
FISHERY ASSESSMENT REPORT

TASMANIAN ROCK LOBSTER FISHERY 2008/09

Caleb Gardner and Philippe Ziegler

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Tasmanian Aquaculture
and Fisheries Institute

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Executive Summary

Current Stock Status

The Tasmanian rock lobster stock declined sharply in 2008/09 due to the impact of prolonged low recruitment. This low recruitment to the fishery is exceptional and has traits unlike any downturn seen previously over the period of four decades from 1970 to 2009.

The Tasmanian rock lobster stock increased substantially in the period from 1998 to 2006 which was attributed to the constraint of total catch under ITQ management. It is now apparent that extreme trends in recruitment contributed to this growth, and also to the decline in stock that has occurred since 2006.

Very high settlement detected in puerulus collector sites in 1995 led to high recruitment into the fishery after QMS was introduced. This affected catches first in the faster growth northern areas then later in the south. Constraint in catch under input controls meant that this recruitment pulse led to good catch rates for several years.

Recruitment over more recent years has been exceptionally low and this has led to decline in stocks over the last three years. The decline in recruitment to the fishery is more severe than other low periods in the data series from 1970 because: (i) recruitment is at or near record lows in most areas; (ii) declines have occurred simultaneously in all areas (declines in one area are more typically balanced by a pulse somewhere else); and (iii) the duration of low recruitment has been more protracted than previously.

Key observations are:

- The total commercial catch almost equalled the TACC, however, the fleet struggled to take the full TACC for the first time due to falling catch rates.
- The fishery continues to exhibit strong regional trends in the distribution of effort and catch in response to changes in production around the State.
- Recruitment was below average in all areas. Without more normal levels of recruitment, the biomass will continue to decline under the current total catch.
- Effort was at or near record low levels in areas 2,3,4,5 and was high in 7, 8. Effort in the deepwater areas 9 and 10 also declined. This signalled extreme spatial trends in effort, which were very different to those seen in the past.
- The average weight of lobsters in north eastern regions has been increasing, which signals decline in recruitment of smaller lobsters. This is because the increase in average weight has occurred currently with decline in catch and catch rate.
- The fishery remained reliant on unusually high level of catch coming from the SW (7 and 8), although there has been some redistribution of catch to areas 3, 4 and 5.
- Statewide catch rate declined (by 13%) and was similar to 1998/99 levels, suggesting much of the stock rebuilding that occurred since QMS management commenced has now been undone.

- Declines in catch rate occurred in all areas but was most pronounced in the south with area 1 (SE) declining by 28%. This region is the most important to the recreational sector so declines are affecting both sectors.
- Fishers expressed concern that an increase in multiple night shots may be masking real trends in catch rate data. When data was restricted to day shots only, declines in catch rate were more pronounced with a 19% decline statewide over the last year.
- Statewide legal size biomass continues to decline with an 8% decline for the year. Legal sized biomass in each area declined by between 5% and 16%.
- Egg production remains adequate for the State as a whole and for southern areas but is below target levels in northern areas. This may be unrelated to future stock stability because of the imprecise relationship between egg production and future recruitment.
- There were no notable trends in protected species and byproduct data.

Implication of Future Harvest Strategies

Significant changes were made to the stock assessment model in 2009 including the incorporation of cost and price data. This enabled the effect of alternative harvest strategies to be examined in terms of economic yield, in addition to traditional biomass and egg production indicators.

Projections of the stock under the *status quo* TACC of 1470 tonnes (implemented for the 2009/10 quota year) indicate that legal sized biomass will continue to fall. This would result in lower catch rates, higher costs and a decline in economic yield from the commercial sector.

Substantial reductions in the catch appear necessary to reverse the decline in the stock and improve community benefit from the resource. Changes in total catch in the order of 15 to 25% appear to have reasonable probability of improving the fishery statewide but are unlikely to address all regional issues, in particular depletion of stock in northern areas.

Status of performance measures for the Tasmania rock lobster fishery.

| Performance measure | Trigger point | Status in 2008/09 |
|--|---|--|
| Statewide commercial catch rates | <95% of reference year | ✓ 22% increase above reference year |
| Regional commercial catch rates | <75% of reference year | ✓ >5% of reference year in all cases |
| Statewide legal-size stock biomass | <95% of reference year | ✓ 38% increase above reference year |
| Regional legal-sized biomass | <75% of reference year | ✓ >20% increase in all areas |
| Regional biomass estimates from fisheries independent surveys. | Significant decline between years | Not available |
| Statewide egg production | < lowest year | ✓ 8% above lowest year |
| Regional egg production | <95% lowest year unless production >40% unfished state (no decline tolerated in Areas where production <10% unfished) | ✓ Decline compared to lowest year in 5 and 6, but not to 95% trigger |
| Total commercial catch | <95% TACC | ✓ 96.5% TACC |
| Size of the fleet | <220 active vessels | ✗ 210 |
| Recreational catch | >10% TACC | ✓ Most recent estimate 2004/05: 7.8% |

DEH recommendations for Ecosystem Based Fisheries Management (EBFM) of the Tasmanian rock lobster fishery applicable to this assessment.

| Recommendation | Status |
|---|---|
| <p>Recommendation 1: <i>The DPIPWE to advise the DEH of any material change to the TRLF management arrangements that could affect the criteria on which Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) decisions are based, within three months of that change being made.</i></p> | <p>The annual fishery assessment document and management documentation provides these requirements.</p> |
| <p>Recommendation 2: <i>Reports to be produced and presented to DEH annually, and to include:</i></p> <ul style="list-style-type: none"> • <i>Information sufficient to allow assessment of the progress of DPIPWE in implementing the recommendations made in the Assessment of the Tasmanian Rock Lobster Fishery 2007;</i> • <i>A description of the status of the fishery and catch and effort information;</i> • <i>A statement of the performance of the fishery against objectives, performance indicators and measures; and</i> • <i>Research undertaken or completed relevant to the fishery.</i> | <p>The annual fishery assessment document provides these requirements.</p> |
| <p>Recommendation 3: <i>Within 2 years, DPIPWE to develop and implement an education program for fishers on species recognition, mitigation measures to minimise interactions and the requirement to accurately report interactions under the EPBC Act.</i></p> | <p>Results from protected species interaction reporting is documented in this assessment.</p> |
| <p>Recommendation 4: <i>DPIPWE, in collaboration with industry, to continue to encourage the adoption of programs that minimise protected species interactions and pot loss. DPIPWE, in collaboration with other jurisdictions, to investigate and implement, where appropriate, the use of seal exclusion devices other than seal spikes to reduce the impact of the fishery on seal species.</i></p> | <p>Ongoing implementation and coverage of the Clean Green Program. Analyse interaction data to review nature and frequency of seal interactions annually to assess if risk of seal mortality changes to warrant exclusion devices. Collect data from fishers with respect to real levels of pot loss.</p> |
| <p>Recommendation 5: <i>DPIPWE to ensure that there is ongoing data collection of bycatch species in the fishery and that bycatch data analysis includes information on temporal and spatial pat-</i></p> | <p>Results from bycatch and byproduct data collection programs is documented in this assessment. More detailed temporal and spatial analysis is underway.</p> |

