

Fishery and Biology of Deep sea Prawns Landed at the Fishing Harbours of Kerala

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Deep-sea prawn landings from 10 fisheries harbours of Kerala during September 2000 to April 2001 have been quantified as 48675 t. The deep sea trawl units showed almost a double fold increase during 2001-02. *Aristeus alcocki*, *Heterocarpus gibbosus*, *Heterocarpus woodmasoni*, *Parapandalus spinipes* and *Metapenaeopsis andamanensis*, were the major species of commercial importance which accounted for major portion of the landings. Species wise catch and catch per effort from various fisheries harbours of Kerala are furnished. Life history traits such as size range and modal size constituting fishery, sex ratio and percentage of berried females in the exploited stock deep-sea prawns are also given.

Keywords : Deep sea prawns; fishery; Kerala

Availability of deep sea prawns in Indian waters was reported by several workers (Wood, 1892; Alcock, 1899, 1901, 1906; Alcock & Anderson, 1899; Kemp & Sewell, 1912). Exploratory surveys during 1958-1965 brought out the exploitable deep sea prawn stock along the shelf edge and the continental slope of south west coast of India. John and Kurian (1959), Kurian (1965), George (1966), George & Rao (1966), Suseelan & Mohammed (1968), Silas (1969), Oommen (1980) and James (1987) and Suseelan (1985) reported deep sea prawn resources of the south west coast of India. A pioneer attempt to quantify the deep sea prawn landed on three harbours of Kerala during November, 1999 to March, 2000 was made by Rajan and Nandakumar (2001). In the present study an attempt was made to bring together the information on the total deep sea prawn landings from ten major as well as minor fisheries harbours of Kerala during September 2000 to April 2002 together with life history traits such as length range, sex ratio and percentage of berried population of the exploited stock.

Materials and Methods

Ten fishing harbours of Kerala viz. Sakthikulangara, Neendakara, Thottapally,

Cochin, Munambum, Murikkumpadam, Ponnani, Beypore, Puthiyappa and Mopla Bay were visited at weekly intervals during August 2000 to July 2002. Deep sea fishing boats deployed from each harbour were enumerated on the date of visit and 30% of the units landed were observed from each harbour. The data computed from each unit with the help of a pre-tested questionnaire included total catch and species wise apportioning, fishing hours of the observed catch, days spent away from the shore, depth and geographical location of fishery, resource characteristics such as size composition, modal size constituting the fishery, sex ratio etc. The daily catch was computed by multiplying the average catch arrived at from individual unit multiplied by total units operated from the harbour on a daily basis. The monthly catch was estimated by multiplying the daily landings with actual fishing days of each month. Detailed biological examination of the exploited stock were made following Holden & Raitt (1984). Length was measured to nearest millimeters from an assorted sample in multiples. Spawning season was arrived at based in the percentage occurrence of the berried prawns in the exploited stock while for the juvenile prawn fishing season was delineated on the

basis when their occurrence exceeded 27% on a monthly basis (Luther & Sastry, 1993). Information regarding the area and depth of operation, duration of fishing trip, actual fishing hours, cruising time, facilities on board etc. were gathered by conducting personal interviews with boat crews. The data was processed with the help of Microsoft excel package developed at the School of Industrial Fisheries.

Shrimp trawlers, either steel or wooden vessels (48-70ft OAL) coated with fibre glass were used for deep sea fishing powered by 106-140Hp diesel engines. The fleet strength of deep sea prawn fishing is around 325 numbers at present, majority of them (>50 ft L_{OA}) operating with their base at Munambum harbour. 80% of the vessels are above 50ft OAL and 99% of them are equipped with GPS, Echo sounders. Recently some of the vessels were found using wireless sets also. In the case of modified new winches, a single drum could accommodate 2500m wire ropes having a thickness of 10mm. Fish hold has a storage capacity of 12t to 20 t in respect of vessels having 70 ft OAL. Maximum fuel capacity of this vessel is 7500litres and about 99% of the vessels carry 5000 to 6000 litres of diesel and 150 block ice for a single trip. Fishing was done with the help of a four seam trawl net having a cod end mesh size of 20 to 22mm. Length of the head rope ranged between 120 to 150 ft and the total length of the net varied between 130-150 ft. Usually eight to nine workers go for deep-sea fishing per trip, which lasted for eight to nine days depending on the season.

