FISHERY ASSESSMENT REPORT

TASMANIAN GIANT CRAB FISHERY 2000/2001

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& Fisheries Institute
University of Tasmania

This assessment of the giant crab resource is the first to be produced by the Tasmanian Aquaculture and Fisheries Institute (TAFI).

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Giant Crab Fisheries Assessment: 2000/01

Summary

This is the first Tasmanian giant crab stock assessment and it reports on the state of the resource after one and a half years of the current giant crab management plan. This management plan introduced individual transferable quota management to the fishery commencing in November 1999. Performance indicators are described in the management plan and relate to catch rates (catch per unit effort), total annual catch, and size structure of the catch. Trigger points are defined for each of these indicators and this stock assessment report evaluates the performance of the fishery in relation to each of these triggers.

Results are mixed, with many performance indicator triggers breached, while others appear well within acceptable limits. Of greatest concern is the steady decline in catch rates over the last 6 years. As with most of the performance indicators, this measure of the status of the resource may be biased by the small amount of data and high incidence of errors within data. Research on improving the giant crab assessment, currently funded through FRDC is focussed on this issue. A priority for the next assessment report should be the provision of standardised catch rate data. Results for each of the performance indicators are:

- Statewide catch per unit effort has declined each year since 1994/95 and thus breaches the trigger of two consecutive years of decline. This may be partially a function of several factors other than declining crab abundance, including misreporting of effort and changing fishing and targeting practices.

- Catch per unit effort in 5 of the 6 regional areas has declined by greater than 20% over 2 years and thus breaches the trigger point.

- Total annual commercial catch was less than the minimum catch trigger of 90% of the total allowable catch of 100 tonnes in 1999/00. However, this is clearly a function of the reduced season opening in that year, which resulted from the introduction of the new management plan (4 months only). In the first full season of the management plan, 2000/01, the total catch was over 96 tonnes and thus this trigger was not breached in the latest year and thus provides no cause for concern.

- Bycatch of giant crabs taken by fishers that do not hold crab quota has been less than 1.5 tonnes for each assessment year since the introduction of quota management and thus does not exceed the trigger of 5 tonnes.

- Both the percentage of crabs less than 3 kg and the percentage of crabs greater than 5 kg differed by greater than 30% from the reference year of 1996/97 and thus breaches the trigger point.

Additional data to that required for assessing trigger points is presented, including preliminary information on bycatch species, proportion of undersize in catches, and the proportion of females in catches. Spermathecae samples collected during 2000/01 were compared with a sample collected during 1994/95. There was no detectable change in the size of spermathecae with crab size, which indicates that mating success has not been affected by fishing activities.

In conclusion, the decline in catch per unit effort in five of the six regional areas in which significant catches are taken may be a real cause for concern. However, because of known problems with the available data in the commercial catch and effort database and CPUE in this report is being calculated using summary data, this decline in CPUE may be real or only apparent. We recommend, therefore, that the commercial catch and effort database be reviewed and cleaned, that the CPUE be standardized to minimize the influence of individual fishers, difference in seasonality of fishing, and where the areas where most effort is expended. The work to make these improvements has already begun.

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1. Introduction

This report is the first formal stock assessment of the Tasmanian giant crab resource and is an annual requirement of the Tasmanian giant crab management plan.

Giant crabs are taken in deeper water than most commercial crustacean species, with fishing effort concentrated around the edge of the continental shelf. The species is only found across southern Australia. Commercial exploitation was sporadic until the early 1990's due to their low market price. Commercial rock lobster fishers had identified regions with high giant crab density off Portland in Victoria by the 1880's and small numbers were marketed in Melbourne. The fishery was reassessed in Tasmania during the 1970's with the aim of establishing an industry based on picked flesh. This never eventuated due to low catches and prices.

Giant crabs collected as a bycatch to the rock lobster fishery continued to be marketed only occasionally in southern Australian States as most animals captured were discarded. The development of markets and techniques for live rock lobster enabled several processors and fishers to start developing markets for live giant crabs in 1991. This resulted in a rapid increase in price and volume of landed product so that fishers were able to target giant crab with steel traps on deeper ground than that for rock lobster. By 1994/95, catches in Tasmania had risen to 290 tonnes from less than 1 tonne in 1991 (Figure 1). Catches subsequently declined and a quota (total allowable catch – TAC) of 100 tonnes was introduced in November 1999 as part of a new management plan for the fishery. The quota season is from March 1st through to the end of February, which is the same as for rock lobster. Other States have had a similar rise and fall in catches. The majority of the Australian catch (and TAC) is now taken around Tasmania.

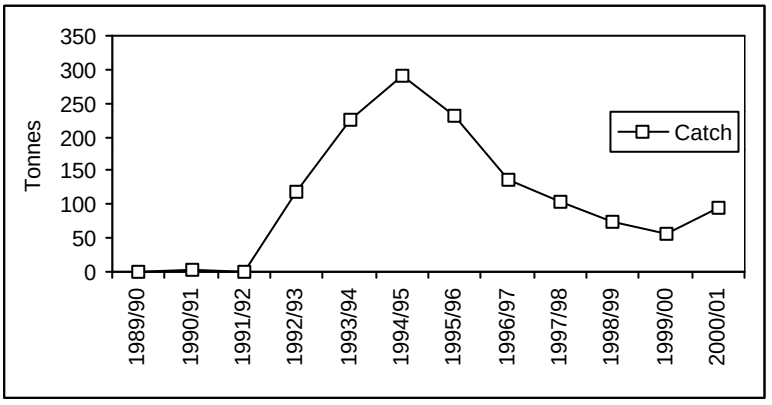


Figure 1. Historical giant crab catch in Tasmania. The Total Allowable Catch was set at 100 tonnes in November 1999.

The giant crab fishery is still closely associated with the rock lobster fishery with many participants shifting effort between the two species depending on catches and market price. Opening of other fisheries, particularly scallop, also influences effort directed at giant crab. Around 10 boats take small catches of a few tonnes as bycatch from rock lobster fishing in deeper water, while the majority of the catch is taken by less than 10 boats specifically targeting giant crab. Fishers targeting giant crab have altered their gear from that used by rock lobster fishers to larger, heavier steel pots to overcome drag from the long buoy lines.

The giant crab industry is small by volume but valuable due to the high market price of the product. The direct value of the Tasmanian giant crab fishery is estimated to be between $3 and $4 million annually. Employment is generated in catching giant crabs and also in support of vessels through provision of fuel, boat maintenance, insurance, bait, etc. These flow-on benefits are typically a high percentage of the catch value in wild fisheries. Live holding and transport is critical for the giant crab industry and employment in processing facilities is also a significant benefit from the fishery. The integration of the giant crab fishery with the rock lobster industry assists both industries by enabling operators to improve efficiency by switching effort in response to markets.

Giant crab catch and fishing effort figures have been recorded throughout the duration of the fishery by the industry and the Tasmanian Department of Primary Industry, Water and Environment. Size-structure samples have been recorded on several occasions by Deakin University, the Tasmanian Aquaculture and Fisheries Institute (TAFI), and also by some fishers. Tagging has also been undertaken with the bulk of this work driven through Deakin University (Levings et al., 2001). Additional research has been conducted by various organisations on a range of other aspects such as larval biology, diet, reproductive biology and product handling (see Appendix 1 – Bibliography of giant crab research publications).

A key step in giant crab assessment research was the production of a yield- and egg per recruit model in 1999 (McGarvey et al., 1999). This model incorporated data from a range of sources, primarily that described by Levings et al. (2001). This model provided estimates of the effect of different size limits on stocks under different fishing scenarios. Further development of this model is currently underway to allow a broader range of scenario testing, including different size limits for males and females (as per rock lobsters) and the harvest of non-berried females during winter.

While the model described by McGarvey et al. (1999) provided information on size limits, it was not intended to be an assessment model that would provide an ongoing measure of the state of the resource. The need for ongoing information on stock size was identified by the Tasmanian Giant Crab Fishery Advisory Committee during the process of formulating the draft management plan. As a result, a new project on the development of giant crab assessment techniques commenced in July 2001 with funding support from the Fisheries Research and Development Corporation. That project has begun to produce results that have fed into this stock assessment report, but the project remains in its infancy. Improvements to the stock assessment process for giant crab are expected to occur over the next few years.

2. Industry Stock Assessment Issues

Fishers interviewed through the course of the FRDC funded giant crab assessment project have identified several assessment issues that are beyond the scope of this report. These issues are presented here as a guide for future research directions.

Some fishers have reported an increased incidence of crabs with black marks on their carapace from the east coast in the last 12 months. Blackening or melanization of the exoskeleton of crustaceans is a common response to a range of diseases or physical traumas (Paynter, 1989). The cause of blackening in these giant crabs is unclear although the pattern of blackening suggests an effect of physical handling or abrasion of some form. Crabs with this discolouration appear to have unaffected flesh, however, the marketability of product is reduced.

