8. VELVET PRAWNS (*METAPENAEOPSIS* SPP.) OF TORRES STRAIT

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8.1 Introduction

Velvet prawn is the FAO common name (Holthius 1980) given to a group of small penaeid species caught in tropical-temperate waters. *Metapenaeopsis rosea* Racek and Dall, 1965 (pink velvet prawn or rosy prawn) and *M. palmensis* (Haswell, 1879) (southern velvet prawn) are the two most abundant of five *Metapenaeopsis* species taken by trawlers operating in Torres Strait.

M. rosea is an Indo-Pacific prawn of minor commercial importance. Distribution of *M. rosea* is restricted to northern Australia (particularly in the vicinity of the Great Barrier Reef) (Racek and Dall 1965), from Mackay (Queensland) through the Gulf of Carpentaria to Darwin (Northern Territory), and the northeastern Arafura Sea (near Irian Jaya) (Grey *et al.* 1983).

The distribution of *M. palmensis* is more extensive and they are of commercial importance in some areas. They form over 15% of the prawn catch in small trawl operations in some areas of central Japan (Hayashi and Sakamoto 1978). This species is found in waters of eastern Borneo, Indonesia and Papua New Guinea (Racek and Dall 1965) and is the most dominant species of *Metapenaeopsis* in the Batan Bay and Tigbauan-Gimbal waters in the Philippines (Motoh *et al.* 1977). In the Gulf of Thailand, small *M. palmensis* are taken as bycatch and are sold as a dried product (Yoo-Sook-Swat and Thubthimsang 1988). Within Australia, *M. palmensis* is found in warm temperate and tropical northern Australian waters from Shark Bay (Western Australia), through to Sydney (New South Wales) in the east, but is much more common in waters along the northeastern coast (Racek and Dall 1965).

Over twenty *Metapenaeopsis* species are distributed widely throughout the world. Approximately nine species are found in Australian waters (Racek and Dall 1965). Other species of *Metapenaeopsis* caught in trawls in Torres Strait are *M. novaguineae* (Haswell, 1879), *M. lamellata* (de Haan, 1850) and *M. mogiensis* (Rathbun, 1902). *Metapenaeopsis* species are found in waters of South East Africa (Racek and Dall 1965; Racek and Yaldwyn 1970; Champion 1973), North and South America (Huff and Cobb 1979; Bauer 1985), Malaysia and Indonesia (Racek and Dall 1965; Racek and Yaldwyn 1970; Hall 1962; Johnson 1976; Kubo 1949; Tseng and Cheng 1980), India (Suseelan *et al.* 1982; Dutt and Ramaseshaiah 1986), South China Sea (Kubo 1949; Hall 1962; Tham 1968b; Tseng and Cheng 1980; Johnson 1976), Melanesia (Hall 1962; Racek and Dall 1965; Racek and Yaldwyn 1970; Johnson 1976), Arabian-Persian Gulf and Red Sea (Miquel 1984).

Despite their wide occurrence, few details are known of the biology of the *Metapenaeopsis* species in Australia, perhaps because *M. rosea* and *M. palmensis* are not specific targets of trawl fisheries in Australia. They are taken as by-products in fisheries for other penaeid species (Grey *et al.* 1983). Catches of these species are not usually recorded by fishermen and are discarded. In recent years it has become common for larger sizes to be retained and marketed. Information on distribution, abundance, and maturation is necessary as their exploitation increases, if management of the fishery is to succeed. This study addresses these needs and represents the first detailed life history study of these species from Australia.

8.2 Methods and Materials

8.2.1 Sampling methods

The fishery was divided into two areas for analysis: (1) west of Warrior Reef (West) an area not fished for prawns since 1981, and (2) east of Warrior Reef (East) the current fishing grounds (Section 5 -Figure 1).

Monthly sampling of sites and processing and examination of samples was completed as described in Section 5. For the purpose of this study, males were considered mature when the first pair of pleonic endopodites had fused to form the petasma. Ovary stages III and IV (Tuma 1967) were used to designate female prawns with mature ovaries.

Lengths of prawns referred to are carapace lengths (CL), and were measured in millimetres (mm). The number of prawns per hectare of bottom swept by trawl nets is referred to as abundance.

8.2.2 Weight-length relationship

Parameters for the weight-length relationship were obtained by simple regression analysis (Table 1), and fitted to a power function (equation 1) and a linear function (equation 2). Linear regression analysis and analysis of covariance (ANCOVA) were calculated on weight and carapace length data, transformed to the natural log, to determine the significance of difference in the weight-length relationship between species and sex.

