

An Economic Analysis of Commercial Fish Landings in the Republic of Palau

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Abstract

To evaluate the trend of current commercial fisheries landings in Palau, landing and price patterns, species characteristics, quantity-price relationships, gear, trade features, and international cooperation aspects were analyzed. Palau's fisheries have many problems and much potential. The problems include follow-up of JICA's cooperation, the PFFA's mismanagement and commercial fisheries development policy including a fixed-price policy, fish handling and grant vessel management. Potential exists not only in solving these problems, but also in developing trochus shell factories, removing institutional constraints for the MMDC, and in utilizing potentially valuable shorebased structures such as the Van Camp facilities.

Key words: Fisheries, Fisheries development, Fisheries economics, Palau, Pacific islands.

Introduction

The Palau archipelago consists of numerous islands, which are encircled by a 396 kilometers-long barrier reef encompassing a lagoon with an area of 1,449 kilometers (PERRON *et al.*, 1983). The average annual yield from intensive reef and lagoon fin-fisheries lies between one and five metric tons (MT) per square kilometer (JOHANNES, 1981). Palau therefore appears to have a potential annual harvest of somewhere between 2,000 to 11,000 MT of reef fish per year. In addition there are significant stocks of crustacean, molluscs and pelagic fish outside the reef.

The total subsistence catch is roughly estimated as 1,628 MT per year (PERRON

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et al., 1983). Commercial fish landings in 1985 was 334 MT, comprised of reef fish (78 %), pelagic fish (21 %) and others. In addition, the average annual catch of trochus shells range from 100 to 300 MT. There seems to be room for a great expansion in fisheries. Now, fisheries resources in Palau are regarded as important, because of its contribution to the national economy.

In the 5 year development plan beginning in 1986, the government decided to invest about 17.3 % of the economic sector's allocations or 1.8 % of the national development ones in fisheries development.

Since the withdrawal of the Van Camp Seafood Company in 1982, an industrialization of fisheries in Palau has been set back while commercial fisheries received more attention. The Palau Federation of Fishing Association (PFFA) and the Palau Fishing Authority (PFA) are closely tied with commercial fisheries development. Although such commercial fisheries have been greatly promoted by a recent (1983) grant from the Japan International Cooperation Agency (JICA), there are some problems.

The purpose of this study is to evaluate the trend of Palau's current commercial fisheries landings from the viewpoints of annual and seasonal fluctuations, fixed price policy, trade potential and international cooperation. To do this, statistical data were collected from the PFFA and Division of Marine Resources, and the Office of Planning and Statistics of the Government of Palau, and interviews with many people concerned with fisheries development in Palau during the period of November 11-24, 1986.

These data were analyzed mainly by an NEC personal computer N5200 Model 07 along with landing and price patterns, species characteristics, quantity-price relationships, gear, and features of trade.

1. Major Species in Commercial Fish Landings

Over the last ten years from 1976 through 1985, commercial fish landings at the PFFA's market were dominated by reef fish (Table 1). In 1976, total commercial fish landings were 102,353 kilograms (kg.) or \$74,437. Of these, reef fish comprised more than 90 % in both weight (90.01 % or 92,183 kg.) and value (90.42 % or \$67,303). The portions of pelagic fish were 8.59 % (8,791 kg.) in weight or 5.79 % (\$4,311) in value, while those of invertebrates were 1.40 % (1,429 kg.) or 3.79 % (\$2,818).

In 1985, ten years later, the total commercial fish landings were 333,025 kg. or \$438,119, an increase of 225 % in weight and 489 % in value. From 1976 to 1985, portions of both reef fish and invertebrates declined from 90.01 % to 77.75 % in weight or from 90.42 % to 79.79 % in value for reef fish and from 1.40 % to 1.00 % in weight or from 3.79 % to 2.97 % in value for invertebrates. On the contrary, the portion of pelagic fish increased from 8.59 % to 21.25 % in weight or from 5.79 % to 17.24 % in value.

Table 1. Commercial fish landings in Palau : 1976 and 1985
(modified from the Division of Marine Resources,
1986 and PERRON *et al.*, 1983).

Species	1976						1985					
	KG.	% ST	% T	\$	% ST	% T	KG.	% ST	% T	\$	% ST	% T
1.Reef fish	92,133	100.00	90.01	67,303	100.00	90.42	258,915	100.00	77.75	349,576	100.00	79.79
Snapper	19,655	21.33	19.20	13,813	20.52	18.56	108,337	41.08	31.93	136,263	38.98	31.10
Parrot fish	11,383	12.36	11.12	8,901	13.23	11.96	42,550	16.43	12.78	48,047	13.74	10.97
Grouper	1,541	1.67	1.50	1,026	1.52	1.38	21,349	8.25	6.41	22,893	6.54	5.23
Rabbit fish	11,508	12.49	11.24	8,867	13.17	11.91	18,513	7.15	5.56	31,998	9.15	7.30
Unicorn fish	8,257	8.96	8.07	6,165	9.16	8.28	37,315	14.41	11.20	46,353	13.26	10.58
Jack	3,002	3.26	2.93	1,677	2.49	2.25	13,119	5.07	3.94	13,620	3.90	3.11
Goat fish	1,009	1.10	0.99	680	1.01	0.91	2,622	1.01	0.79	3,764	1.08	0.86
Wrasse	569	0.62	0.54	414	0.62	0.56	3,435	1.33	1.03	5,313	1.52	1.21
Surgeon fish	337	0.37	0.33	247	0.37	0.33	1,967	0.76	0.59	2,172	0.62	0.50
Squirrel fish	18	0.02	0.02	12	0.02	0.02	530	0.20	0.16	551	0.16	0.13
Sweet lips	-	-	-	-	-	-	1,770	0.68	0.53	1,034	0.30	0.24
Mullet	3,231	3.51	3.16	2,648	3.93	3.56	2,435	0.94	0.73	3,745	1.07	0.85
Silver fish	2,009	2.18	1.96	1,543	2.29	2.07	15,161	0.60	0.47	2,067	0.59	0.47
Dolphin	-	-	-	-	-	-	385	0.15	0.12	580	0.17	0.13
Other reef f.	1,863	2.02	1.80	1,280	1.90	1.72	4,852	1.87	1.46	30,973	8.86	7.07
Assorted reef f.	27,749	30.12	27.11	20,035	29.77	26.92	174	0.07	0.05	203	0.06	0.05
2.Pelagic fish	8,791	-	8.59	4,311	-	5.79	70,766	-	21.25	75,541	-	17.24
3.Invertebrates	14,290	-	1.40	2,818	-	3.79	3,344	-	1.00	13,002	-	2.97
Total	102,353	-	100.00	74,437	-	100.00	333,025	-	100.00	438,119	-	100.00

Note: KG. indicates kilograms; % ST, portion of reef fish sub-total; % T, portion of grand total; and \$, US dollars.

The most economically important reef fish are the unicorn fish: um (*Naso unicornis*); the snapper: mechur (*Lethrinus variegatus*), keremlal (*Lutjanus gibbus*), udech (*Lethrinus nematacanthus*), metengui (*Lutjanus haematopterus*), and kedsau (*Lutjanus bohar*); the parrot fish: kemedukl (*Bolbometopon muricatus*) and ngyaoch (*Scarus harid*); the grouper: temekai (*Anypardon leucogrammicus/Ephinephelus sp.*) and the rabbit fish: kelsebuul (*Siganus gutatus lineatus*) and meyas (*Siganus canalicatus*). Total landings of these 11 species in 1985 were 211,172 kg. (81.6 % of reef fish) or \$ 230,750 (66.0 %). Other important reef fish include jack, goat fish, wrasse, surgeon fish, squirrel fish, sweet lips, mullet, silver fish and dolphin.

Economically important pelagic fish include bonito: katsuo (*Katsunus pelamis*) and king mackerel: ngeIngal (*Scomberomorus commeron*). Total landings of these two species in 1985 were 35,882 kg (50.7 % of pelagic fish landings) or \$ 29,168 (38.61 %). Similarly important invertebrates include mangrove crab: emang (*Scylla serrata*) and lobster: lobster (*Panulirus longipes/Panulirus versicolor*). Total landings of these two species in 1985 were 2,158 kg. (64.5 % of invertebrates) or

\$ 11,374 (85.48 %).