Many giant crab fishers, particularly on the west coast, have observed increased activity of trawlers with many boats working ground fished by crab fishers. Industry is concerned that this trend is leading to gear interaction problems and may also affect giant crab habitat. Benthic video surveys appear to be an option for assessing this issue.

Most of the fishers interviewed stated that they had observed large numbers of small juveniles for the first time in the 1999/00 and 2000/01 seasons. This may be an indication of a recruitment pulse and is consistent with the size structure data presented later in this report (Figure 13, page 14). Many exploited crab populations have large variation in recruitment with occasional strong recruitment pulses. Sainte-Marie et al. (1996) considered these pulses to be a function of cannibalism with the reduction in biomass of larger crabs through fishing leading to pulses of recruitment. These cohorts of strong recruitment then act to suppress future year classes until they also enter the fishery and are fished down. A similar scenario is feasible with giant crab given that their natural diet has been shown to include smaller giant crabs (Heeren and Mitchell, 1997).

Both industry and management have identified the need to improve on our ability to evaluate alternative harvest strategies. Specific issues include the simulation of alternative TACs and methods to shift catch to higher value months. An example of this latter issue is the ability to evaluate the effect of permitting harvest of non-berried females during winter months.

3. Fishery Assessment

As noted earlier, this fisheries assessment report is the first to be conducted for the Tasmanian giant crab resource; information and analyses contained within the report are expected to be improved over the next few years through research conducted with FRDC assistance on giant crab assessment techniques. These improvements will include increased amounts of data on some aspects such as catch structure, new indicators of the state of the resource such as standardising CPUE to account for individual fishers, and improved data precision. The last of these points includes the potential for change to existing historical data as data entry errors and other incorrect information is flagged and adjusted or excluded.

Data is generally presented for years divided as per the current quota year: March to February. While this report relates specifically to the 2000/01 season, more recent data is included where possible. Although this will be for an incomplete quota year, it is of value for assessing the current status.

3.1 Evaluation of trigger points

3.1.1 Catch per unit effort

The giant crab management plan defines two trigger points relating to catch per unit effort:

- When CPUE for the state declines for two consecutive years
- When CPUE for any region declines by a total of 20% in two years.

The data used in this analysis is drawn from commercial logbooks and has changed since the start of targeted giant crab fishing in 1992. Logbook data prior to January 1995 does not include a measure of effort (as number of traps) so that data cannot be used for calculation of CPUE (sum of weight/sum of effort). From 1995 to 1999, giant crab data was stored in the general fish database and effort was recorded as the number of traps and the duration of deployment (soak time). Although this allowed the calculation of effort, it is unclear whether fishers were targeting giant crabs or simply retaining bycatch while lobster fishing. Gear type was recorded as either “crab traps” or “lobster pots”. Fishers recording their gear type as “crab traps” were generally targeting crabs, although many targeted crabs yet continued to call their gear “lobster pots”. Fishers who were taking crabs as bycatch while lobster fishing can be separated to some extent based on their reported depth of fishing. From November 1999 onwards, fishers were asked to specify if they were targeting lobster or crab.

Note that fishing practices for giant crab differ from that of lobsters as gear is generally set for periods of several days when targeting giant crab. To account for variability in soak time, catch rates are standardized to catch per 24 hours soak time.

Statewide trends in CPUE

Trends in statewide CPUE caused the trigger to be reached, that is, CPUE has declined for two consecutive years (Figure 2). Three important biases exist for this data and need to be considered when interpreting trends.

First, the CPUE values for months prior to November 1999 may be under-estimates due to the inclusion of data from fishers that were not targeting crabs. This would act to make the decline in targeted CPUE more severe than indicated in Figure 2.

Secondly, it is suspected that effort was under-reported by some fishers prior to 1999 to enable them to use additional traps. This would act to make the decline in CPUE less severe or possibly even reverse the decline in CPUE shown in Figure 2. Deliberate inaccuracies in the reporting of effort may have contributed to the observed highly variable catch rates between months and years (Figure 3 and Figure 4).

Thirdly, CPUE data from fishers targeting crabs in 1999/00 is drawn from only 4 months, Nov-Feb. These months tend to have higher catch rates (Figure 4). This will act to bias the annual catch rate for 1999/00 upwards relative to 2000/01.

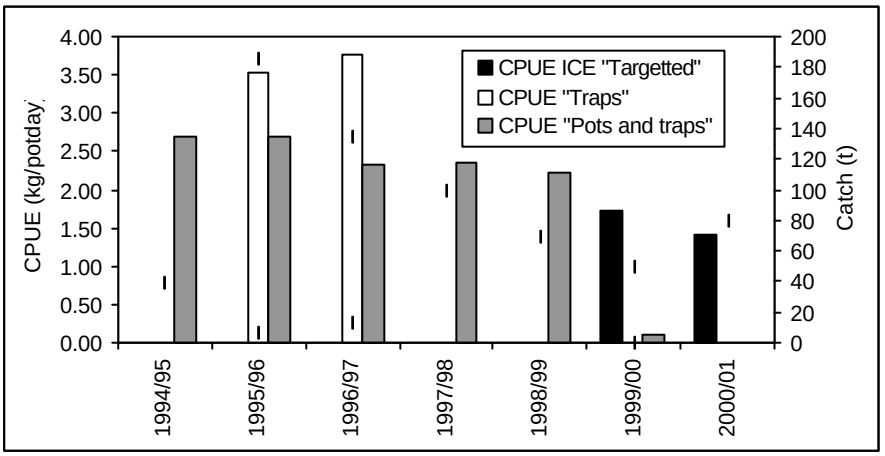


Figure 2. Trends in annual catch per unit effort since 1994/95 (columns) and total catch used to derive these estimates (to provide an indication of sample size; diamonds). Data since the introduction of QMS is restricted to only those catch returns where fishers indicated that they were targeting crabs. Data for years prior to QMS is either for crabs captured by both "lobster pots" and "crabs traps" or "crab traps" only.

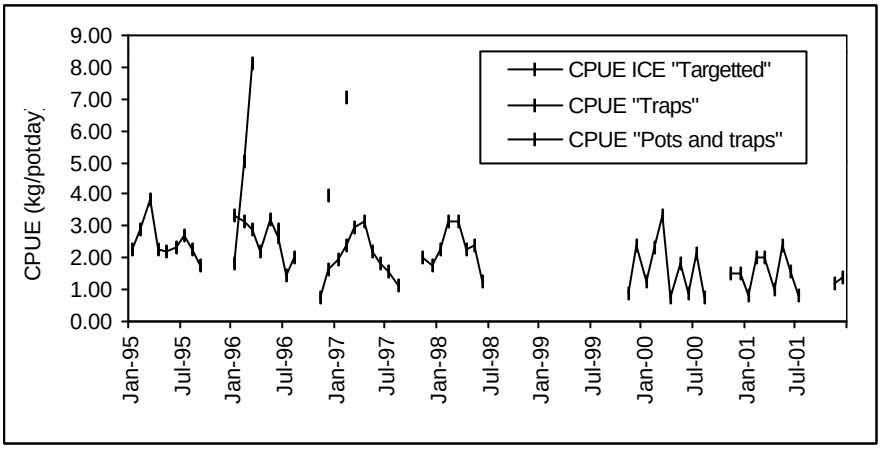


Figure 3. Monthly patterns in CPUE since January 1995. Categories relate to the way fishers defined their fishing activity: either "targeting crabs" (available from 1999 onwards); fishing with "crab traps"; or

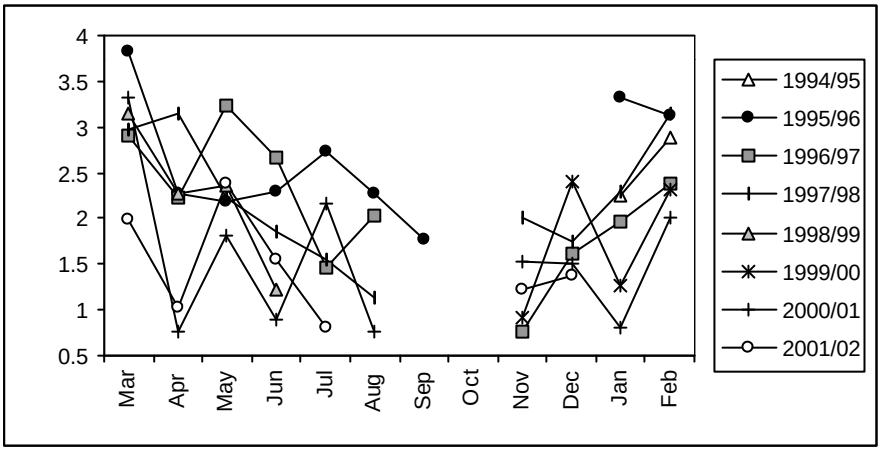


Figure 4. Seasonal patterns in CPUE since 1994/95.