| | |
|---|---|
| <p><i>terns relevant to the TRLF.</i></p> | |
| <p>Recommendation 6: <i>Within 3 years, DPIPWE to review the stock assessment model and model predictions for the TRLF to ensure that TAC levels continue to permit significant stock rebuilding for the rock lobster stock. DPIPWE to consider environmental factors, such as urchin barrens, when setting the TAC annually for the TRLF.</i></p> | <p>The stock assessment model was externally reviewed in 2009 and significantly altered. Capability to evaluate harvests in terms of biomass of large lobsters was developed to allow the development of performance measures relevant to managing lobster – urchin interactions.</p> |
| <p>Recommendation 7: <i>DPIPWE to continue to monitor egg production levels in northern regions and to develop and implement management measures to assist with increasing rock lobster egg production levels in this zone.</i></p> | <p>Egg production estimates are reported here on a statewide and on a regional basis.</p> <p>New performance measures relating to egg production have been drafted for the new strategic policy document including limit and target reference points and timeframes. These are included in this assessment.</p> |
| <p>Recommendation 8: <i>DPIPWE to continue to monitor the level of fishing effort in shallow waters and determine whether further management measures are required to decrease fishing pressure on inshore rock lobster stocks.</i></p> | <p>This assessment includes 3 new assessment regions resulting from splitting deep and shallow areas on the west coast. Further separation of data from deep and shallow areas is planned for the next assessment, in particular for the east coast to better examine issues related to recreational fishing and also urchin barrens.</p> |

Table of Contents

| | | |
|-------|---|----|
| 1 | Introduction | 1 |
| 1.1 | The modern commercial fishery | 1 |
| 1.2 | Economic and market status | 3 |
| 2 | Recent Developments | 5 |
| 2.1 | Management History of the Fishery | 5 |
| 2.2 | Developments in stock assessment analyses | 5 |
| 2.2.1 | Logbook changes | 5 |
| 2.2.2 | Research catch sampling operations..... | 5 |
| 2.2.3 | Changes to the stock assessment model | 6 |
| 3 | Fishery Assessment | 7 |
| 3.1 | Performance Measures..... | 7 |
| 3.2 | Catch | 7 |
| 3.2.1 | Statewide Commercial Catch | 8 |
| 3.2.2 | Regional Commercial Catch..... | 8 |
| 3.2.3 | Non-Quota Commercial Catch | 9 |
| 3.2.4 | Research Quota..... | 10 |
| 3.2.5 | Recreational Catch..... | 10 |
| 3.3 | Commercial Catch and Effort Analysis | 12 |
| 3.4 | Discussion..... | 22 |
| 3.4.1 | Management Advice..... | 22 |
| 3.5 | Biomass..... | 22 |
| 3.6 | Egg production..... | 24 |
| 3.7 | Recruitment..... | 29 |
| 3.8 | Active vessels | 33 |
| 3.9 | Mean Weight..... | 34 |
| 4 | Risk Assessments | 36 |
| 5 | Ecosystem Based Management | 42 |
| 5.1 | Protected Species Interactions | 42 |
| 5.1.1 | Research sampling data | 42 |
| 5.1.2 | Commercial logbook data..... | 43 |
| 5.2 | By-catch Survey Results | 44 |
| 5.3 | Byproduct..... | 45 |
| 6 | Bibliography | 46 |
| 7 | Appendix 1: Historical overview..... | 48 |
| 8 | Appendix 2: Management | 50 |
| 9 | Appendix 3: Summary of Rules | 51 |

1 Introduction

1.1 The modern commercial fishery

The present commercial catch is taken from areas all around the State and involves the annual harvest of around 1.6 million animals. In the 2008/09 season 210 licensed vessels reported catches of rock lobster, down from 314 in 1994/95. In addition, there were approximately 20,000 licensed recreational fishers (taking an estimated 135 tonnes in 2006/2007; Lyle, 2008).

Commercial harvests have been controlled by a quota management system since March 1998, which resulted in substantial stock rebuilding in all assessment areas. This rebuilding can be seen in the historical trends in the fishery (Figure 1 and Figure 2), however, the estimated total legal biomass has now shown a decline for the last few years. In addition, in this latest year, State-wide catch rates have again declined and the effort (cost) required to catch the TACC increased (Figure 1 and Figure 2).

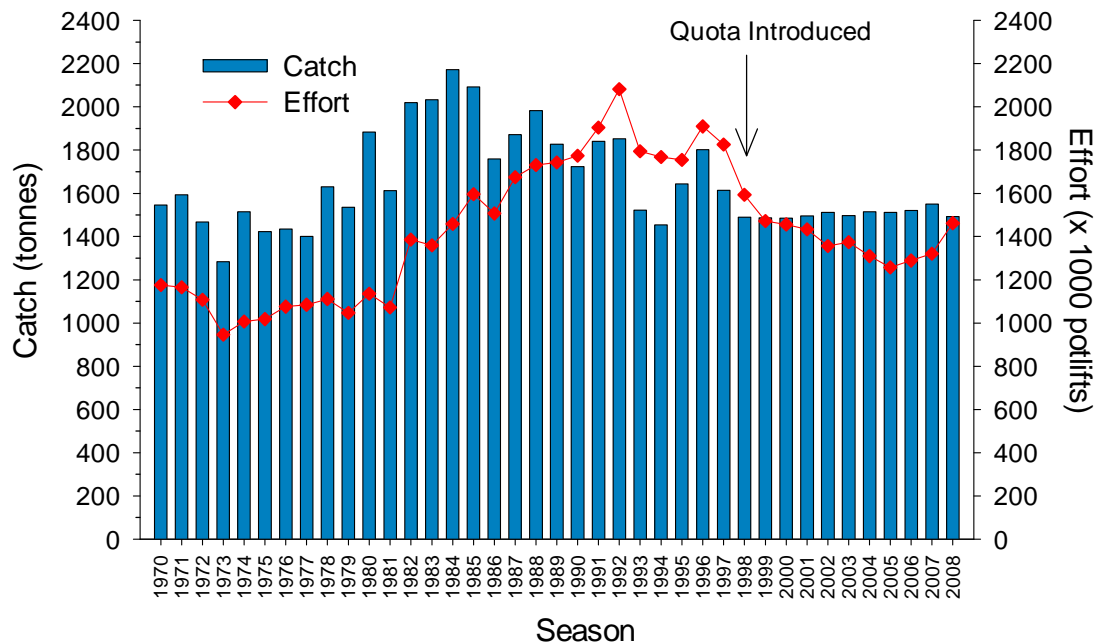


Figure 1. Historical commercial fishing effort (pot-lifts) and catch (tonnes). From 1998 to 2005 the amount of effort required to take the same catch diminished. This trend has reversed in recent years so that effort and catch in the most recent year approximate that in 1998 when quota was introduced.