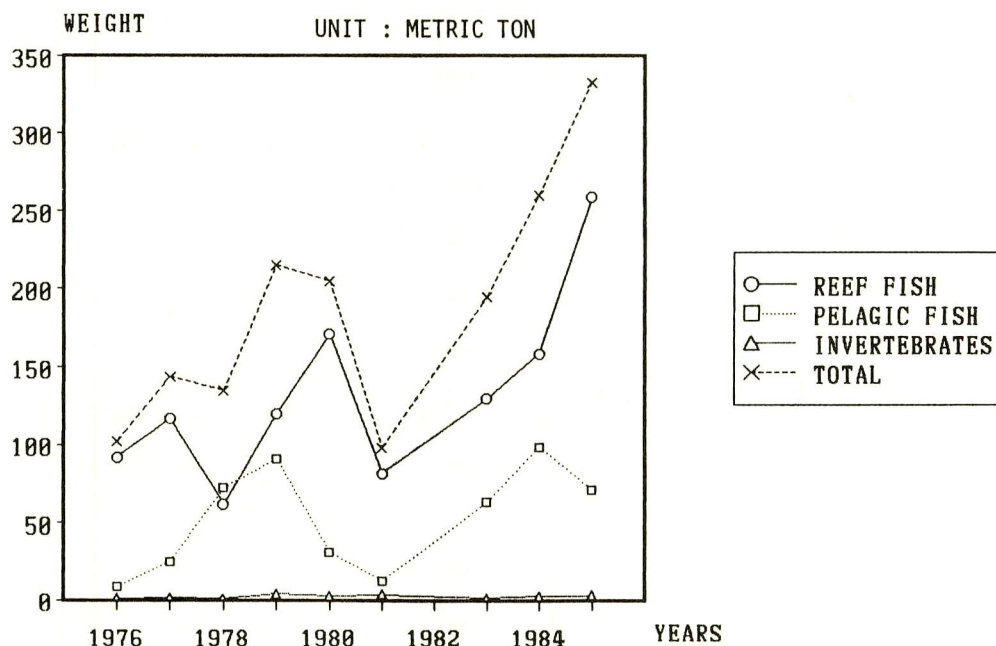
Thus, total landings of commercially important 15 species comprised 249,213 kg. (74.8 % of total fish landings) or \$ 271,292 (61.92 %). This paper analyzed these 15 species mainly.

2. Annual Fluctuations: 1976-1985

Fish landings fluctuate annually. These fluctuations were analyzed in terms of weight, average price and landing patterns by major species, and quantity-price relationships. Due to the lack of data for 1982 and January through March of 1983 and 1984 besides insufficient data for 1985, it is difficult to trace the exact patterns of landings. However, some trends were clearly observed.

a. Landing patterns in weight

Commercial fish landings at the PFFA market during the 1976-1985 period are shown in Fig. 1. Total fish landings increased by 111 % from 102,353 kg. in 1976 to 216,061 kg. in 1979, then declined to 98,632 kg. in 1981, but again increased to 333,025 kg. in 1985, equivalent to a 225 % increase from the 1976 level. The reasons for both 1978 and 1981 declines were not known, though the former case was due to the low harvest of reef fish whereas the latter case



Note : Data was not available for 1982 and January through March 1983 and 1984.

Fig. 1. Palau's fish landings in weight: 1976-1985 (modified from the Division of Marine Resources, 1986 and PERRON *et al.*, 1983)

was correlated with both reef fish and pelagic fish landings.

With annual fluctuations ranging from 91,133 kg. to 258,915 kg., reef fish landings followed a similar pattern with the total landings while pelagic species (8,719 kg.-98,896 kg.) and invertebrates (1,054 kg.-4,213 kg.) followed modified ones. The 1978 decline in reef fish landings was somewhat compensated for by an increase in pelagic fish landings.

Fig. 2 shows landing patterns of individual species during 1976-1981. Roughly

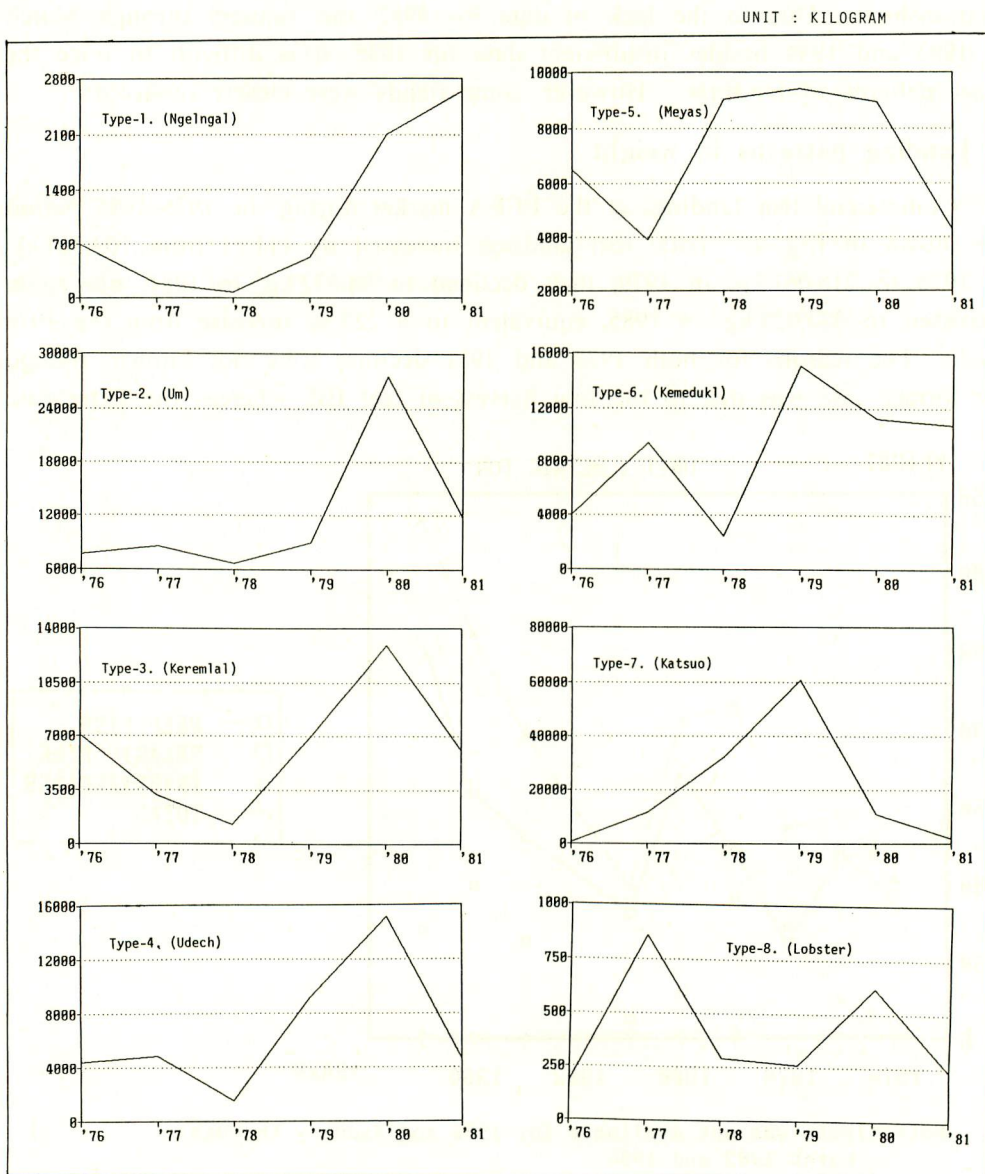
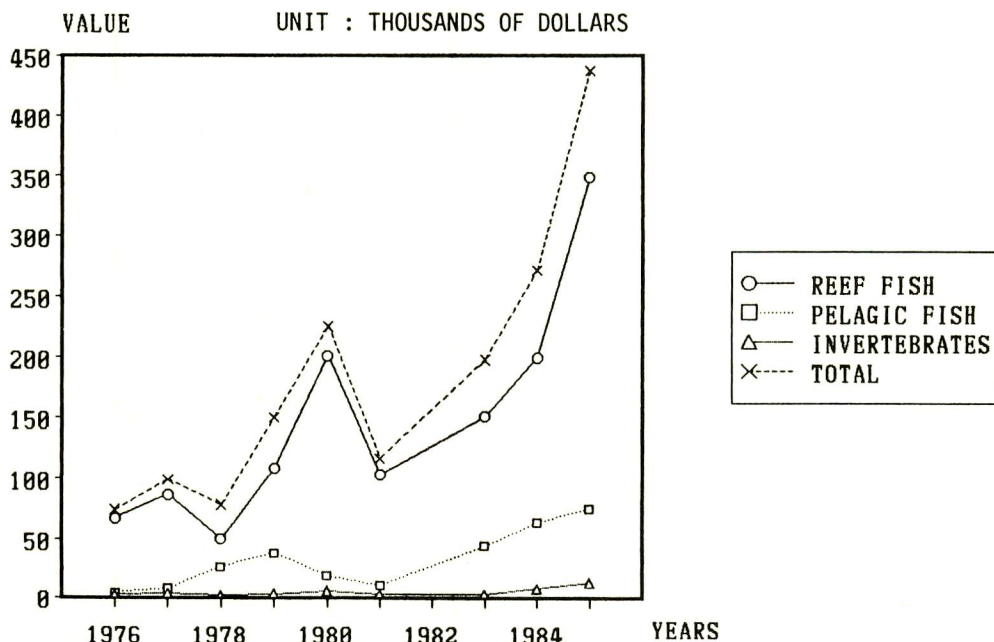


