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LIST OF ILLUSTRATIONS

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We wish to acknowledge gratefully the assistance of the McKay family and crew of the FV 'Regulus' and the crew of Fisheries Research Branch's research trawler the 'Gwendoline May' in collecting prawn samples.

INTRODUCTION

During the 1985 and 1986 fishing seasons, the Queensland Fish Management Authority (QFMA), the Fisheries Management Branch (FMB) of the Department of Primary Industries, and the Queensland Commercial Fishermen's Organisation (QCFO) implemented prawn trawling closures in north-eastern Queensland waters. Fishing grounds from the Torres Strait to the Whitsunday Islands were closed to trawling between 19 January and 28 February in 1985, and grounds between the Torres Strait and Lucinda Point were closed between 14 December 1985 and 28 February 1986.

The closures were intended as a management measure for a penaeid prawn fishery which extends from Cape York to Bowen and involves 200 to 300 trawlers pattern trawling at night. The main species sought is the brown tiger prawn (Penaeus esculentus). Other commercial prawns taken are the grooved tiger prawn (P. semisulcatus), the western king prawn (P. latisulcatus), the endeavour prawn (Metapenaeus endeavouri), the false endeavour prawn (M. ensis), the banana prawn (P. merguiensis), and the leader prawn (P. monodon).

Previous research by Fisheries Research Branch (FRB) indicated that adults of these species spawned offshore on the fishing grounds and produced large numbers of eggs. These eggs hatched into a series of planktonic larval stages which were carried inshore by wind and tidal currents to shallow, coastal and often seagrass-covered 'nursery' grounds. Here the larvae settled out on the bottom and grew until, as juveniles, they began to move back to the fishing grounds. On the east coast of north Queensland this life cycle usually took less than 12 months.

The intention of the seasonal closure of the fishery was to prevent incidental capture of the juvenile prawns as they moved onto the fishing grounds. The closure to trawling would allow the prawns time to increase in size and value, and so increase the productivity of the fishery.

To determine the change in number, size and total weight of prawns on fishing grounds during the 1985-86 closure to trawling (hereupon referred to as the closure), prawn populations were studied at the major trawl areas of Princess Charlotte Bay, Cape Bedford, Cairns and to the north of Townsville.

This report describes the changes observed in penaeid prawn populations during this closure, and compares the results with those from the earlier 1985 closure described by Coles et al. (1985). The intention of this report is to:

- provide basic biological information about the commercially important prawn species found on north-eastern Queensland fishing grounds;
- provide industry and management authorities with an assessment of the effect of cessation of trawling on the number and size of prawns on the fishing grounds;
- compare the effect of the closure at the different fishing grounds sampled; and

- examine the effectiveness of the closure in preventing the capture of juvenile prawns for each of the major target species involved.

MATERIALS AND METHODS

Sampling

Samples of prawns were collected between December 1985 and March 1986 spanning time periods before and after the closure and during the closure itself. On Cairns and Townsville fishing grounds, samples were collected using the FRB trawler, the RV 'Gwendoline May'. On the fishing grounds at Princess Charlotte Bay and Cape Bedford, collections were made using a commercial fishing vessel, the FV 'Regulus', operated by the McKay family. Additional material was also collected from Princess Charlotte Bay and Cape Bedford by the 'Gwendoline May' during February 1986 to standardise catches with the 'Regulus'. In the analyses in this report, the number of prawns collected by the 'Regulus' were equated to 'Gwendoline May' catches using a swept area ratio. The 'Gwendoline May' towed two six-fathom, modified 'Florida Flyer' nets, each with 5.1 cm mesh. The 'Regulus' towed four five-fathom nets of similar mesh size.

Princess Charlotte Bay and Cape Bedford samples were collected on three occasions (15 December 1985, 15 January 1986 and 26 February 1986). Cairns and Townsville collections were made near the time of the new moon commencing in November 1985 and finishing in March 1986. Sample dates were 18 November 1985, 15 December 1985, 14 January 1986, 13 February 1986, and 20 March 1986 at Cairns; and 13 November 1985, 13 December 1985, 12 January 1986, 11 February 1986 and 13 March 1986 at Townsville.

Two Northern Prawn Fishery grids were sampled at Cape Bedford. Two one-hour trawl shots were completed in each grid. At each of the Princess Charlotte Bay, Cairns and Townsville fishing grounds, four grids were sampled. A single one-hour trawl shot was completed in each. (Figure 1).

