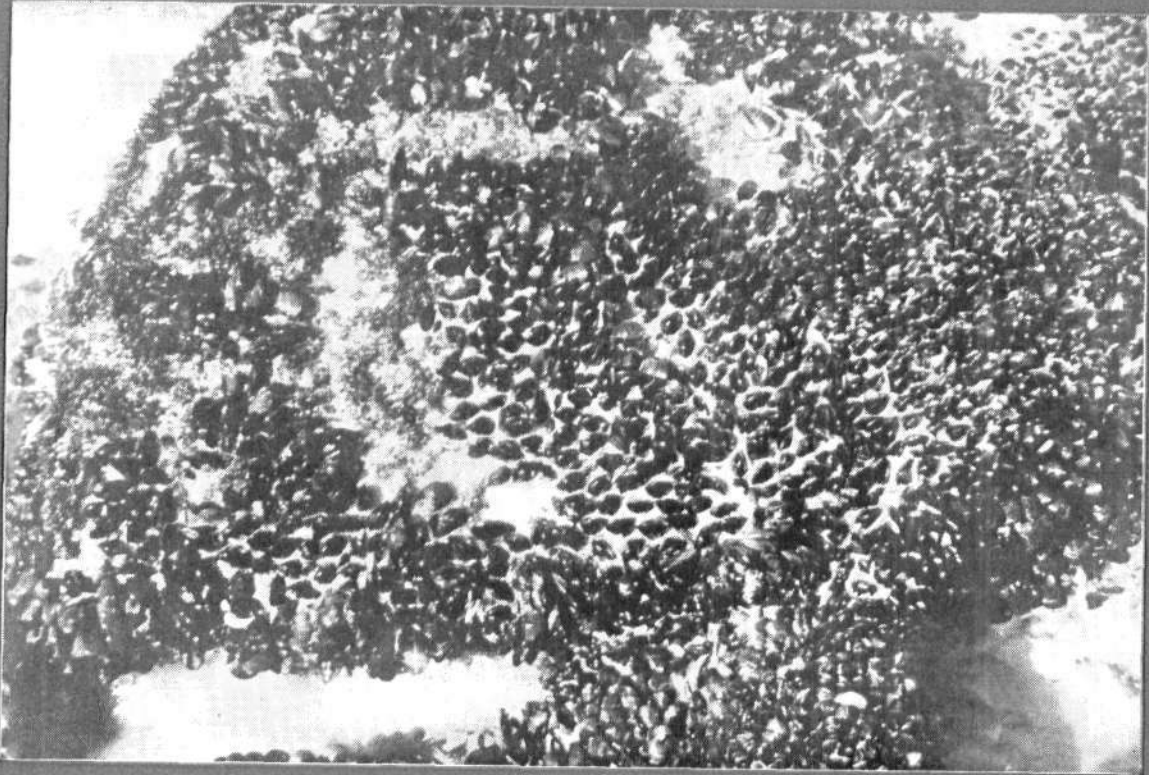




समुद्री मात्स्यकी सूचना सेवा MARINE FISHERIES INFORMATION SERVICE

No. 94

APRIL 1989



तकनीकी एवं विस्तार अंकावली TECHNICAL AND EXTENSION SERIES

कैन्द्रीय समुद्री मात्स्यकी अनुसंधान संस्थान कोचिन, भारत CENTRAL MARINE FISHERIES RESEARCH INSTITUTE COCHIN, INDIA

भारतीय कृषि अनुसंधान परिषद
INDIAN COUNCIL OF AGRICULTURAL RESEARCH

समुद्री मात्स्यिकी सूचना सेवा : समुद्री मात्स्यिकी पर आधारित अनुसंधान परिणामों को आयोजकों, मत्स्य उद्योगों और मत्स्य पालकों के बीच प्रसार करना और तकनीकी का प्रयोगशाला से भ्रमशाला तक हस्तांतरित करना इस तकनीकी और विस्तार अंकावली का लक्ष्य है।

THE MARINE FISHERIES INFORMATION SERVICE : Technical and Extension Series envisages dissemination of information on marine fishery resources based on research results to the planners, industry and fish farmers and transfer of technology from laboratory to field.

Abbreviation – *Mar. Fish. Infor. Serv., T & E Ser., No. 94: 1989*

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मुख आवरण चित्र:

क्वयलोन के निकट चावरा में समुद्री दीवार के निर्माण के लिए उपयोग की गयी एक ग्रेनाइट शिला ब्राउन मसलों से लिपटे हुए।

Front cover photo:

A granite stone used for constructing sea wall at Chavara near Quilon found carpeted with juveniles of brown mussel.

पृष्ठ आवरण चित्र:

चावरा तटरेखा का एक दृश्य जहाँ ब्राउन मसलों की भारी सेटिलमेन्ट समुद्री दीवार के निर्माण के लिए उपयोग की गयी ग्रेनाइट शिला में दिखायी पड़ी।

Back cover photo:

A view of the shore line at Chavara where heavy settlement of spat of brown mussel was observed on the granite groynes used for the construction of sea wall.

THE PRAWN, FISH AND MOLLUSCAN SEED RESOURCES ALONG THE KERALA AND TAMILNADU COASTS*

Introduction

The Central Marine Fisheries Research Institute, Cochin launched a pioneering research project during the period 1976-'80 on the seed resources of commercially important prawns, fishes and molluscs in the surf waters, estuaries and backwaters of Kerala and Tamilnadu. The objective of the project was to gain precise information regarding occurrence and quantitative abundance of seed, their spatial, seasonal and diurnal variations, abundance in relation to lunar periodicities, influence of environmental features and pollution on them and areas suitable for brackishwater culture.

The investigations were carried out in three phases. During the first phase (1976-'78) emphasis was given to the seed resources of the surf area, followed by that in the estuaries and backwaters. A total of 246 stations were covered all along the coasts at monthly interval for the purpose. During the second phase which went on for another year (1979) the studies were centred in the estuaries and backwaters, and 49 stations were covered, again at a monthly interval at four regions. The third phase of the survey which was completed in one year (1980) was devoted for an intensive study on the diurnal variations in seed abundance and on the influence of moon on their occurrence and abundance. For this purpose one centre was selected in each of the six regions and quarterly diurnal sampling at hourly interval was carried out during full, half and new moon phases occurring sequentially in a month.

Six teams of scientists and technical personnel operated the project from six different research centres along the coast namely Calicut, Cochin, Vizhinjam, Tuticorin, Mandapam and Madras. Sampling stations were fixed all along the coastal area at every 6 to 10 km distance. However, within the estuaries and backwaters sampling was carried out at shorter intervals of distance. Along with the collection of seed samples, environmental parameters such as temperature, salinity and dissolved oxygen were also monitored. While a variety of gears were used for the qualitative studies, the quantitative estimates were made by employing the bucket-scoop net method in the surf area and a specially designed quantitative seed sampler developed at the Institute in the estuaries and backwaters. Voluminous data were collected during the investigations and the results are being published in the form of a bulletin. The present account brings out the salient findings of the studies.

1. RESULTS OF FIRST PHASE OF SURVEY

Areas covered

The surf sampling for the seed resources was carried out in Kerala from north to south at Kasaragod, Bekal Fort, Thaikadapuram, Ettikulam, Mattul, Azhikal, Azhikode (north), Cannanore, Dharmadam, Tellicherry, Mahe, Badagara, Iringol, Tikkodi, Quilandy, West Hill (Calicut), Beypore, Kadalundi, Parappanangadi, Tanur and Paravana in the **Kasaragod-Ponnani Region**; Ponnani, Puthuponnani, Mannalamkunnu, Chavakkadu,

* This work was carried out under the Institute Project 'Survey of Fish, Prawn and Molluscan (bivalves) Seed Resources of Kerala and Tamil Nadu'. Personnel associated with the project:

Project Leader : E.G. Silas (1976-'80)
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 Madras : K. Rangarajan (1976-'80)
 M. Rajagopalan (1976-'80)
 K.S. Sundaram (1976-'78)
 T. Dhandapani (1979-'80)

Chetwai, Vadanappally, Nattika, Kaippamangalam, Vemballoor, Azhikode (South), Narakkal, Fort Cochin, Manassery, Chellanum, Anthakaranazhi, Arthumkal, Alleppey, Ambalapuzha, Thottappally, Thrukkunnappuzha, Ayiramthengu, Chavara and Neendakra in the **Ponnani-Neendakara Region**; Sakthikulangara, Thangassery, Paravur, Edava, Perumathura, Veli, Panathura, Vizhinjam, Adimalathura, Puthiyathura to Parithiyur in the south and in Tamilnadu on the southwest coast from Thengapattinam, Enayam, Melmidalam, Colachel, Kadiapattinam, Muttom, Azhikkal, Rajakkamangalam, Manakudi, Kanyakumari west and Kanyakumari point in the **Neendakara-Kanyakumari Region**; Chinnamuttom, Leepuram, Variyoor, Vattakottai, Uvari, Periathalai, Alanthalai, Nariyppur and Yerwadi in the **Kanyakumari-Keelakkarai Region** and Keelakkarai, Sethukarai, Muthupet, Puthumadom, Seeniappa Dharga, Vedalai, Mandapam (Gulf of Mannar), Thonithurai, Pamban, Kundugal, Naduthurai, Rameswaram Road, Hare Island, Manoli Island, Krusadi Island, Shingle Island, Chinnapalam, Rameswaram, Thangachimadam, Pamban, Thonithurai, Mandapam (Palk Bay), Munaikadu, Pillaimadam, Dhargavalasai, Athankarai, Mudiveerapattinam, Devipattinam, Karangadu, Thondi and Sundarapandiapattinam in the **Keelakkarai-Sundarapandiapattinam Region**. No sampling was carried out in the surf area in the **Muthupet-Pulicat Region**.

The stations in the estuarine and brackish water areas worked out along the coast for regular studies starting in Kerala from north to south and around Kanyakumari to north upto Pulicat Lake were Chandragiri, Bekel, Nileswaram, Punnakadavu, Cherukunnu-Thavam, Mattul, Valapattanam, Azhikode (north), Nadal, Anjangadi, Koduvallypuzha, Mahe, Iringol, Kottakkal, Chovai, Korapuzha, Kallai, Elamarakadavu, Manthalakadavu, Beypore, Kadalundi, Poorapuzha and Chamravattom in **Kasaragod-Ponnani Region**; Ponnani, Puthuponnani, Chetwai, Azhikode (south), Kottapuram, Nayarambalam, Puthuvypeen, Thoppumpady, Perumbalam, Anthakaranazhi, Thanneermukkom, Muhamma, Thottappally, Ayiramthengu and Ashtamudi in the **Ponnani-Neendakara Region**; Paravur, Edava, Anjengo, Veli, Panathura, Adimalathura, Karichal, Parithiyur, Thengapattinam, Melmidalam, Colachel, Puthoor, Chinnavilai, Valliar, Azhikkal, Rajakkamangalam and Manakkudi in the **Neendakara-Kanyakumari Region**; Thattarippu, Kuttapuli, Perumanal, Uppar, Hanuman Nadhi, Idinthakarai, Koothankuzhi, Athankarai, Manapad, Thiruchendur, Kayalpattinam, Arumuganeri, Punnaikayal, Palayakayal, Mullakad, Muthiapuram, Tuticorin south, Karapad, Arasadi, Melarasadi, Kalanipattu, Kallar, Kallurani, Vaipar, Vembar, Mookaiyoor,

Valinokkam, Palayar, and Mayakulam in the **Kanyakumari-Keelakkarai Region**; Kanjiramgudi, Periapattinam, Seeniappa Dharga, Pamban, Chinnapalam, Kadarsapad, Rameswaram Road, Pillaimadam, Athankarai, Kottakkarai, Vattanam, Pasipattinam and Sundarapandiapattinam in the **Keelakkarai-Sundarapandiapattinam Region** and Muthupet, Vedaranyam, Uppanar, Adappar, Harichandranadhi, Vellaiyar, Kaduvaiyar, Vettar, Thirumalayar, Arasalai, Virasolanar, Cauvery, Coleroon Killai, Vellar, Pennaiar, Varanganadhi, Kadapakkam, Palar, Kovalam, Adayar, Ennur and Pulicat in the **Muthupet-Pulicat Region**.

