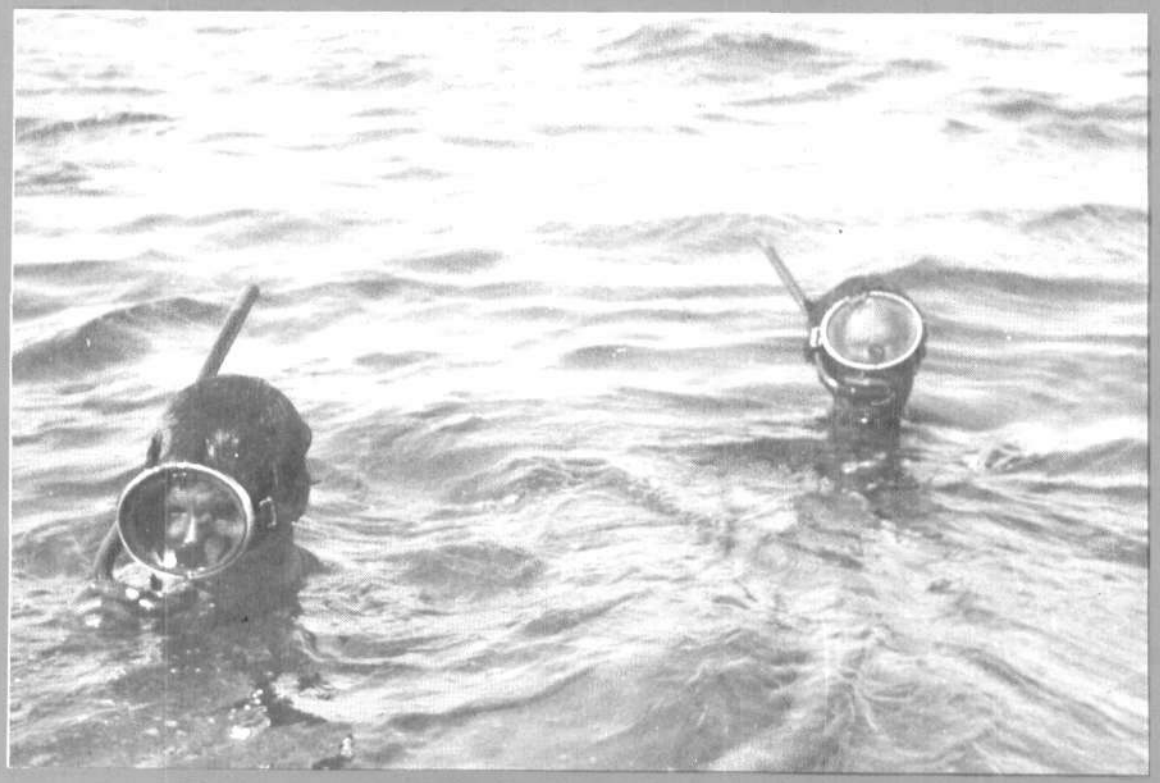
ISSN 0254-380 X

भाकृअप
ICAR

समुद्री मात्स्यिकी सूचना सेवा
MARINE FISHERIES INFORMATION SERVICE

No. 117 JULY, AUGUST, SEPTEMBER 1992



तकनीकी एवं विस्तार अंकावली
TECHNICAL AND EXTENSION SERIES

केन्द्रीय समुद्री मात्स्यिकी अनुसंधान संस्थान कोचिन, भारत
CENTRAL MARINE FISHERIES RESEARCH INSTITUTE COCHIN, INDIA

भारतीय कृषि अनुसंधान परिषद
INDIAN COUNCIL OF AGRICULTURAL RESEARCH

THE SURVEY OF VALINOKKAM BAY AND ADJOINING AREA TO ASSESS ITS SUITABILITY FOR INTEGRATED SEA FARMING — A REPORT*

Introduction

The Valinokkam Bay is situated in the Ramanathapuram District, Tamil Nadu. Even a cursory look at the bay, with its picturesque background and the calm, clear, unpolluted and sheltered waters with depth not exceeding 5 m, impresses one as a congenial site for sea farming activities. A small beginning was made in this direction by the Central Marine Fisheries Research Institute by mooring a pearl culture raft in the bay in 2 m depth on 11-6-'91 and since then a Research and Development Project on location testing and transfer of technology on pearl oyster farming and pearl culture to the local fishermen is being implemented.

