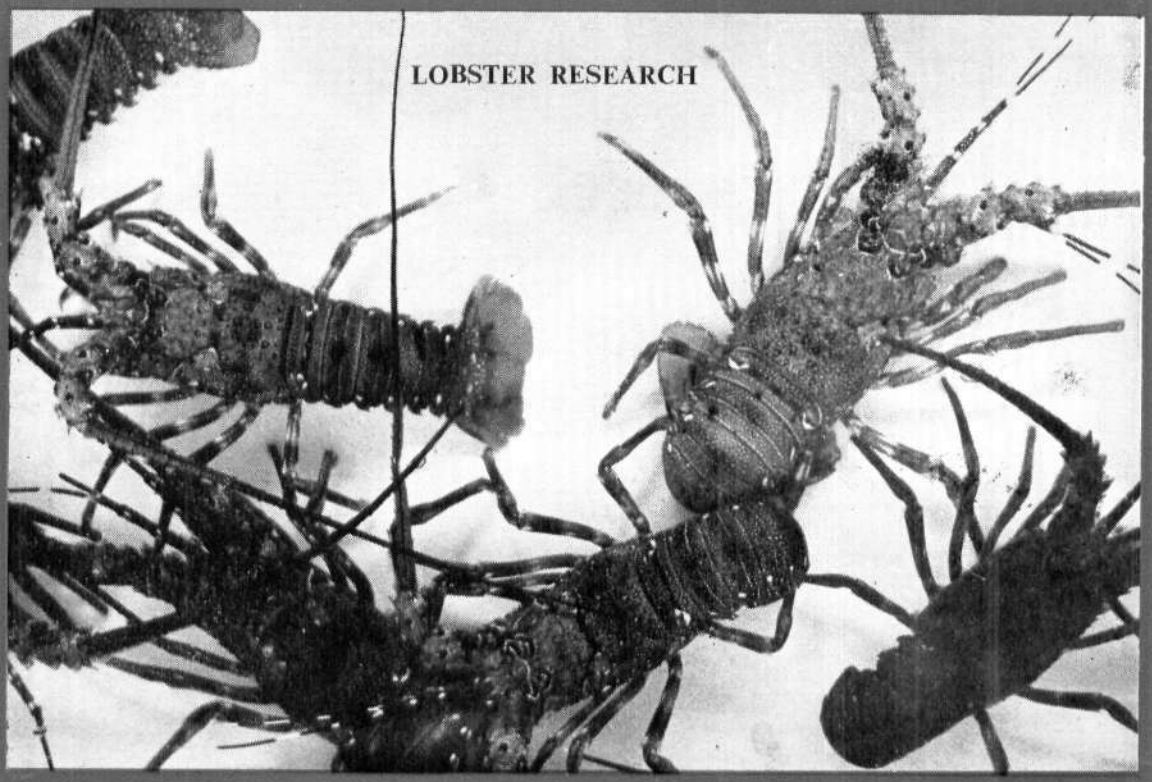
MARINE FISHERIES INFORMATION SERVICE



LOBSTER RESEARCH

Technical and Extension Series

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CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
COCHIN, INDIA

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

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

Abbreviation—Mar. Fish. Infor. Serv. T & E Ser., No. 43: 1982.

CONTENTS

Cover photo: A group of spiny lobsters

MAJOR BREAKTHROUGH IN SPINY LOBSTER CULTURE

E.G.Silas, Director, Central Marine Fisheries Research Institute, Cochin-18.

Spiny lobsters form an important component of the crustacean resources of our marine fisheries. It is second in importance to prawns in terms of commercial value and has an export market. The Central Marine Fisheries Research Institute has been carrying out researches on spiny lobster resources along our coast, their fishery, production and biology based on the natural stocks. Due to its high export value, there has been heavy pressure on these coastal stocks. (Table)

Six species of spiny lobsers of commercial importance occur in Indian waters and these are:

Panulirus homarus (Linnaeus)
Panulirus polyphagus (Herbst)
Panulirus penicillatus (Oliver)
Panulirus ornatus (Fabricius)
Panulirus versicolor (Latreille)
Panulirus longipes (Milne-Edwards)

While the Institute is working on the rational exploitation of the lobster stocks, it has also started programmes for developing proper techniques for their culture. The major constraints encountered in lobster culture are:

1. Our inadequate knowledge of their reproductive physiology
2. Protracted complex life cycle with larval phase extending to several months and problems of maintaining the larvae.
3. Nutritional (feed) requirements of larvae and adults.
4. Slow growth of lobsters from puerulus stage to maturation and harvestable sizes.
5. Behaviour of lobsters.

In fact, even in areas such as water quality requirements, diseases, and management techniques for lobster culture, our knowledge is still meagre. In view of these inadequacies, the Institute has given priority for the following:

- Collection and maintenance of brood stock
- Controlled breeding
- Larval rearing
- Culture of baby lobsters (puerulus) to commercial size.

The programme also involves a multi-disciplinary approach including researches on nutrition, pathology, physiology, endocrinology and genetics.

One of the first tasks undertaken was the collection and the rearing of puerulii and metamorphosed baby lobsters of *P.homarus* to maturation and harvestable sizes. It was possible to collect from the inshore waters as well as from special puerulii collectors operated from rafts used for open sea mussel culture puerulii and young lobsters and rear them to marketable size of 200 gm weight under experimental conditions in a period of 18 months. The growth rates in such culture operations with clam and mussel meat as feed were almost identical with that studied for growth obtaining in the natural population of *P.homarus*. On an average, growth increment worked out to about 12 gm during each intermoult period, the moulting frequency being around once every 30 to 55 days. Further increment of weight is also characterised by such a slow trend of growth.

In connection with the work on growth and reproductive physiology and endocrinology of *P.homarus*, recourse to the wellknown and widely adopted technique of eye stalk ablation was resorted to. Such techniques are employed in studies on crustacean growth and reproduction in many parts of the world. The hormonal system in crustaceans involved in growth and reproduction is antagonistic and reproduction alternates with growth. There are the moulting hormone and the moult inhibiting hormone. Unlike in the case of vertebrates, particularly mammals, the endocrinology of crustaceans has been very little understood. The lobster culture programme in the Institute includes investigation on crustacean endocrinology in order to understand the hormonal regulation of growth and reproduction and to be able to manipulate these hormonal function, once they are clearly understood, to achieve higher growth rate and temporal control of reproduction.

In *P.homarus*,as in other crustaceans, the endocrine complex present in the eye stalk controls the secretion of hormone and hence the need to study this complex in detail. One of the wellknown methods in endocrinology is to block the system and to observe the results. As an experimental procedure, the eye stalk is electrically cauterised or ablated to block the hormonal system and study the effects on growth and reproduction.

Fig. 1. A group of normal spiny lobsters, *Panulirus homarus*.

Fig. 2. A group of eye ablated lobsters

Fig. 3. Close up view of a normal lobster to show the compound eyes

Fig. 4. An ablated lobster with antennule-like growth at the place of the ablated eyes (close up view)

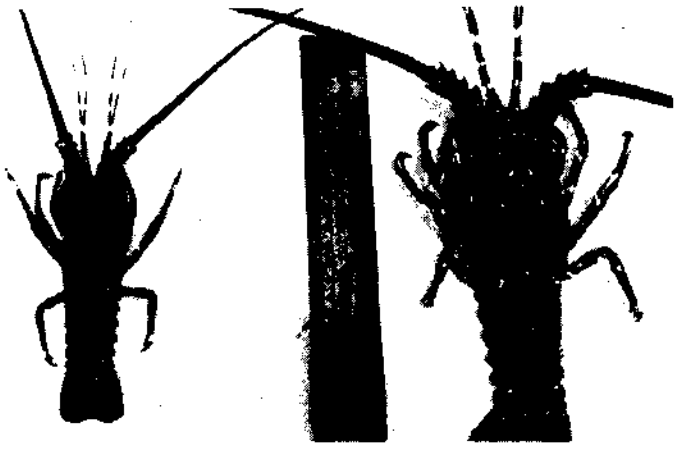


Fig. 5. Control lobster after 90 days normal growth - 49.7 gm to 71.3 gm.

Fig. 6. Eye ablated lobster after 90 days growth - 49.7 gm to 184.3 gm.

Spiny lobster landings (with annual production estimates from three maritime states) and exports from India during 1978-1981

Year	Landings (in tonnes)				Export	
	All India	Maharashtra	Gujarat	Tamil Nadu	Quantity (in tonnes)	Value (1000 Rs.)
1978	1,307	607	339	249	691	45,668
1979	1,135	499	211	340	752	53,456
1980	679	225	204	90	501	27,889
1981	1,481	388	786	238	636	47,003

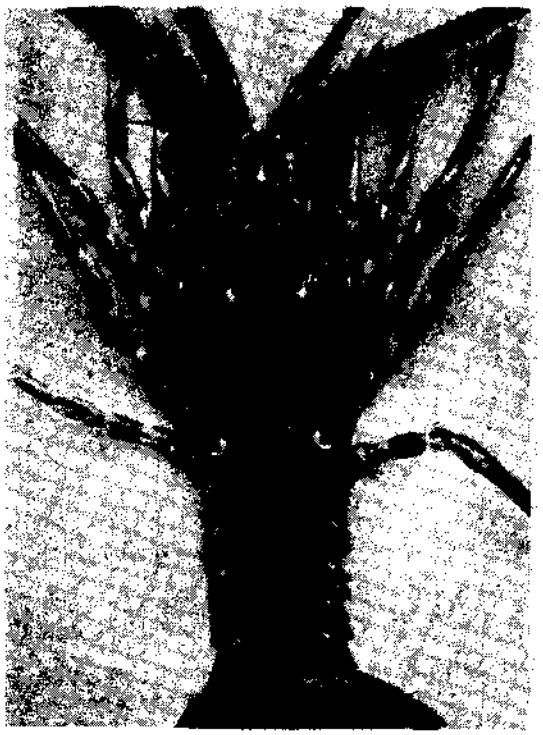


Fig. 7. An ablated lobster with antennule-like growth at the place of the ablated eye (Full view)

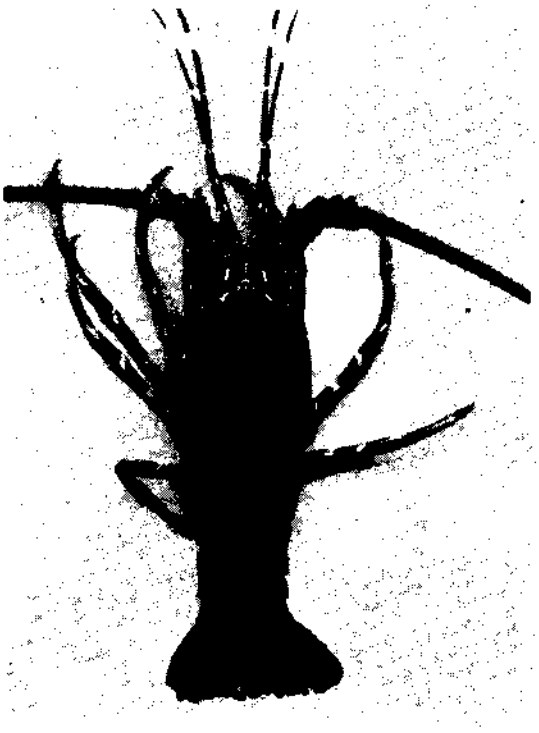


Fig. 8. An ablated lobster without the antennule-like growth.

The higher rate of growth observed in such eye stalk ablated lobsters is of great significance in regard to our understanding the hormonal action on moulting and growth. Since faster growth is a phenomena related to increase in production, it is of importance in culture production.

The results have been spectacular and fully justify consideration as a major breakthrough in making spiny lobster culture a viable proposition. My colleagues Shri E.V.Radhakrishnan and Shri M. Vijayakumaran who have been working under my guidance have in a series of experiments conducted on individual as well as groups of lobsters employing the eye ablation technique demonstrated that:

1. In a group of 10 early juvenile lobsters each weighing about 84.5 gm, when ablated and reared in experimental techniques for 165 days attained a mean weight of 432 gm as compared to the growth increment of only 57 gm for the control group.
2. In another trial involving 14 lobsters the average growth increment was 110.6 gm in 108 days, the corresponding growth for the control lobsters being 37.5 gm.
3. With repetitive trials with different number

Lobsters Are Human Too

IMAGINE a blinded animal growing big and strong and ... antennae in place of their blinded eyes. ... that is what is done to lobsters. S... menon is possible a... Scientist...

Letters to the Editor

Do l... pain

Sir, — (THE HI... Prasad's ... blinding ... that lobs... reminde... that Jew... dissecte... The Ku... black ... being h... A ... phrase ... ford to ... necess... sufferi... would ... pursuit... ing lob... and f... they ...

NOVEM...

TODAY

SCIENCE

LOBSTERS

A Giant Leap

IN A STARTLING discovery, marine scientists recently found that the Indian species of lobster, *Panulirus Homarus*, grow fastest when they have been blinded. The technique was developed at the Kovalam (Mad... ratory ...

... tank for 165 days. These lobsters grew to a mean weight of 432 grams. In the ... ablated group of lobsters ... and weight ...

... their no... The ... was first ... search co... cessful in ...

Do lobsters feel pain when blin...

MADRAS, Oct. 25.

Do lobsters which are blinded by ... tists feel pain? Is it not cruel to cl... eyestalks of these crustaceans?

Many have expressed ... and some have vehemen... of depriving them ... organ so that the...

Dr. Guha ... the Centr... stitute ... is ...

...tting off the legs was evolved ...jection.

...y the concept of "pain" ...tally different from that ...bjections should not ... the organisms ...portant sensory ...r crustaceans ...ory mechani... "pain." ...d by ... ...het thy ...spon... ...ow ...

...tion of accelerated moulting ...tion) and precocious growth ... eyestalks were re...

"How do you know"

Sir, — In defence of blinding lobsters, (THE HINDU, October 26), Dr. Guha Prasad has obeserved that "the question of pain or suffering is a projection of our own mind" and "the concept of pain in lower animals is totally different from that in human beings".

