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Indicators of Fishing Pressure in the Deepsea Snapper Fishery of the Kingdom of Tonga*

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Introduction

The commercial development of the bottom fishery in Tonga began in 1980. It is now Tonga's largest commercial fishery. Currently, there are 43 boats in the fleet, ranging in size from 6 to 11 m. These boats use the FAO-designed Western Samoan hand reel with a multiple hook terminal rig (Mead 1979). The boats fish both the shallower fishing banks and the deeper seamounts at depths ranging from 50 to 450 m. Only the seamount fishery is examined here. As an estimate of size of fishing grounds, the length of the 200 m isobath on the seamounts alone was found to be 294 nautical miles (Fig. 1).

In October 1986, the Fisheries Division of Tonga implemented a 5-year resource assessment program on the commercial fishery for deepwater snappers and groupers in Tonga.

The most recent analysis of the catch and effort data showed that although the fishery shows no signs of overexploitation when viewed as a whole, and the level of fishing mortality is relatively low ($F = 0.3$ year^{-1}), depletion has occurred at individual seamounts (Langi et al., MS).

We examined the data on length and species composition with the aim of finding signals of overexploitation.

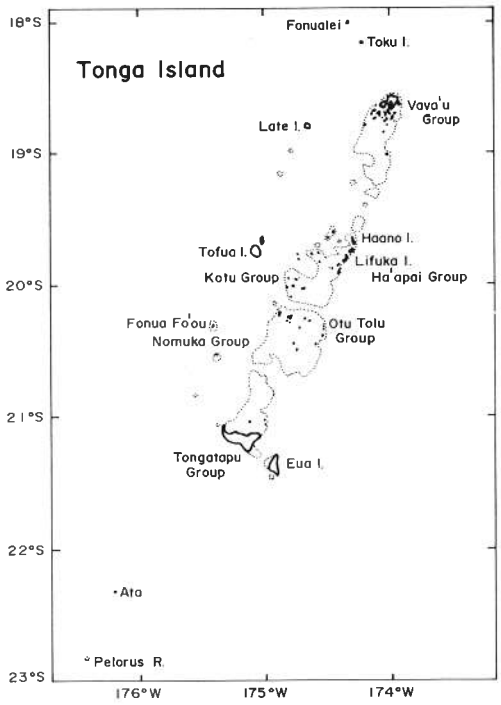

Fig. 1. Fishing groups for bottom fish: Kingdom of Tonga.

*Preliminary results based on a paper written during a Workshop on Length-Based Methods in Fisheries Analysis, 5-17 Dec. 1988, Honiara, Solomon Islands (see Fishbyte 7(1):11-12).

Materials and Methods

Six major species are used in the analysis of the seamount fishery. Together they comprise 80% of the total catch. The two main export species are *Pristipomoides filamentosus* (30% of the catch) and *Etelis coruscans*. The four other important species are: *P. flavipinnis, E. carbunculus, Epinephelus morrhua,* and *E. septemfasciatus*.

For *P. filamentosus*, length data from the (northern) Vava'u island group, where fishing on seamounts began in 1980, were compared with data from the (southern) Tongatapu region, where the seamounts have only been fished in the last three years (Fig. 1).

Three seamounts were examined (Nos. 901, 1001 and 1004) where catch rates have dropped considerably. Seamount 1004 showed the most dramatic decline in CPUE from 4.3 to 1.0 fish per reelhour. Where enough data existed, length-frequency distributions before and after initial depletion were compared.

At seamount 1001, three time periods were selected: December 1986 before depletion; February 1987 directly after depletion; and December 1987 after a year of fishing.

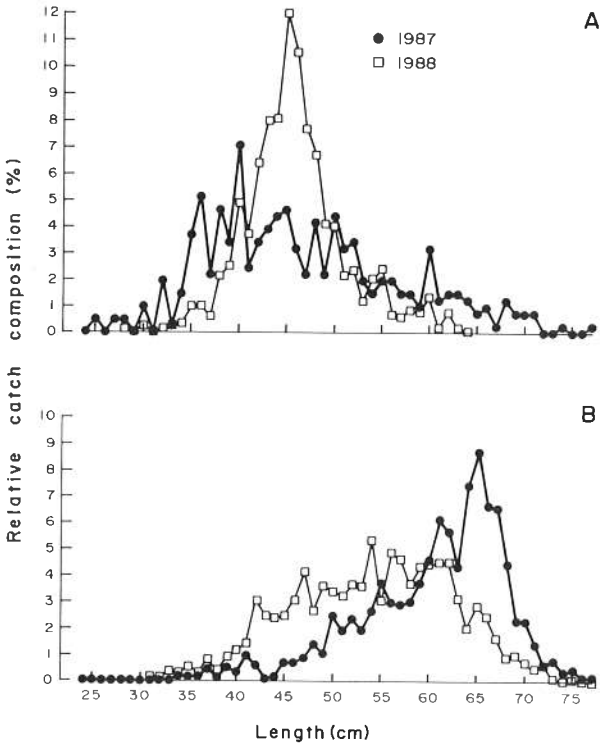

Fig. 2. Difference in the size composition of *Pristipomoides filamentosus* caught on northern (A) and southern seamounts (B).

Results and Discussion

Size variations in P. filamentosus

A significant difference in length distribution was found between *P. filamentosus* landed from the Vava'u seamounts and the Tongatapu seamounts. The median length of the northern fish was 45 cm as compared with 61 cm in fish from the south (Fig. 2).

Also, when comparing 1987 with 1988 for the southern seamounts, a drop in median length of 7 cm (61 to 54) has occurred (Fig. 2B).

In the case of the northern seamounts, no drop in median length has occurred since 1987, but the descending righthand limb of the distribution shows more curvature in 1988 and fish larger than 63 cm have disappeared (Fig. 2A).

