Marine Fisheries Research and Management

Editors
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2000

33 The Indian tiger prawn *Penaeus monodon* Fabricius

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ABSTRACT

The largest penaeid Indian tiger prawn, Penaeus wonodon is widely distributed in the Indian waters and forms an important fishery with high demand in tthe export market. By virtue of its fast growth, hardness and export demand it is cultured in about 1 lakh ha of prawn farms with an annual yield of 82850 t. As the demand is very high it is subjected to heavy fishing pressure at laa stages of life history, seeds and brooders for farm and hatchery and all others for internal and export markets. The paper reviews the work done on its distribution, biology and capture fisheries from estuaries and marine habitats together with its stock assessment and management measures to keep the wild population sustainable.

Introduction

The Indian tiger prawn *P. monodon* Fabricius is the largest species among the penaeids. For a long time there was confusion in the identification of this species. The designation of a neotype in place of the lost original type of Fabricius by Holthuis (1949) has finally resolved the century-long confusion of this species with *P. semisulcatus* de Haan. Although *P. monodon* is widely distributed throughout the Indo-Pacific region, ranging from South Africa to Southern Japan, and from Karachi to northern New South Wales, it forms commercial fisheries only in the central part of the Indo-Pacific region (Mohamed, 1970; Motoh, 1981). With an average annual landing of 915 t, *P. monodon* forms an important marine fishery resource in the country in view of its high demand in the export market. This species is widely distributed in the Indian waters, but forms a substantial component of the prawn landings

from the sea and the estuaries of the east coast (Jones, 1969; Silas *et al.*, 1984). It forms the major component of the cultured prawn production in the country because of its fast growth, hardiness and high market price. It is cultured in about one lakh hectares of prawn farms with an annual production of 82850 t. This species is subjected to heavy exploitation in the estuaries and coastal waters by the capture fisheries sector primarily for exports and also for broodstock for hatcheries and for seed for the prawn farms. Inspite of its importance in the national economy, very little work has been done on its biology and fishery in its natural habitat. An attempt is made here to review the work done on the biology and capture fishery by various workers with emphasis on stock assessment and management of the resource.

Distribution

This species has been recorded in all the maritime states of India (Mohamed, 1970). However, it supports commercial fishery only along the east coast between Cuddalore and the Sunderbans (Rao *et al.*, 1993). Kemp (1915) observed 10 mm long postlarvae in the Chilka lake and in the Ennore estuary. They are pelagic and are reported to live among the weeds. Large numbers of them settle on the weeds in the backwaters of the Gangetic delta, situated many miles away from the sea. Panikkar and Aiyar (1939) reported that the larvae enter the Adayar backwaters along with the postlarvae during all the months. Delmendo and Rabanol (1956) stated that it was probable that this species spawned in the sea not far from the coast and that the youngones were carried to the shallow coastal areas, tidal flats and estuaries by the incoming tide. However, Rao (MS 1) opines that the species spawns beyond 40 m depth, as specimens with ripe ovary have been observed only from the landings from these depths. The postlarvae and the juveniles of *P. monodon* are widely distributed in the estuaries and backwaters, but with greater abundance along the east coast (Manisseri *et al.*, MS). The juveniles bury themselves in the mud during the day and come out for feeding at night. Migration to the sea starts at 100 mm total length (TL) onwards while the juveniles beyond 150 mm TL are rare in the estuaries. However, individuals of 250 mm are met with in the highly saline areas of the backwaters and coastal lagoons (Rao, 1975; Subramanyam and Ganapathi, 1975). In the sea the tiger prawn is distributed from the nearshore waters up to the 100 m depth. The abundance of this species gradually increases from the 11 m to

60 m depth,but thereafter gradually declines towards the 100 m depth (Rao, 1987). Generally the mean size of the population increases with the increasing depth.

Larval history

Silas *et al.* (1978) studied the larval development from the egg to the postlarvae in the laboratory. After hatching, the larvae pass through 6 naupli stages, 3 protozoea stages and 3 mysis stages before becoming the postlarvae. The nauplius subsists on its own yolk and does not take any food. The protozoea were fed mixed diatom culture dominated by *Chaetoceros*; from mysis II onwards the larvae were fed *Artemia* naupli until the larvae metamorphosed into the postlarvae. From postlarvae I to postlarvae 5 they were either fed *Artemia* naupli or egg and prawn custard or both.

