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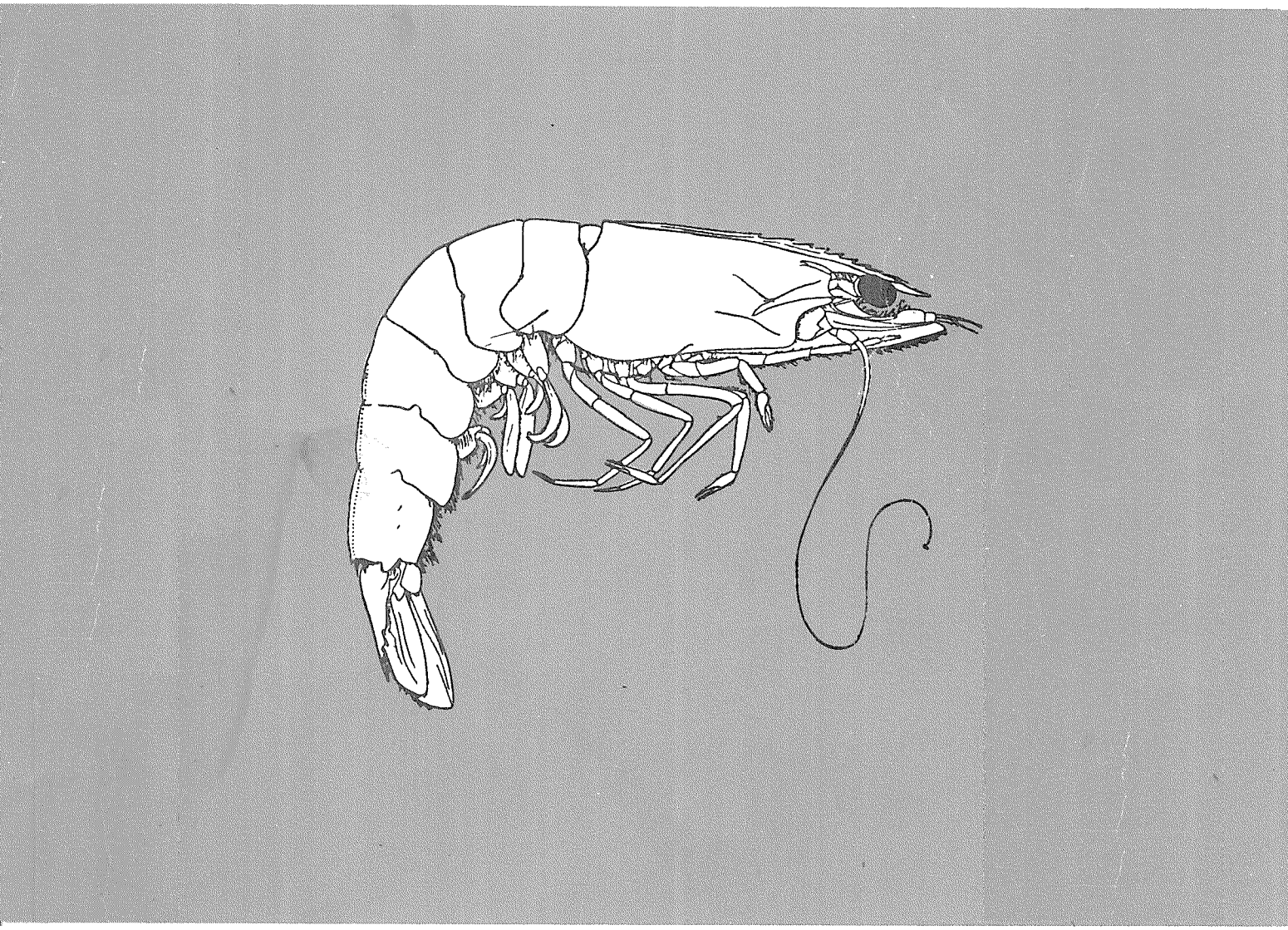

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SYNOPSIS OF BIOLOGICAL DATA ON THE JUMBO TIGER PRAWN *Penaeus monodon* Fabricius, 1798

Exposé synoptique sur la biologie de *Penaeus monodon* Fabricius, 1798

Sinopsis sobre la biología del *Penaeus monodon* Fabricius, 1798

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1/ This synopsis has been prepared according to Outline Version No. 1 (H. Rosa Jr., FAO Fish.Synops., (1) Rev.1, 1965).

