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MARINE FISHERIES INFORMATION SERVICE

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
COchin, INDIA

INdIAN COUNCIL OF AGRICULTURAL RESEARCH
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, Etukulam, Mattul, Azhikal, Pochikode (north), Cannanore, Dharamad, Tellicherry, Mahé, Badagara, Iringal, Tikkodi, Quilandy, West Hill (Calicut), Beypore, Kadalundi, Parappanangadi, Tanur and Paravans in the Kasaragod-Ponnani Region; Ponnani, Putuponnani, Mannalamkunnu, Chavakkadu,

<table>
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<tr>
<th>Location</th>
<th>Team Leader</th>
<th>Team Members</th>
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<td>Vizhinjam</td>
<td>K. Prabhakaran Nair</td>
<td>1976-80</td>
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<td></td>
<td>S. Lazarus</td>
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<tr>
<td>Tuticorin</td>
<td>P. Bensum</td>
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<td>Beratin Fernando</td>
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<td>Mandapam</td>
<td>K.M. Ameer Hams</td>
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<td>P. Nammalvar</td>
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<td>R. Thiagarajan</td>
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<td>G. Nandakumar</td>
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<td>Madras</td>
<td>K. Rangarajan</td>
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<td>M. Rajsopalan</td>
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<td>K.S. Sundaram</td>
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<td>T. Dhananjan</td>
<td>1979-80</td>
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Chetwai, Vadanappally, Nattika, Kaippamangalam, Vemballoor, Azhikode (South), Narakkal, Fort Cochin, Manassery, Chellanum, Anthakaranazhi, Arthunkal, Alleppey, Ambalapuzha, Thottappally, Thruskunnapuzha, Ayiramthengu, Chavara and Neendakara in the Ponnani-Neendakara Region; Sakkikalunangara, Thangassery, Paravur, Edava, Perumathura, Veli, Panathura, Vizhinjam, Adimalathura, Puthiyathura to Paribhiyur in the south and in Tamilnadu on the southwest coast from Thengapattinam, Enayam, Melmidalara, Colachel, Kadiapattinam, Muttom, Azhikkal, Rajakkamangalam, Manakudi, Kanyakumari west and Kanyakumari point in the Neendakara-Kanyakumari Region; Chinammattom, Leopuram, Varyoor, Vattakkottai, Uvari, Periathalai, Alanthalai, Nazippur and Yerwadi in the Kanyakumari-Koelakkara Region and Koelakkara, Sethukarai, Muthupet, Puthumadom, Seeniappra, Dharga, Vadala, 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), Munaiakadu, Pillaimadam, Dhargavalsalai, Athankarai, Mudiveeranpattinam, Devipattinam, Karangadu, Thondi and Sundarapandipattinam in the Keelakkara-Sundarapandiappattinam 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 up to Pulicat Lake were Chandragiri, Bekel, Nileswaram, Punnakadavu, Cherukunnu-Thavam, Mattul, Valapattanam, Azhikode (north), Nadal, Anjangadi, Koduvallippyuzha, Mahé, Iringol, Kottakkal, Chowai, Korapuzha, Kallai, Elamarakadavu, Manthalakadavu, Beyapore, Kadunduri, Poorapuzha and Chamravattom in Kasaragod-Ponnani Region; Ponnani, Puthuponnani, Chetwai, Azhikode (south), Kotiapiram, Nayarambalam, Puthuvypeen, Thoppumpady, Perumbalam, Anthakaranazhi, Thaneerukkumukkum, Mutham, Thottappally, Ayiramthengu and Ashtamudi in the Ponnani-Neendakara Region; Paravur, Edava, Anjengo, Veli, Panathura, Adimalathura, Karichal, Paribhiyur, Thengapattinam, Melmidalam, Colachel, Puthoor, Chinnavilai, Valliar, Azhikkal, Rajakkamangalam and Manakudi in the Neendakara-Kanyakumari Region; Thattarippu, Kuttapully, Perumalai, Uppar, Hanuman Nadhi, Idinthakarai, Koothankuzhi, Athankarai, Manapad, Thiruchendur, Kavalipattinam, Arumuganeri, Punnakayal, Palyakayal, Mollakad, Muthuparam, Tuticorin south, Karapad, Arasadi, Melarasadi, Kallanipatta, Kallar, Kallurani, Vaipar, Vembar, Mookaiyoor, Valinokkam, Palayar, and Mayakulam in the Kanyakumari-Koelakkara Region; Kanjiramgudi, Periapattinam, Seeniappra, Dharga, Pamban, Chinnapalam, Kadarsapad, Rameswaram Road, Pillaimadam, Athankarai, Kottakkara, Vattanam, Pasipattinam and Sundarapandiappattinam in the Keelakkara-Sundarapandiappattinam Region and Muthupet, Vedaranyam, Uppanar, Adappar, Harichandranadhi, Vellaiyur, Kadavuyar, Vettar, Thirumalayar, Aarasalai, Virasolana, Cauvery, Coleroon Killai, Vellar, Pennaiar, Varanganadhi, Kadapakkam, Palar, Kovalam, Adayar, Evoor 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 equaled 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 up to 144‰, were also recorded in and near the salt-pans area.

