

OBSERVATIONS ON THE GROWTH IN CERTAIN PENAEID PRAWNS
STUDIED IN PRAWN CULTURE EXPERIMENTS
IN PADDY FIELD *

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ABSTRACT

In culture experiments conducted in a paddy field situated in the backwaters of Cochin the growth of the commercially important penaeid prawns in their juvenile sizes was traced. Average growth rates of 0.35 mm, 0.47 mm, 0.38 mm, and 0.49 mm per day in the case of *Metapenaeus dobsoni*, *Metapenaeus monoceros*, *Metapenaeus affinis* and *Penaeus indicus* respectively were obtained. These rates are slightly faster when compared with the growth rates recorded for the different species in their estuarine phases in earlier works. The faster growth rates in the case of two species *Metapenaeus dobsoni* and *Penaeus indicus* in the culture compartment in comparison to that of the control compartment might indicate that these two species are more suited for culture practices.

INTRODUCTION

Penaeid prawns in their juvenile stages are extensively fished from the brackish waters and estuaries all along the coast of India. In Kerala alone nearly 4500 hectares of paddy fields bordering the backwaters are utilised for this purpose. A general account of this fishery and some of the fishery biological aspects were given by Panikkar (1937), Menon (1954), Gopinath (1956), Panikkar and Menon (1956), Kesteven and Job (1957) and George, Mohamed and Pillai (1968). In the past the fishery was very lucrative due to the great demand from Rangoon and other places for the prawn pulp, locally called 'chemmeen parippu'. With the advent of machanised fishery and frozen prawn industry in this region the demand for larger prawns has increased considerably and the larger sizes caught from the paddy fields are also now sorted out and channelled to the freezers. Of late, side by side with the increasing demand from the freezing industry the

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prawn pulp trade has diminished mainly resulting from developments taking place in the countries to which this product was traditionally exported. Thus it has become necessary to find ways for increasing the sizes of prawns caught from the paddy fields so that a larger proportion of the catches could be utilised for freezing and canning. A few experiments were therefore designed and carried out from 1964 to 1966 to determine whether some sort of culturing could be introduced into the present practice of prawn filtration to promote the growth of juveniles before trapping them and to find out their growth rates in this particular environment. The results concerning the former has been reported by George, Mohamed and Pillai (1968) and the results obtained in the rates of growth are reported at present.

DESIGN OF EXPERIMENTS

Details of the field and experiments designed and conducted are given by George, Mohamed and Pillai (1968). The prawns caught from the fields are penaeids in their juvenile stages, namely, *Metapenaeus dobsoni* (thelley chemmeen), *Metapenaeus monoceros* (choodan chemmeen), *Metapenaeus affinis* (kazhanthan chemmeen) and *Penaeus indicus* (naaran chemmeen).

Experiment 1 (February to May 1964) was to determine the growth resulting from culturing the prawns for the entire period of the fishery and to compare the yield with the existing practice of trapping the small prawns. Juvenile prawns were let into both the culture and control compartments with the tide every day. While the prawns in the culture compartment were allowed to grow throughout the season, those in the control compartment were fished at the end of the experiment.

Experiment 2 (January to May 1965) was similar to the first experiment except that the culture compartment was fished at intervals of one month.

Experiment 3 (December 1965 to May 1966) was to compare the yields of the two compartments and both were fished according to the local practice.

In all these experiments regular samples of prawns were drawn from both compartments for recording their composition and size. When experiment did not permit use of the sluice net in the culture compartment, samples were obtained with a cast net having the mesh size as that of the sluice net.

GROWTH

All the species of prawns constituting this fishery are continuous breeders and each has more than one breeding peak in a year (George, 1962; Rao, 1968). Recruitment of these prawns into the fishery of the backwaters

and paddy fields takes place from the recently spawned stock in the sea, through the Cochin and Azhikode bar mouths. Consequently the process of recruitment to these waters is more or less continuous, rendering it difficult to trace the growth rate by following the progression of modal sizes in the catches of the respective species. Nevertheless, by plotting the length frequency in 5 mm length groups, it has been possible to discern a certain amount of progression in the successive modes representing the new recruits to the field in each species. The size frequency polygons relating to the 4 species are shown in figures 1-4. As the differential growth rates of males and females is negligible during the juvenile stages represented in the fishery, the two sexes are combined for the length frequency studies.

