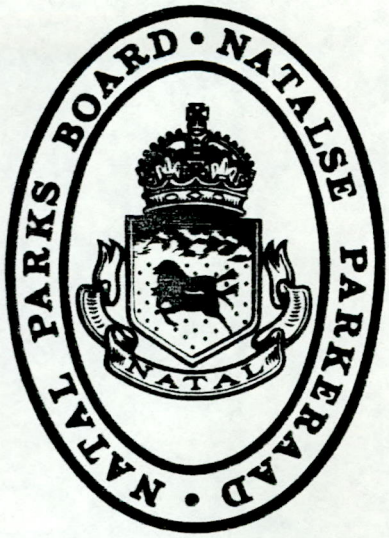

Author RIPLEY B S

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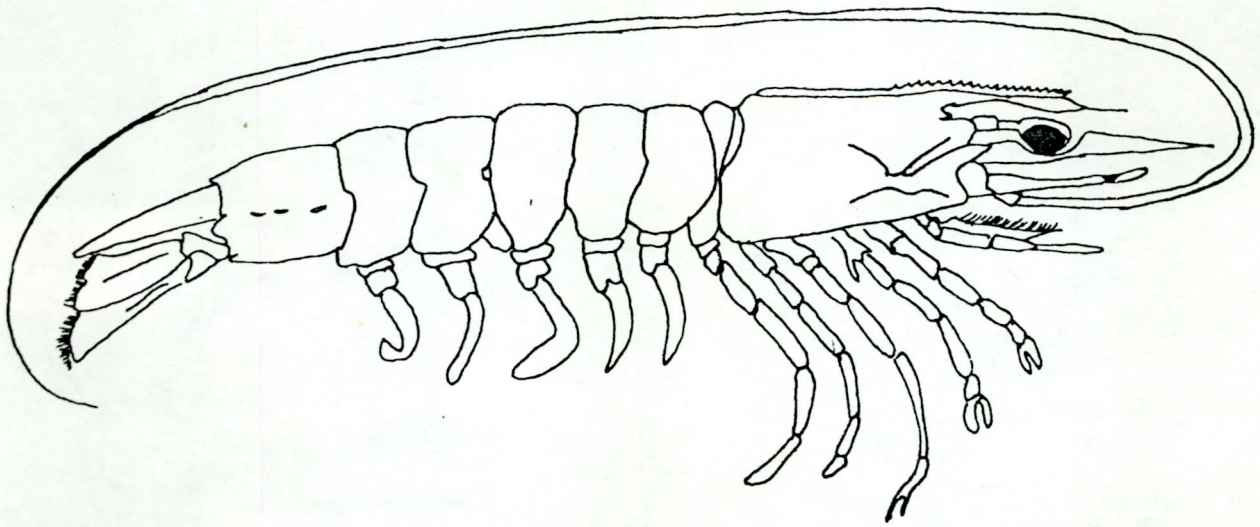


68 ℃
Presumably well arranged + argued.

B. S. Ripley

C O N T E N T S.

INTRODUCTION

The life cycle of Penaeus japonicus (Bate) includes marine adults whose offspring migrate, as larvae, to estuaries to develop and grow before returning to the sea (de Freitas, 1980).
Juveniles are found in estuaries along both the Natal and Mozambique coasts preferring sandy, intertidal flats, where temperature ranges are much broader than those encounted in the sea. Temperature ranges of 13.5°C to 30°C have been recorded at St. Lucia Narrows (Hay, 1985).

Penaeus japonicus is a nocturnal detrital feeder whose diurnal rhythms may be entrained by light and/or tides and may be influenced by feeding (Moller and Jones, 1975). Both temperature and salinity have been found to affect levels of activity (Gaven, 1986). Previous temperature studies on Penaeus japonicus have involved the direct transfer of prawns from holding tanks to tanks at specific temperatures (Gaven, 1986). Gavens' work also investigated the effects of gradually decreasing temperature. The present study augments his work by investigating the affect of gradually increasing temperature.

The St. Lucia system is of special interest as although large numbers of Penaeus japonicus larva have been caught entering the narrows, the numbers of juveniles caught is extremely low (Forbes, 1986). The reason for this disappearance is not known. A study of the temperature limits of Penaeus japonicus may contribute to answering this problem.

METHODS/.....