Fig. 2. Landing patterns in weight : 1976-1981

speaking, 8 types were indentified. Type-1 is characterized by the peak landings in 1981 and represented by ngelngal with peak landings of about 2,600 kg. Types 2-4 are characterized by the highest landings in 1980. The following differences were observed: one outstanding peak landings (type-2), two increases over the previous year's landings (type-3) and 3 increases against the previous year's landings (type-4). Type-2 is represented by um with the highest landings of about 27,500 kg. and includes metengui, sebus (*Lutjanus* spp.) and keskas (*Acanthocybium solandari*). Keremlal with the highest landings of about 13,000 kg. represents type-3 which includes ngyaoch, kelsebuul, mechur and emang. Type-4 is represented by udech with the highest landings of about 15,000 kg. and includes kedsau.

Types 5-7 are characterized by the highest landings in 1979. The following differences were observed: outstanding landings of 3 years or more (type-5), two peak landings (type-6), and one outstanding peak landing (type-7). Type-5 is represented by meyas with highest landings of about 9,500 kg. while type-6 is represented by kemedukl with the highest landing 9,500 kg. while type-6 is represented by kemedukl with the highest landings of about 15,000 kg. and includes temekai. Type-7 is represented by katsuo with the highest landings of about 60,500 kg.

Type-8 is characterized by the highest landings in 1977 and represented by



Note : Data was not available for 1982 and January through March 1983 and 1984.

Fig. 3. Palau's fish landings in value: 1976-1985 (modified from the Division of Marine Resources, 1986 and PERRON *et al.*, 1983)

lobster with the highest landings of about 860 kg..

b. Average price patterns

Fish landings in value at the PFFA's market during 1976-1985 are shown in Fig. 3. Patterns are slightly different from the previous weight patterns. Thus, average price patterns were further examined (Fig. 4). Due to the lack of comparable species data for 1985, the analysis was limited to the 1976-1981 period when 6 types were identified.

Types A, B and C are characterized by the highest average prices in 1981. However, differences were observed along with a gradual increase in the price throughout the period (type A), and an N-shape (type-B) and S-shape increase (type C). Type A is represented by lobster with the peak average price of \$ 3.31/kg. and includes emang, keremlal, meyas, nyaoch and metengui. Type B is represented by kedsau with the average price of \$ 0.81/kg. Type C is represented by kelsebuul with the highest average price of \$ 1.53/kg. and includes kemedukl,

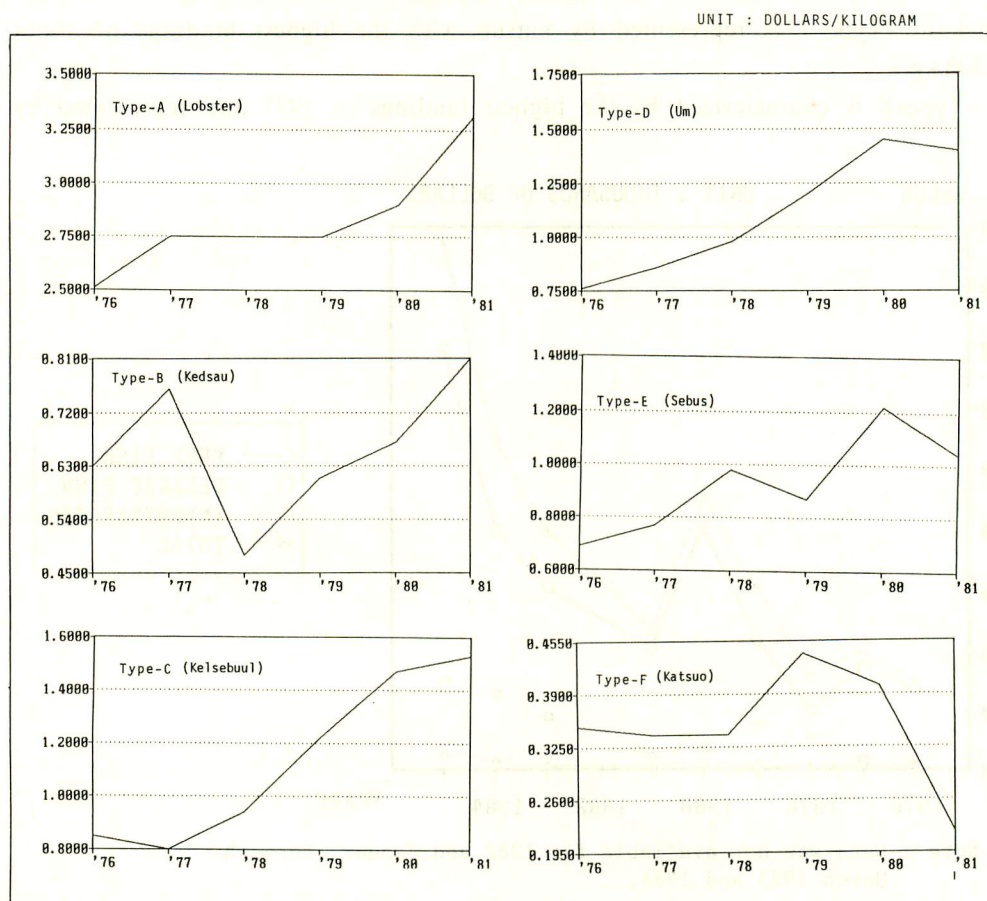


Fig. 4. Average price patterns: 1976-1981

temekai and udech.

Types D and E are characterized by the highest average prices in 1980 and differences were also observed along with the following features: one outstanding peak average price (Type D) and two outstanding peak average price (Type E). Type D is represented by um with the peak average price of \$ 1.45/kg. and includes keskas, while type E is represented by sebus with the highest average price of \$ 1.22/kg. and includes ngelngal. The type F is characterized by the peak average price in 1979 and represented by katsuo with the peak average price of \$ 0.44/kg.

c. Landing patterns by major species

Landing patterns by major species are summarized in Table 2. Identified types are combinations of landing patterns in weight and average price patterns in the sub-sections a and b of this section.

Table 2. Annual landing patterns by major species: 1976-1981
(modified from the Division of Marine Resources, 1986).

