Studies on
Marine Economics

HAWAII'S MARINE AQUARIUM FISH INDUSTRY PROFILE

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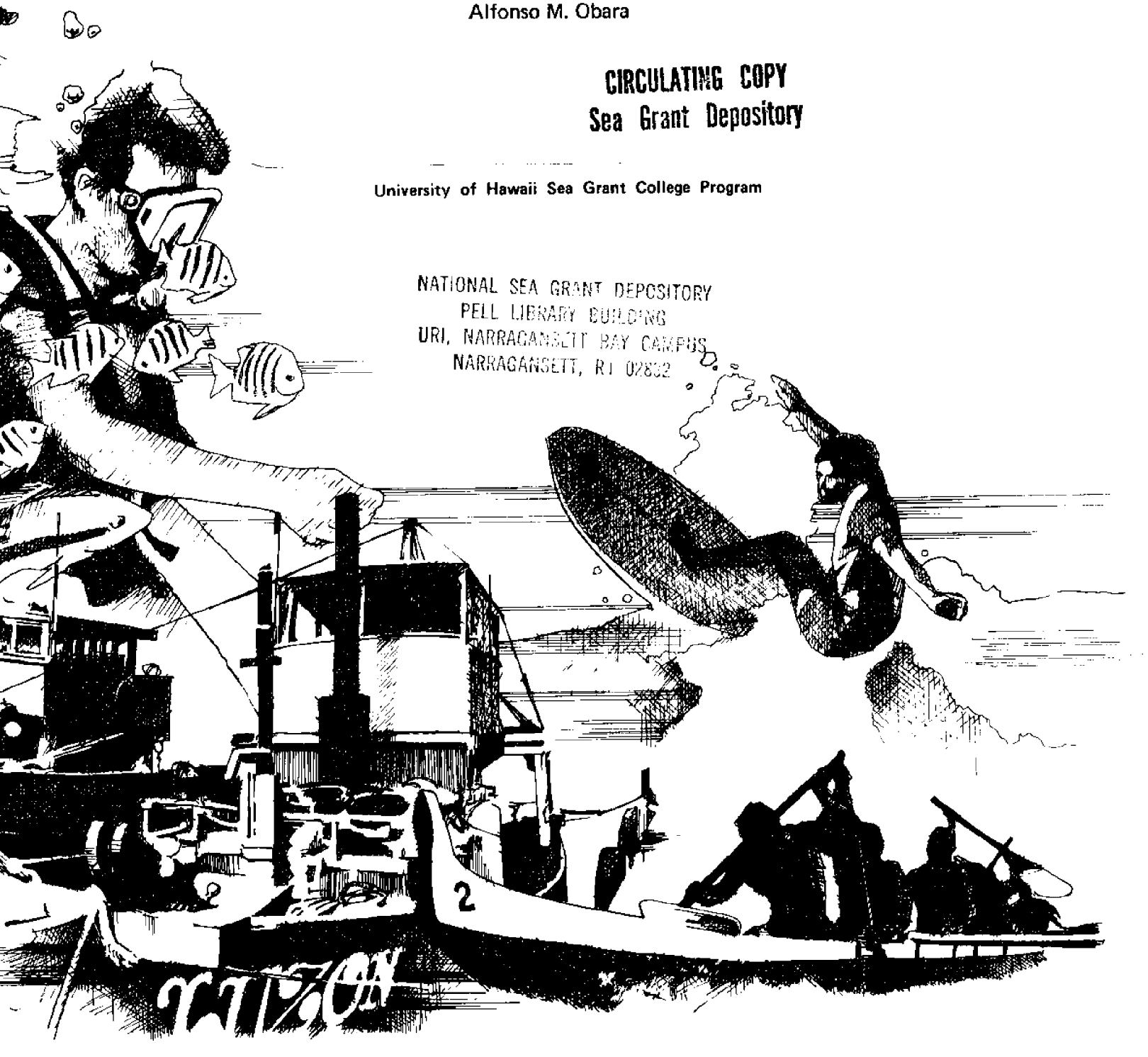

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About the authors

H. Walter van Poollen and Alfonso Obara are researchers on contract with the University of Hawaii Sea Grant College Program.

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INTRODUCTION

Marine aquarium fishes provide hobbyists with the enjoyment of observing fishes as they are found in their natural environment. Hobbyists in Hawaii are fortunate to be able to choose among the marine aquarium fish species from local catch or imports from the mainland U.S. and foreign countries. This means that the marine aquarium fish industry in Hawaii is organized into segments comprising collectors, importers-exporters or wholesalers, and retailers. The marine aquarium fish species caught in Hawaii and exported are highly preferred because of the good survival rate of the fish.

INDUSTRY CHARACTERISTICS

The retailers in Hawaii purchase marine aquarium fish from the wholesalers, importers, and individual collectors for resale to customers. Retailers are typically mixed pet shops in which marine aquarium fishes comprise only a portion of the business.