METHODS

1) SPECIMEN COLLECTION

Penaeus japonicus were seine netted in Durban bay. The exact location where prawns were netted is indicated in Figure 1. The net had a mesh size (stretched) of 3 cm and a purse mesh size of 0.75 cm. The net was dragged through 30 cm to 40 cm deep shallows, which was found to be the most productive regions. Prawns were transferred to buckets and aerated with battery driven pumps. Twenty prawns (carapace lengths 8 to 25 mm) were transferred directly to experimental tanks at 20°c and allowed to acclimatise to a 12 hour dark:12 hour light regime for one week before any experiments were started.

2) EXPERIMENTAL APPARATUS

The experimental set up is illustrated in Figure 2. Two 60cm x 30cm tanks, 30cm deep, each with a thermostatically controlled heater/stirrer, an airlift sandfilter system and a 8cm deep substratum, were set up. Water depth was 22cm and salinity was kept at a constant 34°/oo, being checked with an optical salinometer. Tanks were set up in a constant temperature room at 10°C. Prawns were subjected to a reversed light/dark cycle of 12L:12D, such that 7am to 7pm were the hours of darkness. Illumination was supplied by four 60w incandescent light bulbs, 2 per tank. Dim constant red wavelength light supplied by 2 fluorescent strip lights was used for observation.

Water currents are known to affect prawn behaviour (Rulifson & Copeland 1980) thus the stirrers' exhaust stream was dispersed by a circular perforated tube at the water surface.

Temperatures/.....