I am reminded of the following conversation in an old movie called "I want to live" between Miss Barbara Graham, the condemned prisoner in the gas chamber and her executioner:

Executioner:

"Miss Graham, when I pull the lever the cyanide pellets will sink into the acid and the fumes will engulf the chamber. Take a deep breath, it will be painless"

Graham: "How do you know?"

S. Rajagopalan

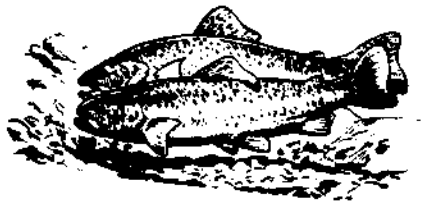
of lobsters varying from 4 to 18, the growth increase in the eye stalk ablated lobsters recorded was between 1.45 and 2.5 gm/day, which in the controls was hardly 0.35 gm/day, all lobsters being fed *ad libitum* with clam meat.

4. In one experiment, a lobster with an initial weight of 254 gm attained 402 gm after a single moult in 31 days - a weight increase of 148 gm after a moult! These figures appear incredible as compared to hardly 12 gm increment in weight recorded in the inter-moult period of about one month in the controls as well as observed in the natural population.

These findings are remarkable since eye ablation technique in the American and Australian spiny lobsters *P.argus* and *P.cyngus* respectively did not yield results. This also definitely shows that culture of lobster from puerulus or early juveniles to a marketable size of 180 to 200 gm is possible in about 5 to 6 months and an almost doubling of weight is possible in another 2 to 3 months - in other words a 400 gm lobster in about 9 months!

From the time that the results of these experiments on spiny lobster growth adopting the eye ablation technique was announced, there has been a spate of letters in some of our national dailies questioning the ethics of such experiments with animals as this is considered as being against the tradition of our country (ref: p.4). In scientific research, experimentation with animals is inevitable. Such researches on other crustaceans have been in vogue for ages all over the world. Here the mandate has been to find out whether mariculture of spiny lobsters is a feasible proposition or not. Complacency due to the negative results obtained by scientists in the USA and Australia would have put the clock back several years. The success with eye ablation technique has now given us a clue as well as a lead to enhance our indepth studies on the endocrinological function of growth and maturation to map the endocrine organ, identify the hormones and understand their functions. The next step could be the acceleration or inhibition of growth/maturation as may be desired in the different phases of culture, through hormonal treatment and not consider eye ablation as the ultimate technology for obtaining higher production.

These researches no doubt open up the great possibilities of developing genetically faster growing strains for producing "Giant" lobsters and more than all make *P.homarus* a very good candidate species for culture. I would also take this opportunity to announce that my colleagues Shri E.V.RadhaKrishnan and Shri M.Vijayakumaran have also met with success in experiments carried out on 2 other species, *P.ornatus* and *P.polyphagus*. The lobster culture programme in the Institute is being accelerated to answer many of the problems that have come up in the course of the work undertaken during the last 2 years.



UNPRECEDENTED GROWTH INDUCED IN SPINY LOBSTERS

E.V.Radhakrishnan and M.Vijayakumaran

Introduction

With the ever increasing demand, the lobster fishing grounds all over the world are being heavily exploited and this is also true in Indian lobster fishery. Attempts for growing lobsters in captivity in order to augment the production have met with only partial success. Apart from other problems their slow growth rate is one of the main constraints. Investigations have been carried out at the Field Laboratory of the Central Marine Fisheries Research Institute at Kovalam, Madras since 1976 to rear the spiny lobster *Panulirus homarus*, which contributes to a major portion of the lobster fishery in southern parts of India. Early juveniles of this species have been consistently reared in the laboratory to marketable sizes in a period of sixteen to eighteen months. However, it was felt that it may not be economically feasible to carryout large scale culture of lobsters unless the rearing period is brought down considerably. The only way to accomplish this is by accelerating the growth rate of lobsters and this has been the major concern of the CMFRI Laboratory at Kovalam, resulting in several experimental studies.

It has been well established that the X-organ sinus gland complex in the eyestalk of crustaceans plays a major role in the control of moulting and growth in them. Experiments in ablation of eyestalks and thereby removal of the gland complex was not found to be useful in the acceleration of moulting in *P. cygnus* in Australia and *P. argus* in America, leading to the conclusion that Moult Inhibiting Factor (MIH factor) may not be present in the eyestalk of palinurid lobsters. However, encouraging results have been obtained for the first time in accelerating moulting frequency and weight gain in the spiny lobster *P. homarus* consequent to the present experiments in removal of eyestalks.

Early juveniles, maturing and mature *P. homarus* ranging from 20 to 250 g in body weight were used in this study. The technique used was bilateral removal of eyestalks by ligation. Lobsters were reared in groups and equal number of males and females were used in all the treatments. Salinity of the seawater used varied between 32 and 35% and the water temperature ranged from 22 to 33.8° C. In the experiments the lobsters were fed *ad libitum* on the clam *Meretrix casta* twice daily. In one of the experiments mussel meat and chopped fishes were given once daily initially and clam meat twice daily later.

Moulting frequency

The results prove that eyestalk removal accelerated frequency of moulting in *P. homarus*, indicating the presence of an MIH factor in the eyestalk. Whereas the control lobsters moulted 4 times in 140 days reaching 70 g, the ablated lobsters moulted 7 times to reach the marketable size of 200 g in the same period. Intermoult period increased with the size in both ablated and control lobsters, but the increase in ablated ones was considerably lower than that of the control.

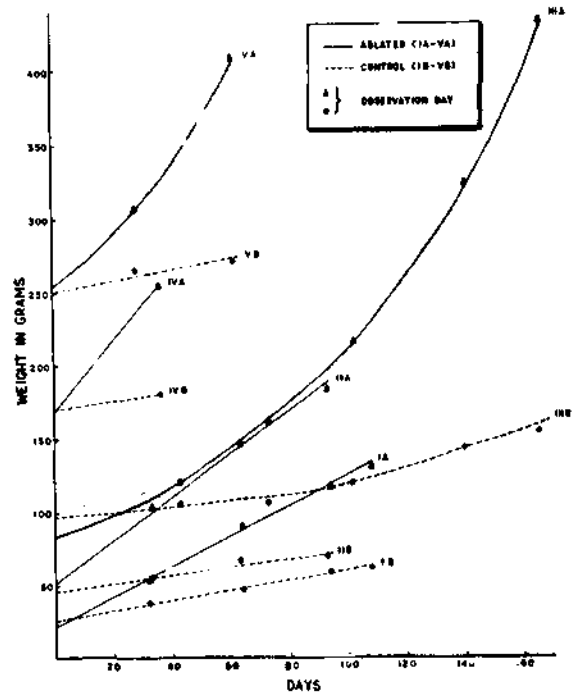


Fig. 1. Increase in weight in eye ablated and control spiny lobsters *P.homarus* in different experiments.

Weight gain

The weight gain in ablated and control lobsters from experiments I to V is shown in Figure 1. Growth of lobsters is a manifestation of moul-

Table 1. *Growth of ablated and control lobsters Panulirus homarus*

Expt. No.		Description	No. of lobsters	INITIAL		FINAL		Total No. of days	Increase in weight/day (g) (Average)	% increase/day
				CL (mm)	Wt. (g)	CL (mm)	Wt. (g)			
I	A	ABLATED	14	27.0	20.4	53.1	131.0	108	1.02	5.0
	B	CONTROL	14	28.7	24.8	39.7	62.3		0.35	1.4
II	A	ABLATED	6 × 3 (18 Nos)	36.5	49.7	59.7	184.3	93	1.45	2.9
	B	CONTROL	6 × 2 (12 Nos)	35.8	46.8	41.9	71.3		0.26	0.55
III	A	ABLATED	10	44.7	84.5	77.4	432.0	165	2.1	2.48
	B	CONTROL	10	47.3	98.6	56.2	155.7		0.35	0.35
IV	A	ABLATED	4	56.2	169.0	65.3	255.0	36	2.38	1.46
	B	CONTROL	4	58.2	169.2	59.2	181.0		0.33	0.19
V	A	ABLATED	6	66.1	256.5	77.8	408.0	61	2.5	0.97
	B	CONTROL	6	66.0	250.3	67.4	272.5		0.36	0.14
VI	A	ABLATED	5	41.2	69.4	53.0	141.0	63	1.14	1.64
	B	CONTROL	5	39.9	66.0	44.2	83.4		0.28	0.42

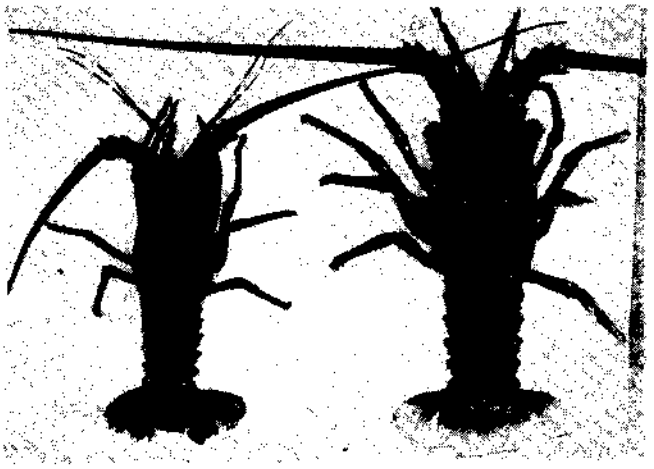


Fig. 2. Growth difference in eye ablated (right) and control (left) spiny lobsters.

ting and size and weight increase at moult. Eyestalk ablation in *P. homarus* accelerated both these factors and enhanced growth rate obtained is the cumulative effect of these two. Three to sevenfold increase in weight was obtained in ablated lobsters compared to the control (Fig. 2). Weight increase per day is proportional to the size of the lobsters. Ablated juveniles recorded an average increase of 1.02 g/day while the increase was only 0.35 g/day in the control. Weight increase per day gradually increased with size and the maximum of 2.5 g/day was obtained in maturing and mature lobsters (Table 1). Eventhough relative increase in growth, expressed in terms of percentage weight gain per day, was more in early juveniles, absolute increase in bodyweight was higher in bigger lobsters. Maximum weight gain of 4.6 g/day was obtained in an ablated mature lobster weighing 256 g.

Food conversion

Accelerated growth is achieved by increased food consumption and assimilation and by better conversion efficiency. The experiments show that in *P.homarus*, at *ad libitum* level of feeding, food consumption of ablated lobsters was twice that of the control animals, recording two to three fold increase in food conversion efficiency. Even when equal quantities of food wire given to both the groups in Expt.VI the ablated ones recorded four fold increase in weight compared to control. This would indicate that increased food intake in ablated individuals only may be supplementing the individuals only may be supplementing the accelerated growth rate caused mainly by hormonal imbalance.

Tail weight

The proportion of tail weight to body weight of ablated and control lobsters weighing 200 g and above shows that there is no significant difference in this relationship between the experimental and control animals. The percentage dry matter in the flesh also showed similar trend indicating that ablation do not alter this relationship.

General remarks

Apparantly there is a Moult Inhibiting Hormone Factor in the eyestalk of spiny lobsters, which on removal accelerate the growth significantly. Further experiments are in progress to

map out the gland so that manipulation of the hormone produced by the gland may accelerate the growth rate without impairing the vision of the lobsters. This basic discovery opens up further avenues for advanced research in lobster endocrinology.

From the present results it is clear that it would be possible to grow marketable size lobsters from juvenile stage in 5 to 6 months and to double the size in another 3 or 4 months. Such phenomenal growth would throw open great possibilities of developing genetically fast growing strains of lobsters and more than all make *P. homarus* a very suitable candidate species for culture.

We are thankful to Dr. E. G. Silas, Director, CMFRI for constant encouragement and guidance.

SYNOPSIS OF MARINE PRAWN FISHERY OF INDIA-1981*

Total production

The total marine prawn production during the year 1981 was estimated at 1,44,969 tonnes against 1,70,737 tonnes in 1980 (Table 1), showing a decrease of 25, 768 t (15.1%). A glance at the marine prawn production of the country over the past few years indicates that the trend of decrease from the maximum in 1975 is maintained over these years and this year the comparative reduction is considerably high and this is mostly brought about by reduced catches in Kerala State, especially in a single centre, ie. Neendakara and that too of a single species of penaeid prawn.

Taking into account the production of the penaeid prawns and nonpenaeid prawns separately the decrease in landings in 1981 is noticed only in penaeid prawns, while nonpenaeid prawns showed an increase from that of 1980 (Table 2). During 1981 the penaeid prawn catch recorded a reduction of 28,498 t (25.4%) and the nonpenaeids an increase of 2,730 t (4.7%). The decrease in penaeid prawn catch is mostly due to the steep decline in a single species catch occurring in Kerala State, the catch declining from 52,633 t in 1980 to 22,268 t in 1981.

Compared to last year, when the maximum production was in the month of July, the maximum productive months in 1981 were April and May, in which months maximum quantities of prawns were landed in Maharashtra (Table 3). The failure of the monsoon fishery of Neendakara in Kerala state this year is the main reason for July going out of the picture, as the maximum productive months for prawns September, June and August were the months in which minimum quantities of prawns were landed. In Kerala State, of course the maximum productive month is July, but the decline in the total quantity of prawns landed in that month at Neendakara to less than one third of the catch of last year has made the month less conspicuous in production at all India level. However for taking the penaeid prawns alone July is the month of maximum production and September and June least productive. For nonpenaeid prawns April-May is the period of maximum production, the major portion coming from the state of Maharashtra. June to September is the least productive months for nonpenaeid prawns.

As usual the statewise production this year also shows the maximum in Maharashtra, being 51.4% showing 10% more than last year. On the contrary the percentage contribution of Kerala state registered nearly 16% decrease, giving only 15.5% of the total production (Table 1) against 31.8% of last year. The statewise and monthwise landings of penaeid and nonpenaeid prawns (Table 4 and 5) indicate that penaeid prawns contribute to the major portion of the fishery in Kerala, Tamil Nadu, Pondicherry and Orissa. Almost the entire fishery of Goa, Andamans and Karnataka is contributed by penaeid prawns. In Gujarat about two thirds of the fishery is contributed by penaeids while in Andhra Pradesh penaeid prawns formed

* Prepared by Crustacean Fisheries Resources team. Compilation: M.J.George, C.Suseelan M.M.Thomas V.S.Kakati, and C.Nalini.

