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The Fishery and Biology of *Penaeus canaliculatus* (Crustacea: Decapoda: Penaeidae) in Laucala Bay, Republic of Fiji

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1. Introduction

Laucala Bay on the southeastern coast of Viti Levu (Fig. 1) offers a variety of habitats for fish and invertebrates, and support local fishing activities. Fishing is carried out on a commercial as well as subsistence basis. The total annual catch of finfish is estimated to be between 30,000-50,000 kg while that of invertebrates (esp. crustaceans and molluscs) is estimated to be between 10,000-15,000 kg. The fishing methods for finfish include gillnetting, seining, hand-lining and spearing; those for invertebrates include trapping, hand-netting, spearing and hand-collecting.

Very little is known about the subsistence fishery which is very popular amongst the residents of urban Suva. Perhaps the most important of this subsistence fishery is that of penaeid prawns. The total penaeid catch is estimated to be about 3,000-5,000 kg per annum. At least six species are known to occur in Laucala Bay (Choy 1983). Of these the witch prawn, *Penaeus canaliculatus* (Olivier 1811) is the most abundant (Table I) and is the mainstay of the penaeid prawn fishery of Laucala Bay.

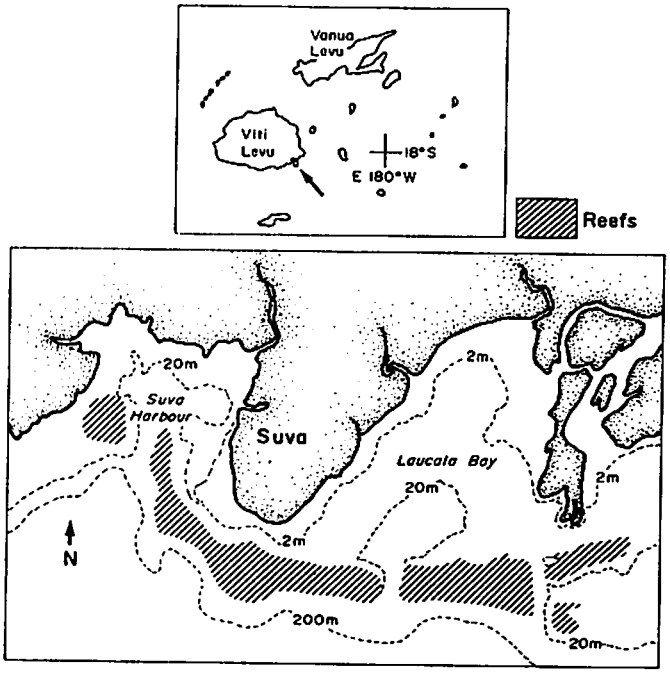

Fig. 1. Location map of Laucala Bay. The isobaths are in metres.

Table I. Species composition of penaeid prawn fishery in Laucala Bay.

Specie	Percentage Composition
Penaeus canaliculatus	85.7
P. latisulcatus	3.0
P. monodon	2.2
P. semisulcatus	1.9
Metapenaeus anchistus	5.9
M. elegans	1.3

2. The Fishery

The presence of coral boulders in Laucala Bay precludes the use of trawls to capture the prawns. The most popular fishing method (Table II) -- locally known as "cina" (pronounced "theena") involves the use of a bright lantern and a spear or handnet and is carried out during low tides at night. Fishing is restricted only to the intertidal and very shallow subtidal zones of the Bay. The total area available for such fishing is about 450 ha or about 10 % of the total surface area of the Bay. The reasons for fishing are given in Table III.

Table II. Methods of fishing for penaeid prawns in Laucala Bay.

"Cina"	75% (predominantly by men)
Scissors nets	15% (predominantly by women)
seining	5% (by men & women)
other methods	5% (by men & women)

Table III. Reasons for penaeid prawn fishing.

Food only	15%
Recreation only	30%
Food & Recreation	45%
Sell	10%

3. Biological Aspects

3.1. *Catch rates*

Beam trawling as well as "cina" were used to carry out regular sampling of Penaeus canaliculatus in Laucala Bay. The monthly variations in the catches (using "cina") are shown in Fig. 2. Size frequency data indicated that there were two cohorts of juveniles per year, one in June (dry season) and the other in November (wet season). A general decrease in the catches of juveniles coincided with an increase in the catches of the adults. Sampling carried out during the different phases of the lunar cycle resulted in lower catches during moonlit nights and higher catches during the dark nights.