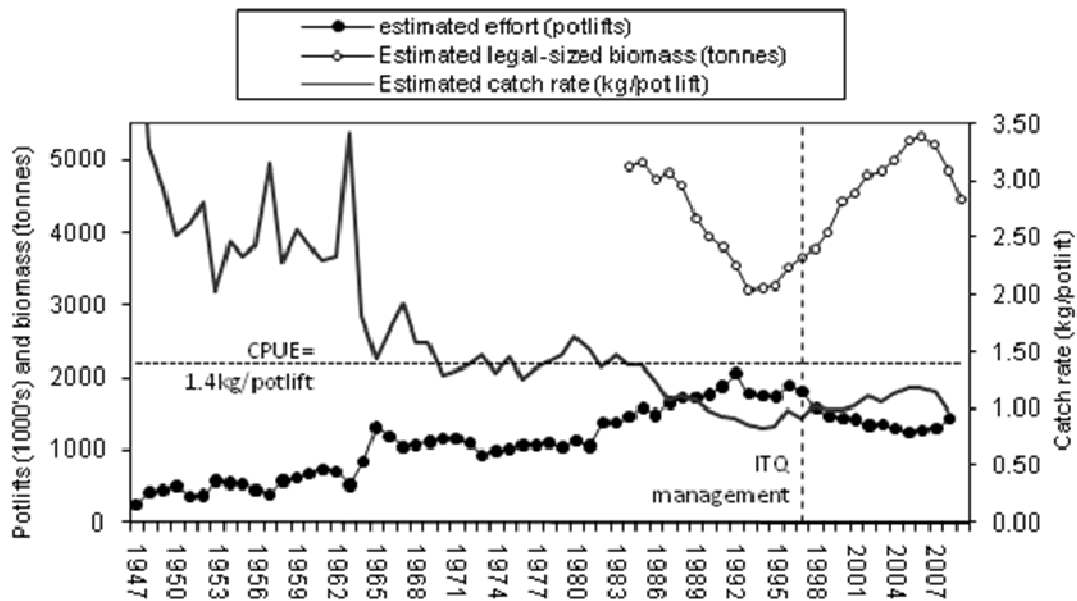


Figure 2. Historical trends in estimated fishing effort (pot-lifts), estimated catch-rate (kg/pot-lift) and estimated legal-sized biomass. Data is in quota years (Mar to Feb) from 1970 onwards. Catch rate and effort are inversely correlated through the series. Dashed lines indicate the introduction of ITQ management and the current commercial industry catch rate target of 1.4 kg/pot lift.

Trends in legal biomass and catch rates are roughly similar although do have some important differences. In the period of stock rebuilding from 1995 to 2005, catch-rates recovered slower than biomass due to a changing fishery dynamics. For example, through fishers increased their effort in locations and months when catch rates are lower but the value of the lobsters taken is higher. In recent years, catch rates have declined faster than estimated biomass possibly again due to similar effects of the fleet.

Both fishing effort and biological parameters vary dramatically from region to region, which presents major challenges for fishery assessment and management. An important step towards meeting these challenges is the use of a spatially-explicit stock assessment model that considers different assessment areas separately (Figure 3).

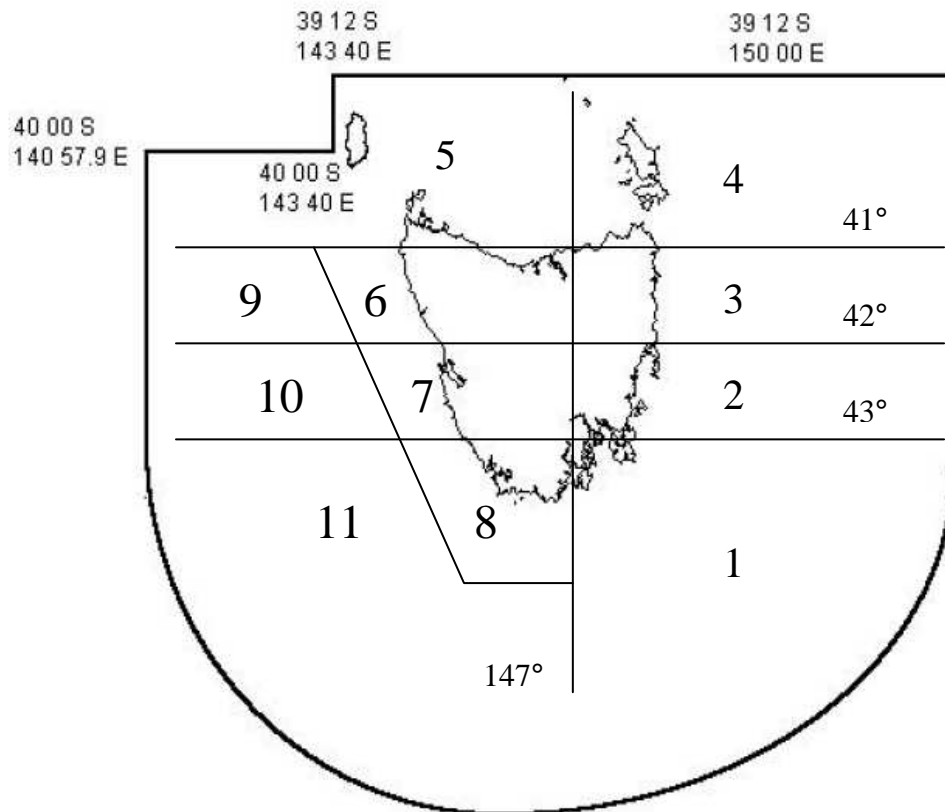


Figure 3. Schematic boundaries of the Stock Assessment Areas and indicative area of State waters for the rock lobster fishery, provided by the offshore constitutional settlement (OCS). Changes to the assessment model over the last year has enable information to be presented separately for water shallower or deeper than 35 fathoms off the west coast. These areas have been assigned new numbers of 9, 10 and 11.

1.2 Economic and market status

The economic benefit from the Tasmanian commercial rock lobster fishery is well distributed around the State, with an estimated 1,350 jobs reliant on the fishery (Econ-Search 2003).

Lobsters are mainly sold into Asian markets although a marketing project is underway with the aim of expanding into markets in the USA.

The economic impact of the Tasmanian rock lobster fishery is far greater than would appear from simple comparisons of total annual revenue (*i.e.* the gross value of product GVP) which was around \$66 million¹ in 2008/2009 (Figure 4). Because a wild fishery has constraints on production, a “scarcity rent” is obtained and the economic yield is many times greater than can be achieved by most primary industries. Economic yield in the lobster fishery is illustrated by the lease price of quota units, which traded in 2008/09 at around \$14. This implies an economic yield from the fishery of around \$21 million dollars (1,523,000 kg * \$14).

