MARINE FISHERIES INFORMATION SERVICE

No. 53

SEPTEMBER, 1983

Technical and Extension Series

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
COCHIN, INDIA

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

THE MARINE FISHERIES INFORMATION SERVICE: Technical and Extension Series envisages the rapid dissemination of Information on marine and brackish water fishery resources and allied data available with the Fishery Data Centre and the Research Divisions of the Institute, results of proven researches for transfer of technology to the fish farmers and industry and of other relevant information needed for Research and Development efforts in the marine fisheries sector.

Abbreviation – *Mar. Fish. Infor. Serv. T & E Ser.*, No. 53 : 1983

CONTENTS

Cover photo: Small fishing trawlers at the jetty at Sakthikulangara

MONSOON PRAWN FISHERY OF NEENDAKARA COAST, KERALA— A CRITICAL STUDY

M. J. George, C. Suseelan, M. M. Thomas, N. S. Kurup, K.N. Rajan, V. S. Kakati, K. N. Gopalakrishnan, K. Chellappan, K. K. Balasubramanian and C. Nalini

Introduction

In a previous article in these columns *(Mar. Fish. Infor. Serv. T & E Ser.* **18**: 1-8, 1980) the results of a detailed analysis of the prawn fishery of Neendakara area with special reference to the trends in production, fishing operations, species composition, seasonal abundance and other biological aspects have been reported. The depletionary tendencies in the fishery leading to an economic overfishing of the resources and the need for adopting suitable conservation measures were indicated in the study. Since the publication of this report in 1980, in a further monitoring of the fishery with a view to evaluate the extent of overfishing of the major species involved during the peak season, the effect of fishing over the seasons on the size of the shrimps and to determine the effective conservation measures to be adopted for optimum exploitation of the resources with reference to both size as well as quantity of the species, an intensive study of the fishery was undertaken during the peak fishing seasons of 1980 to 1982. The outcome of this critical evaluation in continuation of the earlier study is reported in the present contribution.

Trends in seasonal fishery (Fig. 1)

As established earlier the peak fishing season accounting for nearly 83% of the total trawl landings of the year, of which about 38% are constituted by prawns, is during the southwest monsoon period June to September when trawling operations remain very inactive in other parts of the west coast. So the prawn fishery of the area is almost a monsoon fishery, nearly 87% of the total prawn catches of the whole year being landed during the months June to September. Hence the present intensive study is limited to the particular season of the fishery.

The trend in prawn landings at Neendakara-Sakthikulangara area in relation to total catch and effort during the monsoon seasons of the 10 year period from 1973 to 1982 is shown in table 1. The maximum catch during the season (47,951 tonnes) is recorded in 1975. In 1976 there was a steep decline to 11,538 tonnes, and in 1980 again steadily increased to 36,070 tonnes. Thereafter both in 1981 and 1982 very poor catches of less than 8,000 tonnes have been recorded. The effort and catch per effort also show a very similar trend.

Table 1: *Estimated catch, effort and catch rates of prawns for the monsoon period (June-September) against the annual prawn landings at Sakthikulangara (Neendakara) from* 1973 *to* 1982.

Year	Effort (No. of trawler trips)	Total prawn catch (tonnes)	Catch/ boat/ day (kg.)	Annual prawn landings at the centre (tonnes)
1973	62,859	38,542	613	45,477
1974	75,366	18,698	248	27,765
1975	1,50,364	47,951	318	56,750
1976	43,444	11,538	265	14,993
1977	81,184	21,290	262	24,121
1978	1,30,527	28,017	214	33,143
1979	69,455	12,784	178	14,582
1980	99,411	36,070	362	36,558
1981	62,557	7,444	119	9,399
1982	66,708	7,278	109	9,487

Monthly catch variations

From the data given in table 2, over the years it is seen that the fishery starts in the month of June, picks up considerably in July and August and decreases by September, recording the maximum catches either in July or in August. Only in one exceptional year, *ie.* 1977 a regular increase from the minimum in June to a maximum in September is noticed. Among the other years, in all the years prior to 1977 the maximum catches are

seen in the month of August and in the years after 1977 July shows the maximum catches of prawns except in 1981. The monthly input of effort also shows more or less the same trend, increasing steadily from June, reaching maximum in July or August and with the decrease in landings the effort also declines considerably by September. But in 1977 contrary to the regular increase of the catches from June onwards to September, recording the maximum catch in that month, the effort is maximum in August, resulting in a lesser effort bringing in higher catches in September or in other words a higher catch rate in the month. This is exceptional, but in all the other years the catch rate remains high either in August or in July.

Table 2. *Monthwise trawling effort and catch details at Sakthikulangara during the monsoon period from* 1973 to 1982

Year	Effort - No. of boat trips (Catch rate of prawns in kg/boat trip)					Prawn landings in tonnes (Percentage of prawns in total trawl-catch)				
	June	July	August	Sept.	Total	June	July	August	Sept.	Total
1973	15,157 (211)	19,443 (651)	17,799 (1235)	10,460 (67)	62,859 (613)	3,202.8 (53.1)	12,652.2 (83.4)	21,983.3 (85.3)	703.9 (32.8)	38,542
1974	16,002 (80)	8,722 (27)	20,525 (494)	30,117 (234)	75,366 (248)	1,283.0 (21.5)	235,2 (11.6)	10,140.7 (65.5)	7,038.9 (19.3)	18,698
1975	31,557 (67)	61,377 (235)	47,310 (671)	10,120 (31)	1,50,364 (319)	2,109.5 (19.3)	13,806.7 (31.0)	31,722.2 (57.7)	312.8 (11.6)	47,951
1976	8,080 (82)	3,426 (200)	19,721 (495)	12,217 (34)	43,444 (266)	665.0 (33.0)	685.0 (60.1)	9,768.2 (79.2)	419.8 (16.7)	11,538
1977	6,289 (38)	22,191 (150)	30,106 (264)	22,598 (432)	81,184 (262)	241.9 (15.7)	3,334.3 (32.3)	7,949.8 (40.2)	9,763.8 (73.9)	21,290
1978	26,083 (186)	28,039 (573)	41,030 (167)	35,375 (7)	1,30,527 (215)	4,849.7 (49.2)	16,068.1 (64.1)	6,855.9 (26.9)	243.7 (4.2)	28,017
1979	6,801 (132)	23,531 (396)	22,878 (90)	16,245 (10)	69,455 (179)	900.0 (45.3)	9,313.1 (63.5)	2,064.2 (14.9)	506.9 (7.7)	12,784
1980	16,342 (58)	35,681 (757)	21,904 (270)	25,484 (87)	99,411 (363)	946.1 (27.4)	27,012.1 (79.8)	5,903.8 (43.6)	2,208.1 (15.9)	36,070
1981	16,890 (80)	20,679 (119)	16,621 (208)	8,367 (21)	62,557 (119)	1,349.0 (36.0)	2,465.3 (29.0)	3,454.5 (59.6)	175.4 (89.9)	7,444
1982	19,594 (64)	18,063 (258)	18,436 (58)	10,615 (29)	66,708 (109)	1,246.3 (22.8)	4,653.2 (46.7)	1,069.8 (21.4)	308.7 (16.5)	7,278

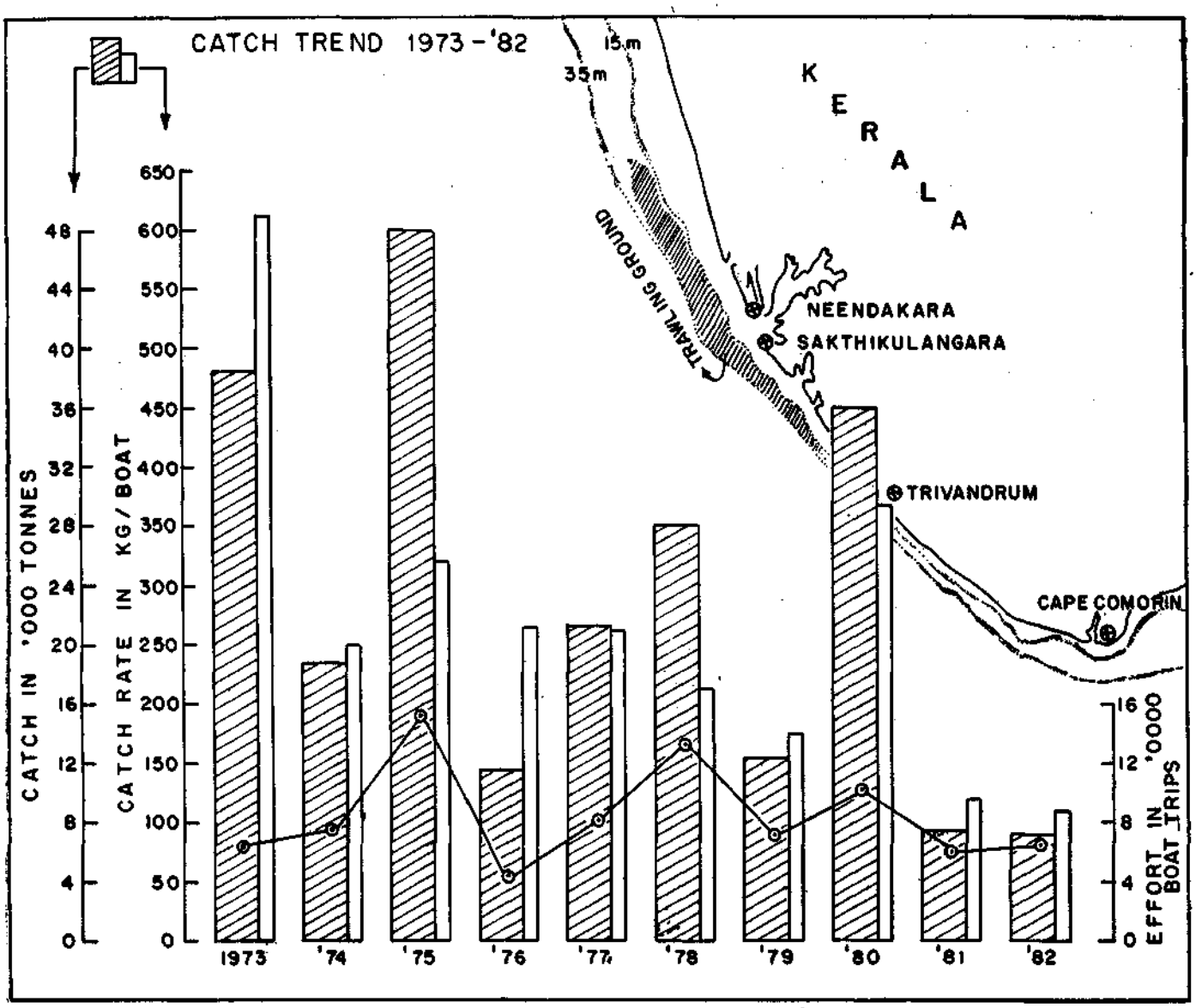


Fig. 1. Production trend of prawns at Neendakara during the monsoon periods of 1973 to 1982

Species composition and variation in abundance

The prawn fishery is supported by penaeid prawns only and that too mostly by one species. The catch composition of the prawn landings of the area during June to September period over the past 10 years is shown in table 3. *Parapenaeopsis stylifera, Metapenaeus dobsoni, M. monoceros, M. affinis* and *Penaeus indicus* are the species represented. *P. monodon, P. canaliculatus* and a few other species are represented rarely. On an average the percentage of *P. stylifera* (Karikkadi) over the years is 85.8, *M. dobsoni* 5.3, *M. monoceros* 4.4, *M. affinis* 1.8, *P. indicus* 1.8 and other species 0.9. As indicated in the earlier publication it is clear from the present study also that the fishery is mostly for *P. stylifera* and thus the fishermen and the industry has named the fishery as 'Karikkadi fishery.' In a period of 10 years only in the years 1973, 1975, 1979 and 1982 does the overall percentage of the species in the fishery go below 90. The least percentage of 70.8 was recorded in 1975 and the highest percentage of 95.7 in 1980.