Categories	English name	Palauan name	Type*	Range in landings (kg.)		Av price range (\$/kg)	
				min.	max.	min.	max.
Reef fish	Snapper	Metengui	2-A	16	9,888	0.56	1.09
		Keremlal	3-A	1,271	12,929	0.66	1.32
		Mechur	3-A	225	5,287	0.75	1.32
		Kedsau	4-B	450	2,335	0.48	0.81
		Udech	4-C	1,546	15,154	0.64	1.05
	Parrot fish	Ngyaoch	3-A	1,166	11,350	0.73	1.32
		Kemedukl	6-C	2,444	15,121	0.82	1.46
	Rabbit fish	Kelsebuul	3-C	2,668	10,575	0.80	1.53
		Meyas	5-A	3,898	9,422	0.72	1.32
	Groupers	Temekai	6-C	861	9,872	0.56	0.82
Um		2-D	6,725	27,545	0.76	1.45	
Pelagic fish	King mackerel	Ngelngal	1-E	72	2,642	0.54	1.11
	Bonito	Katsuo	7-F	719	60,679	0.22	0.44
Invertebrates	Mangrove crab	Emang	3-A	211	1,186	1.67	3.12
	Lobster	Lobster	8-A	180	860	2.51	3.31

*Combination of landing patterns in weight and average price patterns in the sub-sections a and b (Figs. 2 and 4).

During 1976-1981, reef fish landings ranged from 58,968 kg. to 158,760 kg. while average prices of those ranged from \$ 0.48/kg. to \$ 1.53/kg. With the annual fluctuations ranging from 3,508 kg. to 45,593 kg. and from \$ 0.48/kg. to \$ 1.32/kg., the snapper fell into 4 types: 2-A, 3-A, 4-B, and 4-C. Type 2-A is represented by metengui with ranges of 16 kg.-9,888 kg. and of \$ 0.56/kg to \$ 1.09/kg. Similarly

type 3-A is represented by keremlal and includes mechur while types 4-B and 4-C are represented by kebsau and udech, respectively. In summary, keremlal and mechur (Type 3-A) received the highest average prices while kedsau (Type 4-B) received the lowest ones.

Ranging from 5,475 kg. to 31,126 kg. and from \$0.73/kg. to \$1.46/kg. the parrot fish fell into two types: 3-A and 6-C. Type 3-A is represented by ngyaoch while type 6-C is represented by kemedukl. From weight and price points of view, kemedukl (Type 6-C) seems to be preferable to ngyaoch (Type 3-A).

Ranging from 7,742 kg. to 20,984 kg. and from \$0.72/kg. to \$1.53/kg., the rabbit fish fell into two types: 3-C and 5-A. Type 3-C is represented by kelsebuul while type 5-A is represented by meyas. The market prefers kelsebuul slightly to meyas.

The grouper (temekai) belongs to type 6-C whereas the unicorn fish (um) to type 2-D. Among reef fish, the grouper (temekai) is one of the least preferable species as compared to the unicorn fish (um) which belongs to the highest demanded fish with high landings in both weight and value.

Pelagic fish ranged from 8,791 kg. to 91,227 kg. and from \$0.22/kg. to \$1.11/kg. Major pelagic fish are king mackerel (ngelngal) and bonito (katsuo) belonging to types 1-E and 7-E, respectively. They received the lowest market prices among major species. In 1979, katsuo alone landed 60,679 kg. However, average prices of katsuo reached the peak in the same year.

Invertebrates landings ranged from 1,054 kg. to 4,213 kg. and from \$1.67/kg. to \$3.31/kg. in average prices. Major invertebrates, the mangrove crab (emang) and lobster, belong to types 3-A and 8-A, respectively. These landings are small, so that their average prices are quite high.

d. Quantity-price relationships: 1976-1981

Except for ngelngal, um, kedsau and katsuo, simple regression analyses indicate very low relationships between average prices and landings (Table 3). Those with high correlation have the significant level as low as 10%. due to small numbers of samples. Although normal quantity-price relationships are negative, our study indicated that most cases had positive relationships between average prices and landings.

3. Monthly Fluctuations: 1985

Monthly fluctuations of commercial fish landings were analyzed similarly to annual fluctuations. Due to the lack comparable data, this analysis was limited only to the period of 1985.

a. Landings patterns in weight

Monthly fish landings at the PFFA's market in weight are shown in Fig. 5.

Table 3. Quantity-price relationships ; 1976-1981.

($Y = aX + b$, where Y and X indicate quantity and price, respectively)

Categories	English name	Palauan name	a	b	r (Sig. level)*	cor**
Reef fish	Snapper	Kedsau	3,769.44	1,143.33	0.659 ($\geq 10\%$)	High
		Keremlal	7,820.18	-1,494.61	0.534 ($\geq 10\%$)	Low
		Mechur	2,078.59	1,051.74	0.230 ($\geq 10\%$)	Non
		Metengui	9,869.85	-6,576.32	0.559 ($\geq 10\%$)	Low
		Udech	10,778.70	-1,852.71	0.349 ($\geq 10\%$)	Non
	Parrot fish	Kemedukl	5,726.46	2,588.16	0.342 ($\geq 10\%$)	Non
	Rabbit fish	Ngyaoch	8,387.80	-2,931.21	0.528 ($\geq 10\%$)	Low
		Kelsebuul	5,211.23	-913.92	0.550 ($\geq 10\%$)	Low
	Grouper	Meyas	-612.89	7,629.70	-0.055 ($\geq 10\%$)	Non
		Temekai	-15,961.00	16,591.00	-0.474 ($\geq 10\%$)	Low
Unicorn fish	Um	19,559.50	-9,811.45	0.712 ($\geq 10\%$)	High	
	King mackerel	Ngelngal	3,930.55	-2,046.98	0.797 ($\geq 10\%$)	High
Pelagic fish	Bonito	Katsuo	199,267.00	-49,725.80	0.644 ($\geq 10\%$)	High
	Mangrove crab	Emang	80.22	422.50	0.123 ($\geq 10\%$)	Non
Invertebrates	Lobster	Lobster	-31.91	497.42	-0.031 ($\geq 10\%$)	Non

*Correlation coefficient (Significance level)

**Correlation

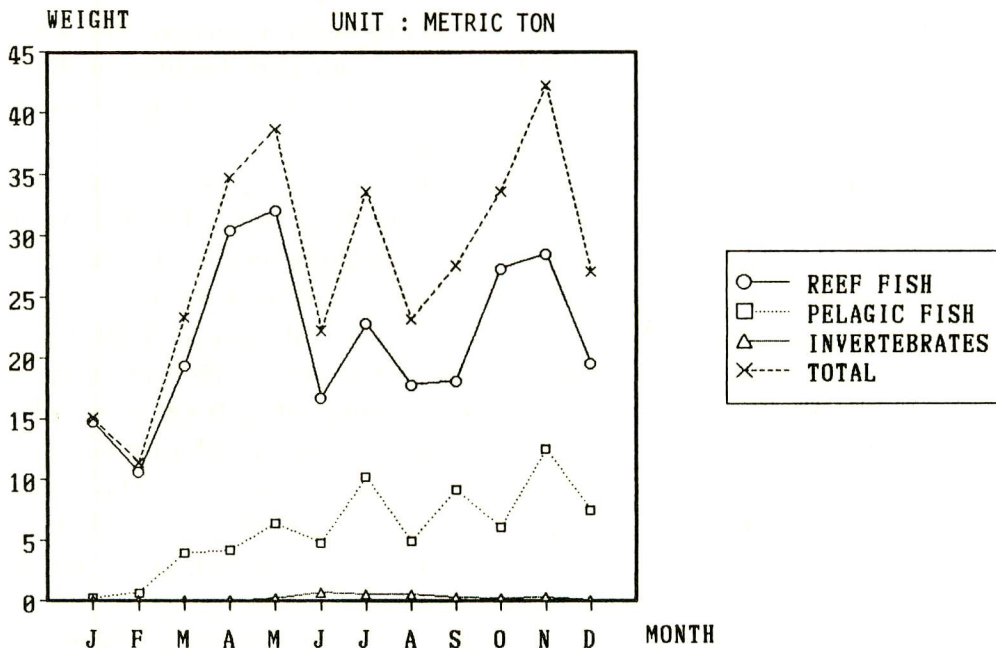


Fig. 5. Palau's monthly fish landings in weight : 1985 (modified from the Division of Marine Resources, 1986 and PERRON *et al.*, 1983)

Dominated by reef fish, total landings fluctuated between 11,389 kg. in February and 42,285 kg. in November with peaks in May, July and November. Landing

patterns of reef fish and pelagic fish were similar with the total landings as compared to those of invertebrates. Invertebrates landings peaked in June whereas landings of reef fish peaked in May, July, and November; and pelagic fish landings peaked in July, September, and November. Reef fish landings range from 10,625 kg. in February to 32,049 kg. in May as compared to pelagic fish landings from 258 kg. in January to 12,459 kg. in November, and invertebrate landings from 43 kg. in January to 726 kg. in June.