¹ Retained profits are actually much greater than this amount because a commercial fisher who leases quota and then goes fishing makes additional profit.

Economic yield is thus an important concept to understand when examining community benefit from fishing because the GVP is only loosely related to economic impact. For example, over the last three years we have seen economic yield from the fishery fall sharply (20%) at the same time as beach price and GVP have risen by 18% (Figure 4). The fall in economic yield despite rising prices has been caused by the rapid rise in costs over the last couple of years. Costs have been driven most significantly by the fall in catch rates – which means fishers now have to fish longer and use more potlifts to take the same catch.

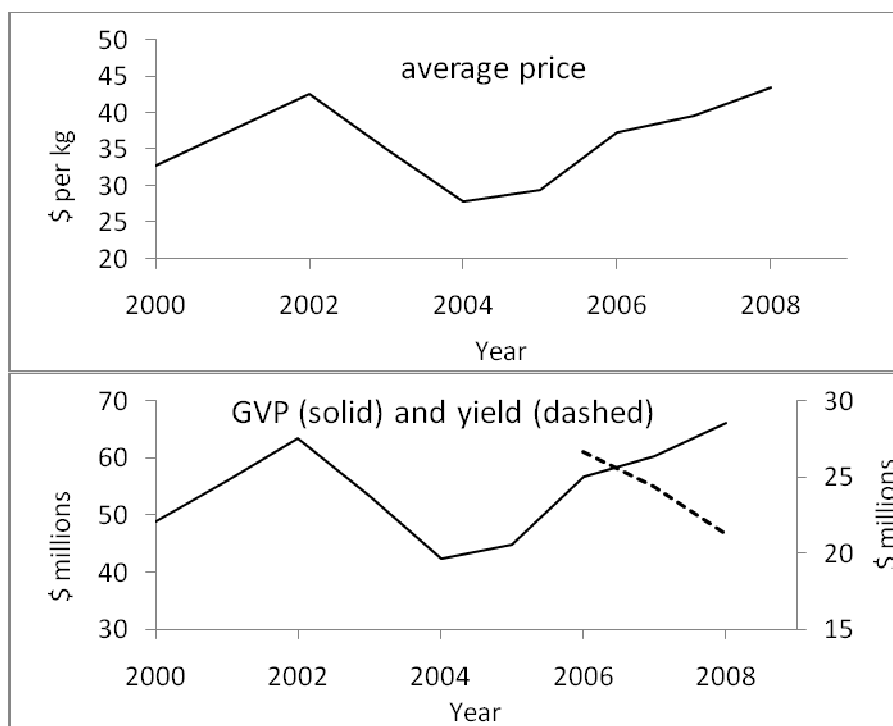


Figure 4. Economic trends in the commercial fishery since 2000. Beach price over the last year has been high which resulted in a very high gross value of product (GVP) of \$66 million. However, economic yield from the fishery fell by \$5 million or 20% over the last 2 years despite the price increased because costs of fishing increased (due to higher effort for the same catch). This decline in economic yield drove a decrease in the market price for lease quota.

In addition to the commercial fishery there is a significant recreational fishery. The objective of management of the recreational sector is enjoyment or utility rather than financial benefit. Nevertheless, the financial cost of recreational lobster fishing can be examined and has been estimated at \$50 million for all recreational fishing in Tasmania (lobsters, abalone, finfish etc.; Lyle *et al.*, 2003).

2 Recent Developments

2.1 Management History of the Fishery

The implementation of the quota system in the commercial fishery in March 1998 resulted in an increased focus on economic yield rather than simply trying to maximize catch and revenue. Previous assessments have discussed the change in the dynamics of the fishing fleet since quota was introduced and highlighted the shift in effort towards winter fishing and shallow water to maximise value (Frusher *et al*, 2003). This has the potential to bias the stock assessment as it could lead to localized depletion in inshore waters while harvest rates in offshore stocks remain low due to the lower price of deep water, pale lobsters. This issue has been addressed over the last year by dividing west coast assessment areas into shallow (less than 35 fathoms) and deep components.

Management of the recreational fishery has remained stable with a daily legal catch limit of five lobsters. Licensing has now been introduced for all methods of recreational lobster fishing and this provides information about levels of participation.

2.2 Developments in stock assessment analyses

2.2.1 Logbook changes

Commercial catch and effort logbooks are regularly reviewed to ensure the effectiveness of assessment data collection. A recent significant change was the introduction of protected species interaction and better by-product reporting. These data are reported under “Ecosystem Interactions”.

2.2.2 Research catch sampling operations

The analyses in the assessment are based on a variety of data sources. Information about temporal changes in lobster stocks are mainly driven by commercial logbook data, research catch sampling surveys, and recreational surveys. The research surveys currently provide data on the size- and sex-structure of lobster catches.

The assessment and catch sampling operations were externally reviewed in 2007 and more extensive sampling occurred as a result in 2008 and 2009. Main changes were:

1. The catch sampling program has been extended with the use of casual observer staff sampling aboard commercial vessels.
2. Improving the spatial and temporal resolution of growth estimates is a high priority and was addressed with tagging of discarded lobsters by observers.
3. Existing tag recapture data was analysed for spatial patterns in growth and this was used to update the model.
4. Spatial and temporal resolution of data on undersized lobsters was increased and contributes to assessment of the stock through the model.

5. Long term monitoring sites were expanded to include sites in each assessment area.

2.2.3 Changes to the stock assessment model

Substantial changes to the assessment model were made over the last year and reviewed externally. The model used for analyses shown here is now in the same structure to the Victorian and South Australian model which allows greater collaboration between agencies and sharing of analytical methods such as for analysing growth or movement.

The most substantial changes in the model over the last year were:

- Model is standardised with SA and Victoria, which allows updates from elsewhere (movement; average weight checks)
- Model has now been externally reviewed in Tasmania, and reviewed through publication of specifications of the standardised model for Victoria and South Australia
- Spatially split into 11 rather than 8 areas
- Estimates of movement between deep and shallow areas are updated each run
- Growth data now updated to give greater accuracy in areas where growth data was previously lacking
- Capacity to include MPAs
- Time series of recreational catch
- Time series of illegal catch
- Projections have updated fleet dynamics model
- Projections now include economics data
- Generalised with vastly expanded capacity (e.g. 3 methods for estimating growth)
- Expanded output capacity (e.g. biomass estimates of large lobsters)
- Expanded projection capacity (e.g. translocation)

Model runs are now supported with standardised automated data extracts. This accounts better for problematic data (e.g. catch records missing location, or data errors within the database) and minimises the risk of inconsistent data extracts between years.

