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INTRODUCTION

In 1985 the Queensland Fish Management Authority, acting in liaison with north Queensland fishermen, implemented a prawn trawling closure in Queensland waters. This was supported by a complementary closure in Commonwealth waters.

The closure in Queensland waters extended from the northern limit of the protected zone in the Torres Strait southwards to the Whitsunday Islands near Bowen and was in force from midday on 19 January 1985 until midday on 28 February 1985. The Commonwealth closure covered offshore waters from Torres Strait south to Cape Tribulation near Port Douglas, from 1 January to 28 February 1985.

The fishery for which the closure was intended, extends from Bowen to Cape York and involves a total of 200-300 trawlers. Most of these are based at Cairns with other fleets at Bowen, Townsville, Innisfail, Port Douglas, and Cooktown.

Prawns in this fishery are caught by pattern trawling at night. Species caught include the brown tiger prawn Penaeus esculentus, the grooved tiger prawn P. semisulcatus, the western king prawn P. latisulcatus and the endeavour prawn, Metapenaeus endeavouri.

These species have a similar life cycle pattern. Previous research indicates that adults spawn offshore on the fishing grounds giving rise to large numbers of eggs. These hatch, probably in less than 24 hours, into a series of planktonic stages which are carried to inshore areas by wind and tidal currents. In these shallow inshore and often seagrass covered "nursery grounds" they settle out on the bottom and grow until as juveniles they begin to move back into the fishery. On the east coast of North Queensland this life cycle takes less than one year. The intention of the Queensland Fish Management Authority in imposing seasonal closures on this fishery was to prevent accidental capture of the juvenile prawns as they move back onto the fishing grounds, thus allowing them time to grow and increase in value.

The timing of these closures was based on information from two sources. Initially commercial fishermen experienced in the fishery, indicated times of the year when trawl catches contained a large proportion of juvenile prawns. This information was then combined with data on prawn life cycles resulting from Fisheries Research Branch projects in the Gulf of Carpentaria and in Trinity Inlet, Cairns. This process provided the best estimatation for the timing of the closure. This decision making process has been documented (Bryan, 1985) for the benefit of fishermen involved in the fishery.

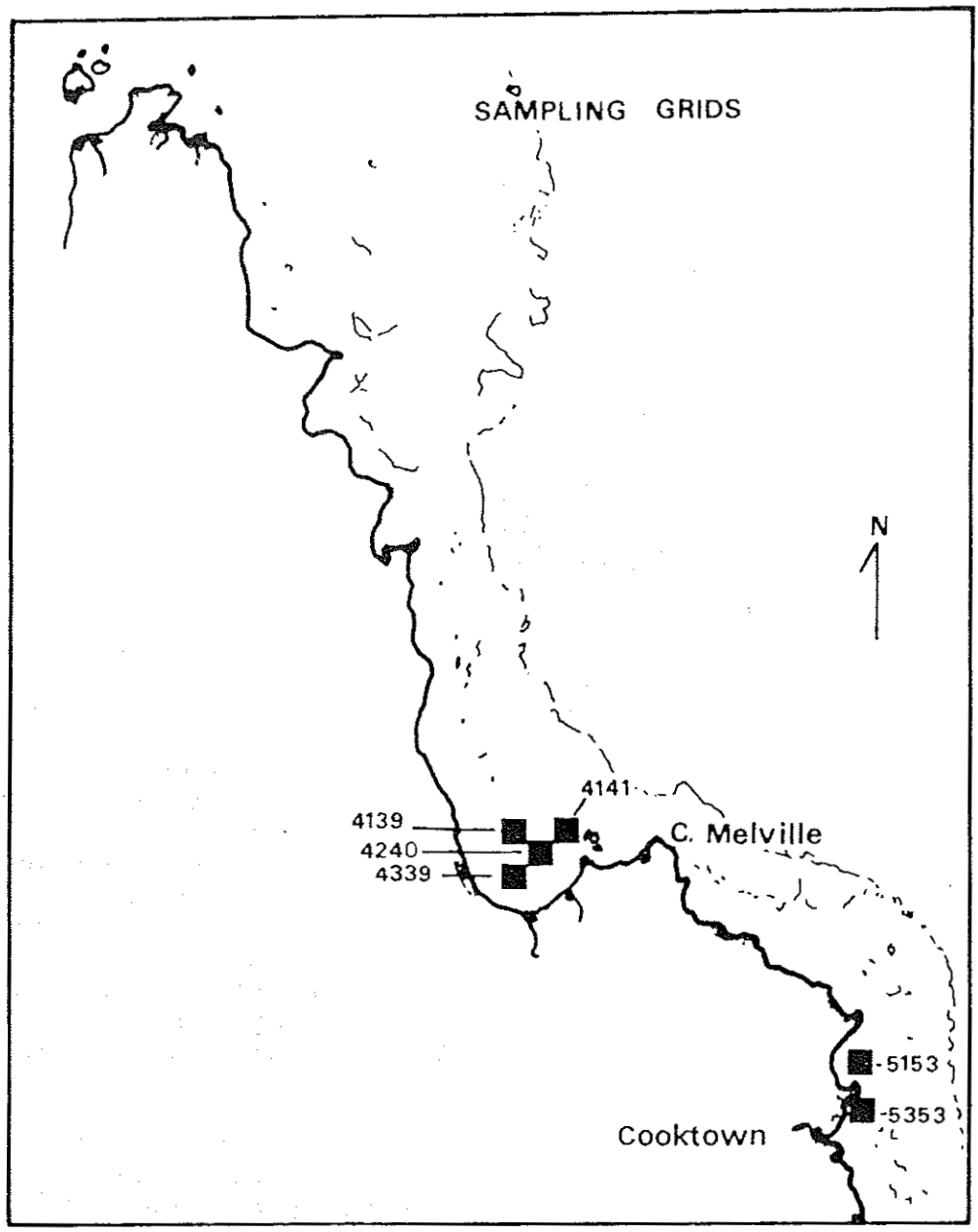

Figure 1. Sampling grids at Cape Bedford and Princess Charlotte Bay.

To determine the effect of the closures on the fishery and to establish if they were a worthwhile management measure, Fisheries Research Branch scientists investigated prawn populations at Cape Bedford and Princess Charlotte Bay. This study was designed to:

(1) 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,

(2) assess the possibility that emigration and natural mortality would result in a net loss of prawns to the fishery during the closed period, and

(3) examine how appropriate the timing of the closure was in preventing capture of juvenile prawns for each of the species involved.

MATERIAL AND METHODS

Sampling

Samples were collected during the closure using the Fisheries Research Branch trawler, the R.V. "Gwendoline May", towing two, six fathom, modified "Florida Flyer" trawl nets with 5.1 cm mesh.