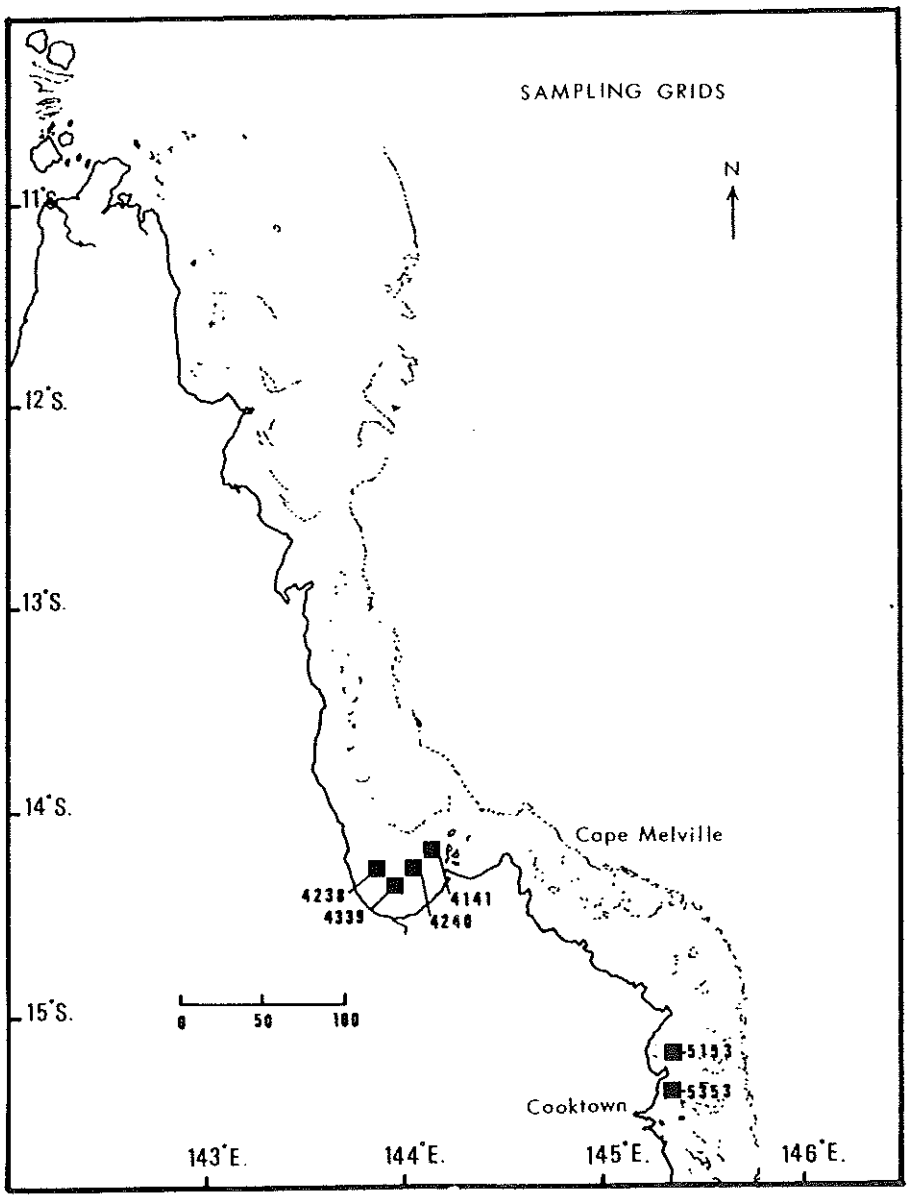

Figure 1a. Sampling grids at Princess Charlotte Bay and Cape Bedford

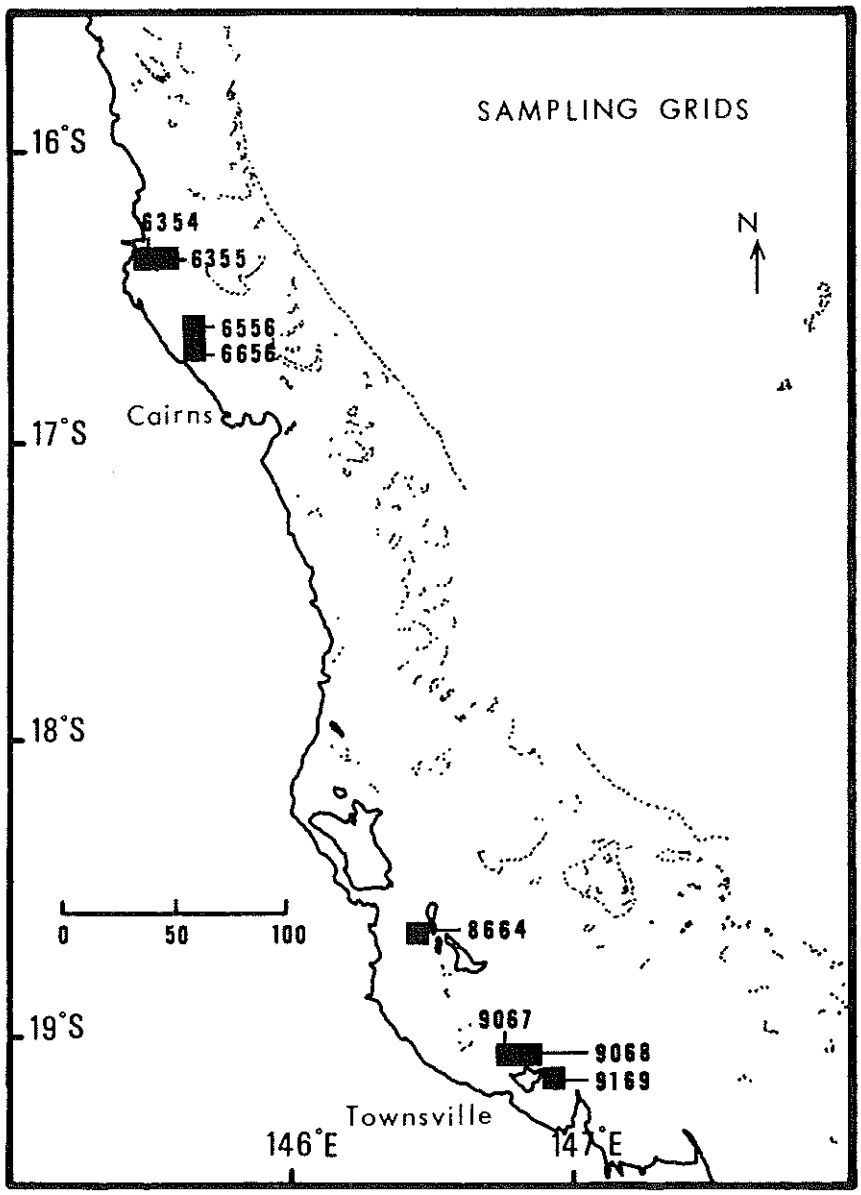

Figure 1b. Sampling grids at Cairns and Townsville.

Measurements

Prawns in each trawl shot were separated into the different species and counted. A total weight, count per kilogramme and a length measure - the carapace length (CL) in millimetres - were recorded in the laboratory. Size frequency distributions for only the Princess Charlotte Bay and Cape Bedford samples were considered for comparison with similar data collected in early 1985 (Coles et al. 1985)

RESULTS AND ANALYSIS

General

Eight commercially important penaeid prawn species were collected (Table 1). The most numerous overall were the brown tiger prawn (P. esculentus), followed by the true endeavour prawn (P. endeavouri) and the grooved tiger prawn (P. semisulcatus).

Table 1. The number of each species of commercial prawns sampled from Princess Charlotte Bay, Cape Bedford, Cairns and Townsville during the 1985-86 closure.

Site	Date	Tigers		Endeavours		Kings		Banana	Leader
		Brown	Grooved	True	False	Western	Red Spot		
Cairns	18/11/85	25	165	39	52	2	0	0	0
	15/12/85	30	106	97	48	0	0	2	3
	14/01/86	86	208	69	64	0	0	0	1
	13/02/86	454	214	185	95	20	2	0	0
	20/03/86	372	474	314	48	48	0	0	2
	Total	967	1167	704	307	70	2	2	6
Townsville	13/11/85	117	269	76	245	9	0	0	0
	13/12/85	148	150	70	159	27	1	0	0
	12/01/86	195	125	94	142	24	0	0	0
	11/02/86	484	224	85	303	13	0	0	2
	13/03/86	501	583	309	405	14	0	0	2
	Total	1445	1351	634	1254	87	1	0	4
Princess Charlotte Bay	15/12/85	868	55	29	12	17	2	8	0
	15/01/86	1754	53	137	4	29	7	45	1
	26/02/86	1233	735	287	2	20	34	2	0
	Total	3855	843	453	18	66	43	55	1
Cape Bedford	15/12/85	248	28	614	0	11	1	0	0
	15/01/86	467	33	988	8	17	7	0	0
	26/02/86	1288	21	413	1	10	0	0	0
	Total	2003	82	2015	9	38	8	0	0

Brown tiger prawn (Penaeus esculentus)

This species formed 61.7% by number of the pooled catch from Princess Charlotte Bay and Cape Bedford during the closure, compared with 52.8% from the same fishing grounds in early 1985. Brown tigers formed 47.3% of the commercial prawn catch from all samples collected during the closure (see Table 1). This species was the most numerous catch component at Princess Charlotte Bay and Townsville, and formed a similiar proportion of the catch to endeavour prawns at Cape Bedford (Fig. 2).

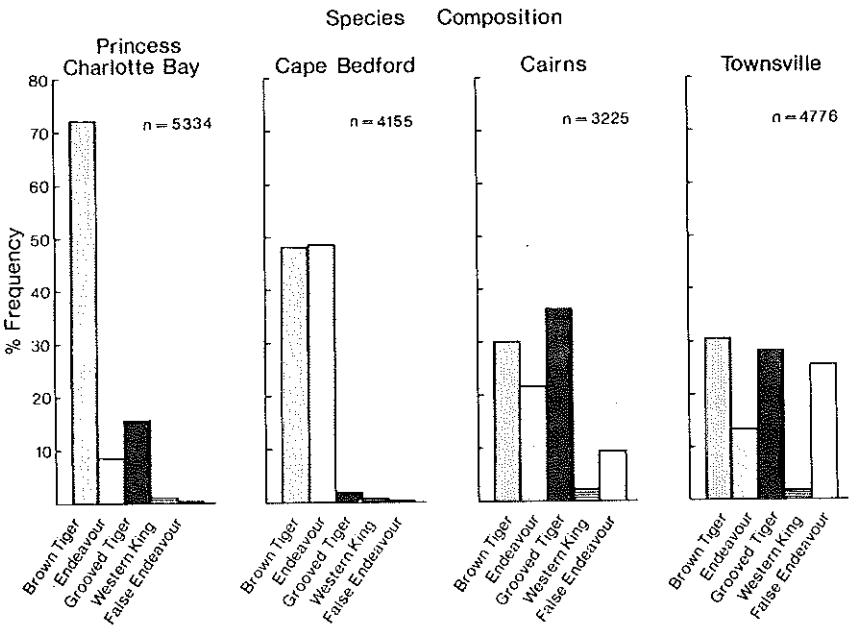

Figure 2. Percentage composition of four common commercial prawn species.

