65	1.20	1.44	2.40	1.60	1.70	1.65	1.68	1.68	32,113
6. Butterflyfish	2.65	2.74	2.10	2.78	4.14	2.20	2.59	3.17	2.35	2.35	30,431
7. Seahorse	1.13	1.10	0.17	0.12	0.88	1.07	1.34	0.35	0.80	0.80	26,515
8. Parrotfish	2.90	4.29	3.33	6.72	6.40	4.04	5.21	5.18	5.74	5.74	25,905
9. Surgeonfish	3.34	2.44	1.85	3.34	4.05	2.51	3.41	3.41	3.47	3.47	22,351
10. Drum	1.83	1.81	1.48	2.02	3.46	1.77	2.24	2.24	2.11	2.11	19,429

III.C.2. Invertebrate Species Statistics

The 137 individual species of invertebrates collected by the marine life industry in Florida from 1990 to 1998 were grouped into 32 major species groups (Table 2) using the same procedure as with the finfish. Due to the diversity of the invertebrate species, these groups are further aggregated into the following three categories: (1) invertebrate animals (including crustaceans, mollusks, starfish, anemones, sea cucumbers, sponges, nudibranches, bryozoa, etc.), (2) marine plants, and (3) live rock and live sand.

The patterns in invertebrate landings volumes and value during the 1990-98 period varied somewhat across the three major groups (Figures 7 and 8). Landings of invertebrate animals exhibited a steady increase from approximately 850,000 individual animals in 1990 to 3.3 million animals in 1998, an increase of 290 percent (Table 9). However, the total dockside value of the animals increased from approximately \$376,000 in 1990 to a peak of \$1.2 million in 1994, then declined steadily to \$896,000 in 1998 as species less valuable on a per unit basis (such as snails, starfish, and sand dollars) garnered an increasing share of the total volume. Landings of plants increased from approximately 31,000 individuals in 1990 to a peak of 37,000 in 1995. Plant landings then declined dramatically (approximately 62 percent) to 14,000 in 1998 (Table 9).

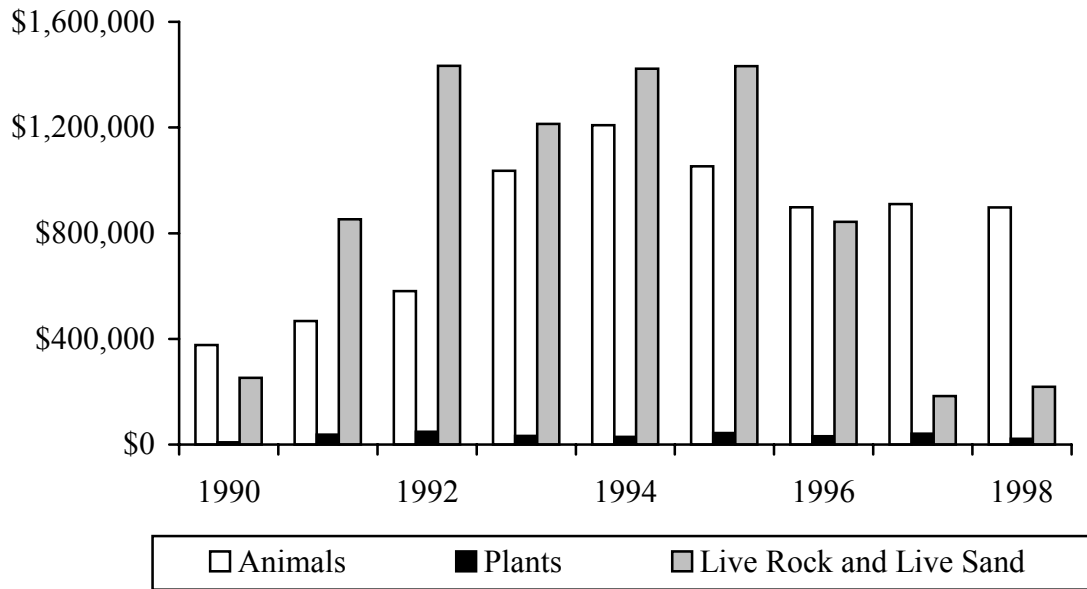


Figure 7. Annual Dockside Value of Invertebrates Collected in Florida by Type, 1990-98

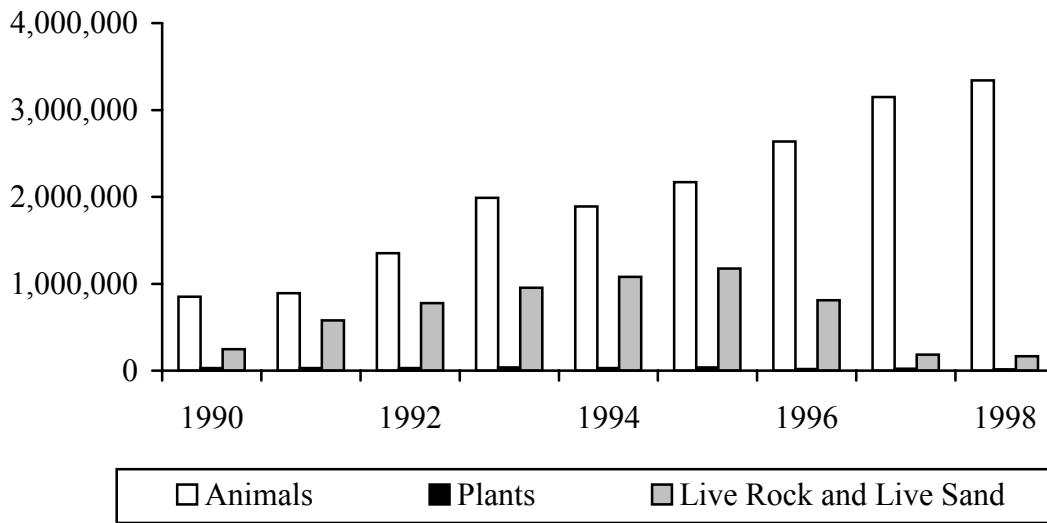


Figure 8. Annual Landings of Invertebrates Collected in Florida by Type, 1990-98 (animals and plants in number of specimens, live rock and live sand in pounds).

Table 9. Annual Landings and Value of Invertebrates (in 1,000s) Collected in Florida by Type, 1990-98

Year	Marine Invertebrate Specimen Type					
	Animals		Plants		Live Rock, Live Sand	
	Number	Value (\$)	Number	Value (\$)	Pounds	Value (\$)
1990	849	\$ 377	31	\$ 8	245	\$ 252
1991	893	467	30	38	578	853
1992	1,352	581	28	48	777	1,433
1993	1,989	1,036	35	33	954	1,213
1994	1,888	1,209	31	29	1,079	1,422
1995	2,171	1,053	37	43	1,175	1,432
1996	2,637	899	20	31	809	843
1997	3,148	911	21	41	185	183
1998	3,340	897	14	22	167	218

The dockside value of marine plants reached peaks in 1992 and 1995, then declined with landings volumes to \$22,000 in 1998. As discussed previously, the landings of live rock and live sand mirror the enactment of legislation intended to eliminate the harvest of naturally occurring live rock. Live rock landings increased from approximately 245,000 pounds in 1990 to 1.2 million pounds in 1995, a 390 percent increase. Following the moratorium on landings in federal waters, landings decreased to 166,600 pounds in 1998. The dockside value of live rock and sand reached equivalent peaks of about \$1.4 million in 1992 and 1995, then decreased dramatically to \$218,000 in 1998 as reported landings were comprised predominantly of live rock that was only cultured on permitted lease sites (Table 9).

Ten invertebrate species groups accounted for over 89 percent of the total dockside value attributable to invertebrate animals, plants, and live rock and sand during the 1990-98 period (Table 10). The most important single species group was live rock, which accounted for almost 50 percent of the dockside value accumulated during the 1990-98 period, despite the drastic declines following the 1995 moratorium. Snails, anemones, and crabs combined accounted for 20 percent of the value, with the other six species contributing the remaining 30 percent of the total dockside value (Table 10). The primary species within each of the top 10 invertebrates species groups are listed in Appendix D, Table D-2.

Table 10. Economic Importance of Top Invertebrate Species Collected in Florida, 1990-98

Species Group	Total Value 1990-98	Percent of Invertebrate Value	Cumulative Percent
1. Live Rock	\$7,357,422	48.8%	48.8%
2. Snails	1,262,345	8.1	56.8
3. Anemones	1,128,348	7.2	64.1
4. Crabs	913,848	5.9	70.0
5. Starfish	729,706	4.7	74.7
6. Gorgonians	685,047	4.4	79.1
7. Sand Dollars	542,991	3.5	82.6
8. Urchins	385,953	2.5	85.1
9. Sponges	349,564	2.2	87.3
10. Live Sand	307,662	2.0	89.3

With the exception of live rock and anemones, all of the top ten invertebrate species groups experienced increases in landings volumes during the 1990-98 period, with some being dramatic. For example, starfish, snails, and crabs, exhibited increases in landings of 1,824 percent, 791 percent, and 755 percent, respectively, from 1990 to 1998 (Table 11). Year-to-year changes in landings of the top 10 species groups are shown in Table 12 and with the average prices in Appendix E, Figures 11-20. As with finfish species, dockside prices also varied across invertebrate species groups. As shown in Table 11, the highest average unit prices during the 1990 to 1998 period were associated with sponges (\$2.40), gorgonians (\$2.29), live rock (\$1.14 per pound), and urchins (\$1.14). Annual dockside prices of the top ten invertebrate species groups are also shown in Table 13.

Table 11. Average Annual Landings (in numbers for animals and pounds for the 'live' products), Unit Prices, and Change over Time by the Top Invertebrate Species Groups, 1990–98

Species Group	Average Annual Landings	Change in Landings 1990-98	Average Annual Price	Change in Price 1990-1998	Average Annual Value
Live Rock	623,279	-63%	\$ 1.38	91%	\$837,491
Snail	373,587	791	0.40	-45	140,261
Anemone	275,812	-26	0.57	30	125,372
Crab	236,674	755	0.57	-62	101,539
Starfish	205,012	1,824	0.39	-89	81,078
Gorgonian	28,736	129	2.29	22	76,116
Sand Dollar	438,850	203	0.14	-33	60,332
Urchin	36,823	29	1.14	234	42,884
Sponge	17,534	1	2.40	80	41,063
Live Sand	42,876	N.A.	N.A.	N.A.	34,185

Table 12. Annual Commercial Landings of the Ten Invertebrate Species (grouped by common name) that Account for the Highest Average Landed Value 1990-98 in Florida

Species Group	Number of Specimens Landed										Average ^a Landings
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1998	
1. Live Rock ^a	249,093	581,376	776,810	954,197	1,087,065	1,094,723	671,226	104,044	90,975	90,975	623,279 ^a
2. Snail	90,369	182,180	257,752	293,688	288,406	480,706	470,357	493,614	805,210	805,210	373,587
3. Anemone	272,476	302,701	334,043	293,590	307,891	335,795	233,649	200,533	201,629	201,629	275,812
4. Crab	92,250	90,845	119,591	152,375	117,889	181,074	252,882	334,559	788,598	788,598	236,674
5. Starfish	26,575	28,220	129,574	333,911	314,071	222,102	543,782	975,368	511,297	511,297	205,012
6. Gorgonian	17,803	24,350	23,898	29,960	32,106	35,976	37,057	44,867	40,743	40,743	28,736
7. Sand Dollar	254,832	88,191	193,574	560,480	578,574	619,716	776,582	781,567	771,817	771,817	438,850
8. Urchin	31,745	35,495	33,008	41,156	39,052	41,268	36,039	33,232	40,900	40,900	36,823
9. Sponge	17,017	18,858	17,886	18,626	18,236	17,659	14,459	15,464	17,166	17,166	17,534
10. Live Sand ^a	N/A	N/A	N/A	N/A	4,802	86,175	138,194	81,129	75,584	75,584	42,876 ^a

^a Number landed for all species except live rock and live sand, which are measured in pounds.

Table 13. Annual Dockside Price of the Ten Invertebrate Species (grouped by common name) that Account for the Highest Average Landed Value 1990-98 in Florida

Species Group	Average Unit Price (\$/specimen)										Average Value
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1998	
1. Live Rock	1.01	1.47	1.84	1.27	1.30	1.20	1.12	1.30	1.93	837,491	
2. Snail	0.38	0.22	0.37	0.61	0.55	0.68	0.28	0.26	0.21	140,261	
3. Anemone	0.37	1.47	0.42	0.48	0.53	0.43	0.44	0.47	0.48	125,372	
4. Crab	0.48	0.43	0.40	1.46	0.86	0.55	0.42	0.34	0.18	101,539	
5. Starfish	0.80	0.78	0.12	0.30	0.95	0.23	0.17	0.08	0.09	81,078	
6. Gorgonian	1.98	1.58	0.94	2.23	3.80	2.42	2.80	2.47	2.41	76,116	
7. Sand Dollar	0.12	0.27	0.15	0.17	0.12	0.10	0.11	0.11	0.08	60,332	
8. Urchin	0.50	0.56	0.34	0.55	1.12	1.77	1.86	1.94	1.67	42,884	
9. Sponge	1.59	1.76	1.49	1.93	3.22	2.77	3.05	2.96	2.87	41,063	
10. Live Sand	N/A	N/A	N/A	1.00	0.78	1.39	0.68	0.59	0.56	34,185	

III.D. Trip-Level Statistics

Data were provided on an individual species basis, thus, trip information (i.e., number of trips) was averaged by species, then averaged by species group.⁵ Hence, the aggregate number of trips cannot be determined; this information would need to be evaluated at the collector level. Due to confidentiality, however, this information is not sufficiently complete to allow for analysis. This is because several full-time collectors essentially specialize in the harvest of certain species. These individuals land other species but have developed either special skills needed to collect certain species (especially fish) or have found areas where such species are located (Larkin and Degner). In addition, some collectors even cultivate certain resources, leaving juveniles to harvest at a later date (larger specimens typically command a higher price).