Regional catch rates

The second trigger concerning catch per unit effort (CPUE) relates to each of the 8 stock assessment regions as used for the rock lobster fishery (Figure 5). This trigger is stated as "CPUE for any region declines by a total of 20% in two years". Data is shown for only areas 2 to 7 as very little catch was reported for areas in the far south: 1 and 8. Catch rates for the year 1999/2000 are based on only a small amount of data due to the protracted fishery closure prior to the implementation of QMS. Consequently, care should be taken in interpreting data for this year.

Reported CPUE is highly variable between years with no clear pattern between regions (Figure 6). The trigger point of a total decline in CPUE of 20% in 2 years was breached in each assessment area except area 5 (Table 1).

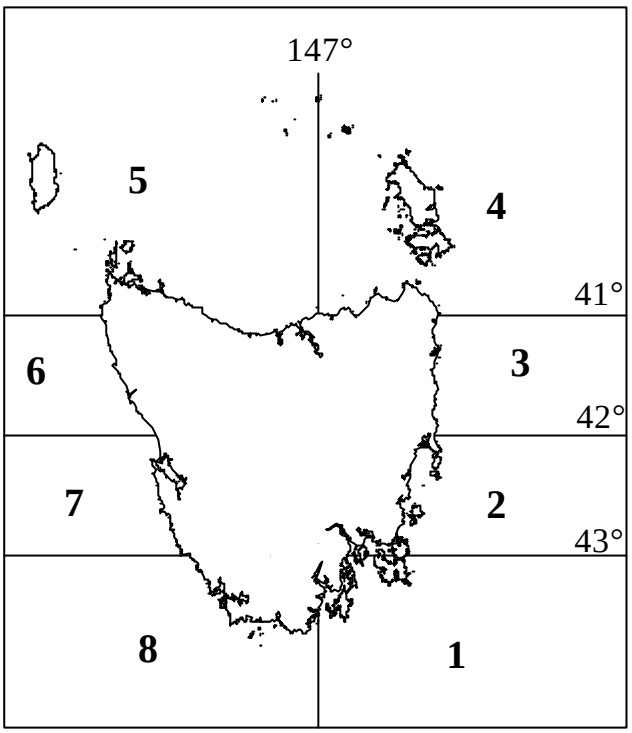


Figure 5. Regional stock assessment areas used for evaluation of regional catch rates. These are the same as those for rock lobster assessment.

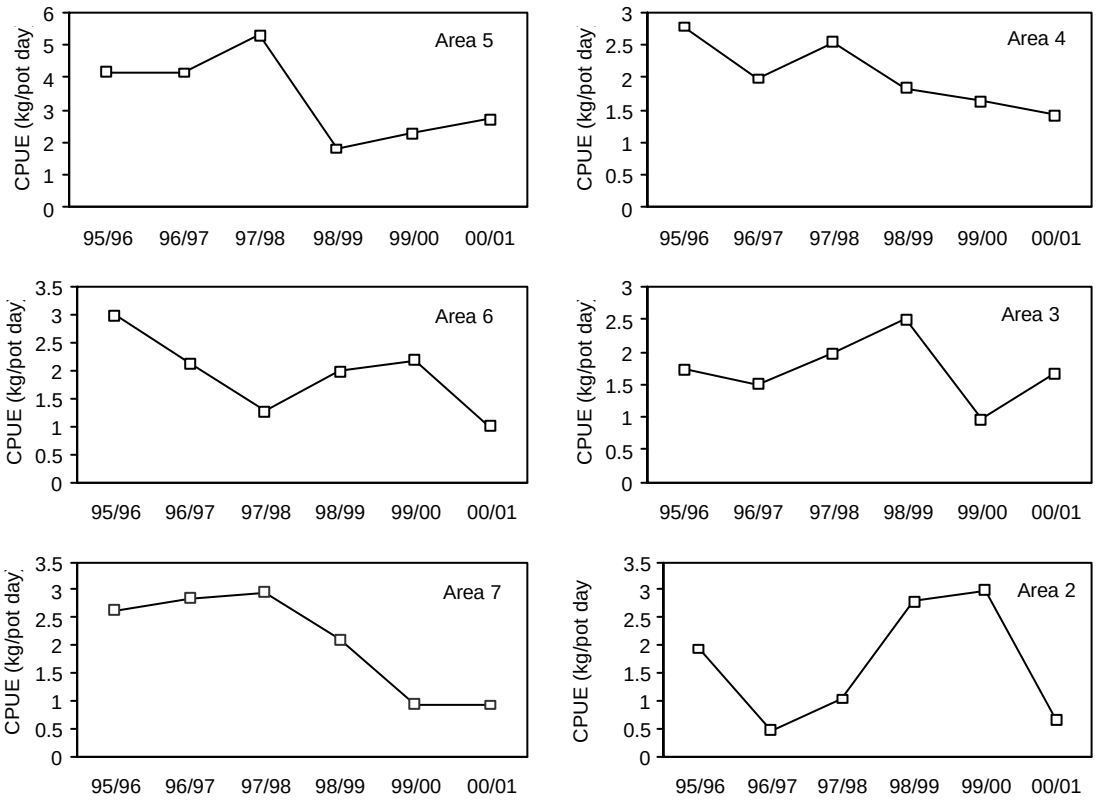


Figure 6. Trends in catch per unit effort (CPUE) from each of the 6 active assessment regions. Years are split by quota years (March –February). Effort is pot days.

Table 1. Catch per unit effort (CPUE) in each assessment area for the 2000/2001 quota year relative to CPUE 2 years ago and CPUE 5 years ago.

Area	CPUE 95/96	CPUE 98/99	CPUE 00/01	% Change last 5 years	% Change last 2 years
2	1.94	2.79	0.67	-65.4	-75.9
3	1.74	2.5	1.68	-3.4	-32.8
4	2.78	1.83	1.42	-48.9	-22.4
5	4.16	1.81	2.73	-34.3	+50.8
6	2.99	2	1.01	-66.2	-49.5
7	2.64	2.12	0.93	-64.7	-56.1

3.1.2 Total annual commercial catch

Two triggers are based on the total annual commercial catch:

- The total yearly catch is not less than 90% of the TAC in any year;
- The bycatch of giant crabs taken by lobster fishers does not exceed 5 tonnes in any year.

Total yearly catch

Catch weight of giant crab is recorded at two stages, at the time of capture in commercial logbooks, and at the time of landing through the quota audit system. Data presented here is from the quota audit system, which is a more accurate measurement as weight is measured by balance rather than just estimated.

Total catch for the first quota year under the Tasmanian giant crab management year (1999/00) was less than the TAC of 100 tonnes although this quota year was abbreviated to run for only 4 months due to the introduction of the new management plan (Table 2).

Total catch weight for the 2000/01 season was in excess of the 90 tonne trigger and it appears probable that this will also be the case for the 2001/02 season.

Table 2. Total catch of giant crab for quota years since introduction of the TAC. Data is presented for 10 months of the 2001/02 season. Although this season is not yet complete, early indications are that the total catch will exceed the trigger of 90 tonnes.

Year	Total catch (kg)	Total N	Mean weight (kg)
1999/00	53054	16394	3.24
2000/01	96226	28636	3.36
2001/02	81474 (to Jan 2002)	22316 (to Jan 2002)	3.68

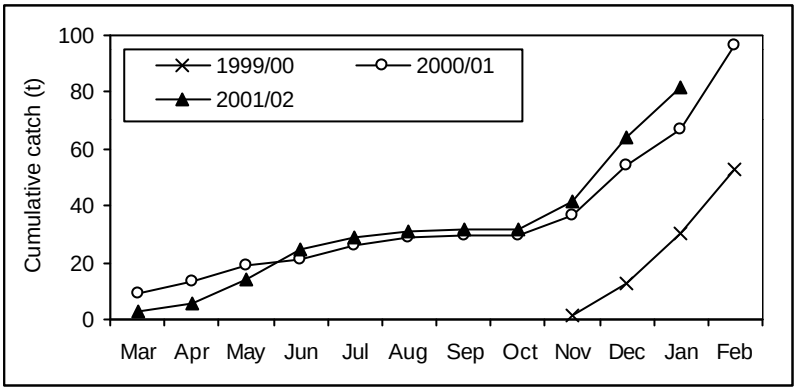


Figure 7. Cumulative catch by month for each quota year since introduction of QMS in 1999. Total catch exceeded 90 tonnes in 2000/01, almost reaching the TAC, and this appears probable in 2001/02 also.

Catch taken as bycatch

Giant crabs can be captured by a range of methods that fall outside the giant crab quota management system. Crabs can be captured in standard rock lobster gear, and provisions in the management plan allow for the landing of a small number of crabs as bycatch. Fishers have also reported capturing giant crabs by a range of other gear types including set nets, baited hooks and trawl. Reported catch taken by these other gear types is small relative to catches from crab traps with catches exceeding 100 kg only for graball nets in 1997/98 and shark nets from 1995/96 to 1997/98 (Figure 8). Reported catch of giant crab from each of these other methods has been less than 100 kg since the introduction of the new management plan in 1999/00. However, anecdotal reports from crab fishers suggest that the true catch by otterboard trawling may be higher than that reported here.