It is interesting to note that among the less represented species the smaller and medium sized species of *Metapenaeus* which were present in comparatively higher percentages have come down considerably in 1981 and 1982, while in the large sized *P. indicus* the percentage which was very low in earlier years has gone up to 3.1 and 6.9 respectively in 1981 and 1982. This is one reason why in these years although the total quantity of prawns landed is considerably less the value realised does not show any serious decrease. The

increase in percentage of *P. indicus* (naran chemmeen) is especially noticed in the month of June when the seasonal fishery commenced. During 1982 season out of 1,246 tonnes of prawns landed at the centre in June, this species alone accounted for 35%. But in subsequent months the representation of the species declined considerably, *P. stylifera* taking up the place exclusively.

Fluctuations in catches

A day to day analysis of the total catches of the species landed at the centre (Fig. 2) shows that there is wide variation in the catches during the season. A study of the figure would indicate that very heavy catches occur only on a few days during the entire season and the magnitude of the fishery for the season mainly depends on the catches of these days. For instance in 1980 this really heavy catch, going upto 1700 kg per boat, occurs only in a few days in the latter half of July and this is reflected in the total catch for the season, reaching a comparatively high figure. On the contrary such high catches are never encountered on any day in the 1982 season, the catch per boat never rising above 400 kg with the result the total catch of the season keeps a very low profile. From the figure it seems that the effort put in is fairly high throughout the season, giving a comparatively low rate of catch per boat. This might probably indicate that the abundance of the

Table 3. *Catch composition of prawn landings at Sakthikulangara during the monsoon period (June-September) from* 1973 *to* 1982

Year	Landings in tonnes (species-wise percentage in parenthesis)						
	P. indicus	*M. affinis*	*M. monoceros*	*M. dobsoni*	*P. stylifera*	Other species	Total prawns
1973	234.7 (0.61)	1,719.7 (4.46)	4,403.6 (11.43)	141.9 (0.36)	31,951.6 (82.90)	90.6 (0.24)	38,542
1974	144.7 (0.77)	238.1 (1.27)	749.5 (4.01)	22.7 (0.12)	17,396.1 (93.04)	146.9 (0.79)	18,698
1975	2,164.7 (4.52)	799.6 (1.67)	2,015.7 (4.20)	7,484.2 (15.61)	33,960.4 (70.82)	1,526.7 (3.18)	47,951
1976	119.6 (1.04)	127.0 (1.10)	147.9 (1.28)	108.0 (0.94)	10,967.0 (95.05)	68.5 (0.59)	11,538
1977	168.7 (0.79)	41.6 (0.20)	1,535.3 (7.21)	—	19,442.6 (91.32)	101.7 (0.48)	21,290
1978	306.2 (1.09)	299.7 (1.07)	423.2 (1.51)	1,721.5 (6.14)	25,239.9 (90.09)	26.9 (0.10)	28,017
1979	78.0 (0.61)	304.5 (2.38)	334.6 (2.62)	1,847.3 (14.45)	10,205.7 (79.83)	14.1 (0.11)	12,784
1980	201.0 (0.56)	386.9 (1.07)	296.1 (0.82)	627.7 (1.74)	34,523.1 (95.71)	35.6 (0.10)	36,070
1981	229.5 (3.08)	77.9 (1.04)	102.6 (1.38)	72.2 (0.97)	6,864.0 (92.21)	98.1 (1.31)	7,444
1982	504.0 (6.92)	40.1 (0.56)	130.8 (1.80)	166.6 (2.29)	6,361.3 (87.40)	75.3 (1.03)	7,278

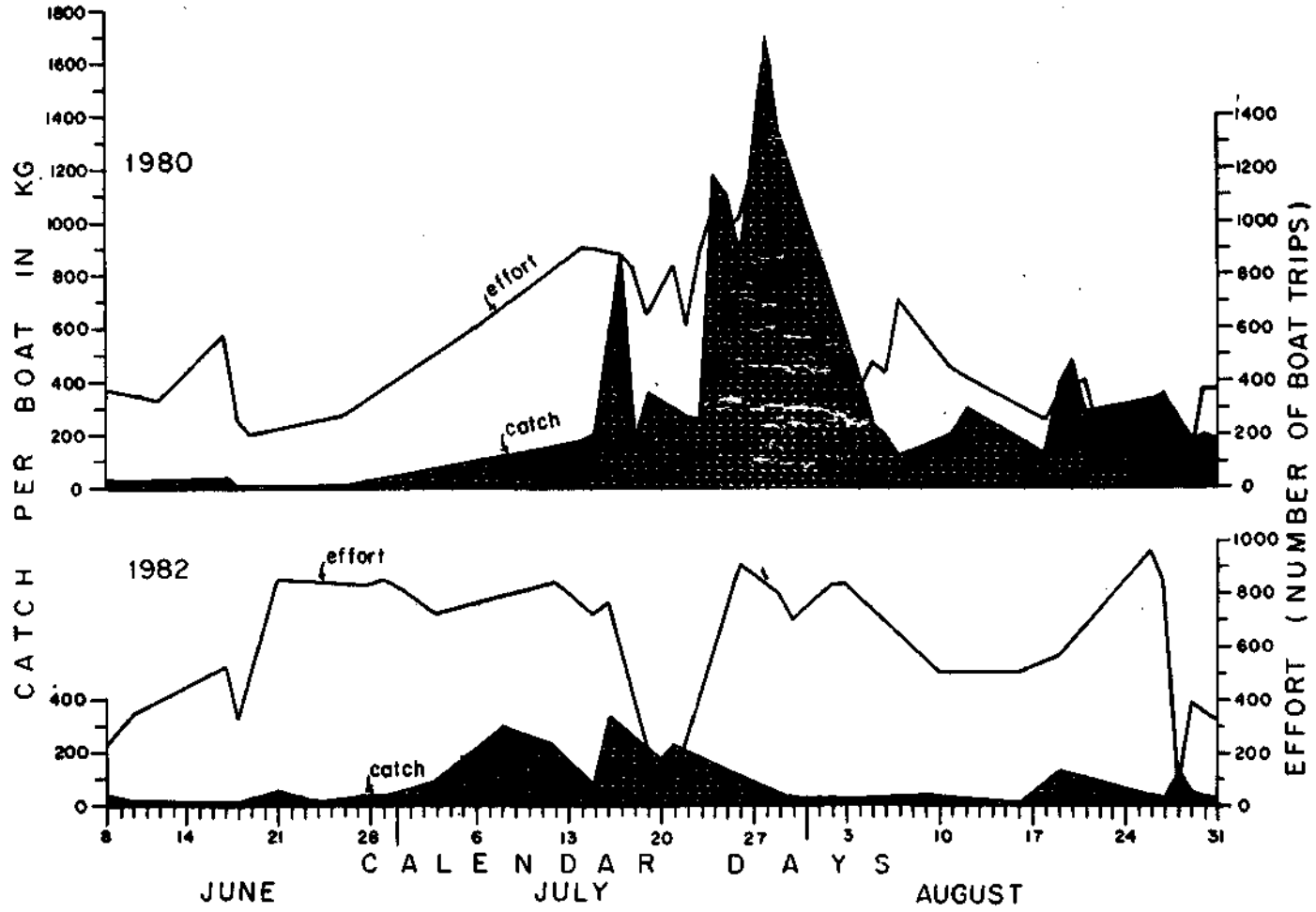


Fig. 2. Catch and effort details of *P. stylifera* on observation days during 1980 and 1982 seasons.

prawns in the particular area of operation of the boats is quite low throughout this season or in other words the stock size has gone down. The sudden fall in fishing effort on 20th and 21st July, 1982 was due to rough sea.

Size distribution

The sex-wise size distribution of *P. stylifera* recorded from June to August 1982 is depicted in Fig. 3. In the overall fishery the size, measured from tip of rostrum to that of telson, ranged from 32 to 103 mm in males and 33 to 115 mm in females. However, the bulk of the catch was made up by 56–95 mm of the former and 56–105 mm of the latter. The size preferred by the industry is normally above 65 mm and since the meat recovery below this size is extremely poor they are otherwise disposed. As could be seen from the figure the catch was mostly constituted by prawns above 75 mm in the beginning of the season and thereafter still smaller sizes entered into the fishery in substantial quantities. In fact, smaller sizes below 65 mm dominated the fishery towards the end of June and July, indicating fresh recruitment of juveniles into the area during that period.

The occurrence of undersized prawns in the fishery was studied in detail during the fishing season of 1981. Table 4 indicates the catch distribution of smaller and larger size groups of *P. stylifera* against the daily catch rates recorded during the observation days. Based on the sample analysis, for the whole season an average of nearly 30% of the catch in terms of number was constituted by smaller size groups below 65 mm. This works out to about 10.5% in terms of weight which, undoubtedly, is quite substantial in an exploited stock. It could be seen from the table that maximum quantities of the young prawns are caught during the period of peak catch rates recorded during the latter half of the season, especially towards the end of July when the catches are at the maximum. The number of smaller prawns caught on certain days during this period sometimes exceeds the larger sizes preferred by the industry and on those days it has been noticed that large quantities of the undersized specimens of the species mingled with small juveniles of fishes are discarded after sorting out the larger sizes. This is evident only on the days when the catches are really high, consequently rendering it

difficult for handling for the lady sorters and at least on those days some wastage of the young prawns is taking place in this area.