From 1990 to 1998, landings of fish per trip for a given species averaged 9.3 but were reported to be as high as 7,800. In terms of value, \$23.12 was the average dockside value of fish species (i.e., revenue for the collector) landed per trip (Figure 9). As further evidence of the heterogeneity between types of trips, the maximum reported value per trip for a fish species reached \$14,605. Bear in mind that some collectors may focus on the harvest of just one species and others may diversify on each trip. Again, this data set does not allow for the evaluation of all species landed on each trip.

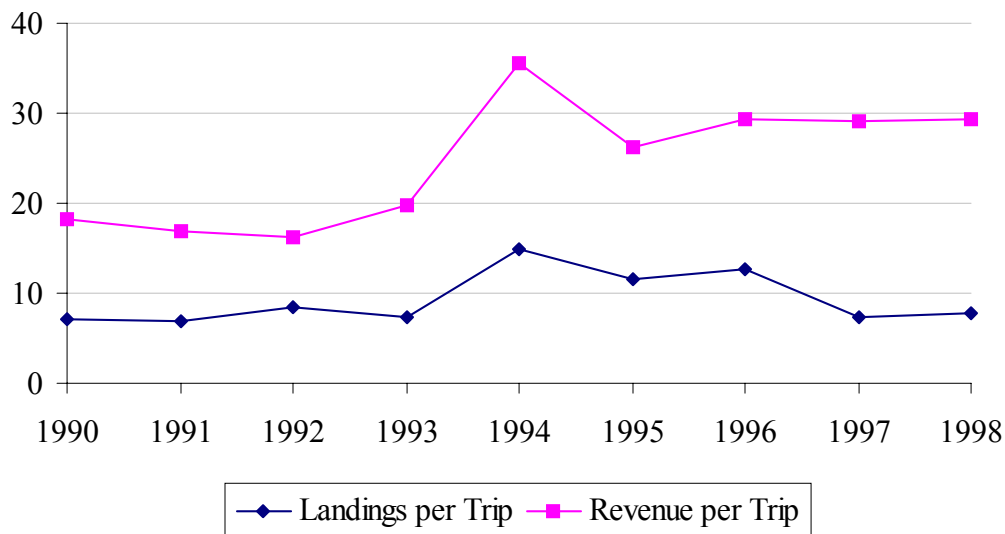


Figure 9. Per Trip Averages for a Given Fish Species, 1990-98

⁵ As will be noticeable below, the average per trip landings and revenue on a species-level basis are characterized by having relatively large standard deviations. Two fish and invertebrate species observations were considered to contain data errors and thus were deleted; however, given the large number of observations, the averages differed by less than one percent.

From 1990 to 1998, landings of invertebrates per trip for a given species averaged 158.5 but were reported to be as high as 92,500. This extreme variation reflects the ability of collectors to harvest thousands of small “critters” in a very short period of time. In terms of value, \$86.52 was the average dockside value of invertebrate species (i.e., revenue for the collector) landed per trip (Figure 10).

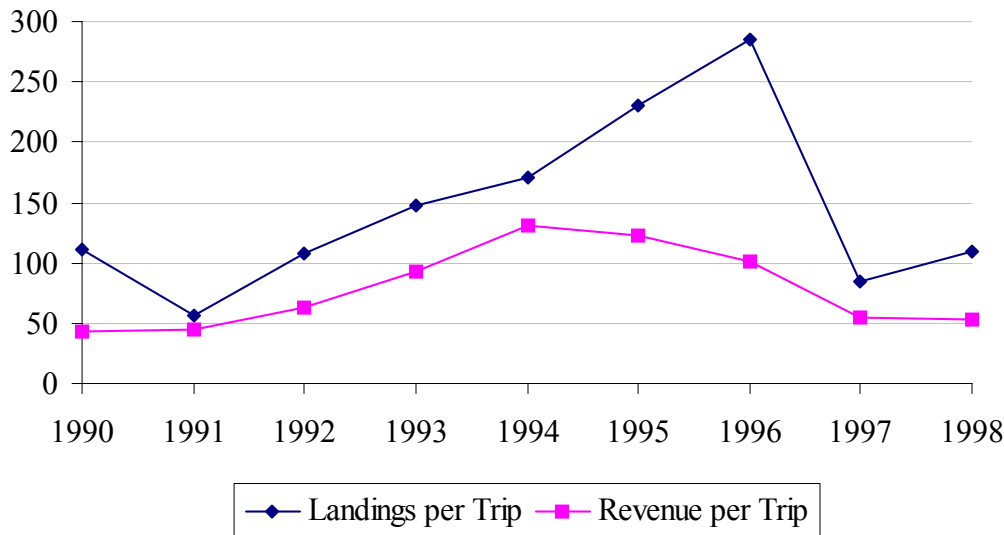


Figure 10. Per Trip Averages for a Given Invertebrate Species, 1990-98

As further evidence of the heterogeneity between types of trips, the maximum reported value per trip for an invertebrate species reached \$44,561. Bear in mind that live rock and live sand are measured in pounds versus numbers if individuals but, given the large number of observations, they affected the average values by 2.3 percent or less. Aside from the aggregate averages, it may be helpful to examine the data for the individual species. To that end, information on annual average landings and value for trip calculated within each of the top 10 species of fish and invertebrates are presented in Tables 14-17.

Table 14 reveals that, with the exception of seahorses, landings for fish species within the top 10 groups averaged from 4 to 18 fish per trip (seahorse landings averaged 162 per trip). Jawfish is perhaps the only species group whose landings per trip have trended either up or down over time; the average catch rate per trip increased from nearly 11 fish per trip in 1990 to over 27 per trip in 1998.

Table 15 summarizes the landings per trip (i.e., catch rate) for the top invertebrate species. In general, catch rates for invertebrates greatly exceed those for fish. Only 4 of the top 10 invertebrate species were characterized by landings of equal to or less than 30 specimens per trip. Landings of sand dollars averaged approximately 6,000 per trip, which is significantly higher than that for the next highest group, snails, with 248 per trip. Note that live rock and live sand are both measured in

pounds and thus cannot be compared to other invertebrate species. However, trends in average catch rates are comparable. Most of the top invertebrates experienced increases in catch rates between 1990 and 1998, unlike the top fish species. In particular, landings of live rock, snails, anemones, and crabs all increased.

Table 16 includes the average annual revenue received per trip by species group. Recall that since collectors can harvest multiple species during a given trip, these revenues may not equal the total trip revenue. Average revenues for the top fish species ranged from \$13 to \$151 for butterflyfish and seahorses, respectively. With the exception of seahorses, the next highest revenue generator per trip was angelfish, which accounted for approximately \$64 per trip. When comparing the average landings in the first few years versus the last, it appears that revenues per trip for hogfish, jawfish, and surgeonfish have increased while those for butterflyfish have declined slightly.

Table 17 shows that the average revenue per trip for invertebrates exceeded that for fish. Among the top 10 invertebrate species, trip revenues averaged from \$17 for starfish to over \$800 for sand dollars. It may be that invertebrate trips are more targeted and thus fewer different species are landed. Revenues per trip increased for nearly all species, especially live rock. However, note that these landings are no longer unrestricted.

IV. Discussion

The marine life collection industry in Florida has grown during the past decade as the number of licensed collectors increased from 159 to 743 and either the volume or value of the primary species increased. The growth is particularly evident in the collection of invertebrate animals. The harvest of live rock and sand also increased dramatically during the 1990-95 period, but declined in later years due to a moratorium on the collection of naturally occurring rock and sand in state and federal waters. Although the number of harvesting participants increased dramatically during the 1990-98 period, the implementation of a temporary moratorium on MLE's has limited further entry into the industry. The moratorium extends to 2002 and is likely to be continued through 2005. Regulations have also been imposed on certain species (e.g., size limits, bag limits, and trip limits), but most regulations apply to the industry as a whole (e.g., acceptable harvesting methods). The implementation of general regulations reflects concern regarding the sustainability of all marine life resources. The information presented in this report represents the only analysis of data collected by FMRI since the initiation of the program in 1990. The reported regional, seasonal, and trip-level analysis (along with trends in landings, prices, and/or total values) provides some insight into the harvest pressure being exerted on wild stocks of marine ornamental finfish and invertebrate animals. Although no stock assessments exist for any of the individual species targeted by the marine life collection industry, such information (particularly for the predominant species) could be useful to resource managers as they develop effective management measures for this growing industry.

Table 14. Annual Landings per Trip of the Ten Fish Species (grouped by common name) that Account for the Highest Average Landed Value, 1990-98, in Florida

Species Group	Average Landings per Trip										Average
	1990	1991	1992	1993	1994	1995	1996	1997	1998		
1. Angelfish	9.17	8.21	9.42	9.30	8.09	9.66	9.85	7.48	6.90	9	
2. Hogfish	5.08	3.88	4.36	4.37	6.34	6.83	6.66	5.23	6.37	5	
3. Damselfish	14.26	9.61	9.75	6.71	9.69	12.68	10.73	10.04	12.72	11	
4. Jawfish	10.71	8.59	18.07	17.39	21.39	16.09	14.40	29.83	27.42	18	
5. Wrasse	8.80	7.33	6.84	5.59	7.61	7.50	6.84	9.58	10.09	8	
6. Butterflyfish	3.46	3.50	4.10	3.78	3.33	3.80	3.55	3.84	4.02	4	
7. Seahorse	26.03	54.67	148.01	139.71	447.27	381.87	193.06	15.25	50.94	162	
8. Parrotfish	3.48	3.42	3.76	3.12	3.99	3.84	2.83	4.82	3.96	4	
9. Surgeonfish	3.57	3.50	3.71	3.83	3.28	4.20	4.07	5.83	6.86	4	
10. Drum	10.25	7.77	6.34	6.34	7.64	7.40	7.53	9.40	8.79	8	

Table 15. Annual Landings per Trip of the Ten Invertebrate Species (grouped by common name) that Account for the Highest Average Landed Value, 1990-98, in Florida

Species Group	Average Landings per Trip										Average
	1990	1991	1992	1993	1994	1995	1996	1997	1998		
1. Live Rock	181.27	237.35	232.11	274.54	280.34	364.04	417.25	404.08	571.35	329	
2. Snail	96.81	108.98	150.85	154.83	162.87	365.72	391.25	382.37	416.71	248	
3. Anemone	167.82	133.42	131.54	109.02	148.05	182.03	134.91	177.83	182.54	152	
4. Crab	33.42	25.51	28.31	72.6	29.72	49.88	128.98	106.88	225.82	78	
5. Starfish								20.95	19.16	20	
6. Gorgonian	24.38	17.8	17.52	21.17	23.84	24.26	20.55	53.58	40.29	27	
7. Sand Dollar	14459.50	2320.75	2901.50	3517.48	5524.83	6272.72	6359.40	7414.00	14352.00	7014	
8. Urchin	25.11	31.12	25.33	29.26	29.22	30.12	25.01	37.25	41.03	30	
9. Sponge	11.98	13.45	10.33	13.24	13.54	12.77	11.45	12.72	16.85	13	
10. Live Sand	n/a	n/a	n/a	n/a	358.03	501.17	1896.48	1223.63	n/a	995	

Table 16. Annual Revenue per Trip of the Ten Fish Species (grouped by common name) that Account for the Highest Average Landed Value, 1990-98, in Florida

Species Group	Average Revenue per Trip (\$)										Average
	1990	1991	1992	1993	1994	1995	1996	1997	1998		
1. Angelfish	49.29	55.42	60.25	78.09	67.03	64.44	75.52	66.13	58.93	64	
2. Hogfish	35.37	25.36	17.80	37.92	57.60	48.80	52.36	42.28	55.28	41	
3. Damselfish	21.22	12.18	11.17	10.08	19.94	16.65	13.09	11.65	15.89	15	
4. Jawfish	21.97	17.73	39.09	41.71	68.23	40.28	37.49	77.57	65.18	45	
5. Wrasse	15.70	12.62	8.01	8.57	20.19	11.46	13.01	16.90	16.25	14	
6. Butterflyfish	9.08	15.01	22.19	12.88	17.73	8.96	12.64	9.96	8.89	13	
7. Seahorse	21.37	47.31	20.92	21.02	596.51	366.56	205.44	26.96	55.56	151	
8. Parrotfish	14.97	13.69	15.38	26.53	28.99	17.20	20.85	24.97	21.07	20	
9. Surgeonfish	10.15	9.38	9.56	14.47	12.56	11.18	13.01	19.72	33.23	15	
10. Drum	31.94	22.33	15.71	18.39	36.00	15.64	19.94	21.40	14.90	22	

Table 17. Annual Revenue per Trip of the Ten Invertebrate Species (grouped by common name) that Account for the Highest Average Landed Value, 1990-98, in Florida