Total bycatch of giant crabs taken by lobster fishers who did not hold giant crab quota is shown in Table 3. Bycatch of giant crab was considerably less than 5 tonnes in each year since the introduction of the management plan. Thus, this trigger was not activated.

Table 3. Giant crab bycatch taken by rock lobster fishers without giant crab quota.

	Giant crab bycatch by lobster fishers (t)	% of total landings
1999/00	1.33	2.45
2000/01	1.07	1.10

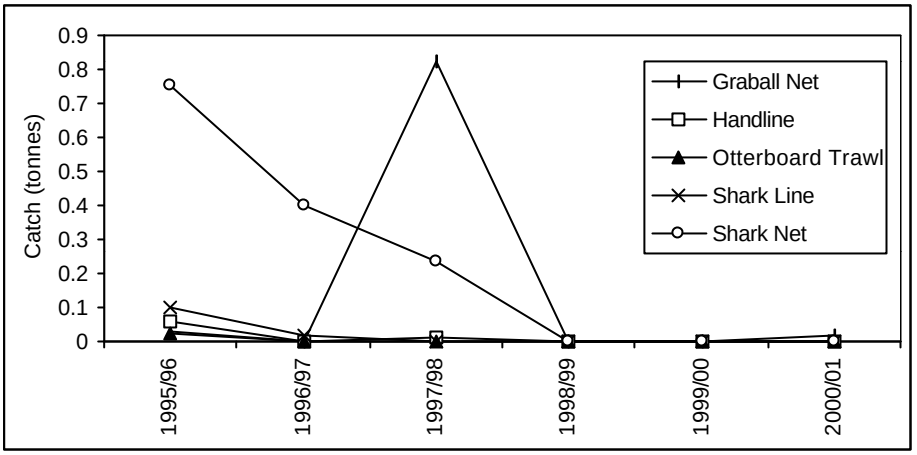


Figure 8. Giant crab catch reported for gear types other than giant crab traps or lobster pots.

3.1.3 Size distribution of the commercial catch

The size distribution of the commercial catch provides a guide to changes to the population as a result of fishing mortality and recruitment pulses. Information on size distribution is obtained from several sources including:

- voluntary measuring of catch (including undersize) by commercial fishers;
- mean weights from estimated catch and number data in commercial log books;
- mean weights from measured weight and number in quota audit data; and
- weights of crabs sold into different price category splits.

Trigger points in the current management plan relate to only the last of these with two triggers listed:

- The proportion of the catch above 5kg varies by more than 30% compared to the 1996/97 distribution;
- The proportion of the catch below 3 kg varies by more than 30% compared to the 1996/97 distribution.

The proportion of crabs falling in small (<3 kg) and large (>5 kg) size splits from sales of fishers to processors are shown in Figure 9. These data were drawn from information collected from both processors and fishers, with the majority of data originating from fishers who tend to work on the west coast. Note this data set does not include all crab sales, rather only those that can be obtained voluntarily from either fishers or processors (Table 4).

Table 4. Proportion of total landed catch included in analyses of processor size-split categories.

Year	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01
%	12.4	23.5	34.2	34.1	27.8	17.4	72.3

Comparison of the proportion of the size split in each category relative to the reference year of 1996/97 is shown in Figure 10. Both these triggers are activated in recent years with an increase in the proportion of large crabs >5 kg of greater than 30% and an decrease in the proportion of small crabs <3kg of greater than 30%.

Two issues require further investigation. First, the observed change in size distribution of the catch may be influenced by the introduction of a maximum size limit in 1999. This would be expected to reduce the proportion of catch in the >5kg category, opposite to that observed here. Also note that the individual fishers that are included within these samples influence conclusions. The need for a large data set is illustrated in Figure 11.

Although no trigger point relates directly to data on the mean size of landed crabs collected through the quota audit process, these are useful nonetheless for observing patterns in the size distribution of the population. Figure 12 shows the mean monthly weight of landed crabs since the introduction of QMS in 1999. No trend is apparent in these data, which suggests stability in size structure of the landed catch.

The size structure of the commercial catch can be collected most directly by measurement of individual animals. Surveys were completed in Jan-Mar 1998 by observers working on commercial vessels off eastern and northwestern Tasmania. A component of the FRDC funded project currently underway is directed towards extending this sampling by obtaining this information from fishers. To date, data has only be been provided from the northwest coast of Tasmania (Dec 2001 – Jan 2002). Size structure of the commercial catch appears to have changed between the 1997/98 and 2001/02 seasons (Figure 13 and Figure 14).

When viewing these catch structure distributions, it is important to note that: (a) the original catch sample from 1997/98 includes only a small sample size; (b) month of sampling differs; (c) precise location and depth of samples differ; and (d) the frequency counts are not scaled to catch rate per trap. These issues are common to most samples of size structure from commercial fisheries catches. They are a more important issue in this instance, however, as data are only available from samples from two years. In time, as more samples are collected, it will become easier to separate true trends in population size structure from random sample variation.

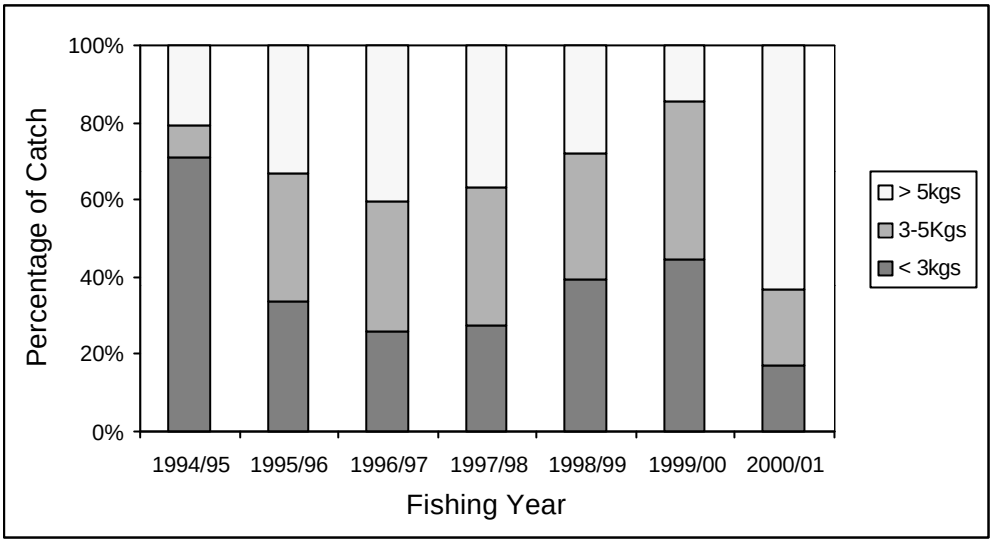


Figure 9. Proportions of landed catch (biomass) in commercial size-split categories.