Table 1. *Statewise prawn landings and percentage contributions during 1981 and 1980*

Maritime States	Prawn landings in tonnes		Percentage	
	1981	1980	1981	1980
Gujarat	15,727	18,590	10.8	10.8
Maharashtra	74,571	70,742	51.4	41.4
Goa	2,237	1,853	1.6	1.0
Karnataka	4,126	3,226	2.9	1.8
Kerala	22,428	54,375	15.5	31.8
Tamil Nadu	14,252	10,028	9.8	5.8
Pondicherry	389	527	0.3	0.3
Andhra Pradesh	8,335	10,006	5.8	5.8
Orissa	1,383	1,104	0.9	0.6
West Bengal	1,495	200	1.0	0.1
Andamans	26	54	-	-
Larger trawlers	*	32	-	-
All India Total	1,44,969	1,70,737	100	100

*144 tonnes included with the catch of Andhra Pradesh

Table 6. *Species wise break up of prawn landings and percentages during 1981*

Species	All India landings in tonnes	percentage
Solenocera crassicornis	8,084	5.6
Penaeus indicus	7,537	5.2
P.merguiensis	1,096	0.8
P.monodon	941	0.6
P.semisulcatus	7,898	5.4
Metapenaeopsis stridulans	506	0.3
Metapenaeus dobsoni	10,059	6.9
M.affinis	5,025	3.5
M.monoceros	7,073	4.9
M.brevicornis	907	0.6
M.kutchensis	857	0.6
Parapenaeopsis stylifera	29,109	20.1
P.hardwickii	2,123	1.5
Acetes indicus	38,430	26.5
Nematopalaemon tenuipes	19,698	13.6
Exopalaemon styliferus	859	0.6
Exhippolysmata ensirostris	2,309	1.6
Other species	2,458	1.7
Total	1,44,969	100.0

Table 2. *Statewise penaeid and non-penaeid prawn landings and their percentage for 1981 and 1980*

Maritime States	Landings in tonnes and percentage							
	1981				1980			
	Penaeid		Non-penaeid		Penaeid		Non-penaeid	
	Catch	%	Catch	%	Catch	%	Catch	%
Gujarat	10,985	13.1	4,742	7.8	14,481	12.9	4,109	7.0
Maharashtra	21,717	26.0	52,854	86.0	23,433	20.9	47,309	80.5
Goa	2,237	2.7	-	-	1,853	1.6	-	-
Karnataka	4,122	4.9	4	-	3,098	2.7	128	0.2
Kerala	22,268	26.7	160	0.3	52,633	46.9	1,742	2.9
Tamil Nadu	13,548	16.2	704	1.1	9,082	8.1	946	1.6
Pondicherry	336	0.4	53	0.1	485	0.4	42	-
Andhra Pradesh	6,728	8.1	1,607	2.6	5,660	5.0	4,346	7.4
Orissa	1,328	1.6	55	0.1	1,074	0.9	30	-
West Bengal	244	0.3	1,251	2.0	152	0.1	48	-
Andamans	26	-	-	-	54	-	-	-
Larger trawlers	*	-	-	-	32	-	-	-
All India total	83,539	100	61,430	100	1,12,037	100	58,700	100

* 144 tonnes included with the catch of Andhra Pradesh.

Table 3. *Monthly prawn landings in different maritime states during 1981*

Maritime states	Prawn catch in tonnes													Total for 1981
	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Larger trawlers	
Gujarat	1,635	428	1,394	1,183	1,063	37	47	210	580	3,841	3,530	1,779	-	15,727
Maharashtra	6,805	7,798	7,056	14,254	17,199	1,228	305	931	2,057	6,480	4,761	5,688	-	74,571
Goa	375	157	414	153	283	205	2	210	6	6	4	422	-	2,237
Karnataka	546	462	297	700	524	10	451	61	242	6	194	633	-	4,126
Kerala	1,415	852	1,060	836	1,662	1,765	7,621	4,732	455	395	969	666	-	22,428
Tamil Nadu	917	730	468	1,144	796	1,649	3,773	1,249	538	802	1,123	1,063	-	14,252
Pondicherry	84	25	23	38	37	54	34	17	9	2	9	57	-	389
Andhra Pradesh	713	1,469	219	605	274	250	945	1,178	806	699	622	411	144	8,335
Orissa	122	114	20	64	103	25	29	51	72	213	165	405	-	1,383
West Bengal	772	-	-	2	2	-	6	2	-	1	568	142	-	1,495
Andamans	-	-	5	-	-	4	-	-	7	-	-	10	-	26
All India Total	13,384	12,035	10,956	18,979	21,943	5,227	13,213	8,641	4,772	12,454	11,945	11,276	144	1,44,969
Monthwise percentage	9.2	8.3	7.6	13.1	15.1	3.6	9.1	6.0	3.3	8.6	8.2	7.8	0.1	

Table 4. *Penaeid prawn landings in different maritime states during 1981*

Maritime States	Prawn catch in tonnes													Total for 1981
	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Larger trawlers	
Gujarat	1,500	345	403	398	295	19	3	162	486	2,822	3,048	1,504	-	10,985
Maharashtra	2,225	1,481	2,347	3,050	1,644	486	151	514	1,390	2,960	2,814	2,655	-	21,717
Goa	375	157	414	153	283	205	2	210	6	6	4	422	-	2,237
Karnataka	546	462	297	700	524	10	451	61	242	6	190	633	-	4,122
Kerala	1,414	829	1,026	811	1,650	1,755	7,591	4,732	430	395	969	666	-	22,268
Tamil Nadu	908	719	452	1,126	783	1,410	3,531	1,217	519	764	1,071	1,048	-	13,548
Pondicherry	48	17	22	38	37	49	34	17	9	2	9	54	-	336
Andhra Pradesh	652	1,461	205	318	271	214	639	459	772	678	538	377	144	6,728
Orissa	122	114	20	64	103	25	29	49	72	174	151	405	-	1,328
West Bengal	-	-	-	-	-	-	4	2	-	1	212	25	-	244
Andamans	-	-	5	-	-	4	-	-	7	-	-	10	-	26
All India total	7,790	5,585	5,191	6,658	5,590	4,177	12,435	7,423	3,933	7,808	9,006	7,799	144	83,539
Monthwise percentage	9.3	6.7	6.2	7.9	6.7	5.0	14.9	8.9	4.7	9.3	10.9	9.3	0.2	

Table 5. *Non-penaeid prawn landings in different maritime states during 1981*

Maritime States	Prawn catch in tonnes												Total for 1981
	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	
Gujarat	135	83	991	785	768	18	44	48	94	1,019	482	275	4,742
Maharashtra	4,580	6,317	4,709	11,204	15,555	742	154	417	667	3,529	1,947	3,033	52,854
Goa	-	-	-	-	-	-	-	-	-	-	-	-	-
Karnataka	-	-	-	-	-	-	-	-	-	-	4	-	4
Kerala	1	23	34	25	12	10	30	-	25	-	-	-	160
Tamil Nadu	9	11	16	18	13	239	242	32	19	38	52	15	704
Pondicherry	36	8	1	-	-	5	-	-	-	-	-	3	53
Andhra Pradesh	61	8	14	287	3	36	306	719	34	21	84	34	1,607
Orissa	-	-	-	-	-	-	-	2	-	39	14	-	55
West Bengal	772	-	-	2	2	-	2	-	-	-	356	117	1,251
Andamans	-	-	-	-	-	-	-	-	-	-	-	-	-
All India Total	5,594	6,450	5,765	12,321	16,353	1,050	778	1,218	839	4,646	2,939	3,477	61,430
Monthwise percentage	9.1	10.5	9.4	20.1	26.6	1.7	1.3	1.9	1.4	7.6	4.8	5.6	

Table 7. *Annual percentage distribution of important species in the prawn landings at different centres during 1981*

Centres	PENAEIDS												
	S.crassicornis	*P.indicus*	*P.merguiensis*	*P.monodon*	*P.semisulcatus*	*M.stridulans*	*M.dobsoni*	*M.affinis*	*M.monoceros*	*M.brevicornis*	*M.kutchensis*	*P.styliferа*	*P.hardwickii*
Veraval	13.9	-	-	-	5.8	-	-	7.5	5.8	-	7.8	41.7	12.4
Bombay	28.7	-	-	-	-	-	-	11.9	10.6	2.8	-	39.1	3.5
Karwar	-	0.2	0.8	0.2	-	-	20.7	9.1	39.1	-	-	29.5	-
Malpe	-	3.7	-	0.5	-	-	32.3	3.7	12.6	-	-	47.2	-
Mangalore	-	3.6	-	0.7	-	-	45.5	1.4	6.8	-	-	42.0	-
Calicut	-	5.7	-	-	-	-	56.3	-	1.4	-	-	36.7	-
Cochin	-	10.9	-	0.2	-	-	37.7	1.1	0.3	-	-	49.2	-
Neendakara	-	9.2	-	0.1	0.1	-	3.5	2.1	1.4	-	-	83.1	-
Tuticorin	-	44.2	-	-	55.0	-	0.4	-	-	-	-	-	-
Mandapam	-	2.3	-	-	81.3	-	-	9.3	-	-	-	-	-
Madras	-	26.7	-	8.6	20.2	-	20.7	-	23.8	-	-	-	-
Kakinada	-	12.3	3.7	8.6	-	-	16.0	8.1	14.5	10.7	-	6.3	-
Waltair	11.7	12.4	-	5.3	0.7	18.3	6.8	-	41.9	-	-	-	-
Puri	-	49.7	35.8	2.8	-	-	-	11.7	-				-

	NON-PENAEIDS			
	A.indicus	*N.tenuipes*	*E.styliferus*	*E.ensirostris*
Veraval	46.0	32.8	-	21.2
Bombay	66.0	32.5	-	1.5
Kakinada	30.6	21.2	20.4	11.5

three fourths of the total prawn fishery. In Maharashtra only more than two thirds of the fishery is constituted by nonpenaeid prawns, out of which the maximum quantities were landed in the months of April and May.

In the overall species composition in the prawn landings (Table 6) as in 1979 *Acetes indicus* ranked first (26.5%), relegating *Parapenaeopsis stylifera* (20.1%), which came first in 1980, to the second position. This was mainly due to the poor landings of *P.stylifera* in this year during the monsoon fishery at Neendakara in Kerala State. The other important species in the order of their abundance were *Nematopalaemon tenuipes*, *Metapenaeus dobsoni*, *Solenocera crassicornis*, *Penaeus semisulcatus*, *Penaeus indicus*, *Metapenaeus monoceros* and *M.affinis*, which collectively accounted for 45.1% of the total production. Noticeable changes evident from previous year's data in the case of the representation of these species are the third position taken by the nonpenaeid prawn *N.tenuipes* relegating *M.dobsoni* to fourth postion and increased representation of *S.crassicornis* and *P. semisulcatus* occupying fifth and sixth positions respectively. The dominant species *A.indicus* was mostly harvested from Maharashtra, Gujarat and Andhra Pradesh. The annual percentage distribution of important species at different observation centres during 1981 is given in table 7.

Gearwise production

Shrimp trawls operated by various sizes of boats formed the single major gear employed in the exploitation of prawns as in the previous years.

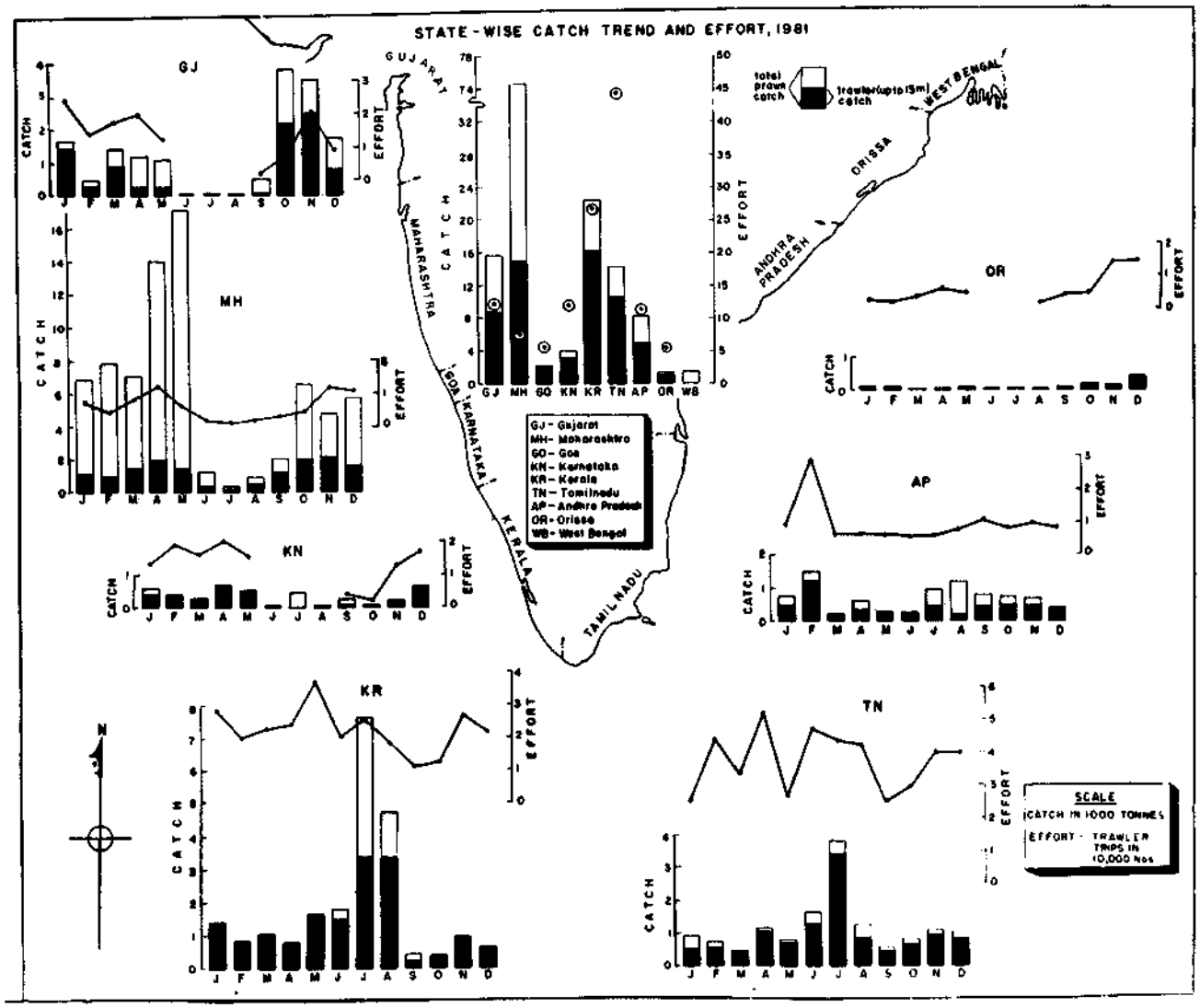


Fig. 1. Prawn landings by commercial shrimp trawlers in relation to the total prawn catch and the fishing effort during 1981.