Results and Discussion

The fishing season of deep sea prawns in Kerala during 2000-01 was reckoned as September to April. The landings of deep sea prawns in Kerala during September 2000 to April 2001 was quantified as 48675t. During the second year (September – May), the same was computed at 19285t, thus registering a reduction to the tune of 60.35% in the deep

sea prawn landings when compared to the preceding year.

Monthly trends in production of deep sea prawns during 2000-02 are depicted in Fig. 1. Though the fishing season commenced from September, bulk of the landings was observed during December to March. On the contrary, during 2001-02, the commencement of fishery was observed slightly earlier from August onwards and continued up to April. In both the years, the peak fishery was observed during December to April while the fishery was appeared to be very bleak in the months of August and October.

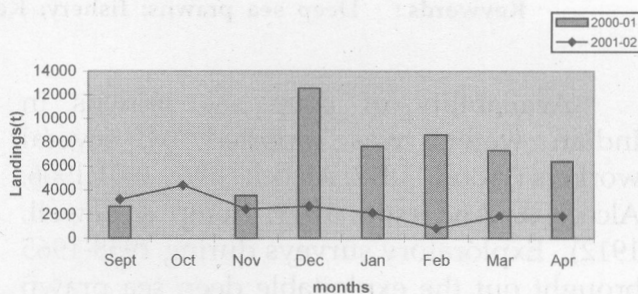


Fig. 1. A comparison of deep sea prawn landings in Kerala during 2000-01

The deep sea prawn fishery of Kerala was constituted by the following 15 species. However, the first ten species listed below were represented in the exploited stock in substantial quantities on a regular basis and their percentage composition during 2000-01 and 2001-02 are shown in Fig. 2a & 2b.

The deep sea prawn fishery of Kerala is constituted by the following species:

- Parapandalus spinipes* (Bate)
- Heterocarpus woodmasoni* Alcock
- Heterocarpus gibbosus* Bate
- Aristeus alcocki* Ramadan
- Penaeopsis jerryi* Perez Farfante
- Plesionika martia* Milne –Edwards
- Metapenaeopsis andamanensis* Wood-mason
- Solenocera hextii* Wood-mason
- Acanthephyra sanguinea* Wood-mason

Acantheephyra armata Milne-Edwards
Heterocarpus laevis Bate
Plesionika alcocki Anderson
Oplophorus typus Milne-Edwards
Parapenaeus investigatoris Alcock and Anderson
Plesionika ensis de Man

P.spinipes appeared as the most dominant species contributing to 19% and 40% of the total exploited stock during first and second year respectively. *H.gibbosus* and *H.woodmasoni* accounted for 7980t (16%) and 7786t (16%) respectively to the preceding year, however, their contribution declined to 10% and 13% respectively in the succeeding year where as *M.andamanensis* accounted for 14% and 21% respectively of the total catch during 2000-01 and 2001-02. *A.alcocki* formed 12% and 10% of the total deep sea prawn landings in these years. *S.hextii* contributed to 14%, with an annual average catch of 6640 t. The catch of this species was very insignificant during the second year with mere 341t forming 2% of the total landings.

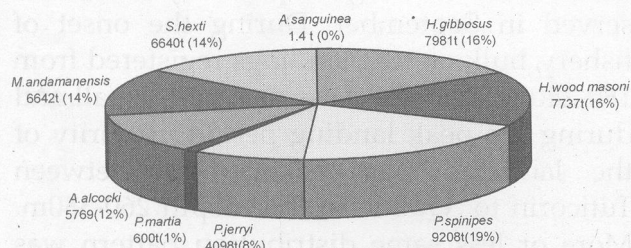


Fig. 2a. Percentage contribution of various species to the total deep sea landings

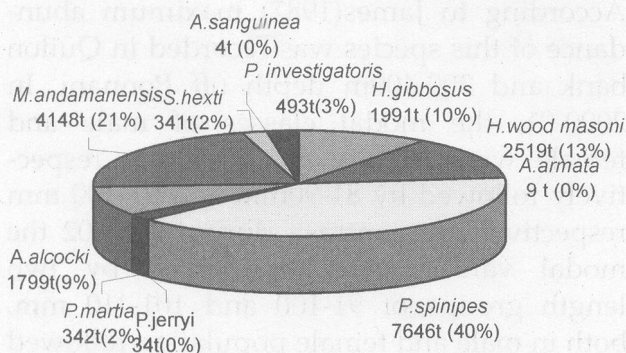


Fig. 2b. Percentage contribution of various species to the total deep sea landings

The harbour wise landings of deep sea prawns in the ten harbours of Kerala during 2000-01 and 2001-02 are depicted in Fig. 3. Sakthikulangara ranked first in deep sea prawn landings during 2000-01, accounting for 61% of the total landings followed by Munambum and Cochin with the share of 21 and 10% respectively. Whereas, the contributions of Murikkumpadam (0.15%), Puthiyappa (0.62%), Ponnani (0.29%), Mopla Bay (0.04) and Thottapally harbours (1.06%) were very insignificant.