A survey of the Valinokkam Bay and adjoining area was conducted on 8-1-1992 and 9-1-1992 to assess its suitability for developing the Integrated Sea Farming Project. A team of Scientists and Technical Staff drawn from both Mandapam and Tuticorin Research Centres participated in the survey. During this two day survey, data were collected on several parameters, relevant for initiating sea farming of several candidate species. The results of this survey are given in this report.

Topography and other features of the Valinokkam Bay and the adjoining area

The Valinokkam Bay is located along the east coast of India, Tamil Nadu in Ramanathapuram District. It is connected by road and is equidistant (about 95 km) from Mandapam and Tuticorin. The Valinokkam Bay and the adjoining area, east of the Bay surveyed, lie between Lat. 9°9' N and 9°12' N and Long. 78°30'E and 78°42'E (Fig. 1). In the east, the bay opens into the Gulf of Mannar by a wide mouth of about 3.8 km and it is bordered on the other three sides by land. The Bay has a waterspread of 5 sq km and the adjoining area 10 sq km. Thus the total area surveyed is 15 sq km. In the bay, proper the maximum depth is 4.5 m and in the adjoining area it is 7.5 m. In the northern sector there is a channel of 2-3 m depth, running parallel and very close (100 m) to the land. This channel is considered to be ideal for ship breaking and plans are afoot to develop this facility. The tides in the bay are semi-diurnal and the maximum amplitude during the spring tides is 0.9 m. The rainfall is scanty with 47 cm during 1991. Also there are no rivers or canals emptying into the bay to be of significance in diluting the bay waters. There is good exchange of bay waters with sea water since the widest part of the bay is at its mouth. At the same time, it is protected from strong wave action as the tidal amplitude is low and the bay is bordered on three sides by land. On the western side, the bay water is pumped by three 50 H.P. motors into a large 110 acre reservoir for salt maunfacture. Prawns and fin fish like *Chanos, Lates calcarifer* and other quality fishes trapped and grown in this reservoir fetch an annual lease rent of Rs. 1.2 lakhs to the Salt Corporation Department of Tamil Nadu. A plant to extract Magnesium (present capacity utilisation 400 t/year) from sea water is located on the western side of the bay close to salt works and a visit to this plant showed that no pollutants are released from the plant into the bay. There are no other industries in the vicinity of the bay.

Perusal of the available information indicates that the bay and the adjoining grounds in the sea are highly productive. During the season April-December, 431 t of fish were landed by trawls which included 23 t of *Penaeus semisulcatus*. Artisanal gears contribute to about 800 t. During June-September the sea weed *Sargassum* is collected in the bay and nearby islands which amounts to 500 t/season. Apart from Valinokkam, Eruvadi is a major fish landing centre (Fig 1).

The survey results

Apart from the results of the survey conducted on 8.1.1992 and 9.1.1992, the available data for July-December 1991 at the site

* Prepared by : K. A. Narasimham, R. Marichamay, D. B. James, P. Nammalwar, A. C. C. Victor, N. Kaliaperumal, M. E. Rajapandian, S. Dharmaraj, G. Maheswarudu, A. D. Gandhi, D. Sundararajan, M. R. Arputharaj, M. Muniyandi, S. Kalimuthu, J. X. Rodrigo, M. Selvaraj, A. Dasman Fernando, F. Soosai V. Rayan, N. Jesuraj, P. Muthukrishnan and D. Bosco Fernando, Research Centre of CMFRI, Tuticorin and Regional Centre of CMFRI, Mandapam Camp.

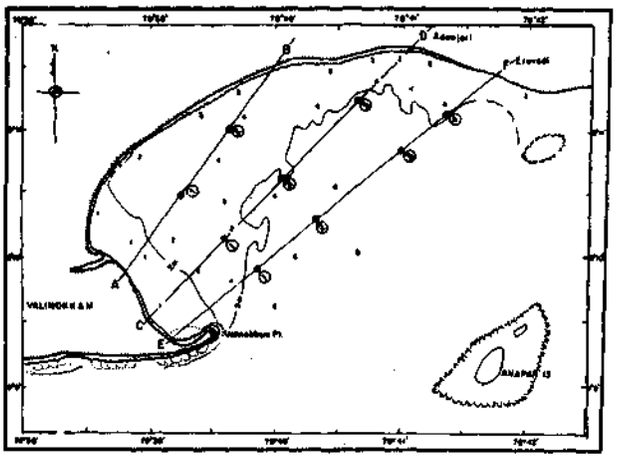


Fig. 1. Map showing the Valinokkam Bay and the adjoining area surveyed. The transects and the stations covered are shown. Small figures indicate the depth in metres.

where pearl culture raft was moored in the Valinokkam Bay are also included in this report.