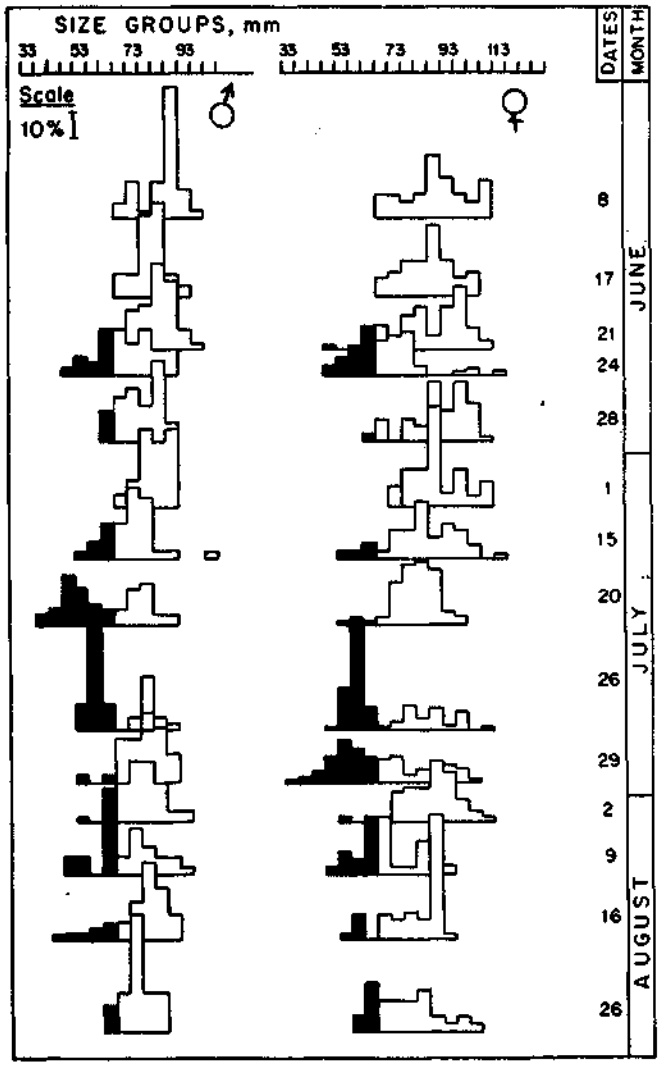


Fig. 3. Size composition of *P. stylifera* on observation days in 1982 season. Undersize groups are indicated in black.

Sex ratio

The general trend of the sex composition of the species in the fishery in 1982 was domination of males over females during major part of the season. From the 2nd to 4th week of July when the highest catch rates were recorded a steady decline in the number of females in the catch (48.8% to 25.3%) was noticed. The overall monthly sex ratio worked out to 56.5:43.5, 58.3:41.7 and 50.6:49.4 for June, July and August respectively with preponderance of males.

Spawning stock

Distribution of different maturity stages of the species was noted for females based on the ovary conditions. Normally the female prawn attains maturity when it is about 65–70 mm total length and the male at slightly smaller size. Throughout the period under investigation the female population included specimens of all maturity stages like immature, early maturing, late-maturing, gravid and spent-recovering. The proportion of late-maturity and gravid females, which can be easily detected from the thick greenish ovary visible through the exoskeleton, was not found to be of any significant level in comparison with the conditions prevailing during the pre-or post-monsoon periods. These stages formed only 17.3% in June, 10.4% in July and 21.8% in August out of the total females exploited by the trawlers. This would indicate that the fishery is not touching the spawning stock of the species at the peak period of the fishery.

Relationship of catch and rainfall

Relationship of prawn catches with rainfall has been indicated in certain areas by earlier workers. In the case of the prawn fishery of Neendakara area the very fact that the fishery is highly seasonal and occurring during the rainy monsoon season indicates that there is a relationship for this fishery with the rainfall. An examination of the rainfall data along with the monthly catches of prawns during the monsoon season for the period 1974 to 1982, as depicted in figure 4, indicates that there is a relationship between the peak fishing days and the peak of the monsoon rains. It is seen that, in general, the peak period of the prawn landings occur in the following month or the month after the heavily raining months. It is also noticed that in the years when there is maximum rains the prawn catches here also are relatively high, showing a direct relationship between the two.

Discussion

Among the interesting facts which emerge from the study may be pointed out that almost single species namely, *Parapenaeopsis stylifera* dominated in the fishery of the area. As mentioned in an earlier investigation (George *et al.*, *Mar. Fish. Infor. Serv. T & E Ser.* **18**: 1-8, 1980) this dominant species is different from the species dominating in the mud bank or 'Chakara' fishery of the adjoining areas north of this particular fishing ground, the species dominating there being *Metapenaeus dobsoni*. It is all the more intriguing that Neendakara fishing

ground which is just outside the estuarine backwaters of the Ashtamudi lake supports a species which does not have an estuarine phase while the area north and farther away from the mouth of the same estuary supports the fishery of a species which uses the estuary as a nursery ground for its juvenile phase. It is probable that it is the nature of the substratum which brings about this peculiar distribution of the species in the fishery in adjoining areas.

both 1981 and 1982 the catch has reached the lowest minimum so far recorded, giving very poor catch rates. Nearly 75% reduction in the catch is noticed in these years as compared to 1980. The situation is quite alarming when viewed coupled with the fact that the input of effort during the period is kept fairly high, probably indicating thereby that the stock of prawns in the fishing ground has really gone down.

Table 4. *Percentage composition of smaller and larger size groups and catch rates of* P. stylifera *landed by shrimp trawlers at Neendakara during June-August* 1981

Observation days	Percentage ratio				
	In number		In weight		
	Below 65 mm TL	Above 65 mm TL	Below 65 mm TL	Above 65 mm TL	Average catch/ boat In Kg.
June, 1981					
11-6-81	3	97	1	99	29.1
25-6-81	24	76	7	93	56.6
30-6-81	3	97	1	99	50.7
July, 1981					
13-7-81	18	82	6	94	137.3
20-7-81	12	88	4	96	171.7
21-7-81	31	69	11	89	46.6
22-7-81	40	60	20	80	216.7
23-7-81	56	44	22	78	226.0
28-7-81	45	55	18	82	14.0
30-7-81	30	70	8	92	1357.0
August, 1981					
6-8-81	30	70	4	96	24.5
7-8-81	34	66	11	89	35.7
10-8-81	38	62	14	86	79.3
24-8-81	34	66	12	88	243.7
25-8-81	47	53	19	81	124.5
28-8-81	26	74	8	92	4.3

TL--Total length measured from tip of rostrum to tip of telson

The investigation mentioned earlier has established that economic overfishing of prawns is taking place in Neendakara fishing grounds. The data on prawn catch and effort during the subsequent years included in the present study confirm this conclusion. Although there was increase in total catch in 1980, subsequently in

Implementation of some effective conservation method seems to be very essential here for the proper management of the fishery. The State Government is advised to take prompt action in the matter before it is too late, so as to prevent any further decline in the fishery which contributes to the shrimp exports from

the state to a very large extent. Taking all aspects into consideration, both biological and economical, the possible management approach which could be advised in the particular fishery may be any one of the two

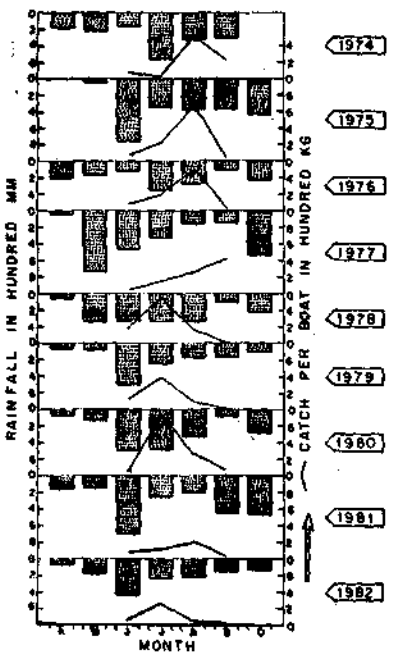


Fig. 4. Relationship between prawn catch and rainfall (shown as shaded) at Neendakara (1974–1982).

methods mentioned below or a combination of both. As indicated in an earlier publication, the most suited method seems to be the restriction of the input of effort in the particular area by limiting the number of vessels in operation through proper licensing and restricting of entry of boats from other parts of the country. Since the peak season fishery is mostly contributed by a single species and very small sizes are fished in large quantities on certain days during the season, the regulation of mesh size of the nets in operation at a higher size than at present is the other method which could be used with advantage. In any case immediate attention of the authorities concerned is required for managing the fishery properly.

At the same time another point worth mentioning here which gives hope for the future, is that the study of the maturity conditions of the species fished shows that at no time during the season does the spawning population of the species appear in real high abundance. Added to that in the sex ratio a preponderance of males is noticed all the time. These might be pointers to the existence of a spawning population of the same species somewhere outside the area where the present fishing operations are carried out. The constant recruitment of younger specimens of the species in the fishery, often in larger quantities and sometimes discarded by the industry when the catches are very high, further strengthens this view. Exploratory cruises being planned to be conducted in the area during the fishing season would probably throw more light on the source of recruitment of the species and the factors influencing the dynamics of the population.

ACIDITY IN VEMBANAD LAKE CAUSES FISH MORTALITY

V. K. Pillai, A. G. Ponniah, D. Vincent and I. David Raj

The sudden changes of variations in the environmental and climatic patterns in an area always cause certain undesirable and unforeseen events as well as problems. The severe drought conditions experienced in South India, especially in the state of Kerala during the summer of 1983 was such an unusual incident. Added to that the monsoon, this year, commenced late. Immediately after the first monsoon rains, in the third week of June, an instance of mass mortality of fishes and clams was reported from the Vembanad Lake. The report indicated that large scale mortality of several groups of aquatic organisms were occurring mainly in the southern half of the lake. Indications were that the phenomena started from the southernmost region and slowly spread to the north. Although, immediate reaction was to look for industrial pollution, the same was ruled out by undertaking immediate monitoring near the major industries situated in the vicinity. Personal discussions with several local farmers, and agricultural and soil scientists working in the region indicated that the unusual phenomena might have been caused by soil acidity. Hydrogen-ion concentration of the water showed that it was in acid range. However, the vast area of the lake affected as well as the quantity

of acid required to effect such a lowering of pH (the pH showed a 50% reduction compared to the normal range) was rather a puzzle which prompted the scientists of CMFRI to undertake a detailed monitoring of the whole area extending from Aroor to Alleppey.

The environment

The Vembanad Lake, situated in the south-west coast of India, connected to the sea through the Cochin backwaters is well known for its fishery resource as well as for its role as a nursery ground for the commercially important crustacean fishery resources. The portion of the backwater system that extends from Cochin to Alleppey covering an area of about 80 sq.km. is generally known as the Vembanad Lake which is primarily connected with the Kuttanad region. The waters of the Vembanad lake is subjected to the flood waters emptied by the river systems and also to the sea water entering into the lake on account of the tidal action. The Vembanad Lake and the backwater system exert considerable influence on the ecology of the surrounding areas.

Four major river systems of Kerala, viz; Meenachil, Manimala, Pamba and Achancoil feed the region with an annual discharge of 11106 M m^3. The discharges of the river systems that enter into the Lake pass through Thanneermukkom barrage. During the S.W. monsoon, usually the discharge from the lake reaches a peak of 65 thousand cusecs (1840 m^3/sec).

Ecology

The ecology of the area with respect to the ability to sustain life, both on land and in water, is conditioned by salinity which in turn is controlled by the combination of flood waters and sea water entering the Lake. The wide spectrum of divergence in salinity, from sweet water to sea water, enables to sustain a wide variety of aquatic life, both plant and animal, in the water. An ecological balance has been struck over the period of its evolution with a combination of plant and animal life.