Table 1. The regression parameters for the weight-length relationships of *M. rosea* and *M. palmensis.*

Species	**Sex**	**N**	**Regression parameters**				r^2
			W=a*CL^b		**ln(W)=a+b*ln(CL)**		
			a	**b**	**a**	**b**	
M. rosea	F	498	1.4E-03	2.79	-6.56	2.79	90.9
	M	501	7.7E-04	3.05	-7.17	3.05	91.8
M. palmensis	F	315	8.9E-04	2.94	-7.02	2.94	94.8
	M	148	5.1E-04	3.17	-7.58	3.17	89.4

$$W = a * CL^b \quad \text{(equation 1)}$$
$$\ln(W) = a + b * \ln(CL) \quad \text{(equation 2)}$$

where:

W represents the weight (g)
CL represents the carapace length (mm)
a is the intercept
b is the slope

8.3 Results

8.3.1 Spatial distribution

By number, *M. rosea* and *M. palmensis* formed a large part of the penaeid prawn catch from all areas surveyed in Torres Strait (Figure 1). Of the two velvet prawns, *M. rosea* was usually the more numerous except in the northeastern sector between Warrior Reefs and the Yorke Islands where numbers of *M. rosea* and *M. palmensis* were similar.

8.3.2 Size distribution

For each year studied, the size of both species ranged from 5 to 30 mm CL (Figure 2). Juvenile prawns of both species recruited into the fishery each year, at around 5 mm CL, in January-March of both years s tudied.

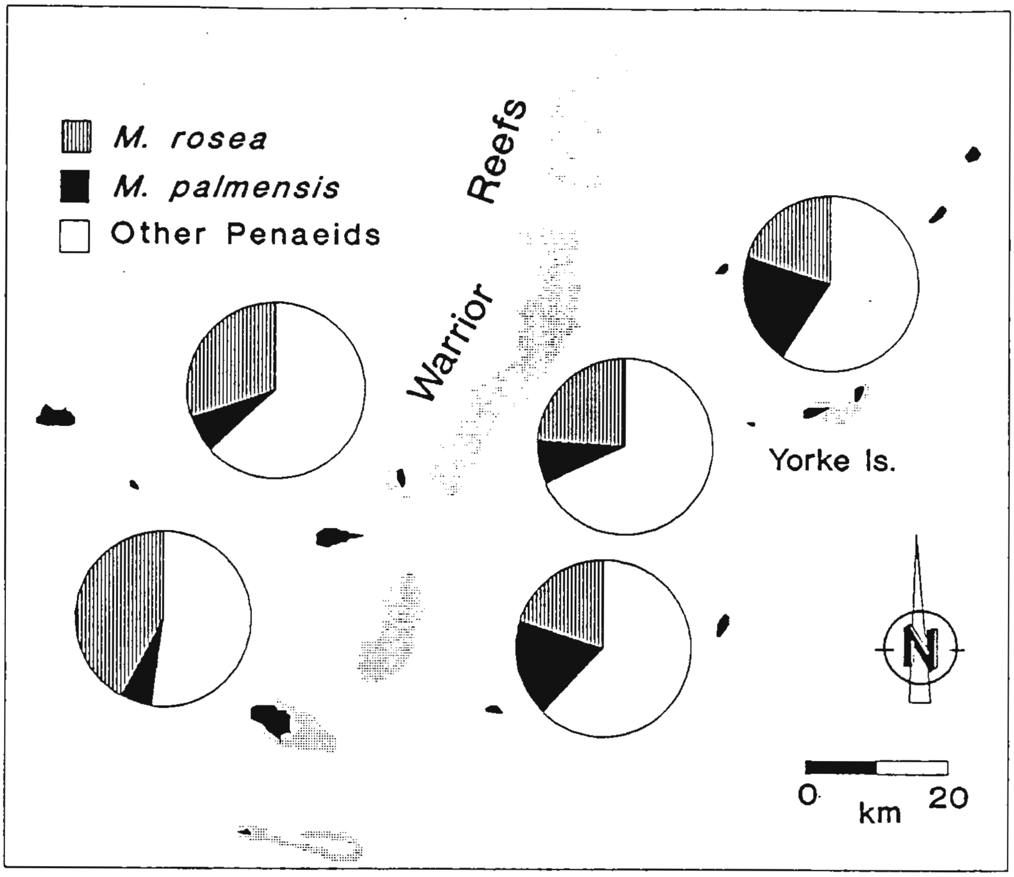

Figure 1. Map of Torres Strait showing the proportion of catches formed by *M. rosea* and *M. palmensis* on a number basis at five areas representing pooled trawling station data.