3 Fishery Assessment

3.1 Performance Measures

The management plan contains an array of different performance measures relating to:

- Commercial catch-rates
- Research catch-rates
- Estimated legal-sized biomass
- Egg production
- Abundance of undersized lobsters
- Total Catch
- Size of the active fleet, and
- Recreational catch

The values for each of these performance measures are compared to standards, termed 'Limit Reference Points' or trigger points. Limit Reference Points define undesirable states for the fishery, and if breached then a management review is initiated. Ideally, Limit Reference Points are paired with Target Reference Points and these have been drafted for the new management plan.

3.2 Catch

Catch in the Tasmanian lobster fishery occurs through a range of sectors / systems: commercial catch, recreational catch, research catch, commercial personal use provisions; non-quota well mortalities; indigenous catch; and illegal catch. Additional mortality occurs as a result of fishing through octopus mortality in traps and discard mortality.

Data is available on the scale of each of these sources of fishing mortality except for indigenous catch and illegal catch. Indigenous catch was assumed to be negligible and was not included in the assessment. Illegal catch was included in stock modelling at 2% of the total commercial catch, based on estimates by Tasmanian Police and DPIPWE quota audit staff.

The commercial sector accounts for the majority of catch followed by the recreational catch and the mortality due to octopus. Other sources of mortality including discard mortality are essentially trivial and in the model assumed to be negligible (Figure 5).

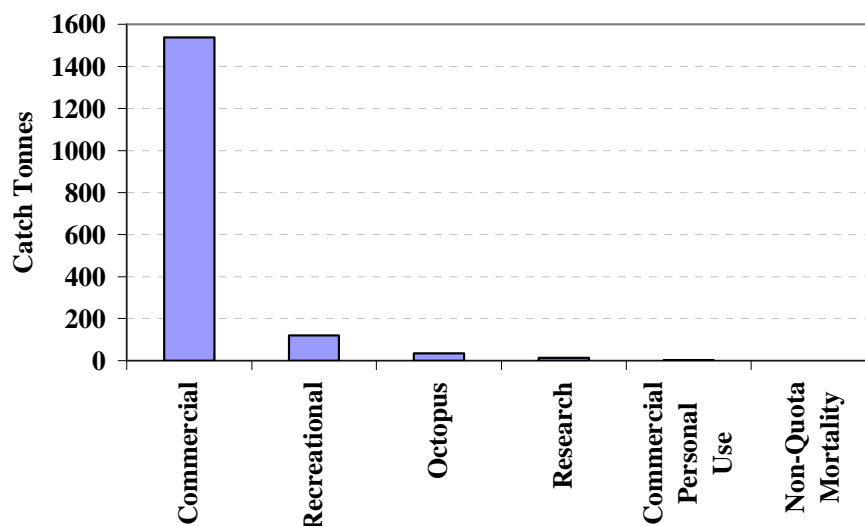


Figure 5. Different sources of fishing mortality in the Tasmanian rock lobster fishery, 2008/09.

3.2.1 Statewide Commercial Catch

Total commercial catch for 2008/09 taken through the quota management system was 1492 t (

Figure 6) or 98% of the TACC of 1523 t (a deficit of 31 t).

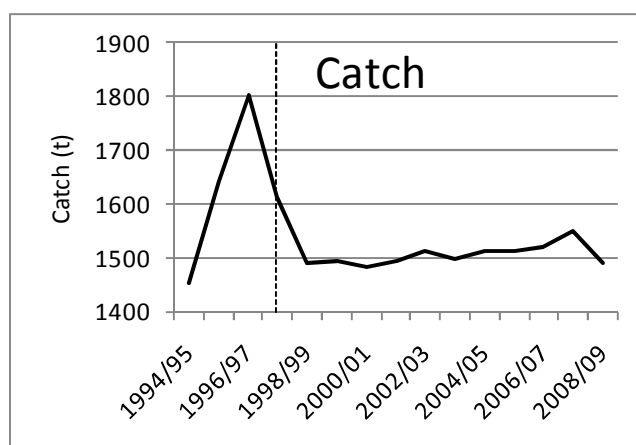


Figure 6. Quota year commercial catch weights reported through catch and effort logbooks. These differ slightly from the TACC because of carry-over provisions and under-catch.

3.2.2 Regional Commercial Catch

Commercial catch has had clear regional trends over the last few decades with declining catch in the north (especially north east) and increase in the south west (Figure 7). Over the last year this trend has reversed slightly, with an increase in catch from Areas 3, 4, and 5 and a decrease in catch from Areas 7 and 8.

Deep water (>35 fm) catch from off the west coast has trended downwards since 1992, most rapidly since ITQ management in 1998. Catch in these areas has been stable over the last year. While fishers didn't increase catch in deep water areas despite the failure to take the TACC in the 2008/09 year, there is an expectation that lower catch rates in the wider fishery in 2009/10 will lead to catch shifting offshore if fishers struggle to take the TACC.