The role of the importer-exporter of marine aquarium fish is an intermediary function between collectors, wholesalers, retailers, or individual customers. An importer-exporter firm may have its own crew of collectors, may function as a wholesaler, and may sell to individual customers on top of selling to wholesalers and retailers.

It is estimated that the importer-exporter segment as a whole imports about 1,000 specimens per week and handles about 3,300 Hawaiian-collected fish per week. Marine aquarium fish caught in Hawaii for export are prepared for shipment by placing approximately 20 specimens per box (this number is highly variable depending on species, size of fish, etc.). The boxes are shipped by plane under controlled temperature. Both amateurs and commercial collectors supply the salt-water hobbyist with marine aquarium fish. Collecting techniques and equipment are varied and depend on the species collected, area, and country in which collection takes place.

In Hawaii, the basic equipment used to collect is a seine or barrier net and/or hand net. The use of barrier nets is the most productive method for collecting the majority of marine aquarium fishes. These monofilament nets (mesh sizes less than 2 inches) are set up in a semi-circular or a swirl pattern in the path of fishes or across a reef. Fish are herded into this nearly invisible barrier and scooped up with hand nets, and then placed into collecting jars or bags.

Another technique used to collect fish is by the use of chemicals such as cyanide. Cyanide causes the fish to become paralyzed and float to the surface where they can be collected. This technique is not used in Hawaiian waters. It is used in other areas of the world, such as the Philippines, to supply fish to the marine aquarium fish industry.

The collection method, transshipping, and the numbers of people involved in getting the fish from the ocean environment to the hobbyists' aquariums

cause stress and mortality on the fish. Certain species have a better tolerance than others. To get an idea of average stress we asked the various segments of the industry for their estimates of losses. Table 1 gives the mortality rates.

TABLE 1. MORTALITY RATES

Losses Occurring	Method of Capturing (%)	
	Net	Chemical*
In the field	1-2	10-25
In the wholesaler's tanks	2-3	50
While shipping to retailers and/or wholesalers	2-3	50
In the retailer's tanks	10	25
From the field to the individual consumer	15-18	85-86

*The use of chemicals such as cyanide to capture fish is prohibited in Hawaii and thus not used by the industry.

The collectors in Hawaii lose only about 1 percent of the fish they handle because of the care taken in collecting as well as in the collecting method. The collecting method makes a significant difference on how many fish survive from the sea to the hobbyist's aquarium. Eighty-five percent of the fish caught with nets in Hawaii survive, while only about 15 percent survive when chemicals are used.

Survival rates are higher with less shock to the fish while being collected, and when the handlers are more knowledgeable about the specific marine aquarium fish species (i.e. water temperature and salinity requirements, disease control, etc.). Of those involved in the industry, the retailing segment has the greater problem finding qualified personnel who know the requirements of the many species they handle. Thus the higher mortality rate (10 percent) experienced by the retailers.

Collectors, importers-exporters, and retailers in the industry estimate that the average life span of the fish after being collected is 12 months, 18 months, and 24 months, respectively. The average life span of uncaptured marine aquarium fish is estimated at about 5 years.

In Hawaii, a permit is needed to collect fish. The number of permits issued for a fee by the Aquatic Resources Division of the Department of Land and Natural Resources has been decreasing for the last 5 years (Table 2), as has the number of reported marine aquarium fish caught.

TABLE 2. MARINE AQUARIUM FISH PERMIT HOLDERS

Year (July-June)	Number of Permits Sold			Fish Caught		
	Total	Commercial (%)	Amateur (%)	Total	Commercial (%)	Amateur (%)
78-79	292	33	65	161,486	99	1
79-80	192	40	60	152,782	98	2
80-81	186	23	77	127,624	98	2
81-82	186	35	65	130,347	99	1
82-83	179	38	62	105,870	98	2

Source: State of Hawaii, Division of Aquatic Resources

Through the years commercial permit holders have accounted for the same proportion (98 to 99 percent) of fish caught. Commercial collectors go to sea an average of 4 days a week for 8 hours a day, at a distance of 1 to 2 miles from the shoreline. The average catching depth is about 40 feet and has remained the same over the years (Table 3). Through their efforts, the commercial collectors catch an average of about 13 fish per hour (Table 3).

TABLE 3. CATCHING EFFORT

Year	Average Catching Depth (ft)		Fish Caught per Hour by Commercial Collectors
	All Species	Species Priced at > $10 per Fish	
1979	43	73	12.74
1980	40	68	12.31
1981	41	74	13.95
1982	42	66	12.82

Note: Calculation based on data from Division of Aquatic Resources

Catch Composition

Yellow tang is the king of the marine aquarium fish. The largest number of any single species collected is the yellow tang and it has the highest estimated total value of all the species collected in Hawaii (Tables 4, 5, 6, 7, and 8). Yellow tang has been consistently the number

one ranked fish collected in Hawaii from 1973 to 1976 and from 1979 to 1982. (Data for 1977-1978 not yet compiled by the Division of Aquatic Resources.)* The number of yellow tang collected has been decreasing; the number caught in 1982 was about half of that collected in 1976. Yellow tang made up 18 percent of the total catch in 1973, 22 percent of the total catch in 1976, and only 16 percent in 1982.

