Variation in banana prawn catches at Weipa:
A comprehensive regional study

DRAFT Final Report

FRDC Project No. 2004/024

Edited by:
Peter C Rothlisberg and Thomas A Okey

October 2006
About this report

Some portions of this report were written with the intention of publication in internationally-refereed journals. Before the full report, or any part of it, is made available for sale or placed on any web site, the publication status and approval from the report editors and each individual section author should be requested.

Enquiries should be addressed to:

Peter C. Rothlisberg (Peter.Rothlisberg@csiro.au) or
Thomas A. Okey (Tom.Okey@csiro.au)

Please cite this report as:
5.2.5 Effort analysis – Neil Loneragan

When commercial prawn fishing began in the Gulf of Carpentaria in the early 1960s, it initially targeted only the banana prawn (*Penaeus merguiensis*) ~ a species that formed dense aggregations that stir the sediment, making visible mud ‘boils’. Catches of *P. merguiensis* peaked at more than 12,000 t in 1974 and have remained high, although they fluctuate from year to year (Dichmont et al. 2006). These large catches, together with open access to the fishery (which attracted large foreign vessels in the 1960s and 70s) and government boat-building subsidies, resulted in the fishing fleet growing to about 280 vessels in the early 1980s (Figure 5-14). Furthermore, because *P. merguiensis* is short-lived and aggregates, the fishery made substantial investments in processing and targeting equipment. The increased efficiencies led to the allowable number of fishing days being reduced from year-round in the 1960s, to a few months in the 1970s, and to just over a month in the 1990s and thereafter (Somers and Wang 1997).

Data from the logbooks were explored using simple linear regression analysis to detect whether there had been major changes in the relationship between catch and effort over three decades of the Weipa fishery and the available years of data since 1999. If the slope of the line has changed over time it suggests that fishing effectiveness (catchability) has changed, while a change in the intercept indicates that the available biomass has changed. Trends in the relationships were compared between Weipa (Stock 11) and Karumba (Stock 9) regions to see whether the relationship between catch and effort was consistent between these two regions.

**Methods**

Data on the total fishing effort for banana prawns and catch (log transformed) of banana prawns were examined in each of the decades from 1970 until 2000 and simple linear regressions were fitted to explain catch in terms of effort.

**Results**

The number of boats operating in the Northern Prawn Fishery has declined from 280 in the early 1980s to about 120 in the 1990s and then to 89 in 2005 due to the introduction of limited entry and various vessel buy back schemes (Figure 5-14a). The total number of days available for fishing each year was 237 in the early 1980s, with only an end of year closure to prevent growth overfishing. Following the introduction of the mid-season closure in 1987, the number of days available for fishing declined to 188 in 1987 (Figure 5-14b). The number of days available for fishing declined further in the 1990s following increases in the length of closed periods to rebuild the *Penaeus esculentus* stocks. Currently, about 150 days are available for fishing. The reductions in both the number of boats operating in the fishery and the number of days available for fishing each year has resulted in a nearly 5 fold decrease in the total number of boat days available for fishing from about 60,000 in 1984 to 13,350 in 2005 (Figure 5-14c).
The notable drop in the number of vessels operating during the 1970s and the lack of boat day estimates prior to 1983 (Figure 5-14a, Figure 5-14c) reflects the considerable uncertainty about fleet size prior to the introduction of limited entry in 1980. Prior to 1980, different definitions of the eligible boats to be counted were used and this accounts for the large differences in numbers of vessels prior to 1980 compared to the “official” AFMA document. Many vessels from the east coast came into the Gulf of Carpentaria for limited times of a month or less, and this migration
of boats into the Northern Prawn Fishery was variable from year to year, thus adding to uncertainty about which boats should be counted. The decision by fishers to participate in the NPF prior to 1980 depended on how participants regarded the relative probabilities of cyclones, bonanza catch post-cyclone, lack of infrastructure to cope with bonanza catches, and what other fishers were planning. All were vessels fishing in the NPF were counted in the fleet audit, whereas the AFMA count may have had an eligibility criterion related to the number of months fishing in the NPF (Janet Bishop, CMAR, personal communication, 28 September 2006).