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

<table>
<thead>
<tr>
<th>Zone Zones</th>
<th>SURF</th>
<th>ESTUARY</th>
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<tbody>
<tr>
<td>No.</td>
<td>Temp. (°C)</td>
<td>Sal. (%)</td>
</tr>
<tr>
<td>1. Kasaragod-Azhikkal</td>
<td>24</td>
<td>34</td>
</tr>
<tr>
<td>2. Azhikkal-Badagara</td>
<td>26</td>
<td>35</td>
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<tr>
<td>3. Badagara-Beypore</td>
<td>26</td>
<td>35</td>
</tr>
<tr>
<td>4. Beypore-Ponnani</td>
<td>27</td>
<td>35</td>
</tr>
<tr>
<td>5. Ponnani-Nattika</td>
<td>24</td>
<td>35</td>
</tr>
<tr>
<td>6. Kaippamangalam-Manasserry</td>
<td>25</td>
<td>35</td>
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<tr>
<td>7. Chellanum-Ambalapuzha</td>
<td>22</td>
<td>34</td>
</tr>
<tr>
<td>8. Thrikunnapuzha-Neendakara</td>
<td>23</td>
<td>35</td>
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<tr>
<td>9. Sakthikulangara-Virjinjim</td>
<td>24</td>
<td>31</td>
</tr>
<tr>
<td>10. Adimalathura-Kanyakumari</td>
<td>23</td>
<td>31</td>
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<tr>
<td>11. Kanyakumari-Periathalai</td>
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<td>34</td>
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<tr>
<td>12. Manapad-Kalanipattu creek</td>
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<td>35</td>
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<tr>
<td>13. Kallar-Mayakulam</td>
<td>25</td>
<td>36</td>
</tr>
<tr>
<td>14. Keejakaraai-Rameswaram</td>
<td>21</td>
<td>35</td>
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<tr>
<td>15. Rameswaram-Sundara-pandiappattinam</td>
<td>—</td>
<td>35</td>
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<tr>
<td>16-18 Muthupet-Pulicat</td>
<td>No sampling</td>
<td>26</td>
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</table>

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-Beypore 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, Male 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-Beypore zone (zone 3) good collections of P. indicus larvae were made during January, March and April. Quillandy, Elathur, Korapuzha, West Hill and Beypore were the centres where good collections were obtained.

The seed of P. indicus were observed in considerable number at Parappanangadi in the Beypore-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 m^2), Nileswar (22/100 m^2), Mattul and Mahe (96/100 m^2) 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, Korapazha, 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 *Penaeus indicus* 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 Vadannappally 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 m^2^ 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 m^3^ 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 m^3^ 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 m^3^ of water respectively. At Pathuvypeen (near Cochin) they were abundant in February with seed density of 15,000 per 100 m^3^.