Food and feeding habits

Hall (1962) observed large crustaceans, vegetable matter, polychaetes, molluscs and fish in the stomach of *P. monodon* and classified it as an omnivore. Rao (1967) confirmed these findings, but Mohanty (1975) found detritus as the major item in the stomach contents. Thomas (1972) observed crustaceans, fishes, molluscs, polychaetes, vegetable matter, mud and sand in that order of abundance. All these investigations were conducted from the samples obtained from estuaries and backwaters. Rao (MS1) studied the food of *P. monodon* from the samples obtained from the sea and observed crustaceans, molluscs, polychaetes and fishes as the major food items. Since vegetable matter and detritus formed only a negligible proportion of the stomach contents, he preferred to classify it as a carnivore. Rao (1988) opined that what was referred to as detritus in the stomach contents of penaeid prawns was only the semidigested matter of the prey animals and agreed with Kubo (1956) that cannibalism was common among the penaeids.

Maturation and spawning

Motoh (1981) studied the maturation and spawning of *P. monodon* from the Philippines. Rao (MS1) studied the reproduction and the spawning of *P. monodon* off Kakinada. *P. monodon* is heterosexual as is the case with all the penaeids. The females attain maturity at 196-200 mm and males at 166-170 mm TL. The five maturity stages distinguished in the ovary could be

termed as immature, maturing, mature, ripe and spent. Fecundity varies from 2 to 10 lakh eggs depending on the size of the females. Spawning takes place in the sea at 40-80 m depth. Although the species is not gregarious it appears they congregate during spawning. Along the Kakinada coast the species spawns throughout the year with different peak periods in different years. Rao (MS 2) observed a similar phenomenon in the spawning off Visakhapatnam. The recruitment of the postlarvae to the estuaries and backwaters and of the juveniles to the inshore waters is continuous with random peaks along the east coast (Rao, 1975; Subramanyam, 1965, 1966; Subramanyam and Rao, 1968).

Age and growth

Rao (1967) and Subramanyam and Ganapathi (1975) studied the age and growth of *P. monodon* in the juvenile phase in the Chilka lake and Godavari estuary respectively. Rao (MS 1), who studied the age and growth of *P. monodon* from the trawler landings at Kakinada, found that the females grew faster than the males even from the age of three months. The growth parameters were estimated for the von Bertalanffy equations as given below.

Males : $l_t = 205\ [1-e^{-1.8(t-0.055)}]$

Females : $l_t = 331\ [1-e^{-1.5(t-0.057)}]$

Age-at-length, calculated from these equations for the males is: 139 mm, 217 mm and 250 mm total length at the end of 6, 12 and 18 months, respectively, and for the females 167mm, 257 mm and 294 mm total length at these ages, respectively. As 95% of the age at $L\infty$ is generally taken as longevity, *P. monodon* life span seems to be about two years. Rao (1967) estimated the total length (mm) - total weight (g) relationship for the specimens sampled from the landings from the Chilka lake for the males and females separately, as given below.

Males : $\log W = -5.3399 + 3.1032 \log L$

Females : $\log W = -4.8953 + 2.9022 \log L$

Craft and gear

A variety of gear is used to exploit *P. monodon* in the estuaries and backwaters (Ramamurthy and Muthu, 1969). Stakenets and dragnets account for

over 90% of the landings from the estuaries like the Hooghly, Mahanadi, Godavari and Krishna while bamboo traps are more common in the Chilka lake. A variety of dipnets and castnets are also used to catch *P. monodon* in the backwaters of the east and west coasts. The craft generally used to operate the estuarine gears includes the dugout canoes along the Tamilnadu coast, plankbuilt canoes in the Chilka and Pulicat lakes and nava and shoe-doni in the Godavari estuary.

In the sea the principal gear landing *P. monodon* is the trawl. The size of the net varies with the length of the boat and horse power of the engine. Trawls are operated by a range of boats like pablo (30'), pomfret (32'), sorrah (35'), sona (43'), minitrawler (52') and Mexican trawlers (65 to 80'). All these boats are of wooden hulls except the Mexican trawler which is of steel hull. The Mexican trawlers operate outriggers for prawns along the northeast coast. The landings of *P. monodon* by shoreseines, boatseines and gillnets are negligible when compared to the trawl landings.

Estuarine fishery

A number of workers contributed to the knowledge on the estuarine phase of *P. monodon* in the Indian estuaries and backwaters. Notable among them are Kemp (1915), Panikkar and Aiyar (1939), Rao (1967), Subrahmanyam (1964, 1965, 1966, 1967), Subrahmanyam and Rao (1968), Subrahmanyam and Ganapathi (1975), Rao and Gopalakrishnayya (1974), Rao (1975, 1990), Lalithadevi (1989) and Sriraman *et al.* (1989). Manisseri *et al.* (MS) compiled the information available on the fishery in different estuaries and backwaters of India.