Samples were collected on two commercial fishing grounds one at Cape Bedford and the other at Princess Charlotte Bay, on three occasions (4 January to 6 January 1985, 3 February to 4 February 1985 and 4 March to 6 March 1985) corresponding approximately to the beginning, middle and end of the closed fishing period. During each sampling trip, two Northern Prawn Fishery grids were sampled at Cape Bedford (5153 and 5353) and four at Princess Charlotte Bay (4240, 4141, 4339 and 4139; see Fig. 1). On each sampling trip, two shots each of one hour duration were taken in each grid at Cape Bedford and a single trawl shot made in each grid at Princess Charlotte Bay.

Measurements

This sampling regime gave sufficient data on the important commercial species for statistical analysis of the changes in the size and weight of prawns on the fishing grounds during the closure. Prawns in each trawl shot were separated into the different species. These prawns were then counted, a total weight and count/kg recorded, and a length measurement, the carapace length (CL) measured.

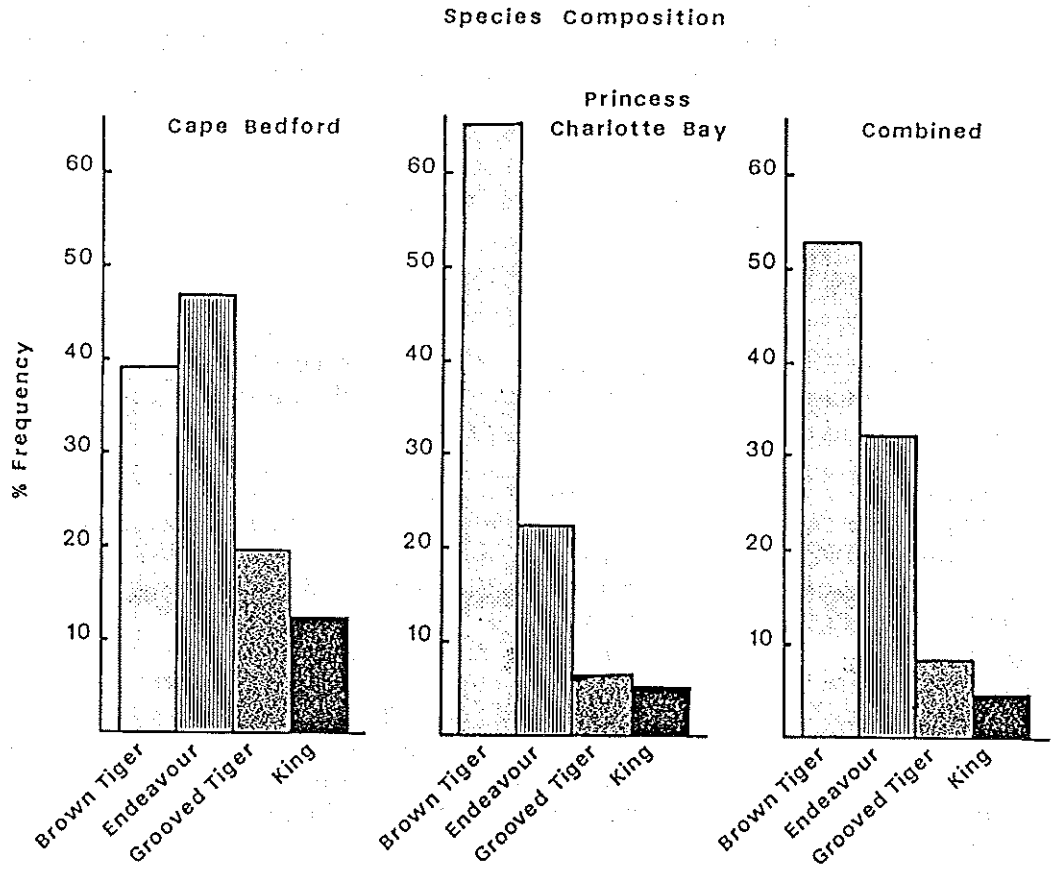

Figure 2. Percentage composition of the four common commercial species.

RESULTS AND ANALYSIS

General

Eight species of commercially important penaeid prawns were caught (Table 1). The most numerous were: the brown tiger prawn, P. esculentus; the grooved tiger prawn, P. semisulcatus; the western king prawn P. latisulcatus and the endeavour prawn, M. endeavouri. Analyses were only conducted for these four species.

As trends in the data were similar for trawl shots on each of the two fishing grounds, Cape Bedford and Princess Charlotte Bay, data from each trawl shot and grid on each of the fishing grounds were combined.

Table 1 The total number and species of the commercial prawns caught by R.V."Gwendoline May" at Cape Bedford and Princess Charlotte Bay during the three sampling trips. CB = Cape Bedford, PCB = Princess Charlotte Bay.

SPECIES	1		2		3	
	CB	PCB	CB	PCB	CB	PCB
Brown Tiger	419	528	524	779	1007	1002
Endeavour	588	141	359	162	1378	483
Grooved Tiger	122	25	156	25	216	192
Western King	8	15	54	27	148	147
Red Spot King	23	1	46	2	46	12
False Endeavour	58	11	0	8	31	14
Banana	2	0	0	0	0	0
Leader	1	0	0	0	1	2

There were differences between the mean size of male and female prawns. However, as fishermen do not distinguish between sexes in their catches, sexes were not analysed separately, except in size frequency histograms (Figs. 7,8,11,12)

Brown tiger prawn (Penaeus esculentus)

Overall this was the most common species forming 52.8% of the catch (Fig. 2). It formed a smaller proportion of the catch at Cape Bedford than at Princess Charlotte Bay, indicating substantial differences between the two fisheries (Fig. 2).

The number and weight of brown tiger prawns caught more than doubled during the closure (Figs. 3 and 4). The mean size of brown tiger prawns increased at both sites (Fig. 5),