Hydrological features

A summary of the results obtained on the environmental features for the respective zones (zones 1-18) is given in Table 1. Temperature, salinity and dissolved oxygen were found to vary considerably especially in the estuarine and backwater areas and were influenced by several factors such as seasons, tide, rainfall, freshwater discharge, pollution and nearness to bar mouth.

The temperature varied over a wide range in the surf area along both west and east coasts and the variation was between 21 and 36°C. The maximum temperature was observed in Tuticorin and the minimum at Keelakkarai in Tamil Nadu. In the estuarine areas even though the minimum remained the same in the surf area the range was still higher and the maximum registered was 40°C in some of the salt-pans in Tuticorin area. Along the Kerala coast, however, the maximum temperature noted in estuaries was 37°C. The relation between temperature and salinity was more pronounced in the interior waters than the surf region.

In the surf area along the Kerala coast the salinity ranged between 11 and 37‰ while in Tamilnadu the range was between 9 and 41‰. In many estuaries and backwaters, salinity came down to near fresh water condition especially during southwest monsoon in Kerala. However, in summer the values almost equalled with the marine conditions. In the estuaries and backwaters of Tamilnadu even though low values in salinity were observed during the rainy season, very high salinities, often reaching upto 144‰ were also recorded in and near the salt-pan areas.

The observed values of dissolved oxygen in the surf and estuaries showed great variations in both the states. Low values of oxygen were generally noticed in the brackish water areas especially where environmental pollution occurred. Surprisingly enough low

Table 1. Hydrological conditions observed in the various zones of observations

Zone No.	Zones	SURF						ESTUARY					
		Temp. (°C)		Sal. (‰)		O ₂ (ml/l)		Temp. (°C)		Sal. (‰)		O ₂ (ml/l)	
		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
1.	Kasaragod-Azhikkal	24	34	25	36	1.6	6.1	26	36	1	35	2.7	—
2.	Azhikkal-Badagara	26	35	11	36	2.6	5.7	27	36	1	35	—	6.8
3.	Badagara-Beyypore	26	35	24	36	2.7	5.7	27	34	1	36	0.5	6.2
4.	Beyypore-Ponnani	27	33	30	36	2.4	6.3	23	35	—	—	2.1	6.2
5.	Ponnani-Nattika	24	35	13	36	2.4	6.3	23	35	0	36	2.5	5.6
6.	Kaippamangalam-Manassery	25	35	13	37	2.4	6.3	26	33	3	35	2.4	5.6
7.	Chellanum-Ambalapuzha	22	34	18	37	2.5	5.9	26	34	2	36	3.2	4.6
8.	Thrikunnapuzha-Neendakara	23	35	19	36	3.0	5.5	—	33	11	35	2.1	5.5
9.	Sakthikulangara-Vizhinjam	24	31	27	37	5.6	5.8	27	37	0.3	21	5.1	6.4
10.	Adimalathura-Kanyakumari	23	31	17	33	5.6	5.8	23	35	0.1	36	5.1	6.4
11.	Kanyakumari-Periathalai	27	34	27	34	4.0	7.8	22	36	1	144	2.5	7.8
12.	Manapad-Kalanipattu creek	28	35	19	41	4.0	8.0	22	40	4	89	2.0	8.0
13.	Kallar-Mayakulam	25	36	9	37	3.0	7.0	24	40	14	117	1.0	8.0
14.	Keelakatai-Rameswaram	21	35	29	44	—	8.3	21	35	2	74	1.4	—
15.	Rameswaram-Sundara-pandiapattinam	—	35	20	38	—	7.6	24	—	6	83	3.1	—
16-18	Muthupet-Pulicat	No sampling						26	34	1	35	2.0	6.2

oxygen value to the level of 1.6 ml/l was obtained for the surf waters in the Kasaragod-Azhikode zone. In the surf area along the Kerala coast the oxygen values ranged between 1.6 and 6.3 ml/l while the range in the surf waters in Tamil Nadu was between 3.0 and 8.3 ml/l.

In certain zones the dissolved oxygen level in the estuarine areas was considerably low. Thus in the Badagara-Beyypore zone in Kerala, value as low as 0.5 ml/l was obtained while the maximum recorded was 8.0 ml/l.

Occurrence and abundance of seed

Region: Kasaragod-Ponnani

The commercially important seed occurring in the region Kasaragod to Ponnani belonged to *Penaeus indicus*, *Metapenaeus dobsoni*, *Mugil* sp. and *Sillago* sp.

P. indicus occurred during almost all the months. However, the availability differed from place to place. The seed were not available from Kasaragod to Azhikode during January and February. But during March they were available in large numbers especially in places

like Chandragiri estuary, Nileswar estuary and Cherukunnu Thavam. During April also the seed were observed at most of the stations of this zone. In October and November the availability of the *Penaeus* seed increased. Maximum number of seed was collected in salinity range 30-34‰, dissolved oxygen 5 ml/l and temperature range 29-30°C.

In the second zone from Azhikode to Badagara the *P. indicus* seed were available during February-April and also in July-August period. It was abundant in December also. At Tellicherry, Mahe and Badagara in the surf and in the nearby estuaries the seed were collected in fairly good quantities (40-600/100 m³ of water).

In the Badagara-Beyypore zone (zone 3) good collections of *P. indicus* larvae were made during January, March and April. Quilandy, Elathur, Korapuzha, West Hill and Beyypore were the centres where good collections were obtained.

The seed of *P. indicus* were observed in considerable number at Parappanangadi in the Beyypore-Ponnani zone (zone-4) (1,733/100 m³ of water).

The length of the *P. indicus* seed ranged from 7 to 15 mm with mean size at 10 mm. About 45% of them occurred in salinity range of 30–34‰ (the observed salinity values ranged between 10 and 39‰). Similarly 64% of the seeds occurred in dissolved oxygen content around 5 ml/l. Though the seed were found to occur in temperature range of 27–33°C, 60% of them occurred in the range between 29 and 31°C.

Metapenaeus dobsoni seed occurred during February, March and October, with the maximum concentration in the latter month. Chandragiri (44/100 m³), Nileswar (22/100 m³), Mattul and Mahe (96/100 m³) were some of the places from where it was collected. The size of the seed ranged between 6 and 20 mm with the mean size at 9 mm.

Though it was recorded in the salinity range of 1–37‰, 25% of it occurred considerably between 26 and 30‰. 35% of the seed occurred in 5 ml/l of dissolved oxygen and 50% was found in temperature ranging from 35 to 35.9°C.

Mugil spp. was the common fish seed collected throughout the year from both surf and estuarine areas. During March, July and October they were found at Mattul, Mahe, Elathur and Beypore. They occurred in salinities ranging from 0–39‰. When their occurrence in different dissolved oxygen levels was analysed it was observed that 55% occurred in 4–4.9 ml/l of oxygen. They were found to occur in the temperature between 27 and 33°C.

Good number of *Sillago* seed was also collected from both surf and estuarine areas. It was recorded during January, March, July and October in places like Nileswar, Mahe, Dharmadam, Tanur, Korapuzha, Beypore and Kadalundi. 70% of them was found to occur in salinities 30–34‰. 80% of the seed of *Sillago* was found to prefer temperature ranging from 27.0 to 27.9°C.

The seed of *Perna indica* were available at Tellicherry, Dharmadam, Quilandy and Tikkodi. The season of its abundance was from September to December.

Region: Ponnani-Neendakara

In this region, among the cultivable species, prawn seed were the most abundant group consisting of *P. indicus*, *M. dobsoni* and *M. monoceros*. Generally speaking, the central part of this region (between Vadanappally and Kayamkulam) was more productive for prawn seed resource.

Penaeus indicus

From the data obtained for three years (1976–78) it was found that the period of maximum abundance of seed of *P. indicus* in the Ponnani-Neendakara region was from February to August and the highest monthly average number obtained was 7,880 per 100 m³ of water in May.

A centre-wise analysis for the abundance of seed showed that Ashtamudi Lake, with an average annual seed density of 7,200 per 100 m³ of water, ranked first followed by Bharathapuzha estuary (5,618 seed), Thottappally estuary (4,357 seed) and Anthakaranazhi (3,100 seed). In the surf area generally the abundance was moderate or even less and the maximum number obtained was 1,796 per 100 m³ of water at Anthakaranazhi.

Month-wise analysis of data for the different centres revealed that *P. indicus* seed were maximum at the Thottappally and Neendakara zone in August and the rate of occurrence was 30,500 and 16,100 per 100 m³ of water respectively. At Puthuvypeen (near Cochin) they were abundant in February with seed density of 15,000 per 100 m³. A high catch rate of 58,700 per 100 m³ was obtained from the Ponnani river mouth area in May, and the seed were generally abundant there throughout the year.

Metapenaeus dobsoni

In this region the estimated number for the average annual abundance of seed of this species both in surf and estuary during the period of investigation was 2,378 per 100 m³ of water. The period from May to August represented their maximum abundance with the peak in July (11,731 seed per 100 m³). In the surf area the maximum abundance was noticed at Vadanappally (31,600 per 100 m³ of water) followed by Narakkal (8,013), Neendakara (7,517) and Nattika (6,564).

As far as the monthly abundance at various stations was concerned, July was found to be the best month for the seed of *M. dobsoni* and the occurrence was of the order of 1,55,400 per 100 m³ of water in the surf area at Vadanappally. During May, Mannalamkundu with 33,600 seed recorded the maximum catch followed by Azhikode (surf) (11,800). In August, the barmouth at Azhikode was especially productive with seed density of 65,900 per 100 m³ of water.

Metapenaeus monoceros

The seed of *M. monoceros* though present in lesser number, were widely distributed in the Ponnani-Neendakara region. The mean annual number was estimated at 85 per 100 m³ of water. The period from May to July appeared to be the best season for the seed of this species. In May an average number of 490 seed occurred per 100 m³ of water.

In this region Mannalamkunnu registered the maximum annual average density of 1,063 seed of *M. monoceros*. At the other centres it was very less. Monthly analysis in the different surf and estuarine stations showed that the maximum occurrence was in the surf at Mannalamkunnu in May where 8,400 seed were obtained per 100 m³ of water. Other stations yielded the seed at a rate of 2,800 (Azhikode bar mouth), 2,100 (Chavakkad surf), 1,800 (Chetwai surf) and 1,300 (Anthakaranazhi surf) in the order of abundance.

Fish seed

Among cultivable species, seeds of mullets and *Chanos* were frequently caught in the Ponnani-Neendakara region. Mullet seed were abundant during the February–April period. An annual average number of 589 mullet seed was obtained in this region. A station-wise consideration of the annual abundance showed that the maximum number of 920 seed was available at Ayiramthengu estuary. Next in abundance was Puthuvyppeen where the occurrence was 800 seed per 100 m³ of water.

Monthly occurrence of mullet seed at the different stations indicated that the Kayamkulam estuary had the highest seed potential of 9,200 per 100 m³ in February while at Puthuponnani river mouth area 2,400 seed per 100 m³ were collected in April. Chetwai-mouth was another productive area where 1,400 seed per 100 m³ were collected in July.

Seed of *Chanos* were least represented in the region. The annual average abundance was of the magnitude of 17 seed per 100 m³ and no remarkable seasonal variation was noticed in their case. However, the period from February–May appeared to be favourable and its maximum occurrence was in May (56). Among the stations Azhikode estuary was the richest with 1,000 seed per 100 m³ in April. From the Cochin bar mouth area *Chanos* seed at the rate of 600 were caught in May. Other places where appreciable number of seed of this

species collected per 100 m³ were Chellanum and Alleppey (500 each in February) and Puthuponnani (400 in May).

Molluscan seed

Mussel seed of the genus *Perna indica* and *P. viridis* were found growing luxuriantly wherever suitable substrata like the granite stones of the sea wall were available. Spat settlement was observed in July. It was observed that after reaching 30–35 mm length the mussels in these beds experienced stunted growth due to over population. South of Tharayilkadavu, green and brown mussels were found while in the northern areas, only green mussels were noticed.

River mouths, estuaries and bar mouths in this region were characterised by the presence of clam beds. Rich clam beds were located at Ponnani, Puthuponnani, Chetwai, Azhikode, Cochin, Ayiramthengu and Neendakara. *Villorita* sp. was the common clam found in the southern parts while *Meretrix* sp. dominated in the northern parts.