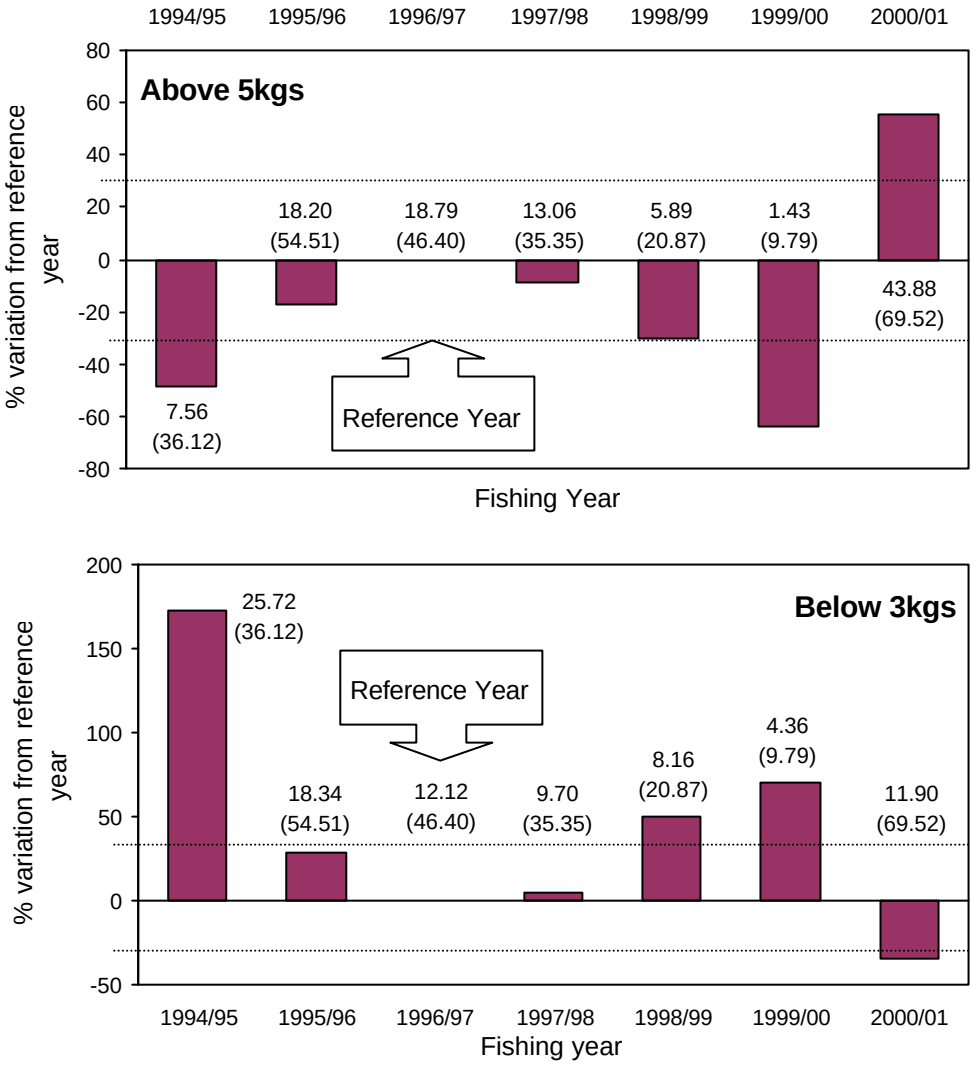


Figure 10. Percentage difference of the proportion of the catch in large or small size splits relative to the reference year of 1996/97. Total weight of catch in each size split is shown next to each column, with the total catch weight that data is available for in parentheses. Dotted lines represent 30% differences.

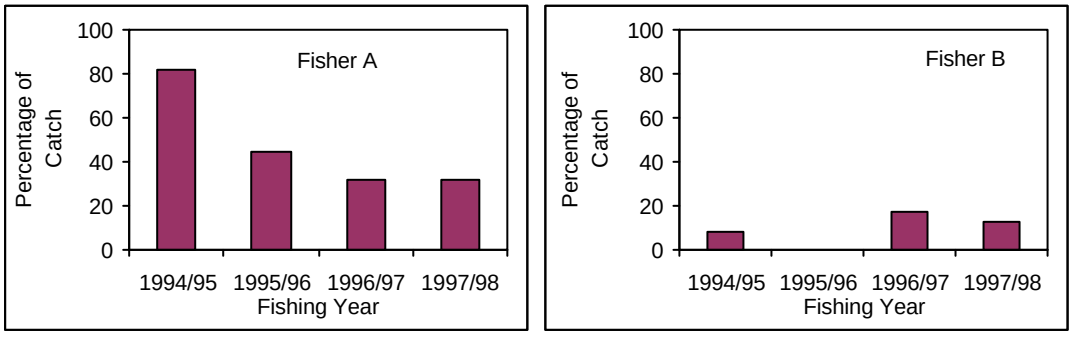


Figure 11. Comparison of the proportion of the catch of two different fishers falling in the <3 kg size bin. This highly variable catch composition between different fishers implies that grouped data may be biased by the fishing patterns of individual fishers. This risk is reduced by increasing the size of data set, with bias and precision improving as the proportion of the total catch sampled increases.

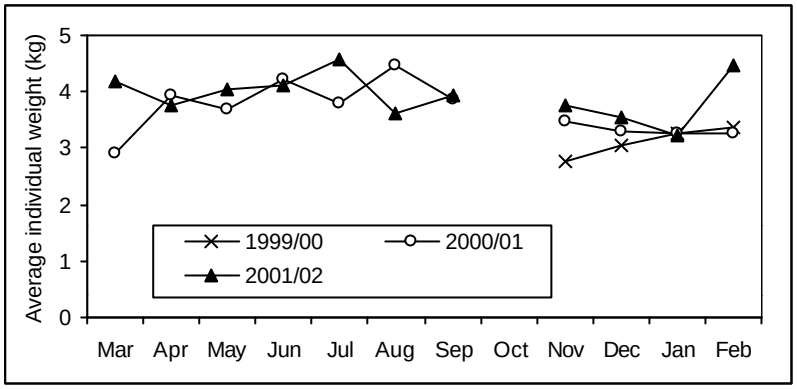


Figure 12. Average weight of crabs landed by month for each year since the introduction of quota management. These data are drawn from numbers and weights reported through the quota audit process.

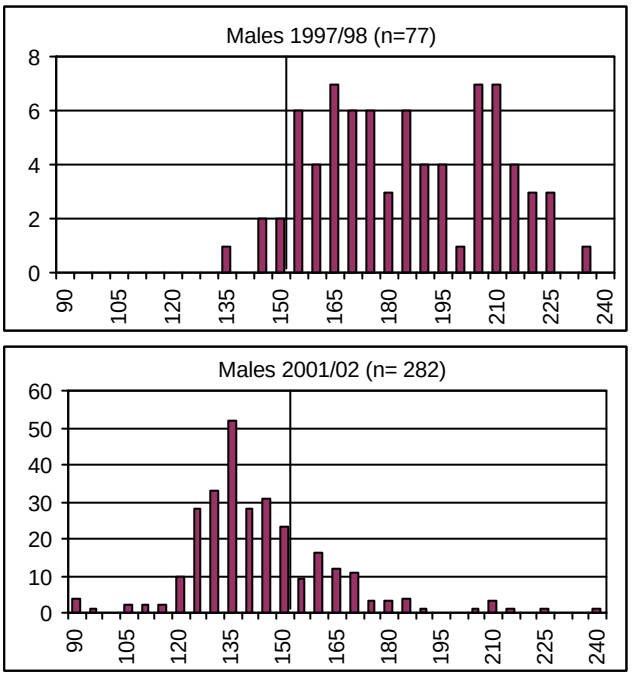


Figure 13. Size structure of samples of male giant crabs from west coast commercial catches taken in Jan-Mar 1998 (1997/98 season; upper) and Dec 2001- Jan 2002 (2001/02 season; lower).

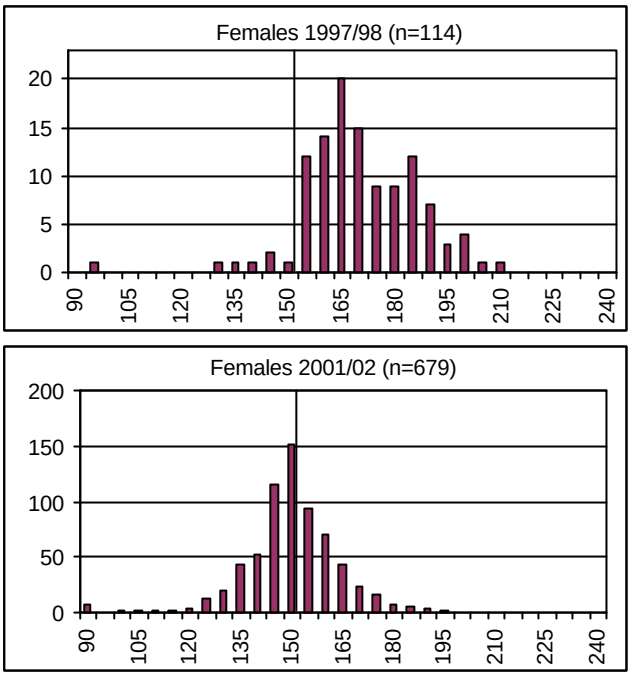


Figure 14. Size structure of samples of female giant crabs from west coast commercial catches taken in Jan-Mar 1998 (1997/98 season; upper) and Dec 2001- Jan 2002 (2001/02 season; lower). The vertical line indicates the minimum size limit.

3.2 Other analyses

3.2.1 Bycatch

Information on bycatch species taken by crab fishers will be recorded as part of catch sampling conducted for the FRDC funded projected on the development of giant crab assessment techniques. This project has only commenced recently so little data has been collected at this stage. These preliminary data are summarised in Figure 16. Few species were recorded as bycatch with the most numerous being the antlered crab *Paromola petterdi* (Figure 15). Hermits crabs (*Strigipagurus strigimanus* and *Dardanus arrosor*) were the next most common species followed by pink ling *Genypterus blacodes*. All hermit crabs and over 90% of antlered crabs were observed to be released apparently unharmed. These animals do not contain air spaces and thus show no apparent effect of the pressure change experienced during hauling to the surface. In contrast, finfish bycatch was moribund.