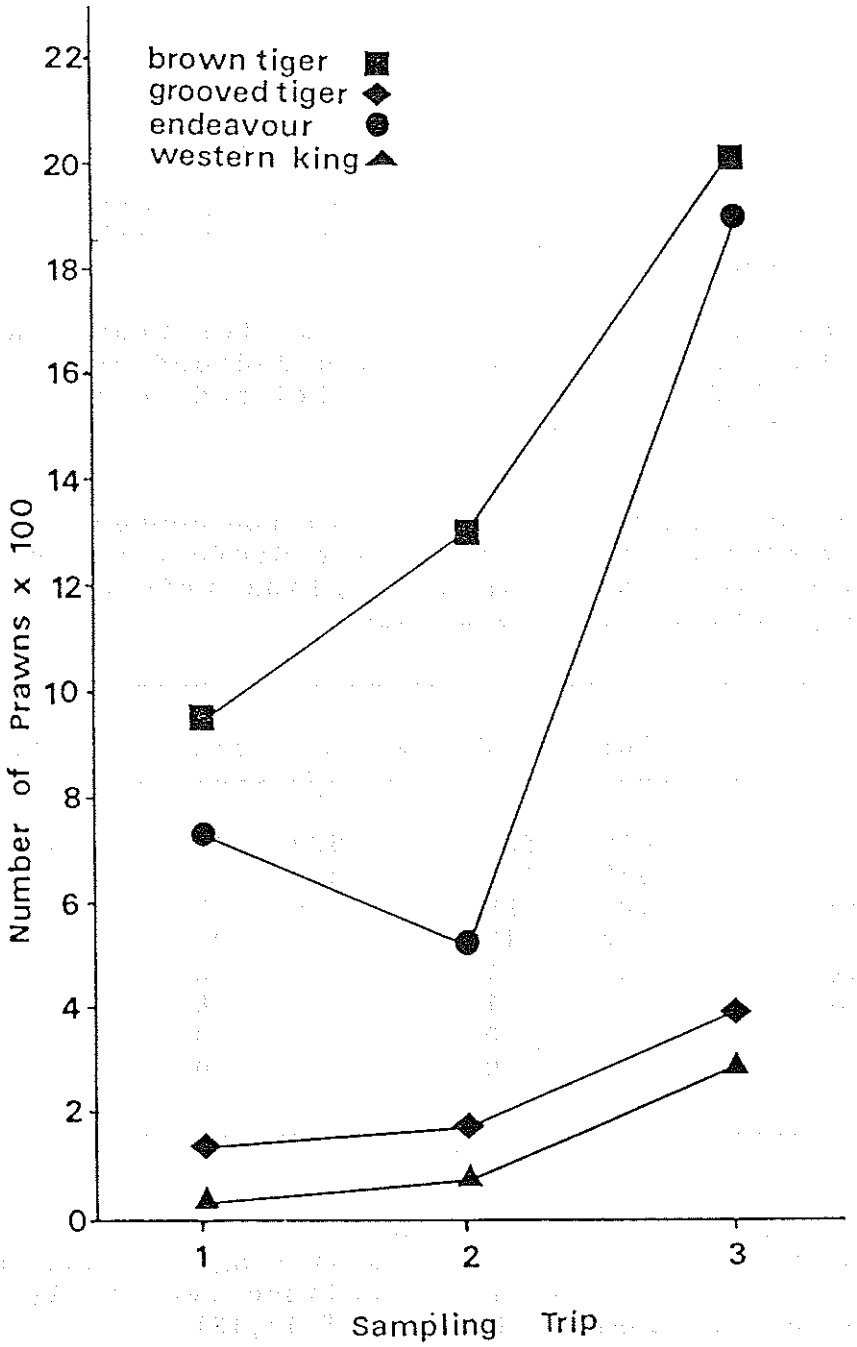

Figure 3. The number of prawns caught in research trawls at the beginning (1), middle (2), and end (3) of the closure. Data from Cape Bedford and Princess Charlotte Bay are combined.

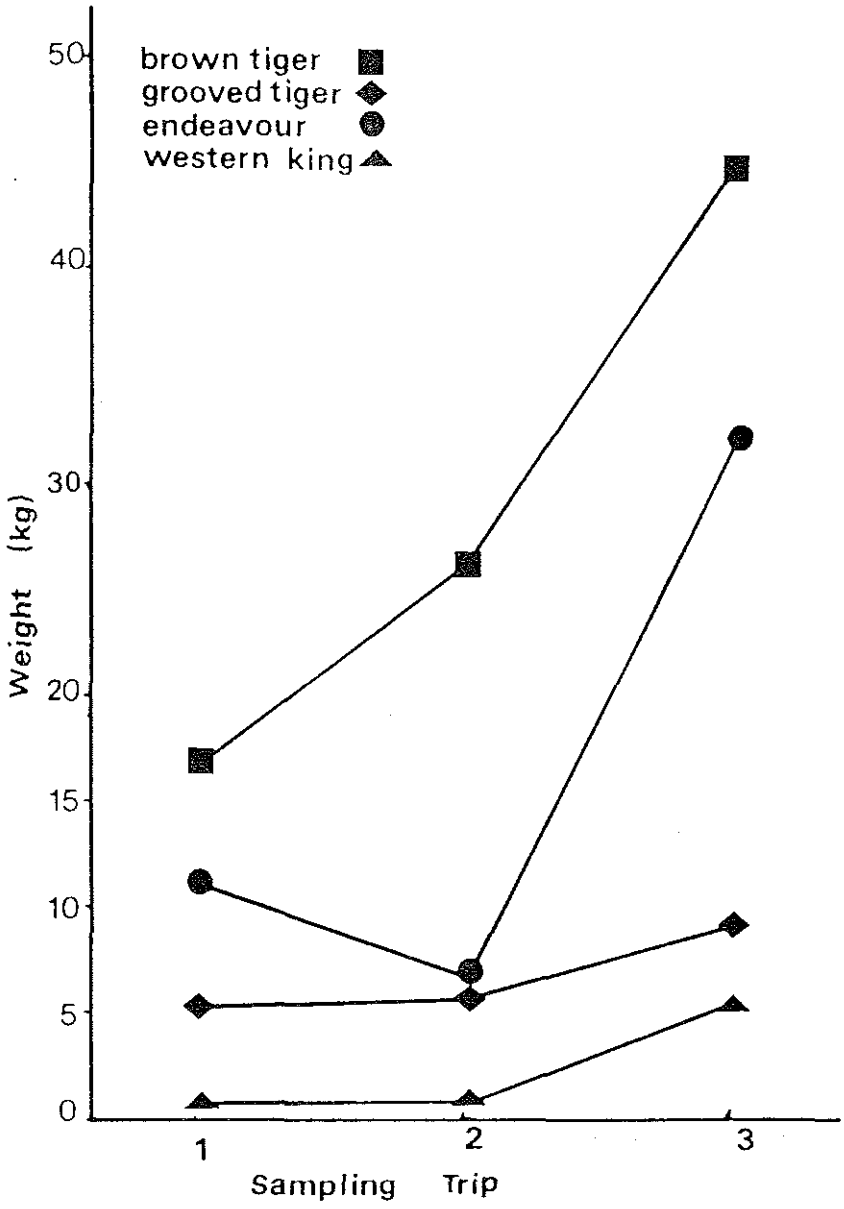

Figure 4. The weight of prawns caught in research trawls at the beginning (1), middle (2), and end (3) of the closure. Data from Cape Bedford and Princess Charlotte Bay are combined.