TABLE 4. TOP TEN MARINE AQUARIUM FISHES COLLECTED IN HAWAII IN FISCAL YEAR 1976

	Species*	Number	Estimated Value ($)	Estimated Value per Fish ($)
1.	Yellow tang	35,006	43,256	1.24
2.	Long-nosed butterfly	10,022	18,718	1.87
3.	Potter's angel	9,299	17,919	1.93
4.	Achilles tang	9,233	18,920	2.05
5.	Clown tang	6,478	14,536	2.24
6.	Four-spot butterfly	4,925	6,997	1.42
7.	Moorish idol	4,520	8,763	1.94
8.	One-spot butterfly	4,496	6,502	1.45
9.	Long-nosed butterfly	4,259	6,914	1.62
10.	Many-banded butterfly	3,623	3,343	.95
	Top Ten	91,861	145,868	1.67
	Total Hawaii	158,381	239,243	1.51
	% of Top Ten	58	61	

Source: A. Katekaru, 1978

*See Appendix A for scientific names

TABLE 5. TOP TEN MARINE AQUARIUM FISHES COLLECTED IN HAWAII IN 1979

	Species	Number	Estimated Value ($)	Estimated Value per Fish ($)
1.	Yellow tang	33,766	36,915	1.10
2.	Long-nosed butterfly	13,282	22,960	1.74
3.	Potter's angel	9,261	18,492	2.01
4.	Clown tang	9,087	18,189	2.02
5.	Achilles tang	7,128	15,519	2.20
6.	Feather duster worm	5,286	2,756	.53
7.	Four-spot butterfly	5,168	7,537	1.47
8.	Moorish idol	5,025	9,418	1.89
9.	Ornate wrasse	4,928	7,113	1.46
10.	One-spot butterfly	4,188	6,038	1.45
	Top Ten	97,119	144,937	1.49
	Total Hawaii	163,054	265,174	1.63
	% of Top Ten	60	55	

Note: Calculation based on data from Division of Aquatic Resources

TABLE 6. TOP TEN MARINE AQUARIUM FISHES COLLECTED IN HAWAII IN 1980

	Species	Number	Estimated Value ($)	Estimated Value per Fish ($)
1.	Yellow tang	29,304	41,010	1.41
2.	Long-nosed butterfly	9,853	19,090	1.95
3.	Potter's angel	8,837	17,327	1.98
4.	Clown tang	7,414	14,809	2.01
5.	Moorish idol	5,202	10,308	2.00
6.	Four-spot butterfly	3,418	5,799	1.71
7.	Achilles tang	3,164	8,831	2.81
8.	Many-banded butterfly	3,079	2,437	.80
9.	Ornate wrasse	3,009	5,124	1.72
10.	Redtail wrasse	2,515	7,207	2.89
	Top Ten	75,790	131,942	1.74
	Total Hawaii	133,289	227,772	1.72
	% of Top Ten	57	58	

Note: Calculation based on data from Division of Aquatic Resources

TABLE 7. TOP TEN MARINE AQUARIUM FISHES COLLECTED IN HAWAII IN 1981

	Species	Number	Estimated Value ($)	Estimated Value per Fish ($)
1.	Yellow tang	25,555	34,244	1.36
2.	Potter's angel	8,349	15,142	1.84
3.	Feather duster worm	7,680	8,894	1.17
4.	Long-nosed butterfly	7,023	13,531	1.95
5.	Clown tang	6,647	14,365	2.19
6.	Achilles tang	6,122	25,456	4.21
7.	Four-spot butterfly	4,702	5,737	1.23
8.	Moorish idol	4,212	8,750	2.10
9.	Ornate wrasse	3,086	4,471	1.47
10.	One-spot butterfly	2,669	3,776	1.43
	Top Ten	76,045	134,366	1.77
	Total Hawaii	136,239	245,782	1.83
	% of Top Ten	56	55	

Note: Calculation based on data from Division of Aquatic Resources

TABLE 8. TOP TEN MARINE AQUARIUM FISHES COLLECTED IN HAWAII IN 1982

	Species	Number	Estimated Value ($)	Estimated Value per Fish ($)
1.	Yellow tang	17,355	24,946	1.45
2.	Long-nosed butterfly	7,061	15,752	2.25
3.	Feather duster worm	6,567	7,300	1.12
4.	Potter's angel	5,974	11,125	1.88
5.	Achilles tang	4,409	18,574	4.26
6.	Clown tang	4,236	9,962	2.38
7.	Moorish idol	3,288	7,938	2.44
8.	Ornate wrasse	3,098	4,758	1.55
9.	Four-spot butterfly	2,965	5,242	1.79
10.	One-spot butterfly	2,630	4,391	1.69
	Top Ten	57,583	109,988	1.91
	Total Hawaii	109,436	206,999	2.11
	% of Top Ten	53	53	

Note: Calculation based on data from Division of Aquatic Resources

Long-nosed butterfly, Potter's angel, Achilles tang, clown tang, four-spot butterfly, Moorish idol, and one-spot (teardrop) butterfly have consistently been in the top 10 marine aquarium fishes collected in Hawaii. The numbers of these species collected have also been decreasing from 1976 to 1982.