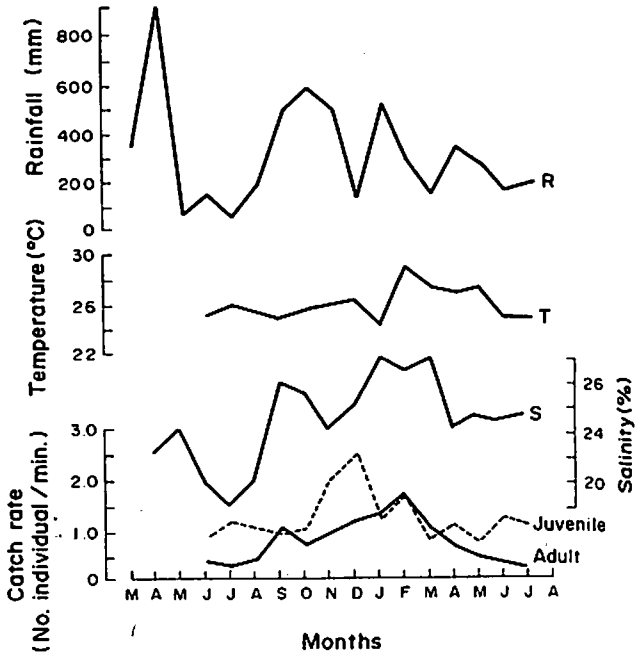

Fig. 2. Monthly catches of juvenile and adult P. canaliculatus, the total monthly rainfall (R), mean sea surface temperature (T) and mean salinity (S) in Laucala Bay (1980-1981).

3.2. *Size and age at sexual maturity*

Sexual maturity in males on the basis of the joining of the pleonic endopodite to form the petasma (copulatory organ) was reached at about 14 mm CL (median value). All males above 20 mm CL (73 mm SL) possessed joined endopodites. The minimum-sized male found with spermatozoa in the spermatophores was 16.4 mm CL.

The median value of females possessing developing ovaries was 20 mm CL (74 mm SL). The minimum-sized female with fully developed ovaries was 18.8 mm CL. About 75% of the inseminated females caught between October-March were between 20-24 mm CL. The estimated age at first maturity was 4-6 months.

3.3. *Reproduction*

The sex ratio and the percentage of females possessing mature ovaries are shown in Fig. 3. Results indicate that females in reproductive condition are found throughout the year with peaks between November-March. The presence of females with ripe ovaries and of the early nauplius larval stages suggest that spawning occurs within, but towards the oceanic side of the Laucala Bay lagoon.

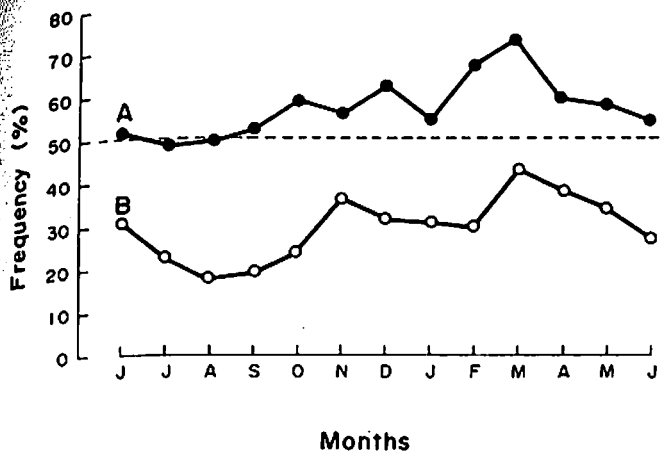

Fig. 3. The ratio of female P. canaliculatus in monthly samples (a) and the percentage of females with mature ovaries (1980-1981).

The number of eggs released at first spawning by captive females ranged from 20,000-100,000; the number increasing with the size of the female according to the equation:

$$y = 110.986\ (1.323)^x;\ n = 14,\ r = 0.72$$

where y = no. of eggs and x = carapace length (mm).