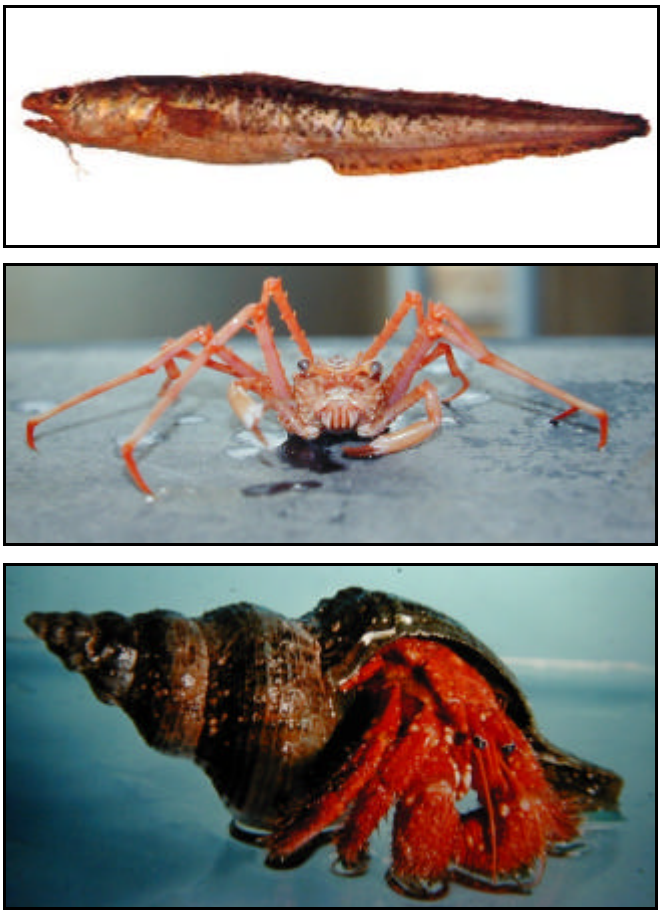


Figure 15. Bycatch species recorded through preliminary catch sampling. Pink ling *Genypterus blacodes* (upper), antlered crab *Paromola petterdi* (mid), and hermit crab *Strigipagurus strigimanus* (lower).

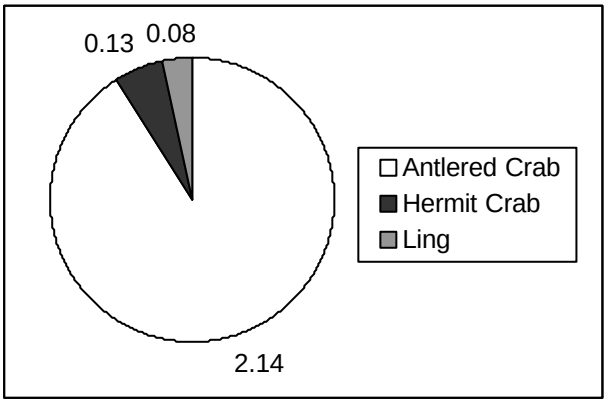


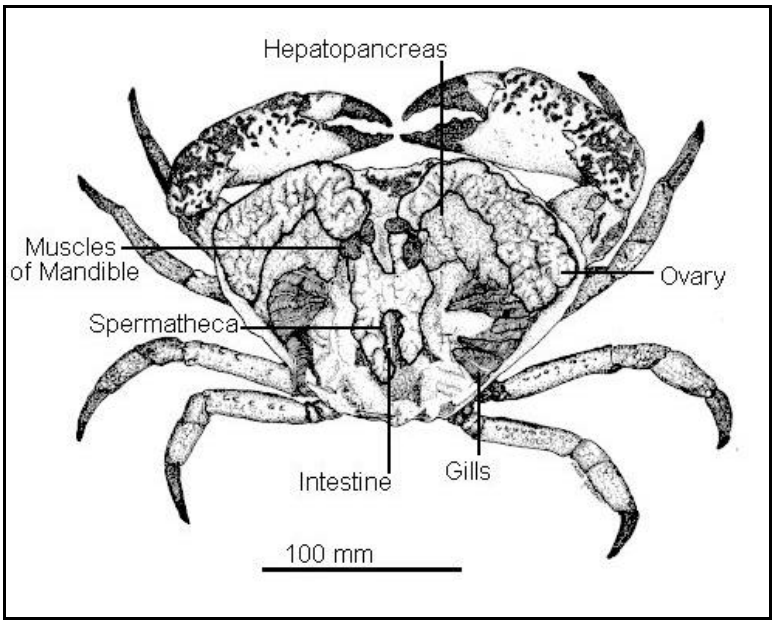
Figure 16. Bycatch recorded in preliminary catch sampling from 100 traps, 2001. "Hermit crab" includes both *Strigipagurus strigimanus* and *Dardanus arrosor*. Values are mean animals per trap lift.

3.2.2 Sperm storage

Giant crab females extrude eggs months or even years after mating occurs (Gardner et al., 1998; Gardner and Williams, in press). The sperm delivered at mating is stored until the time of egg extrusion in organs called spermathecae (Figure 17). These organs provide an opportunity for making observations about the extent of mating in the population. Samples of spermathecae were collected from 95 females in 1994/95, which was around the time of the expansion of this fishery. These samples thus provide an indication of the virgin population. A second sample of spermathecae was collected during 2001 from 195 females. The same fisher collected both samples from northeastern Tasmania.

Both samples indicate that larger females possess larger spermathecae, which may be a function of increased number of matings with age, or the delivery of larger amounts of ejaculate to females of larger size, which has been detected in other crustaceans (MacDiarmid and Butler, 1999). Most importantly, the relationship of spermathecae size with female size did not appear to differ between the two samples. This suggests that the exploitation of the population has not led to reduced mating success or reduced volume of the sperm delivered.

While there appears to be no evidence of sperm limitation in the population at this stage, future monitoring is warranted as the long intermoult of female giant crabs suggests that mating would occur infrequently, perhaps only once every few years (Gardner and Williams, in press; McGarvey et al., in press). Consequently, it is possible that the effects of fishing on mating success may not be detected for several years after a problem begins to develop. Also note that measuring sperm reserves by spermathecae weight is indirect; the weight of spermathecae may vary for reason other than volume of sperm. A more useful measure would be number of sperm per spermathecae. This was not calculated for the 1994/95 sample but is planned for the 2000/2001 sample – which should serve as a more useful baseline for future surveys.



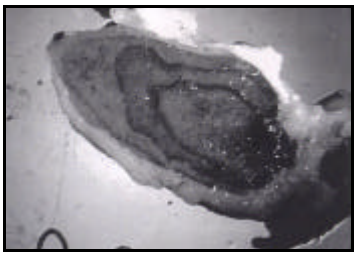


Figure 17. The spermathecae or sperm storage organs of female giant crabs. The organ is located at the base of the ovary and opens ventrally to allow the release of sperm for fertilisation during egg extrusion (upper). Sperm deposits from different matings are seen as separate bands in bisected spermathecae (lower).