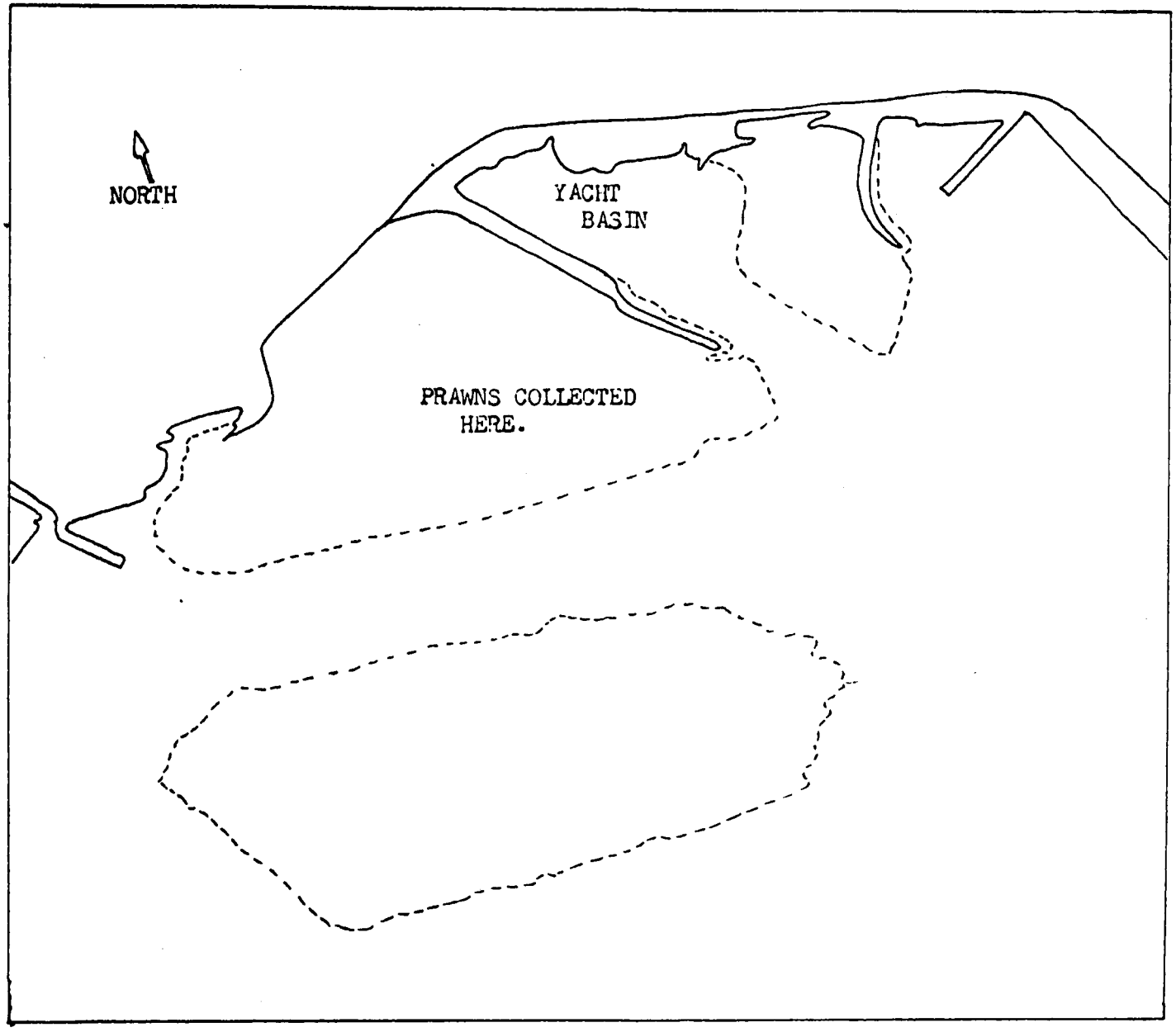


FIG 1 DURBAN BAY (29 52'S,31 1') SHOWING SANDBANKS WHERE PRAWNS WERE SEINE NETTED (AFTER GAVEN,1986).

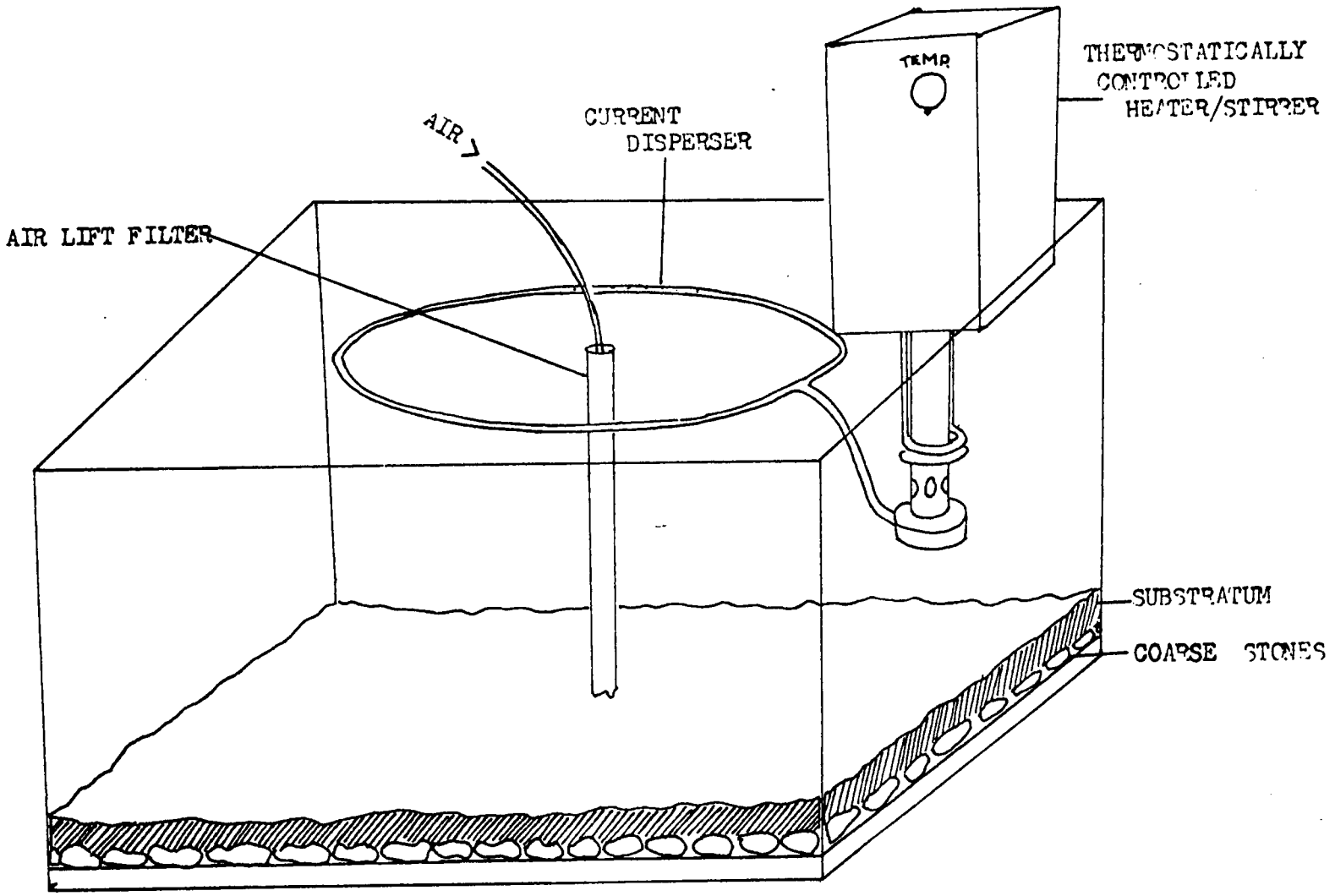


FIG 2 EXPERIMENTAL APPARATUS DESIGNED TO KEEP CONTROLLED TEMPERATURES WITHOUT THE EFFECTS OF WATER CURRENTS. PERFORATED CIRCULAR TUBE WHICH DISPERSES CURRENT IS EVIDENT.