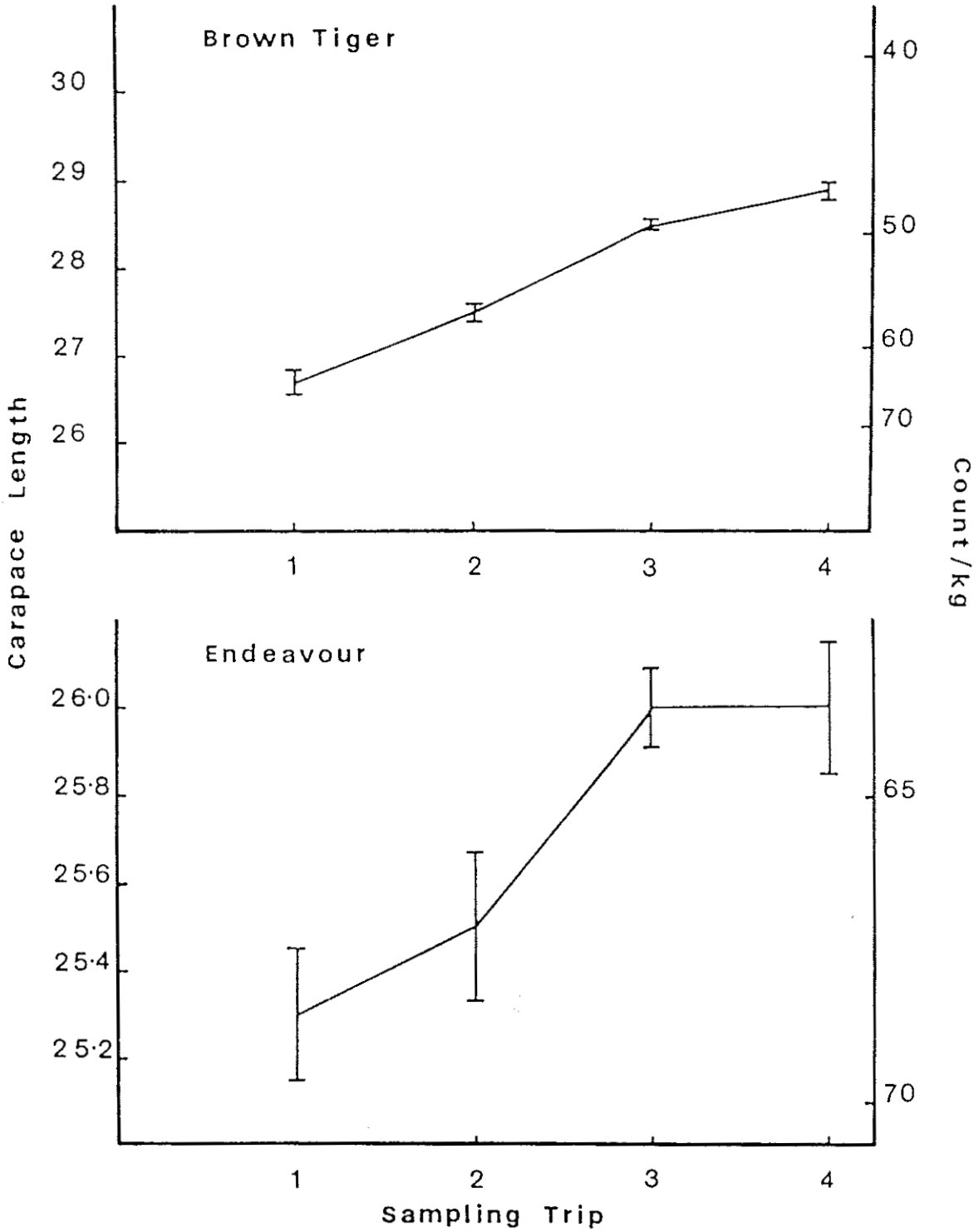

Figure 5. The change in the mean size of brown tiger and endeavour prawns during the closure. Vertical lines represent the 95% confidence limit of the mean.
C.B. = Cape Bedford, P.C.B. = Princess Charlotte Bay.

although the increase was greater at Cape Bedford (a mean CL size increase from 25.6 mm to 29.1 mm) than at Princess Charlotte Bay (27.6 mm to 27.9 mm).

The proportion of brown tiger prawns of a size less than 26 mm CL (equivalent to 30 count/1b commercial grade) decreased at both sites (Fig. 6). At Cape Bedford the proportion of small brown tiger prawns fell from 53.4% at the beginning of the closure to less than 2.3% at the end of the closure. At Princess Charlotte Bay the change was smaller, from 21.2% to 16.8%. The size frequency histogram for this species is distinctly unimodal with little difference between the size of male and female prawns (Fig. 7).

Endeavour prawn (Metapenaeus endeavouri)

This was the second most numerous species and represented 32.2% of all prawns caught. Endeavour prawns were more numerous than the brown tiger prawns at Cape Bedford. The number of endeavour prawns in samples from both fishing grounds increased from 729 to 1861 by the end of the closure (Fig.3). The total weight of this species also increased (Fig. 4).

The mean size of endeavour prawns increased from 25.5 mm CL to 26.0 mm CL at Cape Bedford, and from 24.7 mm CL to 26.0 mm CL at Princess Charlotte Bay. The proportion of endeavour prawns less than 26 mm CL (smaller than 30 count/1b) fell during the closure, from 54.4% to 41.2% at Cape Bedford, and from 53.2% to 44.3 % at Princess Charlotte Bay (Fig. 6). Size frequency histograms for this species showed a single peak in the size distribution (Fig. 8).

Grooved tiger prawn (Penaeus semisulcatus).

Grooved tiger prawns formed 8.1% of the prawn catch by number (Fig. 2). The proportion was similar on both fishing grounds. There were increases in both number and total weight of this species during the closure, although the increases were small compared to that of brown tiger and endeavour prawns (Figs. 3 and 4). The mean size of grooved tiger prawns at both Cape Bedford and Princess Charlotte Bay was greatest at the beginning of the closure (35.5 mm and 32.5 mm CL respectively (Fig. 9)). It decreased during the closure as the proportion of prawns smaller than 26 mm CL (equivalent to 30 count/1b) increased. This was particularly evident at Princess Charlotte Bay (Fig. 10).

Size frequency histograms showed an increase in juvenile prawns of less than 26 mm CL by the last sampling trip (Fig. 11). There was also a population of large female prawns, probably from the previous years spawning. Males do not appear to grow as large as females (Fig. 11).