The overall fishing input by this gear showed improvement to the extent of 6% over that of last year. While the fishing was more active in most of the maritime states this year, it decreased considerably in Maharashtra, Kerala and Orissa.

In spite of the general increase in fishing effort, the production of prawns by trawlers declined to 63,689 t from 87,956 t of the previous year showing a reduction rate of 27.6%. This was mainly due to the lower landings recorded along the coasts of Kerala. While in most of the other states the increase in trawler landings was only marginal, Tamil Nadu and Orissa registered remarkably good catches with an increase to the tune of 82% in the former and 47% in the latter state over the production of the previous year. Out of the total estimated prawn catch of 1,44,969 t from the marine sector the trawler landings accounted for 44% as against 51.5% of last year. The rest of the catch was mainly contributed by fixed bag nets in Gujarat, Maharashtra and West Bengal and seines, gill nets and other indigenous gears in the other states. The statewise percentage contributions of prawn landings by shrimp trawlers for this year as well as the previous year (in parenthesis) were: Kerala-25.6 (52.4), Maharashtra-23.4 (17.1), Tamil Nadu-18.3 (7.3), Gujarat-13.8 (11.7), Andhra Pradesh-8.1 (4.4), Karnataka-5.2 (3.4), Goa-3.2 (2.0), Orissa-1.9 (1.0) and Pondicherry-0.5 (0.4). Penaeid prawns accounted for the bulk of these catches in all the states, forming 92-100%.

The annual as well as seasonal production trends of the commercial trawl fishery of different maritime states in relation to the effort and total prawn landings are depicted in Fig. 1. In the annual prawn landings of individual states trawlers contributed to the major share in Goa (90.5%), Orissa (89.7%), Tamil Nadu (82.0%), Karnataka (78.4%), Pondicherry (76.3%), Kerala (72.7%), Andhra Pradesh (60.5%) and Gujarat (56.0%). In Maharashtra its contribution was only 20% which was slightly less than that of previous year (21.3%). The peak landings were recorded during February in Andhra Pradesh, April in Karnataka, July in Tamil Nadu, July and August in Kerala, November in Gujarat and Maharashtra and December in Goa, Pondicherry and Orissa.

The striking change noticed in this year in the trawl fishery of the country was that of Kerala where a severe decline in the production of penaeid prawns was observed. This was mainly due to the failure of the monsoon fishery for 'Karikkadi' *(Parapenaeopsis stylifera)* at Sakthiku langara--Neendakara area. The sudden increase in prawn catch by indigenous gears in this state was brought about by the unusual landings of 'Poovalan chemmeen' *(Metapenaeus dobsoni)* in boat seines during the monsoon months (July & August) at Cannanore and nearby centres.

Veraval (Fig. 2)

Prawn fishing at Veraval and nearby centres was fairly active with an off-season in June-August for trawlers and July-August for 'Dol' nets due to monsoon. The prawn production, however, was much less than that of the previous year. At Veraval, the penaeid prawn landings of shrimp trawlers amounted to only 1,144 t at an annual catch rate of 2.5 kg/hr as against 1,590 t at the rate of 4.4 kg/hr of trawling during 1980. The maximum catch as well as CPUE were recorded during November. As in the previous year, *Parapenaeopsis stylifera* was the dominant species (41.7%) followed by *Solenocera crassicornis* (13.9%), *P.hardwickii* (12.4%), *Metapenaeus kutchensis* (7.8%), *M.affinis* (7.5%) and *M.monoceros* (5.8%) among the regular species. Significant quantities of other penaeid prawns were also landed occasionally, of which *Penaeus penicillatus* and *P.semisulcatus* were important from the point of export industry. The unusually heavy landings of *P.semisulcatus* during October (64.7 t) to the extent of contributing nearly 63% of the penaeid prawn catches of the trawlers was a significant feature noticed in the prawn fishery of this centre during this year. Normally this species is not caught in commercial quantities along this coast. The new occurrence of the species was spread over the shallow as well as deeper areas upto about 80 m depth. Although a wide range of size groups of this species was represented, males of 141-160 mm and female of 141-195 mm, which were sold at Rs. 40-55 per kg, formed the bulk of the catches. Majority of the females were in 'spent' or 'spentrecovering' stages of ovarian maturity and indicated the possibility of completion of their spawning in the offshore waters of this coast. It is interesting to note in this context that in recent years the occurrence of *P.semisulcatus* in the marine and estuarine environments has been steadily increasing along some other areas also.

There was no significant change in the size distribution of the major species of prawns landed at this centre in comparison with that of the previous year. The important size groups that supported the fishery were 73-78 mm for *P.stylifera*, 58-63 mm and 93-123 mm for *P.hardwickii*,

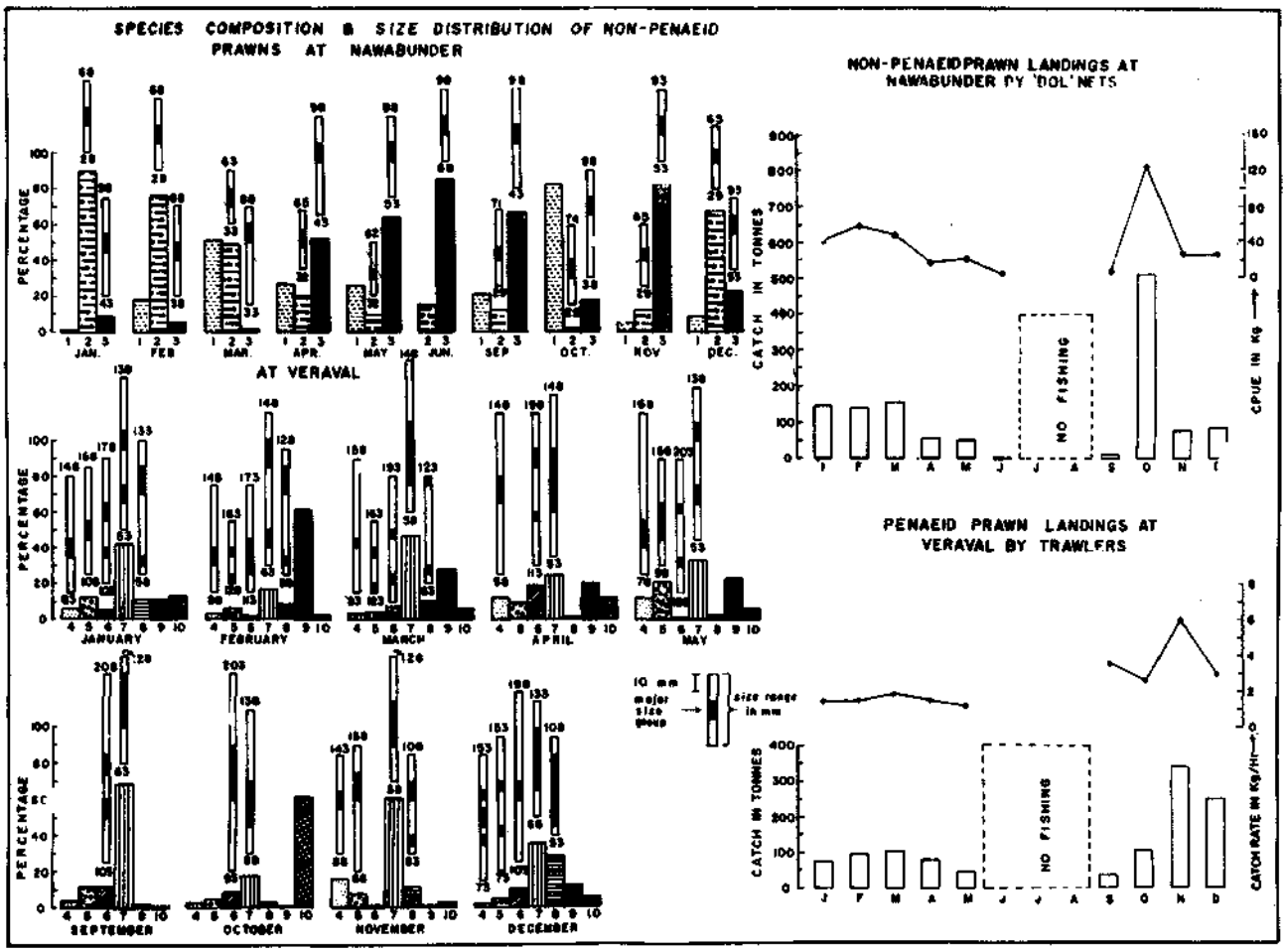


Fig. 2. Catch trend, species composition and size distribution of important species of prawns at Veraval during 1981. *1. A.indicus, 2. N.tenuipes, 3. E.ensirostris, 4. M.kutchensis, 5. M.affinis, 6. M.monoceros, 7. P.stylifera, 8. P.hardwickii, 9. S.crassicornis, 10.* Other penaeid prawns.

113-143 mm for *M.affinis* and 123 -163 mm for *M.monoceros*. Peak spawning activities for most of these species were observed during January to May as in the previous year (Fig. 10).

At Nawabunder the non-penaeid prawn landings by 'Dol' nets decreased to 1,227 t from 1,971 t of last year with a corresponding reduction in CPUE from 77.55 kg to 44.85 kg. *Acetes indicus* (46.0%), *Nematopalaemon tenuipes* (32.8%) and *Exhippolysmata ensirostris* (21.2%) constituted the fishery. Peak landing was recorded in October.

Bombay (Fig. 3)

At New Ferry Wharf an estimated catch of 6,011 t of penaeid prawns was landed by trawlers which was 420 t less than in the previous year. The catch rate worked out to 313.2 kg/unit as against 319.5 kg of last year. Peak landings were recorded during March-April and September--November, with meagre fishing activities during the monsoon period June-August. The comparatively lesser production of prawns this year was mainly due to the reduced landings during the postmonsoon season. The premonsoon fishery, however, was relatively of higher magnitude. As usual, *P.stylifera* dominated in the fishery contributing to 39.1% of the annual landings, which was followed by *S.crassicornis* (28.7%), *M.affinis* (11.9%), *M.monoceros* (10.6%) and others. The catch of *S.crassicornis* was exceptionally high during February to April and so also was *P.stylifera* during October and November. Peak landing for *M.affinis* was recorded during September-October. The principal size groups of the important species were 71-125 mm for *P.stylifera*, 56-105 mm for *S.crassicornis* and 116-145 mm for *M.affinis*. Percentage of mature females in the catch was very low, being 1.7-9.5 only for *P.stylifera* and 1.0-6.1 for *M.affinis*.Peak breeding period was April-May for the former species and November for the latter (Fig. 10).

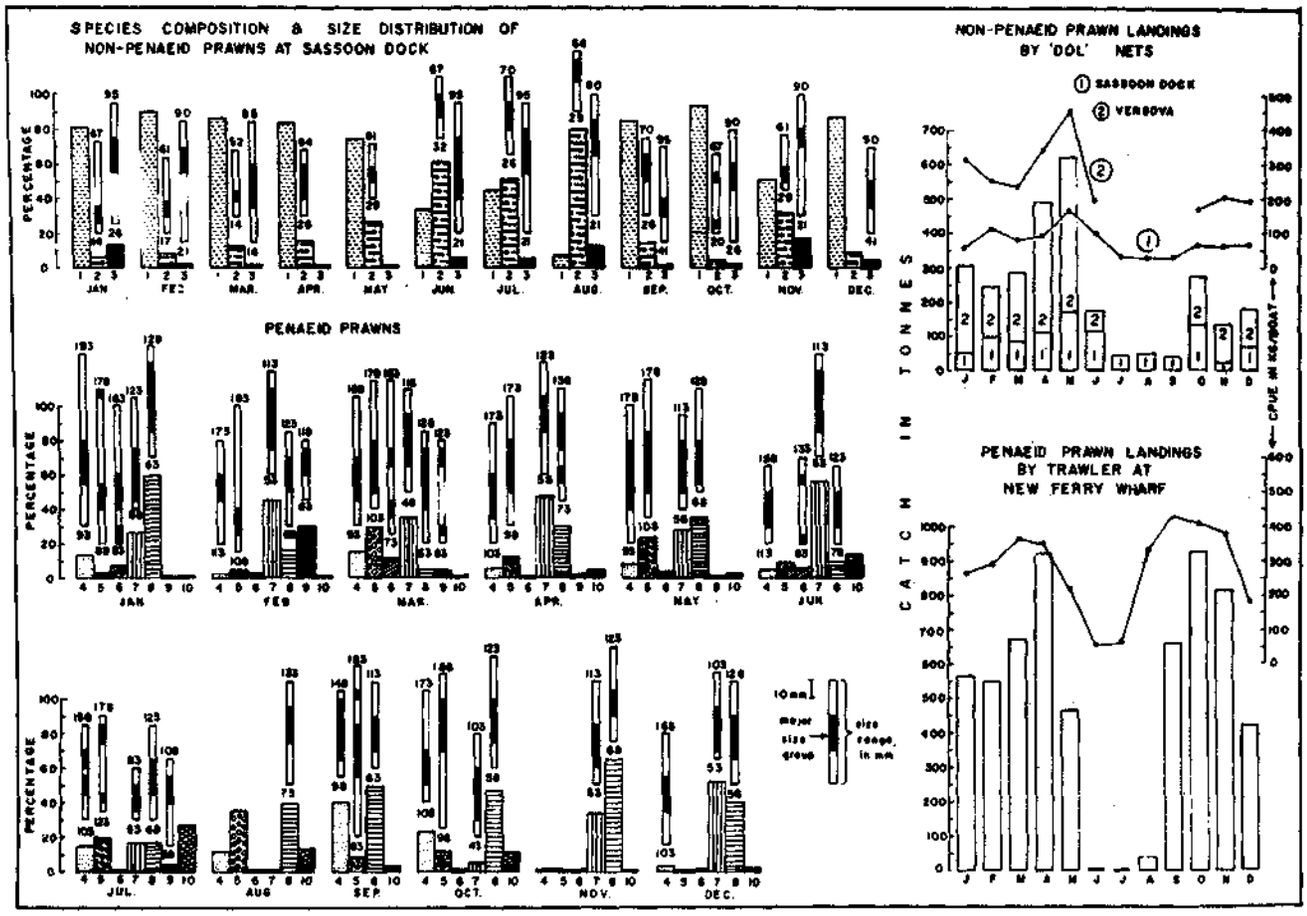


Fig. 3. Catch trend, species composition and size distribution of important species of prawns at Bombay during 1981. *1. A.indicus, 2. N.tenuipes, 3. E.ensirostris, 4. M.affinis, 5. M.monoceros, 6. M.brevicornis, 7. P.stylifera, 8. P.hardwickii 9. S.crassicornis, 10.* Other penaeids.