**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 m^3^ of water. The period from May to August represented their maximum abundance with the peak in July (11,731 seed per 100 m^3^). In the surf area the maximum abundance was noticed at Vadannappally (31,600 per 100 m^3^ 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 m^3^ of water in the surf area at Vadannappally. During May, Mannalamkunu 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 m^3^ of water.
*Metapenaeus monoceros*

The seed of *M. monoceros* though present in lesser number, were widely distributed in the Ponnani-Neenda-kara region. The mean annual number was estimated at 85 per 100 m$^2$ 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 m$^2$ 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 m$^2$ 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-Neenda-kara 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 Puthuvypeen where the occurrence was 800 seed per 100 m$^2$ 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 m$^2$ in February while at Puthuponnani river mouth area 2,400 seed per 100 m$^2$ were collected in April. Chetwai-mouth was another productive area where 1,400 seed per 100 m$^2$ 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 m$^2$ 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 m$^2$ 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 m$^2$ 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. *Villicrta* 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, Etroplus suratensis, Sillago sp., Chanos chanos, Perna indica, Pinicida fucata* and *Crassostrea* sp.

The post larvae and juveniles of *P. indicus* occurred at Sakthikulangara, Paravur, Perumathura, Veli, Thengapattinam, Kadiapattinam, Azhikkal, Rajakkamanganalam 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. dobsonii* 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.

Mullets were the most important fish seed in the region. The main centres of abundance were Paravur, Perumathura, Panathura, Adimalathura, Puthiathura, Parithyur, 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, Parithyur, 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 - Keelakkarai

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 2 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 Punnaiakayal, Tiruchendur, Vattakottai and Valinokkam. The usual size available was between 15 and 85 mm. Seed of Eutropus suratensis were found in negligible number in Kallar, Kayalpattinam, Palayakayal and Punnaiakayal. 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 Punnaiakayal. 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 Punnaiakayal 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 Punnaiakayal central region in smaller number. Plenty of Donax sp. were noticed along the coast between Tuticorin and Veppalodial.

Region: Keelakkarai 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, Kru-sadi 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 Kanjirangudi,
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 Sundarapandiappattinam. 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 Upnar, Adappar and Kaduvaayar. 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, Kaduvaayar, 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, Kadapakam and Kovalam backwaters, Adayar and Korattalaiyar 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), Mappita Bay (500 ha), Dharmadam near Dharmadam estuary (upto 10 km from bar mouth), Koduvally (150 ha), Thiruvonam-bedava near Korapuzha estuary (25 ha) and Perumthuruthi (15 ha) near Korapuzha estuary.

**Region II:** Chetwai (150 ha), Azhikode (375 ha), Vypeen, Kumbalauni, 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), Thengapatattinam (1 ha), Pudur (about 1 km canal area of 5–10 m width), Kadispattinam (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 Nalvedapatty), Killai backwaters, Varanganadi estuary Marakkanaam 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 paused 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, Chennavattom (H.R.)

**Region 2:** Ponnani, Puthuponanani, 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, Thengapatattinam, 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).


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, MBAI, Cochin). The results of the survey, again on a region-wise basis are summarised below.

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

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: Kasaragod to Ponnani

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

Seed abundance

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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 100 m² 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 Puthuppomani.

Among fishes the seed of mullet were the most abundant. The average annual abundance for the region was 646 per 100 m². 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 Pulikkalkadavu in the Chetwai estuary.

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 Punnakkayal.

Region: Kanyakumari-Keelakarai

In this region the centres visited regularly were Thattarippu, Vattakottai, Manapad, Thiruchendur, Punnakkayal, Palyakayal, Putluvally, Kallar and Valinokkam.