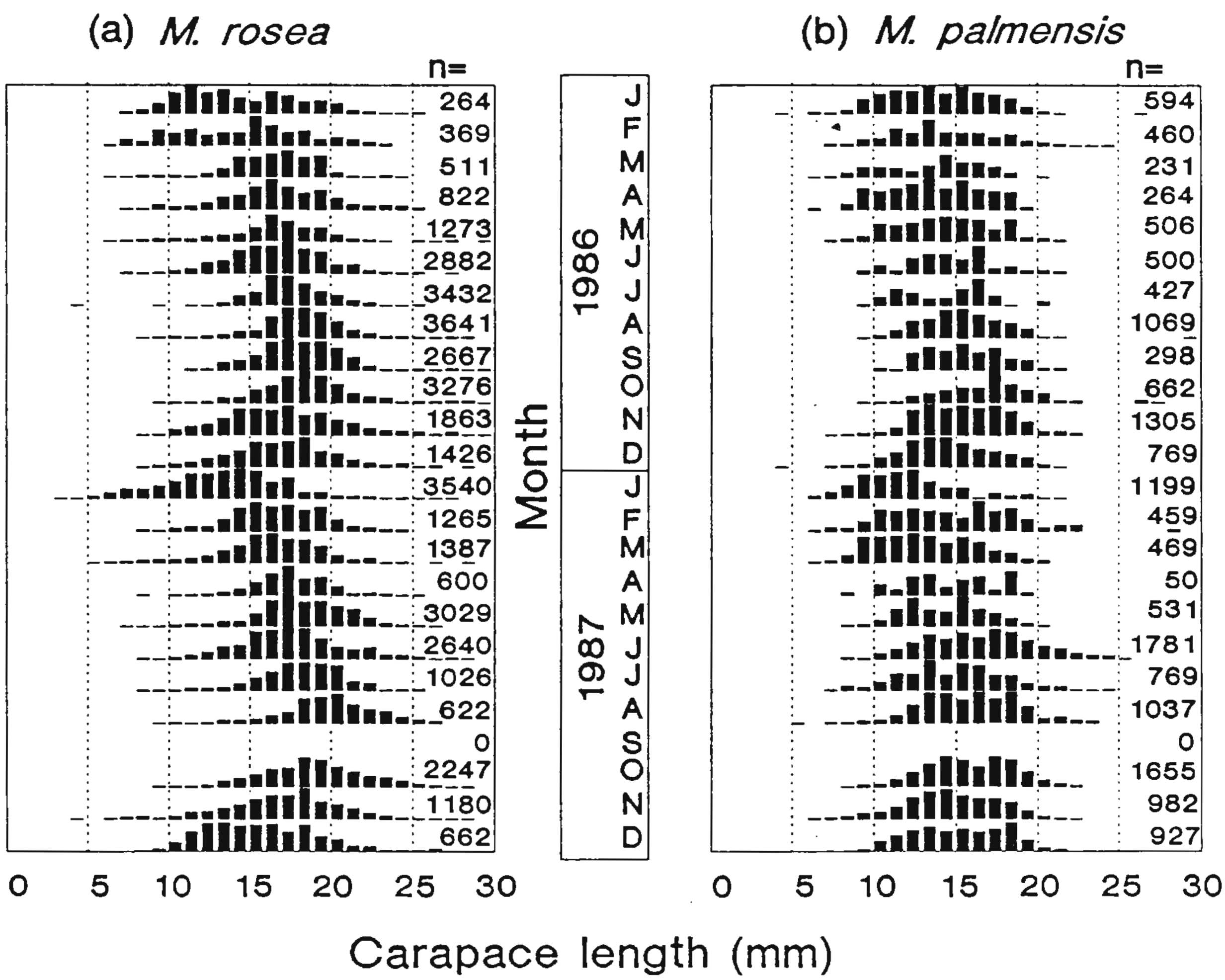

Figure 2. Monthly size distribution of *M. rosea* and *M. palmensis*. Length class abundances are expressed as a percentage on a monthly basis.

8.3.3 Seasonal abundance

Abundance of *M. rosea* was variable and area dependent but generally peaked between May-October (Figure 3). Although this species was twice as numerous in the West as it was in the East, the seasonal pattern of abundance in both areas was similar. Abundance was higher in 1986 than in 1987 for both areas.