Temperatures recorded at various positions and depths in the tanks showed that no temperature layering developed.

3) FEEDING AND BEHAVIOUR.

Preliminary observations were made on the behavioural activities of Penaeus japonicus and on the effects of feeding them. Prawns were kept at 20°C and fed 1 g of finely chopped squid at 11am daily. The food was completely consumed in 24 hours.

Behaviour was recorded for 5 minutes of each hour, from 7am to 7pm. Six activity categories as defined by Gaven (1986) were recognised :- (1) Feeding; (2) Foraging; (3) Swimming; (4) Walking; (5) Motionless; (6) Burrowed into substratum. Observations were made over six consecutive days.

4) RESPONSE TO TEMPERATURE INCREASE

Temperature was increased in 2°C increments every 2nd day from 20°C to 36°C. After each temperature increase prawns were allowed to acclimatise for 1 day and observations made on the second day. Prawns were not fed on observation days. Results were recorded hourly and any deaths were noted at the start of each day, prawns being taken as dead if either the scaphognathites had stopped beating or the animals had turned pink.

RESULTS/.....

FIG.3 PERCENTAGE EMERGED

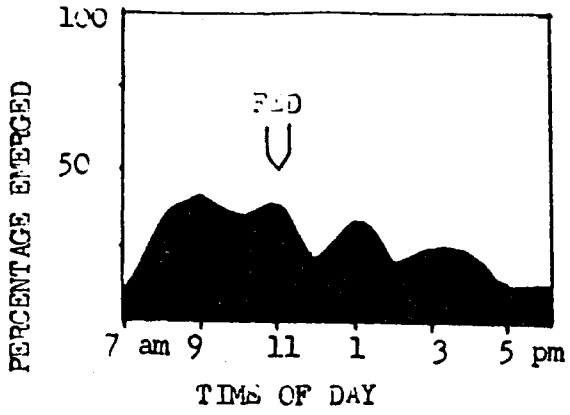


FIG.4 PERCENTAGE FEEDING

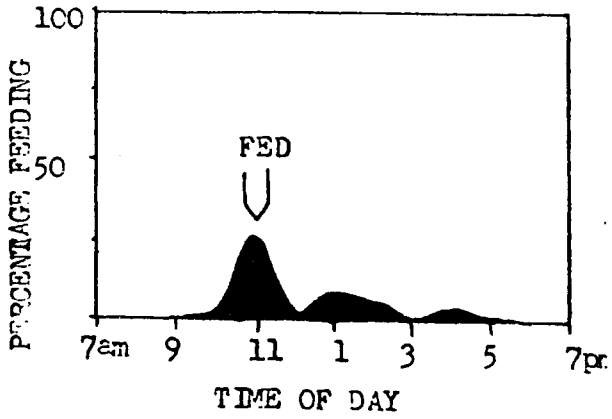


FIG.5 PERCENTAGE FORAGING

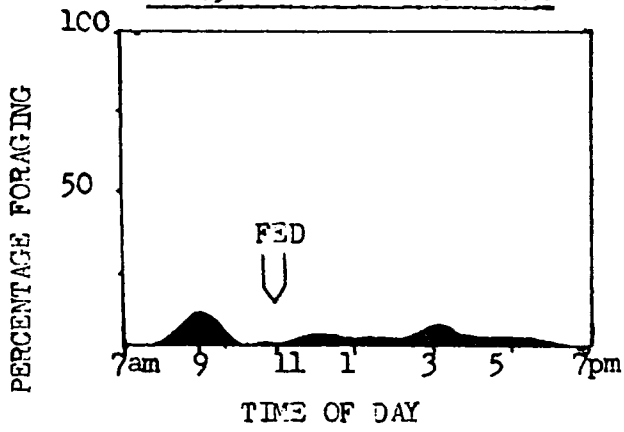


FIG.6 PERCENTAGE SWIMMING

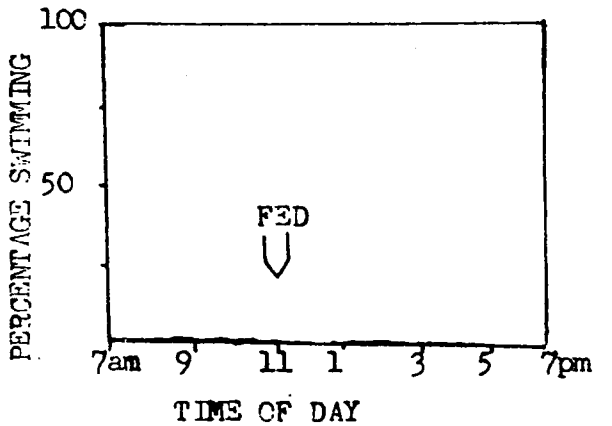


FIG.7 PERCENTAGE WALKING

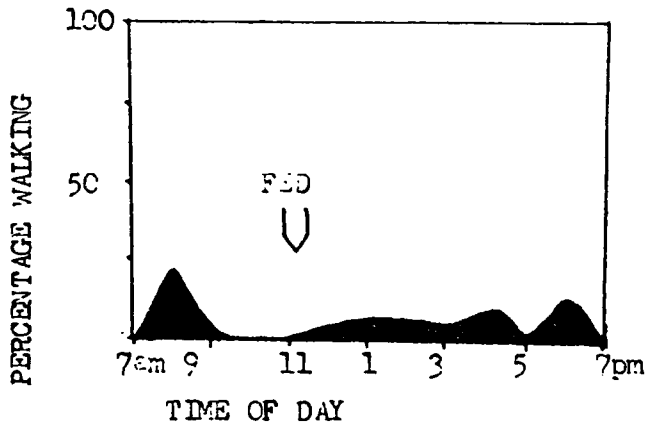


FIG.8 PERCENTAGE MOTIONLESS

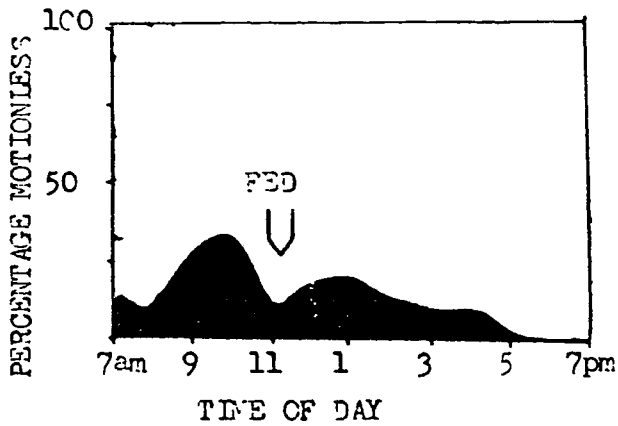
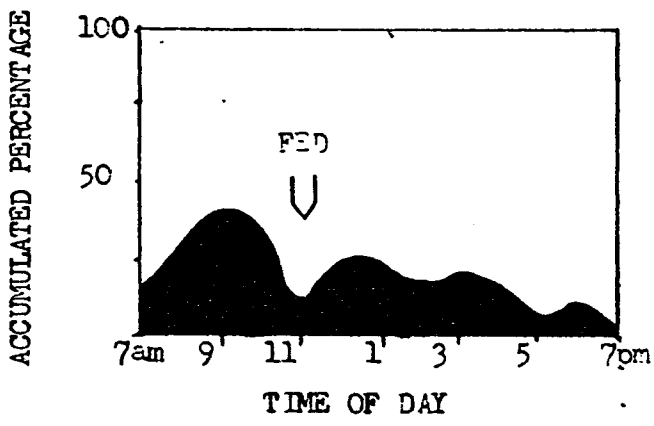


FIG.9 ACCUMULATED PERCENTAGE OF PRAWNS MOTIONLESS+FORAGING+WALKING



FIGS. 3 to 10 SHOW PERCENTAGE OF PRAWNS ENGAGED IN VARIOUS ACTIVITIES DURING A 24 HOUR PERIOD. THE WATER WAS MAINTAINED AT A SALINITY OF 34 °/oo AND AT 20°C. A 12 HOUR LIGHT/DARK CYCLE WAS SUPPLIED AND PRAWNS WERE FED 4 HOURS AFTER THE START OF THE DARK PERIOD.