**Seed abundance**

The annual average occurrence of seed of *P. indicus* was 59 per 100 m². Among estuaries Palyakayal with 149 per 100 m² accounted for the maximum quantity. It was followed by Putluvally (121) and Punnakkayal (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 Palyakayal.

The annual average number of seed of *M. dobsoni* was 13 per 100 m². 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.

Region: Keelakarai-Sundarapandiappattinam

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

**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.

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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 m$^3$ 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>
<thead>
<tr>
<th>Quarter</th>
<th>Date</th>
<th>Duration (24 hrs)</th>
<th>Phase of moon</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>17-18 Oct.</td>
<td>1600-1600</td>
<td>Full moon</td>
</tr>
<tr>
<td></td>
<td>31 Oct. to</td>
<td></td>
<td>Half moon</td>
</tr>
<tr>
<td></td>
<td>1 Nov.</td>
<td></td>
<td>New moon</td>
</tr>
<tr>
<td>II</td>
<td>29-30 Jan.</td>
<td></td>
<td>New moon</td>
</tr>
<tr>
<td></td>
<td>5-6 Feb.</td>
<td></td>
<td>Half moon</td>
</tr>
<tr>
<td></td>
<td>12-13 Feb.</td>
<td></td>
<td>Full moon</td>
</tr>
<tr>
<td>III</td>
<td>26-27 May</td>
<td></td>
<td>New moon</td>
</tr>
<tr>
<td></td>
<td>1-2 Jun.</td>
<td></td>
<td>Half moon</td>
</tr>
<tr>
<td></td>
<td>11-12 Jun.</td>
<td></td>
<td>Full moon</td>
</tr>
<tr>
<td>IV</td>
<td>21-22 Sep.</td>
<td></td>
<td>New moon</td>
</tr>
<tr>
<td></td>
<td>28-29 Sep.</td>
<td></td>
<td>Half moon</td>
</tr>
<tr>
<td></td>
<td>5-6 Oct.</td>
<td></td>
<td>Full moon</td>
</tr>
</tbody>
</table>

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 m$^3$ 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 m$^3$ followed by *M. dobsoni* (210), *M. monoceros*, and *M. affinis*. Among fishes the seed of mullets dominated with 22 larvae per 100 m$^3$. 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%.

Puthiathur (Vizhinjam)

1. Annual abundance

At Puthiathur the fish seed were the most abundant while the prawn seed were only representative. Mullets formed about 96% of the fish seed. *Sillago* sp. and *Etroplus 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* 1, *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
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 *E. suratensis* 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 *E. suratensis* 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 *E. suratensis* 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.

Punaiyakal (Tuticorin)

1. Annual abundance

The seed of *P. indicus* which was most common had an annual average abundance of 375 per 100 m². *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*, *E. suratensis* 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 *Etoplus* 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 *Etoplus* 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. *Etoplus* 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.

Pambaimadam (Mandapam)

1. Annual abundance

At this centre among cultivable prawns, *P. indicus* with an average annual seed density of 10 per 100 m² 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 m². 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 (31%) 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. Mullets 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%. Mullets 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%.

*Keral* और *तमिलनाडु* के तटों में इमे, मछली और मछली बीज संख्याय

परिस्थितियाँ:

केंद्रीय बस्ती माल्की आनुसंधान संस्थान ने 1976-'80 के दौरान केरल और तमिलनाडु के तटों और आर्बनमुखियों में हाफिन्दों को देखा जिसमें प्रवाह मछली और मछली के बीज संख्याओं पर कु छ दोषों और परिस्थितियों को लीजों के सभी वर्गों में वर्गीकृत, जांच आवश्यकता के अनुसार मछली अभिक्रीत फ़ार्मासी लाभ और संरचना का प्रमाण आदि के बारे में व्यक्त सुन्दर वर्णन करना था।