The non-penaeid prawn catch by 'Dol' nets registered a severe decline during this year in continuation of the previous year. The estimated annual catch for the two observation centres viz. Sassoon Dock and Versova was only 2,862 t as against 4,645 t of 1980 and 5,894 t of 1979. The CPUE worked out to 71.1 kg as compared to 69.3 kg at the former centre, thereby showing marginal improvement. *Acetes indicus* contributed 72% at Sassoon Dock and 66% at Versova, followed by *Nematopalaemon tenuipes* and *Exhippolysmata ensirostris* in the order of their abundance. Maximum percentage of berried females of the caridean prawns was recorded during the second half of the years.

Karwar (Fig. 4)

The fishery was sustained mainly by trawlers at Karwar, contributing nearly 97.1 percent of the total prawn catch. An estimated landing of 584.7 t of prawns was recorded during the year 1981, which showed an increase of about 4% over the previous year when it was recorded at 562.4 t. The peak landing was during April amounting to 179.1 t when the catch per hour registered around 7.4 kg.

M.monoceros, in sizes ranging between 51-135 mm in males and 51-180 mm in females, was dominating the catch by 39.1% unlike the status of thefishery for the previous year, when *P.stylifera* was dominating the catch. In the present year, *M.monoceros was followed by P.stylifera, M.dobsoni* and *M.affinis* representing 29.5, 20.7 and 9.1 percentage respectively. Though the prawn catch has increased during 1981, the catch per hour was very low at 5.7 kg compared to that of 1980 when it was 18.2 kg.

The shore seine, 'Yendi' accounted for a total catch of 21.3 t as against 5.8 t of the previous year, of which *P.stylifera* alone constituted nearly 52.4 per cent, followed by *M.dobsoni, P.merguiensis* and *M.affinis*. There was no landing of *P.indicus* as in the previous year when it accounted for

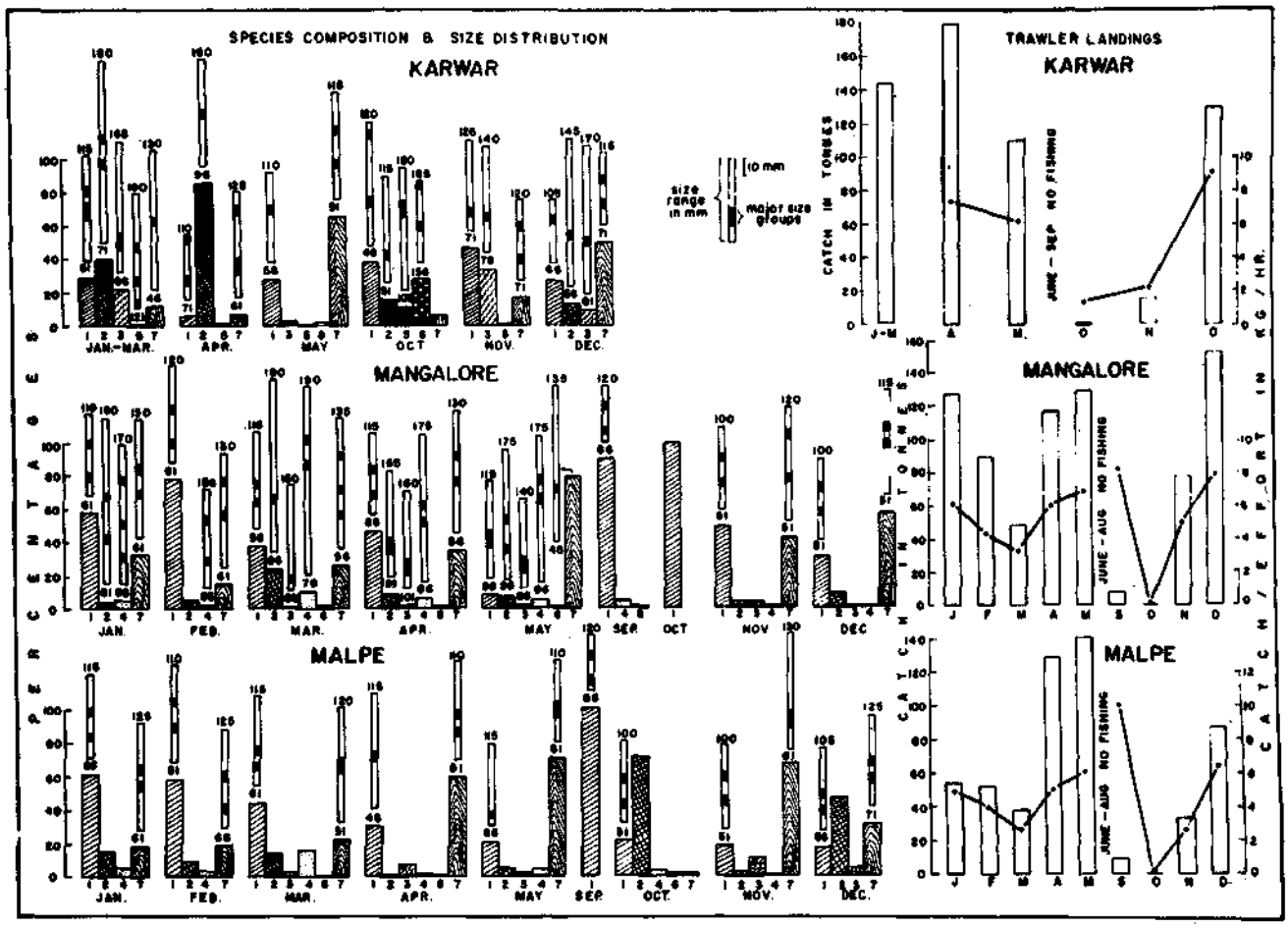


Fig. 4. Catch trend, species composition and size distribution of important species of prawns at Karwar, Malpe and Mangalore during 1981.
1. M.dobsoni, 2. M.monoceros, 3. M.affinis, 4. P.indicus, 5. P.merguiensis, 6. P.monodon, 7. P.stylifera, 8. M.moyebi.

the major share of 44.0 percent.

The matured females of *M.monoceros* were better represented in the months of February and December thereby indicating the spawning peaks (Fig 10)

Malpe (Fig. 4)

The total estimated landing of prawns by trawlers at Malpe was to the tune of 548.9 t. April and May months recorded the maximum catch of 270.0 t which accounted for 49.2 percent. Though the landing in September was very poor, the maximum catch rate was recorded during that month. The overall catch rate per hour for the year was 4.65 kg. *P.stylifera* was the dominant species accounting for 47.2 percent of the total catch, the size range of the species being from 51-130 mm for both sexes, with recurring modes between 81 and 91 mm. The second species in order of abundance was *M.dobsoni* constituting 32.33 per cent, followed by *M.monoceros* of 12.56 per cent, *M.affinis* and *P.indicus* representing 3.72 per cent each in the total prawn landings. *M.dobsoni* was ranging between 46-120 mm sizes.

Relatively high percentage of mature and impregnated females of *M.dobsoni* were observed in the month of September, while those of *P.stylifera were represented in April and November.*

Mangalore (Fig. 4)

The trawl fishing declined during the year with an estimated landing of 752.1 t with the catch rate of 5.8 kg/hr against the total catch of 979.7 t and 6.9 kg/hr of the previous year. The catch per hour has decreased from 7.5 kg of 1979 to 6.9 kg of 1980 and 5.8 kg of 1981. The maximum landing of 153.0 t was recorded during December with the catch rate of 7.9 kg per hour. The CPUE was at the highest rate of 8.3 kg during September but the total landing was very low. The landing of

prawns in October was negligible.

M.dobsoni was the dominating species in the landings, forming 45.5 percent of the total prawns. *P.stylifera* was the next species in order of abundance, constituting 42.0 per cent, followed by *M.monoceros* (6.8 per cent), *P.indicus* (36.7 per cent) and *M.affinis* (1.4 per cent). The size range of *M.dobsoni* was 51-120 mm.

Percentage of mature and impregnated females of *M.dobsoni* was high during March-April and September and those of *M.monoceros* in January and March, *M.affinis* in March-April, *P.indicus* in February and *P.stylifera* during February-March.

Calicut (Fig. 5)

The estimated total catch of prawns by trawlers was 111.6 t with the catch rate of 3.93 kg per hour, and this was obviously far below the recorded landing of 355.0 t with the catch rate of 6.8 kg per hour of the previous year. The highest landing was recorded during December amounting to 48.6 t with the catch rate of 9.1 kg per hour.

Unlike in the previous year, *M.dobsoni* was dominating the trawl catch (56.3 per cent) by relegating P.stylifera to the second position (36.7 per cent) in the present year. *M.dobsoni* was represented in the size range of 56-125 mm, while *P.stylifera* was between 51-135 mm. *P.indicus* accounted for 5.67 per cent in the prawn catch. The monsoon and post-monsoon prawn fishery by indigenous gear yielded an estimated catch of 185.1 t and *M.dobsoni* was the major species accounting for 94.8 percent of the total catch, followed by *P.indicus* (30 per cent).

Cochin (Fig. 5)

The total prawn landing at Cochin was estimated at 2549.5 t with an annual catch rate of 47.5 kg per hour as against the estimated total catch of 3465.7 t with the catch rate of 12.9 kg per hour of

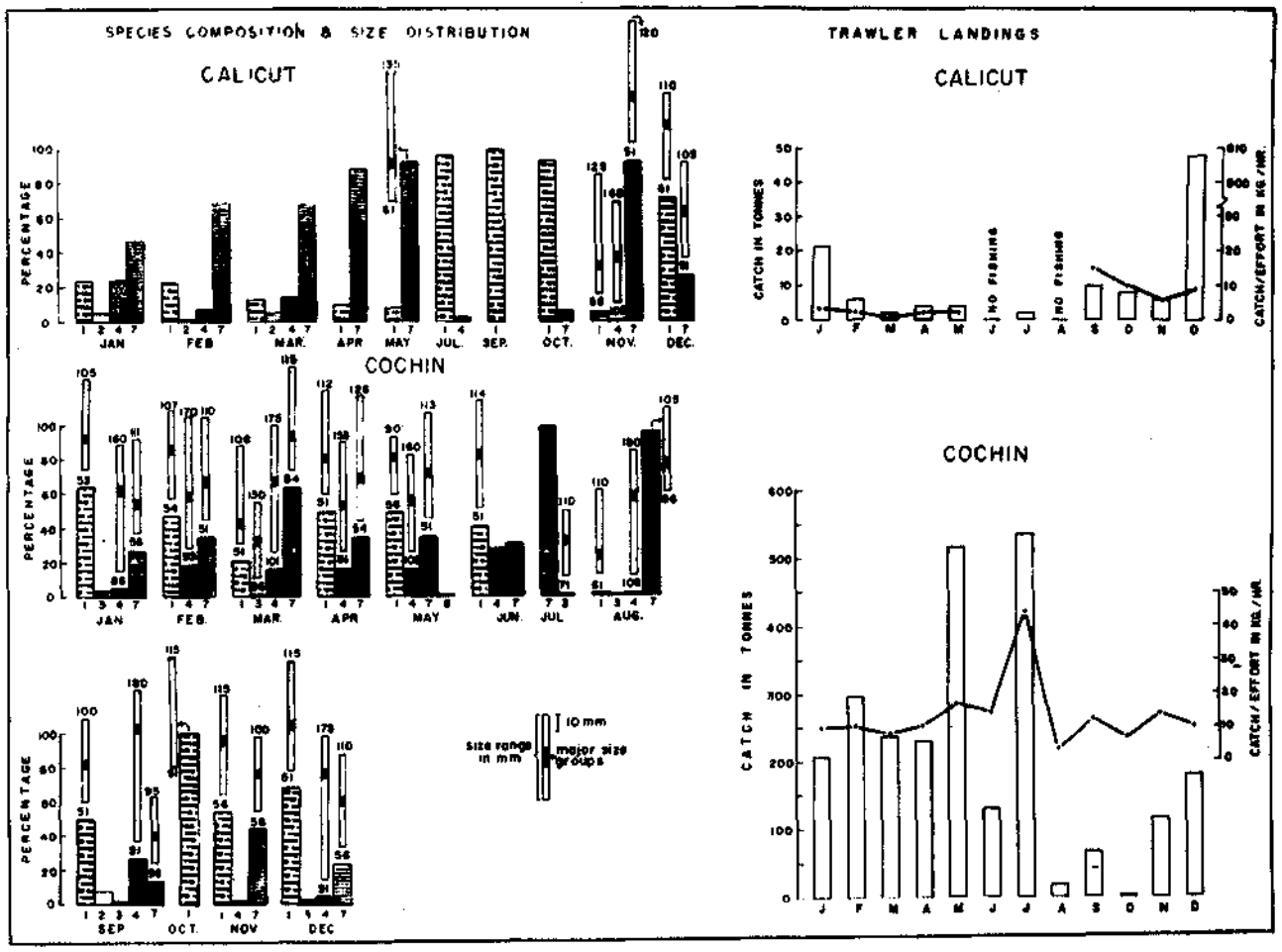


Fig. 5. Catch trend, species composition and size distribution of important species of prawns at Calicut and Cochin during 1981. *1. M.dobsoni, 2. M.monoceros, 3. M.affinis, 4. P.indicus, 6. P.semisulcatus, 7. P.stylifera,* 8. Others.

the previous year. May and July recorded the maximum catches of 517.0 t and 530.0 t respectively. Contrary to the dominance of *M.dobsoni* of the previous year, *P.stylifera* was the leading species, accounting for 49.2 per cent followed by *M.dobsoni* (37.7 per cent) *P.indicus* (10.9 per cent) and *M.affinis* (1.1 per cent). August, September and October months recorded lesser catches with gradual increase during December.