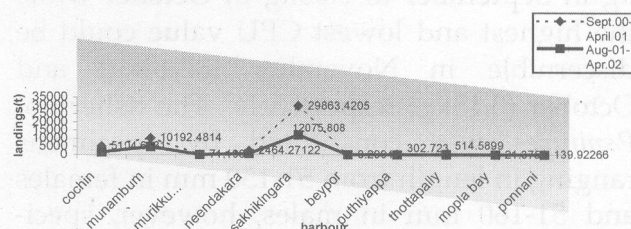


Fig. 3. Harbour wise deep sea prawn landings of Kerala during 2000-01 & 2001-02

The deep sea prawn landings showed a sharp decline during 2001-02 and were found restricted to just five harbours of Kerala viz. Sakthikulangara, Cochin, Munambum, Neendakara and Thottapally. The landings from Sakthikulangara showed a drastic decline from 29863t to 12076t while in Munambum it declined from 10102t to 5105t during the second year, thus showing a decline of 40% and 47% of the total deep sea prawn landings from these harbours respectively. Whereas in Cochin harbour, the landings decreased significantly from 5105t in the former to 1580t in the latter year. The contribution of Neendakara (3.70%) and Thottapally harbours (0.69%) were almost insignificant during the second year.

The average C/hr of deep sea prawns was computed at 12.14kg during 2000-01, which declined to 7.13 kg during 2001-02. In contrast, the average CPU showed an increase from 24.8 kg in the preceding year to 31.28kg in the succeeding year.

Life history traits

Parapandalus spinipes The "oriental narwal shrimp" (Holthuis, 1980) was the dominant

constituent of the deep sea prawn landed in Kerala. Major part of the stock was exploited from the depth zones 190-320 m off Ezhimala in the north and off Thottapally in the south. The same ground was reported to be productive during the survey conducted in 1958 (Suseelan, 1985). The C/hr and CPU of *P. spinipes* showed wide fluctuations and the annual average C/hr showed a drastic decline from 21.74 kg during first year to 9.18kg during the second year. In the preceding year, the C/hr varied between 84 kg in September to 0.08kg in October while the highest and lowest CPU value could be discernible in November (87.14kg) and October (0.15kg) respectively. The fishery of *P. spinipes* was constituted by specimens ranging in length from 51-150 mm in females and 51-160 mm in males, however, specimens below 71 mm and above 121 mm were barely represented in the commercial landings. In *P. spinipes*, the percentage of berried prawns in the landings were very high through out the year except in July (48.28%). The peak breeding was observed during October to January with highest numbers registered during November (92.15%) followed by December (91.03%). In general females showed slight dominance over males in the total landings. About 80% of the population is represented by berried females from September to December with maximum contribution in December (Table 2).

Heterocarpus gibbosus- (Holthuis, 1980) Appeared as the dominant species in the exploited stock landed mostly from 240-380m depth off Cochin coast. The annual average C/hr and CPU of *H. gibbosus* were estimated at 8.00 kg and 20.64 kg respectively. Lowest C/hr and CPU were registered in October while the same was highest in March with 19.81 kg and 36.05 kg respectively. The average C/hr and CPU showed a decline during the succeeding year, with 5.67kg and 26.47kg respectively. In males and females of *H. gibbosus*, the length frequency distribution showed a uni modal character with the modes frequently observed at 91-100mm and 111-120mm length

range. The monthly sex ratio of *H. gibbosus* during the two years indicated that there exists a significant departure from 1:1 ratio during almost all the months due to the dominance of males in the exploited stock. Chi-square analysis of sex ratio showed significant deviation from 1:1 ratio at 5% level. During September and October the preponderance of juveniles in the exploited stock is note worthy, while the contribution of berried females were comparatively less in these months. However, the berried population could be discernible from November onwards which attained peak in March (Table 2). Suseelan (1985) reported that the experimental fishery with CLAUS SUNNANA (1958) registered maximum-berried population of the species during March to April and this is comparable with the present findings.