* As no information was available to the author, these items have been omitted from the text

1 IDENTITY

1.1 Taxonomy

1.1.1 Definition

Phylum Arthropoda
Class Crustacea
Subclass Malacostraca
Series Eumalacostraca
Superorder Eucarida
Order Decapoda
Suborder Natantia
Section Penaeidea
Family Penaeidae
Subfamily Penaeinae
Genus Penaeus Fabricius, 1798
Species Penaeus monodon Fabricius, 1798

1.1.2 Description

Generic

Genus Penaeus Fabricius, 1798 (Suppl. Entomol. Syst.: 408). Type species, by selection by Latreille (1810, Consid. gén. Anim. Crust. Arachn. Ins.: 102, 422): Penaeus monodon Fabricius, 1798. Gender: masculine. Placed on Official List of Generic Names in Zoology as name no. 498.

Rostrum toothed dorsally and ventrally. Carapace without longitudinal or transverse sutures; cervical and orbito-antennal sulci and antennal carinae always present. Hepatic and antennal spines pronounced, pterygostomial angle rounded. Telson with deep median sulcus, without fixed subapical spines, with or without lateral movable spines. First antennular segment without a spine on ventral distomedian border. Antennular flagella shorter than carapace. Maxillulary palp with 2 or 3 segments, usually 3. Basial spines on 1st and 2nd pereiopods; exopods on 1st 4 pereiopods, usually present on 5th. Petasma symmetrical, pod-like with thin median lobes with or without distal protuberances; lateral lobes often with thickened ventral margin. Appendix masculina with distal segment subtriangular or ovoid, bearing numerous spines. Thelycum usually with an anterior process, variable in shape, lying between the coxae of 4th pereiopods; with or without lateral plates on sternite XIV. Pleurobranchiae on somites IX to XIV: a rudimentary arthrobranch on somite VII, and a posterior arthrobranch on somite XIII; mastigobranchiae on somites VII to XII. Zygocardiac ossiole consisting of a principal tooth followed by a longitudinal row of smaller teeth which often end in a cluster of minute teeth. Body glabrous. (After Dall, 1957, slightly modified by Pérez-Farfante).

The genus at present includes about 28 known species. Balss (1957, Bronn's Klass. Ordn. Tierr. 5(1) (7) (12):1518) mentioned a subgenus Salambria Burkenroad, but this is a nomen nudum. Although the genus falls into two very natural groups, no other attempts have been made to recognise these as subgenera.

Specific

Species Penaeus monodon Fabricius, 1798 (Fig. 1).

The original type material no longer exists. A neotype was selected by Holthuis (1949, Proc. Kon. Nederl. Akad. Wetensch., 52(9):1056); it is a male of total length 200 mm from the Bay of Djakarta (Batavia), Java, Indonesia (June 1924, leg. P. Buitendijk) in the collection of the Rijksmuseum van Natuurlijke Historie, Leiden (Reg. No. Crust. D. 5734).

Type locality: "Habitat in Oceano Indico" (Fabricius, 1798), restricted by the neotype selection to Bay of Djakarta, Java, Indonesia.

The name monodon has been used by some older authors for the species at present generally indicated with the name Penaeus semisulcatus De Haan, while the name Penaeus carinatus has been often used for the present species. In recent years the nomenclature of the two species has become stabilized and the name monodon generally accepted for the present species.

Rostrum with 7-8/2-3 teeth, usually 7/3, exceeding tip of antennular peduncle and sigmoid in shape in juveniles and adults. Adrostral carina reaching almost to epigastric tooth. Postrostral carina often more or less flat with feeble indications of a sulcus, carina reaching almost to posterior edge of carapace. Gastro-orbital carina occupying posterior 1/3 to 1/2 distance between postorbital margin of carapace and hepatic spine. Hepatic carina prominent, anterior 1/2 horizontal, the posterior often diverging very slightly below horizontal axis; distinctly separated from base of antennal carina which ends above middle of hepatic carina. Hepatic sulcus ill-defined. Cervical sulcus often with upper 1/3 indistinct, 1/5 to 1/7 length of carapace.