Metapenaeus dobsoni (Fig. 1)

Taking the data for the culture field for 1964, it is seen that a mode at 46-50 mm group on 11 February progresses to 56-60 mm in two weeks (a, in Fig. 1). This group then disappears. Another mode appears at 46-50 mm on 5 March and grows to 61-65 mm by 25 April (b), and a minor mode at 36-40 mm on 12 March moves to 56-60 mm group on 11 May (c). In the same field in the next year the modal group at 46-50 mm on 23 March shifts to 66-70 mm by 17 May (d), and a mode at 36-40 mm on 29 January to 51-55 mm on 2 March (e). In 1966 the samples give no indication of growth, except that the modes at 41-45 mm on 20 March and at 51-55 mm on 23 April may represent the same group (f).

Table I. Growth rate of *Metapenaeus dobsoni*

Culture compartment				Control compartment			
Mode	No. of days	Growth in mm	Growth per day in mm	Mode	No. of days	Growth in mm	Growth per day in mm
a	15	10.0	0.667	g	42	15.0	0.357
b	50	15.0	0.300	h	22	10.0	0.454
c	60	20.0	0.333	i	14	10.0	0.714
d	55	20.0	0.363	j	29	5.0	0.172
e	32	15.0	0.468	k	48	10.0	0.208
f	30	10.0	0.333	l	15	5.0	0.333
				m	30	10.0	0.333
Average growth per day			0.372	Average growth per day			0.325

In the control compartment in 1964, the modal group at 41-45 mm on 3 March shifts to 56-60 mm on 15 April (g). Another mode at the same group on 2 April could be seen shifting to 51-55 mm by 24 of that month (h).