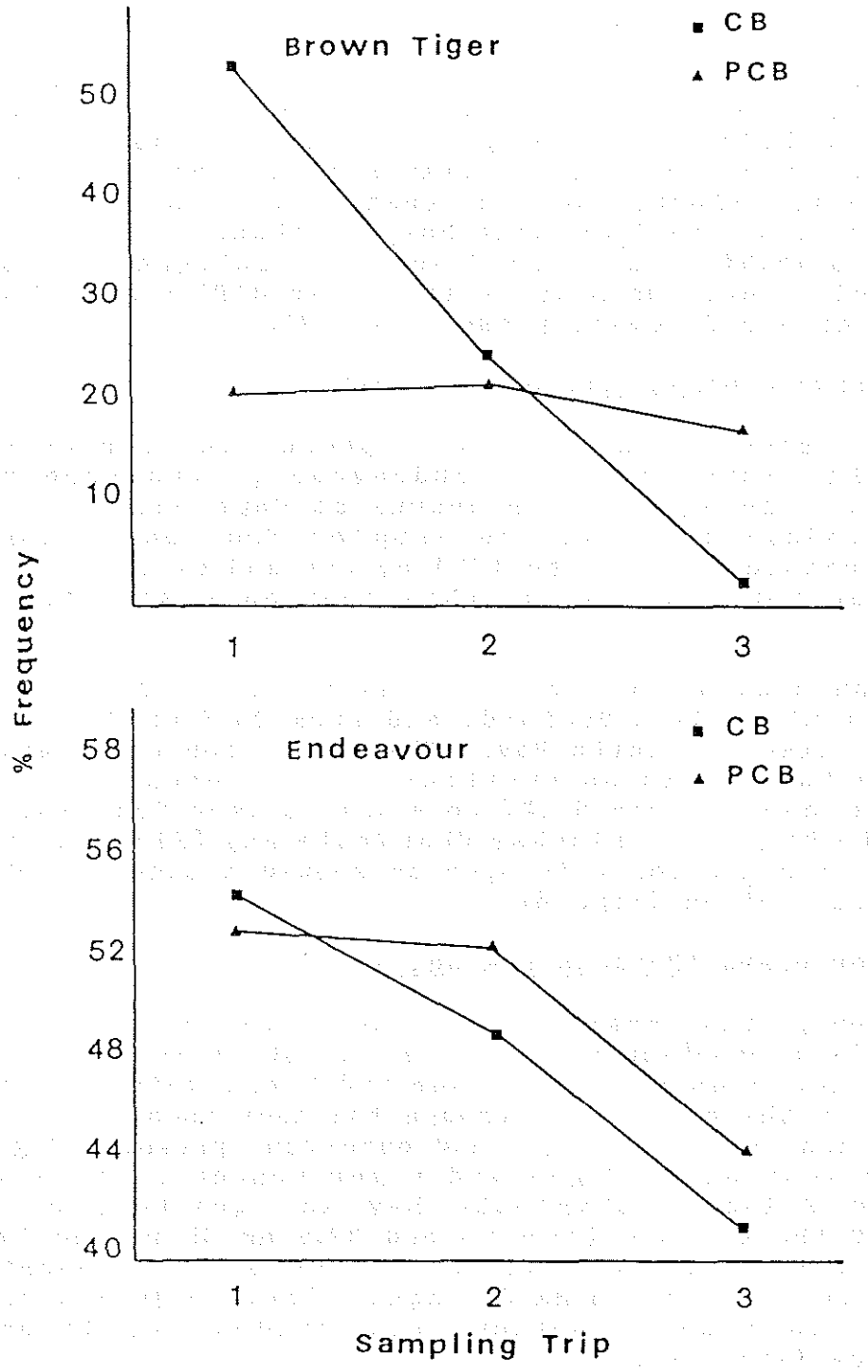

Figure 6. The percentage of brown tiger prawns and endeavour prawns less than 26 mm carapace length (=30 count/lb).
C.B. = Cape Bedford, P.C.B. = Princess Charlotte Bay.

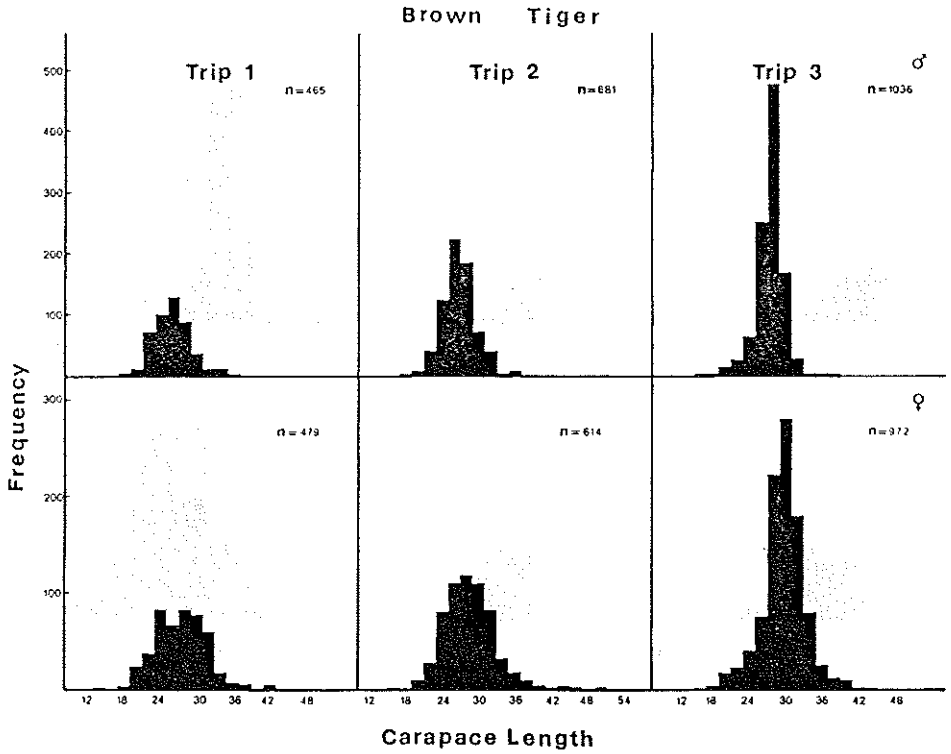

Figure 7. Size frequency histograms for male and female brown tiger prawns.