***Heterocarpus woodmasoni*(Alcock)** Highest landings of the species was recorded from Sakthikulangara. During 2000-01, high C/hr of 21.91 kg was observed in November while the CPU was high in October with 28kg while in 2001-02, high C/hr and CPU of 17.15 and 48.74 kg respectively were observed in September. During the onset of fishery, bulk of the landings registered from 180-240 m, and the sizes was very small and during the peak landing period, majority of the landings was reckoned in between Tuticorin to Quilon in the depth 260-380m. More or less same distribution pattern was noticed by the INP vessels during the exploratory survey (Suseelan, 1985). The landings from northern region was negligible. According to James (1987) maximum abundance of this species was recorded in Quilon bank and 300-400m depth off Ponnani. In 2000-01, the modal classes of male and female were 91-100 and 81-90mm respectively followed by 81-90mm and 91-100 mm respectively. In contrast, during 2001-02 the modal values were represented by two length groups of 91-100 and 101-110 mm, both in male and female population followed by 81-90 mm in both the sexes. The chi-square value showed a significant deviation

from 1:1 ratio during September to December in both the years due to the predominance of females in the catch. A further spurt in the values was observed during May to August due to the abundance of females. In *H.woodmasoni*, the peak occurrence of berried females was observed during December to February during when on an average 88.7% of females were found to carry eggs attached on the pleopodal setae. The second major peak was observed in October during when 81.4% of the total female population were found ovigerous. From March onwards, there was a steady decline of egg carry females to half and the lowest value was realized during July with only 22.75% berries in the total female population.

***Metapenaeopsis andamanensis* (Wood-mason)** -The Rice Velvet Shrimp (Holthuis,1980) is one of the common penaeid present in appreciable quantities during December to April with peak landings in February. This species is often found landed along with *P.spinipes* from relatively shallower grounds from 200-280m, off Cochin coast. The fishery of *M.andamanensis* was constituted by individuals in the range 32 to 148 mm in females and 39 to 141 mm in males in the commercial landings. The male to female ratio of *M.andamanensis* in the exploited stock was 1:2.44 during 2000-01 and 1:1.87 in 2001-02 thus showing the preponderance of females in the population. The month wise analysis indicated a significant deviation from 1:1 ratio in September to April in both the years owing to the predominance of females ($P < 0.05$) and this findings conforms with Rajan and Nandakumar (2001).

***Aristeus alcocki* (Ramadan)** The Arabian Red Shrimp' (Holthuis,1980) locally known as the 'Red ring', is the most valuable deep sea prawn due to the demand for export. The annual average C/hr of *A.alcocki* was computed at 8.64 kg during the preceding year, which declined to 3.22kg in the succeeding year whereas the CPU showed an increase from 27.96kg in the first year to

37.77kg in the second year. The highest C/hr of *A.alcocki* during 2000-01 and 2001-02 was recorded in February and January respectively while the lowest value was in September. This species was not observed in the landings from the vessels operated at depth ranges less than 300m, the maximum quantity being recorded from 380-550m and were mostly recorded from two fishing grounds, off Ezhimala in the north and off Quilon in the south. The existence of two prominent fishing grounds of *A.alcocki* along Kerala coast have already been reported during the exploratory surveys conducted by R.V.VARUNA in 1968 (Suseelan,1985) and the present findings fully conforms with this. This species represented the fishery throughout the season in varying proportions. In females, 121-130mm appeared as the modal size class followed by 101-110mm and 131-140mm (Fig.6. 33). Males found to be very smaller than females in the exploited stock. In males of *A.alcocki*, 81-90 mm formed as the modal class during July, August while 101-110mm length groups frequently represented in the catches during rest of the months. The monthly sex ratio showed a significant departure from the hypothetical ratio 1:1 in all the months except in July in due to the predominance of females in September and December while males predominated in the rest of the months.

***Plesionika martia* (A.Milne-Edwards)** The 'Golden shrimp'(Holthuis, 1980) is a comparatively smaller pandalid prawn landed in minor quantities from November-February in the depth range of 180-330m. The total length varied from 65-102mm in males and 73mm-102mm in females, however, the size groups 81-86mm in males and 90-98mm in females show predominance. The landings could be observed only from November to February with peak in December. The highest c/e was observed in January with 22kg/hr while it was lowest in November (0.94Kg/hr).