Species Group	Average Revenue per Trip for Each Species Group										Average
	1990	1991	1992	1993	1994	1995	1996	1997	1998		
1. Live Rock	185.85	327.09	400.78	340.76	408.55	417.32	460.52	728.67	1001.15		475
2. Snail	54.93	28.69	55.48	87.37	102.61	511.41	112.48	111.85	102.07		130
3. Anemone	74.89	79.78	66.04	68.92	91.25	85.05	70.08	92.49	93.90		80
4. Crab	16.55	11.42	14.54	158.54	26.46	28.90	45.59	49.40	47.10		44
5. Starfish								17.87	16.24		17
6. Gorgonian	52.68	24.75	16.64	47.96	99.22	53.31	67.11	134.55	96.26		66
7. Sand Dollar	1753.09	623.22	448.83	871.36	675.04	687.00	637.74	748.00	1046.00		814
8. Urchin	13.74	20.54	12.13	17.51	32.37	39.23	25.59	40.89	37.57		27
9. Sponge	19.76	22.57	16.68	28.68	25.19	30.48	25.75	31.77	47.54		28
10. Live Sand	n/a	n/a	n/a	n/a	395.58	822.11	971.33	448.38	n/a		659

References

- Aquaculture Development Program (ADP). 1999. "Announcement for an International Conference on Marine Ornamental Aquaculture." Marine Ornamentals '99: Collection, Culture, and Conservation. Honolulu, HI. [www.aloha.com/~aquacult/mareorna.html]
- Division of Marine Fisheries. 2000. "Option for a Limited Entry Program For Florida's Marine Life Fishery." (A Report to the Legislature) Florida Fish and Wildlife Conservation Commission, July 1, 2000.
- Florida Marine Research Institute (FMRI). 1999. Personal communication, marine life industry collection data. St. Petersburg, FL.
- Hess, D. and J. Stevely. 1978. "The Aquarium Reef Fish Collecting Industry of Monroe County, Florida." Monroe County Marine Advisory Program, Florida Cooperative Extension Service. pp. 27.
- Januzzi, C.L. 1991. "A Guide to Developing A Limited Entry Program for the Marine Life Fishing Industry." Research Paper, Marine Affairs Department, Rosenstiel School of Marine and Atmospheric Science, University of Miami, Miami, FL.
- Larkin, S.L. and R.L. Degner. 2001. "The U.S. Wholesale Market for Marine Ornamentals." *Aquarium Sciences and Conservation*, 3(1-3): 13-24.
- Loiselle, P.V. and H.A. Baensch. 1995. *Marine Aquarist's Manual: Comprehensive Edition*, 4th ed. Tetra Second nature (Division of Warner-Lambert): Blacksburg, VA.
- Marine Fisheries Commission (MFC). 1998. "Marine Life." Florida Fish and Wildlife Conservation Commission Staff Paper, Tallahassee, FL.
- National Sea Grant Office (NSGO). 1999. "Conservation and Culture of Marine Ornamental Fishes and Invertebrates: A Case Statement." Chris D'Elia, Chair. Maryland. [www.mdsg.umd.edu/NGSO/research/ornamental/index.htm]
- Pet Industry Joint Advisory Council (PIJAC). 1999. "U.S. Ornamental Aquarium Industry." Pet Information Bureau. Washington, DC. [www2.pijac.org/pijac/PJF001.htm]
- World Resources Institute (WRI). 2000. "Status of the World's Coral Reefs: Tropical Americas." [www.wri.org/wri/indictrs/reefname.htm]

Appendix A

Restricted Species Identified in Chapter 46-42 of the F.A.C.

Restricted Species Identified in Chapter 46-42 of the F.A.C.

Chapter 46-42(2) Fish Species:

- (a) Moray eels – Family Muraenidae
- (b) Snake eels – Genera *Myichthys* and *Myrophis* of the Family Ophichthidae
- (c) Toadfish – Family Batrachoididae
- (d) Frogfish – Family Antennariidae
- (e) Batfish – Family Ogcocephalidae
- (f) Clingfish – Family Gobiesocidae
- (g) Trumpetfish – Family Aulostomidae
- (h) Cornetfish – Family Fistulariidae
- (i) Pipefish/seahorses – Family Syngnathidae
- (j) Hamlet/seabass – Family Serranidae, except genera *Epinephelus*, *Mycteroperca*, and *Centropristis*
- (k) Basslets – Family Grammistidae
- (l) Cardinalfish – Family Apogonidae
- (m) High-hat, Jackknife-fish, Spotted drum, Cubbyu – genus *Equetus* of the Family Sciaenidae
- (n) Reef Croakers – *Odontocion dentex*
- (o) Sweepers – Family Pempheridae
- (p) Butterflyfish – Family Chaetodontidae
- (q) Angelfish – Family Pomacanthidae
- (r) Damsel fish – Family Pomacentridae
- (s) Hawkfish – Family Cirrhitidae
- (t) Wrasse/hogfish/razorfish – Family Labridae, except *Lachnolaimus maximus*
- (u) Parrotfish – Family Scaridae
- (v) Jawfish – Family Opistognathidae
- (w) Blennies – Families Clinidae and Blenniidae
- (x) Sleepers – Family Eleotrididae
- (y) Gobies – Family Gobiidae
- (z) Tangs and surgeonfish – Family Acanthuridae
- (aa) Filefish, triggerfish – Family Balistes, except *Balistidae capricus*
- (bb) Trunkfish/cowfish – Family Ostraciidae
- (cc) Pufferfish/burrfish/ballonfish – *Diodon holocanthus*, *Canthigaster rostrata*, *Chilomycterus schoepfi*.

Chapter 46-42(3) Invertebrate Species:

- (a) Sponges – Class Demospongia, except Order Dictyoceratida
- (b) Upside-down jellyfish – Genus *Cassiopeia*
- (c) Siphonophores/hydrozoa – Class Hydrozoa, except Order Milleporina
- (d) Soft corals – Subclass Octocorallia, except *Gorgonia flabellum* and *ventalina*
- (e) Sea anemones – Orders Actinaria Zoanthidea, Corallimorpharia, and Ceriantharia
- (f) Featherduster worms/calcareous tubeworms – Families Sabellidae and Serpulidae
- (g) Star-shells – *Astraea americana* or *Astraea phoebia*

- (h) Nudibranchs/sea slugs – Subclass Opisthobranchia
- (i) Fileclams – Genus Lima
- (j) Octopods – Order Octopoda, except *Octopus vulgaris*
- (k) Shrimp – Genera *Periclimenes*, *Lysmata*, *Stenopus*, and *Alpheus*
- (l) Crabs – *Stenorhynchus seticornis*, *Stenocionops furcata*, *Clibanarius vittatus*, *Phimochirus opercalatus*, *Porcellana sayana*, *Percnon gibbesi*, *Metoporphaphis calcarata*
- (m) Starfish – Class Asteroidea, except *Oreaster reticulatus*
- (n) Brittlestars – Class Ophiuroidea
- (o) Sea urchins – Class Echinoidea, except *Diadema antillarum* and Order Clypeasteroidea
- (p) Sea cucumbers – Class Holothuroidea
- (q) Sea lillies – Class Crinoidea

Chapter 46-42(4) Plant Species:

- (a) *Caulerpa* – Family Caulerpaceae
- (b) *Halimeda*/mermaid's fan/mermaid's shaving brush – Family Halimedaceae
- (c) Coralline red algae – Family Corallinaceae

Appendix B

Summary of Florida's Collection Regulations

Florida's Collection Regulations (Rule 46-24 titled "Marine Life")

46-42.01 Purpose and Intent; Designation of Restricted Species; Definition of "Marine Life Species".—

(1)

(a) The purpose and intent of this chapter are to protect and conserve Florida's tropical marine life resources, assure the continuing health and abundance of these species, and assure that harvesters in this fishery use nonlethal methods of harvest.

(b) Landing of live rock propagated through aquaculture is allowed pursuant to provisions of this chapter.

(2) The following fish species, as they occur in waters of the state and in federal Exclusive Economic Zone (EEZ) waters adjacent to state waters, are hereby designated as restricted species pursuant to Section 370.01(20), Florida Statutes:

(a) Moray eels – Family Muraenidae

(b) Snake eels – Genera *Myichthys* and *Myrophis* of the Family Ophichthidae

(c) Toadfish – Family Batrachoididae

(d) Frogfish – Family Antennariidae

(e) Batfish – Family Ogcocephalidae

(f) Clingfish – Family Gobiesocidae

(g) Trumpetfish – Family Aulostomidae

(h) Cornetfish – Family Fistulariidae

(i) Pipefish/seahorses – Family Syngnathidae

(j) Hamlet/seabass – Family Serranidae, except genera *Epinephelus*, *Mycteroperca*, and *Centropristis*

(k) Basslets – Family Grammistidae

(l) Cardinalfish – Family Apogonidae

(m) High-hat, Jackknife-fish, Spotted drum, Cubbyu – genus *Equetus* of the Family Sciaenidae

(n) Reef Croakers – *Odontocion dentex*

(o) Sweepers – Family Pempheridae

(p) Butterflyfish – Family Chaetodontidae

(q) Angelfish – Family Pomacanthidae

(r) Damselfish – Family Pomacentridae

(s) Hawkfish – Family Cirrhitidae

(t) Wrasse/hogfish/razorfish – Family Labridae, except *Lachnolaimus maximus*

(u) Parrotfish – Family Scaridae

(v) Jawfish – Family Opistognathidae

(w) Blennies – Families Clinidae and Blenniidae

(x) Sleepers – Family Eleotrididae

(y) Gobies – Family Gobiidae

(z) Tangs and surgeonfish – Family Acanthuridae

(aa) Filefish, triggerfish – Family Balistidae, except *Balistidae capricus*

- (bb) Trunkfish/cowfish – Family Ostraciidae
- (cc) Pufferfish/burrfish/ballonfish – *Diodon holocanthus*, *Canthigaster rostrata*, *Chilomycterus schoepfi*.

(3) The following invertebrate species, as they occur in waters of the state and in federal Exclusive Economic Zone (EEZ) waters adjacent to state waters, are hereby designated as restricted species pursuant to Section 370.01(20), Florida Statutes:

- (a) Sponges – Class Demospongia, except Order Dictyoceratida
- (b) Upside-down jellyfish – Genus *Cassiopeia*
- (c) Siphonophores/hydrozoans – Class Hydrozoa, except Order Milleporina
- (d) Soft corals – Subclass Octocorallia, except *Gorgonia flabellum* and *ventalina*
- (e) Sea anemones – Orders Actinaria Zoanthidea, Corallimorpharia, and Ceriantharia
- (f) Featherduster worms/calcareous tubeworms – Families Sabellidae and Serpulidae
- (g) Star-shells – *Astraea americana* or *Astraea phoebia*
- (h) Nudibranchs/sea slugs – Subclass Opisthobranchia
- (i) Fileclams – Genus *Lima*
- (j) Octopods – Order Octopoda, except *Octopus vulgaris*
- (k) Shrimp – Genera *Periclimenes*, *Lysmata*, *Stenopus*, and *Alpheus*
- (l) Crabs – *Stenorhynchus seticornis*, *stenocionops furcata*, *Clibanarius vittatus*, *Phimochirus opercalatus*, *Porcellana sayana*, *Percnon gibbesi*, *Metoporphaphis calcarata*
- (m) Starfish – Class Asteroidea, except *Oreaster reticulatus*
- (n) Brittlestars – Class Ophiuroidea
- (o) Sea urchins – Class Echinoidea, except *Diadema antillarum* and Order Clypeasteroidea
- (p) Sea cucumbers – Class Holothuroidea
- (q) Sea lillies – Class Crinoidea

(4) The following species of plants, as they occur in waters of the state and in federal Exclusive Economic Zone (EEZ) waters adjacent to state waters, are hereby designated as restricted species pursuant to Section 370.01(20), Florida Statutes:

- (a) *Caulerpa* – Family Caulerpaceae
- (b) *Halimeda*/mermaid’s fan/mermaid’ shaving brush – Family Halimedaceae
- (c) Coralline red algae – Family Corallinaceae

(5) For the purposes of Section 370.06(2)(d), Florida Statutes, the term “marine life species: is defined to mean those species designated as restricted species in subsections (2), (3), and (4) of this chapter.

46-24.002 Definitions.

46-24.003. Prohibition of Harvest: Longspine Urchin, Bahama Starfish.

46-24.0035 Live Landing and Live Well Requirements.

46-24.0036 Harvest in Biscayne National Park Prohibited

46-24.004 Size Limits.--

- (1) Angelfish
- (2) Butterflyfishes
- (3) Gobies
- (4) Jawfishes
- (5) Spotfin and Spanish hogfish

46-24.005 Bag Limit.--

(1) Except as provided in Rule 46-24.006 or subsections (3) or (4) of this rule, no person shall harvest, possess while in or on the waters of the state, or land more than 20 individuals per day of tropical ornamental marine life species, in any combination.

(2) Except as provided in Rule 46-24.006, no person shall harvest, possess while in or on the waters of the state, or land more than 1 gallon per day of tropical ornamental plants, in any combination of species.

(3) Except as provided in Rule 46-24.006, no person shall harvest, possess while in or on the waters of the state, or land more than 5 angelfishes (Family Pomacanthidae) per day. Each angelfish shall be included in the 20 individual bag limit specified in subsection (1).

(4) Unless the season is closed, no person shall harvest, possess while in or on the waters of the state, or land more than 6 colonies per day of octocorals. Each octocoral shall be included in the 20 individual bag limit specified in subsection (1).

46-24.006 Commercial Season, Harvest Limits.--

(1) Except as provided in Rule 46-24.008(7), no person shall harvest, possess while in or on the waters of the state, or land quantities of tropical ornamental marine life species or tropical ornamental marine plants in excess of the bag limits established in Rule 46-24.005 unless such person possesses a valid saltwater products license with both a marine life fishery endorsement and a restricted species endorsement issued by the Department of Environmental Protection.

