SPC/Inshore Fish. Mgmt./BP 10
12 June 1995

ORIGINAL : ENGLISH

SOUTH PACIFIC COMMISSION

JOINT FFA/SPC WORKSHOP ON THE MANAGEMENT OF
SOUTH PACIFIC INSHORE FISHERIES
(Noumea, New Caledonia, 26 June - 7 July 1995)

LOBSTER FISHERY IN THE TONGATAPU ISLAND GROUP, TONGA: ITS BIOLOGY AND THE EFFECT OF NEW FISHERY REGULATION

by

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Abstract

Lobster resource in Tongatapu has been under high fishing pressure and the resource seems to have declined at the same time as the size of lobsters (*P. penicillatus*) has decreased. New Fisheries (Conservation and Management) Regulations, 1994 were recently enacted although the enforcement part of the Regulations is not exercised yet. In the meantime, as the new regulations could reduce the lobster catch by 60 %, resistance from fishermen is well expected. In order to achieve the optimal result from the fisheries regulation, gradual implementation of the size limit accompanied by a short closed season is suggested as a temporary measure. Introduction of a new fishing method to catch live lobsters and an awareness campaign are also recommended.

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Introduction

Lobster is a special ceremonial seafood item in Tonga to be enjoyed during "kai pola" or mass feast occasions such as wedding, birthday, graduation, church conferences and any family cerebration. There are a number of restaurant (at least 5 major ones in Nuku'alofa and two in Vava'u) serving lobster dishes constantly. Exported lobsters are as frozen lobster and are mostly sent to New Zealand (10 tones or TOP$70,000 (US$5,1095)in 1994: Annual trade report 1994).
Concern for the decline of this important resource led to several studies being conducted in Tongatapu (Zann, 1984; Munro, 1987; Prescott, 1990; and Inoue, 1993) in a attempt to establish biologically reasonable management plans to protect this resource.

The present study is a follow-up study of the previous ones; however, its emphasis is more on the economic impact of management plan on the community and fishermen, as the authors believe a management plan is not effective without the understanding and acceptance by the fishermen themselves - especially in an island country which lacks the manpower to enforce the regulations to widely scattered islands.

Present situation of the lobster fishery in Tongatapu

In Tonga, commercial lobster catch is done solely by night spear divers. Night spear diving is a multi-species fishery and the most important inshore fisheries activity (49.8% of inshore landings in 1993: Inshore Fisheries Statistics, 1993). There were at least 11 boats (2 to 7 fishermen each on board) operating in night diving in Tongatapu in 1993.

When weather conditions and market demand are favorable, fishermen go to spear lobsters. The most popular fishing grounds are located on the southern coastline of Tongatapu Island where prevailing south-easterly winds and strong wave action often prevent any fishing activities (Tuavao *et all.* 1994). When landed, lobsters are made into strings of 2 kg to 3.5 kg. The price of the strings ranged from TOP$20 (US$14.6) to TOP$30 (US$21.9) during the survey period. The weight of a string and its price is decided by the fisherman who caught the lobsters.

Although complete data is not available, 4 tones, or TOP$17.6 thousand worth of lobsters were landed in Nuku'alofa in 1993 (Estimated from Inshore Fisheries Statistics, 1993). This means 2.6% of night diving catch in weight and 4.4% in value.

Species composition

Out of 1,765 lobsters sampled from March 1993 to January 1995, 75.9% was *P. penicillatus* followed by *P. longipes* (14.6%), and the slipper lobster *Parribacus caledonicus* (8.7%). Landing of *P. versicolor* and *Scyllarides squamosas* are rare. *P. ornatus* was sighted once, and another species of the Scyllaridae family (perhaps *Scyllarus cultrifer*(Ortmann, 1891))was seen twice. *P. penicillatus* is the targeted species and when fishermen go to lobster fishing they go to the fishing grounds preferred by this species only. The other lobster species are an incidental catch of the finfish fishery.

Stock condition of *P. penicillatus* in Tongatapu

In order to understand the present stock condition, the 1984 situation was compared with the 1994 situation.

Zann(1984)'s carapace length (CL) size frequency distribution was compared with the present study's results. This showed a clear shift to catches of smaller lobsters in recent years compared to catches of 10 years ago (Figures 1 and 2).

According to Zann (1984) the average lobster catch was 9.0 kg per night/diver or 2.7 kg per hour in Ha'apai Islands. During the present survey in Tongatapu, average catch per night was 4.5 strings which weighed 12.15kg and TOP$114.75. The number of strings varied from 1 to 8.7 and STD was 2.27. Catches obviously depend on weather conditions, fishing grounds, and the skill of the fisherman.