P.stylifera in size range of 51-126 mm was represented by both sexes. The dominant size for male was 76-80 mm group while for female it was 81-85 mm. The peak lnding for *P.stylifera* took place during July with a total 528.7 t. The fishery for *M.dobsoni* was at its peak during May when the total catch of the same species was estimated at 251.9 t. Male and females of *P.indicus* were represented in the size ranges of 91-180 mm and 86-180 mm respectively for both sexes. This species occurred in good numbers during February to June, with a peak in May (75.2 t).

In case of *M.dobsoni* higher percentage of mature females (38.7%) were seen in March but impregnated females (31.0%) were observed during May. Maximum percentage of mature females of *P.stylifera* were observed in May (41.0%) and August (37.0%). *P.indicus* showed higher percentage of matured females in January to April (Fig. 10).

Neendakara-Sakthikulangara (Fig. 6)

The total prawn landings at Sakthikulangara amounted to 9399.3 t with a catch rate of 17.7 kg per hour, accounting for 22.5 per cent of the total marine landing. In the previous year the total landing was 36,557.9 t with a catch rate of 43.1 kg.

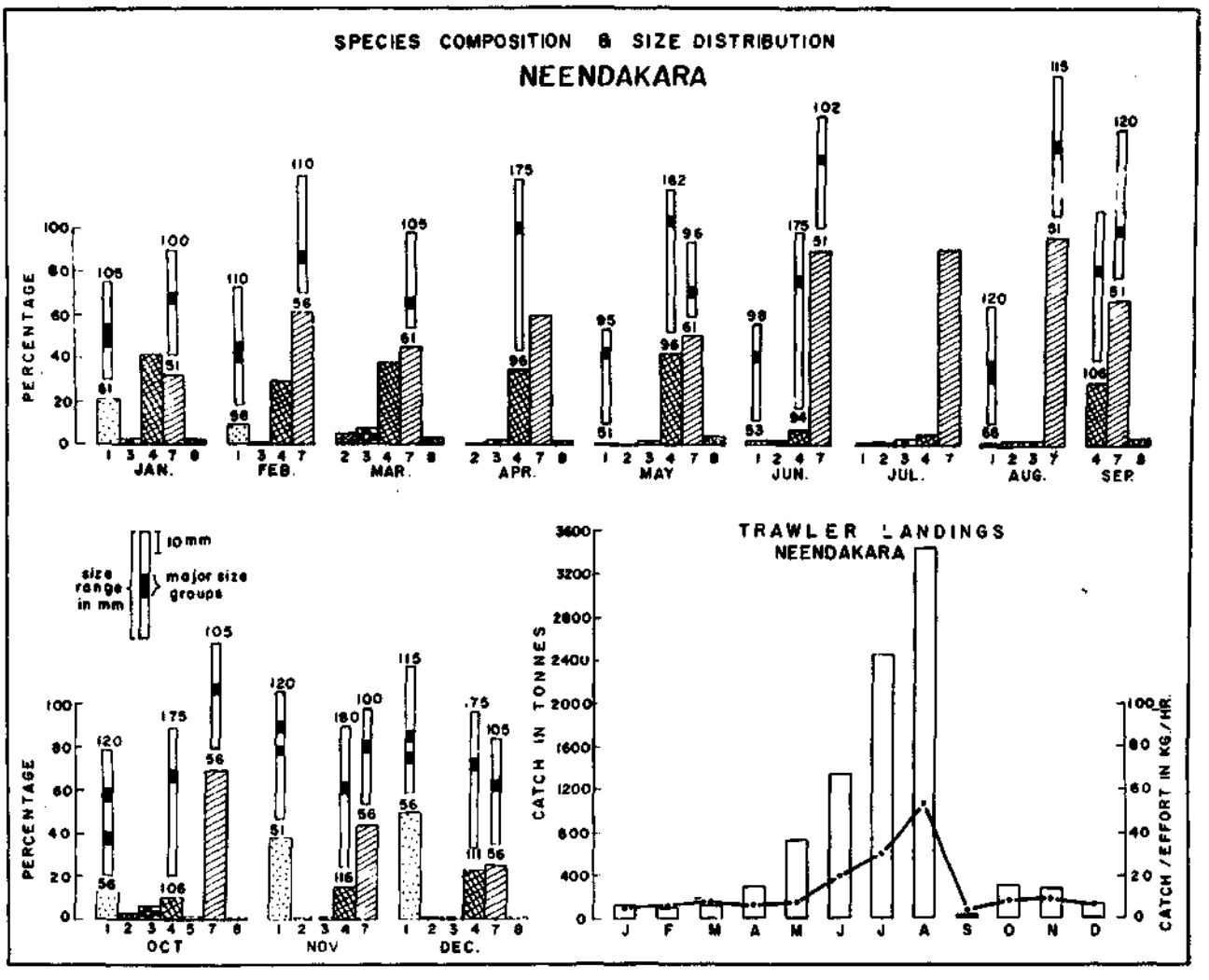


Fig. 6. Catch trend, species composition and size distribution of important species of prawns at Neendakara during 1981. *1. M.dobsoni, 2. M.monoceros, 3. M.affinis, 4. P.indicus, 5. P.canaliculatus, 7. P.stylifera, 8.* Other penaeids.

The reduction in the total catch as well as the CPUE implies that heavy rate of exploitation of the species by using more number of boats is taking place in the area, which obviously calls for the measures of judicious exploitation of the resource by limiting the fishing fleet. The considerable decrease in the landing of *P.stylifera* which declined from 33267.7 t (91.0 per cent) of the previous year to 7815.8 t (83.1 per cent) in the present year, was the main reason for the poor status of the prawn fishery. The species next in order of abundance were represented by *P.indicus* 863.2 t (9.2 per cent), *M.dobsoni* (3.5 per cent), *M.affinis* (2.1 per cent) and *M.monoceros* (1.4 per cent). The males of *P.stylifera* were represented by 51-105 mm sizes and females in 51-115 mm. The modes were at 71-75 mm and 81-85 mm for male and female respectively. *P.indicus* was ranging from 96 to 180 mm with a common mode of 151-155 mm for both sexes. Size ranges for *M.dobsoni* were between 51-102 mm for females. The common mode was at 81-85 mm for both sexes.

During May-June period higher percentage of matured females of *M.dobsoni* (37.41%) and in April-June *P.stylifera* (44-51%) were observed in the month of march. Matured females of *P.indicus* were present during June, August and September (Fig. 10).

Tuticorin (Fig. 7)

The prawn fishery during the year 1981 was very good in comparison to that of the previous year. The total catch amounted to 1508.75 t during the year under report as against 404.03 t in the previous year. Although the peak prawn landing period was restricted to the months of June and July the most important constituent species remained to be *P.semisulcatus* (55%), followed by *P.indicus* (44.2%). Record catch of 1080 t was registered in the month of July. *M.dobsoni* formed about 10% of the prawn landings during January-March. The other species of less importance also occurred during this period.

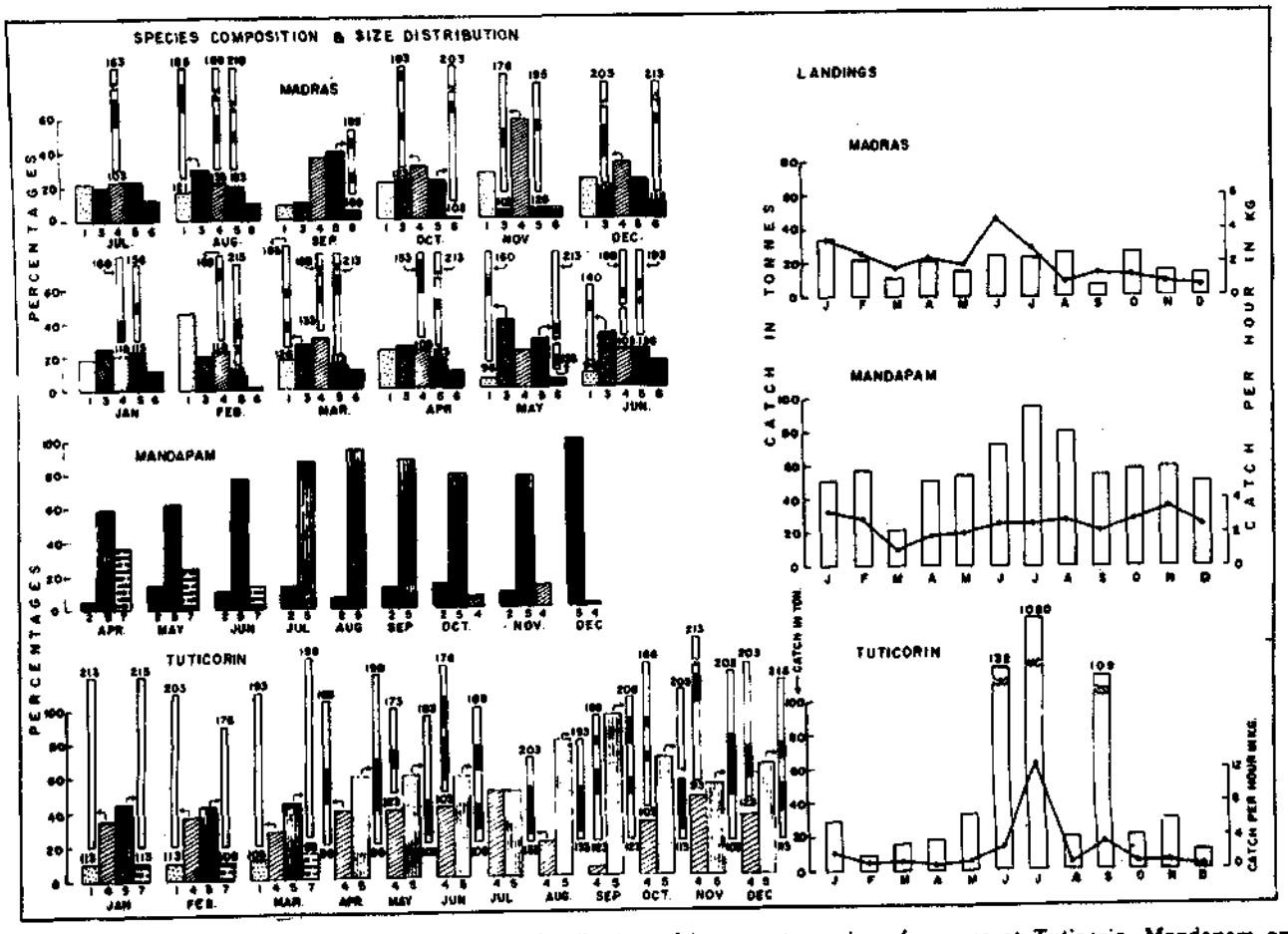


Fig. 7. Catch trend, species composition and size distribution of important species of prawns at Tuticorin, Mandapam and Madras during 1981.
1. M.dobsoni, 2. M.affinis, 3. M.monoceros, 4. P.indicus, 5. P.semisulcatus, 6. P.mondon, 7. Others.

The catch per hour was maximum (12.5 kg) in July while in December it was the least (0.49 kg).

The major size groups represented in the catches of *P.semisulcatus* was 111-195 mm with a size range of 93-218 mm. The spawning activity was at peak during August-November (Fig. 10), during which period 56-91% of the females were with ripe gonads.

Mandapam (Fig. 7)

The prawn landings showed about 1.5 times increase over that of the previous year. Out of the total catch of 707 t about 66.3% was *P.semisulcatuis*. There was considerable difference in the species composition of the catches over the months. During the year under report *M.affinis* which was second in importance formed only 7.6% of the catch while it was about 40% in the previous year.

Although the catch per hour was very poor there was no great fluctuation over the months. It ranged from 0.96 to 3.5 kg, the maximum being in November. The effort also varied from 15914 in January to 37960 in July. The most important constituent of the fishery was *P.semisulcatus* which formed 81.3% of the total prawn catches, the maximum being in the month of July.

Madras (Fig. 7)

The total landings of prawns during 1981 was much more (236.2t) than that of the previous year (173 t). The most important species constituting the fishery was *P.indicus* forming 26.7% of the total landings. This was followed y *M.monoceros* (23.8%), *M.dobsoni* (20.7%), and *P.semisulcatus* (20.2%) in the order of importance. The maximum prawn catch was recorded in January while the percentage of catch of *P.indicus* was highest in November.