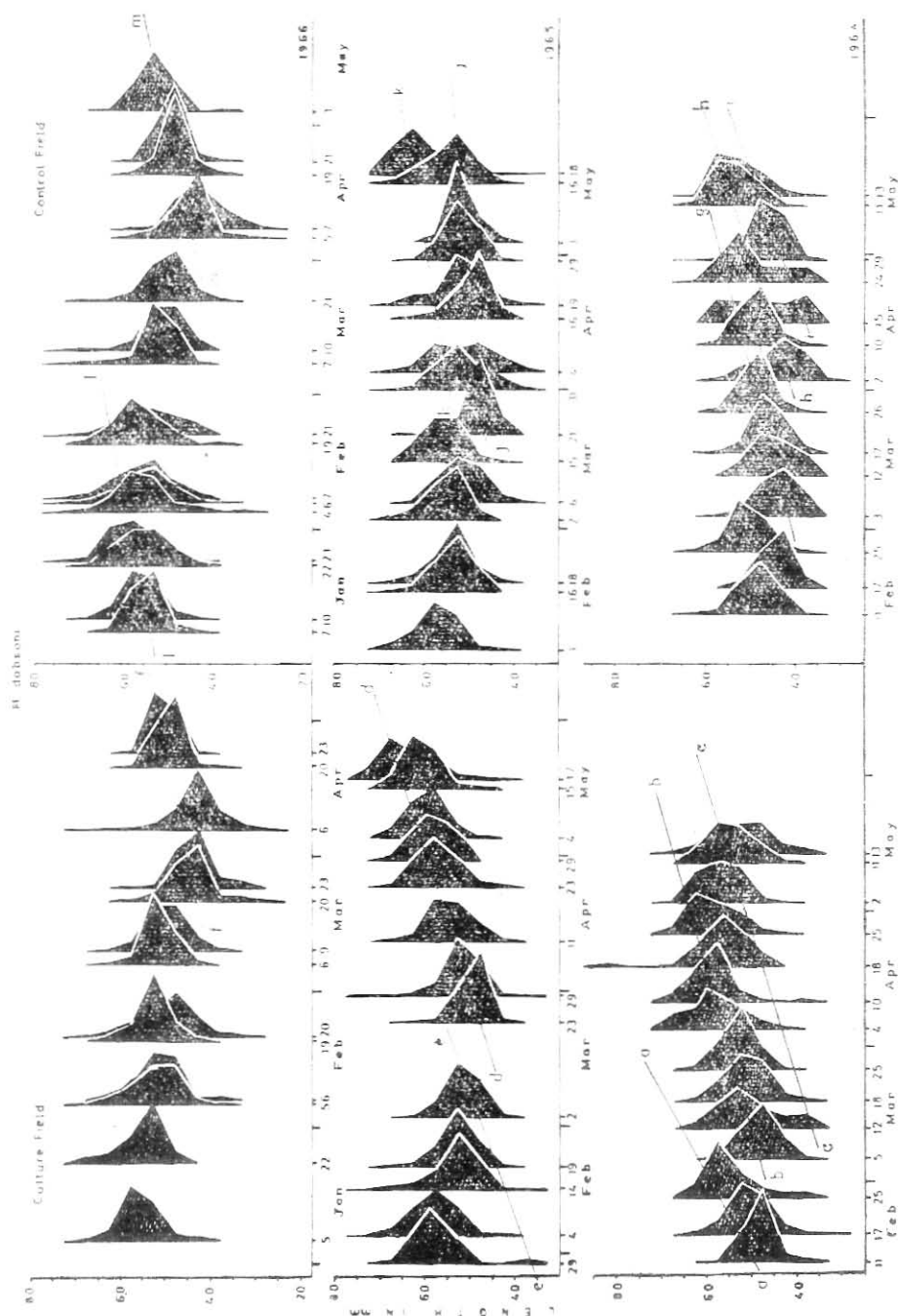


Fig. 1 - Length-frequency distribution of *Metapenaeus dobsoni* in the culture and control compartments, 1964 to 1966.

A third mode at 36-40 mm on 15 April shifts to 46-50 mm on 29 of the same month (i). In 1965 a mode at 46-50 mm on 21 March moves up to 51-55 mm by 19 April (j). A second mode at 51-55 mm on 31 March may be traced to 61-65 mm on 18 May (k). In the next year a modal group at 51-55 mm on 7 January shifts to 56-60 mm by 22 of the same month (l) and another mode at 41-45 mm on 5 April moves to 51-55 mm on 3 May (m). The growth increments indicated by these modal progressions are shown in table I.

The average growth rate of 0.372 per day in the culture field and 0.325 mm per day in the control field noticed here is considerably more than the rate of growth observed by Menon (1951) in the same species for more or less similar size range. The growth per day of these juveniles in these fields is also slightly faster than that recorded from the estuary by Mohamed and Rao (1971) and compares well with the growth of allied species worked out by Hall (1962) in the Singapore prawn pond fishery.

The modal sizes especially towards the latter half of the seasons are higher in the culture field than in the control field in which continuous fishing was carried out. The mode at 66-70 mm was never recorded in the control compartment whereas this group appeared as a mode in the culture compartment towards the end of the second experiment. Menon (1954) observed that the vast majority of prawns of this species do not grow beyond 61-65 mm in this fishery, whereas these groups formed sizable portions of the catches in both culture as well as control compartments during the present experiments. It is significant to note that the larger size group (66-70 mm) did not occur as a mode in the first year's experiment. This is probably brought about by the effect of periodic fishing which reduced mortality caused by overcrowding.

Metapenaeus monoceros (Fig. 2)

In the culture field in 1964 a mode at 51-55 mm on 12 February shifts to 56-60 mm by 25 February (a) and a secondary mode on 17 of the same month at 41-45 mm moves to 71-75 mm on 12 May (b). A mode at 31-35 mm on 5 March is noticed to shift to 46-50 mm group on 18 April (c). In 1965 in the same field one mode at 66-70 mm on 29 January is seen shifting to 71-75 mm on 4 February (d) and another at 46-50 mm on the same day moving up to 66-70 mm by 2 March (e). In the next season the modal group at 51-55 mm on 5 February is noticed to shift to 56-60 mm by 20 February (f), a mode at 36-40 mm on that day progressing to 61-65 mm by 20 April (g) and another mode at 31-35 mm on 9 March moving to 56-60 mm on 23 April (h).