Other species making the top 10 are many-banded (copperband) butterfly, feather duster worm, ornate wrasse, and the redtail wrasse. The feather duster worm has become very popular and was the third most collected species during 1981 and 1982. It appears that a change in hobbyists' demands has taken place in favor of invertebrates such as the feather duster worm.

The top 10 species of marine aquarium fish have over the years made up 50 to 60 percent of the total number of fish collected in Hawaii during the years for which data are available. They have made up 55 to 61 percent of total dollar value of the fish collected in Hawaii.

Five species of marine aquarium fish collected in Hawaii have had a price averaging over $10 to the collector (Table 9). Tinker's butterfly and dragon eel brought the collectors an average of $30.10 and $27.05 per animal, respectively, in 1982. These five species tend to be exported more (average of 54 percent exported) than the other species of marine aquarium fish collected in Hawaii (average of 31 percent exported). These five species tend to be collected at a greater depth (Table 3) and require more time to collect.

TABLE 9. HAWAIIAN COLLECTED FISH WITH COLLECTOR'S PRICE AVERAGING OVER TEN DOLLARS

Species	Average Collector's Price ($)				Percent Exported
	1979	1980	1981	1982	
Tinker's butterfly	16.36	28.79	28.90	30.10	52
Flame angel	6.33	13.65	10.50	7.95	65
Longnose hawk	21.10	17.30	12.92	7.83	22
Hawaiian kole	10.60	10.00	8.81	7.32	40
Dragon eel	15.33	22.10	27.28	27.05	92

Note: Calculation based on data from Division of Aquatic Resources

The total number of fish collected peaked in the late 1970s around 160,000 (Figure 1). The total number collected has decreased since 1979 by approximately a third. While the estimated value to the collector per fish has increased from $1.51 (1976) to $2.11 (1982), the total estimated value to the collectors has decreased some 22 percent since 1979.