During September–November huge quantities of shells of *Barena* sp. were found to be collected by the fishermen from the surf area. The edible oysters belonging to the genus *Crassostrea* were found to occur in lesser densities at the mouth of rivers and estuaries and also some distance inside.

Region: Neendakara - Kanyakumari

The important species of cultivable organisms available in this region were *P. indicus*, *M. dobsoni*, *Eetroplus suratensis*, *Sillago* sp., *Chanos chanos*, *Perna indica*, *Pinctada fucata* and *Crassostrea* sp.

The post larvae and juveniles of *P. indicus* occurred at Sakthikulangara, Paravur, Perumathura, Veli, Then-gapattinam, Kadiapattinam, Azhikkal, Rajakkamangalam and Manakkudi. The length ranged between 13 and 80 mm. The maximum number of seed were collected during April–June period followed by the January–March and October–December periods.

The seed of *M. dobsoni* were abundant than *P. indicus*. The main centres of occurrence were Sakthikulangara, Paravur, Edava, Veli, Adimalathura,

Puthiathura, Thengapattinam, Melmidalam, Chinnavelil, Kadiapattinam, Azhikkal, Rajakkamangalam and Manakkudi. The length ranged from 8 to 70 mm. Sixty per cent of the seed was obtained in the April-June period followed by 30% in the October-December period.

Mulletts were the most important fish seed in the region. The main centres of abundance were Paravur, Perumathura, Panathura, Adimalathura, Puthiathura, Parithiyur, Thengapattinam, Colachel, Kadiapattinam, Rajakkamangalam and Manakkudi. Fry and fingerlings were found in all the months. However, 70% of occurrence was in the October-December period followed by the April-June and January-March periods. Fry were also found in the rocky surf areas of Kanyakumari and Adimalathura.

The main centres for the seed of pearl spot were Sakthikulangara, Rajakkamangalam and Manakkudi. The best period for their abundance was April-June which accounted for 80% of the catch.

Fry and fingerlings of *Sillago* sp. were obtained from Perumathura, Puthiathura, Parithiyur, Thengapattinam and Kadiapattinam. They were more abundant in the southern part of the region. 70% of the seed was collected during the October-December period.

Seed of *Chanos chanos* were obtained from Adimalathura and Thengapattinam only. Few numbers were available in March, May and July.

Among bivalve molluscs, the green mussel was found at Sakthikulangara and Edava. Brown mussels occurred at Kovalam, Vizhinjam, Adimalathura, Colachel, Muttom and Kadiapattinam. Rock oysters of *Crassostrea* sp. were found in the rocky surf regions of Vizhinjam, Colachel, Kadiapattinam, Muttom and Kanyakumari. The pearl oyster occurred on submerged rocks of Vizhinjam, Colachel, Kadiapattinam and Muttom. Clams of the genus *Villorita* were found at Sakthikulangara, Paravur, Veli and Thengapattinam.

Region: Kanyakumari - Keelakkurai

Except in Kanyakumari district seed of *P. indicus* were found to occur in all other centres from Kuthankuzhi to Mayakulam in the post rainy months. The range in size was between 7 and 89 mm. Seed of *P. semisulcatus* were available in good quantities at Tuticorin only. Seed of *M. dobsoni* were obtained in all estuaries and backwaters in this region and they measured between 9 and 72 mm.

Among fish seed, mullet was available invariably in all the centres in all months in this region although in few numbers. The size ranged from 8 to 80 mm. An inverse relationship in abundance was found with the fry of *Chanos*. Seed of milkfish were available during April-May in Punnaikayal, Tiruchendur, Vattakottai and Valinokkam. The usual size available was between 15 and 85 mm. Seed of *Etroplus suratensis* were found in negligible number in Kallar, Kayalpattinam, Palayakayal and Punnaikayal. The length ranged between 24 and 63 mm. Elvers of *Anguilla bicolor* were found in Thattarippu and Vaipar estuaries soon after rains. The length of elvers ranged between 48 and 169 mm. Seed of *Sillago sihama* were available in less number during rainy season at Vembar, Vaipar, Kallar and Punnaikayal. Their length varied from 9 to 82 mm.

The seed of edible oysters were found in good numbers throughout the year, only in Tuticorin and Punnaikayal estuarine system. Seed of brown mussel were available in plenty in Chinnamuttom area and the sizes ranged between 25 and 50 mm. Species of *Meretrix* were found in the exposed mud flats of Punnaikayal central region in smaller number. Plenty of *Donax* sp. were noticed along the coast between Tuticorin and Veppalodai.

Region: Keelakkurai to Sundarapandiapattinam

Prawn seed

Seed of *P. indicus* were widely distributed along the surf area, Athankarai estuary, backwaters and tidal pools of Gulf of Mannar and Palk Bay. They were especially abundant at Kanjirangudi (October-December), Muthupet (July-September) and Thonithurai (April-June). In this region seed of *P. indicus* ranged in size between 12 and 60 mm. Seed of *P. monodon* were present in the coastal waters of Hare Island, Krusadi Island during October-December. In Pillaimadam and Athankarai they occurred in December and April-June respectively. At other centres also they were collected in smaller numbers. Seed of *P. semisulcatus* were almost equally present as *P. monodon* in Pasipattinam, Kottakkarai and Sundarapandiapattinam. Their size ranged from 16-59 mm. *Metapenaeus burkenroadii* was another species whose seed were found widely distributed along the coasts of Gulf of Mannar and Palk Bay. Their size ranged from 15-58 mm.

Fish seed

Fry and fingerlings of *Chanos chanos* were collected in good number in April-June period from Kanjiramgudi,



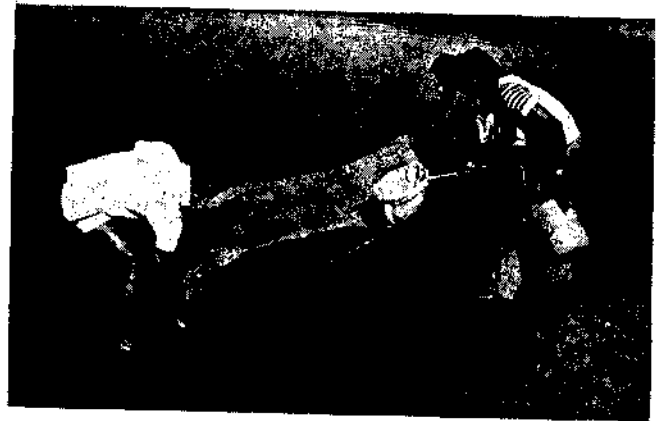
Collection of fish and prawn seed from the surf beaten area in the sea using bucket-scoop net method.



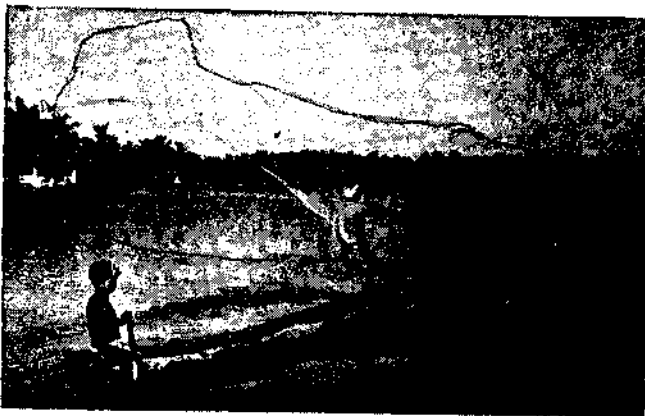
The collected seed are being cleaned of sand and weed after transferring into a bucket.



The cleaned seed are once again filtered through the scoop net and seed are transferred from the net.



Seed collection from estuarine area using velon screen.



Sampling for juvenile prawn and fish using small meshed cast net.



Different stages of lobster *Panulirus homarus* collected from among the crevices of sea wall at Fort Cochin.

Chinnapalam creek, Pillaimadam and Sundarapandiapattinam. Their total length ranged from 14–90 mm. The seed of *Mugil* spp. were present throughout the year in all the stations of Gulf of Mannar and Palk Bay. January to March formed their peak period of occurrence. The size ranged between 12 and 75 mm. Seed of *Sillago sihama* were well represented at Sethukarai, Shingle Island, Hare Island and Athankarai coastal waters. January to June was found to be the best season for their collection. Elvers of *Anguilla bicolor* were recorded in less number in Kanjiramgudi, Periapattinam and Seniappa Dharga.

Region: Muthupet-Pulicat

The prawn seed were represented by species of *P.indicus*, *P. monodon*, *M. dobsoni* and *M. monoceros* in this region. Seed of *P. indicus* were collected from all centres. It occurred throughout the year in almost uniform densities. The size of the seed ranged from 8 to 56 mm. Maximum concentration of seed was seen in Vedaranyam swamp and Thirumarayanur and Vellar estuaries. Seed of *P. monodon* were common in this region from October–December. In May, post larvae of this species were found to approach the coast in large numbers. The seed were common in estuaries namely Uppanar, Adappar and Kaduvaiyar. The size of the seed ranged from 30–40 mm. Seed of *M. dobsoni* were abundant during January–March in the following estuaries: Harichara nadi, Arasalar, Cauvery, Uppanar, Coleroon, Killai and Vettar. Seed of *M. monoceros* were also common in this region. They were found in good quantities in Adappar, Kaduvaiyar, Varanga nadi and Palar estuaries.

Among fishes, seed of *Mugil* spp. were the commonest and were found in Muthupet swamp, Vettar and Adayar estuaries and Pulicat Lake. Their size was found to range between 16 and 60 mm. Seed of *Chanos chanos* were found in large numbers in Uppanar estuary, Kadapakkam and Kovalam backwaters, Adayar and Korattalayar estuaries and Pulicat Lake. They were comparatively more during April–June and their size ranged from 50 to 70 mm. From January to March the seed of *Sillago sihama* of size range 20–34 mm were abundant in Harichandra nadi, Vellaiyar and Pennaiyar.

Areas suitable for farming

During the surveys, special attention was given to locate suitable areas for farming. The following is a list of such areas along with the extent in hectares given in brackets.

Region I: Kavi in Kavipuzha estuary (200 ha), Ezham near Payyangadi estuary (100 ha), Cherukunnu Thavam near Payyangadi river (200 ha), Mappila Bay (500 ha), Dharmadam near Dharmadam estuary (upto 10 km from bar mouth), Koduvally (150 ha), Thiruvano-rekadavu near Korapuzha estuary (25 ha) and Perumthuruthi (15 ha) near Korapuzha estuary.

Region II: Chetwai (150 ha), Azhikode (375 ha), Vypeen, Kumbalangi, Aroor, Perumbalam area upto Vaikom and further south in the Vembanad Lake (210 ha), Anthakaranazhi (10 ha), Kayamkulam Lake (80 ha) and Ashtamudi Lake (830 ha).

Region III: Paravoor (1 ha), Edava (2 ha), Perumathura (4 ha), Adimalathura, Puthiathura and Parithiyur (extensive areas), Thengapattinam (1 ha), Pudur (about 1 km canal area of 5–10 m width), Kadipattinam (1 ha), Azhikkal (4 ha), Rajakkamangalam (1 ha), and Manakkudi (2 ha).

Region IV: Thiruchendur (8 ha), Arumuganeri (extensive areas), Punnaikayal (40 ha), Palayakayal (4 ha), Mullakkad (30 ha) and Kallar (8 ha).

Region V: Pamban–Chinnapalam creek (3.3 ha) and Pillaimadam (250 ha).

Region VI: Point Calimere (extensive areas), Vedaranyam canal (areas between Thopputhurai and Naluvadapatty), Killai backwaters, Varanganadi estuary Marakkanam backwaters, Kovalam backwaters, Ennore backwaters and Pulicat Lake (extensive areas).

Source of pollution

Information were gathered during the surveys on the source of pollution in each of the estuaries and backwaters that posed threat to the seed or farming activities. The following is a summary of the study.

Region 1: Valapattanam (T.S., Ind. p), Azhikode north (T.S.), Dharmadam (T.S., H.R.), Moorat, Chovai, Korapuzha (H.R.), Kallai, Beypore (T.S.), Chaliyar (Ind. p), Kadalundi, Parappanangadi, Mangalam, Chamravattom (H.R.)