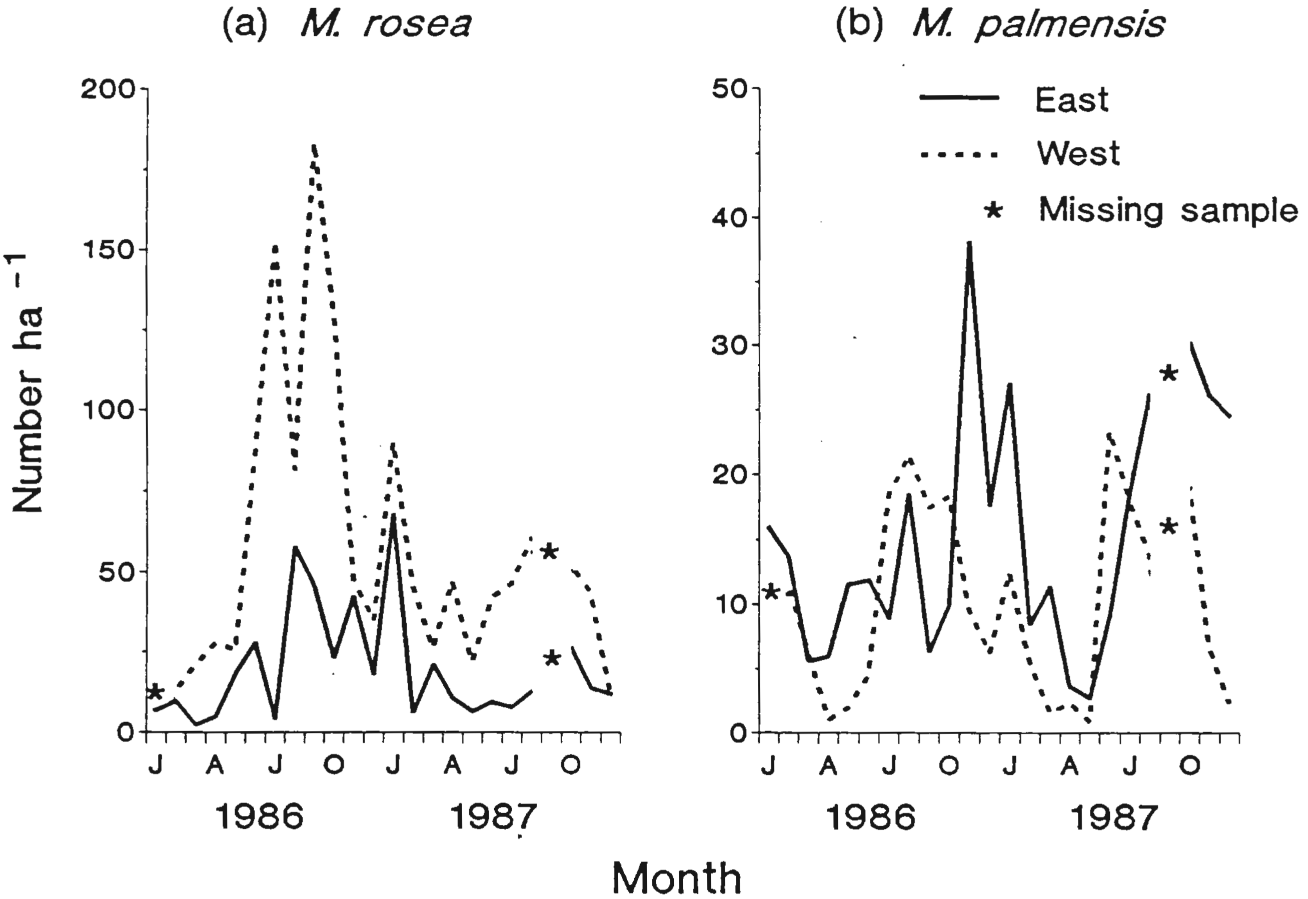

Figure 3. Monthly abundance of *M. rosea* and *M. palmensis* from the East and the West.

A seasonal pattern of abundance for *M. palmensis* caught in the East was found to be similar to that of *M. rosea* caught in the East (Figure 3). Those caught to the East displayed a major peak in abundance from September-January whilst those caught in the West displayed a peak in abundance from May-October. *M. palmensis* numbers recorded from the East and West was 25% that of *M. rosea*.

8.3.4 Weight-length relationship

Power curves and linear regression lines for a weight-length model were plotted for both sexes of *M. rosea* and *M. palmensis* (Figs 4 and 5).

Analysis of covariance on the weight-length relationships showed a significant difference between *M. rosea* males and females ($p < 0.001$), although no difference was found between sexes of *M. palmensis* ($p > 0.2$). A significant difference was found between female *M. rosea* and *M. palmensis* ($p < 0.001$) and between males of the two species ($p < 0.001$) (Table 2).