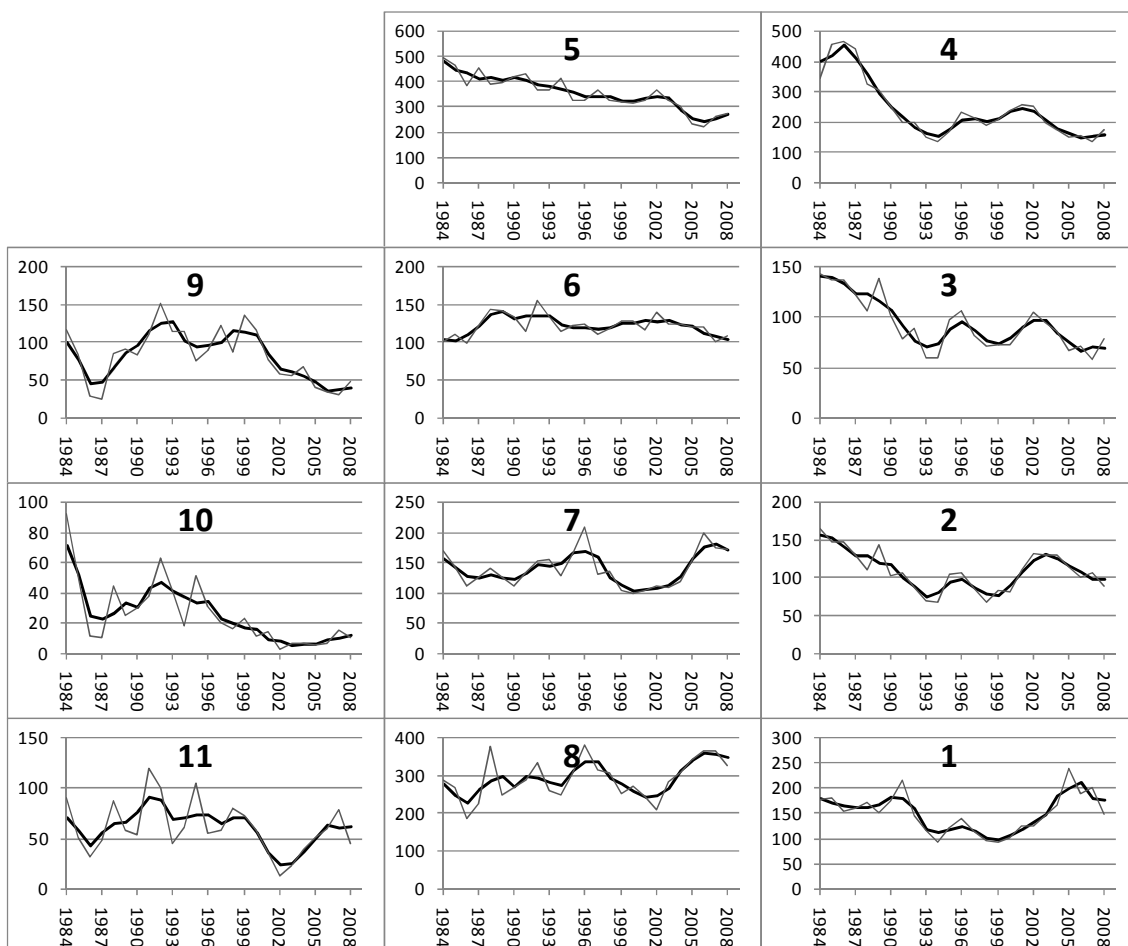


Figure 7. Regional catch in tonnes. Dates shown are quota years with the first part of the year indicated. Each plot shows the 3 year moving average (heavy line) and yearly data (thin line).

3.2.3 Non-Quota Commercial Catch

Non-quota commercial catch occurs in three ways: personal use provisions, well mortalities, and octopus mortalities. Formal reporting of personal use provisions and well mortalities was introduced in 2003/04, while octopus mortalities have been reported since 1992/93.

Reporting was introduced so that firm data could be collected on the scale of these activities. In particular, there were a few instances of well mortalities being discarded and the scale of this loss was questioned. This practice would lead to the under-estimation of commercial catch in the assessment process. The introduction of mandatory report-

ing of these discards without penalty provides a more objective basis for examining the scale of this potential source of mortality.

Personal use in 2008/09 was insignificant at 4.0 t, down from 4.5 t in the previous year. These lobsters are mainly sick animals or octopus kills that were unsuitable for sale into the live market.

Well mortalities were trivial at 0.3 tonnes, down from 1.0 tonne in the previous year.

Octopus mortalities have been steady through time with an average of 42,800 lobsters per year, which equates to an average mortality of 2.35% of the number of lobsters retained (Figure 8). Total number of lobsters reported killed by octopus in the last year was 38,500, which is below average.

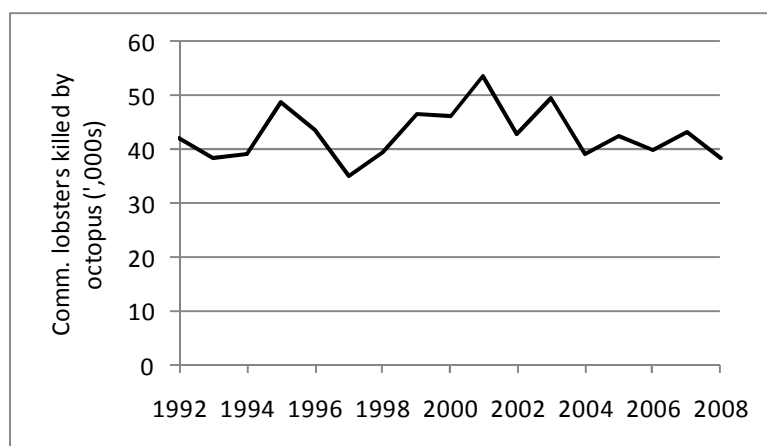


Figure 8. Trends in reported mortalities due to octopus predation. The average mortality rate equates to 2.35% by number.

3.2.4 Research Quota

Research in the Tasmanian rock lobster fishery is partially funded through the allocation of 1% of the TACC. A total of 15 tonnes were utilised in 2008/09. Of this, 10.5 tonnes were leased to fund at-sea data collection for fisheries research. The balance (4.5 tonnes) was leased to fund market research activities of the commercial sector.

3.2.5 Recreational Catch

The most recent published recreational survey of rock lobster catches was for the 2006/2007 fishing year (Lyle, 2008) and was reported in the previous fisheries assessment. A summary of this information is repeated here.

The number of recreational licenses for rock lobster has remained stable for the last 2 years at around 21,400 after average compound growth in license numbers of 7.7% per annum for the previous 9 years (

Figure 9). This represents a rapid growth in the number of license holders, up from around 8500 in 1996.

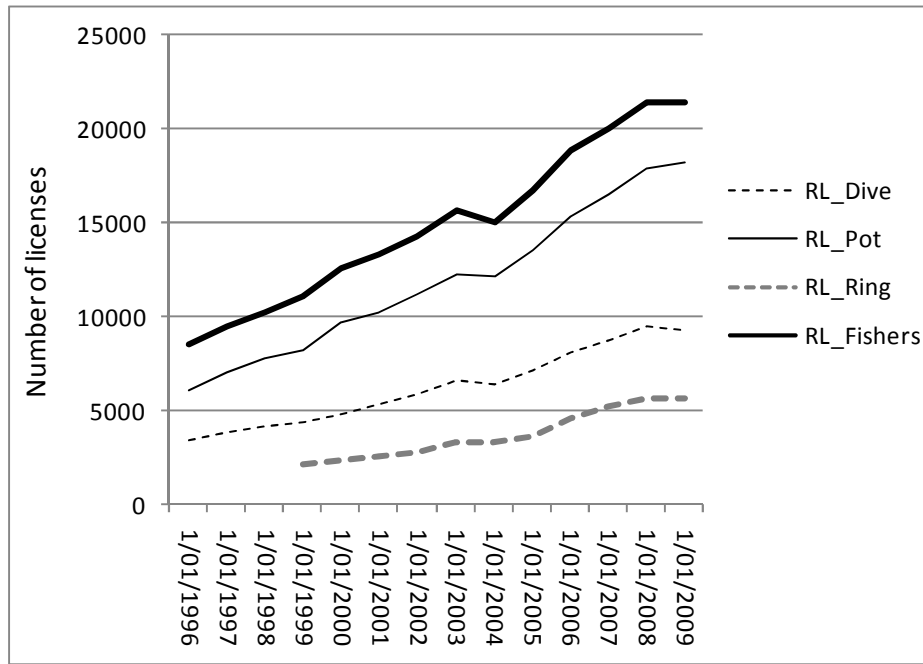


Figure 9. Trends in recreational rock lobster licenses. Fishers may hold licenses for more than one type of rock lobster gear type.