Monthly landing patterns of individual species are shown in Fig. 6. Based on peak landing patterns, the following 9 types were identified. The Spring-Winter (S-W) type is characterized by an outstanding landing peak in spring with a sub-peak in winter. This type is represented by um with peak landings of 6,961 kg. in April and 3,161 kg. in December and includes kemedukl with peak landings of 3,771 kg. in April and 2,804 kg. in January. The Spring-Summer (S-Su) type is characterized by an outstanding landing peak in spring with a sub-peak in summer. This type is represented by ngyaoch with peak landings of 2,998 kg. in April and 1,680 kg. in July. This includes meyas with peak landing of 1,630 kg. in April and 1,300 kg. in July. The Summer (Su) type is characterized by a landing peak in July. This type is represented by temekai with a peak landing of 5,296 kg. and includes mechur with a peak landing of 1,984 kg. The Summer-Fall (Su-F) type is characterized by outstanding landing peaks in summer with a sub-peak in fall. This type is represented by emang with peak landings of 301 kg. in September and 238 kg. in November, and included lobster with peak landings of 210 kg. in August and 103 kg. in November.

The Fall (F) type is characterized by a landing peak in fall and represented by metengui with a peak landing of 2,755 kg. in November. The Fall-Winter (F-W) type is characterized by an outstanding landing peak in fall with a sub-peak in winter. This type is represented by udech with peak landings of 2,866 kg. in November and 2,176 kg. in January. The Fall-Spring (F-S) type is characterized by an outstanding landing peak in fall with a sub-peak in spring. This type is represented by ngelngal with peak landings of 1,248 kg. in November and 538 kg. in March. The Fall-Summer (F-Su) type is characterized by an outstanding landing peak in fall with a sub-peak in Summer. This type is represented keremlal with peak landings of 3,480 kg. in October and 2,587 kg. in August. This type includes kedsau with peak landings of 2,443 kg. in October and 1,949 kg. in June.

The Winter-Fall (W-F) type is characterized by an outstanding landing peak in winter with a sub-peak in fall. This type is represented by katsuo with peak landings of 5,912 kg. in December and 5,538 kg. in September. This type includes kelsebuul with peak landings of 2,030 kg. in January and 1,287 kg. in November.

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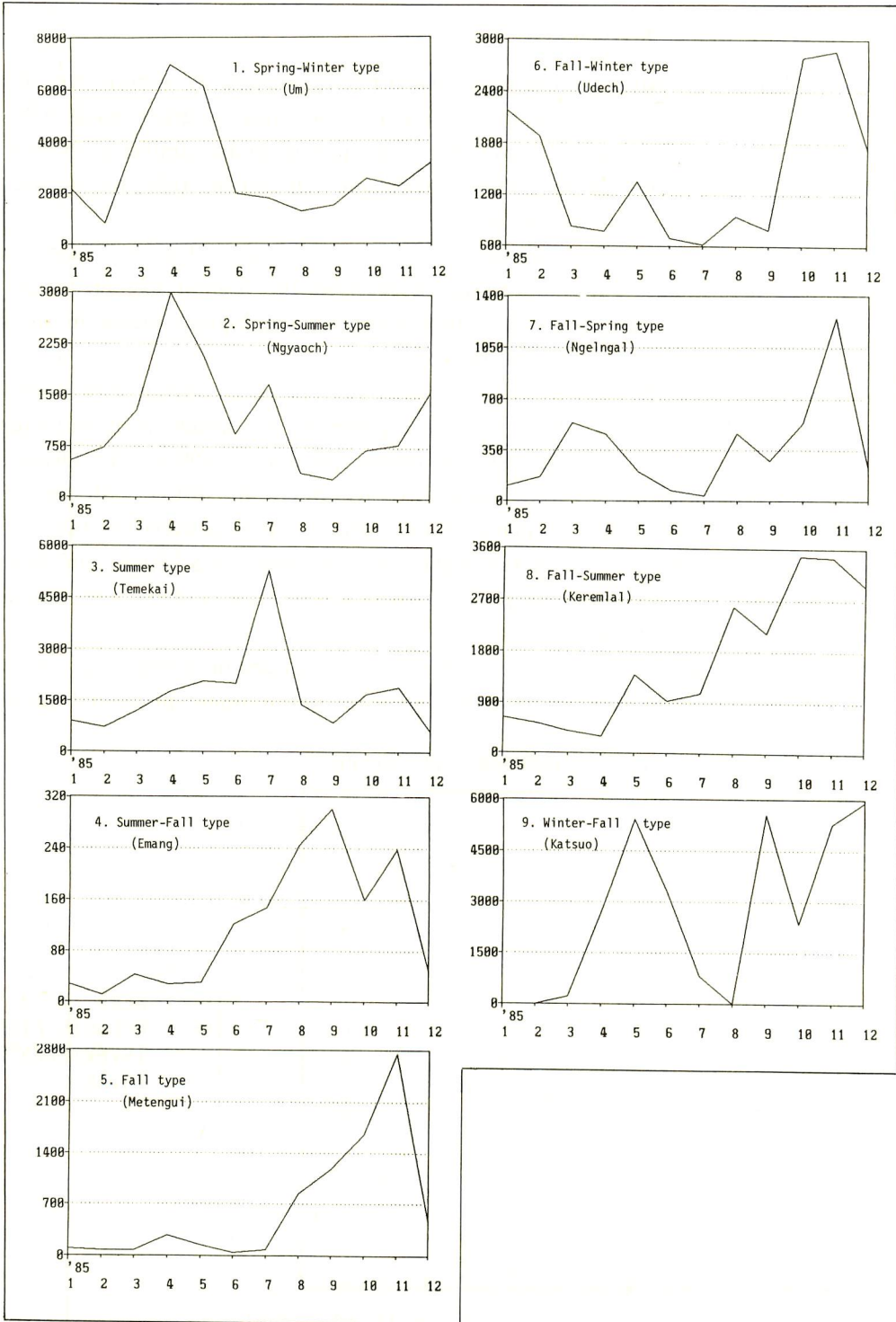


Fig. 6. Seasonal landing patterns in weight : 1-12, 1985

b. Average price patterns

Monthly fish landings in value at the PFFA's market by month are shown in Fig. 7. As in Fig. 5, the total landing pattern in value ranged from \$ 16,791.75 in February to \$ 62,775.04 in November and appears to be similar with that in weight. However, both landing patterns of pelagic fish and invertebrates are slightly different between weight and value.

Monthly average price patterns are further examined in Fig. 8. Eight types (a-h) are identified. Types a through d received the highest average prices in spring as compared to types f through h receiving the highest prices in summer and/or fall, while type-e was in between.

Type-a is characterized by the highest average prices in spring with a decline in price until December. This type is represented by udech with the highest average price of \$ 1.54/kg. and the minimum price of \$ 0.99/kg. in December. Type-b is characterized by the highest average prices in spring with minimum price in May or June after a sharp decline, and a rapid recovery in July. This type is represented by um with the highest average price of \$ 1.32/kg. in January through April and the minimum price of \$ 0.86/kg. in June, and includes keremlal, nyaoch, mechur and meyas.

Type-c is characterized by the highest average prices in spring and fall, with the medium prices in July through October, and the minimum price in December.