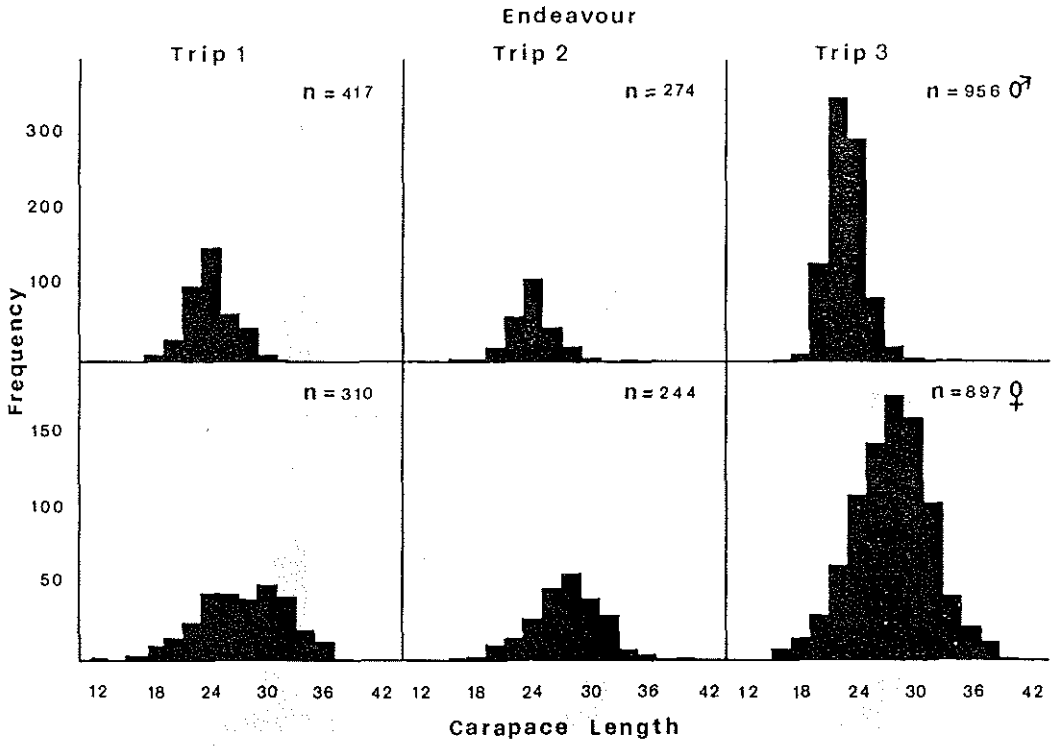

Figure 8. Size frequency histograms for male and female endeavour prawns.

Western king prawn (Penaeus latisulcatus)

Only small numbers of this species were captured during sampling (Fig. 3). Both number and total weight of western king prawns increased during the closure (Fig. 3 and 4). The mean size of prawns fell during the closure from 34.0 mm CL to 31.5 mm CL at Cape Bedford and by 33.1 mm CL to 31.2 mm CL at Princess Charlotte Bay (Fig. 9). This trend resulted from an increase in the proportion of juvenile prawns of this species on the fishing grounds by the end of the closure, as evidenced by the size frequency histograms (Fig. 12).

DISCUSSION

As a management measure, the closure was markedly successful. An increase in the total number and weight of commercially important prawns occurred in the absence of commercial trawling. The overall increase in the total weight of prawns caught and changes in size frequencies show no indication of a reduction in the numbers of larger prawns during the closure. Reductions in the mean size of prawns, where they occurred, were the result of an increase in the proportion of juvenile prawns in the samples.

The single mode in size frequencies for the commercially important brown tiger and endeavour prawns suggests a single spawning period leading to a single period of recruitment of juvenile prawns to the fishing ground. This is similar to results for these species in the Gulf of Carpentaria (Coles and Lee Long, 1985). This fact is important for the management of the fishery. A single seasonal closure to trawling, correctly timed should be adequate to protect juvenile prawns. This would not be the case if there were multiple waves of juvenile prawns entering the fishing grounds.

There were substantial differences between the results taken from the two fishing grounds. It is possible that the east coast prawn fishery does not consist of a single stock. It may be made up of a series of smaller stocks based on separate prawn nursery grounds. The differences between Cape Bedford and Princess Charlotte Bay would suggest that the closure timing may not necessarily be suitable for all parts of the north east Queensland prawn fishery. A sampling programme would be required to establish if life cycle timings are similar on all major fishing grounds to which the closure was applied.

Increases in mean size and decreases in the proportion of small brown tiger prawns (smaller than the commercial grade of 30 count/lb) suggest that the timing of the closure was effective for this species. It was particularly so at Cape Bedford where most prawns were of a commercially acceptable size by the end of the closure to trawling.