Antennular flagella subequal or slightly longer than peduncle. Prosartema reaching to or barely exceeding tip, stylocerite attaining 1/2 basal segment. Endopod of maxilliped III reaching tip of antennular peduncle in adult male, reaching distal end of basal segment of antennular peduncle in females and juvenile males. Dactyl almost length of propodus in male, inserted at 1/5 length of propodus, the distal end of latter

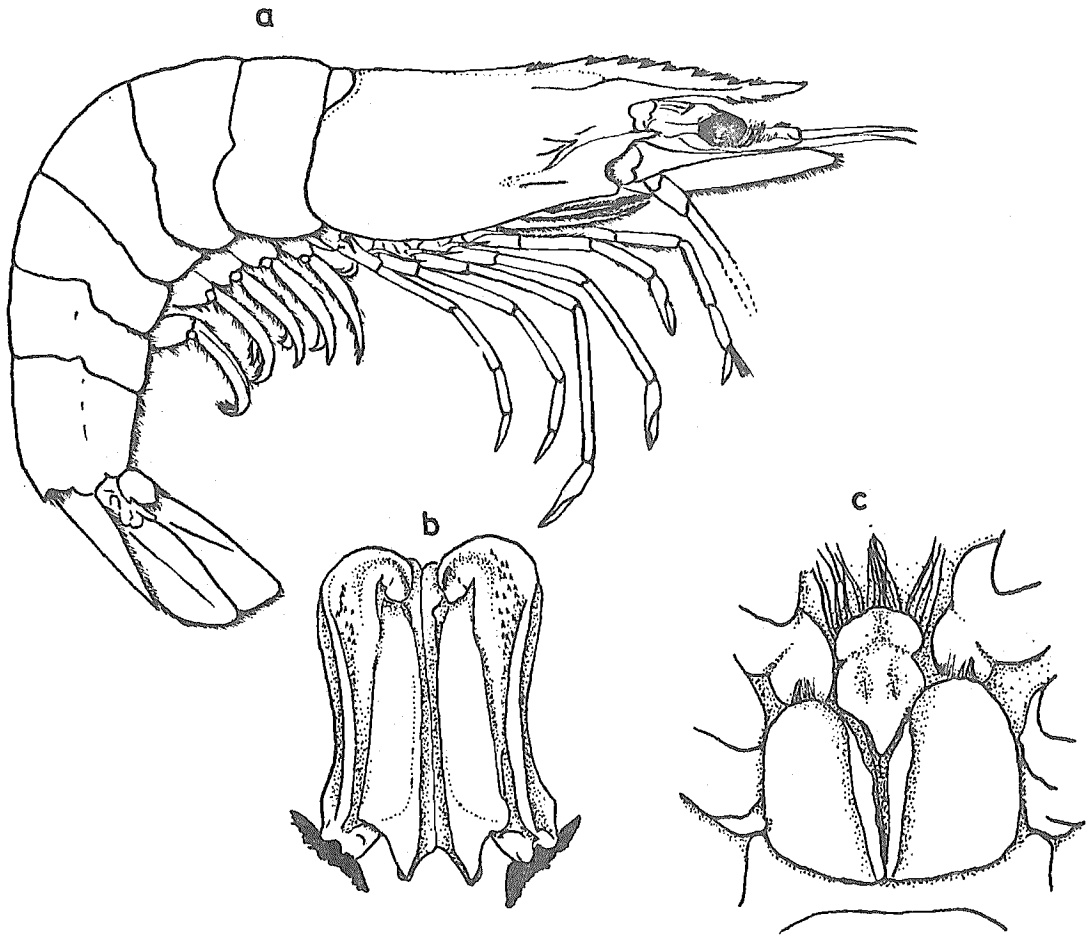

Fig. 1 a. Penaeus monodon; b. Petasma; c. Thelycum
(b. and c. from Hall, 1962)

bearing a tuft of setae as long as dactyl. Dactyl 1/2 to 2/3 length of propodus in female and inserted apically. First pereiopod reaching distal end of or slightly exceeding carpocerite, second reaching distal end of basal segment of antennular peduncle, third reaching to or exceeding tip of peduncle by dactyl, fourth reaching as far as first, fifth exceeding fourth by dactyl. Ischial spine on first pereiopod; no exopod on fifth leg.