(2)

- (a) Angelfish – 75 per person or 150 per vessel, per day, whichever is less
- (b) Butterflyfishes – 75 per vessel per day
- (c) Octocoral season is same as season in federal waters. Harvesters may also harvest attached substrate within 1 inch of the perimeter
- (d) Giant Caribbean or “pink-tipped” anemones – 400 per vessel per day

46-24.007 Gear Specifications and Prohibited Gear.-

- (1) The following types of gear shall be the only types allowed for the harvest of any tropical fish, whether from state waters or from federal EEZ waters adjacent to state waters:
- (a) Hand held net
 - (b) Barrier net, with a total length not exceeding 60 feet, a depth not exceeding 8 feet, and a mesh size not exceeding $\frac{3}{4}$ inch
 - (c) Drop net, with a maximum dimension not exceeding 12 feet and a mesh size not exceeding $\frac{3}{4}$ inch
 - (d) Slurp gun
 - (e) Quinaldine, if:
 - 1. the person possesses a special activity license,
 - 2. the chemical is diluted to no more than 2% with seawater (prior to dilution in seawater, quinaldine shall only be mixed with isopropyl alcohol or ethanol.
 - (f) A roller frame trawl operated by a person possessing a valid live bait shrimping license (i.e., marine life are incidental bycatch)
 - (g) A trawl ($\leq 12'' \times 58''$ and 5lbs) no longer than 15 feet in length and no greater than idle speed to collect live dwarf seahorses (*Hippocampus zosterae*)

(2) Bags or containers may be used to store collected specimens. A single blunt rod, used in connection with an allowable gear type, may also be used.

(3) Species may be harvested as bycatch provided bag limits are not exceeded.

46-42.008 Live Rock: Harvest in State Waters Prohibited; Aquacultured Live Rock Harvest and Landing Allowed.-

46-42.009 Prohibition on the Taking, Destruction, or Sale of Marine Corals and Sea Fans; Exception; Repeal of Section 370.114, Florida Statutes

Appendix C

Marine Fisheries Trip Ticket Fishing Area Codes

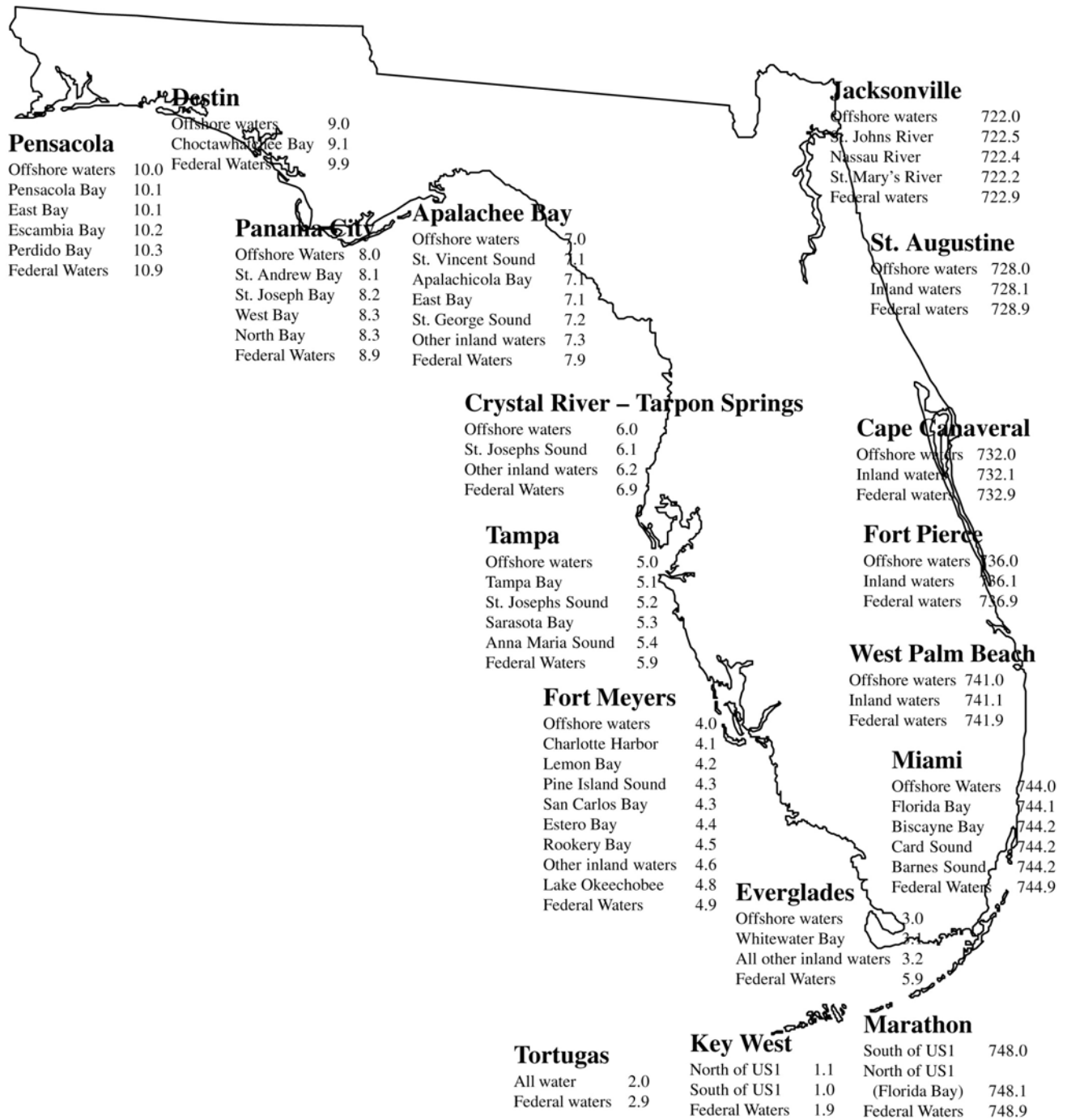


Figure C-1. Marine Fisheries Trip Ticket Fishing Area Codes

Appendix D

Additional Tables

Table D-1. Primary Fish Species within the Top Fish Species Groups in terms of Average Value, 1990-98

Species Group	Species	Scientific Name	Percent Value by Group
1. Angelfish	Blue	<i>Holacanthus Bermudensis</i>	26%
2. Hogfish	Spotfin (=cuban)	<i>Bodianus Pulchellus</i>	70
3. Damsel fish	Blue Chromis (=reef)	<i>Chromis Cyaneus</i>	37
4. Jawfish	Yellowhead	<i>Opistognathus Aurifrons</i>	91
5. Wrasse	Bluehead	<i>Thalassoma Bifasciatum</i>	54
6. Butterflyfish	Spotfin	<i>Chaetodon Ocellatus</i>	99
7. Seahorse	Dwarf	<i>Hippocampus Zosteræ</i>	76
8. Parrotfish	Striped (=painted)	<i>Scarus Croicensis</i>	57
9. Surgeonfish	Blue (young are yellow)	<i>Acanthurus Coeruleus</i>	82
10. Drum	High-hat	<i>Equetus Acuminatus</i>	57

Notes: Ranking based on average value of landings 1990-98. Top individual species (by economic value) based on 1990-96 landings data.

Table D-2. Primary Invertebrate Species within the Top Invertebrate Species Groups in terms of Average Value, 1990-98

Species Group	Species	Scientific Name	Percent Value by Group
1. Live Rock	Algae	NA	36
2. Snail	Turbonella	Family <i>Turbinellidae</i>	45
3. Anemone	Giant Caribbean	<i>Condylactus Gigantea</i>	63
4. Crab	Horseshoe	<i>Limulus Polyphemus</i>	33
5. Starfish	Red Spiny Sea Star (=common)	<i>Echinaster Sentus</i>	65
6. Gorgonian	Red	<i>Swiftia Exserta</i> , Others	38
7. Sand Dollar	Other (not 5-, 6-, notched)	<i>Encope</i> , <i>Leofta</i> , <i>Mellita</i> spp.	90
8. Urchin	Variable or Green (=pincushion)	<i>Lythechinus Variiegatus</i>	56
9. Sponge	Red Tree	? (Class <i>Demospongia</i>)	51
10. Live Sand	NA	NA	NA

Notes: Ranking based on average value of landings 1990-98. Top individual species (by economic value) based on 1990-96 landings data.