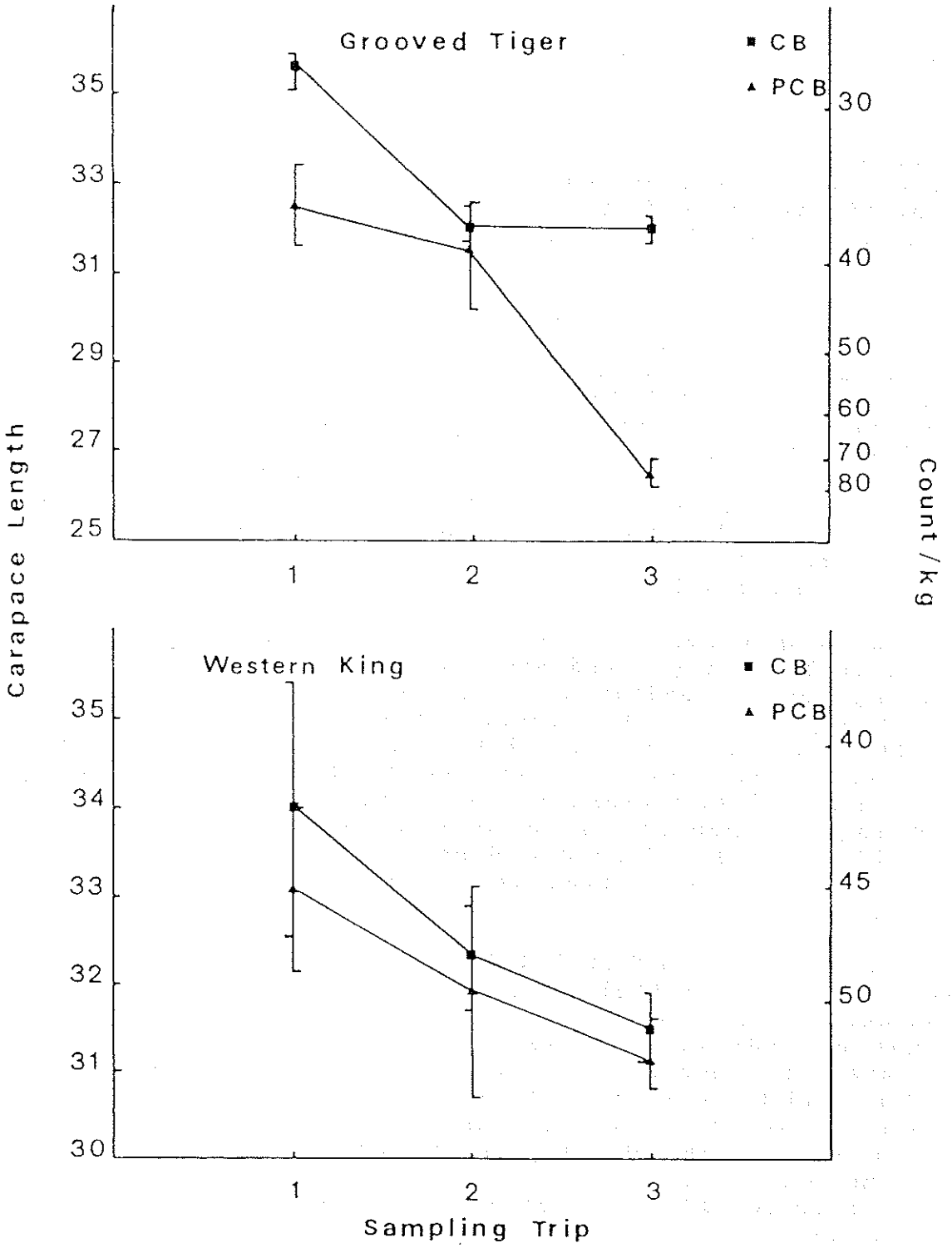

Figure 9. The change in the mean size of grooved tiger and western king prawns during the closure. Vertical lines represent the 95% confidence limits of the mean.
C.B. = Cape Bedford, P.C.B. = Princess Charlotte Bay.

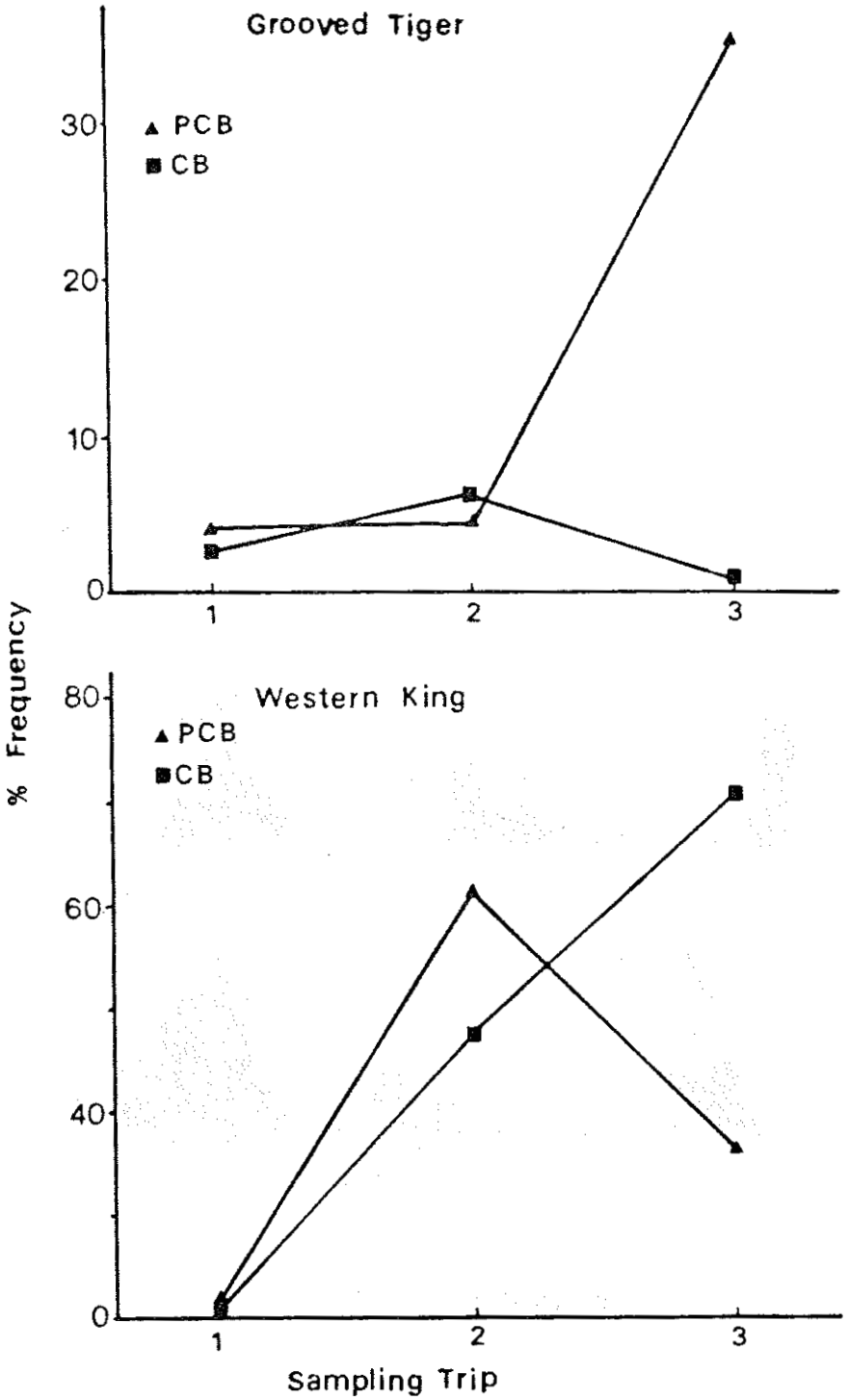

Figure 10. The percentage of grooved tiger prawns and endeavour prawns less than 26 mm carapace length (= 30 count/lb).
C.B. = Cape Bedford, P.C.B. = Princess Charlotte Bay.