Depth and transparency : The depth at different stations varied from 1.5 to 7.5 m and the water was clear in all the stations with visibility upto 7.5 m down (Table 1). Sedimentation was poor and turbidity ranged from 0.1 to 0.3 g/l.

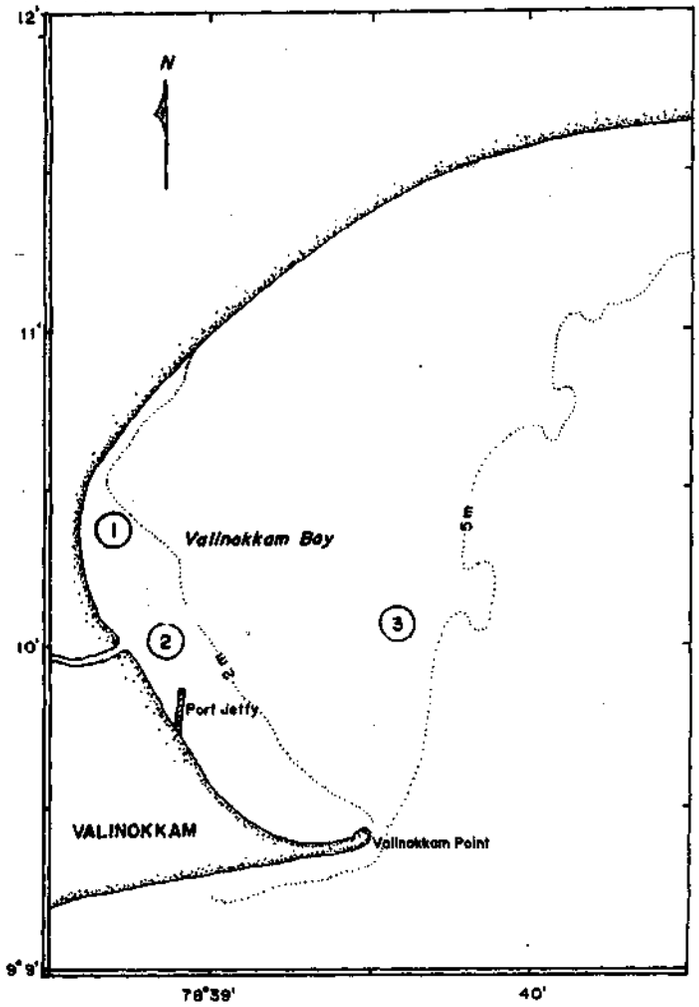
Temperature : The atmospheric temperature varied from 23.5 to 27.0°C; surface water temperature from 25.0 to 26.0°C and bottom water temperature from 25.0 to 25.8°C (Table 1). Near the pearl culture raft site (Fig. 2) water temperature varied from 25 to 28°C.

Salinity : The surface water salinity varied from 30.90 to 32.36 ppt and in the bottom water it ranged from 30.90 to 32.07 ppt (Table 1).

Near the pearl culture raft site, the salinity varied from 33.4 to 38.68 ppt. In November 1991, when the monsoon was at the peak, the salinity value recorded was 33.4 ppt. These data suggest that typical marine conditions prevail in the bay.

The values obtained for the environmental parameters such as dissolved oxygen, pH, inorganic phosphate, silicate, nitrite, nitrate, sediments, phytoplankton, zooplankton and meiofauna are presented in Tables 1-3. The data on seed resources and on the underwater observations are given in Tables 4 and 5.

The nutrients data indicate that the values are generally low and this may be due to the utilisation of the nutrients by the dense sea weed and seagrass populations located in the area surveyed (see below).



1. Site for Prawn Culture. 2. Site for Pearl Culture, Edible Oyster Culture, Clam Culture, Mussel Culture, Sea Cucumber Culture and Seaweed Culture. 3. Site for Cage Culture of Seabass

Fig. 2. Map showing the areas identified in the Valinokkam for taking up sea farming project involving various technologies.

Also in the values of the hydrographic parameters, at majority of the stations, there are not much differences between the surface and bottom waters. This suggests that there is good mixing of the waters.