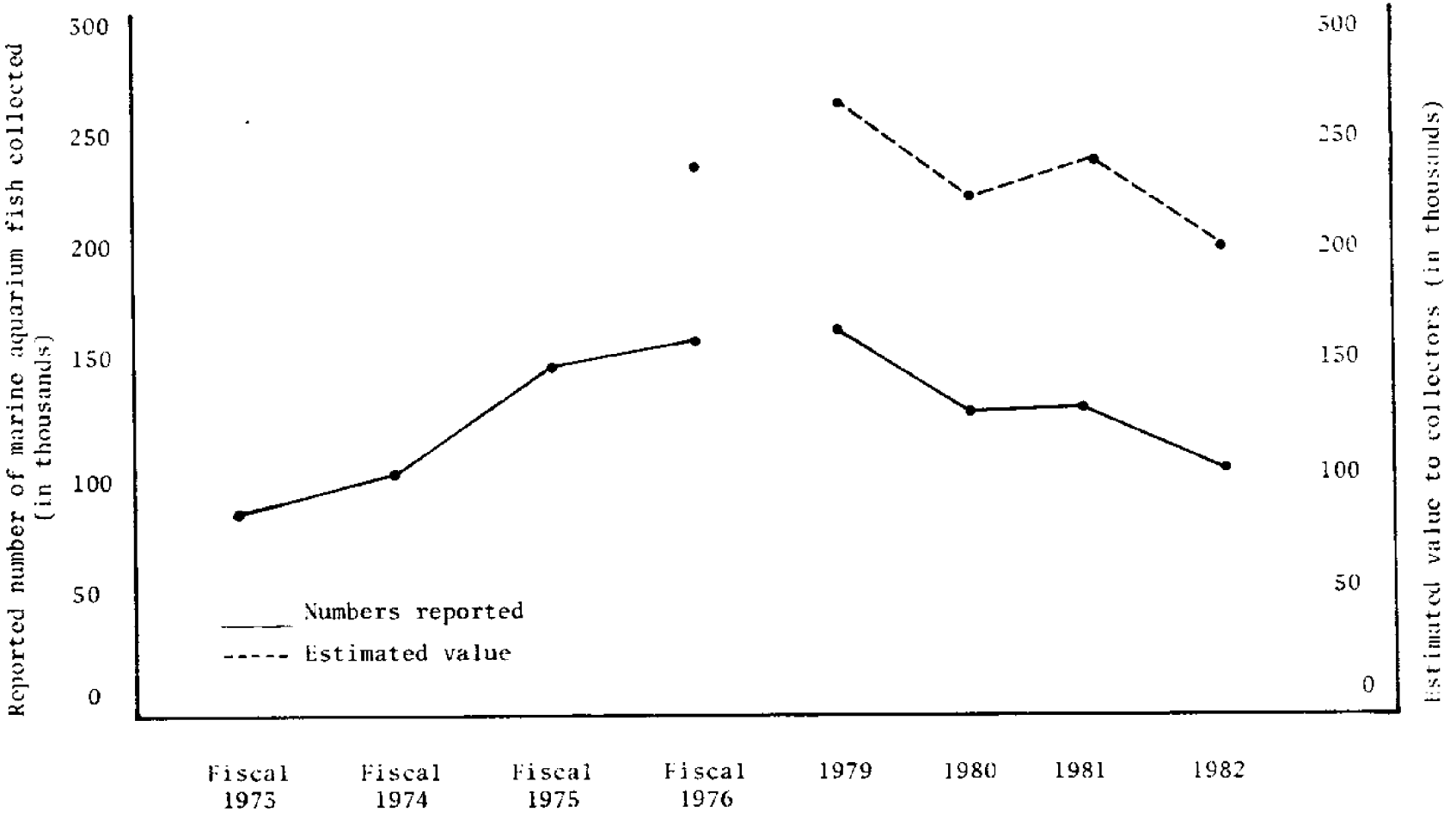

Figure 1. Reported numbers collected and estimated value

Oahu and Hawaii are the two islands from which marine aquarium fish are collected. An average of 82 percent of the total number of fish are caught on Oahu (Figure 2), with only an average of 18 percent on the Big Island. The percentage of the total value of the fish caught for the Big Island has been increasing since 1980 (Figure 3). In 1982, the fish caught on that island accounted for 34 percent of the total value. This value could continue to increase since direct mainland U.S. flights were made possible in 1983.