Region 2: Ponnani, Puthuponnani, Chetwai, Azhikode (H.R.), Vembanad Lake (Ind. p, H.R., pest), Kayamkulam (H.R.), Ashtamudi (Ind.p, H.R.).

Region 3: Edava, Perumathura, Panathura, Adimalathura, Parithiyur, Thengapattinam, Enayam, Pudur and Manakkudi (H.R.)

Region 4: Arumuganeri (Ind.p), Tiruchendur and Vattakottai (H.R.)

Region 5: No major source of pollution.

Region 6: Ennore (Ind.p), Adayar (S.P.), Vedaranyam swamp (Ind.p).

H.R. = Husk retting, Ind. p = Industrial pollution, S.P. = Sewage pollution, T.S. = Timber seasoning, Pest = Pesticide.

2. RESULTS OF SECOND PHASE OF SURVEY

During the second phase of the seed resources survey carried out during 1979-'80, emphasis was towards sampling in the estuaries and backwaters. Sampling for seed especially of prawns was more effective on account of the use of the Quantitative Seed Sampler designed by Mathew *et al.* (*Proc. Symp. Coastal Aquaculture, Part 1: 302-307, 1982, MBI, Cochin*). The results of the survey, again on a region-wise basis are summarised below.

Region: Kasaragod to Ponnani

The estuaries and other brackishwater areas covered in this region during the second phase of the survey were Chandragiri, Neeleswar, Bekal, Kawai, Chittari, Kuppam, Cherukunnu, Nadal, Mattul, Pazhayangadi, Valapattanam, Dharmadam, Koduvally, Mahe, Kanyamcode, Korapuzha, Beypore, Kadalundi and Poorapuzha. Of these Chandragiri had three sampling stations while others had one each.

Seed abundance

Seed of commercially important species of prawns namely *Penaeus indicus*, *Metapenaeus dobsoni* and *M. monoceros* and fish namely *Etroplus suratensis* occurred in this region. Seed of *P. indicus* occurred at the rate of 700 per 100 m² in Chandragiri estuary. 66 % of total seed of this species was obtained from the estuaries between Chandragiri and Cherukunnu. Beypore and Poorapuzha estuaries were not found rich in seed of this species. Two peaks in abundance were observed; one during April and the other during November-January.

M. dobsoni also followed the same pattern of abundance as *P. indicus*. The estuaries between Kasaragod and Valapattanam accounted for 68 % of seed of this species. The peak periods of abundance were April and June. Seed of *M. monoceros* also were

rich in the northern estuaries. Maximum abundance was observed in July and August.

Seed of pearl spot (*E. suratensis*) were the most common among fish seed. They were abundant in the northern parts. Though present in almost all months, maximum was in December. Seed of mullets were commonly found in the southern part of the region. The zone between Beypore and Poorapuzha was especially rich in *Mugil* seed which occurred at the rate of 400 per 100 m² of water area. April and August seemed to be the months of maximum occurrence.

Region: Ponnani-Neendakara

In this region eight estuaries were visited regularly of which Ponnani, Puthuponnani, Azhikode, Puthuvypeen, Kayamkulam and Ashtamudi had one station each while Chetwai estuary and Vembanad Lake had three stations each.

Seed abundance

The annual mean abundance of seed of *P. indicus* which was the most abundant in this area has been estimated to be 1,000 per 100 m². Maximum quantity was obtained from Chetwai estuary where the annual mean abundance was 3,025 per 100 m². The least abundance of 33 per 100 m² was observed at Thanneermukkom in Vembanad Lake. When considered on a monthly basis it was found that the maximum abundance was during February-March period (2,758 per 100 m²). A secondary peak was observed during October-December period. A month-wise and centre-wise estimate showed that Chetwai was the most productive estuary where in March the seed of *P. indicus* occurred at the rate of 21,700 per 100 m².

The seed of *P. indicus* was more in temperature range between 32 and 34°C and least between 28 and 30°C. With regard to salinity this species was found to prefer a range between 20 and 25‰. With regard to dissolved oxygen the most favourable range was between 3 and 5.

The annual mean abundance of seed of *M. dobsoni* in the region has been estimated to be 780 per 100 m². In the different estuaries the abundance was between 313 in Ashtamudi Lake and 1,650 in Puthuponnani estuary. The seed were especially abundant during February and December and the rate of occurrence in these months was 1,358 and 1,491 respectively per 100 m². Among the estuaries, Chetwai with 5,400

seed per 100 m² accounted for the maximum quantity which was in February.

The annual mean abundance of *M. monoceros* has been estimated to be 70 per 100 m². The seed of this species enjoyed a wide distribution in this region though in few numbers. Among estuaries the maximum number of seed taken was at Kundukadavu in Chetwai estuary (338/100 m²). July was the month of maximum abundance. The maximum number of seed collected during a single observation was 500 per 100m² at Puthuvypeen in February.

Though in extremely low numbers, the seed of *M. affinis* were also represented in this region. The annual abundance was only 9 per 100 m². The maximum abundance was in November at Puthuponnani.

Among fishes the seed of mullet were the most abundant. The average annual abundance for the region was 646 per 100m². Estuaries of the northern parts of the region had the maximum mullet seed. The maximum of 2,588 per 100 m² were present at Chetwai. The seed of *Chanos* were collected at an annual average rate of 6 per 100 m². An unusual catch of 5,400 per 100 m² was made at Pulikkadavu in the Chetwai estuary.

The seed of *Etroplus* sp. were present south of Puthuvypeen. They were common during February to September period. At Kumbalangi in Cochin backwaters they were present at the rate of 100 per 100 m² in March, July and September. Further interior in the estuary at Thanneermukkom they occurred at the rate of 900 per 100 m² in February.

Region: Kanyakumari-Keelakarai

In this region the centres visited regularly were Thattarippu, Vattakottai, Manapad, Thiruchendur, Punnaikayal, Palayakayal, Pulluvali, Kallar and Valinokkam.

Seed abundance

The annual average occurrence of seed of *P. indicus* was 59 per 100 m². Among estuaries Palayakayal with 149 per 100m² accounted for the maximum quantity. It was followed by Pulluvali (121) and Punnaikayal (84). October to January was the best period for this species. A secondary peak was observed in March. In January, 424 seed were recorded in Palayakayal.

The annual average number of seed of *M. dobsoni* was 13 per 100m². Manapad accounted for the maximum seed of 400 per 100 m² in January. At the other centres seed of *M. dobsoni* were least represented.

Seed of mullets were available in all the months in all the estuaries surveyed in this region except at Valinokkam. The average annual abundance was 89 per 100 m². November to April appeared to be the most productive period. The area from Manapad to Kallar was particularly rich in these seed.

The period from March to August proved to be the best for the seed of *Chanos* with maximum abundance in April and May. The average annual occurrence was 12 per 100 m² in this region. Except the creek at Vattakottai the seed were available in all the centres with relatively good density at Thiruchendur and Punnaikayal.

Region: Keelakarai-Sundarapandiapattinam

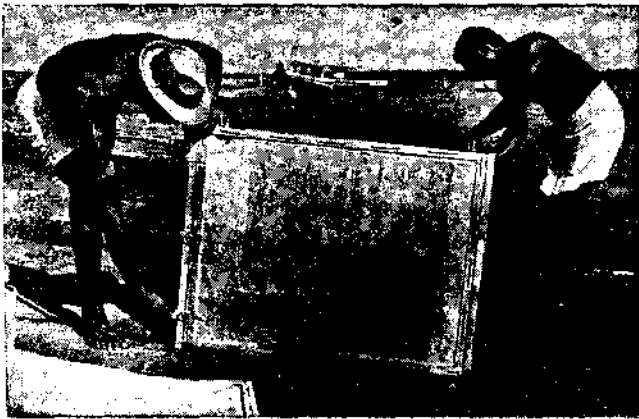
The estuaries, backwaters and tidal pools covered in this region were Kanchirangudi, Pamban tidal pools, Pamban-Chinnapalem creek, Pillaimadam and Athankarai. Collections were also made from coastal waters at Sethukarai, Thonithurai, Pillaimadam, Athankarai and Devipattinam.

Seed abundance

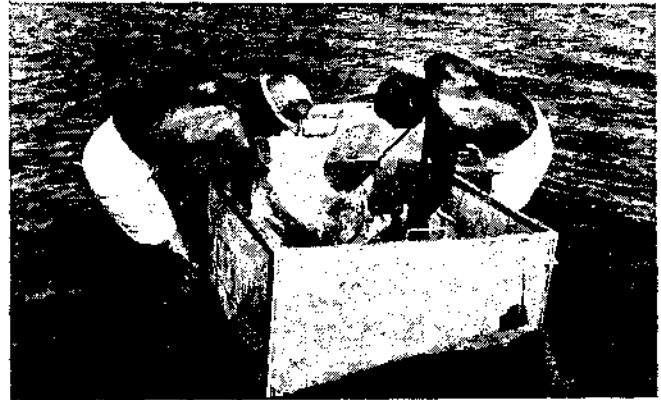
Important seed encountered were of the species *P. indicus*, *P. semisulcatus* and *M. burkenroadii*. Among fish, seed of *Chanos*, *Mugil* and *Sillago* were abundant in this region.

The Pamban tidal pools had the highest concentration of seed of *P. indicus* (2,30,900 per 100 m²), followed by Pamban-Chinnapalam creek with 12,700. April-May was the period of maximum abundance. *P. semisulcatus* occurred at a maximum annual average rate of 300 per 100 m² in Athankarai estuary in April. The maximum number of *M. burkenroadii* collected was 8,400 per 100 m² from Pillaimadam lagoon in January.

Seed of mullet occurred at a rate of 15,500 per 100 m² at Chinnapalam creek. In Pamban tidal pool they were present at a rate of 11,500 in June. Fry of *Chanos* were highly abundant and at Pamban tidal pools they occurred at a rate of 7,74,200 per 100 m² in May. Seed of *Sillago* were present in good numbers in Pillaimadam estuary during March-May and in March the occurrence was at a rate of 17,500 per 100 m².



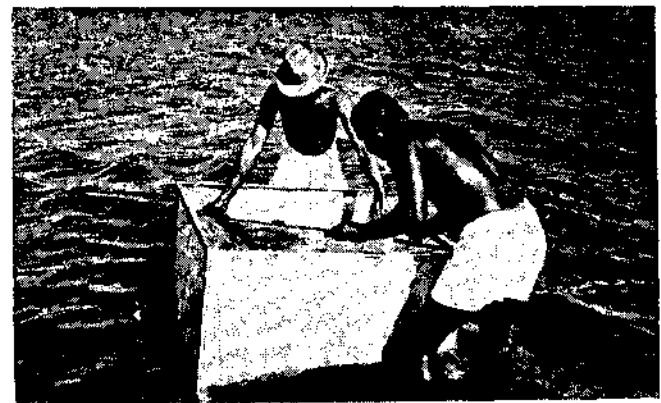
The QSS (Quantitative Seed Sampler) used for sampling in the estuarine areas is being assembled on the shore.



After placing the QSS at the sampling site repeated sampling for fish and prawn seed is being done using a special scoop net.



The assembled QSS being taken to the sampling site.



The scooped seed are being collected for preservation.

3. RESULTS OF DIURNAL OBSERVATIONS IN RELATION TO LUNAR PHASES AT SELECTED CENTRES IN KERALA AND TAMIL NADU

Influence of moon on the reproductive cycle of animals is well known. Breeding and larval migration in marine penaeid prawns are also considered to be greatly controlled by the moon. The traditional prawn farmers in Kerala regulate the opening and closing of farms sluices only in accordance with the different phases of the moon. In order to understand the influence if any, of moon on the diurnal abundance and on the migration of prawn seed into the estuaries and backwaters, a series of field experiments were carried out which went on for one year at three centres in Kerala and two centres in Tamil Nadu simultaneously at a quarterly interval. In each quarter three consecutive observations were made beginning with a full/new moon, through mid lunar phase and ending with a new/full moon. The schedule of sampling is given in Table 2.

Each observation in a quarter was for a duration of 24 hours: during which hourly sampling was made from 1,600 to 1,600 hrs for seed and environmental features. Seed samples were collected by filtering 1 m³ of water. Numerical estimates for the seed were made per 100 m³ of water. The study besides giving information on the influence of moon on the occurrence and abundance of seed of cultivable prawns and fishes, also enabled to understand their abundance during day and night, different seasons, in relation to tide and the influence of environmental parameters on seed. The following is a discussion of the results obtained at the various centres. The quantitative estimates for seed of prawns and fish were made numerically as number per m³ at all the centres.