Abdomen dorsally carinated from anterior 1/3 of fourth somite. Carina curving downwards fairly strongly towards posterior end of sixth somite. The fourth and fifth somites each with a small cicatrice, sixth with three cicatrices. Telson unarmed. Cardiac plate with 18 to 24 spinules, usually 20 to 24, zygocardiac ossicle principal + 9 to 12 conical teeth, usually 9 to 10, followed by several smaller teeth and a cluster of minute teeth, prepyloric acute with 6 to 8 large teeth, sometimes with 2 to 3 smaller teeth on lateral margin.

Petasma symmetrical; median anterior lobe small, separated from lateral by a shallow notch, not projecting as far as lateral lobes. Lateral lobes without distal setae, with distolateral irregular group of ossicles greatly variable in number. Distal piece of appendix masculina 1.6 to 1.7 times as long as width, at least basal half naked. Length of anterior plate of thelycum twice the width, anterior rounded portion concave, posterior bluntly pointed portion inserted between flaps of seminal receptacles for 2/5 their length. Seminal receptacles circular, flaps forming tumid reflected lips on mid line, with smooth inner edges in impregnated females (Dall, 1957).

Colour of fresh specimens dark blue to black, carapace and abdomen transversely banded, a pair of broad dark bands on each abdominal somite. Pleopods fringed with bright red setae. Pleopods and uropods tipped with light blue. Pattern of colour variable.

A key to the Indo-Pacific species of Penaeinae is given by Racek and Dall (1965). A key to African species is given by Barnard (1950).

1.2 Nomenclature

1.2.1 Valid scientific names

Penaeus monodon Fabricius, 1798 (Suppl. Entomol. Syst.: 408)

1.2.2 Synonyms

Objective synonymy

Astacus (Penaeus) monodon (Fabricius) Voigt, 1836, Cuvier's Thierreich, 4:176.

Subjective synonymy

Penaeus carinatus Dana, 1852, Crust. U.S. Explor. Exped. 1838-43, 13(1):602.

Penaeus coeruleus Stebbing, 1905, Mar. Invest. S. Africa 4:77.

Penaeus bubulus Kubo, 1949, J. Tokyo Coll. Fish. 36(1):296.

1.2.3 Standard common names, vernacular names

Country	Standard common names	Vernacular names
Australia	Jumbo tiger prawn Giant (Black) tiger prawn	Tiger prawn, Jumbo prawn, Giant tiger prawn
Philippines	Jumbo tiger shrimp	Sugpo
India:		
Calcutta	-	Bagda chingdi
Madras	-	Yera
Kerala	-	Kara chemmeen
Bombay	-	Jinga
South Africa	Tiger prawn	-

1.3 General variability

1.3.1 Subspecific fragmentation (races, varieties, hybrids)

No subspecies are currently recognized of the present species. Penaeus monodon manillensis Villaluz and Arriola, 1938, proved to be based on an abnormal specimen of Penaeus semisulcatus De Haan.

2 DISTRIBUTION

2.1 Delimitation of the total area of of distribution and ecological characterization of this area

The species is fairly widely distributed throughout the greater part of the west Indo-Pacific region ranging from South Africa to southern Japan, and from Karachi to northern New South Wales, i.e. throughout the coastal districts of sea areas ISW and ISEW, and extending into areas INW and PSE, as defined in Holthuis and Rosa (1965). It occurs on the coasts of land areas 133, 154, 155, 156, 421(W), 423, 432, 433, 434, 437, 441, 451, 453, 611, 612 and 616. The species apparently prefers warm water habitats. It is recorded from seas, rivers, estuaries, backwaters and even from freshwater.