The magnitude of the estuarine fishery for the entire country is not known. In the Godavari estuary the landings are estimated at 500 t per year with considerable variations from year to year. Although the species is landed throughout the year, two peaks of abundance, January-March and July-August are observed in the Godavari estuary. *P. monodon* forms about 6% of the prawn landings of this estuary (Rao, 1975). In the Chilka lake *P. monodon* forms about 8% of the prawn landings of the bamboo trap fishery. Annually about 100 t of *P. monodon* is landed from the Chilka lake.

Seasons

The abundance of the species in different months of the year varies in

different estuaries and backwaters. The seasonal distribution of *P. monodon* is given below.

Name of the estuary	Period of occurrence	Peak period of occurrence
Hooghly-Matlah	Throughout the year	February-May & August-September
Chilka lake	-do-	July-November
Bheemunipatnam backwaters	September-November	October
Godavari	Throughout the year	October-January
Krishna	-do-	October-December
Pulicat lake	do-	October-November
Kovelong backwaters	-do-	December-March
Killai backwaters	-do-	November-December
Manakkudy	-do-	September-November
Cochin backwaters	Occasional	-
Korapuzha	-do-	-
Netravati	-do-	-

The seasonal abundance of the species varies considerably in different areas of the sea also. It is observed in the inshore landings of the east coast throughout the year with seasonal variations at different centres. The peak period of abundance at different landing centres is given below.

Landing centre	Peak period
Paradeep	August-November
Puri	October-November
Visakhapatnam	October-December
Kakinada	January-April
Madras	November-January

Size composition

The size composition at many estuarine and marine landing centres shows little variation between different months. Although *P. monodon* in the length range of 20 to 230 mm is represented in the estuarine and backwater catches, only those in the length range of 60 to 140 mm form the mainstay of the fishery (Rao, 1975). In the marine landings, males of 105 to 265 mm and females of 105 to 325 mm are represented, with males of 185-235 mm and females of 230-285 mm forming the mainstay of the fishery (Rao *et al.* 1993). The monthly size composition did not follow any seasonal trend in most of the years.

Marine fishery

The importance of *P. monodon* in the penaeid prawn fishery in the inshore waters was highlighted by Panikkar (1956), Jones (1969), Mohamed (1969), Rao *et al.* (1980), Silas *et al.* (1984), Lalithadevi (1987), Rao (1987, 1988a, 1988c, 1993) and Rao *et al.* (1993) from different parts of the Indian coast.

Statewise marine landings of *P. monodon* for the period 1975-95 are given in Table 1. Annual landing of *P. monodon* in the country fluctuated widely from 447t in 1977 to 1366t in 1984. The landings of *P. monodon*, estimated at 1752t in 1994, was a very special case in that much of the catch was from farming operations which escaped into the sea because of the overflowing of the prawn farm ponds in Andhra Pradesh due to heavy rains and consequent flooding of all the estuarine creeks and breaching of the dykes of the farm ponds. A part of this population contributed to the marine landings in the years 1995 and 1996 also. If these three years are taken as aberrations in the fishery, it can be seen from the data that the fishery reached its peak during 1978-84 with an average annual landing of 1160 t. The average annual landings during 1985-93 period came down to 659t indicating that the fishery had considerably declined in the latter period. About 92.2% of the landings were recorded from the east coast with the west coast contributing only 7.8%. The maximum concentration of the species is along the Andhra coast. With an average annual landing of 340t Andhra Pradesh contributes 38% to the country's landings followed by Tamilnadu 23%. The large trawler landings are from the Orissa-West Bengal coast. Although the species was landed throughout the year all along the east coast, the seasonal abundance

varied from place to place. In the trawler landings at Kakinada it was observed throughout the year with a peak during January-May (Rao, 1988), while the fishery reached its peak in September-December in the trawler landings of Visakhapatnam (Rao, MS2).