Changes at three depleted seamounts

No decrease in size was found for the two *Epinephelus* species but numbers were low. The decrease in size for *P. flavipinnis*, although small, seems important because the size range in the fishery is so narrow. At seamount 901, the reduction in size may be due to the difference in depth. However, the depth estimates are only approximate due to the difficulty of accurately recording depth of fishing. At seamount 1004, during the period following initial depletion, 1403 fish per nautical mile of 200 m bottom contour were harvested, which far exceeds the estimated sustainable yield of 369 fish/nautical mile (Langi et al., MS). On close examination of the data from 1004, it appeared that the catches of *P. filamentosus* had dropped considerably and had not recovered, and that the fishery had switched to other species, especially *E. coruscans* (Fig. 3).

This switch in species coincided with the fishermen fishing at greater depths. If the reason for targeting greater depth was the fall in catch rate of *P. filamentosus*, then presumably, the overall catch rate would not be sustainable in the long term, as each species would in turn be depleted. This change in species composition may well be an indicator of excess fishing pressure.

Currently, although there is nothing to suggest the fishery as a whole is overexploited if only catch and effort data are examined, the 16-cm size difference between northern and southern seamounts suggests that the stocks of the main export species, *P. filamentosus*, are responding to fishing pressure.

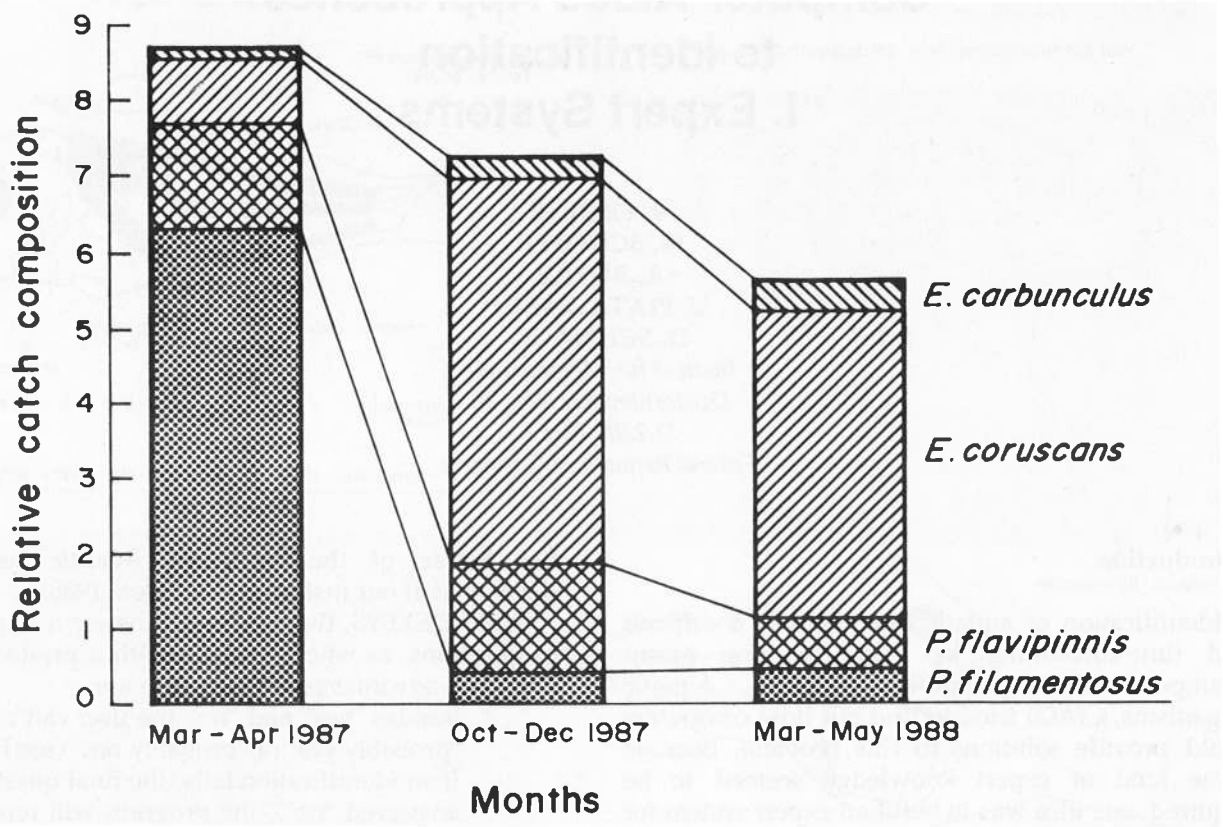

Fig. 3. Change of species composition of catch at seamount 1004, Kingdom of Tonga, March 1987 to May 1988.

The fact that reductions in size were also found for the other major species at depleted seamounts supports this idea.

In Hawaii, a substantial difference in modal size of *P. filamentosus* was found between areas of high and low fishing pressure (Ralston and Kawamoto 1988): in the northwest Hawaiian islands, where fishing pressure was low, the modal size was 9 lbs., while in the main Hawaiian islands (MHI), an area of heavy exploitation, the modal size was 2 lbs. In addition, *P. filamentosus* at MHI were being harvested well before reaching maturity, and growth overfishing was occurring.

The situation in Tonga has certainly not reached a heavy level of exploitation yet, as is suggested by the relatively low estimate of $F = 0.3$ year^{-1}, but further reductions in size of the major species should be carefully monitored.

The change in species composition which occurred at a heavily depleted, small seamount may also indicate heavy fishing pressure, although it could also be the result of fishing at greater depths.

In the absence of detailed CPUE data then, two possible signals may be useful in detecting overexploitation: (a) reduction in size and (b) change in species composition.

Acknowledgments

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