In the control compartment in the first season a mode at 46-50 mm on 3 March shifts to 56-60 mm by 26 of that month (i) and a mode at 51-55 mm

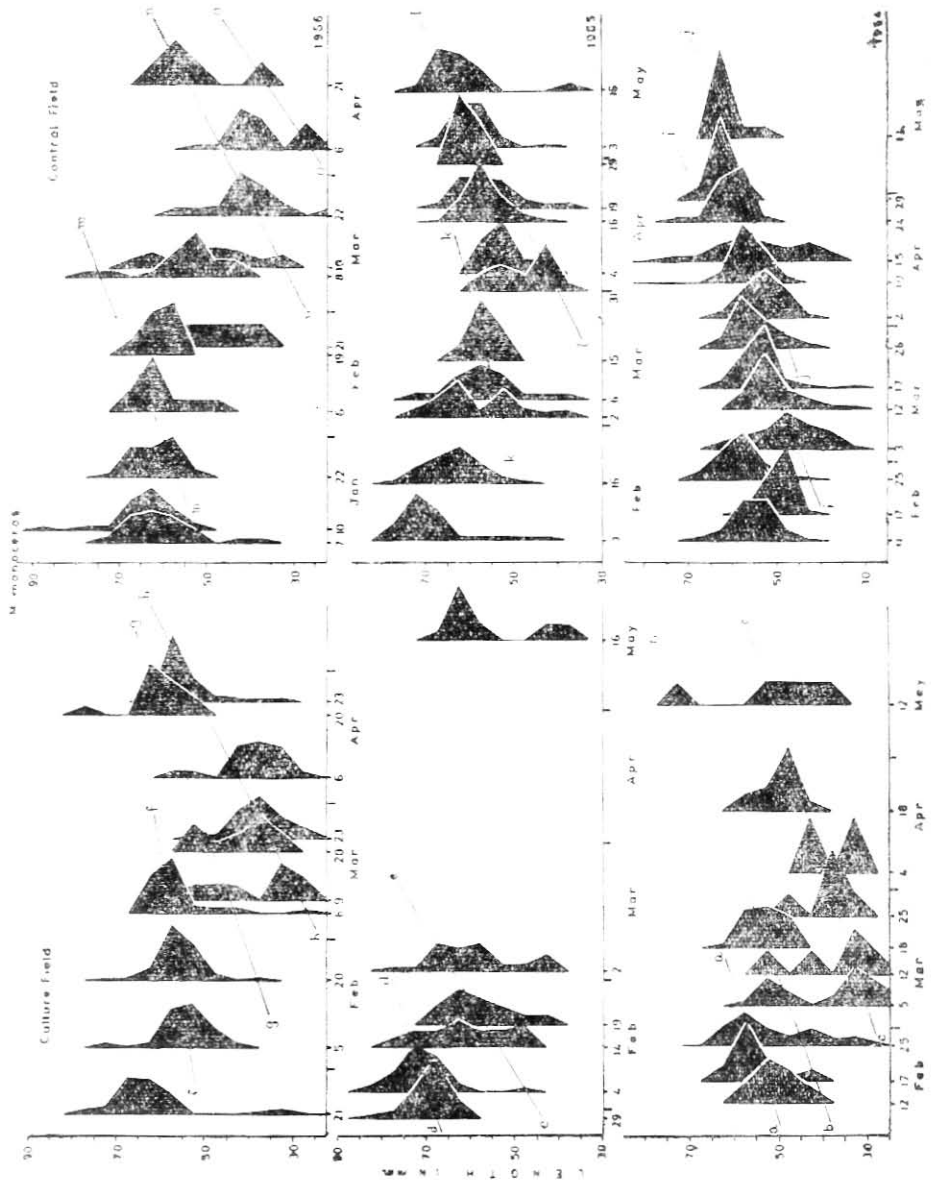


Fig. 2 - Length-frequency distribution of *Matapenaeus monoceros* in the culture and control compartments, 1964 to 1966.

on 2 April to 61-65 mm by 29 of the same month (j). In 1965 two modes could be traced to show some growth progression, namely, one at 51-55 mm on 2 March progressing to 56-60 mm by 15 March and the other at 41-45 mm on 31 March shifting to 66-70 mm by 16 May (k and l). During the 1966 season a mode at 56-60 mm on 22 January is seen shifting to 76-80 mm by 8 March (m). Another mode at 31-35 mm on 10 March moves to 56-60 mm on 21 April (n) and a smaller mode at 21-25 mm on 22 March progresses to 36-40 mm by 21 April (o). The growth rates shown by these shifting modes are presented in table 2.