Geology

In the geologic past, it is believed that the entire area of Kuttanad was part of the shallow coastal area adjoining the Arabian sea. The silt carried by the rivers got deposited at the river mouths giving rise to the present coast and converting the shallow bay into an extensive lake-lagoon-backwater system. The lagoons and lakes gradually silted up and gave rise to sedimentary formations which were eventually converted into garden lands and wet lands by the gradual process of reclamation which now characterises Kuttanad. The deeper portions of the backwaters form the Vembanad Lake which extends from Alleppey in the south to Cochin in the north.

Soil characteristics

Soils of this region may be grouped into three categories viz. (1) Kayal soils (2) Karappadom soils and (3) Kari soils.

1. *Kayal soils:* These are found in the reclaimed lake bed in Kottayam and Alleppey Districts and they occupy an area of about 8,000 hectares. The land is situated 2 to 3 metres below the sea level. The soils are slightly acidic to neutral in reaction, very low in organic matter content, poor in total and available plant nutrients, but are fairly rich in Calcium. As they are seriously affected by salinity, crop failures are common in them.

2. *Karappadom soils:* These soils occur along the inland water ways and rivers and are spread over a large part in the upper Kuttanad covering an area of about 41,000 hectares. They are river borne alluvial soils. The fields lie in about 1–2 metres below sea level. The soils are characterised by high acidity, high salt content and a fair amount of decomposing organic matter. They are generally poor in available plant nutrients, particularly so in phosphorus. They are also highly deficient in lime. Infertility is the more serious problem in these soils.

3. *Kari soils:* These are peat soils found in large isolation patches in Alleppey and Kottayam Districts, covering an area of about 20,000 hectares. They exhibit characteristics of submerged forest area, but are not silted up. Deep black in colour, the soils are characterised by heavy texture, poor aeration, bad drainage and low content of available plant nutrients. They are affected by saline intrusion with consequent accumulation of soluble salts. They are also highly acidic in reaction. In these soils free sulphuric acid is formed by the oxidation of sulphur compounds present in the wood fossils found under the soil. Large amounts of woody matter at various stages of decomposition occur embedded in these soils.

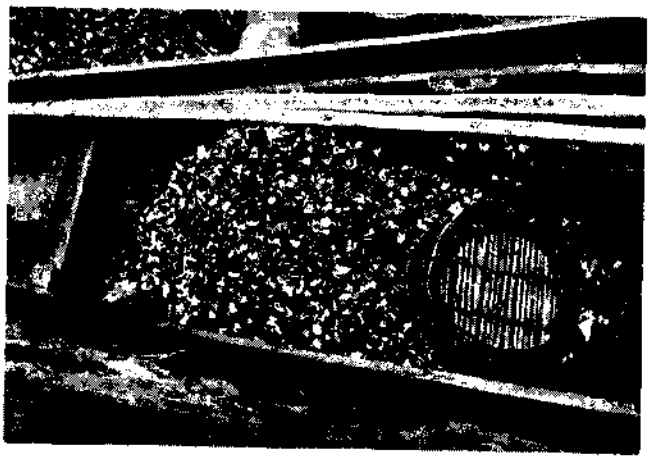
The Kari and Karappadom soils record pH below 5.0 under moist condition. The pH of these soils is found to decrease on air drying. The maximum pH

1

3

4

PLATE I. 1. Collection of samples
2. Dead clams collected by fishermen.
3. A typical kari soil field.
4. Close up of acid water leaching from the soil.
5. The water being pumped out from big paddy fields.



2

5

values of these soils are observed during September-October. On exposure of the soils during crop season the pH progressively decreases and reaches the minimum at post-harvest period, February–March. The seasonal variation is more marked in the Kari and Karappadom soils than in the Kayal soils. The Kari and Karappadom soils resemble the typical acid sulphate soils in several characters. Changes in oxidation reduction potential, oxidation of sulphur compounds under aerobic conditions and subsequent hydrolysis under anaerobic conditions of water logging with the production of mineral acids would all collectively contribute to a decrease in pH on drying (Money and Sukumaran, 1973). They also observed that either air-drying or sun-drying in the field drastically decrease the pH of the Kari and Karappadom soils. This aspect of the soil is significant in the context of cropping pattern, and water management.

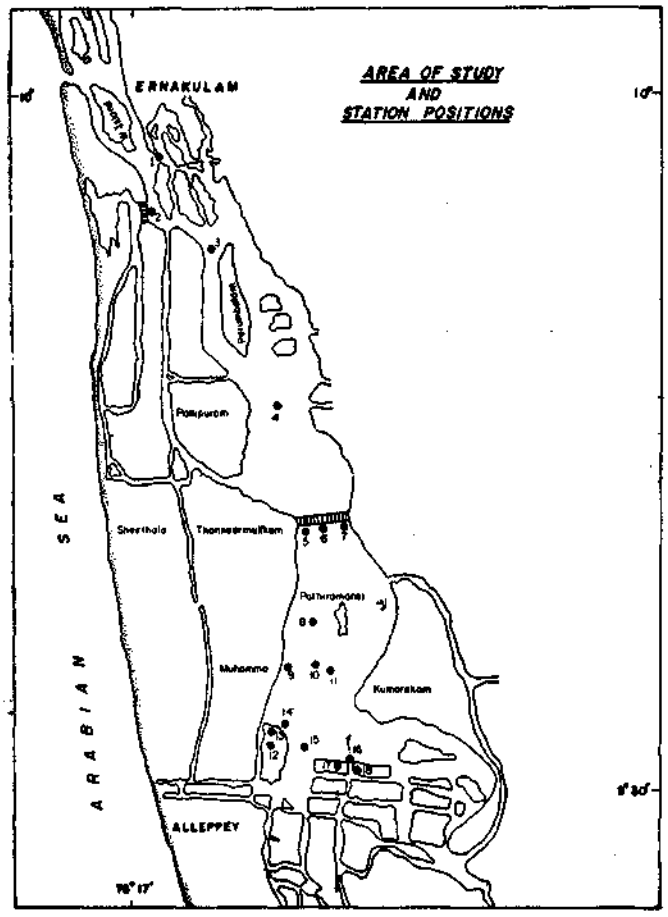


Fig. 1. Map showing the station position.

Observations

This report contains the results of investigations conducted by the Institute on the causes, effects and problems of this unusal phenomena. The details regarding the station positions from which samples were collected and analysed are given in Fig. 1. In order to identify the cause of the phenomena, water samples were collected at different transects covering an area of about 65 km from Aroor to Alleppey. In addition, samples were also collected from the paddy fields bordering the southern tip of the lake and also from the Muvatupuzha river where a major newsprint factory is located. Water temperature and pH were recorded from all the stations. Samples were also analysed for salinity, dissolved oxygen and ammonia.

The team investigating the phenomena monitored the water characteristics over the lake surface and adjacent waters to determine the causative factor and also to record the recovery in the situation during the course of a months time. It was found that in the middle region of the lake where the mortality occurred, lower salinity values were recorded (Table 2) indicating that the area was under freshwater regime. The recorded dissolved oxygen values were within the normal range that could support aquatic life. Very high values of ammonia were recorded in the area where extensive mortality had occurred (Table 3). The source of this high ammonia could be due to the pumping of water from the paddy fields where fertilizers had been used during the last season. But this high levels of ammonia could not have been a causative factor for the mortality of fishes since at low pH the ionization of ammonia will be considerably reduced thereby reducing the lethality of ammonia.

Among the parameters studied, pH showed low values on the acidic range. Most of the pH values recorded were in the range of 3.0 to 7.0 against the normal range of 7 to 8. Details are given in Table 1. On the first day of observation (28–6–'83) at Thaneermukkom the pH recorded was 3.65 and 2 km away (towards south) the same was 4.85. It was significant to note that during the initial sampling time the pH of the water collected from the paddy fields as well as from the open waters at the southern end of the Vembanad Lake recorded very low pH (4.0), especially the water pumped out of the paddy fields (pH 3.8). The paddy fields of Kuttanad are 1 to 2 m below the lake water level. Hence for preparing the fields for cultivation as well as for regulating the water flow during the cultivation, pumping of water is regularly practiced. The size of the pump and the quantity of water pumped out naturally depends on the size of the field, invariably extending to several thousand hectares. All these

Table 1. *Variation in pH in space and time*

Dates of collection	30.6.83 & 1.7.83		4.7.83		16.7.83		1.8.83		6.8.83	
Stations Location	S	B	S	B	S	B	S	B	S	B
1. Thevara	7.59	—	—	—	5.88	—	6.95	—	6.55	—
2. Aroor	4.80	6.44	—	—	5.18	5.70	5.55	—	6.22	—
3. Arookutty	6.22	6.44	—	—	5.88	6.10	6.55	6.40	5.88	6.07
4. Manalpuram	3.68	4.09	—	—	4.21	4.35	—	—	5.60	5.40
Thanneermukkam bund										
5. Western end	3.84	3.85	4.34	—	4.35	—	5.78	—	5.48	—
6. Middle	3.81	3.92	—	—	5.55	—	5.55	—	4.68	—
7. Eastern	3.99	4.06	4.03	—	4.25	—	5.77	—	4.30	—
8. Kaypuram	4.00	4.30	—	—	5.30	5.41	6.00	6.15	5.48	5.50
Muhamma										
9. Near shore 1	3.97	4.38	3.88	—	4.08	3.94	5.69	5.46	5.23	—
10. Near shore 2	—	—	—	—	3.85	3.83	5.92	5.50	—	—
11. Middle	3.97	4.11	—	—	3.85	4.00	5.78	5.65	—	—
Punnamada										
12. Cultivated fields	—	—	3.90	—	4.78	—	5.50	—	4.90	—
13. Canal connecting										
fields	3.90	—	3.80	—	3.70	—	5.40	—	4.80	—
14. Backwaters 1	4.00	—	3.90	—	4.30	—	5.40	—	5.33	—
15. Backwaters 2	4.00	4.20	—	—	—	—	—	—	5.47	5.45
East of Punnamada										
16. Backwaters	3.18	—	—	—	—	—	—	—	4.24	3.93
17. Cultivated fields	3.80	—	—	—	—	—	—	—	3.90	—
18. Fallow fields	—	—	4.41	—	—	—	—	—	4.83	—

water ultimately reaches the lake. However, during thr peak of the summer this year, the level of water in the lake and canals were reportedly lower than in the fields beforc the on set of the rains.

During the initial samplings it was observed that to reduce the acidity of soil which was damaging the crops, continuous flushing was carried out by allowing the lake water into the paddy fields and then pumping it out. This process added to the water acidity caused from the natural run-off from the dry fields and canals through the rivers to the lake. In certain very large paddy fields (blocks) the water remained stagnant during the summer due to non-cultivation for the last one or two seasons. It was noticed that in these fields pH was rather low (3.8 ± 0.53). Even one month after the reported fish mortality in the lake, a few fishes were found dead and floating in these fields.

From the present study it can be conclusively said that the high mortality was only due to the low pH in the water. This low pH was mainly due to the leaching out of acid waters from the paddy fields and adjacent canals.