FIG 11 PERCENTAGE EMERGED PRAWNS ;WATER TEMPERATURE 22°C

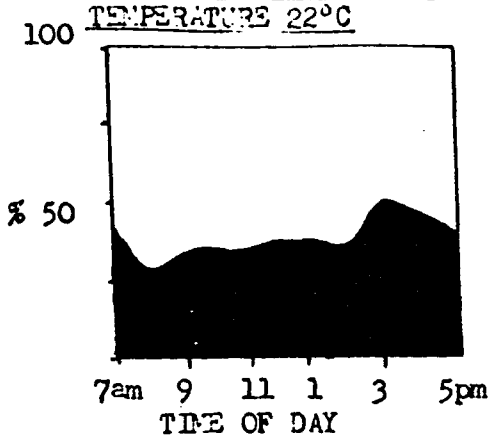


FIG 12 PERCENTAGE EMERGED PRAWNS ;WATER TEMPERATURE 24°C

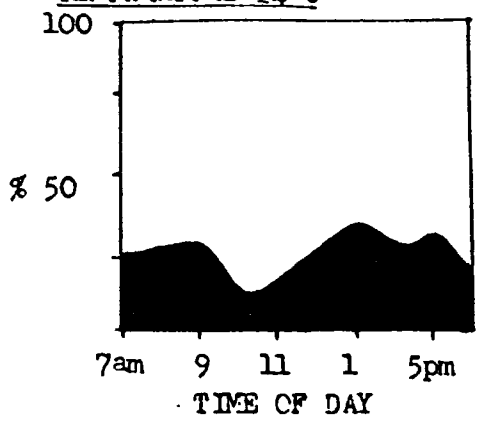


FIG 13 PERCENTAGE EMERGED PRAWNS ;WATER TEMPERATURE 26°C

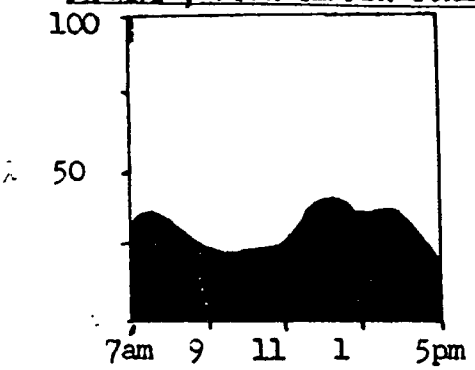


FIG 14 PERCENTAGE EMERGED PRAWNS ;WATER TEMPERATURE 28°C

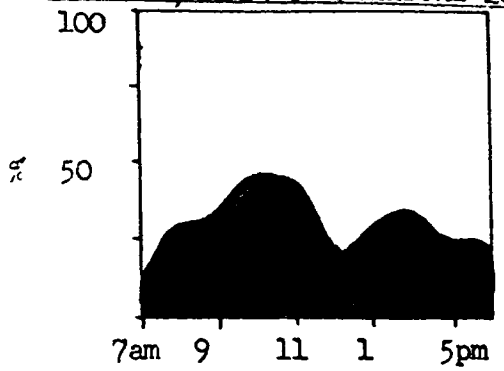


FIG 15 PERCENTAGE EMERGED PRAWNS ;WATER TEMPERATURE 30°C

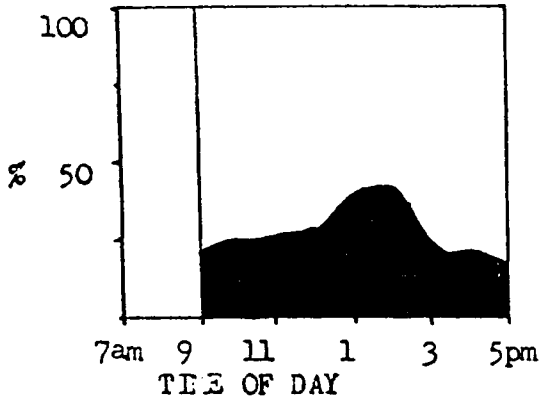


FIG 16 PERCENTAGE EMERGED PRAWNS ;WATER TEMPERATURE 32°C

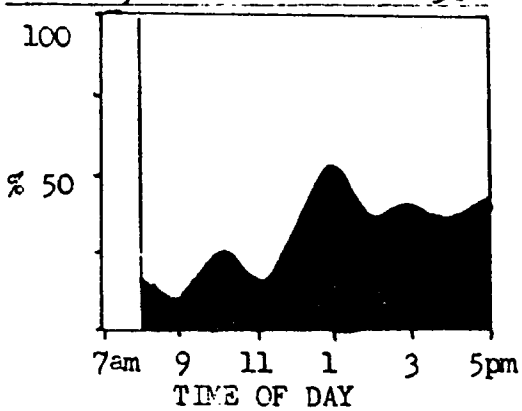


FIG 17 PERCENTAGE EMERGED PRAWNS ;WATER TEMPERATURE 34° C

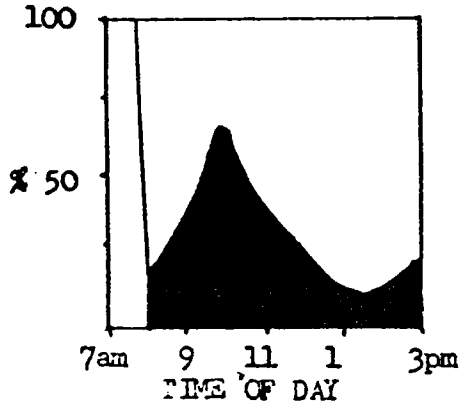


FIG 18 PERCENTAGE EMERGED PRAWNS ;WATER TEMPERATURE 36° C

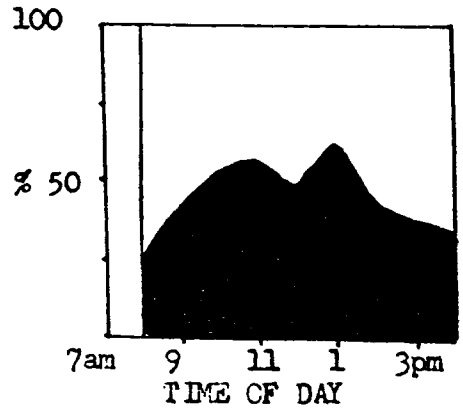


FIG 3 TOTAL PERCENTAGE EMERGED PRAWNS EFFECTED BY TEMPERATURE RANGE OF 20°C TO 36° C.

RESULTS cont....

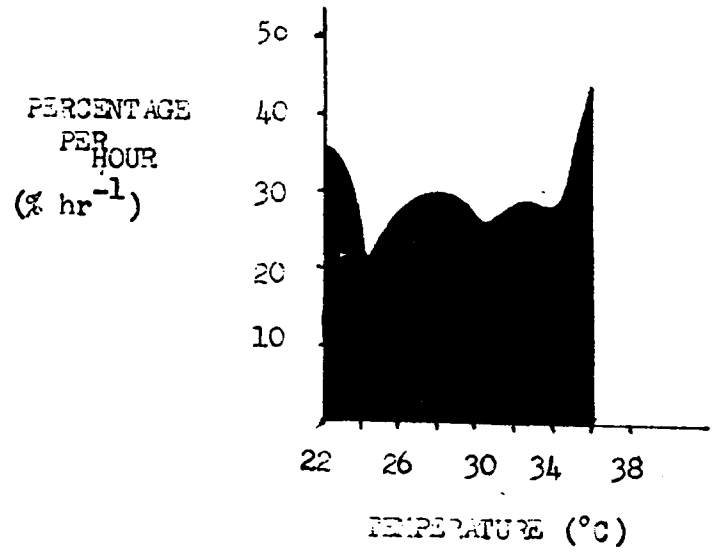
Tenses!

(2) RESPONSE TO TEMPERATURE INCREASE

Increasing the temperature over the range of 20°C to 34°C, had little or no effect on overall activity. (Figures 11 to 17). Peaks in activity are recorded within each day, amounting to about 10% increases, but their significance is questionable. There is however a clear increase in total activity at 36°C (Fig. 18), where emergence increases to an average of almost 45% per hour.