Appendix E

Additional Figures

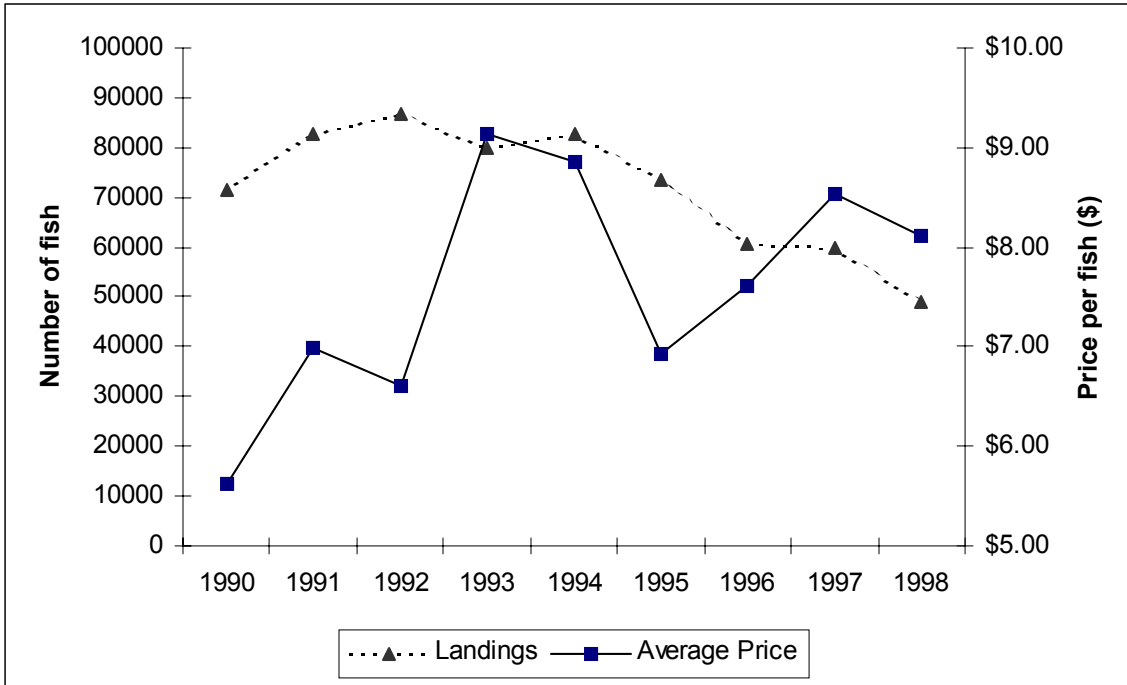


Figure E-1. Landings and Average Dockside Price of Angelfish, Florida, 1990-98

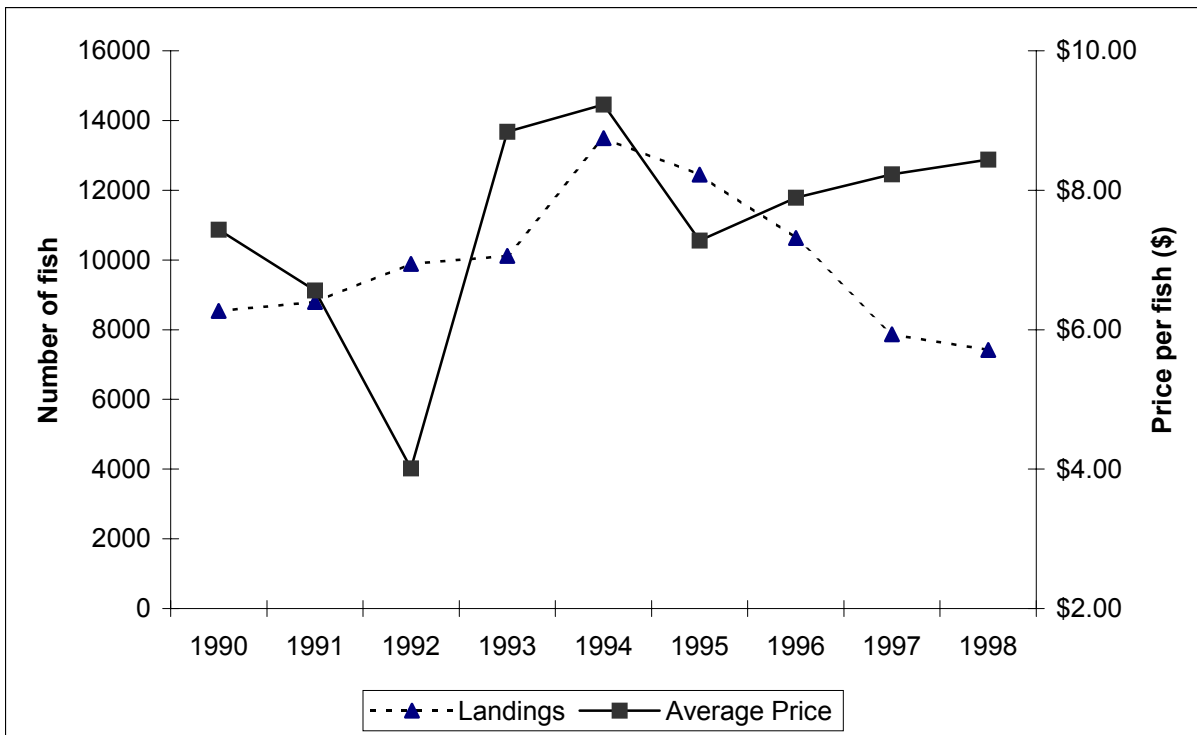


Figure E-2. Landings and Average Dockside Price of Hogfish, Florida, 1990-1998

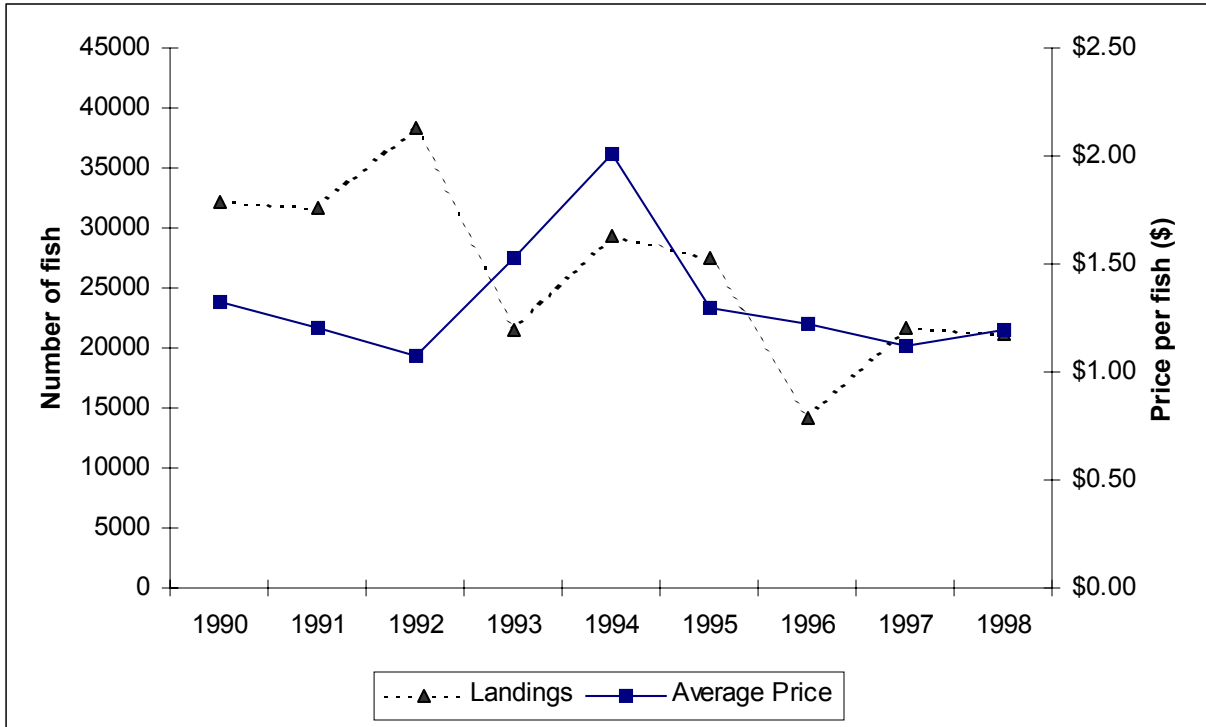


Figure E-3. Landings and Average Dockside Price of Damselfish, Florida, 1990-1998