The catch per hour ranged from 0.64 kg in December to 4.59 kg in June. The effort expended was maximum in August while it was minimum in September. The major sizes ranged from 116 to 180 mm in *P.indicus* while it ranged from 131 to 190 mm in *P.semisulcatus*. In *M.monoceros* the

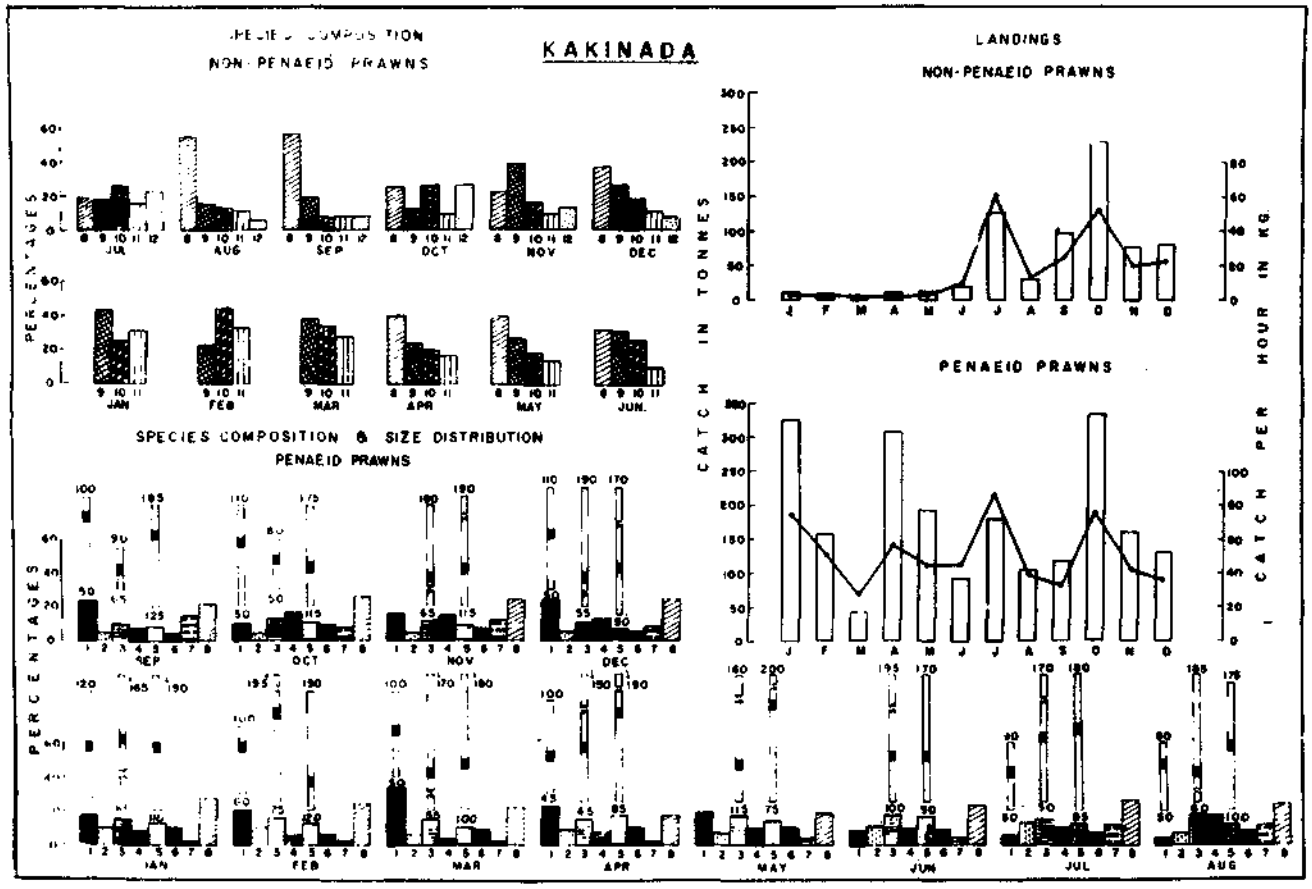


Fig. 8. Catch trend, species composition and size distribution of important species of prawns at Kakinada during 1981. *1. M.dobsoni, 2. M.affinis, 3. M.monoceros, 4. M.brevicornis, 5. P.indicus, 6. P.mondon, 7. P.stylifera, 8.* Other penaeids, *9. Acetes* spp. *10. E.styliferus, 11. N.tenuipes, 12. E.ensirostris, 13.* Other non-penaeids.

major sizes were in the range 126-175 mm.

The spawning activity was maximum during January-April in *P.indicus* and January-March and August-September in *P.semisulcatus*. But in *M.monoceros* majority of females were with fully ripe ovaries during February-March.

Kakinada (Fig. 8)

The penaeid prawn landings of 1981 amounted to 2155.46 t as against 2396.05 t of the previous year. The maximum catch was recorded in the months of October and January. The catch per unit of effort was ranging from 27.4 kg per hour in March to 85.9 kg per hour in July.

The important penaeid prawn constituents of the fishery were *M.dobsoni* (16.0%); *M.monoceros* (14.5%); *P.indicus* (12.3%); *M.brevicornis* (10.7%); *P.monodon* (8.6%); *M.affinis* (8.1%) and *P.stylifera* (6.3%), in the order of abundance.

The important sizes were 66-90 mm in *M.dobsoni*; 66-150 mm in *M.monoceros*, and 116-170 mm in *P.indicus*. The peak spawning seasons were extended from January to April and August to October and December in *M.dobsoni* while in *M.monoceros* it was February-March, May--August and November-December and in *P.indicus* it was from January to April and September.

The non-penaeid prawn catch during the year under report was 707.77 t consisting of 216.4 t of *Acetes* spp., 150.26 t of *Nematopalaemon tenuipes*; 144.22 t of *Exopalaemon styliferus* and 81.46 t of *Exhippolysmata ensirostris*, the remaining being constituted by the less important species. The catch per hour ranged from 1.20 kg in March to 60.15 kg in July.

Waltair (Fig. 9)

The prawn catch during the year was good (768.26 t). The maximum landing was recorded in February (179.06 t) and the lowest in April (5.78 t). The CPUE range was from 1.1 kg per hour in April and May to 5.01 kg per hour in February. *M.monoceros* formed 41.9%, followed by *M.stridu-*

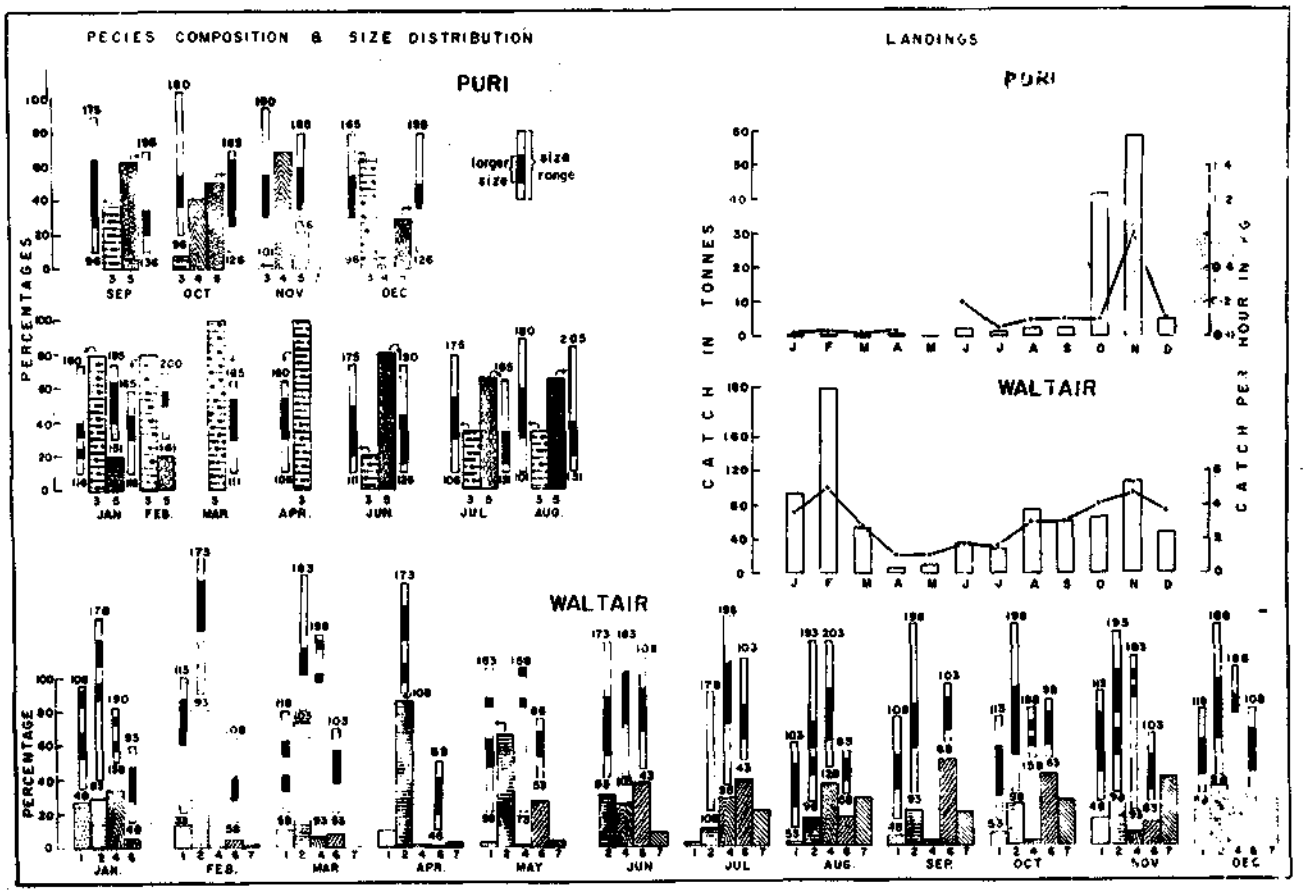


Fig. 9. Catch trend, species composition and size distribution of important species of prawns at Waltair and Puri during 1981. *1. S.crassicornis, 2. M.monoceros, 3. M.affinis, 4. P.indicus, 5. P.merguiensis, 6. M.stridulans, 7.* Others.

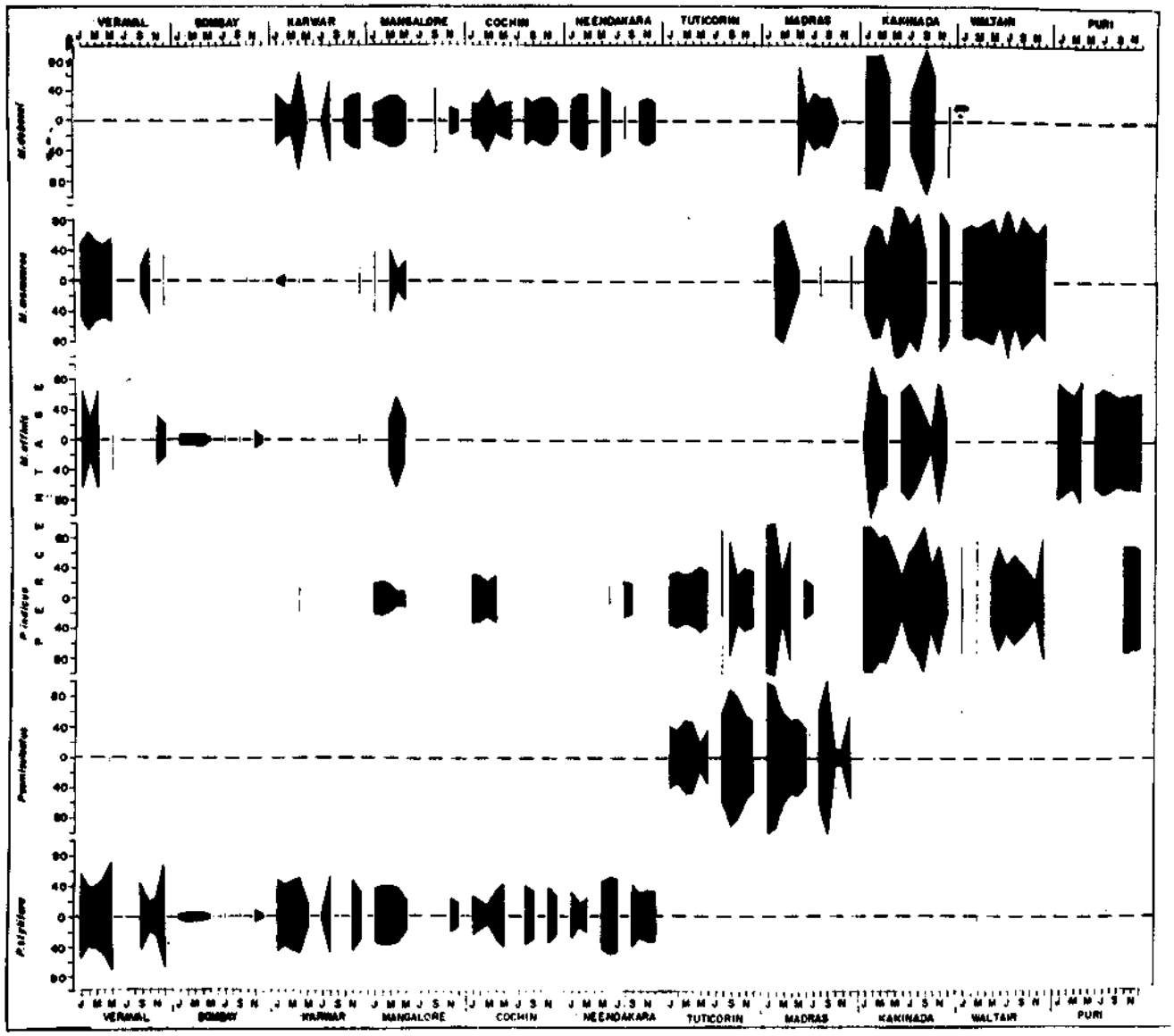


Fig.10. Distribution of the *spawning* population of important species at selected centres during 1981.

lans (18.3%), *P.indicus* (12.4%), *S.scrassicornis* (11.7%),*M.dobsoni* (6.8%) and *P.monodon* (5.3%). The major sizes were from 106 to 165 mm in *M.monoceros;* 136-195 mm in *P.indicus* and 56-100 mm in *M.stridulans.* The maximum percentages of mature females were recorded during January to May-July and September to December in the case of *M.monoceros* while in *P.indicus* it was during the first four months of the year and in Septemeber and in *M.stridulans* majority of females were immature throughout the year.

Puri (Fig. 9)

The prawn landings by indigenous gears showed a marked increase (114.88 t) over that of the previous year (52.07 t), coming close to the landings of 1978. The catches were poor during the first four months, but picked up by August and reached maximum in October-November period. The catch per hour was very poor in most of the months except in October and November (0.87 and 1.13 kg/hr).

The species composition was also slightly changed during the year. *P.mondon* formed a fishery of very little magnitude during October--December. *P.indicus* was also present only during this period. Otherwise, the most important species remained to be *P.merguiensis,* followed by *M.affinis* while the latter was the dominant species in the previous year.