Other details on reproduction and its relation to the moult cycle are given in Choy (1987).

3.4. *Growth and morphometric relationships*

Growth of the early stages of P. canaliculatus is shown in Fig. 4. Post-larvae changed from a pelagic to a benthic habit at about 4 mm CL (10th post-larval instar) when they were about three weeks old. This size corresponded to field observations; smallest prawns found on the substrata were also about 4 mm CL. Many juveniles became pelagic at night; some very near the surface of coastal waters particularly during periods of high tide.

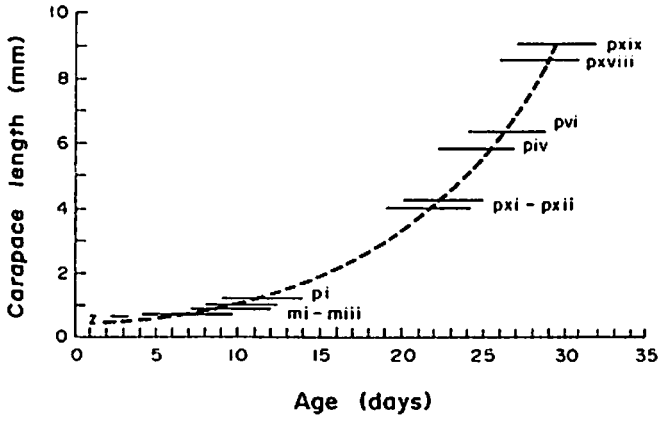

Fig. 4. Growth of P. canaliculatus larvae in the laboratory. z, zoeae; mi-miii, mysis 1-3; pi-pxix, postlarval instars 1-19.

The von Bertalanffy growth curves based on the progression of modes of the size frequency data were as follows:

males : $L_t = 25.31\ [1-e^{-0.0593(t+2.43)}]$
females : $L_t = 32.61\ [1-e^{-0.0486(t+2.43)}]$

The value of t_0 was estimated to be -2.43 weeks (calculated from rearing data). Females grew much faster and reached a much larger size than males.

The relationship between CL and SL, and CL and wet weight (W) of P. canaliculatus were as follows:

Males : $SL = 6.67 + 3.33CL$; n = 288, r = 0.97
$W = 4.16 \times 10^{-3} CL^{2.33}$; n = 288, r = 0.93

Females : $SL = 10.12 + 3.14CL$; n = 288, r = 0.95
$W = 6.61 \times 10^{-5} CL^{3.71}$; n = 288, r = 0.91

Females were larger and heavier than the males of the same age.

Mortality and yield

The total mortality, Z, calculated from length-converted catch curves (Fig. 5) was 0.92 week^{-1} or 4.78 year^{-1} for males and 0.90 week^{-1} or 4.68 year^{-1} for females. The estimated growth, survival and resulting biomass for a single recruitment of P. canaliculatus are shown in Fig. 6. A combination of slower growth rate, smaller size and higher mortality result in an earlier maximisation of the male P. canaliculatus biomass.

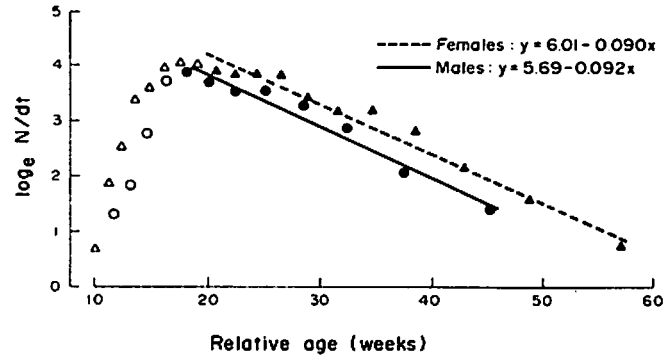

Fig. 5. Catch curves for P. canaliculatus.