The data revealed that the effect of pH reduction seemingly influenced the eco-system only upto the middle of the lake and coming towards the mouth of the estuary the effect appeared to have got neutralized, probably due to the regular tidal action. However, even after a month or so from the period of initial impact, there was not much change in the situation in the affected area. The fact that, though during the latter field trips the acidity was found reducing slowly, still low pH persisting in the southern area even after a months time indicated beyond doubt that the real causative factor for the low pH originated from the soil acidity. It is also reported that mineral acids were usually responsible for excessively low pH. The common mineral acid in natural water is sulphuric acid which results from the oxidation of iron pyrite (Boyd, 1982). The reason for the persisting low pH could be that the river water input into the

Table 2. *Variations in Salinity in space and time (‰)*

Dates of collection		30.6.83 & 1.7.83		4.7.83		16.7.83		1.8.83		6.8.83	
Stations	Location	S	B	S	B	S	B	S	B	S	B
1.	Thevara	7.38	—	—	—	0.21	—	3.88	—	1.36	—
2.	Aroor	6.48	9.83	—	—	1.10	0.28	1.19	—	1.40	—
3.	Arookutty	10.76	11.28	—	—	2.95	3.95	1.89	2.71	0.87	1.00
4.	Manalpuram	5.10	5.11	—	—	1.17	1.15	—	—	0.44	0.35
	Thanneermukkam bund										
5.	Western end	3.80	3.28	2.26	—	1.05	—	0.30	—	0.42	—
6.	Middle	4.27	5.11	—	—	0.94	—	0.35	—	0.42	—
7.	Eastern	3.54	3.35	—	—	0.63	—	0.35	—	0.37	—
8.	Kaypuram	3.37	4.70	—	—	0.49	0.47	0.21	0.17	0.25	0.30
	Muhamma										
9.	Near shore 1	4.24	5.00	—	—	0.51	0.51	0.34	0.18	0.26	0.28
10.	Near shore 2	—	—	—	—	0.47	0.47	0.21	0.19	—	—
11.	Middle	0.81	0.32	—	—	0.49	0.50	0.21	0.19	—	—
	Punnamada										
12.	Cultivated fields	0.98	—	0.99	—	0.50	—	0.29	—	0.50	—
13.	Canal connecting fields	1.82	—	1.16	—	0.66	—	0.35	—	0.54	—
14.	Backwaters 1	0.71	—	0.64	—	0.29	—	0.21	0.19	0.19	—
15.	Backwaters 2	0.48	0.50	—	—	—	—	—	—	0.12	0.12
	East of Punnamada										
16.	Backwaters	2.54	—	—	—	—	—	—	—	0.49	0.49
17.	Cultivated fields	5.09	—	—	—	—	—	—	—	0.67	—
18.	Fallow fields	—	—	—	—	—	—	—	—	0.49	—

lake after several spells of monsoons showers has not been sufficient to flush the acids produced at the water-soil interface continuing for several weeks as the monsoon this season had been weak and halting in the initial period.

Though there are fishes that are exceptionally tolerant to low pH of upto 3.5 (Dunson *et al.*, 1977), many other investigators have found pH 5 as the lowest tolerant limit for freshwater fishes (Jones, 1964; Cooper and Wagner, 1973). For crustaceans, the lowest tolerant limit has been found ranging from 4.5 (Havas and Hutchinson, 1982) to 5.5 (Leivestad *et al.*, 1976). The present observation revealed that it took nearly 30 days for the pH to reach 5 in the affected region south of Thanneermukkom barrage. Irritation to the eyes reported by the divers doing clam fishing and redness of the eyes of fishes caught, indicated the continuous effect or acidity.

From the literature, it is apparent that many aquatic organisms are physiologically unable to tolerate conditions of high acidity (Havas, 1981). By experimental studies it has been established that at least four major physiological functions are altered at low pH. This includes calcium and sodium regulation,respiration and acid base balance. Several studies have revealed that anoxia and sodium depletion result when fishes are exposed to acid waters. (Packer and Dunson, 1972; Dunson *et al.*, 1977; Leivstad and Muniz, 1976; Ultsch and Gros, 1979. During our observations from the middle of July onwards dead as well as dying young ones of cat fish *Keletius* sp. (total length 63–83 mm)

Table 3. *Spacial and temporal distribution of ammonia (ppm)*

Dates of collection		30.6.83 & 1.7.83		4.7.83		16.7.83		1.8.83		6.8.83	
Stations	Locations	S	B	S	B	S	B	S	B	S	B
1.	Thevara	6.07	—	—	—	0.88	—	0.32	—	1.63	—
2.	Aroor	1.07	1.02	—	—	0.60	0.47	0.31	—	0.49	—
3.	Arookutty	0.54	0.40	—	—	0.96	1.06	0.24	0.31	0.49	0.30
4.	Manalpuram	1.28	1.28	—	—	0.75	0.73	—	—	0.29	0.28
	Thaneermukkam bund										
5.	Western end	1.26	1.25	0.84	—	0.89	—	0.32	—	0.30	—
6.	Middle	0.65	1.02	—	—	0.78	—	0.32	—	0.33	—
7.	Eastern	0.91	1.04	0.84	—	0.51	—	0.33	—	0.34	—
8.	Kaypuram	1.05	1.64	—	—	0.86	1.11	0.33	0.28	0.26	0.26
	Muhamma										
9.	Near shore 1	1.53	1.65	—	—	0.89	1.11	0.32	0.35	0.26	0.28
10.	Near shore 2	—	—	—	—	0.95	0.98	0.26	0.26	—	—
11.	Middle	0.09	1.53	—	—	1.88	1.11	0.24	0.24	—	—
	Punnamada										
12.	Cultivated fields	0.51	—	0.59	—	0.66	—	0.49	—	0.19	—
13.	Canal connecting fields	1.32	—	0.42	—	0.95	—	0.65	—	0.74	—
14.	Backwaters 1	0.51	—	0.52	—	0.60	—	0.24	0.30	0.10	—
15.	Backwaters 2	0.36	0.33	—	—	—	—	—	—	0.07	0.05
	East of Punnamada										
16.	Backwaters	0.54	—	—	—	—	—	—	—	0.31	0.49
17.	Cultivated fields	0.42	—	—	—	—	—	—	—	0.67	—
18.	Fallow fields	—	—	1.51	—	—	—	—	—	0.32	—

were observed. The dying fishes were found gasping and struggling at the surface indicating anoxia.

Except for the immediate mortality to fishes (like rays, *Etroplus* and *Mugil*), crustaceans (mainly crabs *Scylla serrata* and *Macrobrachium* sp.) and clams *(Villorita* sp.) the subsequent incidence of mortality were rather limited to the young ones of cat fishes *(Keletius* sp.). During the latter period of survey it was observed that there was limited fishing activity mainly for *Etroplus*. However, the destruction to the clam beds *(Villorita* sp.) is massive. Even after a month from first reports, there was not a single live clam specimen available in the southern half of the lake beyond Thanneermukkom. Subsequent monitoring of the water acidity showed that the effect is getting reduced, although the process is rather slow, it may take a few more months for the ecosystem to be back to maintain the normal balance of equilibrium between the environment and the living organisms.

ACKNOWLEDGEMENTS

The authors wish to record their deep sense of gratitude to Dr. E. G. Silas, Director for the constant encouragement and valuable suggestions. They are also thankful to Dr. P. V. Ramachandran Nair, Senior Scientist and Head of Division, Fishery Environment Management Division, for his constant help, encouragement and also for critically going through the text.

References

Boyd, E. C., 1982. Water Quality Management for Pond Fish Culture. Elsevier Scientific Publishing Co., New York, 1982.

Cooper, E. L. and C. C. Wagner, 1973. The effects of acid mine drainage on fish populations. *Ecol. Res. Ser. Env.* Prot. Agency, R3–73–032: 73-124.

Dunson, W. A., F. Swarts and M. Silvestri, 1977. Exceptional tolerance to low pH of some tropical backwater fish. *J. Experimental Zoology*, **202** (2): 157–162.

Havas, M., 1981. Physiological response of aquatic animals to low pH. p. 49-65. *In* R. Singer (Ed.) Effects of acidic precipitation on Benthos. *Proc. Symp. Acidic Precipitation* on *Benthos*, 1980, North American Benthological Society, Hamilton, N. Y.

———— and T. C. Hutchinson, 1982. Aquatic invertebrates from the smoking Hills, N.W.T: effect of pH and metals on mortality. *Can. J. Fish. Aquatic Sci.* 99 : 890:903

Jones, J. R. E., 1964. Fish and river pollution. Butterworths, London, pp. 107-116.

Leivestad, H. and I. P. Muniz, 1976. Fish kill at low pH in Norwegian rivers. *Nature* 259: 391–392.

————, G. Hendrey, L. P. Muniz and E. Sneknik, 1976. Effects of acid precipitation on freshwater organisms. p. 86-111. *In* F.H. Brackke (Ed.). Impact of acid precipitation on forest and freshwater ecosystems in Norway. Research Report 6/76, SNSF Project.

Money, N. S. and K. M. Sukumaran, 1973. Chemical, Microbiological and Agronomic aspects of the Acid Saline waterlogged soils of Kerala. Technical Bulletin No. 1; Kerala Agricultural University, Trichur, 1973; pp. 1-26.

Packer, R. K. and W. A. Denson, 1972. Anoxia and sodium loss associated with the death of Brook trout at low pH *Comp. Biochem. Physiol.*, 41A, 17–26.

Ultsch, G. R. and G. Gross, 1979. Mucus as a diffusion barrier to oxygen: possible role in O_2 uptake at low pH in carp *(Cyprinus carpio)* gills. *Comp. Biochem. Physiol.* 62A: 685-689.

ACETES SHRIMP RESOURCE OF ANDAMAN AND NICOBAR ISLANDS*

Acetes indicus, locally known as 'Bushy Jhinga", occurs in the creeks, low lying areas and mangrove swamps of the Andaman and Nicobar Islands in large quantities. The genus *Acetes* Milne Edwards is represented in the mainland of India by five species, of which *A. indicus* is the most common and forms a fishery in the estuaries of Bengal, Maharashtra, Gulf of Kutch and Tamilnadu. This species is reported to have a distribution from the Indian Seas through Mergui Archipelago and Gulf of Siam to the East Indies. The information collected on *Acetes* resources in the Andaman and Nicobar Islands during a survey conducted there in February–April 1978 is presented here.

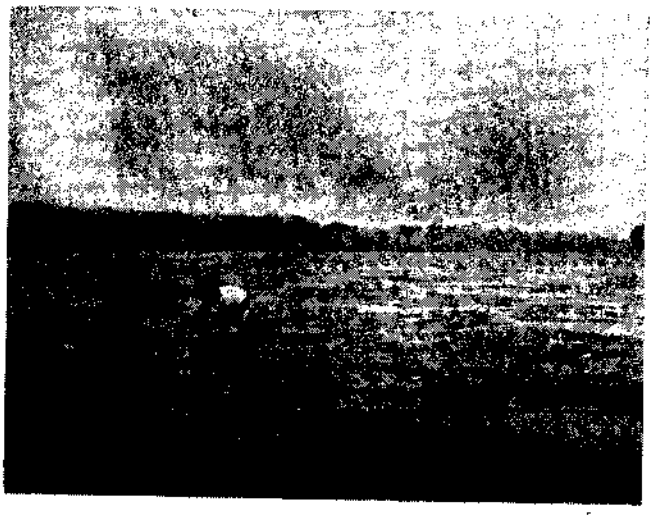
Areas of abundance

Acetes indicus is found to occur in the Andaman and Nicobar Islands in large swarms in the following areas: Landfall Island, Ariel Bay, Kalpong creek, Austin creek, Ray hill area, Bacon Bay, (Fig. 1 & 2), Kalapathar river, Parangara river, Balmi creek, Aves Island, Stewart Island, Rangat Bay, Long Island, Yerratila Jig, North of Baratang Island, Kyd Island, James Island, Mayo Island, creeks around Port Blair, Burmanalla, Chiriyatapu, swamps of Rutland Island; in Dugong creek, Mommunulla, Jackson creek, and South Bay, in Little Andaman. It is also found to occur in the marshy areas of Trinkat Island, Nancowry Island, Katchall Island and in the estuaries of the Calathea river and Alexandria river of Great Nicobar.