आनुसंधान दीर्घ समयों में फिरा था। वहीन दशा (1976-'78) में बीज संख्याओं पर निषेध ध्यान दिया गया जिसके परिणामस्वरूप दहल वे के बीज संख्याओं बढ़ गए। इससे लेकिन अधिकांश तटों मेंः स्थानित 240 के संख्या में बीज बहाल गए। दूसरी दशा (1979) में प्रवाह मछली और प्रायुक्तिकों के वाचनक हूह पक्ष थे। लंबी स्थायी दशा मछली की बढ़ती नोतिक ने हाफिन्दों में विलायतिक, इनकी वस्तुतनता और अवकल्पों में भविष्य का प्रमाण आदि पर हाफिन्द अवख्य बैठे थे और 1980 में यह समाप्त हुआ।

वैज्ञानिक और तन्मानी कर्मचारियों के 6 दशा ने 6 विविध आनुसंधान के केंद्रों अवयुक्त, धारित, लंबे, विषयों, विभिन्न, कमांड, अन्य और मछली में इस परिपथ का परिपथ रखा। केरल के हाफिन्दों पर लंबे 6 में 50 वि. म. और 50 वि. पर प्रतिक्रियाएं के हाफिन्दों की स्थानित और। हाफिन्दों के संक्षेप में के सभी राज्यों, लंबे गणित स्वाभाविक भविष्य का प्रमाण पर भी अवख्य बहाल थे। इस अवज्ञा द्वारा संबंधित दीर्घ समय में प्रमाण नहीं रखा है।
रासायनिक प्रक्रिया के द्वारा धूल त्वचा का परिवर्तन

इन्हें तरंग, प्रमुखता और आवश्यकताओं में बोझ लेंगे के लिए प्रतिपाद पर अभाव बचावे गया। इस अभाव के बावजूद उन्हें पैर से लेकर पानी के बिना तरंगें के बेल्ट से केवल उस्ताद लेने गया।

रासायनिक संयोजन में पानी के तापमान, उच्चताप, और विभिन्न आवश्यकता का अंश आदि के संदर्भ में संक्षेप व्यक्त करे।

रासायनिक तरंगें का तापमान 21° C और 36° C के बीच रहा। इन दो तापमानों के बीच का प्रतियोगिता संयोजन 37° C था।

रेडर के केरेल तरंगों की तापमानिता 11° और 37° C की दोपहर 7% और 41% के बीच थी। यद्यपि रेडर के व्यापक उपयोगिता और परिस्थितियों की परिमाण नहीं के बीच के तापमान नहीं रहा। तथापि रेडर में यह वितरित लेया गया और तापमान उन्हें के लगभग 44% का तापमान था।

चोरी दृष्टिकोण में सिविल आवधन की लागत में भारी बढ़ता रहा।

बीड़ों की उपस्थिति और आवश्यकता

1. कालरोङ्द - पोशाकी

इस दृष्टि ने केरेल बारिशका, राएं से महामूल्य बीड़ भेंडिया इन्कक, नेप्षेल्सिस बोम्बियनो, सुमिल पं. पी. और सिलाई सिल. पी. के बी. थे।

ध. इन्कक केरेल बारिशका, बारिशका, नेप्षेल्सिस बोम्बियनो, सुमिल पं. पी. और सिलाई सिल. पी. के बी. थे।

यद्यपि इन्कक केरेल बारिशका, बारिशका, नेप्षेल्सिस बोम्बियनो, सुमिल पं. पी. और सिलाई सिल. पी. के बी. थे।

बीड़ों पोशाकी तरंगों के भारी में चुलाई तक के महीनों में व्यापर देखा गया। व्यापर तरंगों के जनरल संचालन व्यापक तरंगों में बढ़ा सकता था। भारतीय दृष्टि, इन्कक के बी. बारिशका, बारिशका, नेप्षेल्सिस बोम्बियनो, सुमिल पं. पी. और सिलाई सिल. पी. के बी. थे।