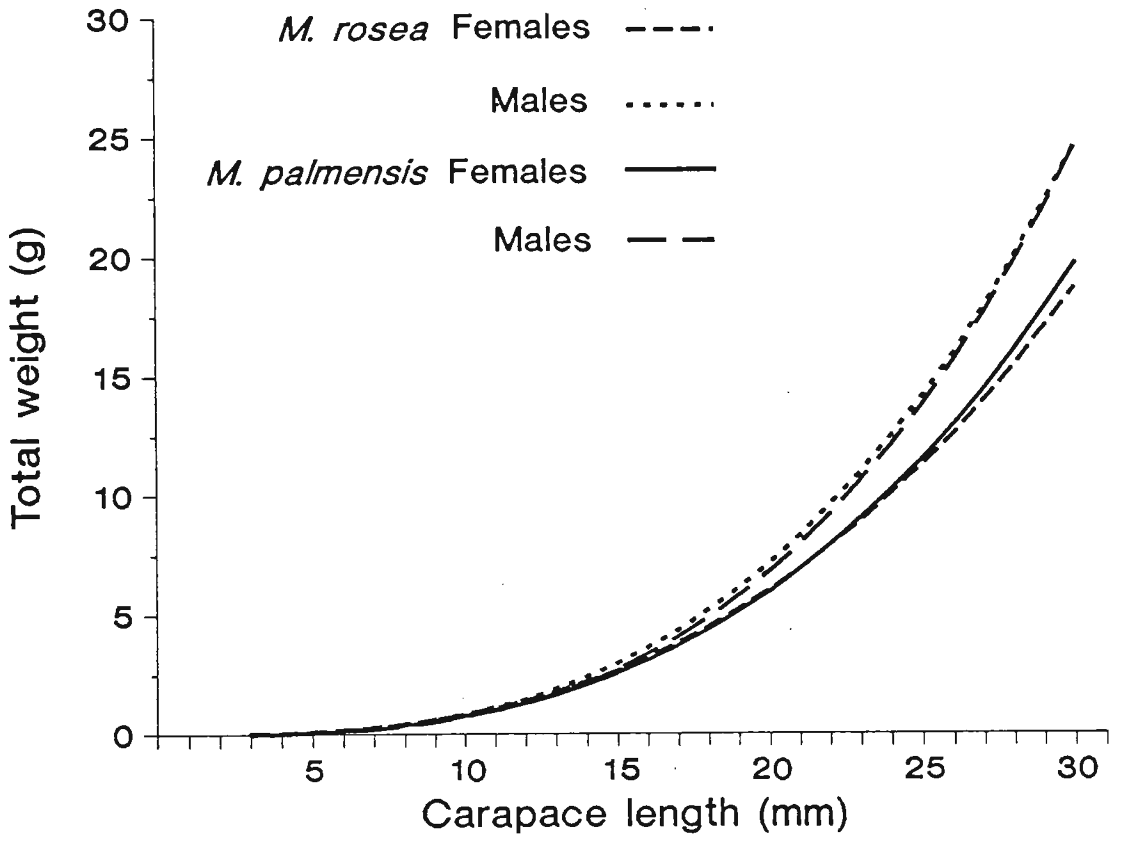

Figure 4. Power curve regression line showing the relationship between weight vs carapace length for male and female *M. rosea* and *M. palmensis.*