Table 2. Growth rate of *Metapenaeus monoceros*

Culture compartment				Control compartment			
Mode	No. of days	Growth in mm	Growth per day in mm	Mode	No. of days	Growth in mm	Growth per day in mm
a	13	5.0	0.384	i	23	10.0	0.434
b	84	30.0	0.357	j	27	10.0	0.370
c	44	15.0	0.340	k	13	5.0	0.384
d	6	5.0	0.833	l	46	25.0	0.543
e	26	20.0	0.768	m	45	20.0	0.444
f	15	5.0	0.333	n	42	25.0	0.595
g	59	25.0	0.423	o	30	15.0	0.500
h	45	25.0	0.555				
Average growth per day			0.445	Average growth per day			0.487

The growth rate of 0.445 mm per day in the culture field and 0.487 mm in the control field observed are considerably higher than that of *M. dobsoni*. Being a larger species, this increase in growth rate seems to be reasonable. George (1959) recorded a growth rate of 7.98 mm per month in laboratory reared specimens and 5 mm by tracing the modal progression of this species from the backwater catches. Menon and Raman (1961) also found the same rate of growth of 5 mm per month in the stake net catches of Cochin. The average growth rate per month in the estuary recorded for the species by Mohamed and Rao (1971) is 6.72 mm and according to Rao (1973) for early juveniles of the species the growth rate is 0.32 mm per day. When compared with these records, the present observations indicate an appreciably higher growth, although they fall short of the fast growth rates varying from 15 to 25 mm per month for the species recorded by Subrahmanyam (1973) from Adyar and Ennore estuaries when they remain closed. The average growth

rates in the two compartments varied, that of the culture compartment remaining low. This is in contrast with the condition observed in *M. dobsoni* which showed slightly better growth rate in the culture compartment.