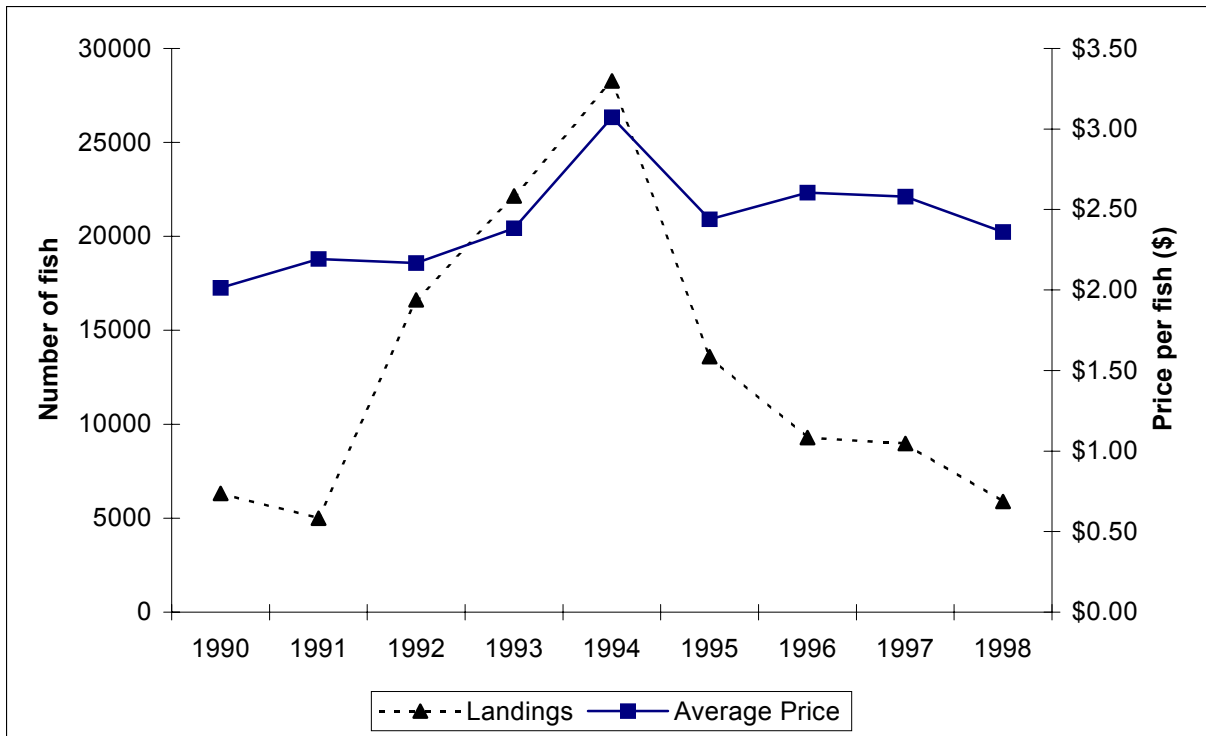


Figure E-4. Landings and Average Dockside Price of Jawfish, Florida, 1990-1998

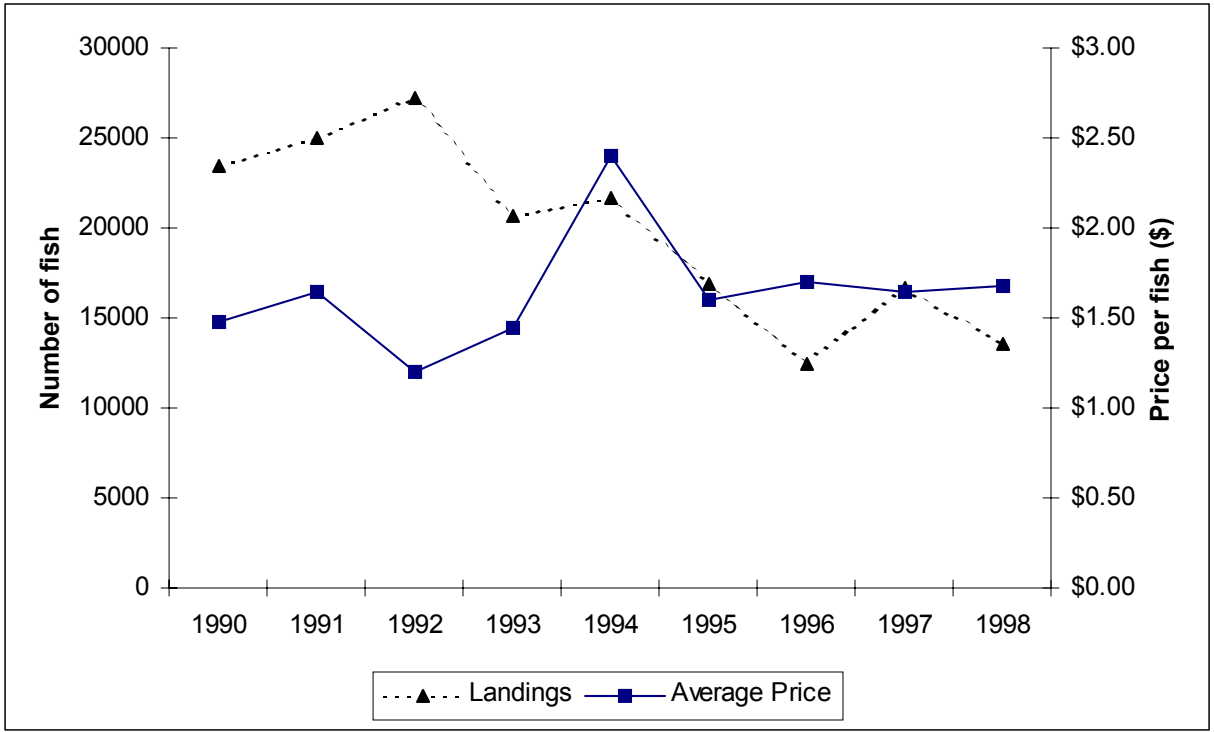


Figure E-5. Landings and Average Dockside Price of Wrasse, Florida, 1990-1998

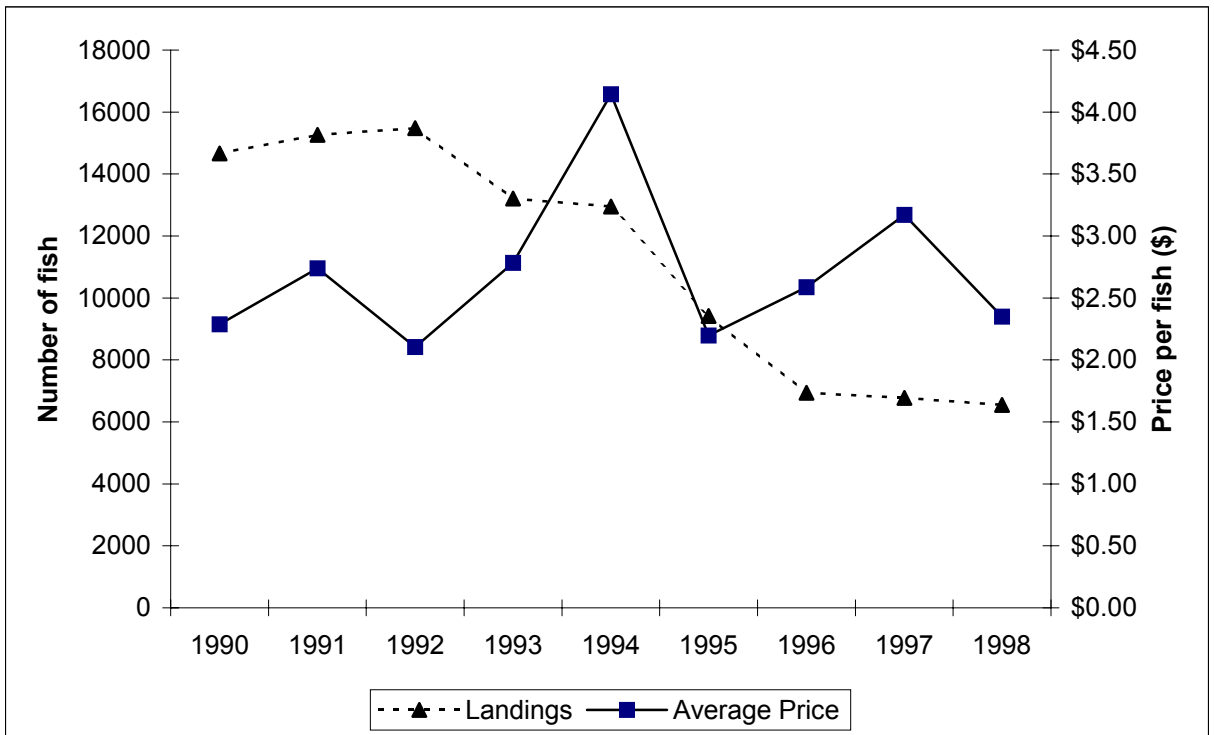


Figure E-6. Landings and Average Dockside Price of Butterfly, Florida, 1990-1998

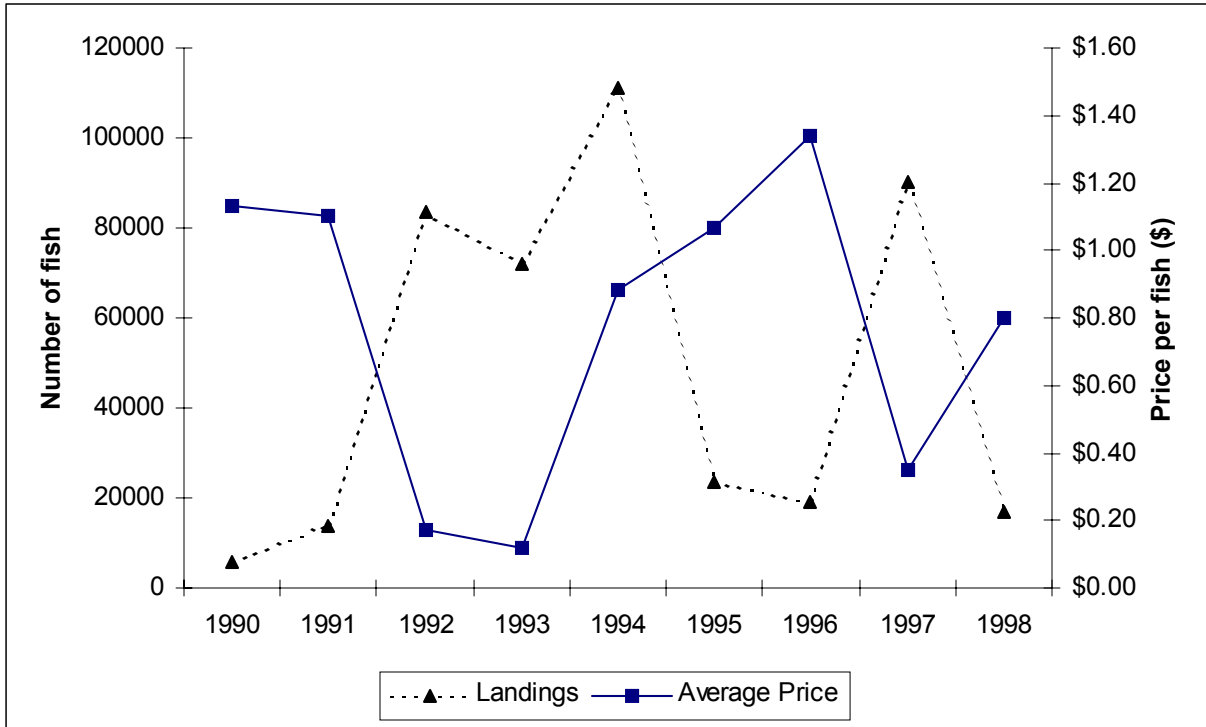


Figure E-7. Landings and Average Dockside Price of Seahorse, Florida, 1990-1998

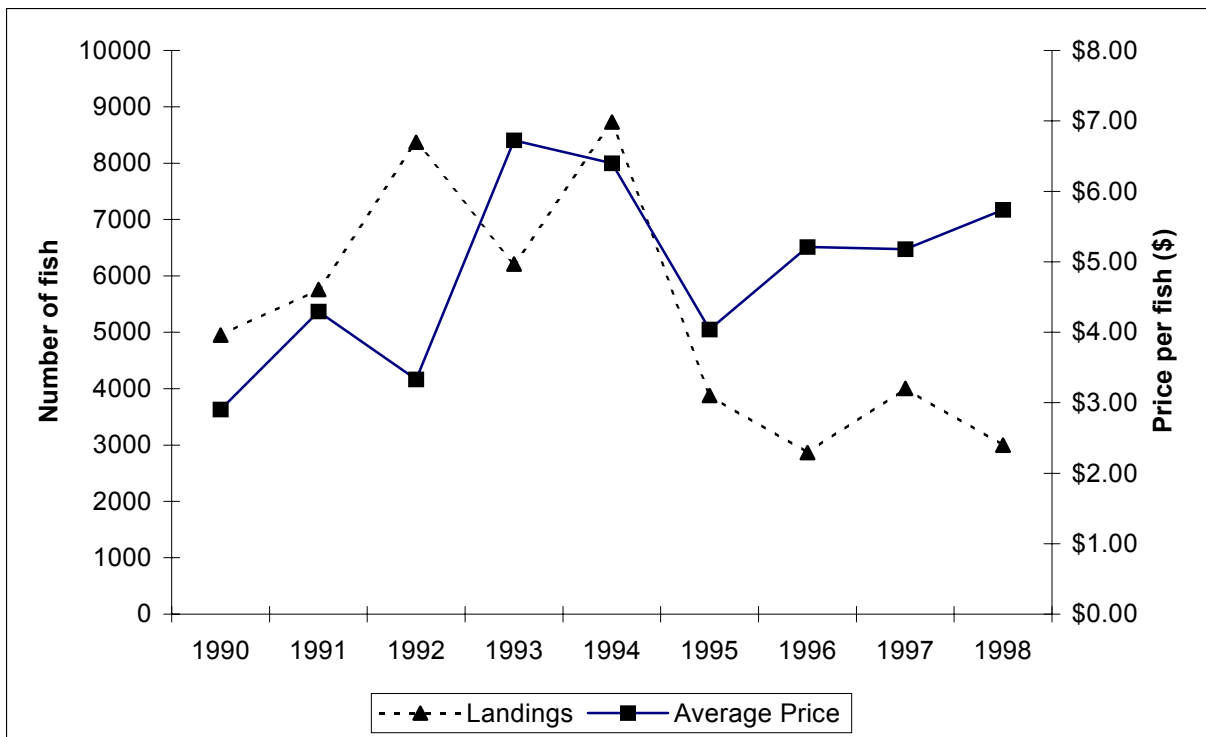


Figure E-8. Landings and Average Dockside Price of Parrotfish, Florida, 1990-1998

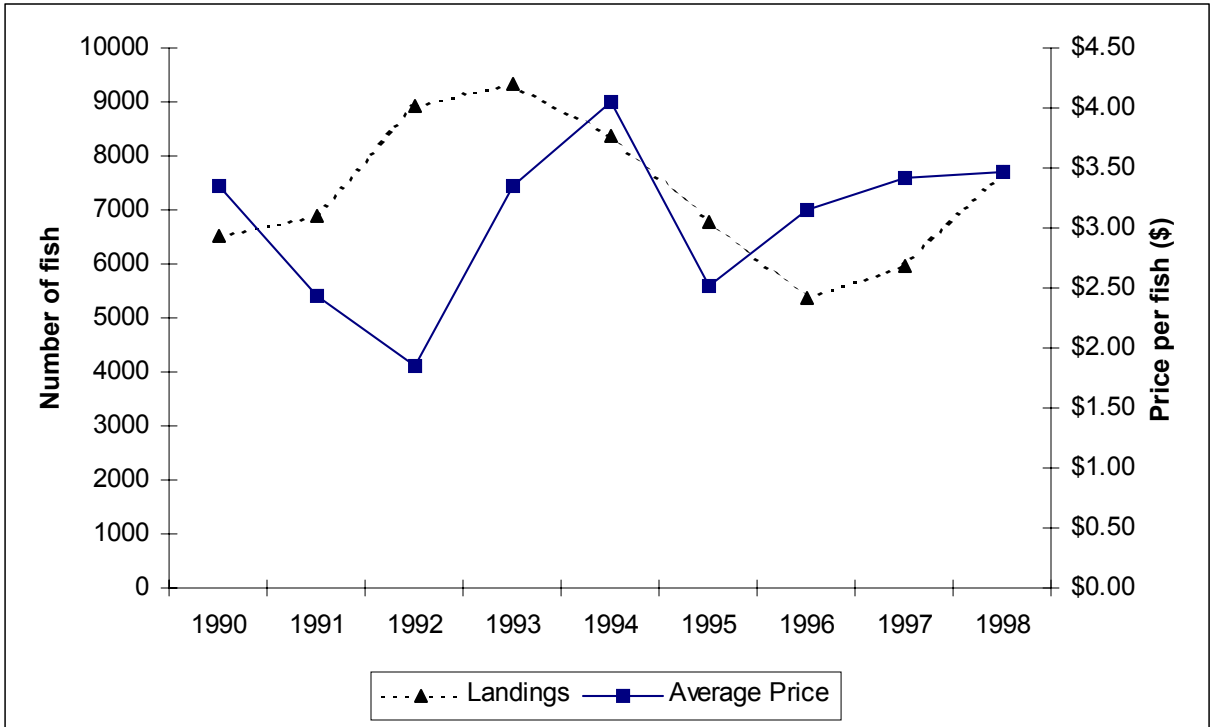


Figure E-9. Landings and Average Dockside Price of Surgeonfish, Florida, 1990-1998

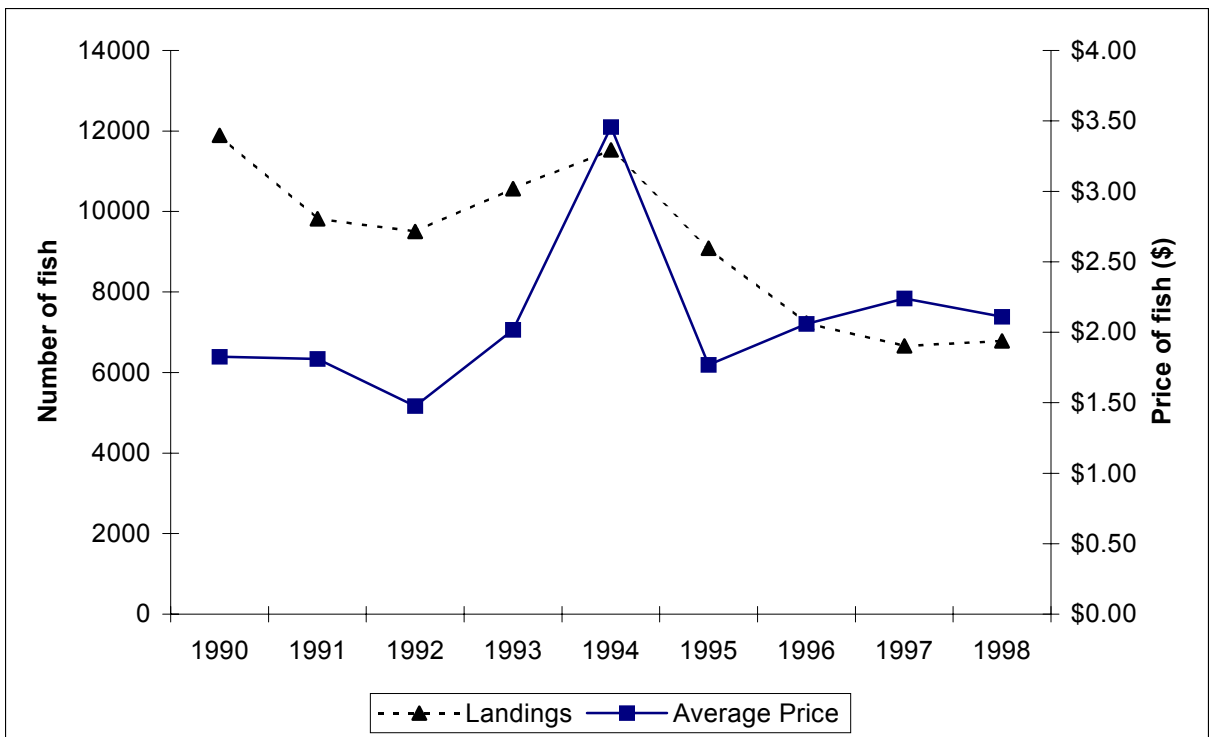


Figure E-10. Landings and Average Dockside Price of Drum, Florida, 1990-1998

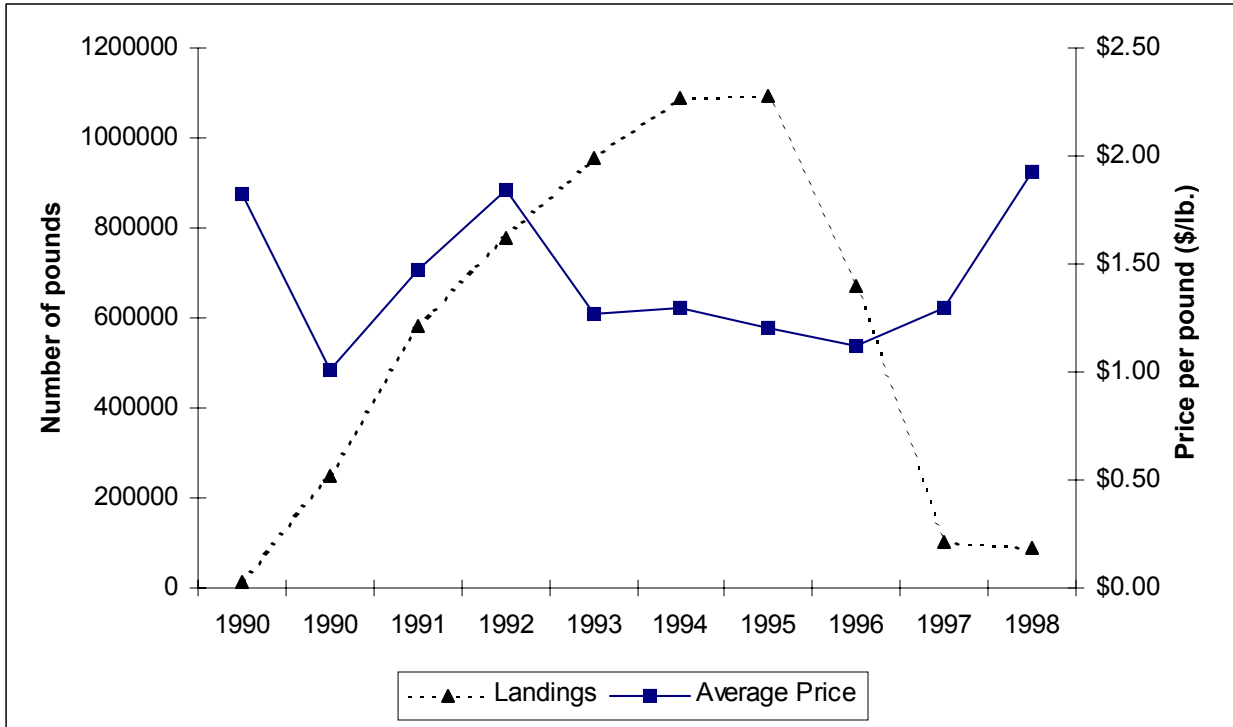


Figure E-11. Landings and Average Dockside Price of Live Rock, Florida, 1990-1998