Zooplankton : The volume of zooplankton varied from 5 to 20 ml (Table 3). It is high in the bay when compared to the values obtained in the adjoining open waters. Copepods were the most dominant component and formed 28.85% to 69.29% in various stations, followed by young ones of bivalves, gastropod young ones, appendicularians, prawn larvae, fish eggs and other decapod larvae.

Sediments : In transect AB, Station 1, the bottom was muddy and in all other stations it was firm, made of fine or coarse sand.

Seed resources : In the low laying areas, adjacent to the bay, seed of *Elops* sp. and *Gerres*

TABLE 1. *Hydrological data and other particulars of the Valinokkam Bay and adjoining area*

Date and time	Transect	Station	Water depth (m)	Water clarity	Nature of bottom	Atmospheric temp°C	Water temp°C Surface/ bottom	pH Surface/ bottom	Dissolved Oxygen ml/l Surface/ bottom	Salinity ‰ Surface/ bottom
8.1.92 10-10	AB	1	1.5	Clear upto bottom	Muddy	27.0	25.0 /25.0	8.4/8.4	4.86/4.92	31.48 /31.77
11-00	"	2	3.75	"	Fine sand	26.5	25.7/25.7	8.4/8.4	3.26/4.80	30.90 /30.90
14-20	CD	1	3.0	"	Coarse sand	25.4	25.5/25.3	8.4/8.4	5.19/5.28	31.77 /31.48
15-00	"	2	6.5	"	Fine sand	26.2	26.0/25.8	8.2/8.2	4.32/4.32	32.36 /31.48
15-35	"	3	6.0	"	"	25.6	26.0/25.8	8.4/8.4	4.21/4.44	31.19 /31.19
9.1.92 08-30	EF	1	6.0	"	"	23.8	25.1/25.1	8.4/8.4	4.52/4.46	31.48 /31.77
09-00	"	2	7.5	"	Coarse sand	23.5	25.3/25.1	8.4/8.4	4.46/4.39	32.07 /32.07
09-30	"	3	7.0	"	Fine sand	25.0	25.5/25.0	8.4/8.4	4.46/4.46	31.77 /32.07
09-50	"	4	6.0	"	Coarse sand	24.8	25.8/25.2	8.4/8.4	4.46/4.37	31.77 /31.48

TABLE 2. *Primary production, nutrients and meiofauna of the sediments of Valinokkam Bay and adjoining area*

Transect	Station	Primary production (mg/m³/day) Surface/bottom	Phosphate (µg. at/l) Sur./bott.	Silicate (µg. at/l) Sur./bott.	Nitrite (µg. at/l) Sur./bott.	Nitrate (µg. at/l) Sur./bott.	Meiofauna
AB	1	313.92 /142.32	0.30 /0.15	9.0 /7.0	0.06 / 0.06	1.25 /1.00	Nil
	2	108.23 /118.17	0.08 /0.08	6.5 /6.0	0.06 /0.06	0.88 /0.88	Polychaetes 2 nos.
CD	1	321.12 /364.96	0.15 /0.18	10.0 /6.0	0.06 /0.04	1.13 /1.00	"
"	2	341.33 /457.09	0.25 /0.05	7.0 /10.0	— /0.06	1.00 /1.00	"
"	3	94.18 /--	0.08 /0.05	8.0 / 8.0	0.11 /0.11	1.25 /1.50	Nil
EF	1	202.11 /107.53	0.05 /0.25	20.0 /5.0	0.15 /0.05	0.75 /0.88	Polychaetes 2 nos.
"	2	478.54 /204.12	0.05 /0.05	8.5 /9.5	0.06 /0.06	0.75 /0.75	"
"	3	114.92 /343.04	0.05 /0.05	16.0 /9.0	0.06 /0.06	1.00 /0.75	Nil
"	4	182.54 /195.28	0.23 /0.05	5.0 /6.0	0.06 /0.08	0.88 /1.25	Polychaetes 2 nos.

sp. were dominant accounting for 41.5 and 33% respectively (Table 4). Seed of white prawn *Penaeus indicus* formed 9% and seed of *Metapenaeus* sp. 4.3%.

Under water observations : The vegetation comprising algae and sea grasses occurred almost at all stations and often profuse growth was observed (Table 5). Totally 31 species of sea weeds (10 species of green algae, 9 species of brown algae and 12 species of red algae) and 6 species of sea grasses were found growing in the Valinokkam Bay and the adjoining area.