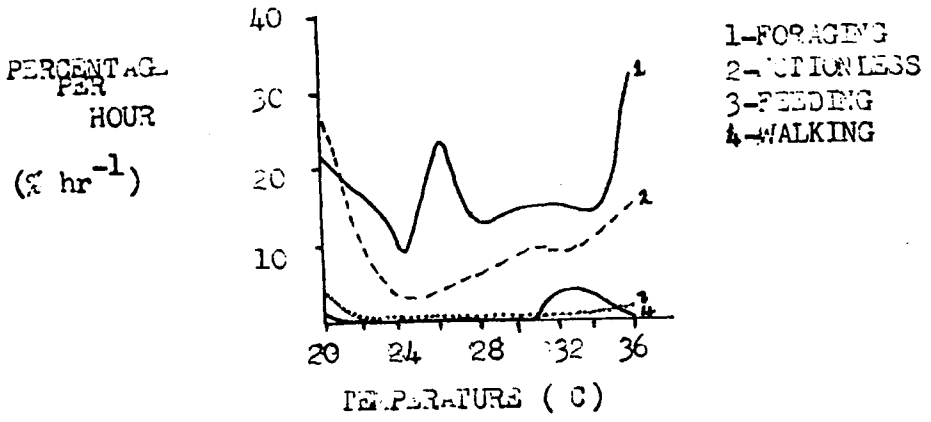
The trend of stable activity from 20°C to 34°C and then subsequent increase at 36°C is borne out in the mean percentage of emerged prawns per hour over the temperature range of 20°C to 36°C (Fig. 19). Again the major activity is foraging. (Fig. 20).

Fig.19 MEAN PERCENTAGE OF EMERGED PRAWNS PER HOUR, FOR TEMPERATURE RANGE 22°C TO 36°C



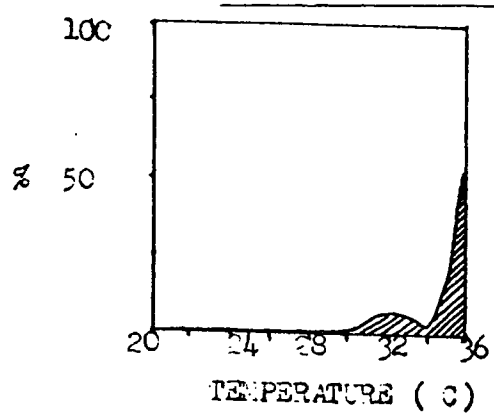
If the/.....

FIG 20 PERCENTAGE LARGE PRAWNS PER HOUR, INVOLVED IN THE VARIOUS INDICATED ACTIVITIES.



If the mean percentage per hour (Fig. 19) is considered in relation to the percentage mortality (Fig. 21), which increased from 5% at 32°C to almost 55% at 36°C, corresponding peaks at 36°C are evident.

FIG 21 PERCENTAGE MORTALITY WITH INCREASING TEMPERATURE



It was also noted that of the size range of prawns used, the prawns with carapace lengths of greater than 20mm were most suseptable to high temperature (36°C).

DISCUSSION/.....

DISCUSSION

or 1975 ?

Moller & Jones (1945) found that if both Penaeus semisculacatus and Peaneus japonicus were starved and then subsequently fed, their daily activities were influenced. As tanks were only fed 1 g of squid per day, which was completely consumed within 24 hours and as competition for food was noted, one can assume that animals were constantly hungry and hence behaviour was dominated by foraging and associated behaviours.

Activity peaked soon after it was dark presumably prawns were hungriest at this time as they spend most of the light hours burried in the substratum.

The decreased activity of the fed prawns may be because prawns no longer needed to forage or feed and hence burried into the substratum.. In contrast to this unfed prawns remained emerged and foraged for food.

Swimming appeared to be of little importance to prawns confined to tanks of these dimensions and was used mainly as an avoidance mechanism, observed frequently when two prawns contacted whilst burrowing.

The increase in prawns activity at the upper limits of temperature tolerance may be associated with an avoidance mechanism. Gaven(1985) suggests a similar phenomenon at prawns lower temperature tolerance, where swimming increased presumably for the migration to more favourable regions.

Although/.....

Although the upper temperature limit of 36°C was only recorded for salinity of 34‰ it is expected to apply to a range of salinities of about 15‰ to 40‰. Both Gaven (1986) and Zein-Eldin & Aldrich (1965) found that for the salinity range of 15‰ to 40‰, upper and lower temperature limits were altered little.

Migration may not be the only means of extreme temperature avoidance as prawns may burrow into the substratum. Although this was not observed in this investigation it may be important in the natural situation where water and substratum temperatures may differ considerably.

Penaeus japonicus survival temperature limits fall well within the range observed at Lake St. Lucia. Hay (1985) recorded water temperature range of 13.5°C to 30°C at the Narrows. However absolute temperature may not be the limiting factor and rates of temperature change should be considered. This may provide some answers as to why catches of Penaeus japonicus are as low as 0.6% of the total catches recorded at St. Lucia (Champion, 1976).

This investigation has emphasised two points, firstly that the behaviour of Penaeus japonicus is uneffected by temperatures ranging from 20°C to 36°C and secondly that the availibility of food may be the major factor influencing behaviour.

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