The number and weight of brown tiger prawns increased at all sites during the closure (Fig. 3). However, by the opening date on the 28 February, 1986, the number and weight of P. esculentus at Princess Charlotte Bay had declined from maxima recorded on 15 January 1986. Brown tiger prawn numbers also peaked before the March samples at Cairns and Townsville. The size (CL) of brown tiger prawns increased at Princess Charlotte Bay and Cape Bedford, and was increasing at Cairns and at Townsville by the end of the closure (Fig. 4).

Size frequency histograms for P. esculentus catches are similar to those reported for the earlier closure in 1985 (Coles et al. 1985) and indicate that brown tiger prawns enter the fishing grounds in a pulse during this time of the year (Fig. 5).

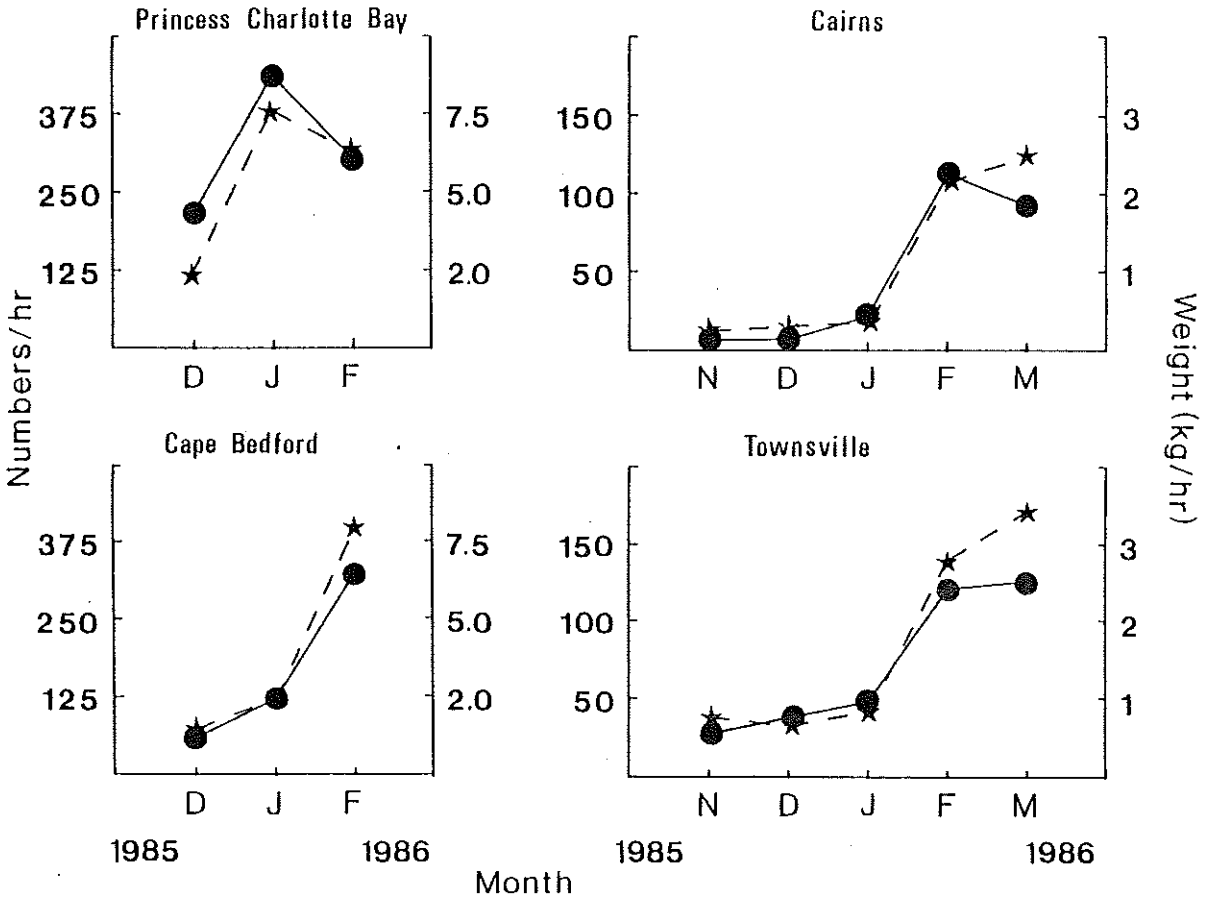

Figure 3. The number (●) and weight (★) of brown tiger prawns (Penaeus esculentus), per hour of trawling on the fishing grounds during the 1985-86 closure to trawling.

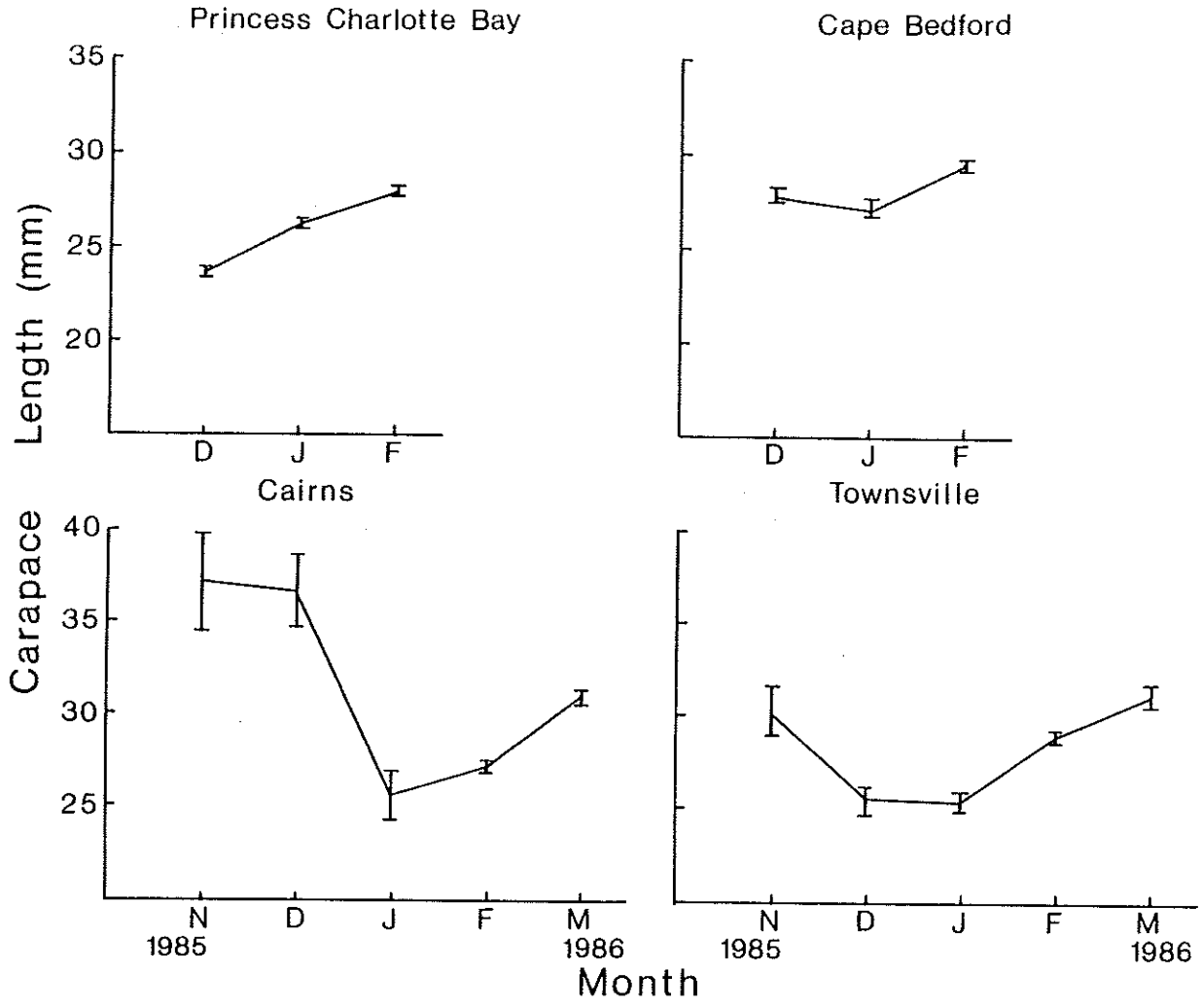

Figure 4. Mean carapace length and 95% confidence limits of the brown tiger prawn (Penaeus esculentus) at the four sampling sites during the 1985-86 closure to trawling.