2.2 Differential distribution

2.2.1 Areas occupied by eggs, larvae and other junior stages: annual variations in these patterns, and seasonal variations for stages persisting over two or more seasons

No information is available on the eggs of the species.

Panikkar and Aiyar (1939) reported that the larvae enter Adayar backwaters (Madras) along with postlarvae during all the months that the bar remains open.

Occurrence of postlarvae has been reported from the Chilka Lake and the Ennur backwaters by Kemp (1915). They are pelagic and are reported to live among weeds. Large numbers of them settle in weed pools and backwaters of the Gangetic delta, situated many miles from the sea. Delmendo and Rabanal (1956) observed that the fry of the species are carried to the shallow coastal areas, tidal rivers and estuaries by the incoming tide. They also enter fish ponds through the coarse screen of the water control gates. In the Philippines the fry are collected from these areas during May to October; peak occurrence being noted in August and September. Juveniles also occur in prawn ponds in Singapore (Hall, 1962). Small numbers of juveniles occur in sheltered shallow waters on the coasts of Zanzibar Island during the northerly monsoon (Hall, 1967).

2.2.2 Areas occupied by adult stages: seasonal and annual variations of these

Kemp (1915) stated that the species is migratory in habit, the adults migrating out to sea during the breeding season. On the Kerala coast the species occurs both in the sea and in the backwaters in relatively smaller quantities. In the trawler catches of the region it is seen that the larger sized prawns are obtained from the deeper waters. In Bombay the catches mostly consist of immature specimens. Hall (1967) stated that adults are fished in water of less than 9 m off Aden and in very shallow water in the Mafia Archipelago, Tanzania.

3 BIONOMICS AND LIFE HISTORY

3.1 Reproduction

3.1.1 Sexuality (hermaphroditism, heterosexuality, intersexuality)

P. monodon is heterosexual. The sexes can be distinguished by external characters such as the presence of sex organs, petasma for males and thelycum for females. The presence of an appendix masculina on the endopod of the second pair of pleopods is another secondary sexual character of the male. While the genital openings of the male are situated on the coxa of the fifth pair of walking legs those of the female are on the coxa of the third pair of walking legs. Females also attain a relatively larger size than males.

3.1.3 Mating (monogamous, polygamous, promiscuous)

Possibly promiscuous as in other prawns. Observations on this species are wanting.

3.1.7 Spawning grounds

Hall (1962) indicated the possibility of the species breeding on the same grounds as P. indicus, outside Singapore waters, during the months February to April.

3.2 Larval history

3.2.1 Account of embryonic and juvenile life (prelarva, larva, postlarva, juvenile)

Information on the early larval history of the species is wanting. Kemp (1915) observed 10 mm long postlarvae in Chilka Lake and Ennur. They are pelagic and transparent with a crimson streak running along the ventral surface, involving the whole of the antennules and the telson, but not the other appendages, except to a slight extent on the uropods. They possess two pairs of lateral spines on the telson. The rostrum in the youngest individuals is without inferior teeth and extends a little beyond the eyes.

Larger postlarval specimens are still slender, but are deeply mottled with dark grey and dull green. They live among weeds. The 'sugpo' fry, figured by Delmendo and Rabanal (1956), appears to be an advanced postlarval stage. The smallest size of fry recorded is 15.3 mm total length, 1.6 mm body depth and 0.025 g weight.

3.3 Adult history

3.3.1 Longevity

Panikkar and Aiyar (1939) found the larval and postlarval stages of the species entering the backwaters of Madras and stated that they grow there for about a year, after which they go back to the sea to breed. The number of age groups in the fishery is not determined. Srivatsa (1953) stated that the life span of the prawns (including P. monodon) in the Gulf of Kutch is 12 to 14 months.

3.3.2 Hardiness

P. monodon is euryhaline, capable of withstanding a wide range of salinity. Panikkar and Menon (1956) observed the species even in the freshwater regions of Collair Lake. To some extent they are eurythermal, as evidenced from the wide gradient of temperature of the natural habitat of the species.