However, there have been a drop in the proportion of *P. penicillatus* to other lobster species in the catch from 97 % in 1984 to 75 % in 1994. This may indicate the decline of the target species.

Figure 1 Female *P. penicillatus* CL frequency distribution in 1984 and 1994

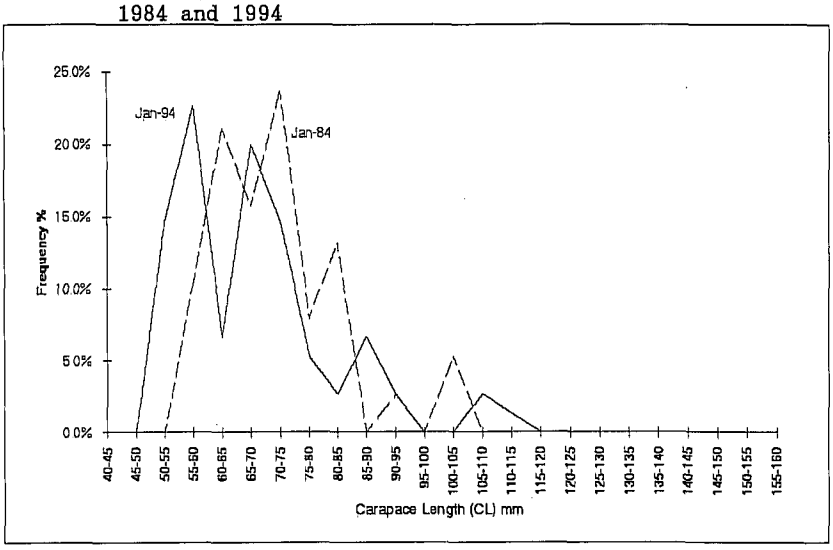
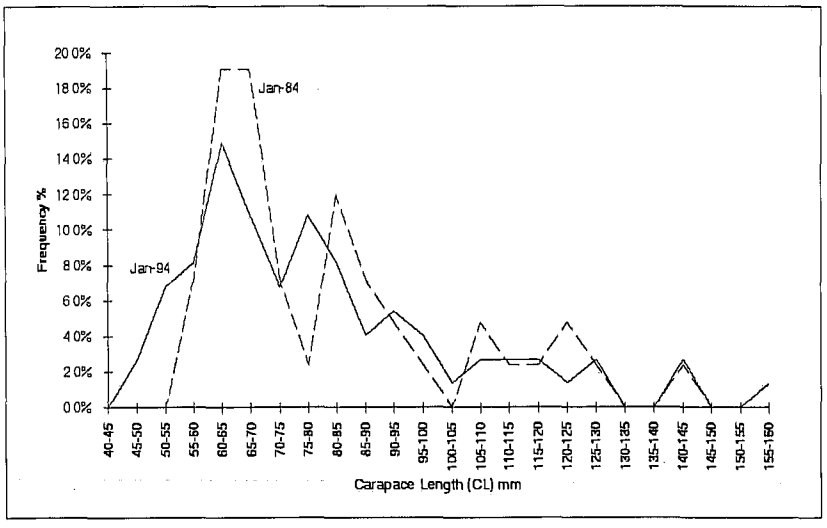


Figure 2 Male P. penicillatus CL size Frequency Distribution in 1984 and 1994



Maturity size and breeding season

The smallest size of ovigerous (carrying eggs) *P. penicillatus* was 53 mm carapace length (CL). Female *P. penicillatus* whose CL was more than 60 mm were considered mature. For those mature females, seasonal changes of mated females (bearing eggs and/or with ''tar spot'') was examined. A high rate of mated females (72-100 %) was found during the summer months (November to March), the number declining to 0-21% during the winter months (May to August) (Table 1).