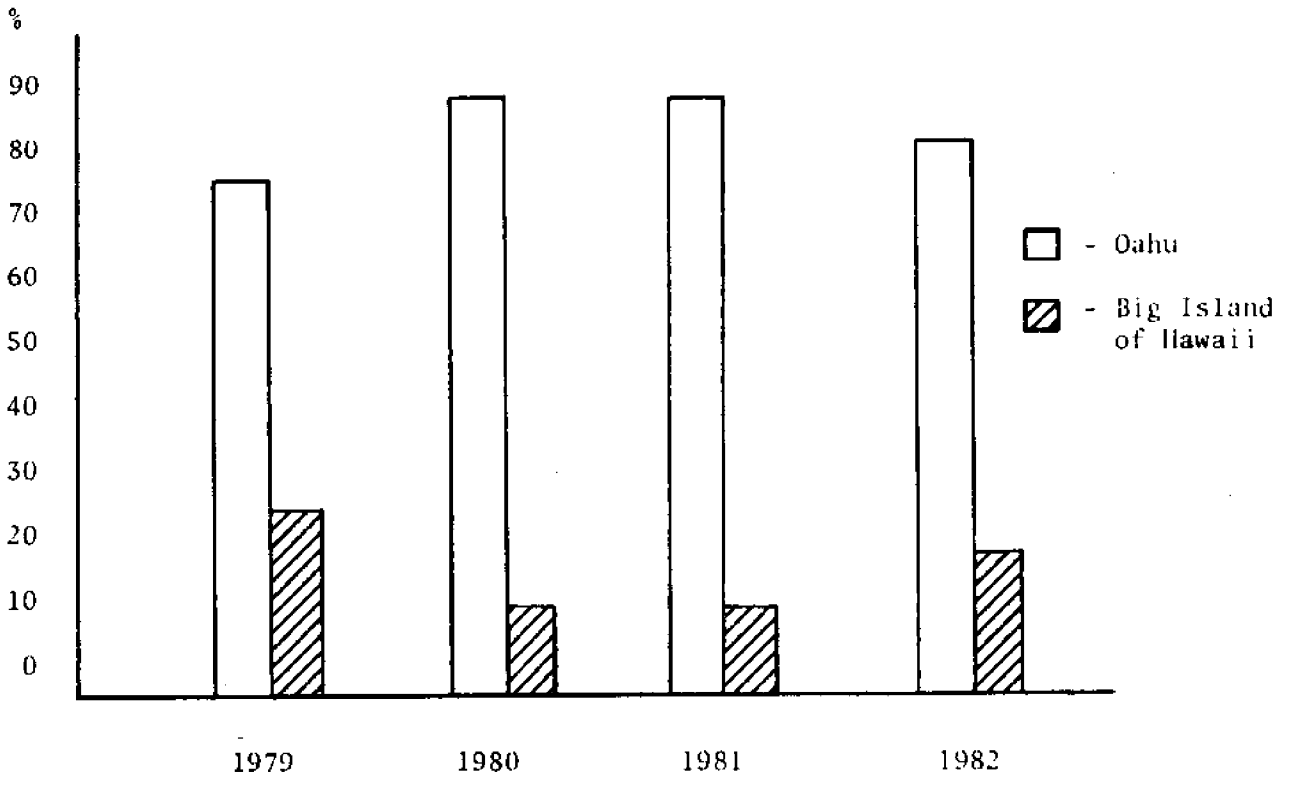

Figure 2. Percentage by area of the total number caught

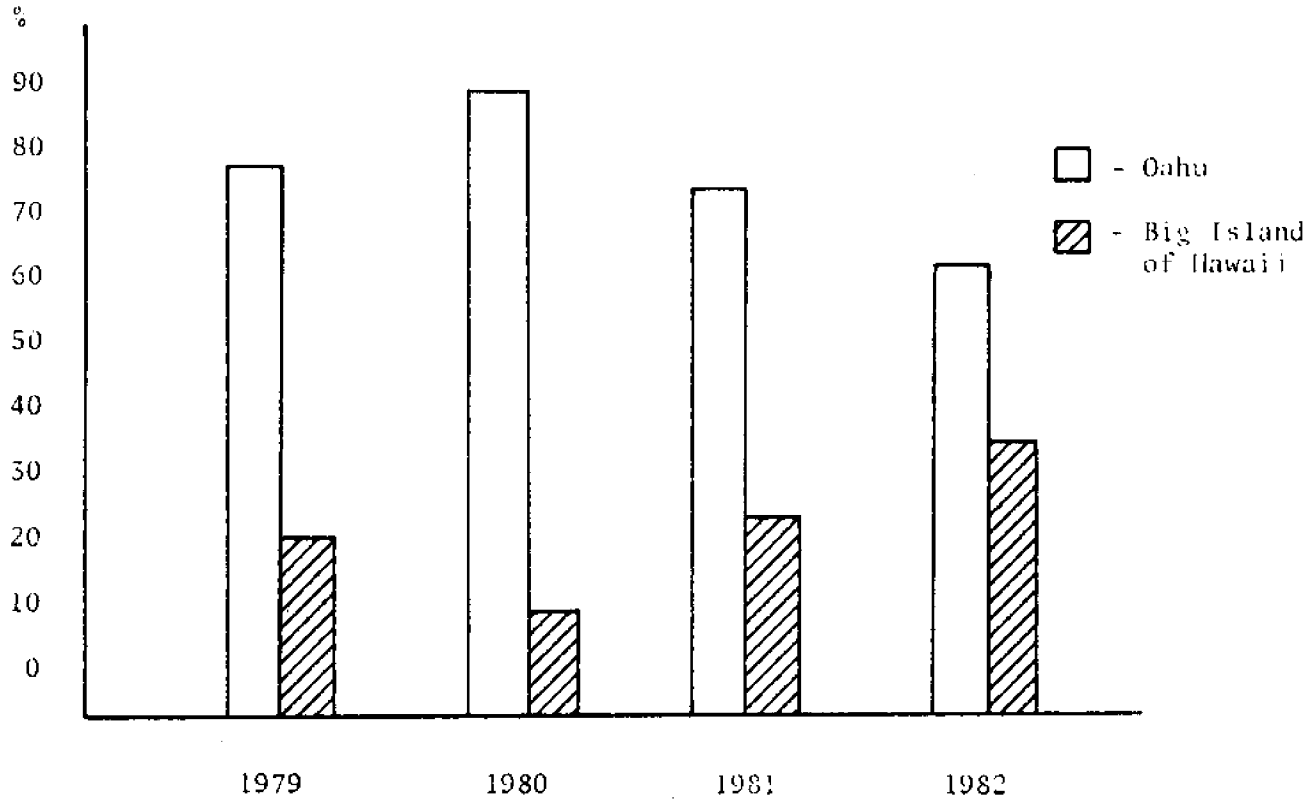

Figure 3. Percentage by area of the total value of the fish caught

ECONOMIC CHARACTERISTICS

There are an estimated 89 people involved in the marine aquarium fish industry doing the collecting, importing and exporting, and retailing of marine aquarium fish (Table 10). The average monthly earnings range from $800 to $1,225, with part-time employees making an average of $3.35 to $6.25 per hour. Most of the 89 people are collectors and range in age from 16 to 35.

The estimated gross sales of the marine aquarium fish industry for 1983 is about $1.76 million (Table 11). The importer-exporter segment brings in the most at $1,100,000. They import about 1,000 per week and handle about 3,300 Hawaiian-collected fish per week (Table 12). About 95 percent of the gross sales of the importers-exporters is to non-local clients, with the largest proportion of sales going to other wholesalers and exporters (Table 13).

Prices of marine aquarium fishes vary widely (Table 14). The average retail price per fish is about $5.25. The average wholesale price per fish is about $4.00, while the average collector price is $1.50. Local species are priced by local retailers two to four times the amount paid to collectors. Local species are priced by mainland retailers at six to twenty times the amount paid to collectors.