On the basis of the observed density of prawns (no. caught over an area swept) the total standing stock in Laucala Bay is estimated to be about 2600 kg. A first approximation of the potential yield, Yp for lightly exploited stocks (Gulland 1983) is:

$$Yp = 0.5 \times 2600 \times 4.73 = 6149\ kg\ yr^{-1}$$

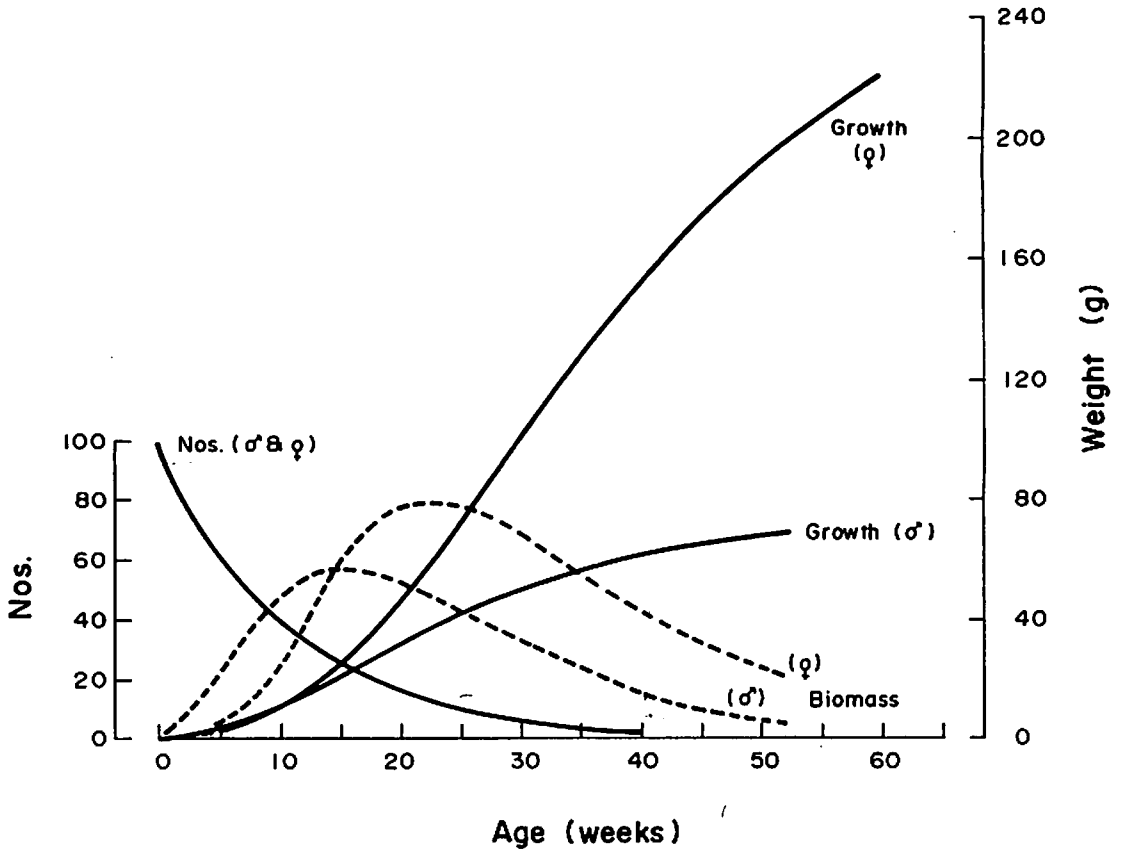

Fig. 6. Estimated growth (g), survival (nos.) and resulting biomass (g) for a single recruitment of P. canaliculatus.

The annual catch is approaching this estimated potential yield.

Discussion

The biology of Penaeus canaliculatus in relation to other species of penaeid prawns has been reviewed elsewhere (Choy 1982).

Any marine habitat close to a heavily populated area is always under the threat of being disrupted and Laucala Bay is no exception. Urban Suva's sewage and industrial wastes are discharged into the Bay and high levels of coliform bacteria and heavy metals are being recorded. Whilst the fishery in the Bay is only a small proportion of the country's catch, the nearshore waters are used extensively by the local residents for commercial, subsistence and, to a lesser extent, recreational fishing. There is already some indication that the total fish catches in the Bay are decreasing. This is attributed to a number of reasons such as increased fishing pressure, pollution, reclamation and dredging. In March 1988 the traditional owners of the fishing grounds in the Bay banned all commercial fishing in the area. This will hopefully have a positive effect on the fishery resources of the Bay.

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