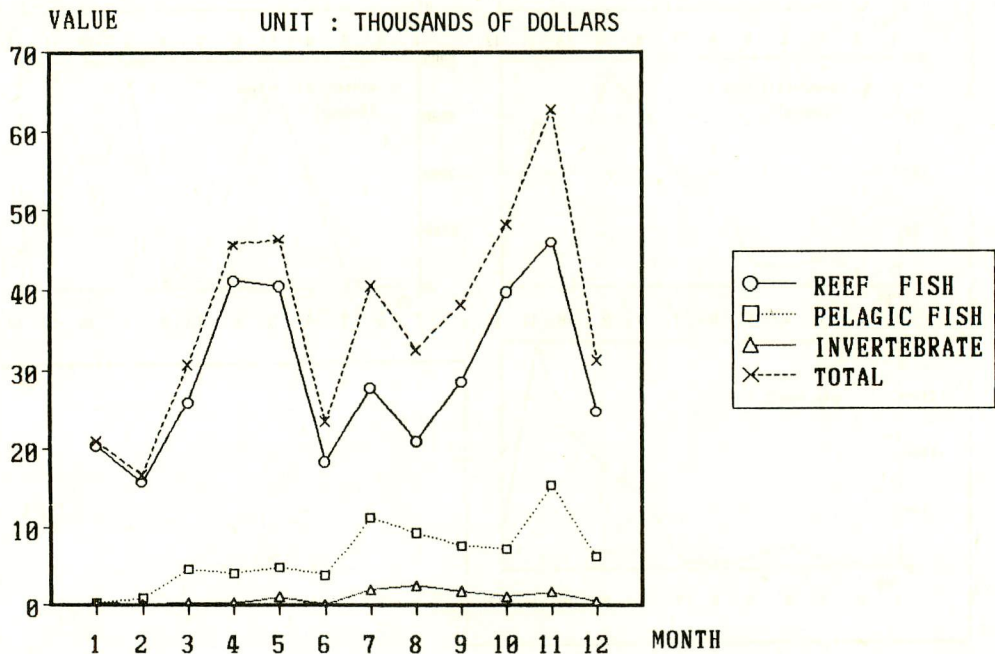


Fig. 7. Palau's monthly fish landings in value: 1985 (modified from the Division of Marine Resources, 1986 and PERRON *et al.*, 1983)

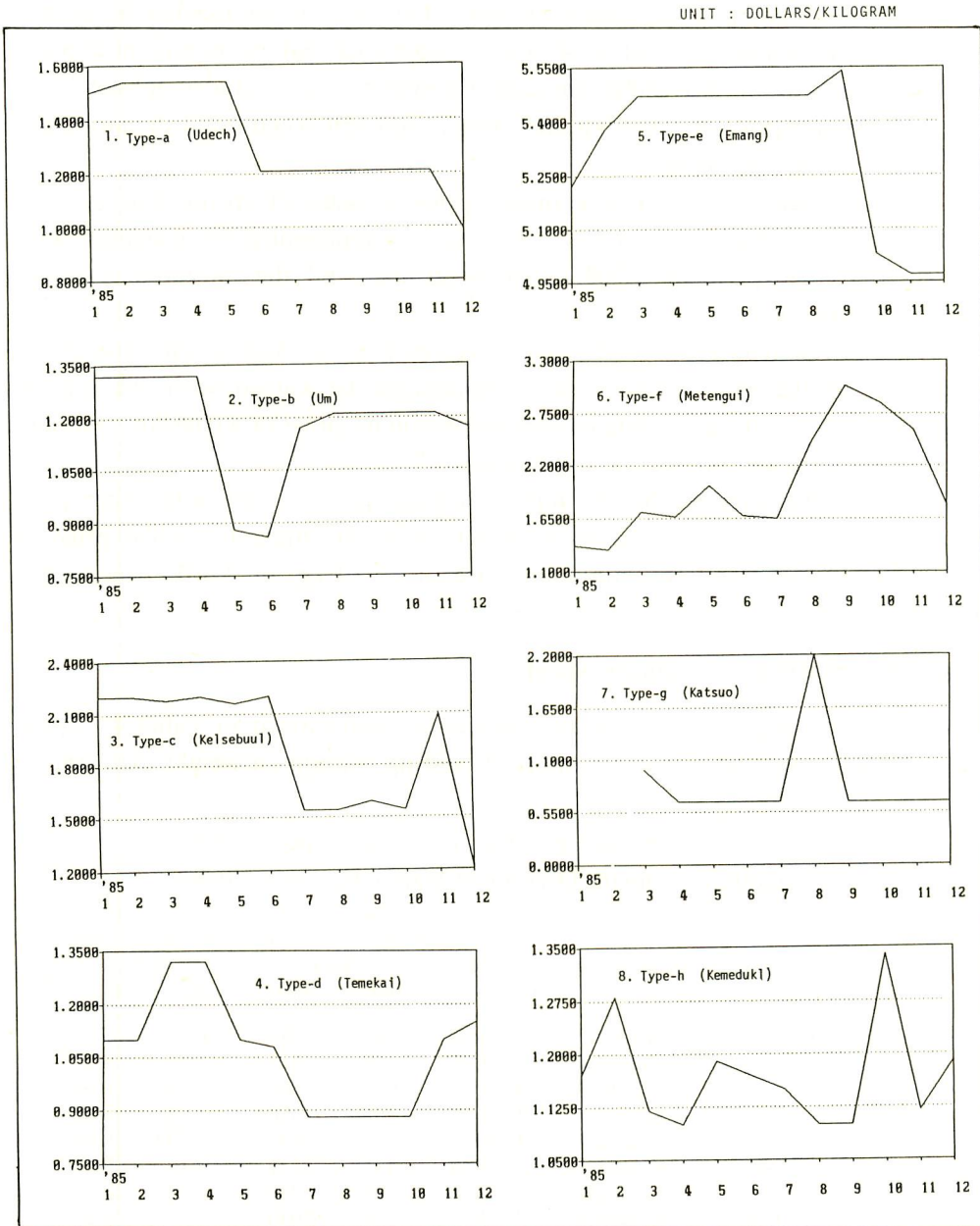


Fig. 8. Monthly average price patterns: 1985

This type is represented by kelsebuul with the highest average price of \$ 2.20/kg. and the minimum price of \$ 1.54/kg. Type-d is characterized by peak average prices in spring and with the minimum price in July through October. This type is represented by temekai with the highest average price of \$ 1.32/kg. and the minimum price of \$ 0.88/kg., and includes kedsau.

Type-e is characterized by continuous high average prices from January to

September with a sharp price decline in fall. This type is represented by emang with the highest average price of \$ 5.47/kg. in September and the minimum average price of \$ 4.97/kg. in November through December, and includes lobster with the highest average price of \$ 5.45/kg. in February through August and the minimum price of \$ 3.40/kg. in September.

Type-f is characterized by a gradual price increase in spring and summer and the highest average price in fall. This type is represented by metengui with the highest average price of \$ 3.04/kg. in September and the minimum price of \$ 1.33/kg. in February.

Type-g is characterized by the highest average price in August with low prices for the rest of the year. This type is represented by katsuo with the highest average price of \$ 2.20/kg. in August and the minimum price of \$ 0.66/kg. January through February are off-season for katsuo.

Type-h is characterized by the highest average price in fall with other peak prices. This type is represented by kemedukl with the highest average price of \$ 1.34/kg. in October and the minimum price of \$ 1.10/kg. in April, August and September.

c. Landing patterns by major species

Monthly landing patterns by major species are summarized in Table 4. Types were classified according to combinations of landing patterns in weight and average

Table 4. Monthly landing patterns by major species : 1985
(modified from the Division of Marine Resources, 1986).

Categories	English name	Palauan name	Type*	Range in landings (kg.)		Av. price range (\$/kg)	
				min.	max.	min.	max.
Reef fish	Snapper	Mechur	Su/b	304	1,984	1.10	1.32
		Metengui	F/f	49	2,755	1.33	3.04
		Udech	F-W/a	620	2,866	0.99	1.54
		Keremlal	F-Su/b	301	3,480	1.04	1.32
		Kedsau	F-Su/d	225	2,443	0.79	1.10
	Parrot fish	Kemedukl	S-W/h	431	3,771	1.10	1.34
		Ngyaoch	S-Su/b	290	2,998	0.88	1.32
	Rabbit fish	Kelsebuul	W-F/c	156	2,030	1.21	2.20
		Meyas	S-Su/b	11	1,630	1.06	1.54
	Grouper	Temekai	S/d	615	5,296	0.88	1.32
Unicorn fish		Um	S-W/b	836	6,961	0.88	1.32
King mackerel		Ngelngal	F-S/f	39	1,248	1.46	2.20
Pelagic fish	Bonito	Katsuo	W-F/g	10	5,912	0.66	2.20
Invertebrates	Mangrove crab	Emang	S-F/e	11	301	4.97	5.54
	Lobster	Lobster	S-F/e	4	210	3.40	5.45

*Combination of landing patterns in weight type and average price patterns types as mentioned in the text : S, Su, F, and W indicate spring, summer, fall and winter (Figs. 6 and 8)

price patterns in the sub-sections a and b of this section.