Korapuzha (Calicut)

1. Seasonal abundance

The important seed occurred were those of *P. indicus*, *M. dobsoni* and *Mugil* sp. Seed of *P. indicus*

occurred at the rate of 1,200 per 100 m³ during the first quarter and 300 during the 2nd quarter. Maximum abundance of 1,400 was noticed in the 3rd quarter. In the last quarter also they were better represented. The seed of *M. dobsoni* were poorly represented during the entire period of observation. Their number ranged between 200 and 600. The seed of mullet occurred in the first and second quarters. *Chanos fry* were collected at a rate of 1,000 in the first quarter.

Table 2. Schedule for diurnal sampling followed at the various centres during different phases of the moon in 1978 and 1979

Quarter	Date	Duration (24 hrs)	Phase of moon
I	17-18 Oct.	1600-1600	Full moon
	31 Oct. to 1 Nov.	"	Half moon
	7-8 Nov.	"	New moon
II	29-30 Jan.	"	New moon
	5-6 Feb.	"	Half moon
	12-13 Feb.	"	Full moon
III	26-27 May	"	New moon
	1-2 Jun.	"	Half moon
	11-12 Jun.	"	Full moon
IV	21-22 Sep.	"	New moon
	28-29 Sep.	"	Half moon
	5-6 Oct.	"	Full moon

2. Day/night abundance

A night time abundance of prawn seed was observed in this estuary. The night abundance was 5,300 while only 3,400 were collected during day. It was also observed that on the whole the abundance was minimum between 12 and 15 hrs.

3. Abundance in relation to lunar phases

The prawn seed were found to be more during the mid lunar phase. On an average while 14,500 prawn seed occurred during mid lunar phase, only 112 and 4,460 were present during the new moon and full moon respectively.

4. Variation in relation to tide

It was observed that the seed were abundant during high tides. Putting all species together 73,700 seed per

100 m³ were collected during high tide against 28,800 during the low tide.

5. Abundance in relation to salinity

During the period of observation the salinity in the estuary varied between 0 and 34.9‰. In general it was found that the salinity was not a limiting factor in the occurrence and abundance of prawn seed.

Neendakara

1. Annual abundance

At Neendakara the most common seed of culture importance were those of prawns. *P. indicus* ranked first whose annual abundance was estimated to be 226 per 100 m³ followed by *M. dobsoni* (210), *M. monoceros*, and *M. affinis*. Among fishes the seed of mullets dominated with 22 larvae per 100 m³. The seed of *Chanos* were present in very few numbers.

2. Seasonal abundance

The second and third quarters were generally good for seed of cultivable species. The maximum number of seed of *P. indicus* was obtained in the 2nd quarter when the estimated value was 644. The seed of *M. dobsoni* were also abundant in the second and third quarter at the rate of 391 and 388 respectively. A few seed of *M. monoceros* were present in the third and fourth quarters while the seed of *M. affinis* occurred in the second quarter alone.

The seed of mullet were present in all the quarters in varying numbers. The maximum of 55 was obtained during the 2nd quarter. In the other quarters they ranged between 9 in the 4th quarter and 12 in the 1st quarter. The occurrence of seed of *Chanos* was highly seasonal. They were absent in the 4th quarter and occurred at the rate of 1 and 3 in the first and third quarters respectively. In the second quarter seed at a rate of 9 were obtained.

3. Day-night abundance in relation to phases of moon

A striking relationship was found between diurnal abundance and lunar phases. Thus during the full moon phase seed of *P. indicus* and *M. dobsoni* were relatively more in day samples than in night samples. The day abundance for *P. indicus* was 677 and for *M. dobsoni* it was 167 during full moons. The night abundance for the respective species was 108 and 144.

During the dark phase of the moon (new moons and half moons) both the species were comparatively more in the night samples. In the case of *M. monoceros* also the day time abundance during full moon phases and night time abundance during half moon phases and new moon phases were quite evident.

The seed of mullets showed night abundance during all the three phases of the moon.

4. Variation in relation to lunar phases

A direct relationship was noticed between different phases of the moon and the seed availability at this centre. As far as *P. indicus* was concerned the full moon periods yielded the maximum seed. The rate of abundance was 404 during full moons, 119 during half moons and 156 during new moons. *M. dobsoni* occurred at the rate of 392 during half moons, 156 during full moons and 83 during new moons. *M. monoceros* and *M. affinis* were more during full and half moon phases and the rate of occurrence was around 26. Seed of *Chanos* were absent in the collections during the new moon phases.

5. Day-night abundance

Out of the six species of prawns and fishes of culture importance considered, seed of species namely *P. indicus*, *M. monoceros*, *M. affinis* and mullets occurred in more number at night samples while the other two species namely *M. dobsoni* and *Chanos* occurred in almost equal number during day and night samples.

When considered numerically, the seed of *P. indicus* were present in the day samples at the rate of 291 against 156 in the night samples. But in the case of *M. dobsoni* while 302 seed were present in the night samples, only 126 occurred in the day samples. Seed of all other species were more in the night samples. In the case of *chanos* day time abundance was noticed.

6. Abundance in relation to tides and phases of moon

During the full moon phases whenever the prawn seed occurred the rising tides brought in more number of seed of *P. indicus*, *M. dobsoni* and *M. monoceros*. A rhythmic up and down oscillation in the abundance of seed of *P. indicus* in accordance with the tidal amplitudes was evident during the full moon. All the peaks were observed where the tides were at the zenith or started receding. During new moon, the trend in increase of seed was the same as during full moon. During half moons remarkable relationship with the tide was not

noticed; instead the variations in abundance was mainly controlled by the day-night phases.

7. Abundance in relation to hydrological features

The prawn and fish seed were found to be influenced by temperature and salinity and the effect was more on the latter. During the entire period of observation the dissolved oxygen was above optimum level and hence had little effect on the seed density.

Seed of *P. indicus* were more abundant in temperature range of 29.4 to 30.9°C. High salinity values of steady nature always favoured a high abundance of seed of *P. indicus*. Seed of *M. dobsoni* were more in temperature between 29.2 and 31.1°C. They were abundant when the salinity range was 29.32 to 34.31‰.

Puthiathura (Vizhinjam)

1. Annual abundance

At Puthiathura the fish seed were the most abundant while the prawn seed were only representative. Mulletts formed about 96% of the fish seed. *Sillago* sp. and *Eetroplus suratensis* (pearl spot) together formed 4%. Prawn seed were represented by *P. indicus*, *M. dobsoni* and *M. monoceros*.

Mullet seed were obtained at an average annual rate of 139 per 100 m², while the seed of other two species formed less than 2 annually. Prawn seed showed the following rate of occurrence: *M. dobsoni* 2, *M. monoceros* 1 and *P. indicus* less than 1.

2. Seasonal abundance

October–November (first quarter) which claimed 37.5% of total seed obtained during the year seemed to be the best season for cultivable species of fishes and prawns in this centre. Of the total quantity of the respective seed, over 72% of *M. monoceros*, 67% of *Sillago* sp. and 37% each of mullets, *M. dobsoni* and *P. indicus* were obtained during this quarter. During the 2nd quarter mullets, *Sillago* and *M. dobsoni* only were present. Seed of all species under consideration occurred during the 3rd quarter. Over 22% of mullet seed came in the 3rd quarter. Almost 97% of the total seed of *E. suratensis* were obtained in the fourth quarter.

3. Day-night abundance

In general the seed were more during day time. 59% of the total number of seed occurred during the

day. The day time abundance was more pronounced in the case of fish seed. Thus 72.8% seed of mullets, 99.3% of *E. suratensis* and 55% of *Sillago* sp. in total were collected during the day hours. In the case of prawns, the occurrence was more during the night. Over 56% of seed of *P. indicus*, 61% of *M. monoceros* and 55% of *M. dobsoni* were collected during night.

4. Abundance in relation to phases of moon

New moon and half moon phases seemed to be favourable for collection of mullet seed. The number varied between 26 and 485 during new moon phases and between 50 and 389 during the half moon phases while during full moon the number varied from 43 to 106. Out of the total mullet seed collected in the course of one year, 42.2% was obtained in the half moon phases followed by 41.3% during the new moon phases. Over 97% of the seed of pearl spot were obtained during the new moon phases. 75% of seed of *Sillago* sp. occurred during the half moon phases.

Prawn seed occurred in more numbers during the full moon phases. However, *P. indicus* occurred in equal proportion during all phases of moon. In abundance *M. dobsoni* had a tilt towards new moon. *M. monoceros* had a clear abundance during full moon.

5. Day-night abundance during different phases of moon

About 88% of the seed obtained during the full moon phases belonged to day hours. Almost 88% of the mullet seed were taken during day. Other fish and prawn seed showed a similar trend.

The difference in day-night abundance of mullet seed during new moon was not as marked as during the full moon phases. Almost 57% was collected during day. The entire quantity of pearl spot seed came in day time while more seed of *Sillago* sp. and *M. dobsoni* were present during night.

During half moon phase mullet seed formed 83% in the day catch. While there was no seed of *Etroplus* sp. during this phase, the catch of *Sillago* sp. was slightly better during day. All the seed of *P. indicus*, 95% of *M. dobsoni* and 82% of *M. monoceros* occurred during night.

6. Abundance in relation to tides and different phases of moon

It was found that in this centre the tides had very little influence on the abundance of seed irrespective of the phases of moon. The maximum number of mullet

seed (3,853) was obtained during a half moon phase. However, the rate of occurrence was almost equal during the high and low tides. Almost the same trend was noticed during the high and low tides of the full and new moon phases.

7. Abundance in relation to hydrological features

Mullet seed were more in temperature between 29 and 31°C during October–November. The maximum number of *Etroplus* seed was obtained in temperature 30.5°C. prawn seed also occurred in fairly good numbers in temperature between 29.5 and 31°C.

Seed of mullet and *Sillago* sp. occurred in all salinity ranges but their maximum abundance was noticed when the mean values ranged from 2.35 to 5.50‰. The seed of *Etroplus* sp. seemed to prefer very low salinity to the level of 0.53‰. Among prawns both *M. dobsoni* and *M. monoceros* were comparatively more in salinities between 0.49 and 5.90‰.

In general the dissolved O₂ content ranged between 2.20 and 5.40 ml/l. The variations in O₂ did not seem to affect the abundance of seed of either fish or prawn.

Punnaikayal (Tuticorin)

1. Annual abundance

The seed of *P. indicus* which was most common had an annual average abundance of 375 per 100 m³. *M. dobsoni* occurred at an average rate of 49 seed. Other prawn species whose seed were encountered had an occurrence rate around 1 seed. Among fish seed, mullet had an annual abundance of 332 seed. All others, composed of seed of *Chanos*, *Etroplus* and *Sillago* spp. were represented by less than 3 seed.

2. Seasonal abundance

The seed of *P. indicus* had the peak abundance during October – December when they occurred at a rate of 551 seed. During January–February period also, it was some what abundant (390). During July–September period the abundance was of the order of 480.

The period of peak abundance of seed of *M. dobsoni* (102) was from January to March. A secondary peak with 46 seed was observed during July–September period.

In the case of mullet the maximum abundance of seed (654) was noticed during the period from April to

June. From July to September the seed occurred at the rate of 265.

3. Day-night abundance

The prawn seed were more during night, the percentage of occurrence being 58.4% for seed of *P. indicus* and 86.2% for seed of *M. dobsoni*. Seed of mullet were obviously more during day and the percentage of occurrence was 73. Seed of *Chanos* and *Sillago* spp. also were more during day. However, the seed of *Etroplus* sp. were relatively more during night.

4. Abundance in relation to phases of moon

Seed of prawns as well as fishes were comparatively more during the full moon phases. 54.25% of seed of *P. indicus* was obtained during the full moon while only 26.71% and 19.04% were obtained during the half moon and new moon phases respectively. In the case of *M. affinis* and *P. semisulcatus* the trend was just the reverse.

In the case of mullet seed, full and half moons together constituted about 74%. Seed of *Chanos* were found to be more during new moon days. But in regard to seed of *Etroplus* sp. the maximum abundance was noticed during the half moon phases.