There is no evidence that there was that great an increase in the number of fish collected from 1982 to 1983. This discrepancy in total number collected can be attributed to: (a) Division of Aquatic Resources is receiving only about 63 percent of the total or (b) the survey participants have inflated the numbers they handle. The authors believe that for estimating total number caught, 3,300 per week is closer to actual number caught, while the Division of Aquatic Resources data give a good estimate of species composition and yearly trends.

TABLE 10. MARINE AQUARIUM FISH INDUSTRY WORK FORCE PROFILE

	Collectors	Importer-Exporter	Retailers
Full-time Employees			
Total number of full-time staff estimated for Oahu		19*	9
Average monthly earnings		$1,225	$800
Part-time Employees			
Total number of part-time employees working 1 to 20 hrs/wk estimated for Oahu	49	6	3
Total number of part-time employees working 21 to 39 hrs/wk estimated for Oahu		1	2
Average hourly earnings	$5.42	$6.25	$3.35
Age Categories (% of staff)			
16 to 24			50
25 to 34		86	22
35 to 44		14	14
45 and older			14
Total people involved in the industry:	89		

*Importer-exporter personnel usually do their own collecting

TABLE 11. ESTIMATED 1983 GROSS SALES FOR THE MARINE AQUARIUM FISH INDUSTRY

Segment	Value
Collectors*	$ 360,000
Impoters-Exporters	$1,100,000†
Retailers	$ 250,000†
Total	$1,760,000

*Estimated using Division of Aquatic Resources data
†Estimated using survey data

TABLE 12. FISH NUMBERS HANDLED BY THE IMPORTERS-EXPORTERS

	Average Numbers of Fish Handled per Week*	Major Species
Imported fish	1,000	Flame angel
Hawaiian fish†	3,300	Yellow tang
		Long-nose butterfly
		Potter's angelfish

*Based on the survey questionnaire
†Using survey data, 3,300 fish per week, suggest that there were 171,600 fish collected during 1982. This estimate is much higher than the estimate based on Division of Aquatic Resources data (109,988 for 1982).

TABLE 13. AQUARIUM FISH SALES BY LOCAL IMPORTERS-EXPORTERS

Market Outlet Distributors/Consumers	Gross Sales (%)
a. Wholesalers-Exporters	65
b. Local Retailers	1
c. Non-local Retailers	30
d. Individual Customers	4
	100

TABLE 14. 1983 FISH PRICES BY INDUSTRY SEGMENT

		Species	Collector's Price*	Wholesaler's Price*	Hawaii Retailer's Price*
Local	1	Yellow tang	1.25 (1.45)†	2.15	3.95
	2	Long-nosed butterfly	1.50 (2.25)†	3.75	4.25
	3	Potter's angel	1.00 (1.88)†	3.75	5.50
	4	Achilles tang	4.00 (4.26)†	6.50	9.00
	5	Clown tang	1.25 (2.38)†	4.50	5.50
	6	Four-spot butterfly	1.00 (1.75)†	3.50	5.50
	7	Moorish idol	1.25 (2.44)†	4.00	6.50
	8	One-spot butterfly	1.00 (1.69)†	-	3.85
	9	Many-banded butterfly	.50 (.80)†	-	2.35
Imported	1	Flame angel	7.00	12.50	21.00
Specialty	1	Tinker's angel	30.00†		52.50
	2	Flame angel	7.95†	12.50	21.00
	3	Long-nose hawkfish	7.83†		27.50
	4	Hawaiian kole	7.32†		
	5	Dragon eel	27.05†		55.00
		Feather duster worm	1.12		2.00
		Ornate wrasse	1.50 (1.55)†	3.50	4.95
		Redtail wrasse	7.00 (2.89)†		4.95

*Based upon price lists and survey data. These are the asking prices and not necessarily the prices received, especially considering the frequent discounts given to certain customers.
†Based on Division of Aquatic Resources data

Although the mark-up is high, so are the expenses. Rent and freight are the retailer's and importer-exporter's major costs. Total freight cost for the industry is estimated to be about $500,000 or some 21 percent of the gross sales. Rent expenses make up about 15 percent and 40 percent for the importer-exporter and retailer, respectively. One would need about $50,000 to set up an importer-exporter business, of which 50 percent would be for equipment. To set up a retail business, one would need about $70,000. Very little is needed by existing retailers to shift from fresh-water fish to salt-water fish.

INDUSTRY PROBLEMS

The major problems facing the retailers are the constantly increasing costs and the difficulty of finding knowledgeable, well-trained employees to handle the fish. Finding better-trained employees would decrease fish losses (10 percent mortality rate) and improve services.

The problems facing the importers-exporters are: the high cost of air-shipping live fish, the constantly changing rate structures between carriers, and missed flight connections. The high freight costs cuts into profit and causes retail prices to be higher, thereby decreasing the demand. The changing rate structure results in erratic fish prices. The problem of missed connections increases the probability of dead fish being delivered because of the extreme temperature changes experienced while in the airport freight terminals on the mainland.