The snapper fell into 5 types: Su/b (mechur), F/f (metengui), F-W/a (udech), F-Su/b (keremlal) and F-Su/d (kedsau). Most of them had their peak landings in summer and/or fall. Except for metengui, all received their highest average prices in spring. Ranging from 49 kg. to 2,755 kg. of landings per species, monthly average prices received by the snapper ranged from \$ 0.79/kg. to \$ 3.04/kg. Metengui received the highest average price while kedsau received the lowest price.

The parrot fish fell into 2 types: S-W/a (kemedukl) and S-Su/b (ngyaoch). Both had their highest landings in spring. Although kemedukl received the highest average price in fall, ngyaoch received the highest prices in January through April. Ranging from 290 kg. to 3,771 kg. in landings per species, average prices received by the parrot fish ranged from \$ 0.88/kg. to \$ 1.34/kg. The prices of kemedukl were slightly higher than those of ngyaoch.

The rabbit fish fell into 2 types: W-F/c (kelsebuul) and S-Su/b (meyas). Kelsebuul had peak landings in winter and fall while meyas had them in summer and spring. From landings point of view, these two species are completely complementary. Nevertheless, both received their highest average prices in spring. Ranging from 11 kg. to 2,030 kg. in landings per species, average prices received by the rabbit fish ranged from \$ 1.60/kg. and \$ 2.20/kg. The price response to kelsebuul was better than that to meyas.

The grouper fell into type S/d with the peak landings in summer and the highest average price in spring. This is represented by temekai with monthly landings ranging from 615 kg. to 5,296 kg. and average prices from \$ 0.88/kg. to \$ 1.32/kg. The unicorn fish fell into type S-W/b with peak landings in summer and winter with the highest average prices in spring. This is represented by um with monthly landings ranging from 836 kg. to 6,961 kg. and the same average price range as temekai.

Thus, reef fish were harvested throughout the year and ranged from \$ 0.79/kg. to \$ 3.04/kg. in average prices. Metengui in the snapper and kelsebuul of the rabbit fish received the higher prices whereas kedsau of the snapper received the lowest prices.

Major pelagic fish fell into two types: F-S/f and W-F/g with peak landings in fall and spring. Type F-S/f is represented by ngeIngal ranging from 39 kg. to 1,248 kg. in monthly landings and from \$ 1.46/kg. to \$ 2.20/kg. in average prices. With peak landings in winter and fall, type W-F/g is represented by katsuo ranging from 10 kg. to 5,912 kg. and from \$ 0.66/kg. to \$ 2.20/kg. However, the peak average price of \$ 2.20/kg for katsuo was in August in which the landings were only 10 kg. As a whole, the average price of katsuo was \$ 0.66/kg. in that year while ngeIngal received much higher average prices than katsuo.

Major invertebrates fell into Su-F/e type with peak landings in summer and fall and average prices of much higher than \$ 3.40/kg. throughout the year with

one or two months exceptions. This type is represented by emang and lobster. Ranging from 4 kg. to 301 kg. of landings per species, monthly average prices received by the invertebrates ranged from \$ 3.40/kg. to \$ 5.54/kg. Emang received higher average prices than lobster.

d. Quantity-price relationships

Results from simple regression analyses between monthly average prices of fish and landings are summarized in Table 5. Out of the 15 most economically important species at the PFFA's market in 1985, only 3 species had high correlations between average prices and landings. Those three species are metengui with the significance level of 1 %, and kemedukl and meyas at the 5 % level. Such correlations of metengui and meyas were positive while that of kemedukl was negative. Although mechur, meyas and ngelngal had low correlations, 10 out of 15 species had no correlation between average prices and landings.

4. Landing Patterns by Gear

Recent landing patterns by gear are summarized in Fig.9. The upper graph shows the monthly fish landings at the PFFA's market from January 1985 to September 1986. Suppliers are categorized into 3 gear groups: fishermen with grant vessels (grant vessels), individual fishermen(ind. fishermen) and other boat owners (other boats). The lower 4 graphs show the results of simple trend analyses

Table 5. Monthly quantity-price relationships: 1985.

($Y = aX + b$, where Y and X indicate quantity and price, respectively)

Categories	English name	Palauan name	a	b	r (sig. level)*	cor**
Reef fish	Snapper	Mechur	-3,477.27	5,088.79	-0.536 (10%)	Low
		Metengui	1,141.70	-1,654.63	0.781 (1%)	High
		Udech	-341.94	2,028.27	-0.101 ($\geq 10\%$)	Non
		Keremlal	-3,859.06	6,425.21	-0.287 ($\geq 10\%$)	Non
		Kedsau	-2,672.64	3,602.00	-0.374 ($\geq 10\%$)	Non
	Parrot fish	Kemedukl	-8,917.21	12,523.60	-0.616 (5%)	High
		Ngyaoch	-523.22	1,777.50	-0.102 ($\geq 10\%$)	Non
	Rabbit fish	Kelsebuul	262.36	147.37	0.253 ($\geq 10\%$)	Non
		Meyas	2,166.57	-2,124.99	0.601 (5%)	High
	Grouper	Temekai	-2,492.90	4,367.27	-0.319 ($\geq 10\%$)	Non
Unicorn fish		Um	-1,564.26	4,754.46	-0.128 ($\geq 10\%$)	Non
King Mackerel		Ngelngal	586.62	-652.93	0.574 (10%)	Low
Pelagic fish	Bonito	Katsuo	-408.33	2,915.46	-0.093 ($\geq 10\%$)	Non
	Invertebrates	Mangrove crab	Emang	-2.38	129.67	-0.005 ($\geq 10\%$)
Lobster		Lobster	13.15	1.19	0.120 ($\geq 10\%$)	Non

*Correlation coefficient (Significance level)