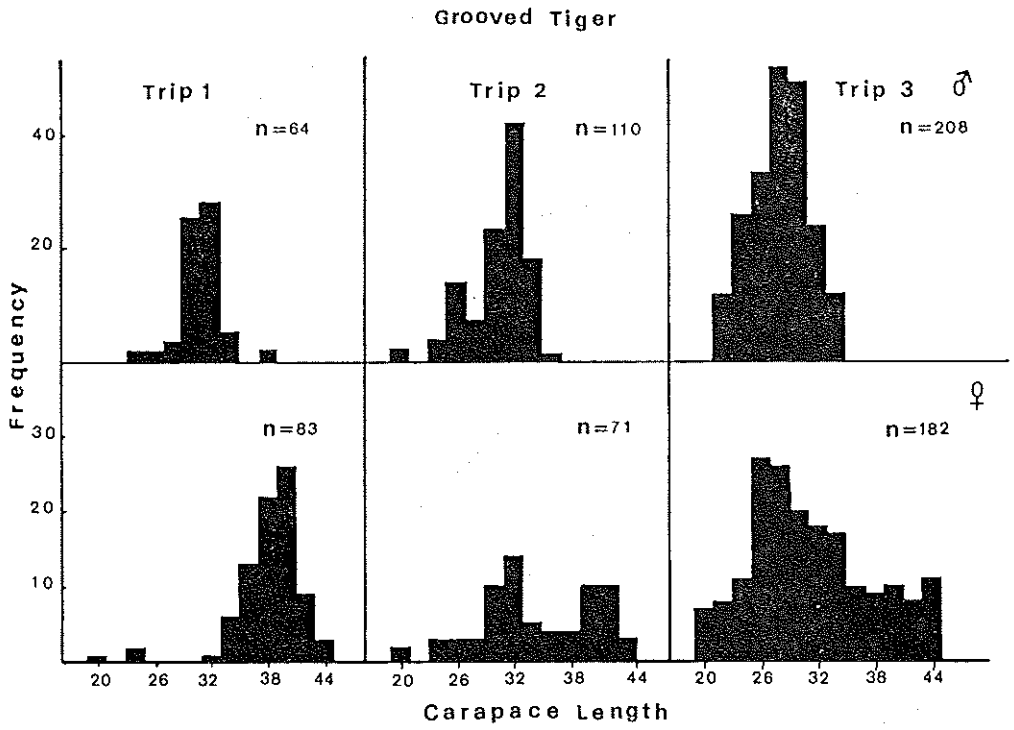

Figure 11. Size frequency histograms for male and female grooved tiger prawns.

The differences in the species composition of prawns at Cape Bedford and at Princess Charlotte Bay may be explained by the proximity of sampling sites to areas of seagrass prawn nursery grounds. Tiger prawn postlarvae have been shown to be most numerous in inshore areas where there are seagrasses (Staples, 1984; Coles and Lee Long, 1985). Large seagrass beds occur around Princess Charlotte Bay but not in the Cape Bedford region (Coles et al, 1985). This would lead to the greater proportion of tiger prawns in Princess Charlotte Bay.

The results for brown tiger prawns at Princess Charlotte Bay, and endeavour prawns at both sites, support the view of the fishing industry that the closures could have started earlier than the 1 January 1985. This would have the effect of preventing the capture of a greater number of juvenile prawns. It is possible that the closure could have been extended later into March. However, without data on natural mortality and prawn migration on the east Queensland coast, such an extension could well result in an overall reduction in the number and weight of prawns on the fishing grounds. This would occur if the rate of natural mortality increased as the prawn population aged or if normal population movement results in prawns moving off the established fishing grounds.

While the closure timing was appropriate for brown tiger prawns and endeavour prawns it was not so for grooved tiger prawns and western king prawns. Bryan's (1985) description of prawn life cycle timings emphasized that grooved tiger prawns spawn later than brown tiger prawns. This later spawning resulted in juvenile grooved tiger prawns entering the fishery late in the closure period. The results for western king prawns were similar. It must be remembered, however, that these two species formed only small proportions (8.1% and 6.9% respectively) of the total catch. If these proportions remain small, future closures based on the timing of the life cycle of the brown tiger prawn will remain effective. If the proportion of these species in the population were to increase the timing of future closures would require re-assessment.

The closure effectively protected for the two months a population of large female grooved tiger prawns. If this leads to an increase in the spawning success of this species, then the proportion of grooved tigers in the catch may increase.

Lifecycle timings, used in the decision on closure timing were based on biological data from only a single year of sampling. In applying a closure without pre-closure sampling, the assumption is made that the life cycle timing of the important commercial species does not vary from one year to the next. Long term data on this point would be extremely valuable as only small changes in the life cycle timing would result in the timing of the closure period being inappropriate.

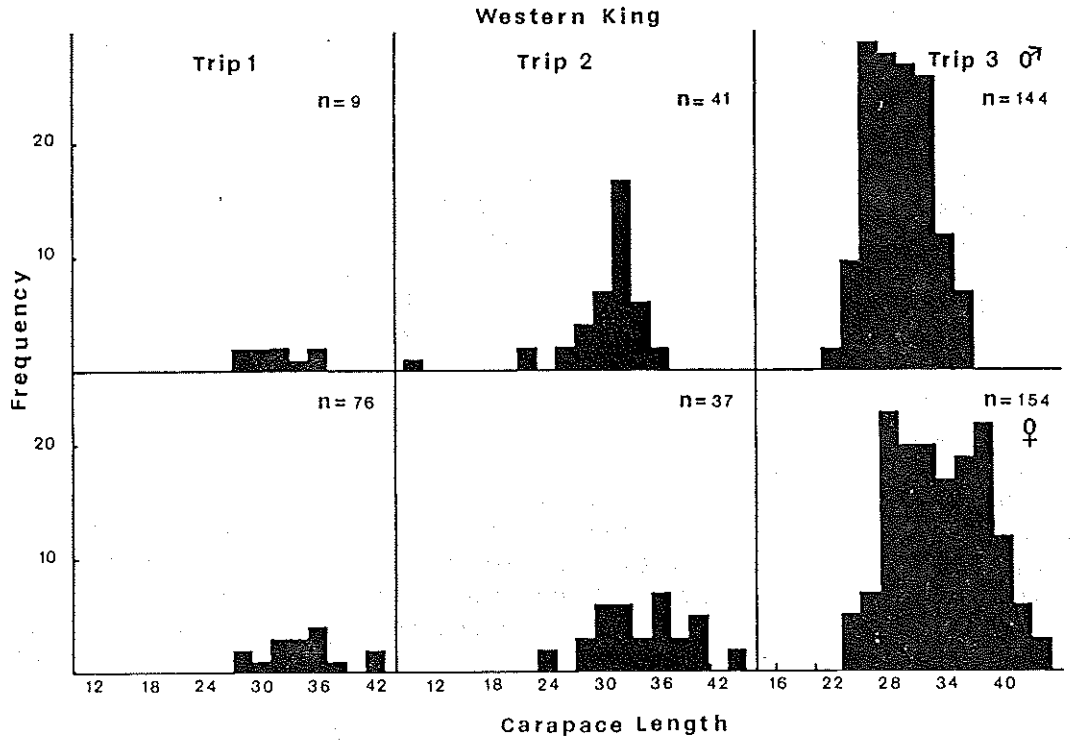

Figure 12. Size frequency histograms for male and female western king prawns.

SUMMARY

(1) The closure was effective in reducing the numbers of juvenile brown tiger and endeavour prawns caught by the trawl fishery. It was less effective in protecting juvenile grooved tiger and western king prawns.

(2) There were differences between the two fishing grounds in the species and size composition, and in the changes that occurred during the closure. It is possible that the closure timing may not be suitable for all fishing grounds included in the closure area. Additional fishing grounds should be included in future sampling programmes.

(3) The trends for an increase in size and decrease in the proportion of juvenile prawns indicates that a longer closure with extension into December may be appropriate.

(4) There were marked differences between the two tiger prawn species and these differences should be taken into account in any analysis of combined tiger prawn catch data.

(5) Data are required on the year to year changes in the timing and extent of juvenile prawn migration to the fishing grounds to establish the need for regular closure sampling.

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