Estimated recreational catches rose steadily each survey from 1992 until 2002/2003 after which they appear to have declined slightly. Catches have started to increase again in this latest survey (Table 3.1). The latest recreational survey is underway and will be summarised in the next assessment.

Table 3.1. Estimated total weight of recreational catches by area and season.

The recreational surveys were usually conducted over a fishing year (November until October – with September and October assumed closed to recreational fishing). However, these figures have now been associated with given quota years. Spatial resolution of the surveys has increased through time.

| Area | 1996/1997 | 1997/1998 | 2000/2001 | 2002/2003 | 2004/2005 | 2006/2007 |
|-------|-----------|-----------|-----------|-----------|-----------|-----------|
| 1 | 39.533 | 35.355 | 51.891 | 43.596 | 42.777 | 51.271 |
| 2 | 20.403 | 13.173 | 26.988 | 29.211 | 16.113 | 13.520 |
| 3 | | | | 21.318 | 15.781 | 16.246 |
| 4 | 6.0075 | 4.813 | 19.57 | 13.506 | 7.343 | 20.896 |
| 5 | 10.381 | 8.058 | 6.272 | 17.595 | 17.437 | 13.824 |
| 6 | 13.361 | 8.271 | 22.084 | 11.866 | 8.225 | 11.435 |
| 7 | | | | 5.497 | 7.889 | 5.943 |
| 8 | | | | 5.937 | 3.791 | 1.932 |
| Total | 89.686 | 69.670 | 126.805 | 148.526 | 119.356 | 135.067 |

3.3 Commercial Catch and Effort Analysis

Catch rate data from the commercial sector serves as a proxy for two very different factors of interest for fisheries management – cost of fishing and the abundance of lobsters.

State-wide commercial rational mean catch rates for the 2008/09 quota year were higher than those recorded in the corresponding reference years (Table 3.2). A comparison of ratio mean catch rates between 2007/08 and 2008/09 shows that catch rates have declined in all areas over this period (Table 3.2). Statewide catch rates now approximate those at the start of ITQ management.

As catch is limited by quota, changes in catch rates mainly affect potlifts required to take the catch. In 2008/09 there was only 76.8% of the effort expended in 1996/97 (Figure 10, Table 3.4). This level of effort was a substantial increase (12%) on that observed in the previous year.

The decline in catch rate has led to lower daily catches, and more working days per active vessel. The average vessel is now working an extra 25 days per year (+19%) to take the same catch as 3 years ago (Figure 10). Fishers report that this increases the risk of accidents at sea as they are less able to avoid bad weather.

Although daily catches per vessel has fallen over the last few years, the daily revenue per vessel has actually increased because of higher beach price (Figure 10). This increase in daily revenue has not been enough to overcome a slump in fishing profitability, as reflected in a decline in the market lease price (-26% over the last 2 years).

Change in effort is an important mechanism for social changes in the fishery as it drives the number of vessels required to take the catch. An increase in effort as seen over the last year would be expected to reduce demand for leased quota, lower the price of leased quota, and encourage new entrants.

Regional declines in ratio mean catch rate were most pronounced in the south with greatest decline in the SE (27%) (Table 3.2 and Figure 11).

Fishers report that there has been a change in fishing practices at night with more multiple night shots. Data is restricted to day shots only in Table 3.3 to exclude any bias. Data from **day shots only** suggest the statewide decline in catch is more pronounced (19% over the last year) although appears more positive in the minor Area 3.

Apparent declines in ratio mean catch rates can be caused by factors unrelated to abundance and for this reason trends in biomass shown later in the report provide a more reliable guide to stock changes.

Table 3.2. Annual ratio mean commercial catch-rates.

Negative values of change indicate a reduction. The reference year is defined as the year with lowest CPUE.

| Area | Lowest Year | Commercial catch rates (kg/pot lift) | | | % change | | Catch stats (March 2008-Feb. 2009) | |
|-----------|-------------|--------------------------------------|---------|---------|-------------|------------|------------------------------------|-------------------------|
| | | Lowest Year | 2007/08 | 2008/09 | vs Ref.Year | vs 2007/08 | Catch (t) | Effort (1000 pot lifts) |
| Statewide | 1994 | 0.82 | 1.15 | 1.00 | 22 | -13 | 1455 | 1456 |
| 1 | 1994 | 0.54 | 0.98 | 0.72 | 33 | -27 | 146 | 205 |
| 2 | 1994 | 0.54 | 1.02 | 0.82 | 53 | -19 | 87 | 108 |
| 3 | 1994 | 0.43 | 0.77 | 0.76 | 78 | -2 | 77 | 101 |
| 4 | 1994 | 0.61 | 1.01 | 0.96 | 56 | -5 | 171 | 178 |
| 5 | 1995 | 0.89 | 1.22 | 1.15 | 29 | -6 | 271 | 237 |
| 6 | 1994 | 1.06 | 1.20 | 1.11 | 5 | -8 | 111 | 99 |
| 7 | 1994 | 1.12 | 1.50 | 1.38 | 23 | -8 | 170 | 121 |
| 8 | 1993 | 0.76 | 1.18 | 0.99 | 30 | -16 | 334 | 342 |
| 9 | 1996 | 1.40 | 1.65 | 1.60 | 14 | -3 | 44 | 26 |
| 10 | 1994 | 1.00 | 1.40 | 1.22 | 22 | -13 | 10 | 8 |

* estimated catch from logbooks (where effort is also recorded) as compared to total (QMS) landed catch.

Table 3.3. Annual ratio mean commercial catch-rates – DAY SHOTS ONLY.

Negative values of change indicate a reduction. The reference year is defined as the year with lowest CPUE.

| Area | Lowest Year | Commercial catch rates (kg/pot lift) | | | % change | | Catch stats (March 2008-Feb. 2009) | |
|-----------|-------------|--------------------------------------|---------|---------|-------------|------------|------------------------------------|-------------------------|
| | | Lowest Year | 2007/08 | 2008/09 | vs Ref.Year | vs 2007/08 | Catch (t) | Effort (1000 pot lifts) |
| Statewide | 1994 | 0.85 | 1.21 | 0.99 | 15 | -19 | 290 | 294 |
| 1 | 1994 | 0.57 | 1.3 | 0.99 | 74 | -24 | 42 | 43 |
| 2 | 1994 | 0.45 | 1.13 | 0.77 | 69 | -32 | 6 | 7 |
| 3 | 1994 | 0.51 | 0.98 | 1.14 | 124 | 17 | 12 | 10 |
| 4 | 1994 | 0.51 | 0.86 | 0.83 | 64 | -3 | 20 | 25 |
| 5 | 1991 | 0.92 | 1.03 | 1.04 | 14 | 1 | 15 | 14 |
| 6 | 1991 | 0.74 | 1.06 | 1.07 | 45 | 1 | 21 | 19 |
| 7 | 1997 | 0.76 | 1.22 | 1.04 | 36 | -15 | 41 | 40 |
| 8 | 1993 | 0.7 | 1.21 | 0.89 | 28 | -26 | 92 | 103 |
| 9 | 1991 | 1.25 | 1.53 | 1.49 | 20 | -3 | 16 | 11 |
| 10 | 1994 | 0.83 | 1.47 | 1.17 | 41 | -20 | 4 | 3 |

Table 3.4. Summary of state-wide commercial catch and effort statistics.

