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The penaeid shrimp resources of the Pacific Islands

By

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Introduction

1. Fisheries for penaeid shrimps[1] (Class Crustacea, O.Decapoda, S.O. Natantia, F. Penaeidae) are amongst the most lucrative in value terms and as such are often accorded high priority in commercial and Government development plans. World shrimp landings, dominated by penaeid shrimp, but including cold water carid shrimps and fresh water Macrobrachium, were approximately 1.7 million mt in 1981, showing little or no growth since 1977. The volume of the international trade in shrimp products at this time was around 450,000 mt of product, valued at $ 3,000 million (Anon, 1983 a). By 1985, the total landings had increased slightly to 1.9 million mt (Anon, 1987 a). This growth is believed to have mostly come from the rapid expansion in culture of penaeid prawns, most fisheries based on natural stocks now operating near or beyond sustainable levels.

2. Nearly 90% of shrimp landings are classified as warm water, with four of the top five producers in the Indo-Pacific region (China, India, Indonesia and Thailand). Seven other countries in the Indo Pacific region (Vietnam, Japan, Philippines, Pakistan, Australia, South Korea and Malaysia) are in the top twenty producers of shrimp(Anon, 1983 a).

3. The presence of the large valuable fisheries on the western edge of the Pacific Islands region has aroused expectations that penaeid fisheries might be developed in Pacific Island countries. However most lack the sizeable areas of soft-bottom continental shelf which typically support penaeid fisheries. Typically, a relatively narrow lagoon surrounds even the larger islands, with a barrier coral reef at the seaward extremity. Within the lagoon, the substrate is usually rough and dotted with coral patches, except for small areas near river months. This generally precludes the use of bottom trawl nets, the normal commercial capture method for penaeid shrimp.

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[1] The terms "shrimp" and "prawn" are used interchangeably, as there is no clear definition of their use (Holthuis, 1980).

4. Outside the reef, substrates are again typically rugged and descend steeply to depths in excess of 1000 m, close to shore. There is thus virtually no shelf. In such areas, a resource of carid shrimps (Heterocarpus spp) occurs, which is considered elsewhere in this workshop, but penaeid shrimps are generally uncommon and of limited commercial value (King, 1986).

5. This paper reviews the available information on the occurrence of penaeid shrimp in various Pacific Islands, fisheries and surveys for them and prospects for future development.

Species present

6. As with most marine species, there is a marked decrease in species diversity eastwards from PNG, at the western periphery of the region. Grey et al. (1986) record over 50 species of penaeid prawns from Australia, 10 of which are considered to be of major economic importance. A similar number of species probably occurs in Papua New Guinea. Monod (1976) lists 3 species from a partial collection in New Caledonia, Choy (1983) confirmed the presence of 8 species (Penaeus, 5; Metapenaeus, 3) in Fiji, and Braley (1979) two species in Tonga (Penaeus, 1; Metapenaeus, 1).

7. In three surveys of fisheries literature, in the Solomon Islands (Gillett, 1987), Western Samoa (Gillett and Sua, 1987) and Vanuatu (Gillett and Kenneth, 1987), no references to penaeid prawns could be found, and it is clear that penaeids are an uncommon and inconspicuous part of the inshore marine fauna in most countries, particularly where the area of suitable habitat, soft bottom shallows, often adjacent to mangrove - lined estuaries, is small.

8. Several species are of particular interest to Pacific Islands. Penaeus monodon, a large prawn reaching up to 150 g in weight, occurs as far east as Fiji, and is increasingly the subject of commercial mariculture. Penaeus semisulcatus has a similar distribution and has been trawled in both Fiji and Tonga (Braley, 1979). Penaeus canaliculatus and P. longistylus appear to be coral-reef associated species (Holthuis, 1980). A major fishery for the latter has recently developed within the Australian Great Barrier Reef (Robertson and Dredge, 1986), which may have implications for the larger of the Pacific Islands. Penaeus marginatus has been the target of offshore surveys (65-230 m) in Hawaii (Struhsaker and Yoshida, 1975) but has not been specifically sought elsewhere in the region and is presumably not common, as it appears to be a continental shelf species (Holthuis, 1980).