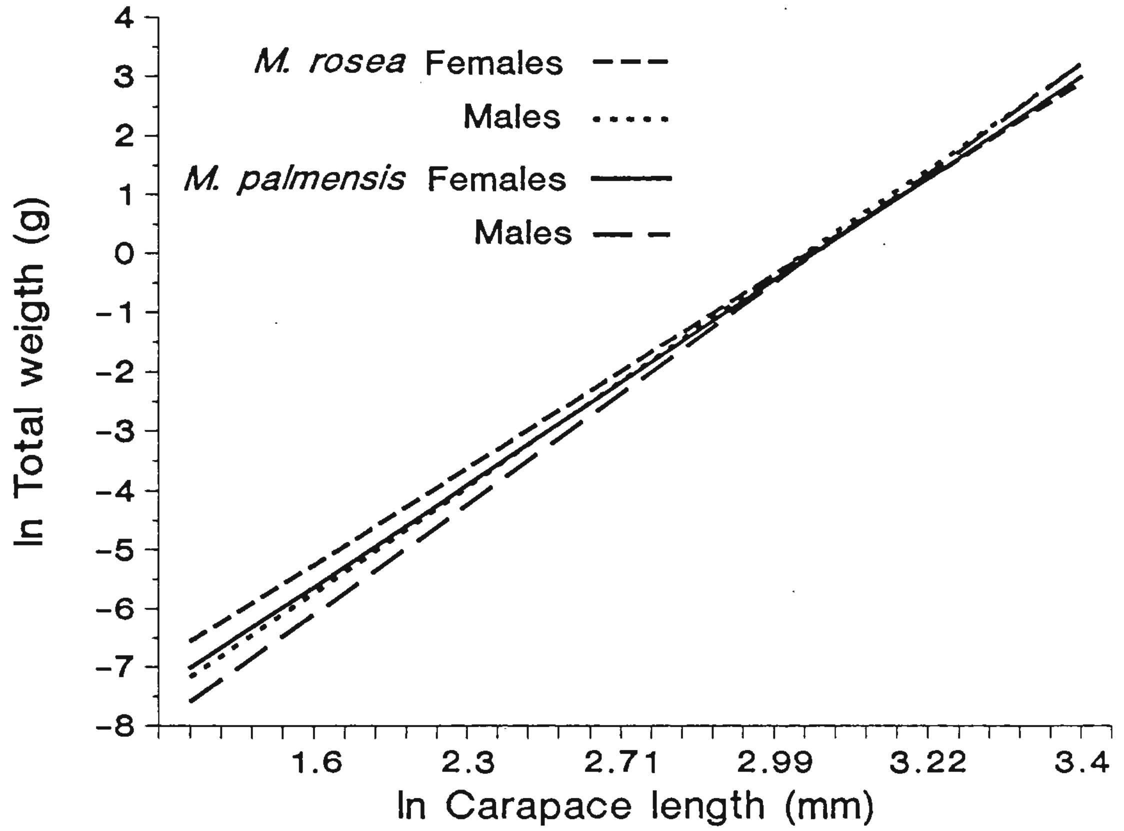

Figure 5. Linear regression lines showing the relationship between ln weight vs ln carapace length for male and female *M. rosea* and *M. palmensis.*

Table 2. ANCOVA table for ln carapace length (CL) vs ln total weight (W) for species and sex interactions.

Source of Variation	Sig. level
Between species	
M. rosea female vs *M. palmensis* female	0.0006 *
M. rosea male vs *M. palmensis* male	0.0000 *
Between sex	
M. rosea female vs *M. rosea* male	0.0000 *
M. palmensis female vs *M. palmensis* male	0.2045 ns

8.3.5 Seasonal ovary development

The proportion of *M. rosea* or *M. palmensis* females with developing-ripe ovaries (stages II to IV) was usually less than 20% of those sampled, except when peaks of up to 50% of females with developing-ripe ovaries were present, indicating major breeding periods (Figure 6).

Spawning periods (stages III to IV) for *M. rosea,* occurred in April and July in 1986, and in April, July and October in 1987. Peak spawning periods for *M. palmensis* occurred in April, July and October in 1986 and 1987 (Figure 6). The October spawning peak for both species, appears to correspond to the January-March recruitment periods (Figure 2).