5. Day-night abundance in relation to phases of moon

A marked difference in the occurrence of seed of cultivable species between day and night during different phases of the moon was not highly discernible at this centre. Seed of *P. indicus* were slightly more at night during full moon. In the case of *M. dobsoni* seed were more abundant at night during all the 3 phases of moon.

Seed of mullet were particularly more in day during all 3 phases of moon. Seed of *Chanos* were abundant in day of new moon and least during day of full moon. Seed of *Sillago* presented an almost equal abundance during day and night of half and full moons but were more during day times of new moon. *Etroplus* sp. had maximum abundance at night times of half moon followed by night times of full moon.

6. Abundance in relation to tide and lunar phases

High abundance of seed of *P. indicus* on full moon days appeared usually with rising or receding tides. This was particularly so in October, February and June when the tidal amplitudes were high. During half moon phases peak abundance occurred coinciding with

higher tidal amplitudes. During new moon phases there was no particular regularity in regard to occurrence of seed of this species with tidal heights.

In the case of *M. dobsoni* the maximum abundance of seed took place coinciding with low tides on half moon phases.

7. Abundance in relation to hydrology

The seed of *P. indicus* showed an increasing trend with increasing temperature. With decreasing salinity from October to November a decrease in the abundance was noticed. With regard to seed of *M. dobsoni*, high abundance was observed between temperature of 27.5 and 30.7°C and salinity of 20 and 47.2‰.

Among fish seed, mullet seed were found to be more in higher temperature of 31 to 32°C. Also higher salinities favoured the abundance of this seed.

Pillaimadam (Mandapam)

1. Annual abundance

At this centre among cultivable prawns, *P. indicus* with an average annual seed density of 10 per 100 m³ of water ranked first followed by *P. semisulcatus* with 4 seed. Among fishes seed of *Sillago* sp. and mullet were the most dominant with 6 seed each per 100 m³. Eventhough *Chanos* is a common seed in this area its abundance was not very much reflected in the annual average during these investigations as its abundance is highly seasonal.

2. Seasonal abundance

The maximum quantity of seed of *P. indicus* was obtained during October–November period (35) followed by *P. semisulcatus* during September–October (20). Seed of mullet were abundant during May–June period and occurred at the rate of 26. The period of abundance for seed of *Sillago* was October–November and the rate of occurrence was 21.

3. Day-night abundance

Among cultivable prawns and fishes 80.4% seed of *P. indicus*, 75.0% of *Chanos* and 53.0% of mullets occurred during the day time while 80% seed of *Sillago* sp. and 74% of *P. semisulcatus* occurred in night samples.

4. Abundance in relation to different phases of moon

Seventy seven per cent of seed of *P. indicus* was taken during new moon phase and only 1.3% was present during the full moon phases. However, seed of *P. semisulcatus* were more abundant during the full moon phases (51%) while only 6% occurred in the new moon samples. In the case of mullets the percentage of abundance was more (63%) during mid lunar phases and also during full moon (27%).

5. Day-night abundance in relation to different phases of moon

In general, the day time occurrence of prawn and fish seed increased during new moon. However, in the case of *P. semisulcatus* the seed were abundant during nights of full and mid lunar phases. Mulletts contributed more during night in full moon period. However, these were more in day samples of new moon phases. Seed of *Sillago* sp. and *Chanos* occurred in more numbers during night in full moon phases while they occurred in abundance during new moon phases in the day samples.

6. Abundance in relation to tides and different phases of moon

It was observed that during full moon and new moon phases, irrespective of day or night, the rising tides brought in more number of seed of *P. indicus* and *P. semisulcatus*. No relationship was found with regard to day-night abundance during the new and full moon phases. No particular variation was noticed in those months when there was no tidal effect due to the closure of the bar mouth.

With regard to day-night abundance of seed in relation to tides, it was found that *P. indicus* and mullet occurred in day time during high tides. However, more of *P. semisulcatus* occurred at night during the high tides. Seed of *Sillago* sp. were in abundance towards morning and evening during low tides.

7. Abundance in relation to hydrological features

At this centre seed of *P. indicus* were more in temperature between 28 and 29.5°C and salinity between 15 and 20‰. *P. semisulcatus* was dominant in temperature 29°C and salinity 30.5‰. Mulletts seemed to prefer a temperature of 31°C and salinity of 32-35‰. *Sillago* sp. was dominant at mean temperature of 30°C and salinity 35‰.



केरल और तमिलनाडु के तटों में झींगे, मछली और मलस्क बीज संपदायें

प्रस्तावना:

केन्द्रीय समुद्री मात्स्यकी अनुसंधान संस्थान ने 1976-'80 के दौरान केरल और तमिलनाडु के पश्चिम और ज्वारनदमुखियों में वाणिज्य की दृष्टि से प्रधान मछली और मलस्क के बीज संपदाओं पर एक पुरोगामी परियोजना शुरू की थी। प्रस्तुत परियोजना का लक्ष्य बीजों के सभी पहलुओं जैसे सर्वास्थिति, चांद आवर्तिता के अनुसार मात्रात्मक अधिकता पर्यावरणीय लक्षण और प्रदूषण का प्रभाव आदि के बारे में व्यक्त सूचना प्राप्त करना था।

अनुसंधान तीन दशकों में किया था। पहली दशा (1976-'78) में बीज संपदाओं पर विशेष ध्यान दिया गया विशेषकर फेनिल तरंगों के बीज संपदाओं पर। इसकेलिये कुल मिलाकर तटों में स्थापित 240

स्टेशनों में ऑच चलाया गया। दूसरी दशा (1979) में पश्चिम और पश्चुरियों के अध्ययन मुख्य थे। सर्वेक्षण की तीसरी दशा बीजों की बहुलता में दैनिक परिवर्तन, इसकी उपस्थिति और अधिकता में चन्द्रमा का प्रभाव आदि पर गहन अध्ययन किया था और 1980 में यह समाप्त हुआ।

वैज्ञानिक और तकनीकी कर्मचारियों के 6 दल ने 6 विविध अनुसंधान केन्द्रों अर्थात् कालिकट, कोचिन, विषिजंभ, टुटिकोरिन, मण्डपम और मद्रास से इस परियोजना का परिचालन किया। तटीय क्षेत्रों पर प्रत्येक 6 से 10 कि. मी. की दूरी पर प्रतिचयन केन्द्रों की स्थापना की। बीजों के संकलन के साथ ही साथ तापमान, लवणीयता पानी की ऑक्सिजन मात्रा आदि पर भी अध्ययन चलाये गये। इन अध्ययनों द्वारा संकलित ढाढाओं का प्रकाशन हो रहा है।

सर्वेक्षण की प्रथम दशा बीज सर्वेक्षण का परिणाम

फेनिल तरंगों, पशुजलों और जारनदमुखियों में बीज संपदाओं के प्रतिचयन पर अध्ययन चलाये गये। इस अध्ययन केलिये उत्तर से लेकर दक्षिण तक केरल के विविध तटों में केन्द्र स्थापित किये गये।

जलवैज्ञानिक सर्वेक्षण में पानी के तापमान, लवणीयता, विलीन ऑक्सिजन का अंश आदि में अन्तर दिखाये पड़े, विशेषकर ज्वारनद-मुखियों और पशुजलों में।

फेनिल तरंगों का तापमान 21°C और 36°C के बीच रहा जब कि ज्वारनदमुखियों में यह 21 -से 40°C के बीच रहा। पर 40°C का तापमान ट्यूटोरिन के लवण कुण्डों में देखा था। केरल में देखा गया उच्चतम तापमान 37°C था।

केरल के फेनिल तरंगों की लवणीयता 11 व 37% के बीच थी जबकि तमिलनाडु में यह 7 व 41% के बीच थी। यद्यपि केरल के ज्वारनदमुखियों और पशुजलों की लवणीयता मानसून के ऋतु में स्वच्छ जल की लवणीयता के निकट आ पहुँचा था तथापि प्रीष्म ऋतु में इस में लवणीयता बढ़ गई थी। तमिलनाडु में भी यह स्थितिविशेष देखा गया लेकिन वहाँ के लवणकुण्डों की लवणीयता 44% तक बढ़ते हुये देखा गया।

दोनों राज्यों में विलीन ऑक्सिजन की मात्रा में भारी अन्तर देखा गया।

बीजों की उपस्थिती और आधिक्य

क्षेत्र: 1 कासरगोड - पोन्नानी

इस क्षेत्र में वर्तमान वाणिज्यिक दृष्टि से महत्वपूर्ण बीजों पेनीअस इन्डिकस, मेटापेनिअस डोबसोनी, मुजिल एस. पी. और सिल्लामे एस. पी. के थे।

पी. इन्डिकस सारे वर्ष के दौरान दिखाये पड़े। लेकिन विविध महीनों में इसकी लभ्यता का स्थान बदलते रहे जैसे जनवरी और फरवरी के महीनों में कासरगोड से लेकर अर्षीकोड तक इसके बीज उपलब्ध नहीं थे। मार्च में चन्द्रगिरी व नीलेश्वर के ज्वारनदमुखियों में बड़े तादाद में यह उपलब्ध थे। अप्रैल के दौरान इस क्षेत्र के सारे के सारे केन्द्रों में बीज उपस्थित थे। अर्षीकोड से बडगरा तक के केन्द्रों में फरवरी-अप्रैल और जुलाई-अगस्त के दौरान पी. इन्डिकस के बीजों का आधिक्य था। बडगरा-बेपूर भागों में जनवरी मार्च और अप्रैल के महीनों में भारी बीज संग्रहण हुआ था। संग्रहित पी. इन्डिकस के बीजों का आकार 7 मि. मीटर से 15 मि. मीटर के बीच का था। निरीक्षण के अनुसार इन में 45% , $30-34\%$ के बीच की लवणीयता में, 64% बीज 5 मि. ली/ली के विलीन ऑक्सिजन की मात्रा में और 60% बीज 29 और 31°C के बीच के तापमान में रहते थे।

मेटापेनिअस डोबसोनी का अच्छा संग्रहण फरवरी, मार्च और अक्टूबर के महीनों में किया। चन्द्रगिरी, नीलेश्वर मट्टुल, माही आदि स्थानों

से इन्हें पकड़े गये। इनका आकार 6 और 20 मि. मीटर के बीच का था। निरीक्षण के अनुसार उसके 25% बीज $26-30\%$ की लवणीयता में 35% बीज 5 मि. ली/ली. के विलीन ऑक्सिजन की मात्रा में और 50% 35.9°C के तापमान में रहते थे।

मुजिल एस. पी. के बीजों को मार्च, जुलाई और अक्टूबर के दौरान मट्टुल, माही, एलत्तूर और बेपूर से संग्रहण किया था। इसके लिए अनुयोज्य लवणीयता $0-39\%$, विलीन ऑक्सिजन की मात्रा $4-4.9$ मि. ली./ली और तापमान 27 से 33°C थे।

सिल्लामे के बीजों को जनवरी, मार्च, जुलाई और अक्टूबर के दौरान नीलेश्वर, माही, धर्मादम, तानूर कोरपुषा, बेपूर और कडलुन्डी से संग्रहण किया था। इन में 80% , $30-34\%$ की लवणीयता में, 80% 27.0 से 27.9°C के तापमान में रहते थे।

पेरना इन्डिका के बीजों टेल्लिचेरी धर्मादम, कोयिलान्डी और तिकोडी से संग्रहण किया था।

क्षेत्र 2: पोन्नानी-नीडकरा

इस क्षेत्र में दिखाये गये मुख्य बीजों पी. इन्डिकस, एम. डोबसोनी और एम. मोनोसेरोस के थे।

पोन्नानी-नीडकरा से फरवरी-अगस्त के दौरान ज्यादा मात्रा में पी. इन्डिकस के बीज मिले। तोट्टुप्पल्ली और नीडकरा में अगस्त में और पुतुवैपिन में फरवरी में अधिकतम मात्रा में इनके बीज मिले थे।

मेटापेनिअस डोबसोनी

मई-अगस्त के दौरान इनके बीजों ज्यादा मिले थे। फेनिल-तरंगों में वाडानप्पल्ली में इसके अधिकतम बीजों देखे गये। वाडानप्पल्ली में जुलाई में वजालमकुन्नु में मई में इन्हें ज्यादा पकड़े गये।