Rao (1993) gave a detailed account of the large trawler prawn fishery of the east coast of India. The tiger prawns represented by *P. monodon*, *P. semisulcatus and P. japonicus* form an important component of the large trawler prawn landings. *P. monodon* forms about 95% of the tiger prawns landed by large trawlers. The proportion of the tiger prawns in the large trawler landings declined in recent years (6.3%) as compared to the earlier period of 1979-83 (11.2%). The catch per hour gradually declined from 2.5 kg in 1984-85 to 0.9 kg in 1991-92. The landings of the tiger prawns gradually increased from May to October and declined till February. Although *P.monodon* is available at all the depths upto 100 m, the abundance gradually increases from 11m to 60 m and then declines gradually till 100 m (Fig.1).

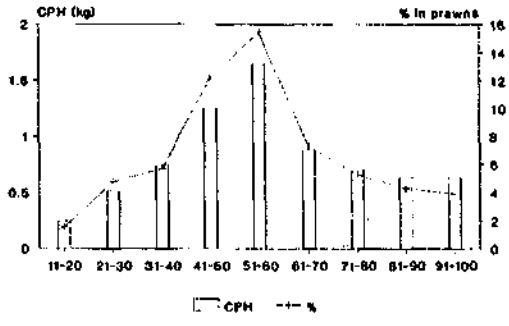

Fig.1. Depth-wise destribution of 'Tigers' in the large trawler landings, 1986-'87

Table 1: **Statewise annual landings of *P. monodon* in tonnes.**

Year	West Bengal	Orissa	Andhra Pradesh	Tamil Nadu	Kerala	Karnataka	Large trawl	Total
1975	83	34	744	195	159	22	-	1237
1976	86	34	389	152	69	18	-	748
1977	20	39	144	141	80	23	-	447
1978	24	83	534	230	90	60	209	1230
1979	16	38	504	232	59	33	133	1015
1980	6	53	410	162	105	22	301	1059
1981	10	65	457	303	23	34	327	1219

1982	12	101	495	244	66	46	327	1293
1983	16	98	359	137	67	50	216	941
1984	92	101	527	271	71	30	266	1358
1985	10	124	143	122	11	2	279	691
1986	16	120	191	175	11	2	305	820
1987	12	141	119	160	6	1	178	617
1988	8	78	96	146	67	50	177	581
1989	21	13	137	151	75	12	235	644
1990	26	54	158	202	18	3	188	649
1991	13	22	233	187	18	3	220	696
1992	27	10	130	213	26	5	100	511
1993	28	21	226	160	24	3	100	562
1994	13	15	1024	464	36	4	100	1656
1995	34	21	235	427	4	2	100	823
1996	14	13	227	413	5	2	100	777
Average	27	58	340	222	50	18	176	890

Stock assessment

Rao *et al.* (1993) estimated the mortality rates and other population parameters of *P. monodon* along the east coast from the data for the 1985-88 period. Estimates for both the sexes are given below.

Parameters	Males	Females
Natural mortality rate (M)	2.050	1.840
Fishing mortality rate (F)	2.277	2.256
Total mortality rate (Z)	4.327	4.096

Exploitation rate (E)	0.526	0.551
Annual catch in t	245	393
Maximum sustainable yield in t	251	401
Average standing stock in t	80	164

The estimates of MSY are higher than the landings during the 1985-88period indicating that the landings can be increased further. However, to attain the MSY levels in both the sexes F has to be increased enormously (Fig.2). It may not be economical to increase the F 3.016 times to increase the catch by 6 t of males and 1.665 times to catch an additional 7 t of females. Hence it is better to harvest the species at the present level of effort. However, it should be noted that even if the present level of effort is doubled there is no threat of overfishing of the stock of *P. monodon*.

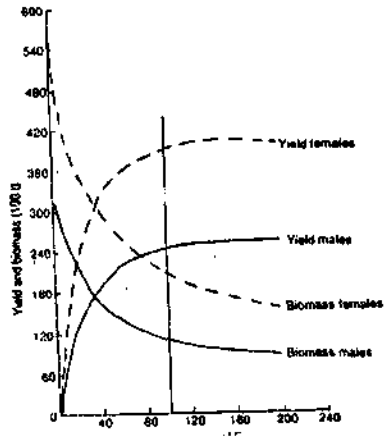

Fig.2. Yield curves of *P. monodon* by the method of Thompson and Bell.

Management measures

Although the fishery dependent factors indicate that there is no threat of overfishing for the species as per the population estimates based on the data for 1985-88, the fishery independent factors particularly associated with the culture of the species in the east coast seem to pose serious threat to the species. They are (1) Enormous quantities of seed of *P. monodon* are caught to stock the farms. The seed collecting methods are such that a good quantity is wasted in catching, transporting and handling and finally only 50% reaches the ponds. (2) Some of the natural nursery grounds of the penaeid prawns are encroached upon by prawn farms and other allied activities, hampering the life of *P. monodon* during this phase of its life.