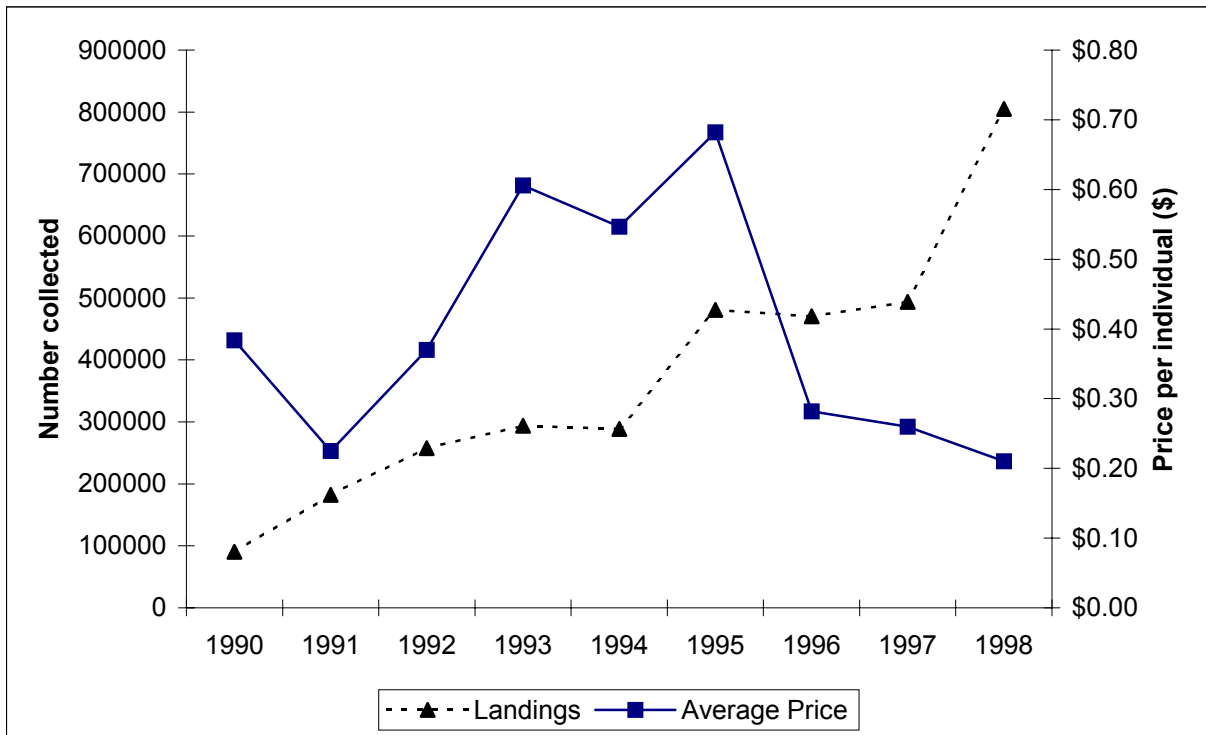


Figure E-12. Landings and Average Dockside Price of Snail, Florida, 1990-1998

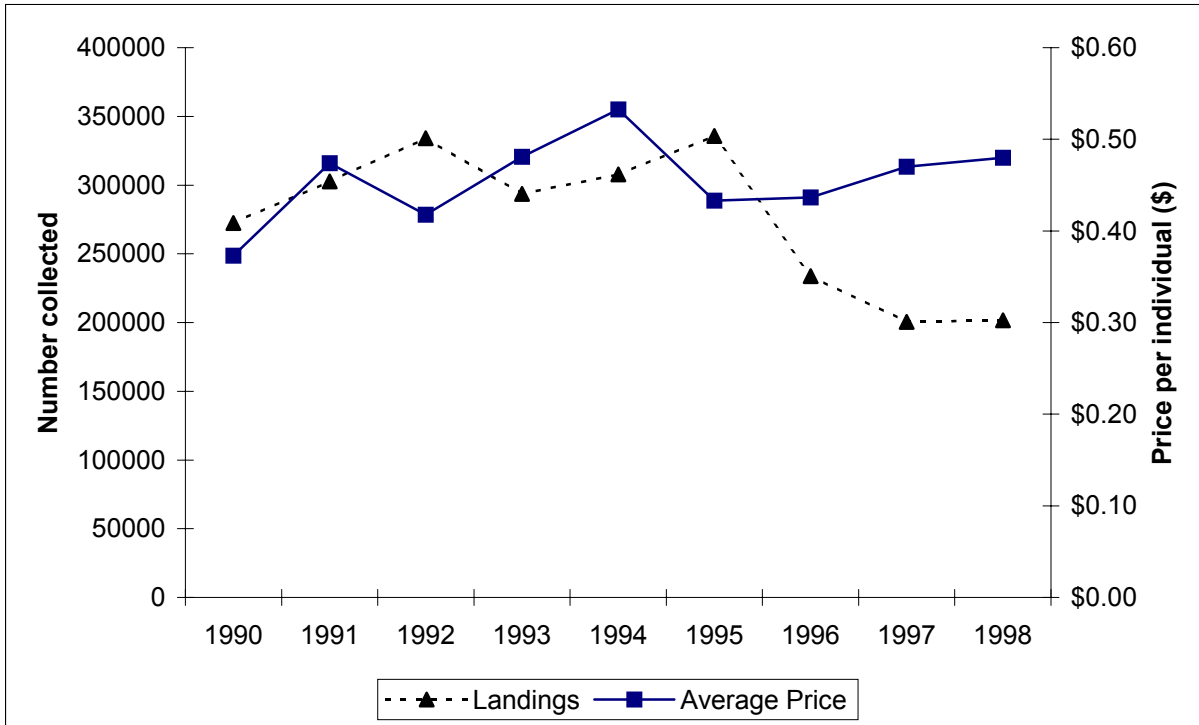


Figure E-13. Landings and Average Dockside Price of Anemone, Florida, 1990-1998

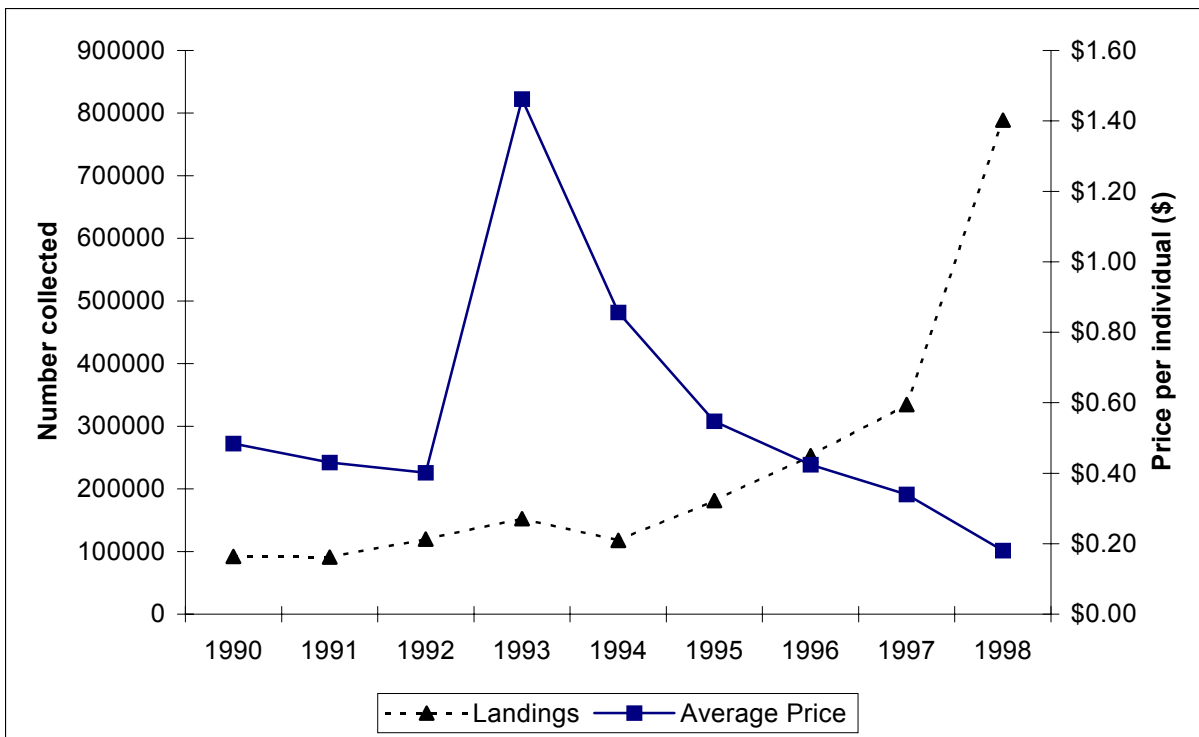


Figure E-14. Landings and Average Dockside Price of Crab, Florida, 1990-1998

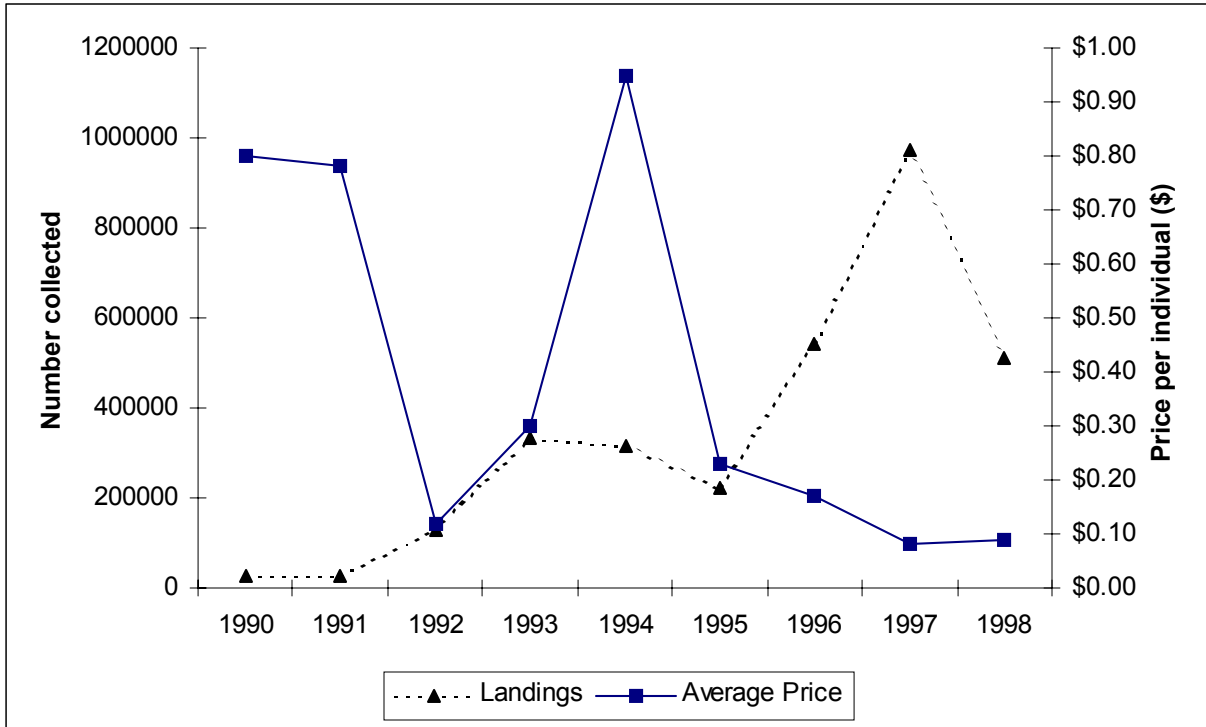


Figure E-15. Landings and Average Dockside Price of Starfish, Florida, 1990-1998

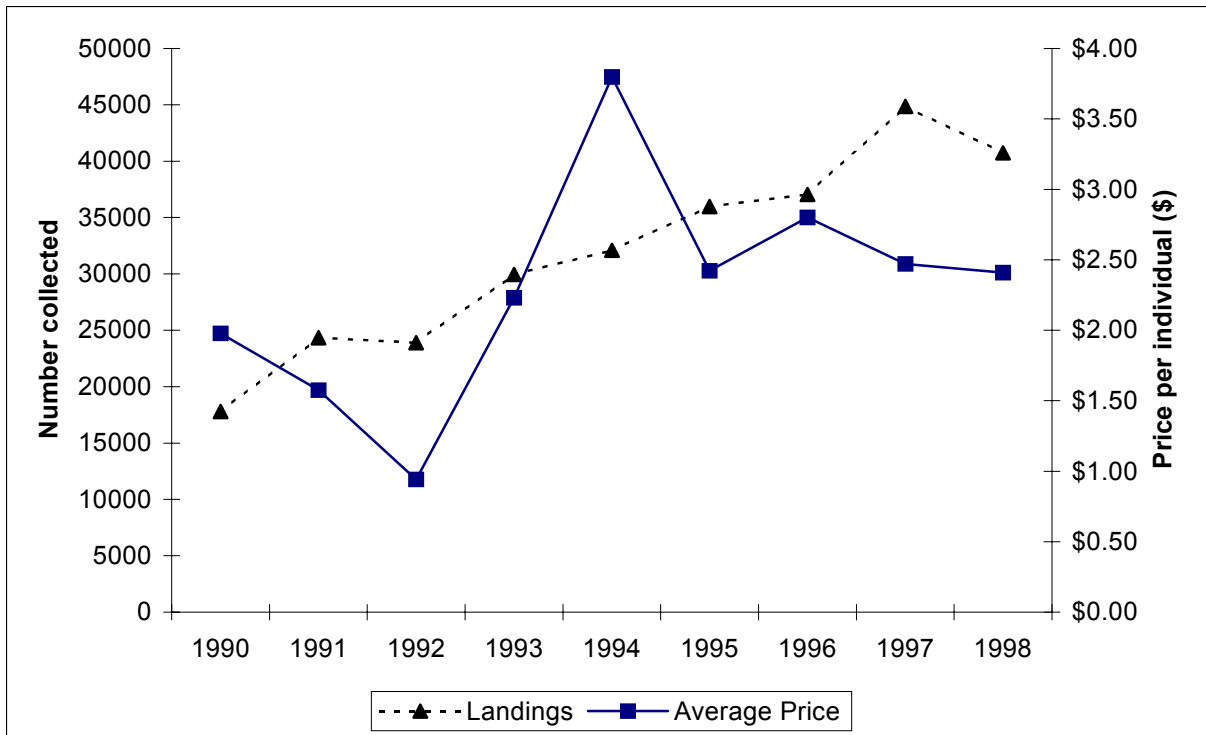


Figure E-16. Landings and Average Dockside Price of Gorgonian, Florida, 1990-1998