3.3.6 Greatest size

The greatest length recorded by Racek (1955) was 305 mm, but Crosnier (1965) recorded a female of 307 mm from Madagascar and quoted 337 mm as the largest recorded from any area.

3.4 Nutrition and growth

3.4.1 Feeding (time, place, manner, season)

Panikkar (1952) observed that the food of young penaeids consisted of organic detritus, algal material and other extremely small organisms contained in the mud. Hall (1962) found that the food of the species consisted of large crustaceans, vegetable matter, polychaetes, molluscs and fish. Small crustaceans and insects were taken occasionally. Small crustacean material only was found in the stomachs of prawns obtained from prawn ponds and mostly consisted of harpacticoid copepods. Large crustacean food items were mostly of brachyuran origin. He observed three specimens having their food bolus divided into three parts, each having different food items. Based on this he suggested that the species had been engaged in ingesting material of secondary choice when no opportunity was presented for ingesting preferential crustacean material. According to him the presence of a split bolus was not indicative of varying feeding behaviour during different periods of the day.

3.4.3 Relative and absolute growth patterns and rates

From the available literature it is fairly clear that the species migrates into the estuaries and backwaters early in life. No information is available on its growth in

TABLE I

Average rate of growth of P. monodon under cultivation (Delmendo and Rabanal, 1956)

Duration of culture	Total length in mm	Body depth in mm	Weight in grams
Fry	15.3	1.6	0.025
1 wk	21.5	2.5	0.06
2 wk	28.2	3.6	0.08
3 wk	38.8	4.5	0.02
4 wk	45.3	5.7	0.78
5 wk	57.1	7.8	1.63
6 wk	60.3	9.7	3.30
7 wk	69.5	10.9	4.36
2 mo	79.0	9.8	4.34
3 mo	94.7	11.1	6.88
4 mo	120.0	15.3	14.5
5 mo	I n c o m p l e t e		
6 mo	141.9	18.3	22.3
7 mo	152.6	16.4	25.1
8 mo	I n c o m p l e t e		
9 mo	178.0	27.8	57.3
10 mo	211.6	30.2	62.8
11 mo	223.0	32.0	70.7
1 yr	229.8	32.0	95.1

Note - The data for the 9th to 12th months are for the 1951 to 1952 season only and are therefore not strictly comparable with averages for the earlier periods.

the sea. The average growth observed by Delmendo and Rabanal in the Philippine nursery ponds is given in Table 1.

Delmendo and Rabanal (1956) recorded that the growth rate may be still faster. The largest one-year olds may be as long as 250.0 mm and weigh 120 g while the smallest may be only 180 mm in length and 50 g in weight. They observed that a kilogram of one year old 'sugpo' may contain 8 to 20 individuals.

Hall (1962) estimated the weight length relationship of the species as

$$W = 1.0000\ C^{2.640}$$

where W is weight of prawn in g and C is carapace length in cm.

3.5 Behaviour

3.5.1 Migration and local movements

That the young ones of the species take shelter under weeds in the estuaries was reported by Kemp (1915), Domantay (1956) and Delmendo and Rabanal (1956). Kemp noticed that the young of the species ascend estuaries and make their way to waters of low salinity only in those seasons in which the species is not breeding. The pelagic stages of larvae and postlarvae are apparently carried by the tide well up into the Gangetic delta. According to him the adults annually resort to the sea in the breeding season. Delmendo and Rabanal (1956) stated that it is probable that the 'sugpo' spawn in the sea not far from the coast and that the young are carried to shallow coastal areas, tidal rivers and estuaries by the incoming tide. They also enter fish ponds through the coarse screens of the water control gates, where they constitute a welcome and gratuitous addition to the cultivated fish crop. Shaikhmahmud and Tembe (1960) observed that the species is caught regularly in Bombay waters. From the available information about this species, as well as others of the genus, it is quite clear that the general pattern of movement seen in most of the penaeid prawns, sea to estuary and back, is followed by this species also.