***Solenocera hextii* (Wood-mason)**-A larger prawn often known as the 'Deep sea Mud

Shrimp' (Holthuis, 1980) was represented in the catch through out the fishing season except in October, mainly exploited off Cochin from 130-320m depth. Highest quantity was landed in December, February and March and the females outnumbered the males in the landings and almost all mature females were in the impregnated condition.. Size varied from 89mm- 140mm in males and 103mm-149mm in females but the size groups having the preponderance of 110-130mm of the former and 129-140mm of the later in the landings was quite discernible.

***Penaeopsis jerryi* (Perez Farfante)-** Commonly known as the 'Gondwana Shrimp' is a widely distributed small penaeid prawn represented the landings from the depth of 251-300m. Peak period of abundance was during January to March. Size range of 58-108mm in males and 67-114mm in females contributed to the fishery. The modal sizes between 76-89mm dominated in the catches in both sexes.

***Acantheephyra sanguinea* (Wood-mason)-** A deep red coloured prawn often mistaken as *A.alcocki* by the fishermen landed in minor quantities and represented the fishery in April from 320 m off Cochin. Size range of males was 88-100 mm and 102-118mm in females. The impregnated females outnumbered the males in the total landings.

The deep sea prawn landings showed wide fluctuations along Kerala coast during Sept-00 to April-2002. The monthly distribution of catch per effort indicates that December is the peak month of abundance followed by February and March. The exploratory surveys made by M.V.Klauss sunnana, R.V. Varuna and M.V. Velameen revealed the existence of 14 species constituting the catches in the exploratory surveys (Suseelan, 1985). However, fifteen species could be recorded in the commercial landings in varying proportions. Among the 15 species of deep sea prawns landed at various harbours of Kerala, the commercial fishery was mostly focused on 5 species

viz. *A.alcocki*, *H. woodmasoni*, *H. gibbosus*, *P.spinipes* and *M.andamanensis* in their order of preference. By virtue of the excellent demand for export, *A.alcocki* was exclusively procured by the seafood processing plants. As a result, with the onset of fishery, majority of the fishermen started selective harvesting of this species of high value by embarking in the grounds known for their predominance. In contrast to the observation of Rajan and Nandakumar (2001) on the dominance of *H.woodmasoni* in the exploited stock, *P. spinipes* appeared as the most dominant species in the total deep sea prawn landings, contributing 19% and 40% respectively during 2000-01 and 2001-02. *H.gibbosus* and *H.woodmasoni* contributed to 16% each during the first year and occupied second position in the landings, however, their contribution declined to 10% and 13% respectively thereby shifting to third position during the second year. A comparison of catch per hour of deep sea prawns registered for various depths during 2000-02 also showed a steady decline in all the depths during 2001-02 when compared to 2000-01.

Due to the ever increasing demand for prawns from the processing industry, deep sea trawl units engaged in trawl fishery showed almost a double fold increase during 2001-02 when compared to 1999-2000 and consequently there was an exponential increase in the fishing effort with in a short period of two years. At present, nearly 300 shrimp trawlers have been converted for deep sea operations and also by fitting GPS and Echo sounders, besides more than a dozen of new crafts were recently commissioned in and around Munambum harbour exclusively targeting for deep sea prawn fishery. Results of spawning biology of deep sea prawns showed that the peak spawning was more or less synchronizing with peak fishing season. In addition, the results of month wise and lengthwise sex ratio analysis brought out the preponderance of females over males in a number of commercially

important species such as *P.spinipes*, *H.woodmasoni*, *M. andamanensis* and *A. alcocki*. This skewness in the sex ratio by females would suggest the possibility of differential migration of male population from the fishing ground and this can be postulated as one of the reasons for the stock depletion of deep sea prawns. Percentage of berried pandalid shrimps were found very high during December to March, in the range 71.33 to 91.25% and a decline of the fishery registered during the second year can well be attributed to the indiscriminate exploitation of berried females by the commercial fishing units.

Protection of the breeding stock, prevention of growth over fishing annual closure of the fishery during south west monsoon and imposition of restricted fishing season together with strict regulation of the units put under operation are some of the options for the sustenance of the stock. However, the ever increasing demand for export purpose may further aggravate the fishing pressure even at higher depths and hence there is every possibility of stock depletion in near future. The indiscriminate exploitation of berried population of deep sea prawns may lead to recruitment over fishing as defined by Pauly (1982). It would thus appear that the stock of deep sea prawns would be in a dangerous situation in near future unless otherwise the fishery is regulated at optimal levels giving due attention to maximum sustainable yield, stock-recruitment relationship and growth rate of individual species.

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