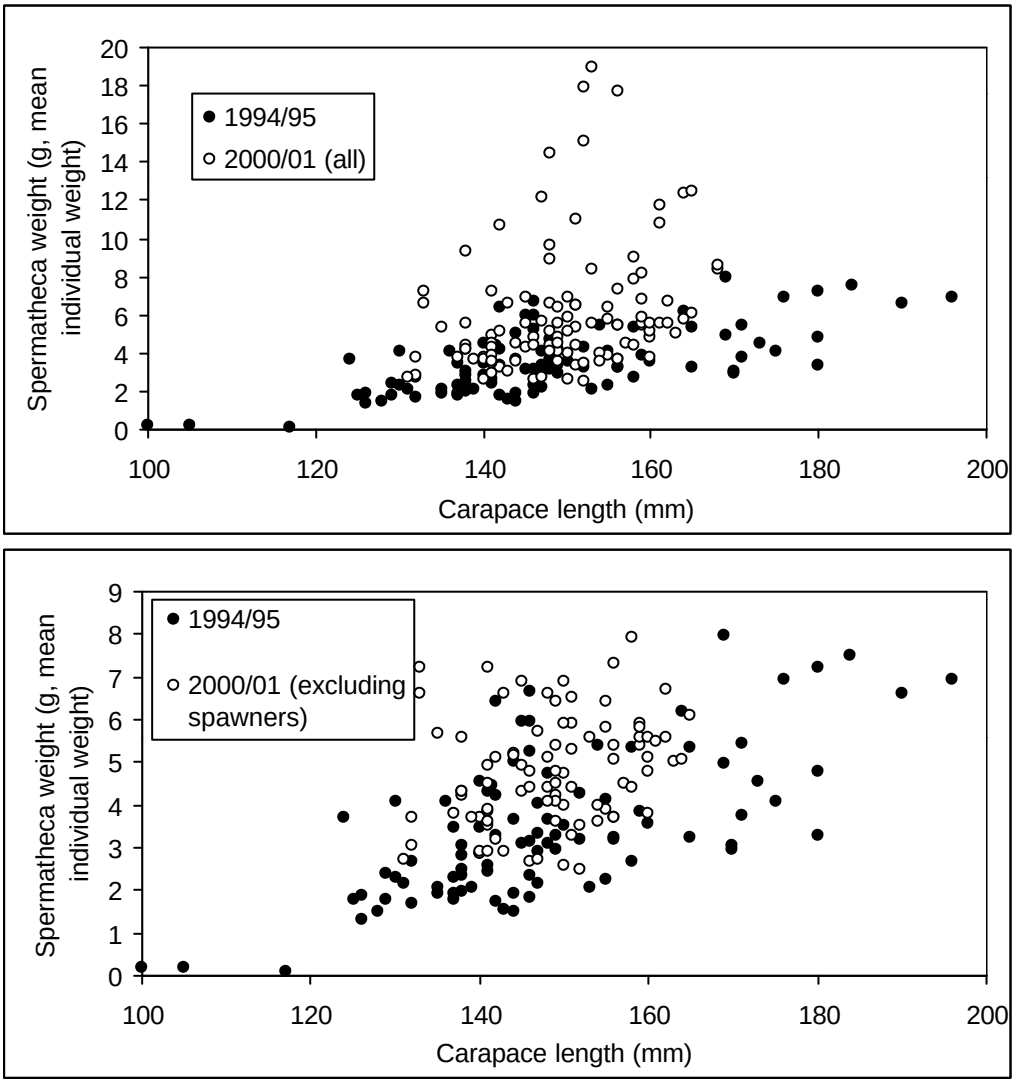


Figure 18. Mean weight of spermathecae (sperm storage organs) from females sampled in 1994 and 1995 shortly after targeted fishing commenced compared with spermathecae weights from females sampled in 2000 and 2001. A lower weight of spermathecae may imply smaller sperm reserves. Some of the females sampled in 2000/01 had recently spawned which results in higher moisture content of spermathecae. When these females were excluded (lower plot), a regression through the 2 samples were not significantly different ($P>0.3$, using log transformed data due to increasing variance with mean), which implies that fishing has had no detectable effect on mating success or volume of sperm transferred.

3.2.3 Spatial distribution of catches

The spatial distribution of catch is shown in Figure 19. The majority of the catch is taken north of 42°S, although fishing grounds extend south of this on the west coast into Area 7. Since the commencement of the new management plan in November1999, the proportion of the catch coming from the northwest has tended to increase, while the proportion coming from the northeast has tended to decrease. However, note that the months included in each year differ (1999/00 – Nov-Feb; 2000/01 – Mar-Feb; 2001/02 – Mar-Dec).

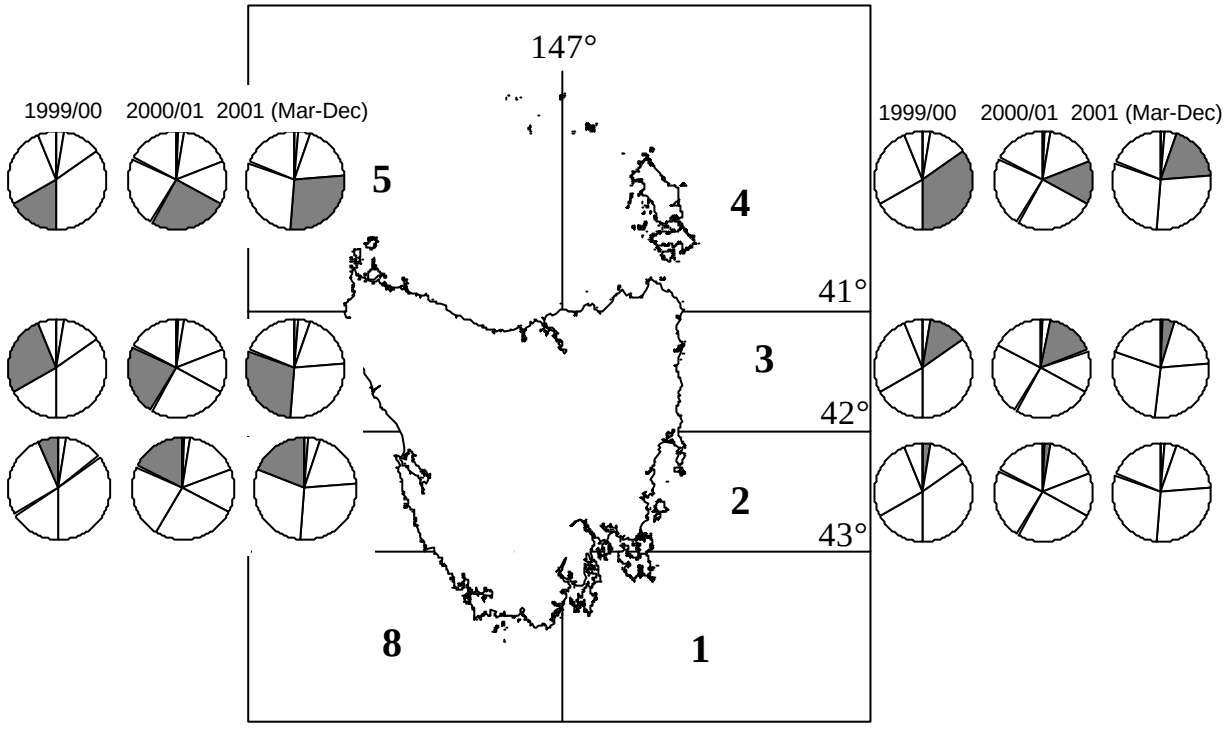


Figure 19. Distribution of legal-sized, retained catch between assessment areas (as percentage of total number of animals). Catch from areas 1 and 8 represent less than 1% of total catch.

3.2.4 Structure of catches: proportion undersize, female/male, and discarded

Following the introduction of a new logbook in November 1999, fishers now provide details of the structure of their catch in terms of the number of males and females retained, the number of undersize crabs discarded, and the number of animals discarded for other reasons (eg oversize, damaged or berried). This information will provide a valuable guide to changes in the fishery in the future and will assist in interpreting changes in catch rate. Data available at this stage is for 3 seasons only and two of these are incomplete; the first season where this data was collected ran for only 4 months from November 1999 to February 2000, while the 2001/02 season is incomplete at the time of preparation of this report (March 2001-December 2001 only).

Seasonal patterns

As noted in Section 3.1.1 (page 4) catch per unit effort varies seasonally with highest catch rate from November to March. It can be seen in Figure 20 that this period corresponds to those months where a large proportion of the retained catch is female (approximately 2-3 females for each male retained). The proportion of females in retained catch declines in autumn, as females become ovigerous or berried.

The legal minimum size limit for the crabs is 150 mm carapace length, with a maximum of 215 mm. The proportion of undersize in catches (Figure 21) and other discarded crabs (Figure 22) appears relatively stable across all months, although the proportion of discarded crabs from both groups was marginally higher in August and September. It is noteworthy that the decline in the proportion of female crabs in retained catch during autumn (Figure 20) does not translate into an increase in the proportion of discarded crabs (Figure 22), which indicates reduced catchability while berried. In addition, the proportion being discarded was lower in 2001/02 than in 2000/01 (Figure 25), indicating that discarding the larger and one-clawed animals is not leading to an increased proportion of these animals in the population.

The observations relating to the relative proportion of smaller animals in the catch is consistent with comments made in interviews with fishers that the number of juvenile animals present over the past two years was relatively high.

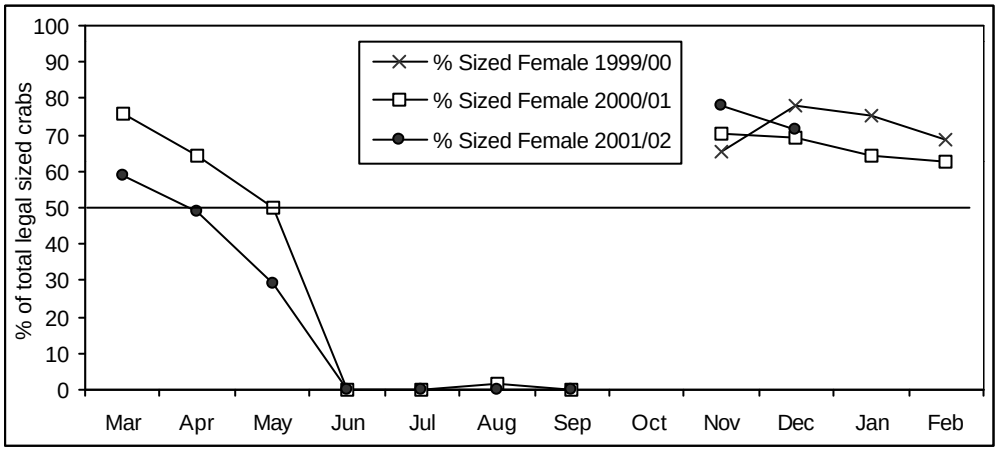


Figure 20. The proportion of retained giant crabs that were female for each month since November 1999. Note these proportions are based on number of individuals, not weight, and that a proportion of 0.75 equates to catch comprised of three females for every male.