General Biology

9. Penaeid prawns inhabit shallow marine and brackish water soft bottom habitats in tropical and sub-tropical areas. Growing in some cases to 150 grms in weight but generally < 50 grms, they graze on benthic micro-organisms and particulate organic matter, often exhibiting species-specific substrate preference.

10. The life cycle commences with the shedding of fertilised eggs into the surrounding seawater, unlike most prawns, crabs and lobsters which carry eggs attached to the abdomen until they hatch. The planktonic larvae (nauplii) drift into inshore nursery areas (often seagrass beds), developing through a series of moults (zoea x 3, mysis x 3) into post-larvae which generally ressemble adults in form. At this stage, they grow rapidly in productive inshore waters (typically estuaries) until moving out into shallow coastal areas at an age of approximately 4 months. A few species can however pass the entire life cycle in the estuarine environment.

11. Many species move offshore, often considerable distances, with the onset of maturity. Spawning may commence at 6-7 months of age but full reproductive capacity is generally not achieved until 12 months of age. The spawning season may be extended, since individuals are partial spawners. Double-spawning (two periods of spawning) is common to many species and an "overwintering" in estuaries occurs in some species. Spawning is generally linked to the moult cycle, and may occur in dense aggregations.

12. Aspects of this generalised life cycle can adapt to the seasonally oscillating environment in which most penaeid prawns live eg. monsoonal estuaries. Catches are strongly influenced by environmental factors, which influence recruitment success. The burrowing behaviour of many species according to diurnal, tidal and lunar cycles also influences trawl catchability. Recruitment overfishing has been demonstrated in some cases when heavy exploitation was followed by periods of environmentally -induced low recruitment. The economics of most fisheries generally dictate that the larger offshore prawns are harvested in preference to immature inshore stocks. A variety of management measures reflects this strategy.

(Summary largely based on Garcia (1984) and generally referrable to the main commercial Penaeus spp)

Existing Fisheries

Papua New Guinea

13. Since the early 1970's, an industrial trawl fishery has operated in the Gulf of Papua and has produced an annual catch of approx. 1000t. (tails) from an average of 15 boats, operated in the main by joint-venture companies (Branford, 1982). In 1987, 32 licences were issued, 28 for the Gulf of Papua and 4 for the smaller Orangerie Bay fishery to the east. Only PNG owned vessels are permitted to operate within 3 miles of the shoreline, and there are restrictions on number of vessels, and maximum vessel size and engine horse power (Anon, 1987b).

14. Elements of this fishery have also targeted seasonally on spawning migrations of the ornate rock lobster (Panulirus ornatus). This is now subject to regulation, including periodic capture bans.

15. The main species taken are banana prawns (Penaeus merguiensis, P.indicus), tiger prawns (P. semisulcatus, P. monodon) and endeavour prawns (Metapenaeus endeavouri, M. ensis). Gwyther (1982), using both surplus yiled and yield-per.-recruit models, concluded that the fishery was operating at close to the maximum sustainable yield level in 1979, and estimated a total prawn catch of approx. 1200 tonnes (tails) might be sustained. The introduction of licence restrictions in 1976 had successfully pegged catches at just below this level.

16. Although the Gulf of Papua represents the largest and most productive area of penaeid habitat in PNG, other areas exist which are still very large by Pacific Island standards. Several of these have been surveyed eg. Sepik Coast (Anon, 1982; Campbell, 1981), Huon Gulf (Quinn and Kojis, 1983), Tufi (Anon, 1983) and others (Rapson and McIntosh, 1971), but no permanent commercial fishery has yet been established outside the South Papuan coast.

17. Attempts have also been made to establish a low technology fishery, based in Daru, using small vessels (7 m or less), sail or motor powered, with simple beam trawls (Dredge, 1984; Cook and Tenakanai, 1985). Encouraging initial catch rates of mainly banana prawns (P. merguiensis) were made, but it is not known to what extent this fishery has since developed.

18. Little or no data are available on artisanal shrimp catches in PNG. Daru villagers are known to seasonally beach seine P. merguiensis and P. monodon, and no doubt small scale artisanal fisheries exist in other parts of PNG.