**Correlation

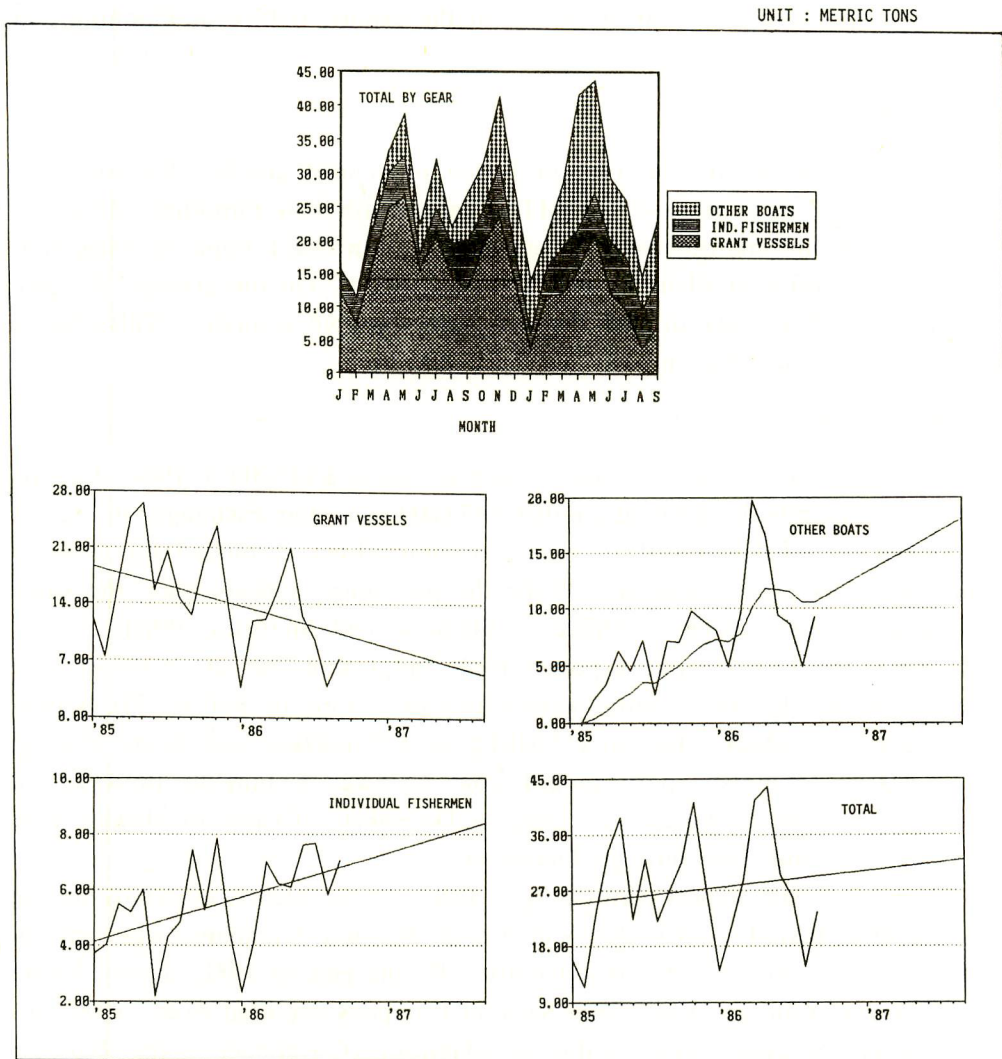


Fig. 9. PFFA's fish landings in weight: 1985-1986

based on regression models. Fish landings by grant vessels have a decreasing trend whereas landings by individual fishermen and other boats have increasing trends. The total fish landings are increasing.

5. Characteristics of Total Fish Trade

As the economy expands, amounts of both imports and exports increase. This is true in the case of Palau. At the same time, it is widely recognized that the import of commodities in Palau is high when compared to export (LITJENS, 1986). However, the difference is much smaller in the case of fish trade. In 1984, the total imports amounted to \$ 22,237,000, based on FOB-value. Fish imports in the same year amounted to \$ 310,756 (1.4 % of the total imports) as compared

to the fish exports of \$ 147,000 or 31.7 % of the exports (Office of Planning and Statistics, 1985).

a. Fish imports

Fish are imported in the form of frozen or canned goods. Between 1975 and 1984, 225 MT of frozen and 913.4MT of canned fish were imported. Although annual fluctuations are observed, no upward or downward trend is recognized in the import (Office of Planning and Statistics, 1985). On the average, 22.5 MT of frozen fish and 91.3 MT of canned goods were imported annually. This relative share of fish in the total imports has been declining.

b. Fish exports

Palau's fresh and frozen fish exports were valued at \$ 147,000 in 1984. Exports of unfinished trochus shells raised another \$ 173,000 in foreign exchange, or 37.3 % of total exports. Taken together, these two commodities accounted for 69 % of the nation's 1984 export package. While the percentage appears high, the value is still low in absolute terms (Office of Planning and Statistics, 1985).

In 1985, the PFFA alone exported fresh and frozen fish of 75,369 kg. and received \$ 190,465.70. Destinations were Guam (42,888 kg. or \$ 80,367.50), Saipan (13,994 kg. or \$ 26,224.20), Hawaii (17,948 kg. or \$ 79,138.00.), and Japan (537 kg. or \$ 4,736.00). Monthly exports ranged from 2,376 kg. in June to 10,847 kg. in November. Exports to Japan were only in December. Export to Hawaii were limited to May and July through December.

In previous years, export earnings from fish were far higher, especially during the 1964-1981 period, when the Van Camp Seafood Company was actively transshipping tuna from its Malakal facility. By the end of 1981, shortly before closing it's operation, the Van Camp Seafood Company exported over 10,000 tons of tuna annually, representing a value of \$ 3 million (Government of the Republic of Palau, 1986).

6. Discussion

Over the last decade, fisheries activities in the Republic of Palau began to move from subsistence to commercial fishing (TAUFIQ *et al.*, 1987). However, the commercial fish landings in 1985 is regarded as only 20 % of subsistence catch.

In 1974, to promote commercial fisheries, the PFFA was established as a Palau Government chartered non-profit corporation under the jurisdiction of the Palau Fishing Authority (PFA), a quasi-government agency. In 1983, however, the PFFA was taken over by the national government due to mismanagement and is currently managed by the PFA. These entities oversee the operation of a 100 gross ton cold storage facility and three block ice machines with a combined

production capacity of 16 tons per day.

Commercial fishing has also been greatly promoted by a recent (1983) grant from the Japan International Cooperation Agency (JICA). This grant consisted of eleven 35-foot fiberglass fishing boats, with 70 HP Yanmar engines and ice plants. These boats and plants were assigned to the villages of Angaur, Peliliu, Aimeliik, Ngeremlengui, Ngardmau, Kayangel, Melekeok, Nghesar, and Koror (PERRON *et al.*, 1983). These boats are both to catch fish and transport them to the PFFA market (the only central fish market in Palau). The added capability of producing ice in the villages reduced the frequency of trips to market and therefore increased the profit margin obtained by village fishermen. Unfortunately, all of the flake ice machines are now out of order.

With this in mind, let's us again look at the annual and monthly fluctuations, preferences, quantity-price relationships, trends in fishery, and trade aspects.

With seasonal as well as annual fluctuations, a growing trend in commercial fisheries in Palau is not deniable. Although commercially important species in this study are restricted to 15 species, other species are also important because their prices are comparable to commercially important species. The reason for not counting them is due to the low landing volume.

Domination of reef fish at the PFFA's market manifests the marine resource potential and fishing methods used by Palauan. The most popular fishing methods in Palau are stationary barrier nets, gillnets, trollinglines, droplines, spearguns, and illegal dynamite fishing in some cases.

Based on the average prices, there are some differences among species. According to the promotion policy, the PFFA set fish prices monthly, emphasizing deep sea/offshore species and exportable species fishing. Nevertheless, there was no relationship between quantity and price in most cases. The PFFA's pricing policy has a limited success in terms of price stability and incentive in some cases such as metengui and meyas. The problem of the fixed-price policy is that the quality of the fish is neglected. The same fish receives the same price with no regard to size, freshness, and damage.

The growing trend of total fish landings is due mainly to increasing landings by individual fishermen and other contract boats, not by grant vessels. Out of 11 grant vessels, one was not used in 1985. And the role of grant vessels in transportation has been increasing as out-board engines become popular. As a result, landings by grant vessels have been decreasing.

Traditional trochus fishing is a seasonally significant source of revenue for many local fishermen. Average annual catches range from 100MT to 300MT, with a dockside value of \$ 60,000 to \$ 180,000. Although unfinished trochus shells are currently exported to Japan, foreign exchange will drastically improve if the finished products are exported.

Foreign exchange from fresh and frozen fish is also greatly improved if fish

are well sorted and graded. The Micronesian Mariculture Demonstration Center (MMDC) exported giant clam and trochus seeds to other Pacific islands and received considerable revenues, but all these revenues were directed to the general fund despite a pressing need for upgrading of the physical plant and program support (Government of the Repepublic of Palau, 1986).

In the private sector, potentially valuable shorebased structures such as the Van Camp facilities, the Katsuobushi (smoking) plant, and several cold storage facilities are presently underutilized. Among imports, canned goods are very popular because these are convenient and not perishable. Their tastes have been customarily accepted. Therefore, the reduction of these imports is difficult.

7. Conclusion

Except for industrial fisheries, a growing trend in commercial fisheries in Palau has been studied. Although they are growing, there are many problems as well as potential. The problems include follow-up of JICA's assistance, the PFFA's mismanagement potential and commercial fisheries including the fixed-price policy, fish handlings and grant vessel management.

Potential do certainly exists not only in improving these problems, but also in development of trochus shell factories, removal of institutional constraints for the MMDC, and the utilization of potentially valuable shorebased structures such as the Van Camp facilities.

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