यद्यपि इन्कक केरेल बारिशका, बारिशका, नेप्षेल्सिस बोम्बियनो, सुमिल पं. पी. और सिलाई सिल. पी. के बी. थे।
क्षेत्र 3: नीरवरा-कल्याणकुमारी

इस क्षेत्र में गाये गये क्रम स्थिरता पी. हिन्दक, एम. शेखरमनी, है. सराक्सियोल फिल्टर, ए. पी, पशुशल चार्जिंग, पेनुलिया द्वारा, पिकलिया फ़ुटबॉल और ओरोफिया एम. पी, के रूप में।

क्षेत्र 4: कल्याणकुमारी-बोधिसारी

पी. हिन्दक के अनुसार बुधेश्वर के लिए मात्रकल तक रखे गये।

क्षेत्र 5: कांशवाड़े-सुंदर पांडपुरसम

गाये के विषय केंद्रों में पी. हिन्दक, मात्रकल, एम. बोधिसारी और एम. नागरिकों की मुख्य स्थिति बांधे।

क्षेत्र 6: सुरुनेवाल-पुलिकलत

गाये के विषय केंद्रों में पी. हिन्दक, मात्रकल, एम. बोधिसारी और एम. नागरिकों की मुख्य स्थिति बांधे।

हाँ, समायोजन क्षेत्र

हाँ, समायोजन क्षेत्र हेलेडों में नवीन मात्र यह है:-

क्षेत्र 1: बोधिसारी जनरलस्वामी (200 है.), परमपंचायत जनरलस्वामी (100 है.), मात्रकल (300 है.), बोधिसारी (150 है.), कोपपुरुष जनरलस्वामी (25 है.)

क्षेत्र 2: वेंचार (150 है.), अर्धकोट (375 है.), केबिनेट शील (210 है.), कामडुकम शील (80 है.), अर्धपुर्ण शील (830 है.)

क्षेत्र 3: पल्लू (1 है.), बक्सा (2 है.), फेंकरलुआ (4 है.), अर्धकोट (4 है.), केबिनेट शील (2 है.)

क्षेत्र 4: वेंचारशहर (8 है.), सुलभायात (40 है.), सुलभायात (30 है.), केबिनेट शील (8 है.)

क्षेत्र 5: भवन-विकलपन (3.3 है.), पिंजराम (250 है.)

क्षेत्र 6: वेंचारशहर भवन, वस्त्रितकों आर्थिकस्वामी, आर्थिकस्वामी, फिल्टर, केबिनेट और एम. पूर्वक स्वामी

स्थानिक की दूसरी दुनिया का नतीजा

1979-80 के दौरान वरिष्ठ गृह दूसरी दुनिया का नतीजा में इसी वरिष्ठ गृह दूसरी दुनिया के तत्त्वों पर विशेष ध्यान दिया गया। इस तत्त्वों के लिए समुदाय उपलब्धि के माध्यम से उपलब्धि की उपलब्धि के तत्त्वों पर विशेष ध्यान दिया गया।

क्षेत्र: कांशवाड़े-बोधिसारी

इस क्षेत्र के बोधिसारी, नागरिक, बक्सा, बोधिसारी, कामडुकम, केबिनेट, नागरिकों, परमपंचायत जनरलस्वामी और परमपंचायत जनरलस्वामी के गृहों के निर्माण पर विशेष ध्यान दिया गया।

क्षेत्र: बोधिसारी-बोधिसारी

इस क्षेत्र के पल्लू, बक्सा, जनरलस्वामी, बक्सा, जनरलस्वामी, कामडुकम, परमपंचायत जनरलस्वामी, बक्सा, जनरलस्वामी, कामडुकम, परमपंचायत जनरलस्वामी के गृहों के निर्माण पर विशेष ध्यान दिया गया।
1. প্রথমে আপনার সন্ধান করতে হবে।