The major sizes were 111-155 mm in *M.affinis*

and 131-190 mm in *P.merguiensis*. In *P.indicus*, 146-170 mm was dominant size.

The females of *M.affinis* were mostly ripe (57.58-79.31%) throughout the year; but the peak spawning period was during the months of January, April and July when more than 70% of the females were with ripe ovaries. In *P.merguiensis*, the condition of maturity was more or less similiar with peak season in January-February, August and December, crossing the 70% mark.

EARNING BY LEARNING AND DOING **

The Krishi Vigyan Kendra (Farm Science Centre) for mariculture was established at Narakkal in December 1976 with a view to transfer the aquaculture techniques developed in the laboratory to the end users. Till date the Kendra has trained more than 1,300 farmers in Prawn and Fish culture. A follow-up survey to evaluate the impact of the training programme and the mode of utilisation of the technology among the trained farmers was conducted for the second time in 1981. The results indicated that 73% of the farmers have utilised the training in one way or another. This article, on the success story of a harijan youth, is one among the many to be published in MFIS.

.....OFFICER-IN-CHARGE, KVK, NARAKKAL

Mr.N.K.Sudhakaran, a harijan youth of Nikathithara house, Narakkal is an agriculture labourer. He is aged 28, married and with a daughter. His family is put up in a tiled house in a ten cents plot amongst prawn filtration fields, not far away from the Government Fish Farm, Narakkal. Sudhakaran, as professed by his ancestors,has been deeply involved in the traditional system of 'Pokkali' rice cultivation and subsequent prawn filtration in the fields of his landlord.

Way back in 1979, one of his well-wishers, who had undergone one month's training in Prawn and Fish culture from the Krishi Vigyan Kendra, Narakkal had an opportunity to casually discuss with Sudhakaran the merits of scientific prawn culture from what was learned and seen during the training programme. Sudhakaran felt sorry for his friend and his remark at that time was that his friend has been brain-washed by the KVK. This harijan youth believed that the scientific prawn culture programme was a highly expensive operation and that only big landlords and moneyed farmers could do it.

In those days, 'naran', *(Penaeus indicus)* culture was just on the move and farmers were suspicious of that operation. The results from two neighbouring canals, where 'naran' culture was conducted made Sudhakaran think and though with hesitation decided to enter into the trade. Thus, he collected some guidance from his friend and stocked a nearby canal of 0.2 ha with 15,000 'naran' seeds. After about three months, the canal was harvested and to his disappointment nothing

**Presented by K.N.Rasachandra Kartha, KVK, Narakkal with permission of N.K.Sudhakaran, Nikathithara House, Narakkal.

except few kg of Tilapia and *Metapenaeus dobsoni* (Thelly) could be obtained.

With the failure of the maiden attempt, Sudhakaran visited the KVK and narrated the whole story. He was advised by the staff to undergo the training course and was selected for the 33rd course of 15 days duration.

After successful completion of the training programme from 8th to 24th November 1979, he fixed a minisluice gate in the leased canal, physically eradicated the predatory animals and stocked it again with 18,000 numbers of 'naran' seeds, collected from nearby backwater areas. Being badly in need of money, the canal had to be harvested after 61 days of culture operation. To his surprise, he could get 136 kg of 'naran' which was sold for Rs. 1,632.00 at the rate of Rs. 12.00 per kg. (Sudhakaran says that the market value of prawns on that occasion was the lowest). Taking into account the effort expended by him and also the cash down payment, the total expenditure worked out to Rs. 1,050.00. Thus he could earn a net profit of Rs. 582.00

Encouraged by this, he determined to continue the programme. During January 1981, Sudhakaran leased in a bigger canal of 0.6 ha and after preparing it, stocked with 60,000 numbers of 'naran' seeds, brought from Puthuvaippu. After waiting for 2 months, the stock was partially harvested for bigger prawns and 60 kg of 'naran' valued at Rs. 1,500.00 was cast-netted. Subsequently on 14th April, 1981, the final harvest was conducted in which 200 kg of 'naran' valued at Rs. 3,420.00 was realised, bringing the total income to Rs. 4,920.00 from a single culture operation. The net income to Sudhakaran was Rs. 3,400.00. He had to surrender the canal back to the landlord as the lease period was to expire on the last week of April.

Mr. Sudhakaran is at present fully engaged in 'naran' farming. When contacted for details of his recent harvest, he had a word of request that some arrangement may be made by the KVK or any other government agencies for the timely supply of 'naran' seeds. According to him, if this is implemented, it would go a long way in the full utilisation of the entire canal water system, hitherto lying idle amongst the coconut groves of Vypeen island.

Literate, with a pass in VII standard, Sudhakaran operates an account in the local bank at present. He is thankful to the KVK for bringing him to the present status where he has a place in the society.

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PROVEN TECHNOLOGY

INDUCED MATURATION OF PRAWNS FOR PRODUCTION OF SPAWNERS FOR HATCHERIES

High lights:

Spawners for hatchery production of prawn seeds were always collected from the commercial fishing grounds where they are known to mature and spawn. The collection of these spawners from the sea has been a serious problem as their availability is not only seasonal and uncertain but their procurement and transport expensive. The researches carried out at the NPCL of CMFRI have made it possible to mature and develop the spawners from the farm reared prawns. Adult prawns taken out from the grow-out ponds of the farm are subjected to unilateral eyestalk ablation and treated in special broodstock development pools where they attain full gonadial development and become ready to spawn. Using this technique several generations of the Indian White prawn *Penaeus indicus*, that have not gone to the sea during any phase of their life cycle, have been grown in the NPCL farm.

Operational details:

Large sized *P.indicus* (over 140 mm in size) caught from the grow-out ponds are acclimatised in 32-34 ppt settled and filtered seawater kept in one ton capcity plastic pools for a day. After acclimatization the females are selected and one eyestalk of each of them is removed by using an electro-cautery apparatus (Fig.1). Mortality caused by the procedure is negligible. The cauterised females and half the number of acclimatised males

Fig.1. Unilateral eyestalk ablation by electric cauterisation at Narakkal Prawn Culture Laboratory.

Fig. 2. Brood stock pools at NPCL

are transferred to the maturation facility for gonadial maturation. The facility consists of 10 ton capacity circular seawater tanks fitted with sub-gravel biological filters with air-lift recirculation arrangement for maintaining the quality of the seawater (Fig.2). The biological filter converts the toxic ammonia excreted by the prawns into relatively harmless nitrates and maintains water quality. The pH of the seawater is adjusted to remain at 8.2. The prawns are fed *ad libitum* with fresh clam meat. Under these conditions the females mature within 3-5 days after eyestalk removal and then they are transferred to the spawning tanks of the hatchery. About 75% of ablated females develop mature ovaries and spawn viable eggs.

Production:

40 females and 20 males of *P.indicus* are kept in a 10 ton capacity broodstock pool. On an average 30 spawners will be ready for spawning in 3-5 days and each spawner will produce not less than 1,00,000 nauplii i.e. 3 million nauplii from each pool. If daily production is required the number of broodstock pools should be increased to 5 or 6. At present, NPCL has 3 broodstock pools.

Inventory and cost:

The maturation facility is to be considered as part of a hatchery meant to produce prawn seeds. The special inventory required for the maturation facility for a daily production of 3 million nauplii consisting of pools, filters, compressors,pumps, chemicals and testing equipments will cost around Rs. 0.5 million; the land and building will cost

around Rs. 0.5 million and contingencies including salary component, labour, maintenance, feed, seawater pumping cost, etc. will cost around Rs.0.5 million; totalling to about Rs.1.5 million. However this cost can be considerably reduced when the project is undertaken as part of a hatchery project.

Estimated cost of production:

It is difficult to estimate cost of production in view of the fact that the broodstock pools form part of a hatchery utilizing many of its general facilities. However the production cost per spawner may not exceed Rs.5.

Prospects:

A maturation facility, as an integral part of the hatchery, ensures a steady supply of spawners and helps efficient planning of hatchery operations to produce prawn seeds on a large scale. In a developed state it may be possible to sell spawners to nearby hatcheries or even sell newly hatched nauplii to those having only rearing facilities.

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NEWS-INDIA AND OVERSEAS

Stranding of a sperm whale at Tranquebar

Sperm whale, *Physeter macrocephalus* Linnaeus, which is a synonym of *P.catodon,* the largest of the toothed whales is oceanic and cosmopolitan in distribution. They are found in Atlantic, Pacific and Indian Oceans. The earlier records of the species from Indian seas is mentioned in the report on a stranded young specimen from near Quilon in *Mar. Fish. Infor. Serv. T & E Ser.* 25 p. 14.

On 8th June, 1982, evening at 3 p.m. the fishermen at Pudupatinam, near Tranquebar noticed a whale in the sand silt surf region struggling to get back into the sea. The animal was making some distress calls and blood mixed with water was oozing out through the dorsal slit. Some fishermen tied the animal to a mechanised boat and towed it to the shore, where it died after 12 hours.

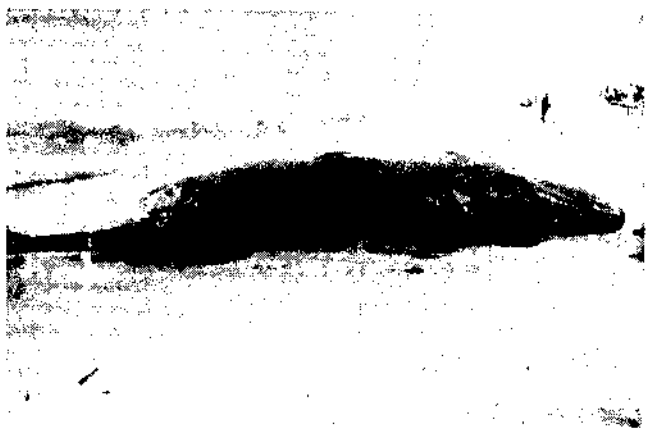

Fig 1. Stranded sperm whale at Tranquebar.

The stranded whale was found to be an young male measuring 9.06 m (Fig. 1), estimated to be five years old and weighing about 6 tonnes. Although whales are known to have good sense of direction using sonar, they may yet find themselves stranded occasionally while pursuing their prey in shallow areas and gently shelving beaches due to some error in navigation.

The sperm whale has massive barrel like head, which is blunt and accounts for about a third of the animal's length and behind it the body tapers to the tail flukes. The lower jaw is very narrow and does not reach the end of the snout. On the lower jaw, there are two rows each of fourteen unerupted and six erupted teeth. The upper jaw is devoid of functional teeth and it carries few (4 to 5) rudimentary teeth in the gum which is tough and rubbery with a number of sockets into which the teeth of the lower jaw fit when the mouth is shut. The blow hole lies near the front of the forehead. The colour of the whale was jet black with flippers lighter in shade. The body measurements of the specimen are given below:

Morphometric Characters	**Measurement(cm)**
Total length (Snout to the tip of caudal)	906
Standard length (Snout to the caudal peduncle)	819
Fork length (Snout to notch of caudal flukes)	879

Tip of snout to origin of dorsal fin	302
Length of dorsal fin base	57
Tip of snout to anterior insertion of flipper	269
Flipper length	36
Outer curvature length of flipper	52
Maximum breadth of flipper	39
Tip of snout to bifurcation origin of lower jaw	142
Notch of flukes to centre of anus	190
Tip of snout to blow hole	134
Breadth of snout	106
Length of upper jaw	131
Length of lower jaw	128
Length of blow hole	15
Breadth of blow hole	5
Tip of snout to centre of eye	195
Eye diameter	8
Tip of snout to centre of anus	549
Preorbital length	195
Distance from centre of anus to caudal fork	190
Anus length	11
Anus breadth	6
Tip of snout to origin of genital organ	465
Length between genital region and anus	64
Length of penis	77
Diameter of the penis at the base	54
Diameter of the penis at the middle	27
Diameter of the penis at the tip	7
Number of rudimentary teeth in the upper jaw	5
Number of erupted teeth in the lower jaw	12
Number of unerupted teeth in the lower jaw	28
Height of the body	241
Body depth near head region	448
Depth at origin of flipper	482
Depth at origin of genital region	434
Depth at caudal peduncle	202
Estimated weight	6 tonnes

On the eighth day of its stranding, the whale was cut open. The stomach contents consisted of 158 beaks of squids, 15 undigested squids and other semidigested sea grasses. About 50 litres of oil was extracted from the blubber from the body collected by the Tamil Nadu Fisheries Department, Tuticorin. The whale was burried in order to retrieve the skeleton for the Museum of the Mandapam Regional Centre of Central marine Fisheries Research Institute, Mandapam Camp.

Reported by P. Nammalwar and V. Thanapathi.

Baby lobsters from France released in the Mediterranean

The first batch of 10 month old lobsters, numbering about 25,000 were released in the Mediterranean Sea during this year. The baby lobsters, young ones of the European lobster *Homarus gammarus*, came from the Ile d' Yeu hatchery in southern Brittany and were released in the Bouches du Rhone area as part of the region's fishery and aquaculture programme.

French scientists involved in the work preferred midday for release of the lobsters while their British counterparts working on the project earlier favoured night time for release as they considered darkness as a protection against immediate predation.

Fish Farming International 9(5): July 1982

Fish without sex grows faster

Reports in the journal International Agricultural Development indicate that Scottish scientists at Aberdeen University in U.K. have developed a simple method for sterilising fish which they report would make them grow fatter. The idea is that fish without sex would put all their energy into growth, resulting in more weight for the fish. The technique will allow production of fish double the present size without any change in feeding pattern.

Existing methods for sterilising fish involve direct surgery, which is time consuming,or the use of hormones, which poses health hazard. The researchers took a cue from a fertility disease of bulls involving rapturing of testes. They found that the damaged testes produce chemicals which stimulate the animal's immune system to reject the reproductive organs. Drawing a parallel the scientists ground up the ovaries and testes from fish and injected a small quantity into a young male salmon trout. The experiments showed that the immune system of the young fish rejected the foreign tissue and simultaneously its own sexual organs because of their similarity. The technique was equally effective with young female fish as well. Experiments are in progress to prove the possibility of the faster growth in these sterilised fishes. According to the report of the scientists the technique would hold good for other species of fishes also.

Compiled and prepared by M.J.George, G.Subbaraju and S.K.Dharmaraja.
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