Fishing gears

Fishing is mainly carried out by one or two persons with or without a canoe. The net is made of mosquito netting with a wing portion and a bag-like cod end measuring 2 m in length. Two bamboo poles 2 m long, are used to make a triangular opening at the anterior and to give support to the sides of the net. (Fig. 3). The posterior ends of the poles which overlap each other

* Prepared by R. S. Lalmohan



Figs. 1 & 2. Acetes fishing areas in Bacon Bay with two Karens, the Burmese Settlers.

Fig. 3. Bushy jhinga net with two Karens of Mayabunder.

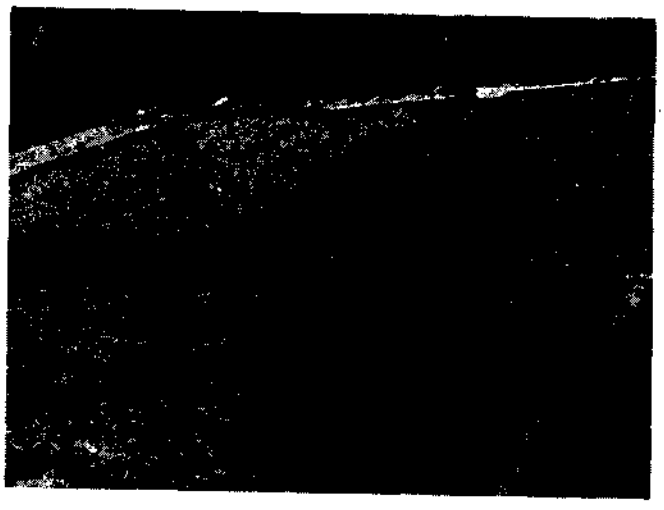


Fig. 4. Bushy jhinga kept for drying in Kyd Island, Middle Andaman.

serve as a handle to push the net from behind by a person wading in the water. The net is quite similar to the 'Dhobbu Vala' used in Kakinada (Andhra Pradesh) to catch prawns in the creek, reported by Ramamurthy and Muthu (CMFRI Bulletin No. 14: 1969). In Baratang area and in Middle and South Andaman Islands stationary bag nets and stake nets with mesh size 2 mm are also used by the fishermen.

Fishing season

It is gathered that *Acetes* forms a fishery from May to July and October to February, appearing in large swarms.

Species association

In a sample collection made from Bacon Bay, although it was during the off season for the shrimps,

Acetes indicus contributed 46.2%, followed by *Metapenaeus monoceros* (47.0%), *Penaeus merguiensis* (4.5%), *Mugil* spp. (1.6%) and *Ambassis* spp. (0.7%). In Kyd Island about 80% of the catch was that of *Acetes indicus* and *P. merguiensis* and 2% *Mugil* spp. When compared to areas where *Acetes indicus* forms a major fishery this is quite significant. Along Maharashtra coast on the mainland where *Acetes indicus* contributes to a good fishery the percentage representation of the species in the prawn landings is 20 to 30.

Utilisation

Based on enquiries it has been estimated that about 25 tonnes of 'Nappi' a preparation made from *Acetes*, is sent annually from Andamans to Nicobar. The Karens and Nicobaris living in Andamans use this preparation with rice. The 'Nappi' has the following composition: Moisture-40.4%, Protein-35.0%, Ash-22.0%, Acid insoluble-2.4% and Liquid-0.2%. A good quantity of *A. indicus* is consumed fresh and also after sundrying (Fig. 4).

Remarks

Although 'Bushy Jingha' is exploited to a certain extent by the local fishermen with their traditional gear, it is quite evident that there is no organised effort for the harvesting of this rich resource. The level of production can be increased considerably with an organised exploitation by using proper craft and gear and at the right time. Side by side proper utilisation also has to be thought of by improving the marketing facilities for 'nappi' and other products.

ALFALFA PROMOTES GROWTH IN PRAWNS*

Introduction

In recent years, culture of prawns in ponds and paddy fields has attained much importance as a means of augmenting production of these crustaceans for export. In this context, it was thought worthwhile to have investigations to enhance the growth of prawns using different anabolic chemicals/agents. Alfalfa, a known growth promoter was added to the supplementary feed and experimented with juveniles of *Penaeus indicus* in the laboratory and in the field culture ponds as well. The present report deals with the results of the experiments to assess the impact of Alfalfa on the growth rate of prawns.

* Prepared by D. S. Rao, P. P. Pillai, K. J. Mathew, K. Rengarajan, D. Vincent and L. R. Khambadkar

Growth promoting agents

Certain classes of chemical compounds such as antibiotics, vitamins, hormones, arsenicals, tranquillisers and surfactants have been reported to stimulate the growth of animals. Recently the use of some chemicals has been found to enhance the production of Indian major carp fry and fingerlings (Sen, P. R. and D. K. Chatterjee, 1979). Enhancing production of Indian major carp fry and fingerlings by the use of growth promoting substances. *Advances in Aquaculture,*

FAO Technical Conference on Aquaculture. Fishing News Books Ltd., Farnham, Surrey, England, pp. 134 – 141). The chemicals used included Proloid, Eltroxin, Berin, Macrabin, Vitamin B complex, Yeast, Starch, Selenium, Molybdenum, Boron, Cobalt chloride, Enterocycline, Chloromycetin, Hoestacycline and Manganese. They found that Cobalt chloride, Starch, Boron and Manganese significantly enhanced the survival rate.

Role of Alfalfa

The leguminous forage plant known botanically as *Medicago sativa* commonly known as lucerne, alfalfa, purple medick or chilean clover, is known to be a good source of vitamin K. The exact function of vitamin K in the metabolism of animals is unknown, although it has been postulated that it is a fat soluble, thermostable compound essential for the formation of normal amounts of prothrombin which diminishes the clotting time of blood. Unlike other grasses, Alfalfa does not possess large amount of reserve polysaccharides in the form of fructosans, but it contains small amount of starch and large quantities of pectin. The protein content is high and if the crop is cut in the early flowering stage the crude protein content is above 20%. Alfalfa is a valuable source of the element Magnesium (0.20–0.36%). Many forage plants are known to contain plant estrogens which in limited amounts, have a beneficial effect on the fattening of animals similar to that of giving synthetic hormones such as stilbestrol and hexestrol. Alfalfa has been found to contain such estrogenic substances (McDonald, P., R. A. Edwards, J.F.D. Greenhalgh 1973. *Animal Nutrition.* Longman, London, pp. 357-358).

As early as 1933 Chibnall A. C., E. F. Williams, A. L. Latner and S.M. Piper (1933. *Biochem. Jl.*, 27, pp. 1885–1888) had isolated the principal chemical component of Alfalfa wax, as n-triacontanol, M.p. 86.3 – 86.5°. Triacontanol is insoluble in water, soluble in acetone, ethylacetate and benzene and crystallises in the form of lustrous plates M.p. 86.5°. Triacontanol was isolated from waxes (Robinson, 1934. *J. Chem. Soc.*, p. 1545). It was shown that triacontanol was the active material of Alfalfa grass which resulted in higher yields of crops when sprayed in minute quantities (Stanley, K. R. 1975). In view of the above, it was decided to investigate whether Alfalfa can be of any effect to enhance the growth in juvenile prawns.

Experiments

Juveniles of prawn *Penaeus indicus* were reared both in aquarium tanks in the laboratory and culture ponds in the field at Neendakara simultaneously.

In the laboratory, duplicate aquarium tanks of 30 x 70 x 35 cm size were selected of which one served as control and the other as experimental unit. 30 litres of water having salinity of 20‰ was taken in each container. The juvenile prawns were brought to the laboratory and after acclimation for 10 days the healthier ones of almost same length and weight were separated, the initial size (both length and wet weight) were recorded and stocked at the rate of 40 prawns per tank. The duration of the experiment was 35 days during which the environmental parameters such as temperature, light, pH, dissolved oxygen were kept almost identical in both control and experimental units. About 50% of water in both the units was changed every day. The average temperature in the aquarium tanks in the laboratory during the experiment was 30.07°C, the fluctuation during the period was within ± 1.5°C. The average salinity fluctuation in the experimental as well as control tanks was within ± 1.5‰. The dissolved oxygen was kept at 4.5 ml/l by aeration except for one day due to power failure when there was mortality.

Table 1. *Details of Alfalfa incorporated in the supplementary diet and fed the prawns in experimental tank at the laboratory and in the culture pond. Prawns in the control tank and culture pond were also fed with supplimentary diet without Alfalfa.*

At the laboratory		At the field	
Week	Quantity of Alfalfa (gm)	Fortnight	Quantity of Alfalfa (gm)
1st	0.011	1st	0.4375
2nd	0.011	2nd	0.5250
3rd	0.070	3rd	0.6125
4th to 7th*	0.105	4th	0.7000

* The amount of Alfalfa in the feed was kept constant from 4th week due to mortality of experimental prawns due to insufficient aeration caused by power failure.

In the field, two identical and adjacent culture ponds of 0.024 ha were selected of which one was kept as control and the other for experiment. The juvenile prawns were stocked in the ponds at a density of 0.104 million/ha. The average conditions of temperature, salinity and dissolved oxygen at the surface were 33.8°C,

Table 2. *Details of experiments conducted by rearing the juvenile prawns in tanks at the laboratory and in culture ponds at the field*

	Laboratory		Field	
	Experimental	Control	Experimental	Control
Initial				
Number of specimen	40	40	2,500	2,500
Size — Mean length (mm ± S.D.)	33.75 ±3.98	33.22 ±3.43	32.0	32.5
Size — Mean weight (gm)	0.286	0.280	...	...
Duration of Experiment (days)	35 (29.3.1980 to 3.5.1980)		48 (12.41980 to 30.5.1980)*	
Final				
Number of specimen	27	25	*	*
Size — Mean length (mm ± S.D)	58.18 ±5.33	50.56 ±5.40	79.25 ±9.79	64.06 ±6.36
Size — Mean weight (gm)	1.750	1.237	...	...
Differences (Final-Initial) — Length (mm)	24.43	17.34	47.25	31.56
Differences (Final-Initial) — Weight (gm)	1.464	0.957	...	...
Growth per day — Length (mm)	0.698	0.495	0.984	0.658
Growth per day — Weight (gm)	0.042	0.027	...	...