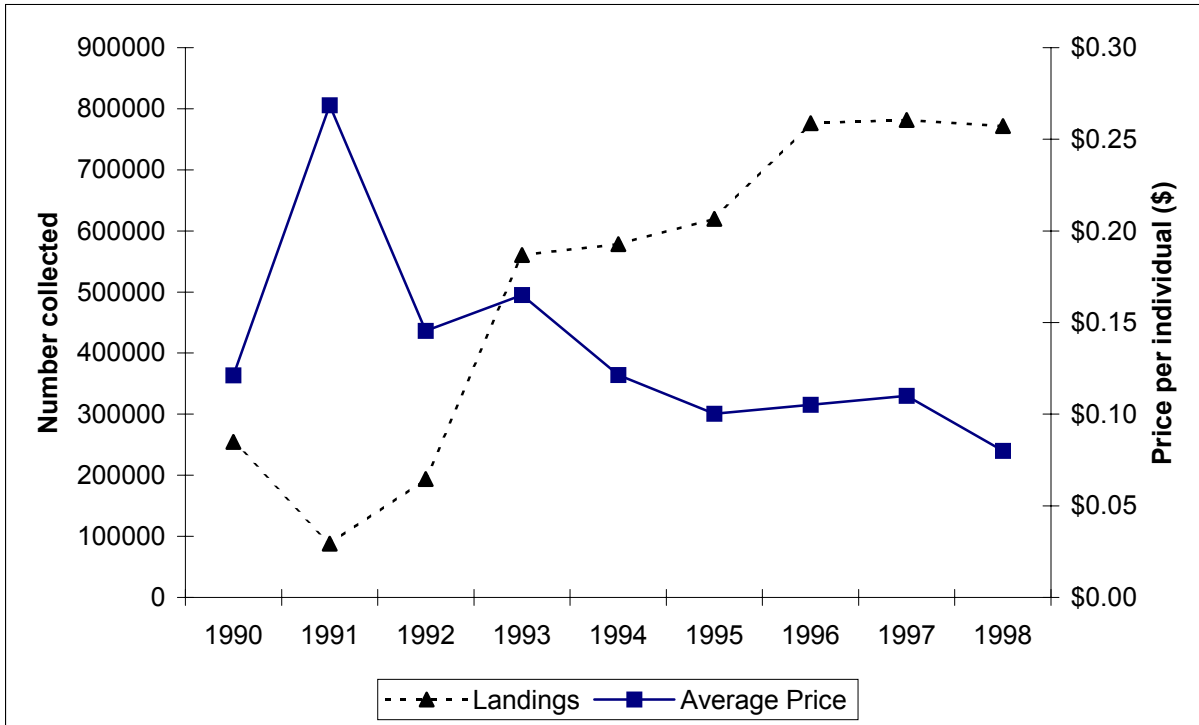


Figure E-17. Landings and Average Dockside Price of Sand Dollar, Florida, 1990-1998

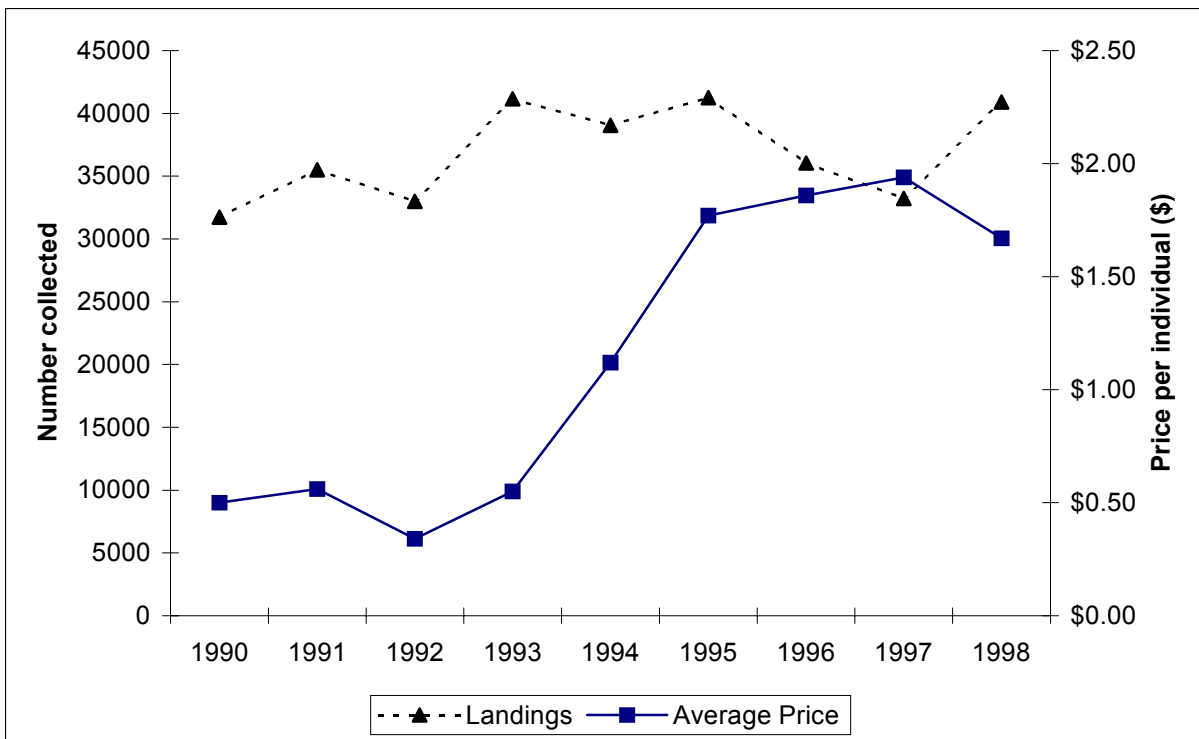


Figure E-18. Landings and Average Dockside Price of Urchin, Florida, 1990-1998

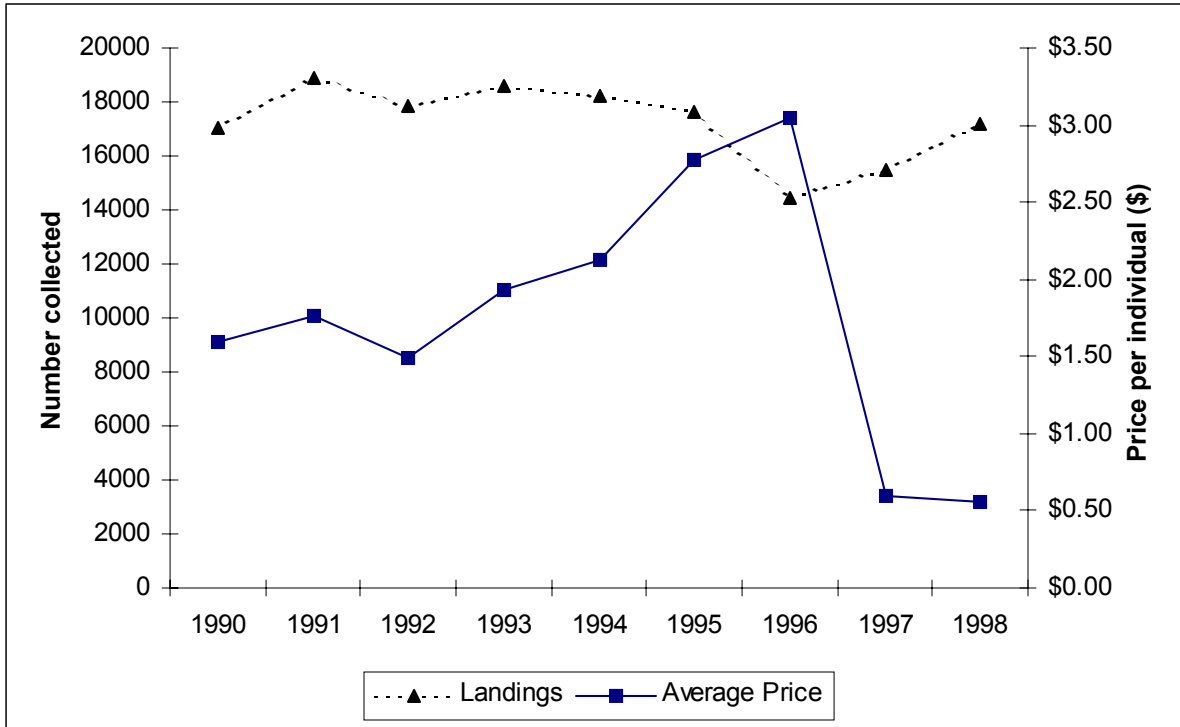


Figure E-19. Landings and Average Dockside Price of Sponge, Florida, 1990-1998

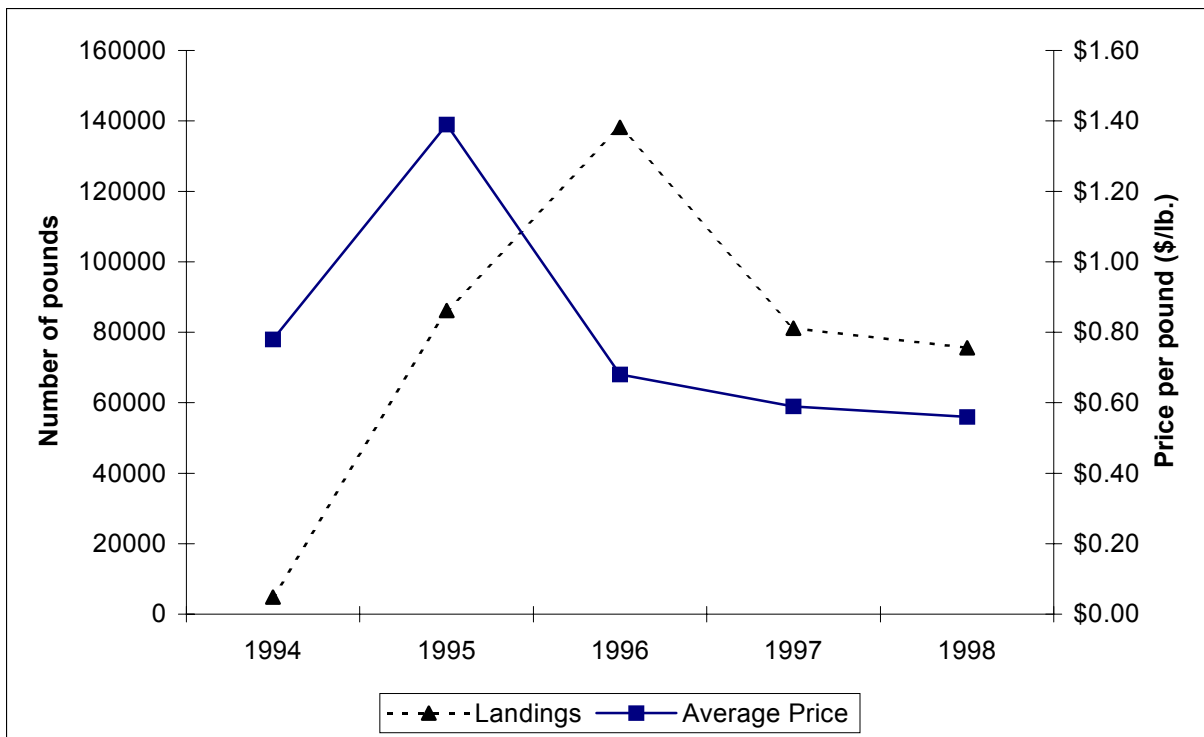


Figure E-20. Landings and Average Dockside Price of Live Sand, Florida, 1990-1998



Science Serving Florida's Coast

For Florida's 15.5 million residents and about 50 million annual visitors, the coast and its resources are a major attraction and an important part of their environment. Nowhere else in the United States are so many people so close to such an extensive and economically valuable coastline.

Working together, all Floridians must find a socially acceptable way to satisfy the demand for these resources while protecting their ecological integrities. Florida Sea Grant has a vital role to fill in this complex endeavor. Florida Sea Grant's mission is to enhance the practical use and conservation of coastal and marine resources to create a sustainable economy and environment. Now in its 30th year, Florida Sea Grant is the only statewide university-based coastal research, education, extension/outreach and communications program in Florida. One of 30 Sea Grant programs nationally, it is a partnership program among the National Oceanic and Atmospheric Administration, Florida's universities and Florida's citizens, businesses and governments.

Florida Sea Grant has a demonstrated record of success. Its program of research, education and extension earned a rating of "Excellent" from a federally mandated review by the National Sea Grant College Program in 2000. We invite you to learn more about Sea Grant's contributions and its leadership role in helping Floridians to rationally manage continued growth in the coastal zone by reading the 2002-2005 Florida Sea Grant College Program Strategic Plan, available by visiting the Florida Sea Grant web site at:

<http://www.flseagrants.org>.



Science Serving Florida's Coast

Florida Sea Grant College Program
University of Florida
PO Box 110409
Gainesville, FL 32611-0409
(352) 392-2801
www.flseagrant.org