Since the farming of *P. monodon* is yielding enormous profits compared to the capture fishery operations, people may not be ready to compromise their farming interests for the sake of the capture fishery. During the year 1994-95, 82,800 t of *P. monodon* valued at Rs.1657 crores were produced

through the culture operations while the capture fishery produced only 823 t valued at Rs.16.46 crores during 1995.

However, it should be noted that we still depend on the wild broodstock for the hatcheries and hence it is necessary to take proper management measures to keep the wild population at the optimum level to maintain the catches through the capture fishery and to get continuous supply of breeders for hachery operations.

References

Delmendo, M.N. and H.R. Rabanal, 1956. Cultivation of "sugpo" (jumbo tiger shrimp), *Penaeus monodon* Fabricius, in the Philippines. *Proc. Indo-Pacific Fish. Coun.*, 6(2-3): 424-31.

Hall, D.N.F. 1962. Observations on the taxonomy and biology of some Indo-West Pacific penaeids (Crustacea, Decapoda). Vol.17 p. 1. 229. Fisheries Publication Colonial Office, London.

Holthuis, L.B. 1949. The identity of *Penaeus monodon* Fabr. *Proc. Acad. Sci. Amst.*, 52: 1-8.

Janardhana Rao, K., G.H. Gopalakrishnayya, 1974. Penaeid prawn catches from Pulicat lake in relation to migration of post-larvae and lake hydrography. *Nation. J. Fish. Gent.*, 51(2): 445-454.

Jones, S. 1969. The prawn fishery resources of India. *FAO Fish. Rep.*, 57(2): 735-747.

Kemp, S. 1915. Fauna of the Chilka lake, crustacea, decapoda. *Mem. Indian Mus.*, 3: 201-325.

Kubo, I. 1956. A review of the biology and systematics of shrimps and prawns of Japan. *Proc. Indo-Pacific Fish. Coun.*, 6(3): 387-398.

Lalithadevi, S. 1987. Growth and population dynamics of three penaeid prawns in the trawling grounds of Kakinada. *Indian J. Fish.*, 34: 245-64.

Lalithadevi, S. 1989. Observation on the fishery and biology of Penaeid prawns from Godavari estuary. *Indian J. Fish.*, 35(1): 52-63.

Manisseri, M.K. (MS). The prawn fisheries of estuaries and backwaters.

Mohamed, K.H. 1969. Genus *Penaeus* Fabricius 1798: In prawn fisheries of India. *Bull. Cent. Mar. Fish. Res. Inst.*, No.14: 49-95.

Mohamed, K.H. 1970. Synopsis of biological data on the jumbo tiger prawn *Penaeus monodon* Fabricius. 1988. *FAO Fish. Rep.*, (57) 4: 1251-56.

Mohanty, S.K. 1975. On the food of 'Bagda' *Penaeus monodon* Fabricius from the Chilka lake. *Bull. Dep. Mar. Sci. Univ. of Cochin*, 7 (3): 645-52.

Motoh, H. 1981. Studies on the fishery biology of the giant tiger prawn *Penaeus monodon* in the Philippines. *SEAFDEC. Tech. Rep.*, 7: 1-128.

Panikkar, N.K. and R.G. Aiyar, 1939. Observations on breeding in brackishwater animals of Madras. *Proc. Indian Acad. Sci.*(B), 9b.: 343-364.

Panikkar, N.K. and M.K.Menon, 1956. Prawn fisheries of India. *Proc. Indo-Pacific Fish. Coun.*, 6(3): 1-17.

Ramamurthy, S. and M.S. Muthu, 1969. Prawn fishing methods. *Bull. Cent. Mar. Fish. Res. Inst.*, No. 14: 235-257.

Rao, A.V.P. 1967. Some observations on the biology of *Penaeus indicus* H.M. Edwards and *P. monodon* Fabricius from the Chilka lake. *Indian J. Fish.*, 14: 251-70.

Rao, G. Sudhakara, 1975. Prawn fishery of the Kakinada backwaters. *Bull. Dept. Mar. Sci. Univ. Cochin*, 7: 427-446.

Rao, G. Sudhakara, 1987. A preliminary study on the prawn fishery of big trawlers along the northeast coast of India. *Indian J. Fish.*, 34: 312-328.