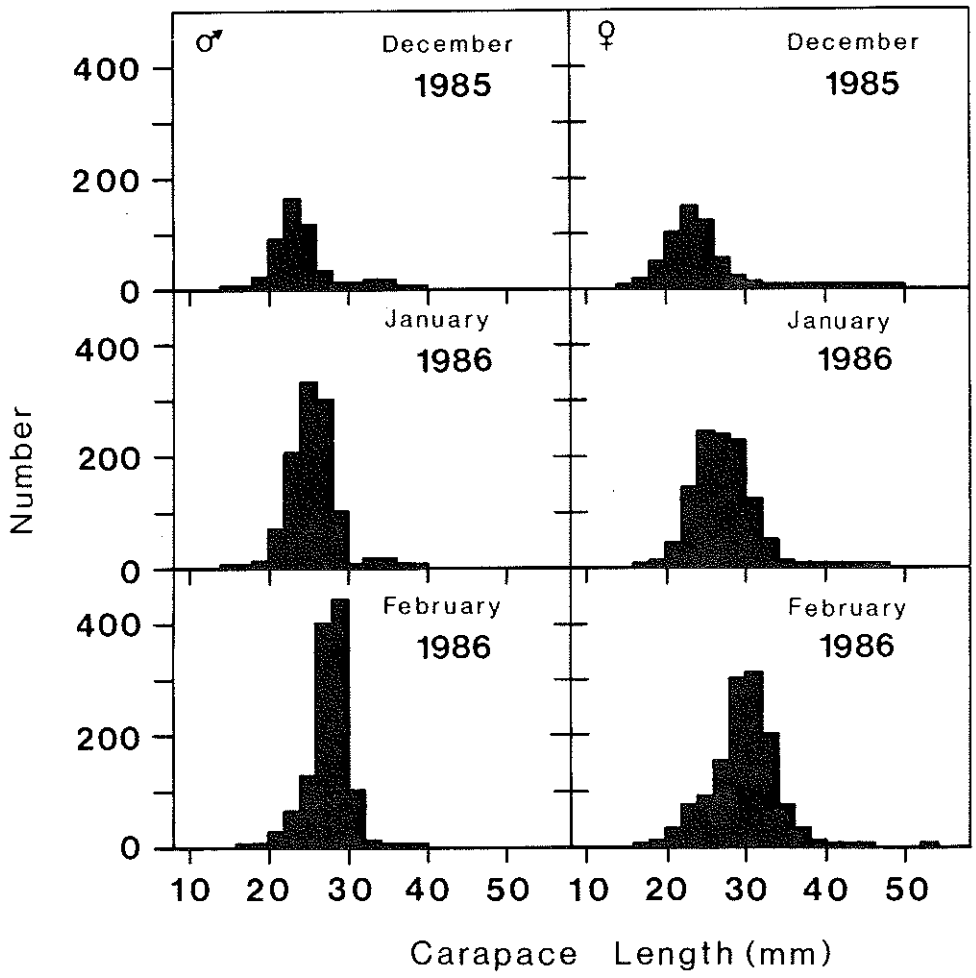

Figure 5. Size frequency histograms for male and female brown tiger prawns (Penaeus esculentus) caught at Princess Charlotte Bay and Cape Bedford.

Grooved tiger prawn (Penaeus semisulcatus)

Grooved tiger prawns formed 9.8% by number of the pooled commercial prawn catch at Princess Charlotte Bay and Cape Bedford during the closure. This is very similiar to the 8.1% figure from the same fishing grounds during the early 1985 closure (Coles et al. 1985). Grooved tiger prawns made up 19.8% of the total commercial prawn catch from all four sites in 1985-86. This was the most numerous species at Cairns, and the second most numerous at Townsville (Table 1).

The number and weight of grooved tiger prawns at Princess Charlotte Bay increased during the closure (Fig. 6). Catches of this species were few at Cape Bedford and declined during the closure. On Cairns and Townsville fishing grounds, the number and weight initially decreased from November 1985 levels, then increased during January and February (Fig. 6). With the exception of Cape Bedford, the mean size of grooved tiger prawns decreased markedly during the closure to trawling (Fig. 7).

Size frequency histograms show juvenile P. semisulcatus entered the Princess Charlotte Bay and Cape Bedford fishing grounds in February 1986, at the end of the closure to trawling (thus reducing the median size) (Fig. 8).

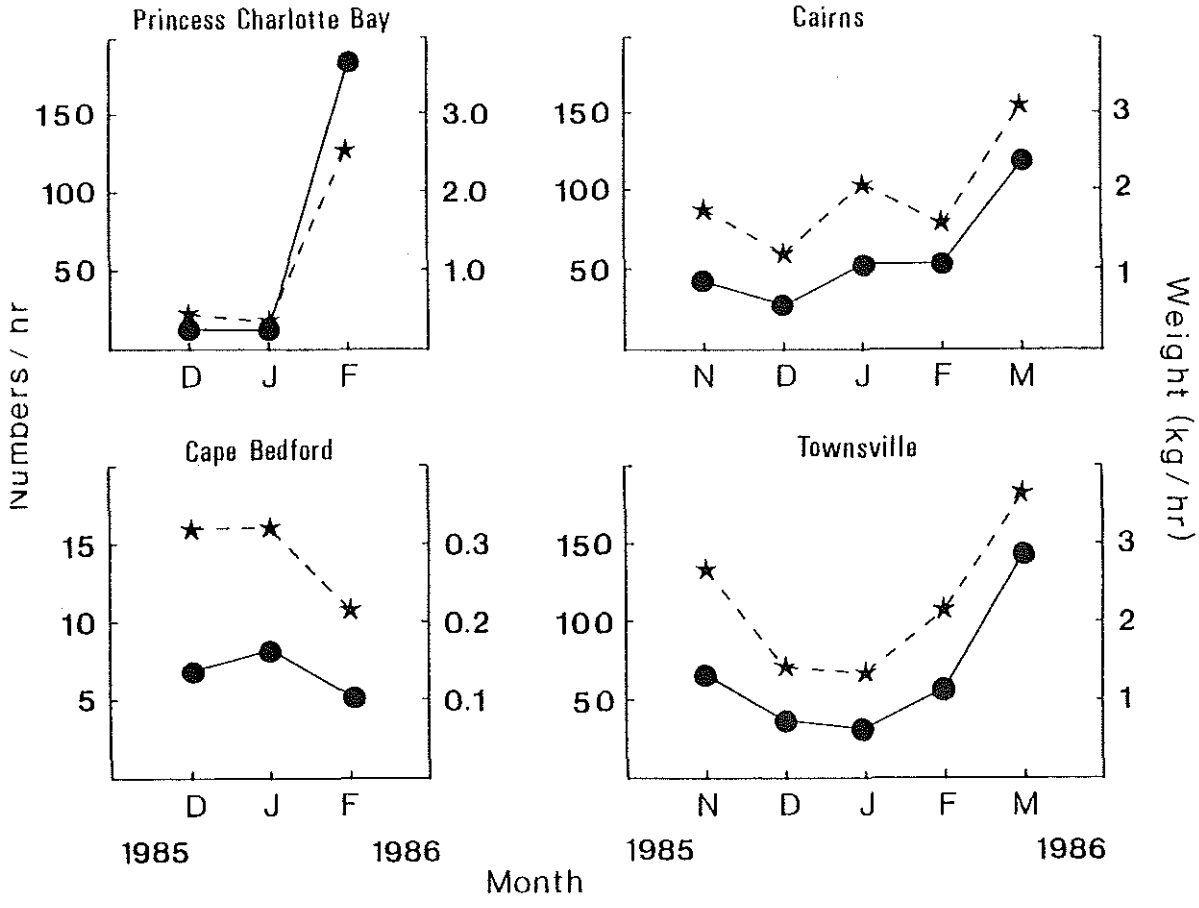

Figure 6. The number (●) and weight (★) of grooved tiger prawns (Penaeus semisulcatus), per hour of trawling on the four fishing grounds during the 1985-86 closure to trawling.