मेटापेनिअस मोनोसेरोस

बीजों पोन्नानी-नीडकरा के भागों में मई से गुलाई तक के महीनों में ज्यादा देख गये। फेनिल तरंगों और ज्वारनदमुखियों में इनकी उपस्थिति के बारे में किये गये माहवार निरीक्षणों के अनुसार वजालमकुन्नु के फेनिल तरंगों में मई के महीने में, इनकी उपस्थिति अधिकतम रेकोर्ड की गयी।

मछली बीज

मछली बीजों में मुल्लेट के बीजों कृषि-योग्य देखा गया। ये बीजों मुख्यतः आथिरमत्तेशु, पुतुवैपिन, पोन्नानी, नीडकरा से प्राप्त हुये। माहवार, बीज उत्पादन शक्यता की दृष्टि से कायमकुलम ज्वारनदमुखी सब से आगे है इसके पीछे पुतुपोन्नानी और चेटवा आते हैं। दूसरा कृष्य बीज चानोस का है इसकेलिये अनुयोज्य मौसम फरवरी-मई है। अर्षीकोड, चेल्लानम, आलप्पी व पुतुपोन्नानी से ये ज्यादा मिलते हैं। मल्लुस्काई बीजों में पेरना इन्डिकस और पी. विरडिस समुद्री पत्थरों में बढ़ते हुये देखा गया।

क्षेत्र 3: नीडकरा-कन्याकुमारी

इस क्षेत्र में पाये गये कृष्य स्वीशीज़ पी. इन्डिकस, एम. डोबसोनी, ई. सराटेनसिस सिल्लगो एस. पी. चानोस चानोस, पेरना इन्डिका, पिनकटाडा फ्युकाटा और क्रोसोस्ट्रिया एस. पी. के थे।

पी. इन्डिकस के पूर्वाडिम्भकें शक्तिकुलङ्करा, परबूर, पेरमातुरा, वेलि, तेन्गापट्टनम, कडैपट्टनम, अर्षीकल में देखे गये। अप्रैल-जून के दौरान अधिकतम पकड़ हुई। एम. डोबसोनी के बीजे शक्तिकुलङ्करा, परबूर, एडवा, वेलि, अडिमलतुरा, पुतियतुरा, अर्षीकल, और मानक्कुडी से मिले। अप्रैल-जून व अक्टूबर-दिसंबर उचित मौसम देखा गया। मछली बीजों में मल्लट के बीजों प्रमुख थे। अक्टूबर-दिसंबर और अप्रैल-जून इसकेलिये अनुकूल मौसम ठहरा। शक्तिकुलङ्करा, राजक्कामंगलम और मानाकुडी मुक्ताशुक्ति बीजों केलिये अनुकूल देखा। अडिमलतुरा और तेंगापट्टिनम से चानोस चानोस के बीज मिले।

क्षेत्र 4: कन्याकुमारी-कीलाकरै

पी. इन्डिकस के बीजे कुत्तानकुडी से मायाकुलम तक देखे गये। ट्टिकोरिन में पी. सेमिसुलकाटस के बीज का बाहुल्य था। सारे ज्वारन-दुम्बियों और पश्चजलों से एम. डोबसोनी के बीज मिले। मछली बीजों में चानोस और मल्लट के बीजों सारे केन्द्रों में देखे गये। एटोप्लस सुराटेनसिस आन्निवला बैकालेर और सिल्लगो सिहामा के बीजों भी देखे गये। वर्ष के दौरान खाद्य शक्तियों के बीजों भी यहाँ से मिले।

क्षेत्र 5: कीलाकरै-सुन्दर पान्डैपट्टनम

यहाँ के विविध केन्द्रों में पी. इन्डिकस पी. मानोडोन, पी. सेमिसुल-काटस आदि के बीजों मौजूद थे। माजार खाडी और पाक की खाडी में मेटापेनिअस बरकनरोडी के बीज सर्वत्र देखा गया। कृष्य मछली बीजों में चानोस चानोस, मुजिल एस. पी., सिल्लगो सिहामा आदि मुख्य थे। अन्निवाला बैकालेर के डिम्भक छोटी संख्या में यहाँ देखा गया।

क्षेत्र 6: मुत्तुपेर-पुलिकट

यहाँ के केन्द्रों से पी. इन्डिकस, पी. मानोडोन, एम. डोबसोनी और एम. मोनोसेरोस के बीजों का संग्रहण किया गया अधिकतम बीजों वेदनारायणम महापेक, तिरुमारायनुर और वेल्लार ज्वारनदुम्बियों से पकड़े गये।

मछली बीजों में मुजिल एस. पी. पी. के बीजों साधारण थे। चानोस चानोस, सिल्लगो सिहामा के बीजों भी उपस्थित थे।

कृषि योग्य क्षेत्र

कृषि योग्य क्षेत्र हेक्टरों में नीचे प्रस्तुत है :-

क्षेत्र 1: कविपुषा ज्वारनदुम्बी (200 हे.), परयंगाडी ज्वारनदुम्बी (100 हे.), माप्पिला खाडी (500 हे.), कोडुवल्ली (150 हे.), कोरपुषा ज्वारनदुम्बी (25 हे.)

क्षेत्र 2: चेटवाई (150 हे.), अर्षीकोड (375 हे.), केम्बनाड झील (210 हे.), कायमकुलम झील (80 हे.), अष्टमुडी झील (830 हे.)

क्षेत्र 3: परबूर (1 हे.), इडवा (2 हे.), पेरमातुरा (4 हे.), अर्षीकल (4 हे.), मनक्कुडी (2 हे.)

क्षेत्र 4: तिरुचेन्दुर (8 हे.), पुषकायल (40 हे.), मुल्लक्काड (30 हे.), कल्लार (8 हे.)

क्षेत्र 5: पम्बन-चिन्नपालम (3.3 हे.), पिल्लैमडम (250 हे.)

क्षेत्र 6: वेदनारायणम कनाल, वरंगनाडी ज्वारनदुम्बी, मारक्कानम, किल्लै, कोवलम और एओर के पश्चजल।

सर्वेक्षण की दूसरी दशा का नतीजा

1979-80 के दौरान चलायी गयी दूसरी दशा के सर्वेक्षण में एश्चुरियों और पश्चजलों के बीज विशेषकर क्षीण बीजों के प्रतिचयन पर विशेष बल दिया गया। इस प्रतिचयन केलिये मात्यु आदि द्वारा विकसित 'क्वान्टिटेटिव सीड साम्पलर' का उपयोग किया गया।

क्षेत्र: कासरगोड - पोन्नानी

इस क्षेत्र के चन्द्रगिरी, नीलेश्वर, बेकल, कावाई, चित्तारी, कुप्पम, चेरुकुञ्जु, नडाल, मत्तुल, पण्यंगाडी, बालापट्टनम, धर्मदम, कोडुवल्ली, माही, कनयमकोड, कोरपुषा, वेप्पुर, कडलुन्डी और पूरपुषा, में सर्वेक्षण किया गया।

बीज बहुलता: वाणिज्य की दृष्टि से महत्वपूर्ण पेनिअस इन्डिकस मेटापेनिअस डोबसोनी और एम. मोनोसेरोस के बीज यहाँ देखे गये। चन्द्रगिरी और चेरुकुन्नु से पी. इन्डिकस के 60% बीज प्राप्त हुये। कासरगोड और बालापट्टनम से एम. डोबसोनी के 68% बीज प्राप्त हुये। पूर्वी पश्चजलों में एम. मोनोसेरोस के बीज बहुत मिले। मत्स्य बीजों में ई. सुरारेनसिस के बीज ज्यादा देखा तो मल्लटों के बीज भी सामान्य मात्रा में देख लिया।

क्षेत्र: पोन्नानी - नीण्डकरा

इस क्षेत्र के पोन्नानि, पुतुपोन्नानी, अर्षीकोड, पुतुवैपीन, कायमकुलम, अष्टमुडी, चेटवाई और केम्बनाड, एश्चुरियों का निरीक्षण किया।

बीज बहुलता: पी. इन्डिकस के बीज यहाँ ज्यादा देखे गये। चेटवाई में इसका प्रति 100 m² पर वार्षिक बीज बहुलता 3025 देख लिया। इसके बीज 32 - 34° C के तापमान में अधिक और 28 - 30° C के तापमान में कम देख लिये। इसकेलिये अनुयोज्य लवणीयता 20-25% के बीच देख ली गयी। एम. डोबसोनी के वार्षिक बीज बहुलता 100m² पर 780 प्राकलित किया गया। इसका उच्चतम बीज बहुलता चेटवाई में देख लिया गया। एम. मोनोसेरोस का वार्षिक बीज बहुलता प्रति 100 m² पर 70 था। मत्स्य बीजों में मुल्लेट के बीज ज्यादा मिले। चानोस, एटप्लस आदि के बीज भी उपस्थित थे।

क्षेत्र: कन्याकुमारी - कीलाकरै

तटारिप्पु, बहाकोट्टै, मनपाड, तिरुचेन्दुर, पुन्नैकायल, पालयकल, पुल्लुवल्लै, कल्लार और बलिनोक्कम आदि केन्द्रों में सर्वेक्षण चलाया गया।

बीज बहुलता: पी. इन्डिकस बीजों का वार्षिक बहुलता 100m³ पर 59 था। उच्चतम मात्रा पुनैकायल में देखा गया। एम. डोबसोनी का वार्षिक औसत बीज बहुलता 100m² पर 13 था। उच्चतम बहुलता मनपाड में देखा गया।

मल्लेट, चानोस आदि मत्स्यों के बीज भी यहाँ से मिले। इसका वार्षिक बहुलता 100 m³ पर यथाक्रम 89 और 12 था।

क्षेत्र: कीलाकरै-सुन्दरपान्डैनपट्टनम

इस क्षेत्र के मान्चिरनगुडी, पम्बन, पम्बन-चिन्नपालम, पिल्लैमडम और उत्तारनकरै में सर्वेक्षण चलाया।

बीज बहुलता: पी. इन्डिकस, पी. सेमिगुलकाटस और एम. बरकनरोडे के बीज यहाँ उपस्थित थे। पी. इन्डिकस के बीज सब से अधिक पम्बन में देखा गया। पी. सेमिगुलकाटस का बीज सब से अधिक अतानकरै में प्रति m² पर 300 देख लिया। पिल्लैमडम में एम. बरकनरोडे के बीज प्रति 100 m² पर 8,400 देख लिया।

चिन्नपालम में मुल्लेट के बीज (प्रति 100m³ पर 15,500) और चानोस के पम्बन में (प्रति 100 मी. पर 7,74,200) देखा गया।

चाँद प्रावस्था के सम्बन्ध में केरल और तमिलनाडु के चुने हुये केन्द्रों में चलाये गये दैनंदिन निरीक्षणों का परिणाम।

जन्तुओं के जीवन चक्र पर चाँद का प्रभाव बहुत ही विदित है इस प्रकार झींगों के प्रजनन और प्रवास पर भी चाँद का बड़ा प्रभाव होता है। केरल के परंपरागत झींगे मछुए झींगे खेतों के द्वार चाँद प्रावस्था के अनुसार खोलते और ब बँधते हैं। झींगा बीजों के दैनंदिन वर्धन और प्रवास पर चाँद का कोई असर है या नहीं इस विषय पर सी. एम. एफ. आर. आइ. में क्षेत्र संपरीक्षाएँ चलायी गयीं। परीक्षण केलिए केरल और तमिलनाडु से पाँच केन्द्र चुन लिए और परीक्षण तिमाहियों में चाँद प्रावस्था की तीन दशाओं माने नया चन्द्र, आधा चन्द्र और पूर्ण चन्द्र के आधार पर चलाये गये।

प्रत्येक तिमाही की प्रत्येक निरीक्षण अवधि 24 घण्टे थे। झींगे बीजों पर चाँद के प्रभाव के अलावा दिन रात में बीजों की प्रचुरता, ज्वार से होनेवाला विविध मौसम, बीजों पर वातावरणीय पारामीटर्स का प्रभाव आदि पर भी अध्ययन ने प्रकाश डाली। विविध केन्द्रों में चलाये गये निरीक्षण का परिणाम नीचे प्रस्तुत है।