Another problem facing importers-exporters is concerned with import restrictions, collection forms, and import forms. The import restrictions tend to limit the size of business, industry, and market. There has been a change in demand from people who wanted just a few common species in a glass bowl to a desire for hard-to-find exotics and invertebrates to create a microniche of the ocean environment in the home. Because of the import restrictions, the flow of these products bypasses Hawaii, decreasing the amount of business for Hawaii.

GOVERNMENT INVOLVEMENT

The Plant Quarantine Inspection Office of the State Department of Agriculture is responsible for enforcing these import restrictions set by other government agencies who, in theory, have the expertise to determine the reasons for restrictions. The Plant Quarantine people are trained to identify the thousands of species of plants, but unfortunately, are not experts in identifying the various growth forms, varieties, and species of marine aquarium fish and invertebrates. Because of the inspectors' lack of training in this specialized area, the inspection at the airport may be time-consuming which causes slightly higher mortality rates. It is easier for the inspectors to work with a regulation which has a blanket restriction on importation of certain types of animals. Training the inspectors would be costly, especially for a relatively small industry.

Should the law be changed, there are a number of requirements to be considered: (a) train existing personnel or hire qualified personnel; (b) have proper handling equipment and facilities; and (c) have the importers-exporters set up holding tanks at the airport to handle their shipments. By requiring the fish to be kept on the airport grounds, they do not legally enter Hawaii, and inspectors will have better enforcement control. Unfortunately, these requirements may be too costly to both the importers-exporters and the state, in view of the relatively small size of the industry.

CONCLUSIONS

The 89 people involved in the retail, import-export, and collecting segments of the marine aquarium fish industry generate about $1,760,000 in gross sales. The marine aquarium fish species caught in Hawaii are handled with care, thereby insuring a relatively low mortality rate.

The collectors catch about 13 fish per hour at an average collecting depth of some 40 feet. The amount of effort to catch the fish and the average catch depth have not changed form 1979 to 1982. This indicates that there is no adverse effect on the number of marine aquarium fish from collecting.

Yellow tang, long-nosed butterfly, Potter's angel, Achilles tang, clown tang, four-spot butterfly, Moorish idol, and one-spot butterfly have consistently been in the top ten marine aquarium fishes collected from 1976 to 1982 in Hawaii.

The total number of retailers has decreased since 1979. The total number of fish collected has decreased since 1979 by approximately one-third due to a changing demand.

The hobbyists are demanding more species diversity which includes invertebrates such as the feather duster worm. Importers-exporters are tapping other sources, such as the Marshall Islands and Indonesia, to satisfy this changing demand. Hawaii is only able to supply certain types of fish from its own waters and traditionally has been in the role of a contract collector. An opportunity exists for the importers-exporters to become distributors, not just contract collectors.

Hawaii's importers-exporters have three advantages over the mainland importers-exporters: (1) our climate is extremely stable, thereby allowing for a lower mortality rate; (2) there are certain species indigenous to Hawaii whose distribution can be controlled by the importers-exporters; (3) Hawaii has a lot of direct flights to and from the small islands in the Pacific where the fish are collected, thereby allowing our importers-exporters to provide the species diversity required to become a distribution center of marine aquarium fish.

Unfortunately, there is an obstacle. The size of the businesses and industry is limited by import restrictions. The import restrictions cause the flow of the marine aquarium fish to bypass Hawaii, allowing the West

Coast U.S. to be the distribution center, decreasing the amount of business for Hawaii. If the import restrictions were lifted, the industry's gross sales are estimated to double. (This estimate is based on the average gross sales of importers-exporters in Los Angeles, and assuming no new companies would be created because the restrictions are lifted.)

Should the law be changed a number of requirements are needed. These requirements may still be too costly, especially considering the relatively small size of the industry.

REFERENCE CITED

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APPENDIX

APPENDIX A. MARINE AQUARIUM FISH

Common Name	Scientific Name
Yellow tang	*Zebrasoma flavescens*
Long-nosed butterfly	*Forcipiger longirostris, F. flavissimus*
Potter's angel	*Centropyge potteri*
Clown tang (Kala)	*Naso lituratus*
Achilles tang (Nae nae)	*Acanthurus achilles*
Feather duster worm	*Isaurus elongatus*
Four-spot butterfly	*Chaetodon quadrimaculatus*
Moorish idol (Kihikihi)	*Zanclus cornutus, Z. canescens*
Ornate wrasse	*Halichoeperes ornatissimus*
One-spot butterfly (Teardrop)	*Chaetodon unimaculatus*
Many-banded butterfly (Copperband)	*Chaetodon multicinctus*
Redtail wrasse	*Anampses chrysocephalus*
Tinker's butterfly	*Chaetodon tinkeri*
Flame angel	*Centropyge loriculus*
Long-nose hawk	*Oxycirrhitus typus*
Dragon eel	*Muraena pardalis*
Hawaiian kole (Black surgeon fish)	*Ctenochaetus hawaiiensis*