2. সেখানে আপনার সন্ধান করার জন্য একটি সুন্দর মেয়ে নষ্ট হয়ে যায়।

3. একটি সুন্দর মেয়ে নষ্ট হয়ে যায়।

4. সেখানে আপনার সন্ধান করার জন্য একটি সুন্দর মেয়ে নষ্ট হয়ে যায়।

5. একটি সুন্দর মেয়ে নষ্ট হয়ে যায়।

6. একটি সুন্দর মেয়ে নষ্ট হয়ে যায়।

7. একটি সুন্দর মেয়ে নষ্ট হয়ে যায়।

8. একটি সুন্দর মেয়ে নষ্ট হয়ে যায়।

9. একটি সুন্দর মেয়ে নষ্ট হয়ে যায়।

10. একটি সুন্দর মেয়ে নষ্ট হয়ে যায়।

11. একটি সুন্দর মেয়ে নষ্ট হয়ে যায়।

12. একটি সুন্দর মেয়ে নষ্ট হয়ে যায়।

13. একটি সুন্দর মেয়ে নষ্ট হয়ে যায়।

14. একটি সুন্দর মেয়ে নষ্ট হয়ে যায়।

15. একটি সুন্দর মেয়ে নষ্ট হয়ে যায়।

16. একটি সুন্দর মেয়ে নষ্ট হয়ে যায়।

17. একটি সুন্দর মেয়ে নষ্ট হয়ে যায়।

18. একটি সুন্দর মেয়ে নষ্ট হয়ে যায়।

19. একটি সুন্দর মেয়ে নষ্ট হয়ে যায়।

20. একটি সুন্দর মেয়ে নষ্ট হয়ে যায়।
6. प्रभुता और हाइड्रोज़न कालेख का सम्बन्ध

लगभग लगभग एका या तथा उच्च चम्कन के सीधे प्रभुता है।

विभिन्न भविष्यकाल का एक अनुभव के लिए कहा जा सकता है।

पुत्रसन्तर (विविक्रम)

1. वातिक प्रभुता

पुत्रसन्तर में माता के बीं भूता का नाम भी जस्ता ही शीर्ष प्रभुता माता में देखा जाता है। माता बच्चों के 96% मलेलो बीं थे। देखे यह माता बीं पी. हिन्दुस्तान, एम. बोस्नेसी, एम. मोटोसेतोग आदि के थे।

2. क्षयालक प्रभुता

जब से वातिक के भूमिक प्रभुता देखा जाता है। इस अध्ययन के दौरान एम.मोटोसेतोग के 72% सिक्के एम. पी. के 67% मलेलो के 37% बीं भूता है।

3. दिन-रात प्रभुता

दिन-रात के 59% दिन में देखा गया। यह एक मलेलो के बीं के 72.8% एम. सुसानिराम के 99.3% और सिक्के एम. पी. के 55% दिन में देखा गया। यह सिक्के एम. मोटोसेतोग के 56% एम. मोटोसेतोग के 61% एम. मोटोसेतोग के 55% बीं भूता में देखा गया।

4. नाता प्रभुता

दिन रात्यादि माता का प्रभुता माता के बीं का संबंध

दिन रात्यादि माता का प्रभुता माता के बीं का संबंध

5. भूमिक प्रभुताव

पूर्ण बीं भूमिक माता में बीं के 88% दिन में देखा है। मलेलो बीं के 88% दिन के दौरान पकड़े गए। आधा बीं और भी बीं भूमिक माता के प्रभुता में दिन की भूमिका में देखा है।

6. हाइड्रोज़न कालेख का आधार पर दिन-रात प्रभुता

मलेलो के बीं 32 और 31 और भी बीं 32.5 और 31.5 उच्चता के बीं में देखा गया। गुलमूल एवं मलेलो एम. पी. के बीं 3.25 और 3.5% की आधार पर उच्चता में देखा गया। भी बीं 0.49 और 5.9% की लगभग में दूरी से आधार देखा गया। विभिन्न भविष्यकाल का बंधन 2.20 और 5.40 दिनों/जीवन के बीं देखा गया।