In transect AB, station 1, rich growth of sea grass *Cymodocea* was seen. The sea anemones, star fishes, ascidians, tubuculous worms and sea weeds were well represented in this Station. Empty edible oyster shells were strewn here and there. In station 2 empty shells of gastropods were seen. In the area between 1 and 2 stations two speciemens of the holothurian *Actinopyga miliaris* were collected. They measured 140 and 150 mm (wt 125 and 130 g). Both the specimens were immature. This species has commercial value. About 200 m north-east of station 2, the

TABLE 3. *Zooplankton (in percentage) collected at Valinokkam Bay and adjoining area*

Transects & Stations	Volume of plankton (ml)	Copepod	Prawn larvae	Other decapod larvae	Fish eggs	Appendicularia	Salps	Gastropod young	Bivalve young ones	Pteropod	Amphipod	Medusa	Stomatopod	Chaetognaths	Polychaete larvae	Clodoceran	Fish larvae
Tr AB																	
Stn. 1	10.0	50.00	9.62	7.7	11.5	4.9	1.9	3.8	11.54	1.9	-	-	-	-	-	-	-
Stn. 2	20.0	69.29	5.0	3.5	2.1	5.7	0.7	0.7	-	-	1.4	7.25	0.7	3.6	-	-	-
Tr. CD																	
Stn. 1	15.0	34.42	6.5	4.9	13.1	9.8	-	8.2	16.4	-	-	3.25	3.3	-	-	-	-
Stn. 2	15.0	36.11	9.7	6.9	19.4	4.2	-	-	13.9	-	-	8.34	-	-	1.3	-	-
Stn. 3	11.0	28.05	-	7.3	4.8	14.6	-	24.4	15.8	1.2	-	-	2.4	-	1.2	-	-
Tr. EF																	
Stn. 1	6.0	42.55	-	-	-	8.5	-	10.6	25.53	-	-	-	12.7	-	-	-	-
Stn. 2	7.0	35.00	5.2	-	-	3.5	-	22.8	2.0	3.5	-	7.0	1.7	-	-	-	-
Stn. 3	5.0	24.40	14.6	9.7	-	7.3	-	12.3	29.3	-	-	-	2.4	-	-	-	-
Stn.4	6.0	38.45	4.4	5.6	1.1	4.4	-	20.8	17.6	1.1	-	-	1.1	-	-	3.3	1.1

sea grass *Cymodocea* occurred abundantly over a wide area.

In the transect CD, station 1, the sea weed flora was predominantly composed of *Gracilaria edulis* and *Hypnea* sp. Starfishes occurred abundantly in this region. In station 2 there was no vegetation. One specimen of the sacred chank *Turbinella pyrum* and the clam *Meretrix casta* were collected along with empty shells of bivalve molluscs from this station. Station 3 was rich in sea weeds; rays were also found abundantly. A single holothurian *Holothuria spinifera* measuring 230 mm (wt 285 g) was collected. The specimen was immature. Another immature *H. spinifera* (length 252 mm, wt. 290 g) was collected in the region between stations 2 and 3.

In transect EF stations 1 and 2 there was no vegetation. Only empty gastropod shells were collected. Station 3 was rich in sea weeds, dominated by *Gracilaria* sp. and *Dictyota* sp. Also rays were found in abundance. In station 4 several species of sponges and corals were seen.

Observations on the clams of surf beaten open sea coast, south of Valinokkam Bay

The beach is sandy and shore seines are operated in this area. Analysis of the sediments showed good concentration of the wedge clam *Donax cuneatus*. Their density varied from 1 to 54/m². The length ranged from 22.0 to 39.5 (average 30 mm) and the clams were indeterminate stage.

Miscellaneous observations : The edible oyster *Crassostrea madrasensis* was found attached to the inlet pipes of the salt works in the western side of the bay. Ten live oysters measuring 44 to 88 mm were collected. The foulers *Balanus* sp. ascidians, hydrozoans and polychaetes were found attached to these oysters. At a couple of places dead oyster shells were found attached to the boulders and stones along the southern shore of the bay. In the same area gastropods *Patella* sp, *Nasa* sp. and *Nerita* sp. and the crab *Charybdis* sp. were found.

Prospects for sea farming

It is well known that aquaculture of any organism is location specific. The success of any aquaculture venture is largely dependant, apart from other factors, upon the favourable interaction of the candidate species with the environment.