New Caledonia

No organised commercial penaeid fishery exists in New Caledonia.

19. Aquaculture developments in New Caledonia, based on Penaeus monodon, P. indicus and others, have produced promising results, diverting attention from natural stocks. Total production in 1985 and 1986 respectively was 95 and 65.1 mt. This is projected to increase rapidly by 1990. Trawling in the extensive lagoon is currently prohibited, but may be permitted to allow the development of a fishery for saucer scallops (Amusium sp.), in the north. Penaeus longistylus does occur in the lagoon (Laboute and Magnier, 1979), but stocks have not been surveyed.

Fiji

20. Trawl surveys were carried out in 1976 (western Viti Levu, otter trawl) and 1983 (northern Vanua Levu, beam trawl) with only modest results, with the rough bottom a severe constraint. Unfortunately very few data were recorded during these surveys. Trials with small beam trawls have been carried out near Suva (King , pers. comm) and the biology of P. canaliculatus studied (Choy, 1981).

21. Artisanal shrimp catches(penaeids combined with Macrobrachium species), have varied between 25-40 tonnes in recent years (Lewis, 1985). Penaeus monodon is the primary penaeid species, being taken with fine spears or scoops, in conjunction with lamps, in estuaries at night. Small quantities of P. canaliculatus, P. semisulcatus and Metapenaeus spp. are also taken, along with small sergestids (Palaemon). Local P. monodon have been used as aquaculture broodstock, and a small population of P. merguiensis, introduced for experimental mariculture, seems to have established itself in western Viti Levu, in the Ba River delta (Choy, 1981). Aquaculture production (P. monodon, P. indicus) has not exceeded 20 mt. p.a.

Kiribati

22. Small quantities of P. canaliculatus are taken in Tarawa Lagoon, leading to some exploratory beam trawling for this species in 1983. Stocks are unlikely to support even a small fishery.

Tonga

23. Biological studies of P.semisulcatus and M. ensis were carried out in 1975-76 (Braley, 1979). Small catches are made by local fishermen using small gillnets, but there is no organised fishery.

Hawaii

24. Surveys for the aloha prawn (Penaeus marginatus) during 1968-72 produced modest catches in depths of 65-185 m (nighttime) and 185-230 m (daytime), and generated enough optimism for a small trawl fishery to operate in the Pailolo Channel between 1974-77 (Uchida, 1986). This produced 2.2- 4.4 mt p.a. but it is no longer in operation. Small recreational catches are still made using dip nets at night. The biology of this species has been studied (Cordover, 1975) and grow-out trials for possible aquaculture carried out (Tebano, 1986)

Other countries

25. No data are available.

Prospects for the future development

26. Despite the generally bleak prospects for the development of penaeid fisheries in most countries, expressions of interest are regularly received from outside concerns. This is based presumably on the continuing strong international demand for the high value product and the management restrictions (eg. limited entry) imposed on nearby fisheries such as northern Australia, which are already operating at or near estimates of sustainable yield.

27. With the exception of Papua New New Guinea, options for utilising natural stocks of penaeids prawns would seen to be restricted to

(i) Developing small vessel trawl fisheries near estuaries or larger rivers.

(ii) Providing brood stock for mariculture of suitable species

28. In the former case, only some Melanesian countries (Solomon Islands, New Caledonia, Fiji and possibly Vanuatu) would appear to have any realistic opportunity to develop such fisheries. The likely scale of these fisheries would logically limit involvement to small vessel beam trawling, or passive methods such as stripe net fishing (Lowe, 1986), given the restricted areas involved, the obstacle-encumbered bottom, and the expected moderate catches, which are likely to be strongly seasonal.

29. Similarly in the latter case, monodon, the current indigenous species of choice for mariculture, semisulcatus, merguiensis and indicus are all essentially restricted to the Melanesian area.

30. Papua New Guinea, with an estimated shelf area (to a depth of 200 m) of 17.37 x 10^6 ha (Munro, 1976), clearly has potential for futher development in areas outside the currently exploited Gulf of Papua and Orangerie Bay grounds. Lack of infrastructure would be a major constraint in many areas with potential for development, and it is suggested that the small vessel low technology approach would be the most appropriate in these areas.

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