Table 1 Seasonal changes of mated female *P. penicillatus* and their egg stage condition (CL more than 60 mm). Numbers are percentages

	Nov '93	Dec '93	Jan '94	Feb '94	Mar '94	Apr '94	May '94	Jun '94	Jul '94	Aug '94	Sep '94	Oct '94
No sign	8.6	27.8	27.3	NA	10.8	40.0	100.0	NA	NA	77.1	47.6	40.9
Tar	11.4	18.5	13.6		24.3	13.3	0.0			18.6	27.0	29.5
Stage1	37.1	37.0	9.1		5.4	13.3	0.0			2.9	7.9	15.9
Stage2	20.0	13.0	29.5		37.8	26.7	0.0			1.4	14.3	13.6
Stage3	20.0	1.9	18.2		8.1	6.7	0.0			0.0	0.0	0.0
Stage4	2.9	1.9	2.3		13.5	0.0	0.0			0.0	3.2	0.0

Note: For the months that the sample number was less than 10, data was omitted and shown as "NA"

Problems facing the fishery and the new fisheries regulations

As strong fishing pressure and decline in stocks of *P. penicillatus* have been identified, fisheries regulations were introduced for the lobster fishery. However, lack of personnel to enforce the regulations and as well as other constraints that make enforcement difficult have been recognized.

The CL size distribution of *P. penicillatus* give the percentage and cumulative percentage of each size groups (Appendices 1 and 2). According to this information, the 75 mm size limit set by the new fisheries regulations would cause a 70.3% reduction in the number of female lobsters caught and a 49.4% reduction in male lobsters caught. Appendices 1 and 2 also show the conversion of the numbers to weight. These figures imply that there will be a strong resistance to the regulations by fishermen.

Prohibition of catching or possession of berried females is hard to implement because the fishing method (spearing) is fatal to any lobsters and it is hard to determine whether the lobsters are carrying eggs or not before they are speared.
In the meantime, injured lobsters which are not caught probably die and thus are wasted.

Finally, the quality of the lobster being sold at market is quite low and they often smell bad. Some of the lobsters caught during the early hours of fishing are spoilt as the digestive organs in the carapace

were destroyed and decomposition started. The lack of ice in the fishing boat accelerates the spoilage. Furthermore, a string is put through the animals from carapace to tail to display at market, and this also spoils the quality of the flesh.

Management options and its economic impact on fishermen

(1) 75 mm size limit strictly observed (female is well protected too)

As mentioned earlier, it is difficult to enforce the regulation without cooperation from fishermen. The 75 mm size limit should be strictly observed for the export market and Ha'apai Island fishing only where larger CL size lobsters are still abundant (Zann, 1984, Prescott, 1990). However, for Tongatapu fishery, the impact of the size limit seems too strong at this time. Gradual implementation of the regulations may be needed.

(2)65 or 70 mm size limit with seasonal closure(to protect 1-2 spawning of a lobster)

As the mode of the size frequency distribution lies in these size groups, it is much more acceptable for fishermen to follow a 65 or 70 mm minimum size limit.
This minimum size option may be used as temporary measure for the Tongatapu lobster fishery only.

Table 2 Affect of minimum size regulation on male and female *P. penicillatus*

Size limit	Number(%) Reduction	Weight (%) Reduction*	CL growth per year mm*	Weight Increase (%) per year*
75 mm	59.7%	31.7%	F 15,5; M 26.5	24.3%
70 mm	46.9%	22.1%	F 16.5; M 27.5	18.6%
65 mm	32.1%	13.0%	F 18.5; M 29	12.4%

Note: (1) $W = 0.001542\ CL^{2.835}$ for female and $W = 0.001950\ CL^{2.757}$ for male ('Ulunga and Udagawa, in prep.) were used to estimate Total body weight.
(2) CL growth rate was adapted from Munro (1987)
(3) Weight increase is realized by not catching small lobsters for the next year. Percent to the unregulated total catch. Mortality of 0.4 suggested by Prescott (1990) was used.

Weight (income) increase is realized as a kind of interest from leaving a resource in the ocean. Just like saving money at the bank and gain 10% or so interest for your money, you will get higher gain by keeping young lobsters in the ocean in the future. Each size class's CL growth in a year was obtained from Munro (1987), then converted to weight using the formula estimated be 'Ulunga and Udagawa (in prep.). Alternative size limits and their respective outcomes are shown in Table 2.

In exchange with the larger size limit to the smaller one, the beginning of spawning season should be closed fishing season to protect their reproduction activities. Lobsters usually spawn 2-3 times during

breeding season (October-March). The demand of lobsters during October to November is not high. Seasonal closure is easy to enforce as a management measure.

Recommendations and future directions

(1) It is essential to hold meeting with fishermen immediately to discuss the regulation for mutual understandings. Fishermen should be given chance which option to take. The Ministry of Fisheries will gain the fishermen's confidence if the outcome of the regulations is confirmed as beneficial to them in the future.

(2) Workshops should be organized to teach fishermen alternative fishing method that will utilize the resource more effectively and sustainedly. For example, lobster scissors is one potential gear for collecting live lobsters without changing the night divers present fishing style.