In the selection of site for taking up sea farming projects the following five criteria are considered. (a) Topography (exposure, depth etc.), (b) Physical features (currents, tides, turbidity, sediments and water temperature), (c) Chemical features (dissolved oxygen, salinity PH, organic load, nutrient load and pollutants, (d) Biological features (primary and secondary production, fouling, boring, predators, competitors, parasites etc.) and (e) accessability (road, transport, fresh water availability etc.).

The two day survey was conducted keeping in mind the above five criteria. In such a brief survey the limitations are obvious, notable being the absence of quantitative data for some parameters and the absence of information on

TABLE 4. *Composition of the seed collected in the vicinity of the Valinokkam Bay*

Species	Nos.	%
Fishes		
Caranx sp.	3	0.6
Gerres sp.	172	33.0
Elops sp.	217	41.5
Sphyraena sp.	2	0.4
Scatophagus sp.	4	0.8
Leiognathus sp.	2	0.4
Leptocephalus sp.	52	10.0
Elops		
Prawns		
Penaeus indicus	48	9.0
Metapenaeus sp.	22	4.3

seasonal variations of the parameters. Nevertheless, the supplementary information available at the pearl culture raft site since July 1991 and the physiography of the Valinokkam Bay permit us to assess the prospects for undertaking sea farming of several candidate species for which technologies have been developed by the Central Marine Fisheries Research Institute at its several centres during the last two decades.

1. *Pearl oyster farming and pearl culture* : This project in operation since July 1991 generated adequate data to show that the Valinokkam Bay offers more favourable environmental conditions than the Tuticorin Harbour Basin where the Institute is running a R & D project on pearl culture for several years. The positive aspects that emerged in the studies at Valinokkam Bay are (1) The pearl oyster *Pinctada fucata* whose natural habitat in the Gulf of Mannar is in the deep waters of 15-20 m can be successfully farmed in the shallow waters of 2 m depth, (2) The growth of the oyster is faster compared to its growth in the harbour basin, (3) silt load is low which is conducive for good growth, (4) The fouling intensity is low compared to the harbour basin which reduces competition for the food of pearl oyster and cuts down the labour costs involved in farm maintenance, (5) pearl sac formation and the production of cultured pearls is fairly good compared to the harbour basin. (This can be related to the appreciable mixing of the Valinokkam Bay water with the open sea water—a situation not prevalent at harbour basin due to the narrow opening of the Tuticorin Harbour in to the sea) and (6) with scanty rainfall and little land drain typical marine conditions prevail in the Valinokkam Bay even during the peak monsoon month. *P. fucata* thrives well in such environment. As the Valinokkam Bay offers favourable conditions, expansion of the current pearl culture project is suggested. To reduce production costs rack method may be tried.

The blacklip pearl oyster *P. margratifera* occurs in the Andamans and is famous for its black pearls. It prefers clear unpolluted waters. Although this species was successfully spawned and several thousand spat produced in the CMFRI hatchery at Tuticorin, attempts made to grow the spat in the Tuticorin Harbour Basin proved futile. It is worthwhile to grow this species in the Valinokkam Bay as the bay waters are clear and are apparently not polluted.

2. *Edible oyster culture* : The Indian backwater oyster, *Crassostrea madrasensis* is euryhaline and grows well in bays, back waters, creeks, etc. in relatively turbid waters. Ten oysters were collected from the western side of the bay during the survey. Under purely marine conditions with little silt in the water the growth of the species may be slow. On the other hand *Saccostrea cucculata* which thrives well under marine conditions may fare well, but as of now, has little commercial value. It is suggested that culture of *C. madrasensis* by ren method may be tried in the Valinokkam Bay to get basic information on growth, survival and production.

3. *Clam culture* : The blood clam, *Anadara granosa* lives well in areas of soft muddy bottom (silt and clay over 50%), high turbidity and moderate salinity (15-30 ppt). Valinokkam Bay does not appear to be suitable to culture this species. The venerid clams *Paphia malabarica, Meretrix meretrix* and *M. casta* prefer sandy substratum. These three species are also known to prefer brackishwater and growth in the Valinokkam Bay may be slow. It is suggested that experimental farming of the above three species may be taken up in the Valinokkam Bay by adopting the on bottom culture techniques.