4 POPULATION (STOCK)

4.1 Structure

4.1.2 Age composition

Attempts have not been made to assess the age composition of the species in the marine catches. Based on the growth rate given by Delmendo and Rabanal (1956) the prawns observed in Bombay stake net catches by Shaikhmahmud and Tembe (1960) may be considered as 0-year class. The backwater fishery and the prawn pond fishery are fully supported by the 0-class. In a general study, Srivatsa (1953) observed that the Gulf of Kutch prawns (including this species) have only one year span of life and perhaps die soon after spawning.

4.1.3 Size composition

Panikkar and Menon (1956) recorded 10 to 11 in (25.4 to 27.9 cm) as its largest size in the marine catches off the coasts of India. Shaikhmahmud and Tembe (1960) observed prawns of 10 to 15 cm in the Bombay catches.

5 EXPLOITATION

5.1 Fishing equipment

5.1.1 Fishing gear

On the southwest coast of India the species is caught in small quantities by stake nets, cast nets, dip nets, etc. In the Philippines, Domantay (1956) described several nets and contraptions made of cotton twine and bamboo poles for the capture of the species, particularly from the mangrove swamps. These contraptions include impounding nets, push nets, skimming nets, drive-in-nets, lever nets, drag nets, dip nets, cover pot, entangling nets, guiding barriers, etc. Fish lures locally known as 'bon-bon', are extensively used in Philippine waters to catch the fry of the species. Intertidal traps called 'valakira' are used to catch young prawns in Madagascar (Crosnier, 1965), and similar traps are used in some other east African countries (Hall, 1967).

From the sea the species is caught in stake nets, shore seines, boat seines and trawl nets.

5.1.2 Fishing boats

Catamarans, dug-outs, canoes and trawlers land P. monodon along with other prawns.

5.2 Fishing areas

5.2.1 General geographic distribution

P. monodon is fished to some extent throughout its geographical range (see Section 2.1), but its commercial importance is greatest in India and the Philippines.

5.2.3 Depth ranges

From the estuarine and backwater fishery the juveniles and postlarvae are caught from shallow regions. From the sea the adults are caught in depths up to 60 fm (110 m).

5.3 Fishing seasons

In the Kerala backwater fishery the species is caught throughout the season in small numbers. In the Gautami estuary the species is caught in all the months but the intense fishery is from November to early January (Subrahmanyam, 1966). The 'sugpo' fry season in the Philippines starts from May and extends up to October. In Bombay they are found in the commercial catches from August to October. Year to year variation in the fishing season is generally not evident.

5.4 Fishing operations and results

5.4.3 Catches

Srivatsa (1953) estimated that 10 percent of the Gulf of Kutch prawn fishery is constituted by P. monodon. Delmendo and Rabanal (1956) stated that unstocked ponds in the Philippines yield 50 to 200 kg of prawns per hectare per year and the stocked ponds yield about 500 kg, of which 70 percent may consist of P. monodon. Subrahmanyam (1966) estimated the catches of the species from the Gautami estuary as 500 tons in 1960 to 1961 and the average rate of catch as 2.1 kg/day/net.

5.6 Fish farming, transplanting and other intervention

The species is cultured in Philippine waters and to some extent in Formosa (Delmendo and Rabanal, 1956; Kesteven and Job, 1957). In the Philippines the 'sugpo fry' (advanced postlarvae) are collected, reared, transplanted and grown in culture ponds. The 'sugpo fry' are collected from natural waters of the tidal creeks by using 'bon-bon' lures made of a bunch of water grass and are transported to the nursery ponds. After attaining some growth the small prawns are collected from the nursery ponds and are stocked in rearing ponds, either by themselves or along with Chanos chanos. Best results are obtained when prawns are stocked alone. They are harvested twice - once at the time of transplantation to the rearing ponds and a second time at the final harvesting. They attain marketable size within six months to one year. Delmendo and Rabanal (1956) record the following three factors which exercise some kind of limitations to this lucrative practice:

i. Harvesting of the crop is rendered difficult due to the nongregarious habits of the prawn.

ii. Rate of survival of the fry is poor, estimated at 10 to 50 percent.

iii. Season for 'sugpo fry' collection varies from year to year and the supply fluctuates considerably.

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