पुत्रसन्तर

1. वातिक प्रभुता

शीर्ष बीं के पी. हिन्दुस्तान के बीं बादा माता ने और एम. बोस्नेसी के बीं बादा माता में देखा गया। गुलमूल बीं में मलेलो मुख्य है।

2. भीमी भूमिका

बीं. हिन्दुस्तान के बीं दूर अलसार-सँगकार, अलसार-सँगकार और अलसार-सँगकार के दौरान व्यापार 551, 390 और 480 छोड़ा। एम. बोस्नेसी का बीं दूर अलसार-सँगकार और अलसार-सँगकार के दौरान व्यापार 102 और 46 छोड़ा। गुलमूल के बीं अलसार-सँगकार के दौरान व्यापार देखा गया।

3. दिन-रात प्रभुता

शीर्ष बीं दूर में पुनः दूर के जो माता, सिक्के एम. पी. के दिन में।

4. बीं प्रभुता और प्रभुता का सम्बन्ध

पूर्ण बीं अलसार-सँगकार में शीर्ष बीं माता को देखा गया। यह सिक्के एम. मोटोसेतोग के बीं भूमिक के दौरान अलसार-सँगकार के दौरान देखा गया।

5. चार्ज प्रभुता और दिन-रात प्रभुता का सम्बन्ध

चार्ज प्रभुता के आधार पर बीं के दिन-रात प्रभुता का अन्तर यहाँ स्पष्ट नहीं था।

6. आधार और बीं प्रभुता के आधार पर प्रभुता

पूर्ण बीं प्रभुता में आधार-बीं की तरंगें या दिन बीं प्रभुता देखा गया। चार्ज प्रभुता में उच्चता तरंगों में दिन की भूमिका में देखा गया। एम. मोटोसेतोग की उच्चता बीं प्रभुता प्रभुता मध्यम बीं अलसार-सँगकार से भाले तरंगों में देखा गया।

7. भीमी भूमिका और प्रभुता का सम्बन्ध

बीं. हिन्दुस्तान के बीं अलसार-सँगकार तरंग में और बीं उच्चता में बदली भूमिका दिखाई। मलेलो बीं की बदली भूमिका अलसार तरंग में तकनीकी भूमिका देखा देखा गया।

प्रियोज्यम (मंदरप)

1. वातिक प्रभुता

शीर्ष बीं के पी. हिन्दुस्तान और गुलमूल बीं के सिक्के एम. पी. के बीं पुनः दूर।

2. भीमी प्रभुता

बीं. हिन्दुस्तान के बीं जबादा अक्षुर-सँगकार में और बीं. हिन्दुस्तान-सँगकार के दौरान देखा गया। मलेलो के बीं अलसार-सँगकार के दौरान देखा गया।

3. दिन-रात प्रभुता

बीं में 80.4% पी. हिन्दुस्तान के बीं और मलेलो में 75.0% पुनः दूर के माता दिन में बीं देखा गया। बीं बीं के बीं दिन में जबकि दिन के
The articles intended for publication in the MFIS should be based on actual research findings on long-term or short-term projects of the CMFRI and should be in a language comprehensible to the layman. Elaborate perspectives, material and methods, taxonomy, keys to species and genera, statistical methods and models, elaborate tables, references and such, being only useful to specialists, are to be avoided. Field keys that may be of help to fishermen or industry are acceptable. Self-speaking photographs may be profusely included, but histograms should be carefully selected for easy understanding to the non-technical eye.

The write-up should not be in the format of a scientific paper. Unlike in journals, suggestions and advice based on tested research results intended for fishing industry, fishery managers and planners can be given in definitive terms. Whereas only cost benefit ratios and indices worked out based on observed costs and values are acceptable in a journal, the observed costs and values, inspite of their transitionality, are more appropriate for MFIS. Any article intended for MFIS should not exceed 15 pages typed in double space on foolscap paper.

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