कोरप्पुषा

1. मौसमी-प्रचुरता

अधिक संख्या में देखे गये बीज पी. इन्डिकस, एम. डोबसोनी और मुजिल एस पी. के थे। पहली दूसरी और तीसरी तिमाहियों में पी. इन्डिकस का बीज दर प्रति 100 मी. पर यथाक्रम 1,200, 300 और 1,400 था। सारी अवधि में एम. डोबसोनी के बीज कम देखे गये। चानोस के बीज पहली तिमाही में और मल्लेट के बीज पहली और दूसरी तिमाही में देखे गये।

2. दिन रात की तुलनात्मक प्रचुरता

दिन से बढ़कर रात में पेनिअस इन्डिकस के बीज ज्यादा देखे गये।

3. चाँद प्रावस्था के आधार पर प्रचुरता

मध्यम चन्द्र की प्रावस्था में औसत 14,500 झींगे बीज देखे गये जबकि नया चन्द्र और पूर्णचन्द्र की प्रावस्थाओं में यथाक्रम 112 और 4,460 बीज।

4. ज्वार-भाटे के आधार पर परिवर्तन

ज्वार के समय बीजों की संख्या अधिक थी जबकि भाटे के समय कम।

5. लवणीयता के आधार पर प्रचुरता

निरीक्षणाधीन वर्ष के दौरान एरचुरी की लवणीयता 0 और 34.9% 0 बीच रहीं।

नीडकरा

1. वार्षिक प्रचुरता

नीडकरा में पी. इन्डिकस के बीज ज्यादा देखे गये। नीचे के क्रम में एम. डोबसोनी एम. मोनोसेरोस और एम. अफिनिस के बीज देखे गये।

2. मौसमी प्रचुरता

पी. इन्डिकस के बीज दूसरी तिमाही में ज्यादा प्राप्त हुये। एम. डोबसोनी के बीज भी दूसरी और तीसरी तिमाही में ज्यादा मात्रा में देखे गये।

3. दिन-रात प्रचुरता

डैयुरनल प्रचुरता और चान्द्र प्रावस्था के बीच बताने योग्य सम्बन्ध देख लिया। पूर्व चन्द्र की प्रावस्था में रात की तुलना में दिन में पी. इन्डिकस और एम. डोबसोनी के बीज ज्यादा देखे गये। शुक्ल पक्ष में दोनों की संख्या रात में दिन से अधिक थी। एम. मोनोसेरोस के सम्बन्ध में भी यही स्थिति देखी गयी। चन्द्र की तीन दशाओं में मल्लेट के बीज रात में अधिक देखे गये।

4. चाँद-प्रावस्थाओं के आधार पर परिवर्तन

चाँद की प्रावस्थाओं और बीज की उपस्थिति के बीज सीधा सम्बन्ध देख लिया। पूर्ण चन्द्र के दिनों में पी. इन्डिकस बीजों का उच्चतम उत्पादन हुआ। बीज प्रचुरता का दर पूर्ण चन्द्र, मध्यम चन्द्र और नया चन्द्र प्रावस्थाओं के दौरान यथाक्रम 404, 119 और 156 था। एम. डोबसोनी का प्रस्तुत दर यथाक्रम 392, 156 और 83 था। एम. मोनोसेरोस और एम. अफिनिस को पूर्ण चन्द्र और मध्यम चन्द्र प्रावस्थाओं के दौरान अधिक देखे गये।

दिन-रात उपस्थिति के अध्ययन से मालुम हुआ की पी. इन्डिकस के बीज दिन में रात से अधिक वर्तमान थे जबकि एम. डोबसोनी के रात में दिन से अधिक। अन्य स्पीशीज़ों के बीज रात में अधिक देखे गये।

5. प्रचुरता में ज्वार-भाटा व चाँद प्रावस्थाओं का सम्बन्ध

पूर्ण चाँद और उच्चज्वार के समय पी. इन्डिकस, एम. डोबसोनी और एम. मोनोसेरोस के बीज अधिक देखे गये।

6. प्रचुरता और हाइड्रोलजिकल लक्षणों का सम्बन्ध

ताप और लवणीयता से झींगे और मछली के बीज प्रभावित है। विलीन ऑक्सिजन का अंश ऑप्टिमम लेवल से ऊपर देख लिया।

पुतियतुरा (बिबिजंम)

1. वार्षिक प्रचुरता

पुतियतुरा में मछली के बीज की प्रचुरता थी जबकि झींगे बीज नाम मात्र में देखे गये। मछली बीजों के 96% मल्लेट बीज थे। देखे गये मछली बीज पी. इन्डिकस, एम. डोबसोनी, एम. मोनोसेरोस आदि के थे।

2. ऋतुकालिक प्रचुरता

सब से अनुकूल ऋतु अक्टूबर-नवंबर देख लिया। इस अवधि के दौरान एम. मोनोसेरोस के 72% सिल्लगो एस. पी. के 67% मल्लेट के 37% बीज प्राप्त हुये।

दूसरी तिमाही में सिर्फ एम. डोबसोनी और सिल्लगो वर्तमान थे। मल्लेटों के 22% तीसरी और ई. सुराटेनसिस के 97% चौथी तिमाही में प्राप्त हुये।

3. दिन-रात प्रचुरता

कुल बीज के 59% दिन में देखे गये। इस प्रकार मल्लेट बीजों के 72.8% ई. सुराटेनसिस के 99.3% और सिल्लगो एस. पी. के 55% दिन में पकड़े गये। पी. इन्डिकस बीजों के 56% एम. मोनोसेरोस के 61% व एम. डोबसोनी के 55% बीज रात में पकड़े गये।

4. चान्द्र प्रावस्था और प्रचुरता के बीच का सम्बन्ध

नया चाँद और मध्यम चाँद की प्रावस्थायें मल्लेट बीजों के संकलन केलिये अनुकूल देख लिया। वर्ष के दौरान संकलित किये मुल्लेट बीजों के 42.2% मध्यम चान्द्र की और 41.30% पूर्ण चाँद प्रावस्थाओं में प्राप्त हुये थे। झींगे बीज अधिकतम मात्रा में पूर्ण चाँद की प्रावस्थाओं में प्राप्त हुये।

5. चाँद प्रावस्थाओं के आधार पर दिन रात प्रचुरता

पूर्ण चाँद प्रावस्था में बीजों के 88% दिन में प्राप्त हुये। मल्लेट बीजों के 88% दिन के दौरान पकड़े गये। अन्य मछली और झींगे बीज भी समान प्रवृत्ति दिखायी। अर्ध चाँद प्रावस्था में मल्लेटों के 83% दिन में प्राप्त हुये। जबकि सारे पी. इन्डिकस के बीज एम. डोबसोनी के 95% और एम. मोनोसेरोस के 82% रात में उपस्थित थे।

6. हाइड्रोलजिकल लक्षणों के आधार पर प्रचुरता

मल्लेट के बीज 29 और 31 और झींगे बीज 29.5 और 31°C के तापमान के बीच रहते हुये देखे। मल्लेट और सिल्लगो एस. पी. के बीज 2.35 से 5.50% 0 की लवणीयता में ज्यादा देखे गये। झींगे बीज 0.49 और 5.9% 0 की लवणीयता में तुलनात्मक दृष्टि से ज्यादा देखे गये। विलीन ऑक्सिजन का अंश 2.20 और 5.40 मि. ली./ली. के बीच देखा गया।

पुन्नेकायल

1. वार्षिक प्रचुरता

झींगे बीजों में पी. इन्डिकस के बीज ज्यादा मात्रा में और एम. डोबसोनी के बीज औसत मात्रा में देखे गये। मछली बीजों में मल्लेट मुख्य थे।

2. मौसमी प्रचुरता

पी. इन्डिकस के बीज दर अक्टूबर-दिसंबर, जनवरी-फरवरी और जुलाई-सितंबर के दौरान यथाक्रम 551, 390 और 480 था। एम. डोबसोनी का बीज दर जनवरी-मार्च और जुलाई-सितंबर के दौरान यथाक्रम 102 और 46 था। मल्लेटों के बीज अप्रैल-जून के दौरान ज्यादा देखे गये।

3. दिन-रात प्रचुरता

झींगे बीज रात में प्रचुर थे तो चानोस, सिल्लगो एस पी पी. के बीज दिन में।

4. चाँद प्रावस्था और प्रचुरता का सम्बन्ध

पूर्ण चाँद प्रावस्थाओं में झींगे मछलियों के बीज ज्यादा देखे गये। जबकि मल्लेट के बीज दर दोनों पूर्ण चाँद और मध्यम चाँद प्रावस्था के दौरान एक ही रहा।

5. चाँद प्रावस्था और दिन-रात प्रचुरता का सम्बन्ध

चाँद प्रावस्था के आधार पर बीजों के दिन-रात प्रचुरता का अन्तर यहाँ स्पष्ट नहीं था।

6. ज्वार-भाटे व चाँद प्रावस्था के आधार पर प्रचुरता

पूर्ण चाँद प्रावस्था में ज्वार-भाटे तरंगों में पी. इन्डिकस के बीज ज्यादा देखे गये। मध्यम चाँद प्रावस्था में उच्चज्वार तरंगों में ये देखे गये। एम. डोबसोनी की उच्चतम बीज प्रचुरता मध्यम चाँद प्रावस्था में भाटे तरंगों में देखी गयी।

7. हाइड्रोलजी और प्रचुरता का सम्बन्ध

पी. इन्डिकस के बीज अधिकतम तापमान में और कम लवणीयता में बढ़ने की प्रवृत्ति दिखायी। मल्लेट बीजों की बढ़ती केलिये अधिकतम तापमान व लवणीयता उचित देख लिया गया।

पिल्लैमडम (मंडपम)

1. वार्षिक प्रचुरता

झींगे बीजों में पी. इन्डिकस और मछली बीजों में सिल्लगो एस पी. के बीज प्रचुर थे।

2. मौसमी प्रचुरता

पी. इन्डिकस के उच्चतम बीज मात्रा अक्टूबर-नवंबर में और पी. सेमिखुलकाटस के सितंबर-अक्टूबर में देखे गये। मल्लेट के बीज मई-जून के दौरान और सिल्लगो के अक्टूबर-नवंबर के दौरान देखे गये।

3. दिन-रात प्रचुरता

झींगों में 80.4% पी. इन्डिकस के बीज और मछलियों में 75.0% चानोस के व 53.0% के मछली बीज दिन में वर्तमान थे जबकि सिल्लगो

एस. पी. के 80% बीज और पी. सेमिसुलकाटस के 74% बीज रात में देखे गये।

4. चाँद प्रावस्था और प्रचुरता के बीच का सम्बन्ध

पी. इन्डिक्स बीजों के 77% नया चाँद और 1.3% पूर्ण चाँद प्रावस्थाओं में देखे गये लेकिन पी. सेमिसुलकाटस के 51% पूर्ण चाँद और 6% नया चाँद प्रावस्था में देखे गये।

5. चाँद प्रावस्था के आधार पर दिन-रात प्रचुरता

झींगे और मछली बीज नये चाँद के दौरान दिन में ज्यादा देखे गये। सिल्लगो, मल्लेट और चानोस के बीज पूर्ण चाँद के रातों में भी देखे गये।

6. ज्वार-भाटा और चाँद प्रावस्था के आधार पर प्रचुरता

पूर्ण चाँद और नया चाँद प्रावस्थाओं में दिन-रात भेद-भाव के बिना पी. इन्डिक्स और पी. सेमिसुलकेटस के बीज ज्वार तरंगों में उपस्थित थे।

7. हाइड्रोलजिकल लक्षण और प्रचुरता का सम्बन्ध

इस केन्द्र में पी. इन्डिक्स के बीज 28 और 29.5 के तापमान में और 15 और 20% की लवणीयता में ज्यादा देखे गये। पी. सेमिसुलकेटस के बीज 21°C के तापमान और 30.5% लवणीयता में अधिक देखे गये। मल्लेट और सिल्लगो एस. पी. यथाक्रम 31°C और 30°C का तापमान और 35-35% व 35% लवणीयता में ज्यादा देखे।

यह काम संस्थान के 'केरल और तमिलनाडु के मछली, झींगे और मल्लेकाई बीज संपदाओं का सर्वेक्षण' नामक परियोजना के अधीन चलाया गया। परियोजना में भाग लिये कर्मिक

परियोजना का नेता : ई. जी. सैलास 1976-'80

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