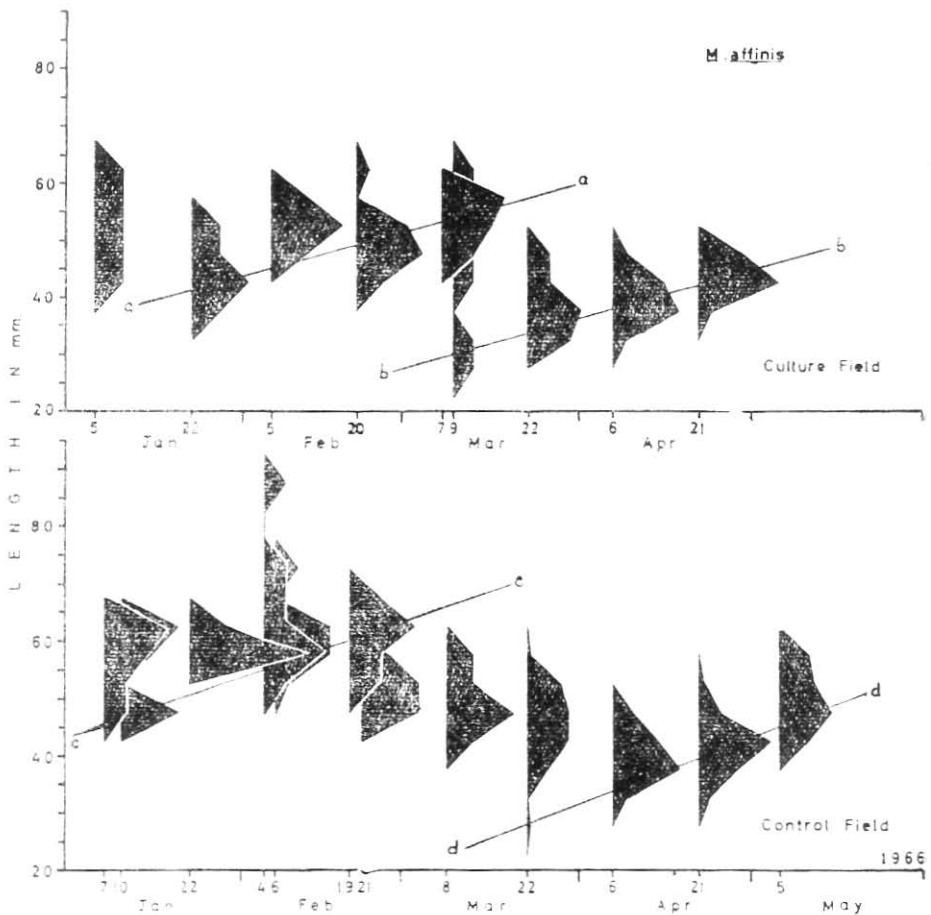


Fig. 3 - Length-frequency distribution of *Metapenaeus affinis* in the culture and control compartments, 1966.

Metapenaeus affinis (Fig. 3)

The percentage composition of this species in the catches being very low throughout the seasons, the representation of the species in the samples analysed is very limited, rendering it difficult to trace the progression of the modal groups in the length frequency curves. However, progression of modes could be traced to a certain extent in the 1966 season (Fig. 3). In the culture compartment, a mode at 41-45 mm on 22 January shifts to 56-60 mm

by 7 March (a) and another mode at 26-30 mm on 9 March moves to 41-45 mm by 21 April (b). In the control compartment also two modes could be traced, one at 46-50 mm on 10 January shifting to 61-65 mm on 19 February (c) and the other at 26-30 mm on 22 March progressively moving to 46-50 mm by May (d). The rate of growth depicted by these modal shifts are shown in table 3.

Table 3. Growth rate of *Metapenaeus affinis*

Culture compartment				Control compartment			
Mode	No. of days	Growth in mm	Growth per day in mm	Mode	No. of days	Growth in mm	Growth per day in mm
a	44	15.0	0.340	c	40	15.0	0.375
b	43	15.0	0.349	d	43	20.0	0.465
Average growth per day			0.345	Average growth per day			0.422

The average growth rate of the species is slightly higher in relation to that of *M. dobsoni* particularly in the control compartment. As in *M. monoceros* the growth in the control field was observed to be faster than that in the culture field. Mohamed and Rao (1971) recorded an average monthly growth rate of 8.25 mm for the species in the estuarine environment, but George, Raman and Nair (1968) record a growth of 4-5 mm in sizes above 120 mm in total length from the marine catches off Cochin. The growth rate obtained in the present experiments appears to be much faster.

Penaeus indicus (Fig. 4)

In the culture field in 1964 modes at 51-55 mm and 86-90 mm on 12 February shift to 96-100 mm on 2 May (a) and 126-130 mm by 11 May (b) respectively. Another mode at 101-105 mm on 17 February shifts progressively to 126-130 mm by 18 April (c) and one mode at 41-45 mm on 25 March moves to 66-70 mm on 11 May (d). In the next year a mode at 91-95 mm on 19 February shifts to 121-125 mm on 4 May (e) and the modal group at 111-115 mm on the same day can be seen shifting to 126-130 mm by 23 March (f). Another mode at 71-75 mm on 29 March may be traced to 96-100 mm group by 15 May (g). In 1966 season a mode at 111-115 mm on 22 January is seen to move to 121-125 mm by 19 February (h) and one mode at 76-80 mm on 5 February can be traced to 98-100 mm on 22 March (i). Another mode at 51-55 mm on 19 February progressively shifts to 81-85 mm on 6 April (j) and the mode at 36-40 mm on 6 March moves up to 61-65 mm by the same date of the next month (k).