The giant clams, *Tridacna* sp. are the inhabitants of marine ecosystem and occur in Andamans and the Lakshadweep. There is considerable work going on in the Pacific islands and elsewhere to develop hatchery technology and culture methods for these clams as their adductor muscle is highly priced. Giant clams are the only autotrophic farm animals known to

TABLE 5. *Occurrence of algae and sea grasses in the Valinokkam Bay*

Transect AB : Station No. 1

Algae :

Caulerpa lessonii f. *tuticorinensis*
Neomeris annulata
Chaetomorpha linoides
Padina tetrastromatica
Dictyota dichotoma
Rosenvingea intricata
Hypnea valentiae
Solieria robusta
Gracilaria verrucosa

Seagrasses :

Cymodocea serrulata
Syringodium isoetifolium
Halodule uninervis
Halophila ovalis
H. ovata

Sampling made between Station 1 & 2 in Transect AB

Depth : 3.0 m
Bottom : Fine sand
Waterclarity : Clear upto bottom

Algae :

Caulerpa lessonii f. *tuticorinensis*
Padina boergesenii
Solieria robusta
Hypnea valentiae
Gracilaria verrucosa

Seagrasses :

Cymodocea serrulata

Transect AB : Station No.2

Algae :

Caulerpa scalpelliformis
Hypnea valentiae
Gracilaria verrucosa

Seagrasses :

Halodule uninervis
Halophila ovalis
Syringodium isoetifolium

Sampling made after Station No.2 in Transect AB

Algae :

Sphacelaria tribuloides
Jania rubens

Seagrasses :

Cymodocea serrulata
Syringodium isoetifolium
Halodule uninervis

Transect CD : Station No.1

Algae :

Resenvingea intricata
Dictyota dichotoma
Gracilaria edulis (wellgrown plants)
G. verrucosa
Hypnea valentiae
Solieria robusta

Seagrasses :

Halodule uninervis
Halophila ovalis
Syringodium isoetifolium

Transect CD : Station No. 2

Vegetation : Nil

Transect CD : Station No.3

Algae :

Rhizoclonium kochianum
Colpomenia sinuosa
Hypnea valentiae
Champia parvula

Seagrasses :

Cymodocea serrulata
Halodule uninervis

Transect EF : Station No.1

Algae : Nil

Seagrasses :

Halodule uninervis

Transect EF : Station No.2

Vegetation : Nil

Transect EF : Station No.3

Algae :

Cladophora sp
Dictyota dichotoma
Hypnea valentiae
Gracilaria corticata var. *corticata*
G. Verrucosa
Solieria robusta
Laurencia obtusa

Seagrasses :

Halodule uninervis

Halophila ovalis

Transect EF : Station No.4

Algae :

Codium tomentosum

Halimeda macroloba

Padina tetrastromatica

Dictyota bartayresiana

Dictyopteris delicatula

Sargassum tenerrimum

Halymenia floresia

H. porphyroides

Solieria robusta

Champia parvula

Jania rubens

Seagrasses :

Cymodocea serrulata

C. rotundata

Halophila ovalis

Halodule uninervis

Syringodium isoetifolium

Sampling made between Transect EF : Station No.4 and shore (*Ervadi*)

Depth : 3.0 m

Bottom : Sand

Water clarity : Clear upto bottom

Algae :

Struvea delicatula

Hypnea valentiae

Jania rubens

Seagrasses :

Cymodocea serrulata

Syringodium isoetifolium

Nearshore area adjacent to port jetty

Depth : 0.5 to 1.5 m

Bottom : Sandy

Water clarity : Clear upto bottom

Algae :

Enteromorpha compressa

Sphacelaria tribuloides

Gracilaria verrucosa

Hypnea valentiae

Grateloupia lithophila

Centroceras clavulatum

Seagrasses :

Cymdocea serrulata

Syringodium isoetifolium

Algae growing on pearl culture raft

Cladophora colabens

Cladophora sp.

Sphacelaria tribuloides

Padina boergesenii

Colpomenia sinuosa

Gracilaria edulis (young plants developed from spores)

G. corticata var. *corticata*

G. corticata var *cylindrica*

G. follifera

G. arcuata

G. verrucosa

Hypnea musciformis

H. valentiae

Jania rubens

man as they make their own food with the help of the symbiotic zooxanthellae occurring in their mantle. In the long range perspective, the Valinokkam Bay seems to offer a favourable habitat for farming the giant clams along the Indian mainland coast.