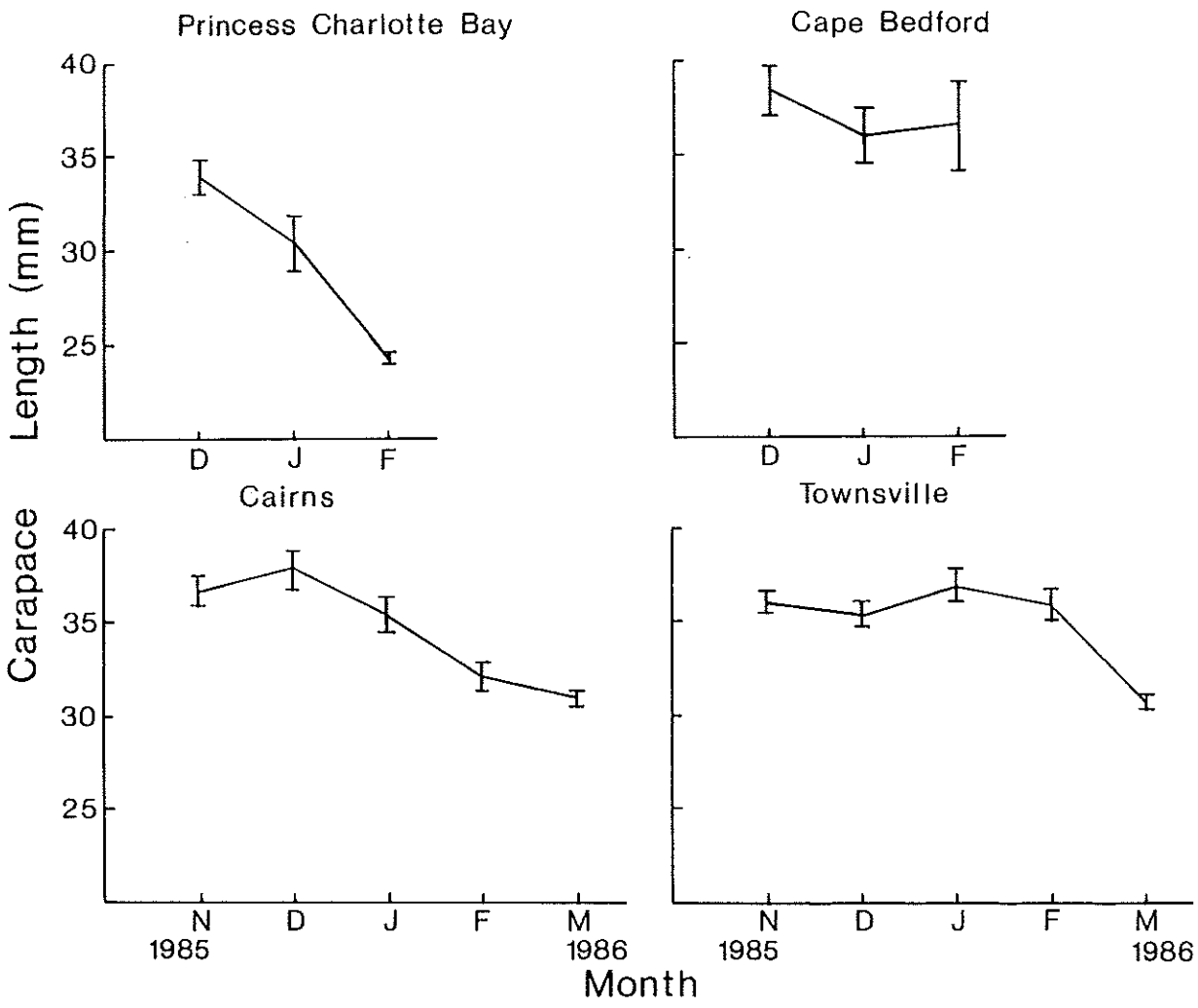

Figure 7. Mean carapace length and 95% confidence limits of the grooved tiger prawn (Penaeus semisulcatus) at the four sampling sites during the 1985-86 closure to trawling.

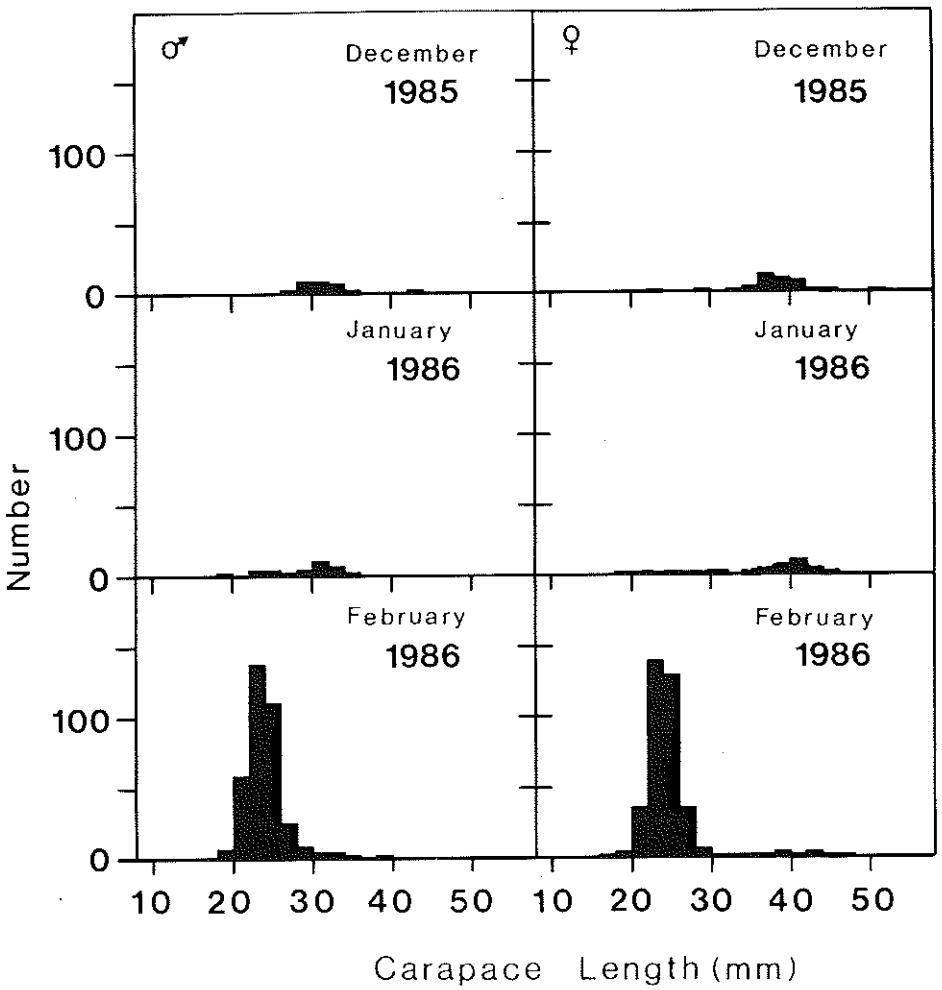

Figure 8. Size frequency histograms for male and female grooved tiger prawns (Penaeus semisulcatus) caught at Princess Charlotte Bay and Cape Bedford.