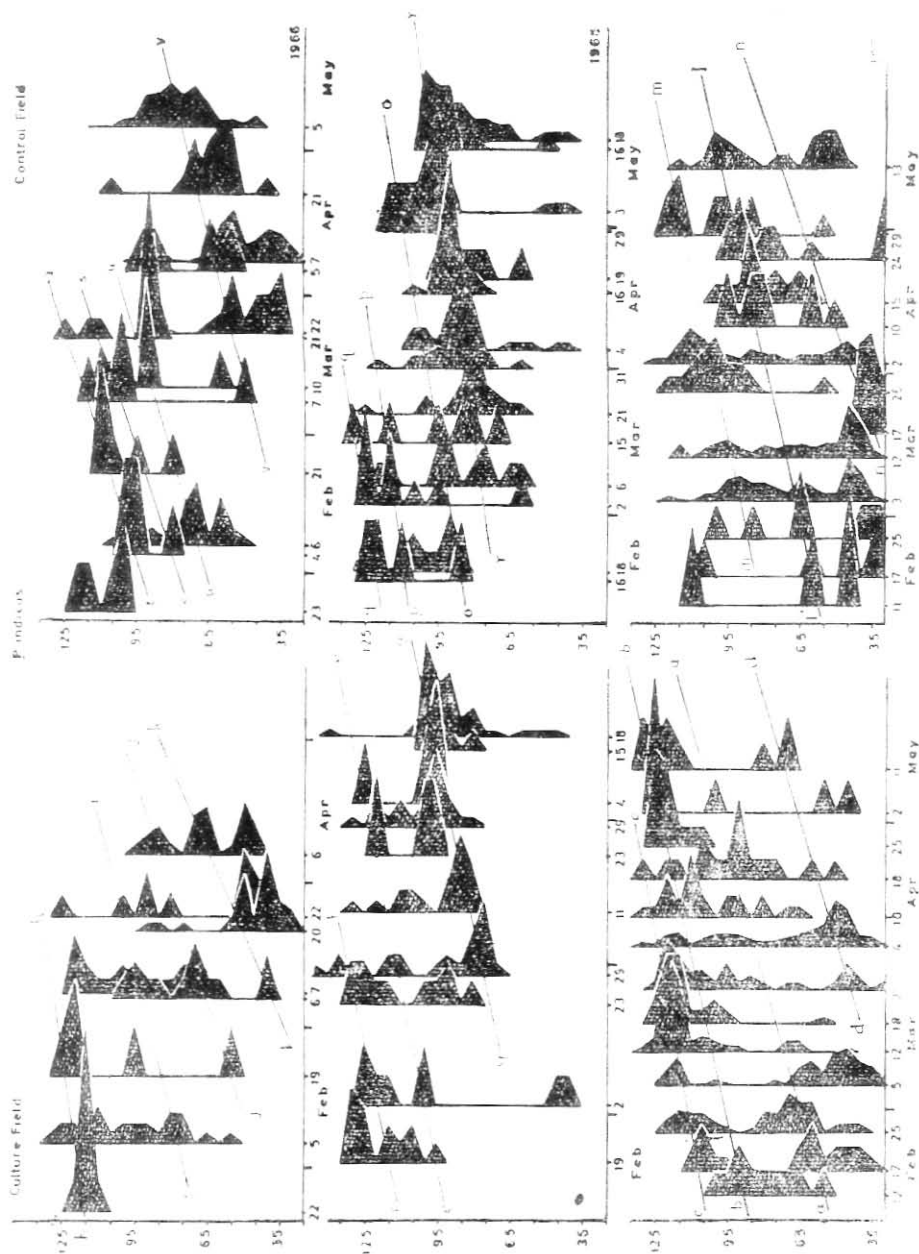


Fig. 4. Length-frequency distribution of *Penaeus indicus* in the culture and control compartments, 1964 to 1966.

In the control compartment in 1964 three modes can be traced to show growth, namely, one mode at 56-60 mm on 17 February shifting to 96-100 mm on 13 May (l), a second mode at 81-85 mm on 25 February reaching 111-115 mm by 29 April (m) and a third at 31-35 mm on 17 March moving to 66-70 mm on 13 May (n). In the next year 4 modes may be traced for growth progression. Of these 3 modes come into the picture on 16 February at 81-85 mm, 106-110 mm and 116-120 mm and these shift to 106-110 mm, 116-120 mm and 126-130 mm respectively by 29 April, 31 March and 15 March (o, p and q). The fourth mode is at 71-75 mm on 6 March and that shifts to 96-100 mm on 16 May (r). In 1966 also 4 modes show some progressions. The first two appear on 4 February at 76-80 mm 91-95 mm and they are noticed to shift to 111-115 mm and 121-125 mm groups respectively by 21 March (s and t). The other two are, one appearing at 66-70 mm on 6 February moving to 86-90 mm on 10 March (u) and the other seen at 46-50 mm on 7 March progressively shifting to 76-80 mm on 5 May (v). The growth pattern that is discerned out of these modal progressions are given in table 4.