* On 30.5.1980 there was flood which affected the ponds and hence the experiment was terminated.

29.84‰ and 3.8 ml/l respectively and 33.7°C, 29.84‰ and 2.1 ml/l respectively at the bottom. The fluctuation in temperature in both the ponds was high at noon rising up to 36.0°C due to solar radiation.

Feed

A compounded feed was prepared using starch, fish meal, groundnut oil cake, wheat bran and starmin P.S. in the proportion 4:5:5:4:2 by weight and made into pellets and used for controls in the laboratory and in the field. The same feed prepared identically but with an addition of 10% w/v alcoholic extract of Alfalfa by volume in the proportion 4:5:5:4:2:7 was used for the experimental tanks in the laboratory and pond in the field. The triacontanol content of Alfalfa raw material from which the alcoholic extract was obtained was 0.998% by dry weight. The quantity of Alfalfa incorporated in the supplementary diet for prawns both in the laboratory tanks and in the culture ponds during the period of experiment are given in Table 1. The prawns in the laboratory and field (both control and experimental units) were fed with the respective compounded feed at a rate of 10% body weight.

Results and Conclusions

The details of experiments and the results obtained both in the laboratory and field are given in Table 2.

In the laboratory experiments it was found that the prawns in the experimental tank grew faster and has recorded an increase of 0.20 mm growth (0.02 gm) per day over the control kept in an identical situation and fed but without Alfalfa. In the field culture experiments an increase of 0.33 mm growth per day over the control was recorded.

The results indicate that Alfalfa increases the rate of growth in prawns. The optimum amount of Alfalfa to be applied for maximum growth based on the length and weight of experimental rearing animals has to be further studied.

NEW PENAEID PRAWN RESOURCES SHOWING UP ALONG MAHARASHTRA COAST*

Introduction

Introduction of mechanised trawling operations has been greatly beneficial to the maritime states of India and this has been found to be the case in Maharashtra state as well, since the fishermen has been able to fish beyond the traditional close inshore areas of the coast line and tap the fishery resources not exploited by the indigenous fishing operations. In several areas this has resulted in locating new fishing grounds and exploitation of unexploited resources of prawns and other groups, thereby increasing the production considerably over the years. The prawn fishery of Maharashtra state has been studied by Mohamed (1967, *Proc. Symp. Crustacea Mar. biol. Assoc. India* part IV: 1408–18) and others and they have enumerated the species of prawns contributing to the fishery. In recent times from 1977 onwards consequent to the increased operations of the trawlers especially in slightly deeper areas, some prawns which have not been earlier represented in this fishery are noticed to occur in increasing abundance in the landings at Sassoon Dock so as to contribute to substantial fishery. In view of the increasing demands for prawns, the details of the fishery and biological aspects of these prawns have been studied right from the initial occurrence of the species in the fishery and the results are presented here.

Species composition

The following four species of prawns belonging to the penaeidae were represented (Fig. 1–8).

Metapenaeopsis stridulans (Alcock): This is the 'fiddler shrimp' growing to a maximum total length of about 100 mm and can be easily identified by the presence of the stridulating organ (a row of small ridges) on the postero–lateral part of the carapace.

Parapenaeus longipes Alcock: Popularly known as the "flamingo shrimp", this is a still smaller species reaching a maximum total length of only 95 mm. The species is reported in fishable quantities for the first time and one of the important diagnostic feature is the presence of the longitudinal suture from the anterior to posterior margins of the carapace laterally.

Trachypenaeus curvirostris (Stimpson): This species known in popular English name 'southern rough shrimp' and locally 'Dugdu' grows to a maximum total length of 105 mm. The short and stumpy nature is characteristic of the species which is reported as a fishery in India for the first time.

Solenocera choprai Nataraj: FAO English name for the prawn is 'Ridgeback shrimp.' It reaches a maximum total length of 125 mm and the foliaceous antenna is the diagnostic generic character.

M. stridulans and *P. longipes* together constituted about 75% of the total landings of the four species at Sassoon Dock, the former contributing to 40% and the latter 35%. *S. choprai* formed 15% and *T. curvirostris* 9% on an average. *Atypopenaeus stenodactylus* and the crangonid shrimp *Pontocaris* sp. were found in stray numbers.

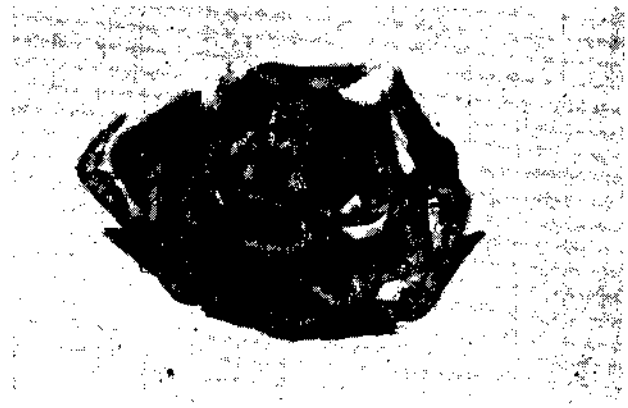
Fishing operations

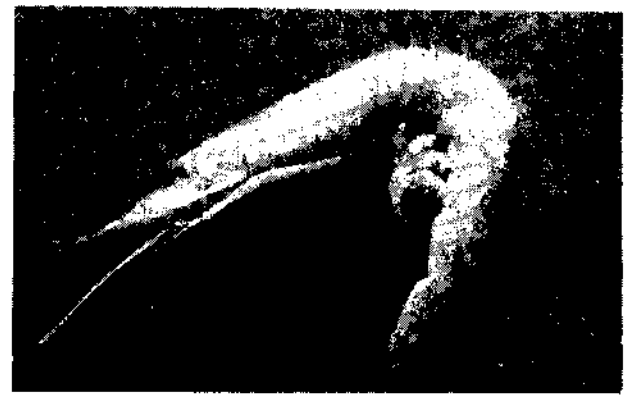
The fishing was carried out by mostly country crafts operating 18–22 m shrimp trawls off Murud, Srivardhan and Harnai coasts of Maharashtra in a depth zone ranging from 40 to 75 m (Fig. 9). Gokhale (Science Today: 5–8, 1982) reported that fishermen of both Maharashtra and Gujarat fish in areas of this depth range using their small country crafts. Very recently the research vessel R. V. Saraswathi of Central Institute of Fisheries Education caught good numbers of some of the above mentioned species in a depth range of 60 to 70 m off Harnai coast (area 17–72.5 B) in trial fishing operations with a pelagic trawl, confirming the presence of these species in these depth areas.

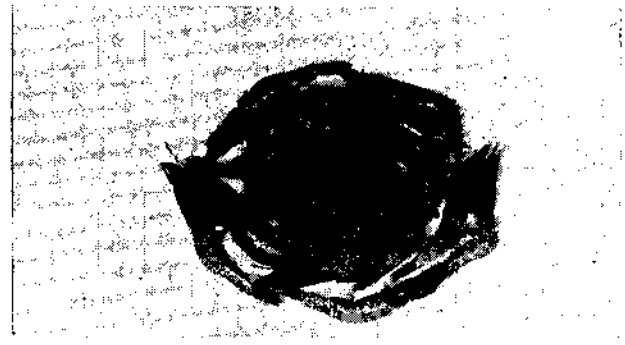
Production

The combined total production of these four species put together at the centre was estimated at 11,720 tonnes during the years 1977 to 1983 with an average

* Prepared by M. Aravindakshan and J. P. Karbhari







Figs. 1 & 2. *Solenocera choprai* Nataraj; 3 & 4. *Trachypenaeus curvirostris* (Stimpson); 5 & 6. *Metapenaeopsis stridulans* (Alcock); 7 & 8. *Parapenaeus longipes* Alcock.

yearly landing of 1,674 tonnes for each season. The magnitude of the landings of the constituent species during the different years is presented in Fig. 10. Taking the total production of the species, the landing figures were the highest during 1978 and 1979. Thereafter a slight decline was noticed in 1980 and 1981. However, in 1982 and 1983 the catches have gone up, although not reaching the 1978 and 1979 level. The average catch per unit amounted to 70 kg.

Fishing season

The fishery for these species is highly seasonal. The fishery commences from late February or early March and continues up to June, by the end of which month the trawler operations in deeper regions are suspended. The availability of large sized penaeid prawns in the shallower inshore areas in larger quantities and the onset of the monsoon are the factors leading to the suspension of fishing for these prawns.

Biological observations

Biological aspects like size ranges, sex ratio, maturity, food preferences etc. have been studied.

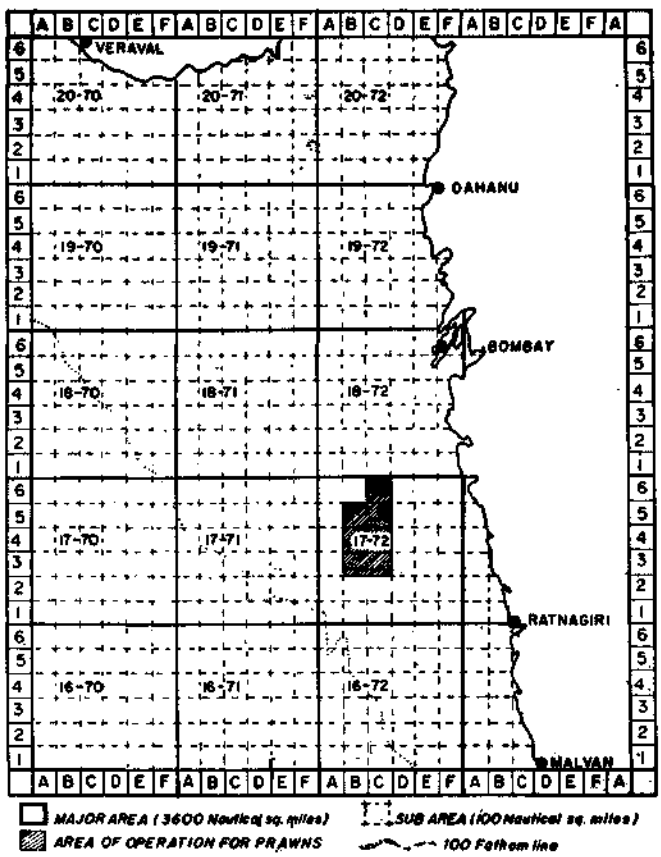


Fig. 9. Map showing the fishing area

M. stridulans was found to have a size range in the fishery between 55–85 mm. The sex ratio was 2:1 with females in domination. Analysis of the stomach contents of 1,125 specimens revealed appendages of decapod crustaceans, remains of gastropod molluscs followed by foraminifera, sand grains and debris. The

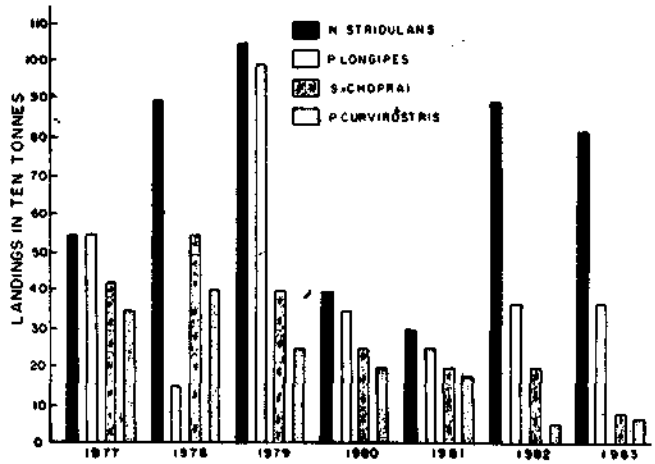


Fig. 10. Specieswise prawn landings during 1977-1983

major food items of crustacean remains formed 70%. The presence of sand grains and debris indicated a bottom feeding habit. Polychaete remains were not observed in the stomachs of the species. Percentage of mature females was observed to be maximum of 70% in March, indicating March–April as probable spawning months.