Endeavour prawn (Metapenaeus endeavouri)

In samples from the Princess Charlotte Bay and Cape Bedford fishing grounds during the closure, endeavour prawns were the second most numerous commercial species, being 26.0% of the pooled catch from both areas. This compares well with the figure of 32.1% obtained from the same fishing grounds in early 1985 (Coles et al.). The endeavour prawn was the second most numerous of all species when the samples from all four 1985-86 sites were combined, and was common at all sites (Fig. 2).

The weight and number of endeavour prawns caught, increased during the closure at all sites except Cape Bedford (Fig. 9). Prawn size (CL) increased at Princess Charlotte Bay and Cape Bedford, but decreased overall at Cairns and Townsville (Fig. 10). There was little detectable change in size frequency for this species during the closure to trawling at Princess Charlotte Bay and Cape Bedford (Fig. 11).

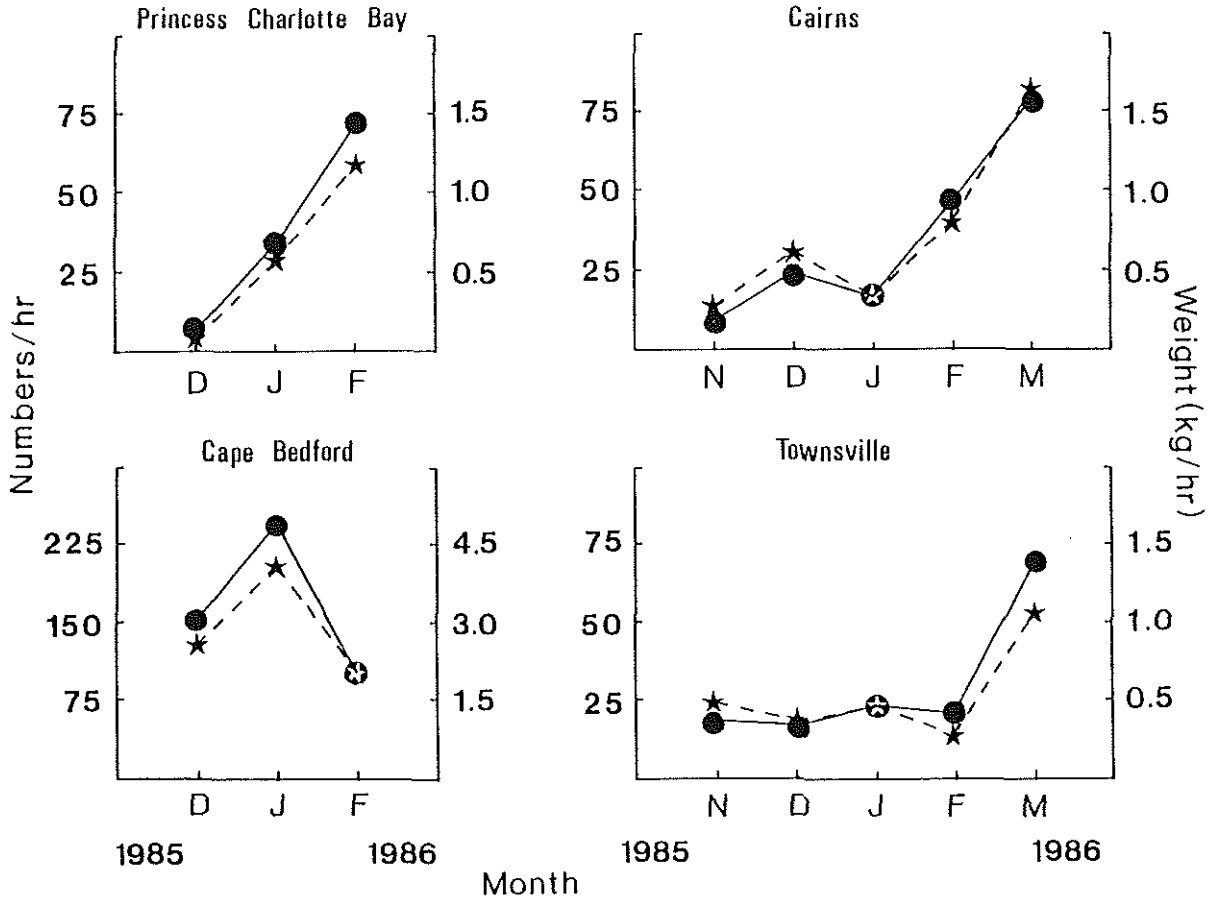

Figure 9. The number (●) and weight (★) of endeavour prawns (Metapenaeus endeavouri) per hour of trawling on the four fishing grounds during the 1985-86 closure to trawling.

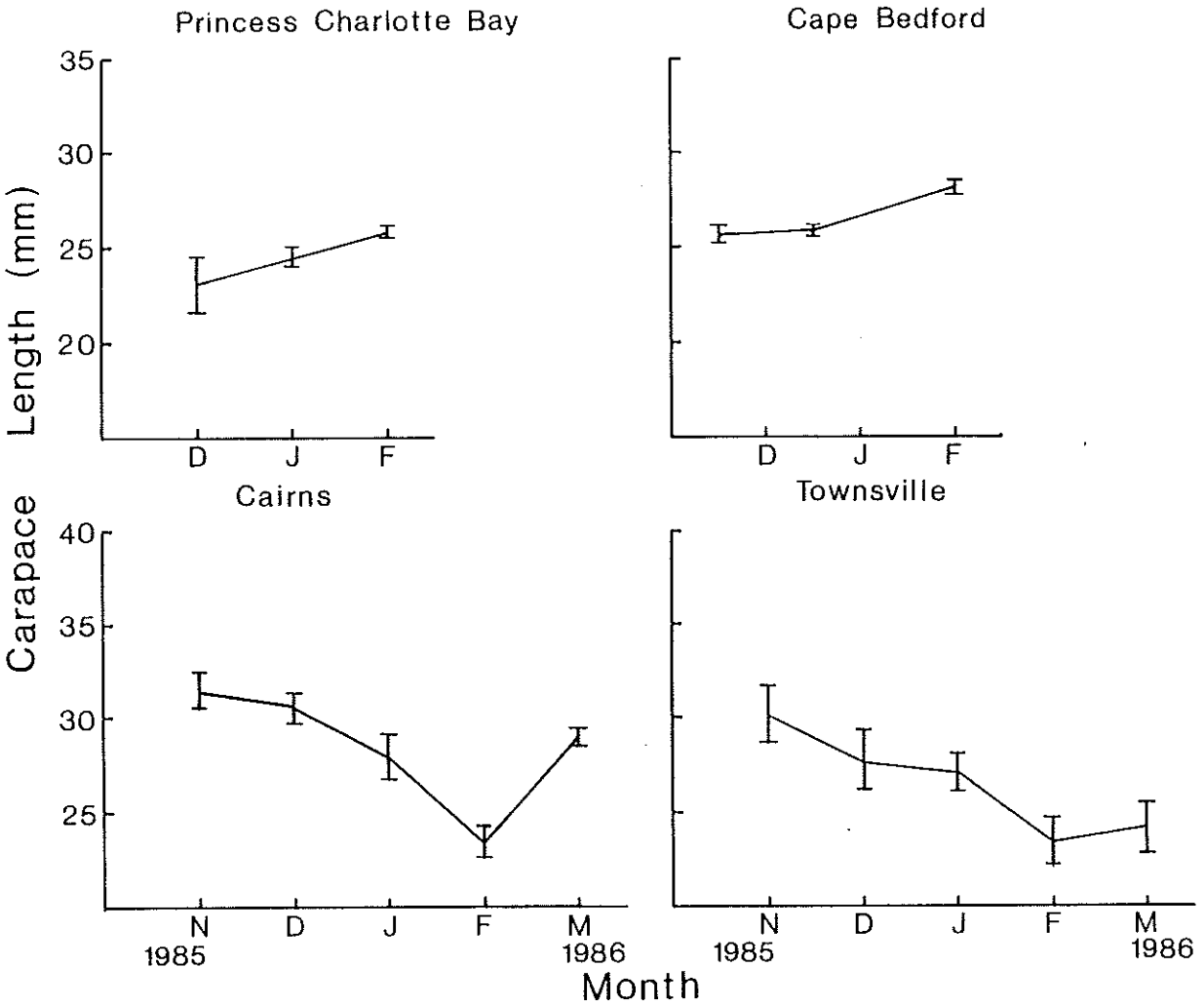

Figure 10. Mean carapace length and 95% confidence limits of the endeavour prawn (Metapenaeus endeavouri) at the four sampling sites during the 1985-86 closure to trawling.