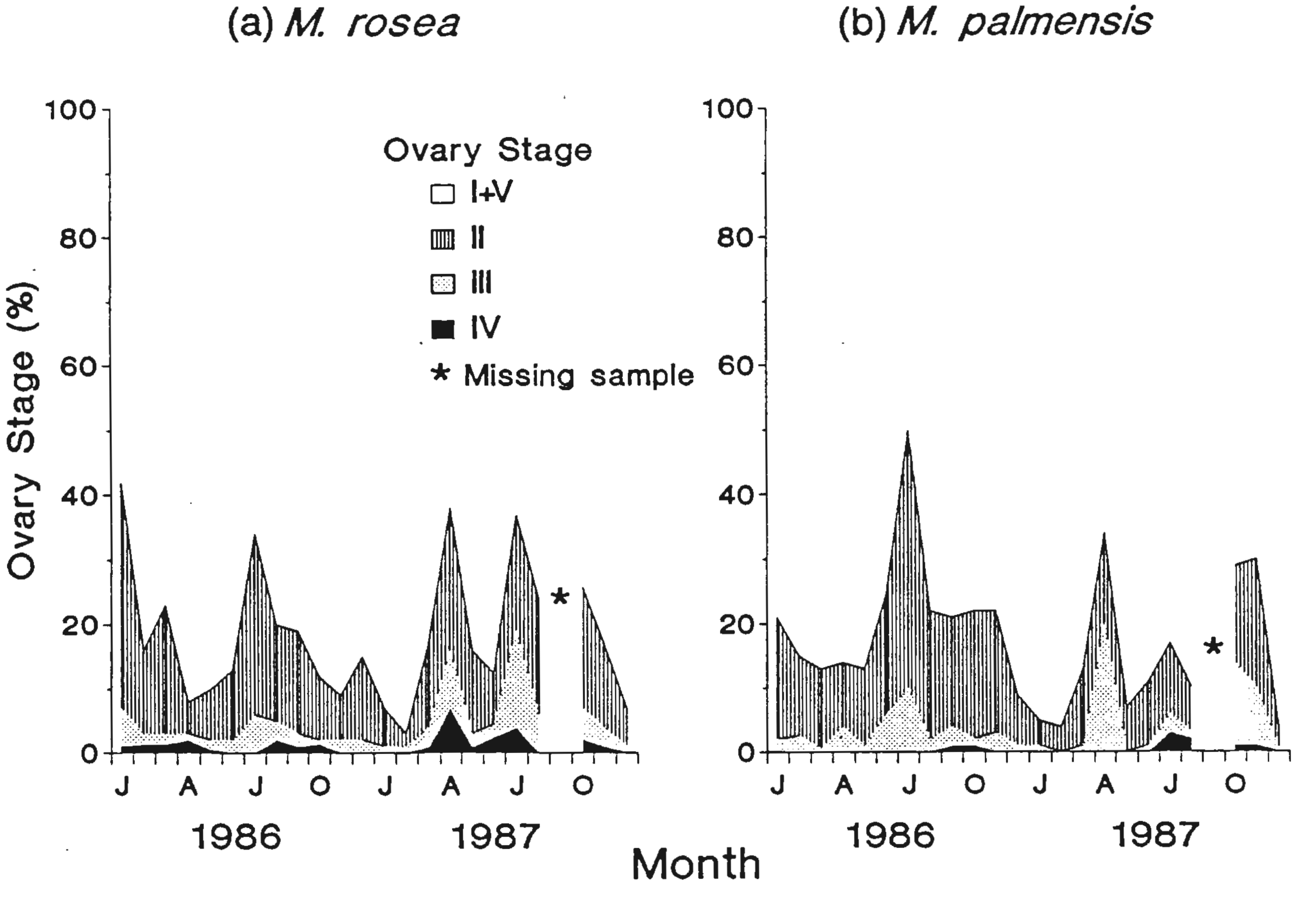

Figure 6. Monthly changes in the abundance of ovary stages (after Tuma 1967) of *M. rosea* and *M. palmensis* (I=quiescent, II=developing, III=early maturity, IV=ripe, and V=spent).

8.3.6 Maturation

Gravid females of both species first appeared at 12 mm CL (Figure 7). Regardless of carapace length, the percentage of ripe females (stages III and IV) never exceeded 20% (Figure 7).

Fusion of the petasma of male *M. rosea* and *M. palmensis* was evident in some individuals as small as 5 mm CL. All males were mature by 9 mm CL.

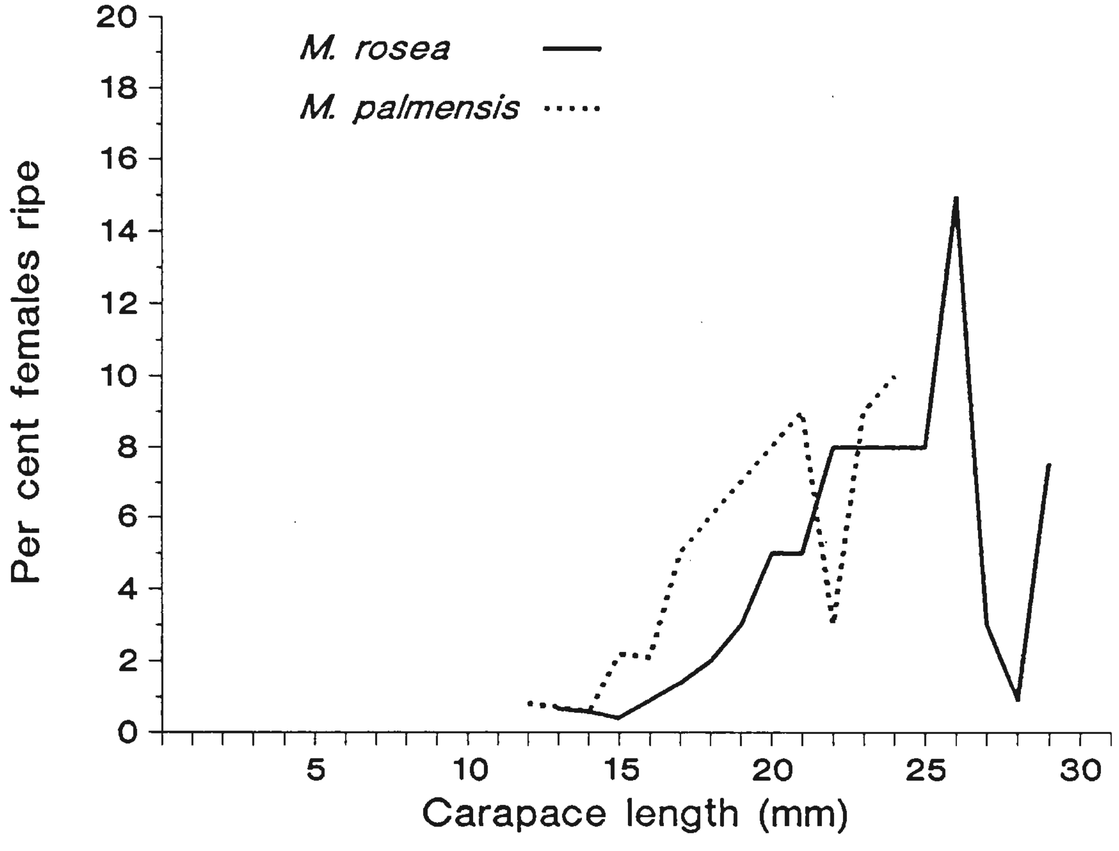

Figure 7. Relationship between the percentage of females with early mature-ripe ovaries (stages III-IV) and carapace length for *M. rosea* and *M. palmensis.*