(3) It is also possible to catch live lobsters by hand without damaging them so much. A Tongan lobster fisherman recently asked to catch live lobsters caught 12 of them in one hour. Nine of them are still alive in the Ministry's fish tank one month later.

(4) There will be no prohibition on the use of spears during the transition period between fishing gear. It is the fisherman who chooses the fishing method.
Even so, stringing the lobsters together at market should be prohibited for health and hygiene reasons. We also suggest the fishermen use ice on boats used for speared lobsters.

(5) Potential for a new lobster fishery should be sought. Deeper water lobster or shrimp resources and slipper lobster resources may have potential to supply more lobsters without damaging currently utilized stock.

(6) Restaurant owners/chefs should be invited also to a meeting with the aim of improving the quality of lobsters and cooperating with our program by increasing the purchase price for high quality lobster.

(7) General public should be educated through a resource conservation awareness campaign and school education (videos, posters, lectures).

(8) For all of these activities, awareness promotion facilities being constructed will be fully utilized.

(9) Lobster exporters should not take advantage of cheap Tongan lobsters to supply a low quality market overseas. High quality live lobster should generate more income to exporter and fishermen.

(10) The Ministry of Fisheries will facilitate the construction and maintenance of thanks for holding live lobsters at the fish market whenever fishermen are ready to start live lobster fishing.

(11) The Ministry of Fisheries will continue its lobster studies especially the landing site survey and inshore fisheries statistics data collection.

(12) Studies on biology of *P. longipes* as well as growth studies of *P. penicillatus* will be continued.

Acknowledgment

The authors would like to acknowledge the help given by lobster fishermen and suggestions and comments given by many staff of the Ministry of Fisheries, especially Ken-ichi Kikutani(JICA expert) and Patricia Kailola (FAO consultant).

This study was financially supported by Aquaculture Research and Development Project, Japan International Cooperation Agency (JICA).

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Appendix 1 Female *P. penicillatus* CL size Frequency Distribution and relevant estimated weight Data from March 1993 to January 1995

Class	Number	Percentage	Cumulative	CL mean	Weight	# x weight	Percentage	Cumulative
35-40	0	0.0%	0.0%	37.5	44.7	0.0	0.0%	0.0%
40-45	3	0.5%	0.5%	42.5	63.8	191.3	0.1%	0.1%
45-50	12	1.8%	2.3%	47.5	87.4	1048.8	0.5%	0.6%
50-55	52	7.9%	10.2%	52.5	116.1	6035.9	2.9%	3.5%
55-60	87	13.2%	23.3%	57.5	150.2	13069.6	6.4%	9.9%
60-65	102	15.5%	38.8%	62.5	190.3	19409.1	9.5%	19.4%
65-70	113	17.1%	55.9%	67.5	236.7	26744.8	13.0%	32.4%
70-75	95	14.4%	70.3%	72.5	289.8	27533.8	13.4%	45.8%
75-80	61	9.2%	79.5%	77.5	350.2	21359.2	10.4%	56.3%
80-85	36	5.5%	85.0%	82.5	418.1	15049.9	7.3%	63.6%
85-90	32	4.8%	89.8%	87.5	493.9	15806.2	7.7%	71.3%
90-95	20	3.0%	92.9%	92.5	578.2	11564.5	5.6%	76.9%
95-100	9	1.4%	94.2%	97.5	671.3	6041.6	2.9%	79.9%
100-105	8	1.2%	95.5%	102.5	773.5	6188.4	3.0%	82.9%
105-110	7	1.1%	96.5%	107.5	885.4	6197.6	3.0%	85.9%
110-115	8	1.2%	97.7%	112.5	1007.2	8057.3	3.9%	89.9%
115-120	4	0.6%	98.3%	117.5	1139.3	4557.2	2.2%	92.1%
120-125	5	0.8%	99.1%	122.5	1282.2	6410.9	3.1%	95.2%
125-130	2	0.3%	99.4%	127.5	1436.2	2872.3	1.4%	96.6%
130-135	2	0.3%	99.7%	132.5	1601.6	3203.3	1.6%	98.2%
135-140	1	0.2%	99.8%	137.5	1779.0	1779.0	0.9%	99.0%
140-145	1	0.2%	100.0%	142.5	1968.6	1968.6	1.0%	100.0%
145-150	0	0.0%	100.0%	147.5	2170.7	0.0	0.0%	100.0%
	660	100.0%				205089.3	100.0%	