The total fishing effort in boat days per annum at Weipa (stock region 11) decreased steadily from the 1970s (600 to 1400 boat days per annum until the 1990s (400 to 800 boats days) but has shown a greater rate of decline since 1997 and not exceeded 100 boat days since 2000 (Figure 5-15). Fishing effort at Karumba (stock region 9) also declined between the 1970s (450 to 2546 boat days) and 1980s (75 to 557 boat days, except for 1981 with 2159 boat days) but did not continue to decline further and has always exceeded 345 boat days in each year since 1990 (Figure 5-15).

![Figure 5-15. Fishing effort (boats days) on banana prawns in Weipa (stock 11) and Karumba (stock 9) from 1970 until 2004.](image)

The decline in effort through the decades is explained by the decrease in the number of boats operating each year in the NPF and a reduction in the number of days available for fishing because of the introduction of seasonal closures (Figure 5-14).

At both Weipa and Karumba, the slope of the relationship between catch and effort in the 1970s and 1990s was about 2 to 3 times higher than that in the 1970s (Figure 5-16, Figure 5-17, Table 5-2), indicating a difference in the fisheries dynamics.
between these two decades. However, in the 2000s, the slope of the Weipa relationship was low, while that for Karumba was the highest estimated.

The proportion of variation in total banana prawn catch explained by effort, varied greatly between decades at Weipa and ranged from 73% in the 1970s to only 23% in the 1980s (Figure 5-16, Table 5-2). In Karumba, the proportion of variation in catch explained by fishing effort was more consistent and higher than at Weipa, ranging from 70% in the 1970s to 95% in the 1980s (Figure 5-17, Table 5-2).

Figure 5-16. Relationship between total fishing effort (boat days) and total annual catch for Weipa (stock 11). Lines show regression lines for each decade of data i.e. 1970s, 1980s, 1990s and 2000s. Equations and fit of the regressions are shown in Table 5-2.

Figure 5-17. Relationship between total fishing effort (boat days) and total annual catch for Karumba (Stock 9). Lines show regression lines for each decade of data i.e. 1970s, 1980s, 1990s and 2000s. Equations and fit of the regressions are shown in Table 5-2.
Table 5-2. Summary of regressions equations for the relationship between annual catch (C) and effort (E) for banana prawns in each time period for (a) Weipa and (b) Karumba. N = 10 for each decade except the 2000s, where N = 5.

<table>
<thead>
<tr>
<th>Region and decade</th>
<th>Equation</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Weipa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1970s</td>
<td>C = 1.693E - 807.75</td>
<td>0.77</td>
</tr>
<tr>
<td>1980s</td>
<td>C = 0.634E + 107.53</td>
<td>0.23</td>
</tr>
<tr>
<td>1990s</td>
<td>C = 1.289E - 145.15</td>
<td>0.49</td>
</tr>
<tr>
<td>2000s</td>
<td>C = 0.543E + 0.744</td>
<td>0.28</td>
</tr>
<tr>
<td>(b) Karumba</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1970s</td>
<td>C = 1.702E - 558.91</td>
<td>0.70</td>
</tr>
<tr>
<td>1980s</td>
<td>C = 0.607E + 211.86</td>
<td>0.95</td>
</tr>
<tr>
<td>1990s</td>
<td>C = 1.643E - 228.63</td>
<td>0.85</td>
</tr>
<tr>
<td>2000s</td>
<td>C = 2.210E - 487.97</td>
<td>0.96</td>
</tr>
</tbody>
</table>

Discussion
These results, from simple descriptive analyses, highlight the different nature of the fishery at Weipa and Karumba and the change in relationship between catch and effort over the decades, particularly between the 1970s and 1980s at Weipa. They also highlight the difference in the relationship between Weipa and Karumba since 2000.

The also suggest that the dynamics of the fishery is different in the two regions, particularly since the 1980s. Effort and catch show a strong, consistent relationship at Karumba but a weaker and less consistent relationship at Weipa. From discussions with fishers, Weipa is now fished by only a small proportion of the fleet and for short time intervals, while fishing effort has continued at Karumba where spotter planes are used to locate schools of banana prawns.

References