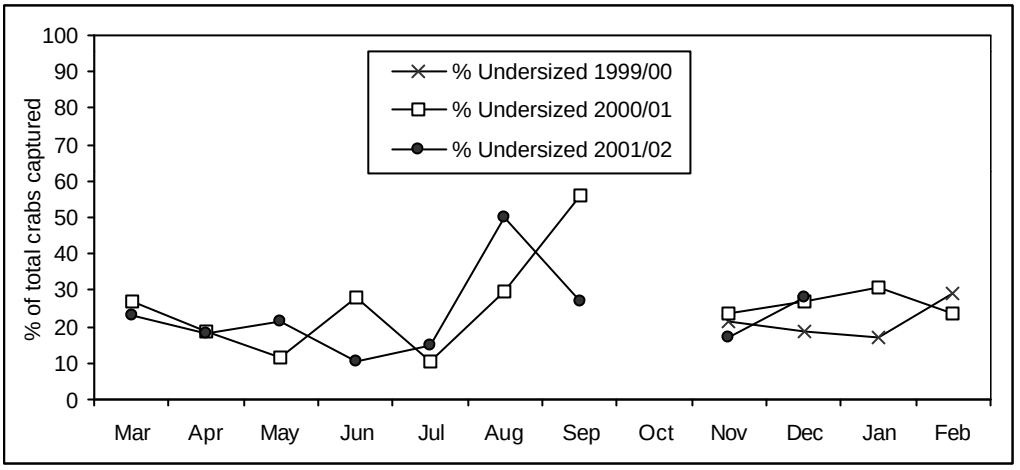


Figure 21. The proportion of giant crab catch that was undersize for each month since November 1999. Note these proportions are based on the number of individuals, not weight.

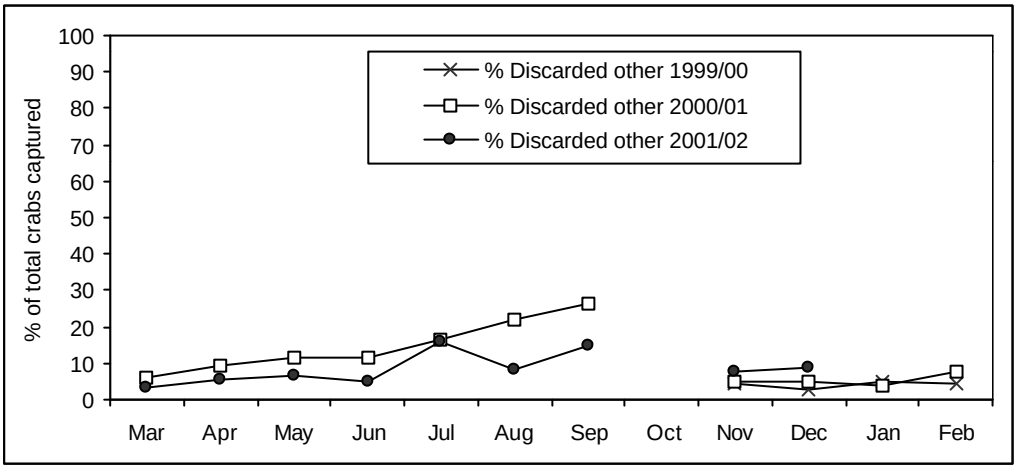


Figure 22. The proportion of giant crab catch that was discarded, but not undersize, for each month since November 1999. Crabs in this category include berried females, males larger than the maximum legal size of 216 mm, and animals with only one claw, which are usually discarded due to their low market value. Note these proportions are based on the number of individuals, not weight.

Interannual patterns

Information on the change in the proportion of females and undersize crabs in catches will be of value for future monitoring of annual changes in giant crab stocks. Data collected since November 1999 is presented here, although as noted earlier, data is available for only one full year.

The proportion of undersize crabs in catches appears stable since 1999/00, while there has been a steady decline in the proportion of females in the retained catch (Figure 23). This change in the proportion of females may be an artefact of the reduced season in 1999/00 where fishing only occurred in summer months when females form a high proportion of the catch. Likewise, data for the 2001/02 season is incomplete with 2 additional months of fishing to be completed in summer 2002 (January and February).

Regional patterns in the proportion of females in the catch are shown in Figure 24. Catches on the east coast tend to include a higher proportion of females than those from the west.

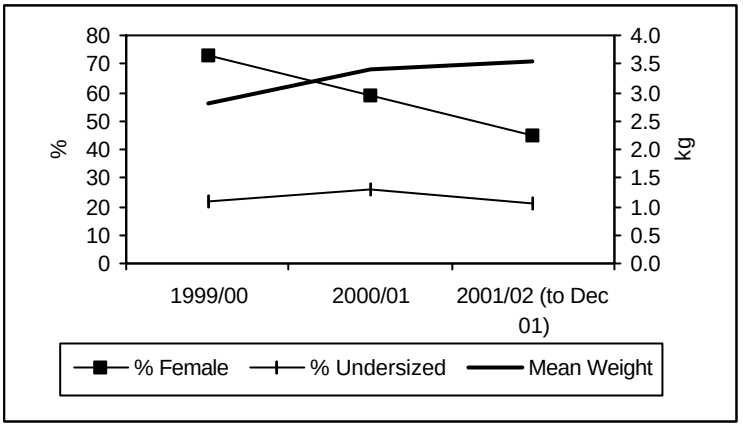


Figure 23. Statewide, interannual trends in the proportion of females in retained catch, proportion of undersize in catch, and mean weight of retained crabs.

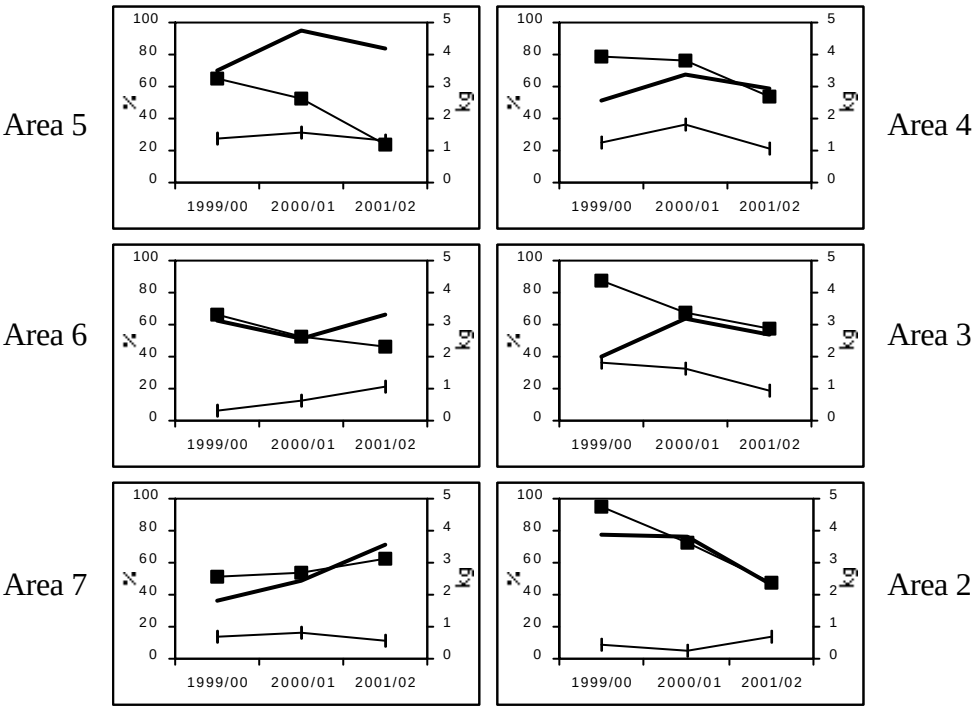


Figure 24. Interannual change in the proportion (based on numbers of individuals) of females in retained catch (solid squares), proportion of undersize in catch (hollow diamonds), and mean weight (heavy line) for each assessment area. Areas 1 and 8 are omitted due to low catches.

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5. Appendix 2. Summary of rules for the Tasmanian Giant Crab Fishery

Table 5. Summary of rules for the Tasmanian Giant Crab Fishery.

COMMERCIAL

Management zone	one management zone for the State (since January 1997)
Limited entry	106 licences (approximately 1/3 of the rock lobster licences in the state).
Limited seasons	Open season: 1st March -30th September, 11 November – 23rd February (both sexes).
Limits of pots on vessels	minimum of 15 pots, maximum of 50 pots
Quota	Total allowable catch of 102.3 tonnes
Restrictions on setting pots	pots cannot be set for more than 48 hours in less than 120m depth
Restrictions on pot size	maximum size of 1250 mm x 1250 mm x 750 mm.
Escape gaps	one escape gap at least 57 mm high and 400 mm wide and not more than 150 mm from the inside lower edge of the pot, or two escape gaps at least 57 mm high and 200 mm wide and not more than 150 mm from the inside lower edge of the pot (as per rock lobster pot)
Size limits	minimum of 150 mm CL and maximum of 215 mm CL for both sexes
Berried females	taking of berried females prohibited

RECREATIONAL

License requirements	rock lobster potting licence (recreational) - 1 recreational pot per person,
Daily limit	1 per recreational license holder
Limited seasons	In 2000: closed season 1st September-10th November (both sexes).
Restrictions on setting pots	as per commercial fishers
Restrictions on gear	as per commercial fishers
Escape gaps	as per commercial fishers
Size limits	as per commercial fishers
Berried females	as per commercial fishers
Sale or barter of lobsters	prohibited