P. longipes ranged from 55–95 mm in length in the landings. In this species also females were always dominant (sex ratio 2:1) and larger in size. Stomach contents of 1,227 specimens showed that crustacean remains formed the major item of food, forming about 60% with molluscan remains and foraminifera constituting 18%. Sand grains and debris constituted remaining 22%. High percentage of mature females (80%) was observed in months of April and May, indicating spawning during these months.

S. choprai. The size range of the species noticed in the fishery was from 55–125 mm. Males were always smaller in size and less in numbers. Males exceeding 100 mm were not noticed and the sex ratio was 3:1 in general with females in domination. Study of stomach contents of 421 specimens showed a carnivorous diet with crustacean remains dominating (60%) mainly in the form of appendages of decapods.

Gastropod remains and foraminifera followed by sand grains and debris formed the remaining 40%.

Mature females occurred in larger numbers in March and April. During 1980 mature females were observed in August and September as well. The number of eggs in a fully mature female of 107 mm total length was estimated at 1,30,850. The high fecundity of the species points out to the possibility of existence of more exploitable stock in the case of this species.

T. curvirostris ranged from 60–105 mm in size in the fishery. The general sex ratio was 3:1 with females in domination. Males rarely exceeded 70 mm. Stomach analysis of 906 specimens showed items of food similar to the other three species, with crustacean appendages forming the major portion (70%). The percentage of mature females was observed to be 80 in April and May.

General remarks

Among the four species of these prawns it was noticed during the study that *M. stridulans* and *T. curvirostris* were hardy and lesss susceptible to decay than the other two species, *P. longipes* and *S. choprai* which developed blackening of appendages and gill region due to bacterial action much quicker. This would naturally affect the quality of the processed product and create problems for the processor. In order to keep the quality of the prawns proper preservation of the catches on board the vessels and small boats by carrying sufficient ice would be very essential.

The catches are being auctioned at the landing centre, the price varying from Rs. 10 to 15 per kg depending on the size and freshness of the prawns. At an average price of Rs. 12 per kg, prawns of these varieties at an estimated cost averaging 2 crores of rupees are being landed every season at this particular centre. As the price varies with the freshness of the prawns landed and the prawns being of the variety which develops blackenings quickly, no effort should be spared to see that the prawns are landed under proper preservation so that the fishermen could get the maximum price for his catch.

The authors are deeply grateful to Dr. E. G. Silas, Director, CMFRI for the interest and encouragement. They also express their sincere gratitude to Dr. M. J. George, Senior Scientist for scrutinising the manuscript and suggesting modifications. Thanks are also due to our colleague Shri S. K. Chakraborty.

GOOD SEASON FOR PRAWNS PREDICTED OFF MADRAS*

Forecasts of the magnitude of the prawn fishery based on the index of postlarval and juvenile abundance in estuaries and backwaters have been attempted by earlier authors. Garcia and Reste (1981 *FAO Fish. Tech. Rep.* 203:129) have summarised the forecasts based on earlier stages of life cycle. They have stated that "when an attempt is made to relate shrimp catches at the sea to the abundance of one of the preceding stages of the life cycle, it seems that only migrating sub-adults can give useful short-term prediction index (about three months in advance)" With the data available from the Ennore estuary near Madras on the postlarval and juvenile abundance an attempt was made to see whether any prediction of the forthcoming fishery of the ensuing season in 1983–84 was possible.

Regular weekly collections of juveniles were made with a small drag net made of velon screen of five m length at the Ennore estuary from three stations about 1 km apart from each other the first one being near the bar mouth. During the course of this study it was found that collections from Station III was good when compared to the other two stations as far as juvenile prawns are concerned and the data collected from this station for 19 months during March,1982 to September '83 is analysed and interpreted in the present report. During day time three hauls were made roughly covering an area of 100 sq m. for each haul. The Ennore bar mouth is more or less kept open through out the year to draw coolant water for the thermal plant.

* Prepared by D. B. James and P. Thirumilu.

From Table 1 it is seen that during the period March, 1982 to September, 1983 maximum number of juveniles were collected during the months of July, 1983 (320 Nos) and August, '83 (342 nos.). During all other months on an average only 50 juveniles were collected. *Penaeus semisulcatus* started appearing by November to January period. The increased occurrence of the juveniles tend to show that the fishery for these species particularly *P. semisulcatus*, *P. indicus* and *P. monodon* will be high during the coming season from November to January period.

Table 1. *Numbers and sizes of juvenile prawns collected at Station III in Ennore estuary during* 1982–1983

Months	*Metapenaeus dobsoni*		*Metapenaeus monoceros*		*Penaeus indicus*		*Penaeus semisulcatus*		*Penaeus monodon*		Total
	No.	Size range mm	No.	Size range mm	No.	Size range mm	No.	Size range mm	No.	Size range mm	
1982											
March	2	7–18	5	12–24	1	15	1	37	—	—	9
April	1	13–22	5	13–22	1	24	—	—	—	—	7
May	10	9–21	5	11–34	1	15	—	—	—	—	16
June	9	5–16	1	24	1	13	1	17	—	—	12
July	6	7–17	19	7–20	—	—	—	—	—	—	25
August	2	9–13	42	7–25	—	—	1	17	—	—	45
September	64	7–21	10	7–28	—	—	1	15	—	—	75
October	24	7–16	14	7–15	—	—	—	—	—	—	38
November	47	8–22	1	11	—	—	—	—	4	18–30	52
December	90	7–18	12	7–19	—	—	—	—	—	—	102
1983											
January	62	8–16	2	9–12	—	—	—	—	—	—	64
February	29	8–25	15	11–36	—	—	—	—	—	—	44
March	26	8–18	7	8–46	—	—	1	35	—	—	34
April					No collection						
May	23	7–24	6	7–28	—	—	19	11–62	—	—	48
June	7	10–21	9	13–39	—	—	12	11–44	—	—	28
July	274	8–20	7	11–24	27	13–26	12	13–62	—	—	320
August	119	9–13	15	16–54	90	14–52	97	16–56	21	14–64	342
September	154	7–34	12	9–52	10	15–22	5	11–52	1	16	182

during the month of May, 1983, *P. indicus* in July 1983 and *P. monodon* in August, 1983. When twigs were encountered in the drag net more juveniles of *P. monodon* were collected.

In Table 2 date-wise collections of juveniles from May 1983 when algal bed was formed is given. It is seen that the modal size increased in all species from May to September. Also it was found that the size range of the specimens collected was more in September than in May. This rapid growth in the estuary would result in the prawns reaching marketable size

The hydrological conditions of the estuary during 1982 and 1983 indicate that in 1983 the temperature has gone up to 37.2°C in May, 1983 whereas it was only 33.1°C in May, 1982. The four degree higher temperature may be the cause for the germination of the spores of the algae. The salinity was also found to be more in 1983 from May onwards.

It is interesting to note that the occurrence of the juveniles of some species especially *P. semisulcatus* show a relationship with formation of algal bed. In 1983 with the formation of algal bed composed of

Table 2. *Details of juvenile prawns collected per haul from Ennore estuary at Station III during May-September* 1983

Date	*Metapenaeus dobsoni*		*Penaeus semi-sulcatus*		*Metapenaeus monoceros*		*Penaeus indicus*		*Penaeus monodon*		Total
	No.	Size range mm	No.	Size range mm	No.	Size range mm	No.	Size range mm	No.	Size range mm	
4-5-83	2	11-24	10	11-62	2	14-28	—	—	—	—	14
18-5-83	18	7-20	3	11-17	2	7-15	—	—	—	—	23
26-5-83	8	9-17	13	11-32	4	13-28	—	—	—	—	25
29-5-83	2	13-17	37	14-57	22	13-56	2	32-76	1	27	64
1-6-83	5	10-17	2	13-44	7	11-27	—	—	—	—	14
8-6-83	3	16-21	3	17-44	5	13-21	—	—	—	—	11
15-6-83	—	—	6	11-42	2	15-32	—	—	—	—	8
22-6-83	3	8-20	5	18-42	1	39	—	—	—	—	9
6-7-83	3	9-16	1	13	1	15	—	—	—	—	5
20-7-83	180	8-20	8	15-62	4	11-24	28	13-26	—	—	221
24-7-83	48	6-22	128	15-84	4	13-32	20	17-37	—	—	199
31-7-83	73	7-22	58	15-52	19	17-41	28	10-42	4	11-24	189
3-8-83	74	20-27	20	16-56	6	16-54	20	14-41	6	14-30	126
7-8-83	38	8-24	32	15-69	38	11-80	16	15-56	5	16-41	129
10-8-83	15	9-30	16	15-60	—	—	32	16-52	9	14-63	72
21-8-83	8	12-29	32	15-81	13	16-90	14	16-90	2	9-24	69
24-8-83	29	12-32	44	15-94	6	16-60	45	15-52	6	17-40	130
28-8-83	4	16-22	32	19-68	9	14-46	4	16-38	1	25	50
31-8-83	40	12-31	49	14-93	8	13-57	24	13-72	7	14-62	128
4-9-83	11	16-41	5	32-100	9	16-67	2	27-72	—	—	27
7-9-83	10	11-34	2	11-43	3	15-51	3	15-22	—	—	18
14-9-83	8	7-23	2	19-52	4	9-52	4	15-22	2	16-39	20
25-9-83	14	7-14	4	24-71	4	22-62	19	15-44	—	—	41
28-9-83	135	7-29	—	—	5	11-32	4	17-44	—	—	144

species of *Hypnea, padina, Chaetomorpha* etc. there was sudden spurt of *P. semisulcatus* juveniles in the month of May. Again due to heavy rain in the month of August, 1983 most of the algae was found to be dead by 4-9-83. This immediately resulted in poor collection of juveniles particularly *P. semisulcatus* which always live in association with algae. In fact the juveniles of this species is locally known as *Pachi Yera* referring to this habit. The fact of absence of algal bed formation in 1982 when there was lesser juveniles also strengthen the point of view that there is correlation between algal bed and occurrence of these prawn species.

Compiled and prepared by M. J. George, G. Subbaraju, C. Suseelan and S. K. Dharmaraja
Published by Dr. M. J. George, Senior Scientist on behalf of the Director, Central Marine Fisheries Research Institute
Cochin-682018 and printed at PAICO, Cochin-31