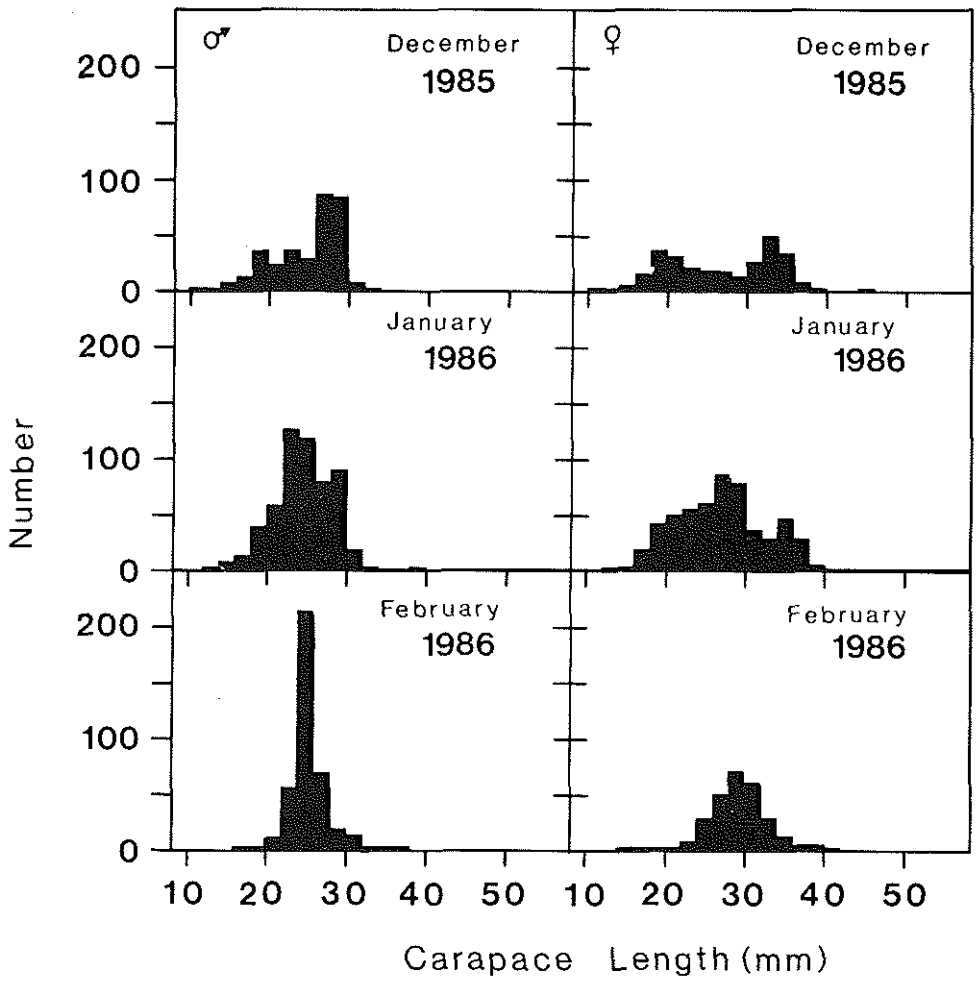

Figure 11. Size frequency histograms for male and female endeavour prawns (Metapenaeus endeavouri) caught at Princess Charlotte Bay and Cape Bedford.

False endeavour (Metapenaeus ensis)

False endeavour prawns were the fourth most numerous commercial prawn (8.4%) in combined samples from all sites during the closure. They comprised only 1.4% of prawns in the 1985 closure samples (Coles et al. 1985). Approximately 98% of false endeavours were collected from fishing grounds at Cairns and Townsville (see Fig. 2). The number and weight of this species remained constant at Cairns (Fig. 12). At Townsville, the number and weight increased after January 1986. The size of the prawns

decreased from November 1985 to January 1986 at Cairns, and then increased in March 1986 (Fig 13). At Townsville, the size of M. ensis was relatively constant throughout the closure monitoring period.

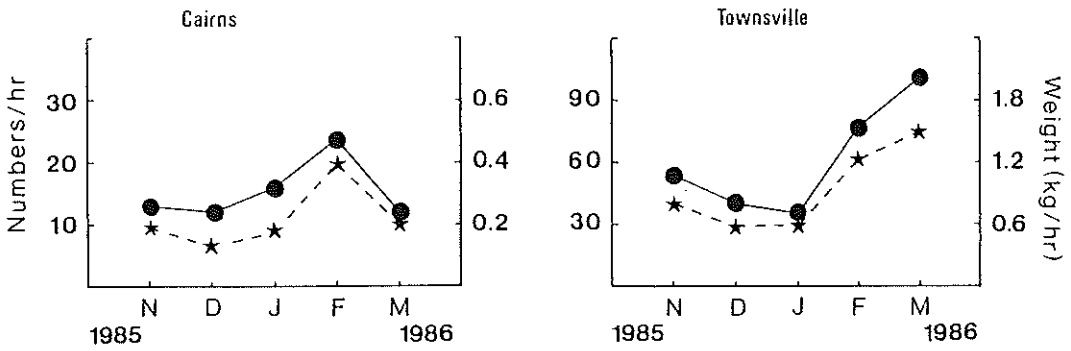

Figure 12. The number (●) and weight (★) of the false endeavour prawn (Metapenaeus ensis) per hour of trawling on the sampling grids of Cairns and Townsville during the 1985-86 closure to trawling.

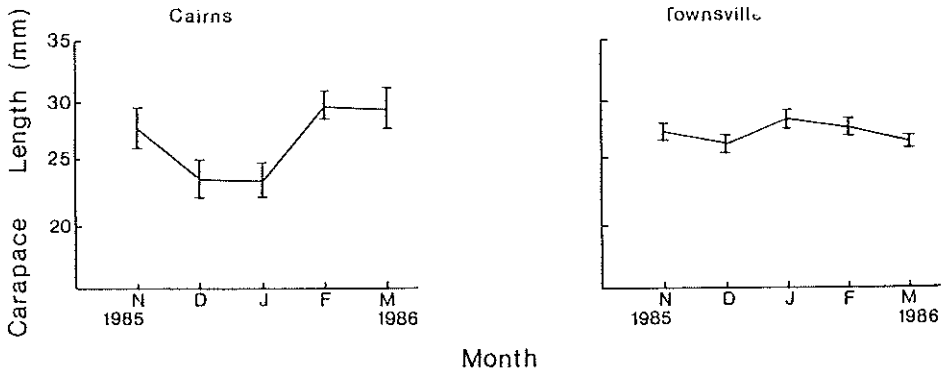

Figure 13. Mean carapace length and 95% confidence limits of the false endeavour prawn (Metapenaeus ensis) caught on the fishing grounds at Cairns and Townsville during the 1985-86 closure to trawling.

Western king prawn (Penaeus latisulcatus)

This species represented only 2.0% of prawns caught in the pooled closure samples; this compared with 4.6% in the 1985 samples from Princess Charlotte Bay and Cape Bedford (Coles et al. 1985).