Rao, G.Sudhakara, 1988a. Exploitation of prawn fishery resources by trawlers off Kakinada with a note on the stock assessment of commercially important species. *Indian J. Fish.*, 35: 140-155.

Rao, G. Sudhakara, 1988b. Studies on the feeding biology of *Metapenaeus monoceros* (Fabricius) along the Kakinada coast. *J. mar. biol. Ass. India.*, 30: 171-181.

Rao, G. Sudhakara, 1988c. Prawn fishery of the big trawlers along the north-east coast of India. *Mar. Fish. Infor. Serv. T & E Ser.*, 87: 15-30.

Rao, G. Sudhakara, 1990. An assessment of the penaeid prawn seed resources of the Godavari estuary and the adjacent backwaters. *Indian J. Fish.*, 37: 99-108.

Rao, G. Sudhakara, 1993. An appraisal of the marine fishery resources of Visakhapatnam coast. *Fishing Chimes*,. 13(1): 81-87.

Rao, G.Sudhakara, 1993. Shrimp fishery in the coastal and offshore waters of upper east coast. *Proc. of the National workshop on 'Development of Marine Fisheries for higher productivity and export'* organised by Department of Agriculture and Co-operation at Cochin during 9-10th June 1992, pp. 31-61.

Rao, G. Sudhakara, (MS1). Biology and fishery of *Penaeus monodon* along the Kakinada coast.

Rao, G. Sudhakara, (MS2). An assessment of the prawn fishery resources off Visakhapatnam. Proceedings of the Seminar on the Agricultural Potential of north coastal districts held at Srikakulam on 29-30 December 1991.

Rao, G. Sudhakara, C. Suseelan and S.Lalithadevi, 1980. Impact of mesh size reduction of trawl nets on the prawn fishery of Kakinada in Andhra Pradesh. *Mar. Fish. Infor. Serv. T & E. Ser.*, 21: 1-6.

Rao, G.Sudhakara, V.T. Subramanian, M.Rajamani, P.E.S.Manickam and G.Maheswarudu, 1993. Population dynamics of *Penaeus* spp. on the east coast of India. *Indian J. Fish.*, 40: 1-19.

Rao, R.M. and V.Gopalakrishnan, 1970. Identification of juveniles of the prawn *Penaeus monodon* fabricius and *P. indicus* H. M. Edwards. *Proc. IPFC*, 13(2): 128-131.

Silas, E.G., M.J. George and T. Jacob, 1984. A review of the fisheries of India: a scientific basis for the management of the resources. In: *Penaeid shrimps their biology and management*, Eds. Gulland,J.A. and Rothschild, B.J.P. 83-103.

Silas, E.G., M. S.Muthu, N.N.Pillai and K.V.George, 1978. Larval develop-

ment *Penaeus monodon* Fabricius. *Bull. Cent. Mar. Fish. Res. Inst.*, No.28: 2-12.

Sriraman, K., S. Ajmalkhan and R. Natarajan, 1989. Age and growth in *Penaeus monodon* Fabricius of Porto Novo coast. *J. mar. biol. Ass. India*, 31: 261-266.

Subrahmanyam, M. 1964. Fluctuations in prawn landings in the Godavari estuarine system. *Proc. Indo-Pacific Fish. Counc.*, 11(2): 44-46.

Subrahmanyam, M. 1965. Lunar, diurnal and tidal periodicity in relation to the prawn abundance and migration in the Godavari estuarine system. *Fish. Technol.*, 2(1): 26-41.

Subrahmanyam, M. 1966. Fluctuations in the prawn landings in Chilka lake. *Proc. Indo-Pacif. Fish Counc.*, 12(2):202-209.

Subrahmanyam, M. 1967. Further observations on lunar periodicity in relation to the prawn abundance in the Godavari estuarine system. *J. mar. biol. Ass. India*, 9: 111-115.

Subrahmanyam, M. and P.N. Ganapati 1975. Biology of the prawn, *Penaeus monodon* Fabricius from the Godavari estuarine system. *Bull. Dept. Mar. Sci. Univ. Cochin*, 7(3): 653-670.

Subrahmanyam, M. and K.J. Rao 1968. Observations on post-larval prawns (penaeidae) in the Pulicat lake with notes on their utilisation in capture and culture fisheries. *Proc. Indo-Pacific Fish. Coun.*, 13(2): 113-127.

Thomas, M.M. 1972. Food and feeding habits of *Penaeus monodon* Fabricius from Korapuzha estuary. *Indian J. Fish.*, 19(1/2): 202-204.