Table 4. Growth rates of *Penaeus indicus*

Culture compartment				Control compartment			
Mode	No. of days	Growth in mm	Growth per day in mm	Mode	No. of days	Growth in mm	Growth per day in mm
a	80	45.0	0.563	l	86	40.0	0.465
b	89	40.0	0.449	m	64	30.0	0.469
c	61	25.0	0.410	n	57	35.0	0.614
d	47	25.0	0.532	o	72	25.0	0.347
e	75	30.0	0.400	p	43	10.0	0.233
f	33	15.0	0.455	q	27	10.0	0.370
g	47	25.0	0.532	r	71	25.0	0.352
h	28	10.0	0.357	s	45	35.0	0.778
i	45	20.0	0.444	t	45	30.0	0.667
j	46	30.0	0.652	u	32	20.0	0.625
k	31	25.0	0.806	v	59	30.0	0.508
Average growth per day			0.498	Average growth per day			0.482

As *Penaeus indicus* is the largest growing species constituting this fishery, it shows the fastest average growth rate among the paddy field prawns. The growth rate, however, is relatively slow in the control compartment as was observed in the case of *M. dobsoni*. Hall (1962) found a growth

rate of 0.102 mm per day in carapace length in the same species in the Singapore prawn pond catches. According to his own conversion ratio this amounts to a growth rate of 0.428 per day in total length. Although not very appreciable, the species seems to have a slightly faster growth rate in the paddy field prawn fishery of this area, comparing well with the average rate of growth of 14.36 to 16.0 mm per month recorded for the land-locked *P. indicus* population of Ennur and Adyar estuaries by Subrahmanyam (1968).

GENERAL REMARKS

Growth rate of all the species represented in this fishery was faster than that observed in the respective species in the trawling grounds off Cochin (George, Raman and Nair, 1968). As the trawl fishery is constituted exclusively by adult prawns, the observed difference in growth rate may be attributed to normal decreases associated with adult stages. But taking into consideration the growth rate in the estuarine phase only, the present results show a faster rate of growth when compared to all the growth results available from the same estuary in the case of all these species (Menon, 1951; 1954; George, 1959; 1970a, 1970b, 1970c; Menon and Raman, 1961; Mohamed, 1970; Mohamed and Rao, 1971; Rao, 1973). Still faster growth rates have been recorded in allied species from other regions. According to Gunter (1950) and Williams (1955) the growth rate is 1.2 mm per day in the case of *Penaeus setiferus* and in the same species Lindner and Anderson (1956) recorded a daily growth of approximately 1.33 mm. In the Philippine prawn culture ponds Delmendo and Rabanal (1956) observed a growth of 0.63 mm per day in *Penaeus monodon*. George (1961) reported a growth rate of 1.39 mm per day in the brown shrimp *Penaeus aztecus* from the estuarine environment of Louisiana. Pond-reared *P. aztecus* showed a growth rate ranging between 0.9 mm and 1.5 mm per day from postlarval stages onwards (Wheeler, 1966). In the case of *Metapenaeus monoceros* a fast rate of growth varying from 15.0 to 25.9 mm per month was recorded by Subrahmanyam (1973) from Adyar and Ennore estuaries at the time when they remain land-locked.

A comparison of the growth rates attained by these prawns in the culture and control compartments shows that *M. monoceros* and *M. affinis* exhibit a lesser growth rate in the culture compartment while the other two species seem to grow faster in the same field. This difference in growth rate indicates that the factors existing in the culture field were more conducive to a fast growth of the latter two species. The faster growth rate and adaptability to the field conditions exhibited by these two species suggest the possibility of introducing culture practices with advantage in the paddy field prawn fishery of this region, particularly in respect of *M. dobsoni* and *P. indicus*.

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