No marked overall changes in number and weight of this species were observed in samples from Princess Charlotte Bay and Cape Bedford in 1985-

86 (Fig. 14). Average size, however, tended to increase during the closure (Fig. 15).

Numbers of western king prawns caught at the Cairns and Townsville fishing grounds in 1985-86 were too low to infer a change in the weight of catches and the average size of prawns.

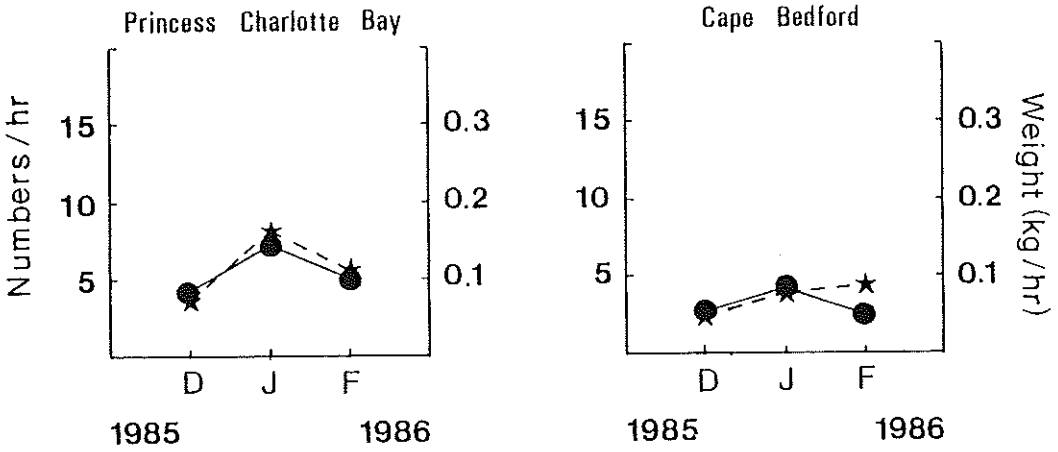

Figure 14. The number (●) and weight (★) of the western king prawn (Penaeus latisulcatus) per hour of trawling from the fishing grounds of Princess Charlotte Bay and Cape Bedford.

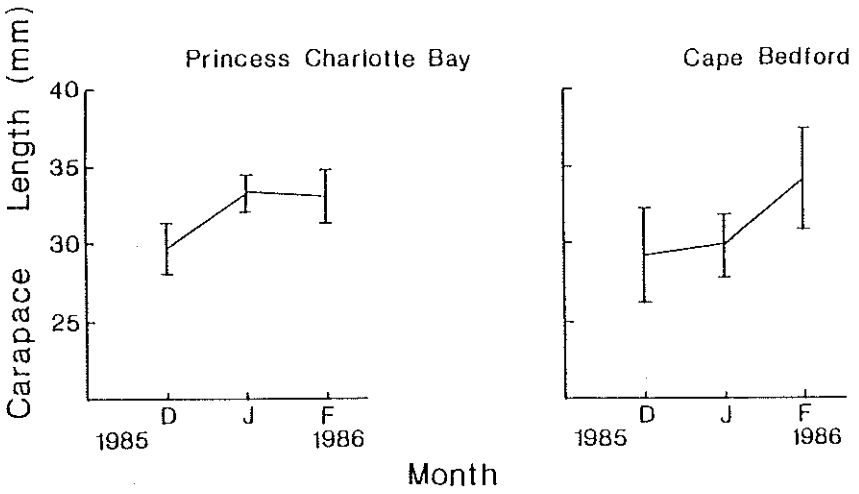

Figure 15. Mean carapace length and 95% confidence limits of the western king prawn (Penaeus latisulcatus) from sampling sites at Princess Charlotte Bay and Cape Bedford.

DISCUSSION

The closure to trawling during the 1985-86 fishing season successfully prevented the incidental capture of many juvenile P. esculentus as they entered commercial fishing grounds along the north Queensland coast. It is certain that had the fishing effort applied in March 1986 been shifted forward into January or February of that year, then a greater proportion of small P. esculentus would have been captured than was the case. The closure was less effective overall in allowing an increase in the number, total weight and size of other species due to the considerable variability in results from the different fishing grounds.

As also reported by Coles et al. (1985) for the early 1985 closure, the size distributions of P. esculentus and M. endeavouri - the two most commercially important species - were unimodal in 1985-86. This suggests a single wave of recruitment to the fishery, and so a correctly timed single seasonal closure to trawling should prevent unwanted capture of juveniles of these species. It is possible that additional juveniles enter the fishery later in the year. Longer term sampling would be required to determine if this occurs.

As was the case in 1985, the closure timing was not appropriate for the grooved tiger prawn P. semisulcatus. Juveniles of this species entered the fishery late in the closure period at all sites except Cape Bedford. The mean carapace length of grooved tiger prawns decreased during the closure as the juveniles entered the fishing grounds (see Fig. 8). It is likely that the majority of small tiger prawns captured early in the 1986 fishing season would be grooved tiger prawns.

At Cape Bedford and Princess Charlotte Bay, where P. semisulcatus comprised only 9.8% of the total prawn catch, the presence of these juveniles may not reduce the value of the closure as a management measure. This is not the case for fishing grounds at Cairns where P. semisulcatus formed the greater proportion of the tiger prawn catch, or at Townsville where it formed nearly half of all tiger prawns caught (Fig. 2).

The numbers of P. semisulcatus increased on all fishing grounds except Cape Bedford. It is likely that if sampling had continued beyond March 1986, this species would have represented an even larger proportion of the tiger prawn catch than that recorded.

Setting an optimal closure timing is also made difficult by the interaction between the numbers of prawns on the fishing grounds and their size. By the end of the closure period at Princess Charlotte Bay, the number and total weight of brown tiger prawns were decreasing, although the average size (CL, see Fig. 4) was increasing. It would require a complex fisheries management model to include information on the changes in size, number, and weight for each of the species, as well as to include the change in the value of the prawns with their size. The data from the closure samples strongly suggest that the differences between the fishing grounds sampled, in species composition and in the changes in number and size of prawns captured during the closure period, would render such a

model useful for only a limited subset of the fishing grounds to which the closure was applied.

The differences between life cycle timing of the prawn species (particularly the tiger prawns) and between the species composition of the fishing grounds, support the concerns expressed by Coles et al. (1985) about the application of a blanket closure for the east coast trawl fishery.

Development of appropriate management measures to optimise catch values for the northern Queensland prawn fishery is complicated by the multi-species nature of the fishery, the size-related value of the prawn catch, and the biological variability apparent among the various fishing grounds. Longer term sampling from a wider range of fishing grounds is required before suitable yield models can be developed and management measures devised to optimise catch values.

Until such a sampling programme can be undertaken, the present closure strategy is likely to be the best proposition for fishery managers. It is undoubtedly achieving its aim of reducing the capture of juvenile brown tiger prawns.

SUMMARY

- The trawl closure in the 1985-86 fishing season was effective in reducing the incidental capture of juvenile brown tiger prawns P. esculentus. It was ineffective for the grooved tiger prawn ,P. semisulcatus, which forms a major component of the catch from Cairns and Townsville fishing grounds.

- Because of marked biological differences among prawn species on the various fishing grounds, the closure time cannot be appropriate for all fishing grounds included in the closure to trawling.

- A longer term (12 months) sampling programme incorporating a wide range of fishing grounds on the north-eastern Queensland coast is required as a basis for developing more refined management methods.

- The present strategy of fixed seasonal closures is reducing the catch of small brown tiger prawns, and in the absence of more detailed biological data is likely to remain the best management strategy available.

REFERENCE

Coles, R.G.,Lee Long, W.J., Mellors, J.E., and Goeden, G.B. (1985), An assessment of the 1985 Queensland east coast prawn trawling closure, QDPI Information Series QI85023.