4. *Sea cucumber culture* : During the survey, specimens of the sea cucumbers *Actinopyga miliaris* and *Holothuria spinifera* were collected. The former has commercial value while the latter was once rated high in the *Beche-de-mer* industry but now not much preferred. It is gathered that large quantitites of *A. miliaris* are collected from the Valinokkam Bay and adjoining areas for processing. Each specimen is sold at Rs. 3 to 4 depending upon size. The most important commercial species is *Holothuria scabra* and not a single specimen of this species was collected during the survey. It is suggested that farming of *H. scabra* may be attempted in the Valinokkam Bay by transplanting the juveniles, either from CMFRI hatchery or collected from the wild, into suitable pen enclosure or cages.

5. *Green mussel culture* : The culture of green mussel *Perna viridis* has considerable potential for sea farming and so far the experimental work conducted by the CMFRI and other organisations at Calicut, Karwar, Goa, Madras and Kakinada have adopted the raft method,

except for a few attempts by the CMFRI to grow the mussels in net bags or ropes suspended from racks in the shallow Muthukadu lagoon and Ennore near Madras. The mussel culture rafts could not be moored in the sea year round wherever it was tried due to rough weather conditions. Valinokkam bay is suitable to keep the rafts in position throughout the year as revealed by the pearl culture project and an attempt can be made to test the viability of mussel culture from raft. However, for the purpose of location testing of the technology, it is suggested that green mussel seed can be cultured in net bags suspended from racks as this method is cost effective. For this purpose seed will have to be brought from other areas like Cuddalore since the Valinokkam Bay is devoid of any green mussel population.

6. *Sea bass culture* : Owing to its fast growth, delicately flavoured flesh, high market value and export potential, sea bass *Lates calcarifer* is an important species cultured in Thailand, Singapore, Philippines etc.

Selection of site suitable for net cage culture of sea bass is demanding. The site should be sheltered so that the net cage is protected from strong winds and waves and can be maintained in position. A tidal amplitude of 0.5 to 1.0 m, good mixing of surface and bottom waters and a minimum of 5 m depth ensure good flow of water, through the floating net cage so that uneaten food, faecus, debris etc. at the bottom of the cage do not pose problems. The fouling of the net cage is caused by silt and fouling organisms, rendering the cage maintenance job difficult. In the selected site, silt load and the presence of foulers should be low. A salinity range of 28-33 ppt is considered as optimum for sea bass farming. The proximity of the farm site to the shore which in turn is well connected by road, facilitates proper management of the farm, easy transport of fingerlings and juveniles, fish feed, farm equipments and necessities of life. The above attributes and other requirements are mostly fulfilled in the Valinokkam Bay and it is suggested that net cage culture of sea bass can be taken up.

7. *Prawn culture* : Two species namely *Penaeus semisculcatus* and *P. indicus* are considered as suitable for sea farming in the bay. The occurrence of prawn seed in the low lying areas adjacenet to the bay suggests that the bay is suitable for prawn farming and the above two species are known to thrive well under marine conditions. The CMFRI has developed the hatchery technology for the production of *P. semisulcatus* seed at Mandapam camp and a programme on sea ranching of the hatchery produced seed of this species is in progress. It is suggested that pen/cage culture of *P. semisulcatus* may be taken up in the Valinokkam Bay.

8. *Sea weed culture* : The following factors observed during the survey are favourable for undertaking seaweed culture in the Valinokkam Bay.

a) Required depths (upto 4 m) are available.

b) Sea is calm without much wave action.

c) Bottom is sandy.

d) Good growth of sea weeds, and sea grasses already occurs in the major part of the bay.

e) Natural growth of *Gracilaria edulis* (fully grown plants) occurs in some areas in the bay and also young plants of *G. edulis* developed from spores were observed on the pearl culture raft.

f) Water is very clear with visibility upto 7.5 m depth. This will provide good light penetration upto the bottom, promoting the photosynthetic activity of the plants.

g) Sedimentation is low.

It is suggested that cultivation of *G. edulis* may be taken up in the Valinokkam Bay on coir ropes and nets using casuarina poles in shallow waters and sinkers (anchors of granite stones) in slightly deeper waters.

The areas selected as suitable for the cultivation of various candidate species are indicated in Fig. 2. It is suggested that during the first year a programme on a small scale with the objective of location testing of the sea farming technologies for various species may be implemented. Based on the results of the interaction of the species with the environment, scaling up of the operations of the selected technologies may be considered in the following years.

The team members are thankful to Capt. Sainath, Port Officer, Rameswaram and the Conservator of Valinokkam Port for the facilities given and the keen interest shown in the survey.