8.4 Discussion

The distribution of velvet prawns in Torres Strait is likely to be related to sediment types or water depth. *M. rosea* are found southwest of the Warrior Reef complex. This region has fine sediments (Harris 1988) and shallower waters (10 to 14 m). *M. palmensis* is mainly found in the section north of the Yorke Islands. This region has coarser sediments (Harris 1988) and deeper waters (24 to 40 m). Other studies report that sediment preferences for *M. rosea* range from mud to mud-sand at 30 m depth (Racek and Dall 1965; Grey *et al.* 1983), while *M. palmensis* occurs over mud or sand bottoms at 5 to 30 m depth (Grey *et al.* 1983). Another species, *M. goodei* found in waters off Florida is commonly found on coarse sand and shell substrates in 37 m of depth (Huff and Cobb 1979).

Recruitment of velvet prawns in Torres Strait occurs during the months of January-March. Some northern hemisphere *Metapenaeopsis* species also recruit during the summer. Small *M. palmensis* enter the central Japanese fishery from July-November (Hayashi and Sakamoto 1978), and *M. barbata* from August-October (Sakamoto and Hayashi 1977). However, settlement of juvenile *Metapenaeopsis* species onto seagrass beds showed increases in numbers from August and September or October in Dorado on the north coast of Puerto Rico (Bauer 1985), inferring a possible winter recruitment into the fishery.

Velvet prawn abundance in Torres Strait was greatest during May to October and less so from December to March. Huff and Cobb (1979) reported peaks of abundance of *M. goodei* during summer and autumn in the Caribbean. This increased abundance is associated with spawning aggregations (Huff and Cobb 1979). The number of individuals of *M. barbata* was highest during autumn in Japan (Sakamoto and Hayashi 1977). Bauer (1985) reported little seasonal variation in *Metapenaeopsis* adult numbers on the north coast of Puerto Rico. Abundance is related to recruitment but also to survival. In Torres Strait, fishing effort is most intense in the East during the period of March to April, which reduces the numbers of all species substantially (Channells *et al.* 1988).

In Torres Strait, the peak periods of female velvet prawn breeding, based on ovary condition, is April, July and October. *M. palmensis* spawn from June-September in central Japan (Hayashi and Sakamoto 1978). These authors believed that each individual female spawned only once but there is no evidence for this for *M. palmensis* from Torres Strait. Hall (1962) reported that *M. barbata* bred twice yearly in Singapore waters.

The smallest Torres Strait velvet prawns found with developed ovaries were 12 mm CL. No literature could be found relating prawn age or size with ovary development. Huff and Cobb (1979) found impregnated females of *M. goodei* were from 8 to 16 mm CL in size but did not report on ovary development.

Maturation of male velvet prawns occurred at between 5 mm and 9 mm CL. This is similar to *M. goodei* which begin to mature at 4 mm CL and are completely mature by 6 mm CL (Huff and Cobb 1979).

A knowledge of weight-length relationships is important in relating prawn carapace length to commercial gradings. Analysis of the weight-length relationship for *M. rosea* showed that males of any given carapace length were significantly heavier than their female counterparts, though males do not reach the same maximum size as females. This difference has also been reported for larger penaeid species such as *Penaeus longistylus* (Penn 1980), *P. latisulcatus* and *P. esculentus* (Penn and Hall 1974). Male and female *M. palmensis* were of similar weight and carapace length although males did not attain the same maximum carapace length as females. Yoo-Sook-Swat and Thubthimsang (1988) found female *M. palmensis* slightly heavier than males in the Gulf of Thailand. For a given carapace length, *M. rosea* of either sex are heavier than their *M. palmensis* counterpart. Hall (1962) published weight-length relationships for *M. stridulans* and *M. barbata.* He reported that although the weight-length relationship between congeneric species appears similar, the relationship does differ significantly.

Acceptance in the market place for velvet prawns will increase, as they have a reputation for flavour that exceeds that of the larger commercial penaeid species (Poole 1987). When demand increases a knowledge of velvet shrimp biology will be essential for the effective management of these species as a fisheries resource.

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