Appendix 2 Male P. penicillatus CL size Frequency Distribution and relevant estimated weight Data from March 1993- January 1995

Class	Number	Percentage	Cumulative	CL mean	Weight	# x weight	Percentage	Cumulative
35-40	0	0.0%	0.0%	37.5	42.6	0.0	0.0%	0.0%
40-45	1	0.1%	0.1%	42.5	60.2	60.2	0.0%	0.0%
45-50	9	1.3%	1.5%	47.5	81.8	736.1	0.3%	0.3%
50-55	33	4.9%	6.3%	52.5	107.8	3556.5	1.2%	1.5%
55-60	57	8.4%	14.7%	57.5	138.5	7894.3	2.7%	4.2%
60-65	73	10.8%	25.5%	62.5	174.3	12723.3	4.3%	8.5%
65-70	85	12.5%	38.1%	67.5	215.5	18316.6	6.3%	14.8%
70-75	77	11.4%	49.4%	72.5	262.4	20205.9	6.9%	21.7%
75-80	71	10.5%	59.9%	77.5	315.4	22392.3	7.7%	29.4%
80-85	45	6.6%	66.5%	82.5	374.7	16862.1	5.8%	35.1%
85-90	39	5.8%	72.3%	87.5	440.7	17187.6	5.9%	41.0%
90-95	45	6.6%	78.9%	92.5	513.7	23115.3	7.9%	48.9%
95-100	33	4.9%	83.8%	97.5	593.9	19599.0	6.7%	55.6%
100-105	17	2.5%	86.3%	102.5	681.7	11589.1	4.0%	59.6%
105-110	20	2.9%	89.2%	107.5	777.4	15547.4	5.3%	64.9%
110-115	11	1.6%	90.9%	112.5	881.2	9692.9	3.3%	68.2%
115-120	7	1.0%	91.9%	117.5	993.4	6953.9	2.4%	70.6%
120-125	11	1.6%	93.5%	122.5	1114.4	12258.0	4.2%	74.8%
125-130	10	1.5%	95.0%	127.5	1244.3	12443.0	4.3%	79.0%
130-135	11	1.6%	96.6%	132.5	1383.5	15218.7	5.2%	84.2%
135-140	6	0.9%	97.5%	137.5	1532.3	9193.6	3.1%	87.4%
140-145	4	0.6%	98.1%	142.5	1690.8	6763.4	2.3%	89.7%
145-150	4	0.6%	98.7%	147.5	1859.5	7438.0	2.5%	92.2%
150-155	3	0.4%	99.1%	152.5	2038.5	6115.5	2.1%	94.3%
155-160	2	0.3%	99.4%	157.5	2228.1	4456.2	1.5%	95.8%
160-165	1	0.1%	99.6%	162.5	2428.6	2428.6	0.8%	96.7%
165-170	0	0.0%	99.6%	167.5	2640.2	0.0	0.0%	96.7%
170-175	0	0.0%	99.6%	172.5	2863.3	0.0	0.0%	96.7%
175-180	1	0.1%	99.7%	177.5	3098.0	3098.0	1.1%	97.7%
180-185	2	0.3%	100.0%	182.5	3344.5	6689.1	2.3%	100.0%
	678	100.0%				292534.3	100.0%	

Appendix 3 Ovigerous rate of *P. penicillatus* by CL size class

Class	Number	Percentage	Cumulative	Ovigerous	Cumulative
40-45	3	0.9%	0.9%	0	0.0%
45-50	3	0.9%	1.7%	0	0.0%
50-55	31	9.0%	10.8%	6	19.4%
55-60	50	14.6%	25.4%	16	32.0%
60-65	52	15.2%	40.5%	24	46.2%
65-70	68	19.8%	60.3%	33	48.5%
70-75	51	14.9%	75.2%	35	68.6%
75-80	21	6.1%	81.3%	10	47.6%
80-85	15	4.4%	85.7%	7	46.7%
85-90	15	4.4%	90.1%	8	53.3%
90-95	8	2.3%	92.4%	4	50.0%
95-100	2	0.6%	93.0%	1	50.0%
100-105	4	1.2%	94.2%	2	50.0%
105-110	7	2.0%	96.2%	5	71.4%
110-115	4	1.2%	97.4%	4	100.0%
115-120	2	0.6%	98.0%	0	0.0%
120-125	3	0.9%	98.8%	2	66.7%
125-130	2	0.6%	99.4%	0	0.0%
130-135	1	0.3%	99.7%	1	100.0%
135-140	1	0.3%	100.0%	0	0.0%
	343			158	