1996/97 had the maximum level of effort since 1994/95 and other years are scaled to this peak. QYear is quota year (Mar 1st – Feb 28/29th). State CPUE is the total catch divided by the total pot lifts.

| QYear | Catch (t) | Pot Lifts (‘1000) | % effort of 96/97 | State CPUE (kg/potlift) |
|--------------|------------------|------------------------------|------------------------------|------------------------------------|
| 1994/1995 | 1435 | 1753 | 91.99 | 0.818 |
| 1995/1996 | 1637 | 1746 | 91.62 | 0.938 |
| 1996/1997 | 1799 | 1906 | 100.00 | 0.944 |
| 1997/1998 | 1611 | 1823 | 95.68 | 0.884 |
| 1998/1999 | 1488 | 1592 | 83.56 | 0.934 |
| 1999/2000 | 1486 | 1471 | 77.21 | 1.010 |
| 2000/2001 | 1492 | 1455 | 76.38 | 1.025 |
| 2001/2002 | 1498 | 1433 | 75.22 | 1.045 |
| 2002/2003 | 1511 | 1351 | 70.89 | 1.118 |
| 2003/2004 | 1483 | 1371 | 71.93 | 1.082 |
| 2004/2005 | 1517 | 1309 | 68.71 | 1.158 |
| 2005/2006 | 1509 | 1253 | 65.75 | 1.204 |
| 2006/2007 | 1522 | 1289 | 67.67 | 1.180 |
| 2007/2008 | 1513 | 1301 | 68.29 | 1.163 |
| 2008/2009 | 1455 | 1456 | 76.40 | 0.999 |

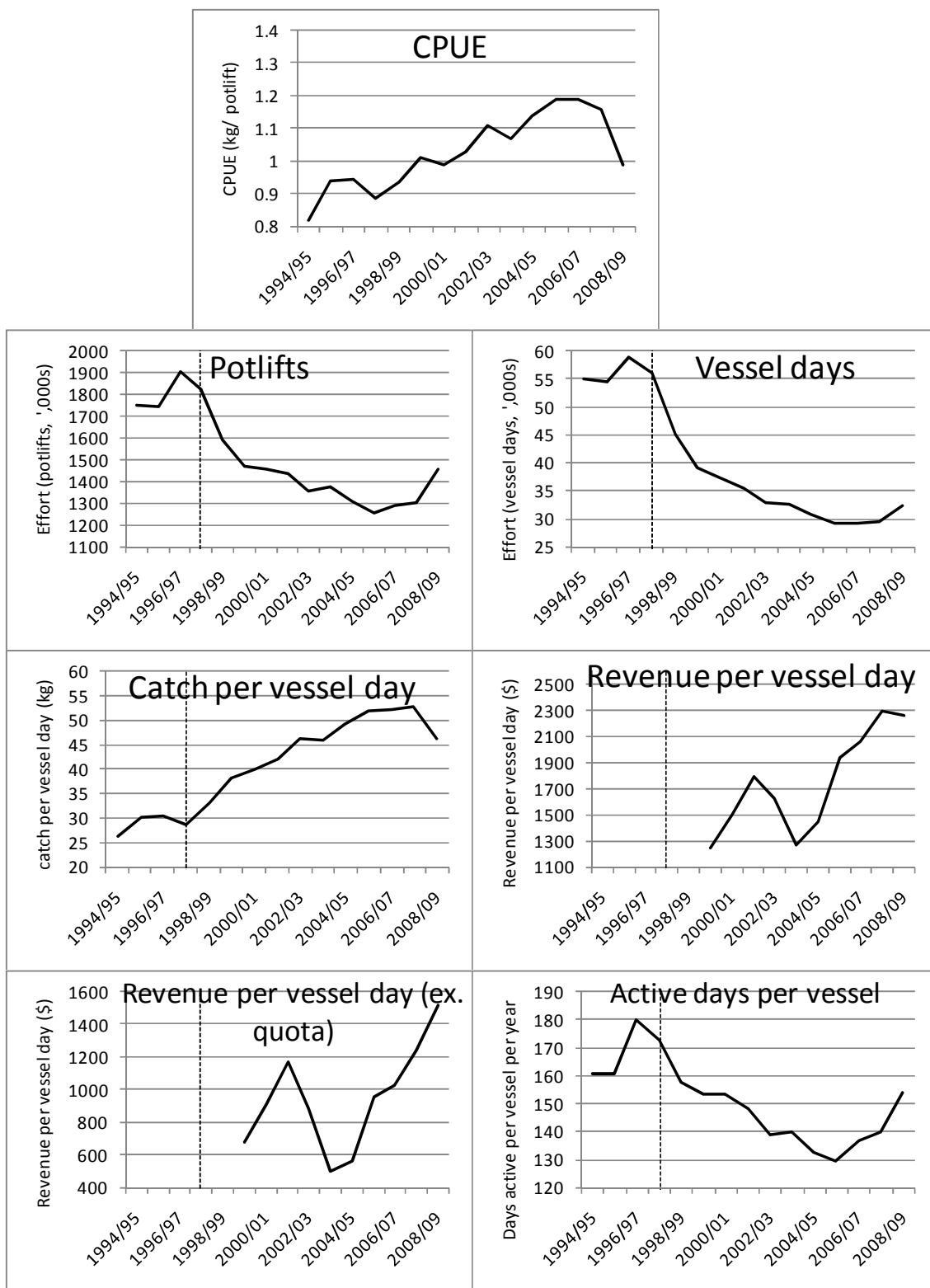


Figure 10. Trends in average State-wide commercial catch data since before the introduction of the quota system in 1998/99. The 1994/95 quota year was when catch rates (as sum of catch/sum of pot lifts) reached their lowest point state-wide. Revenue per vessel day assumes average yearly beach price. Revenue per vessel day ex-quota excludes the opportunity cost of using quota which could otherwise be leased out.

Trends in regional catch and effort suggest the declines seen over the last few years have occurred around the state, with the exception of Area 3 which is stable at very low catch rate. Catch rates have declined in deep (9-11) and shallow (1-8) assessment areas (Figure 11). The trends in catch rates in northern and eastern Tasmania is especially concerning as it has occurred despite concurrent decline in effort (Figure 12). If recruitment to the fishery were stable, then this large decline in effort should result in higher catch rates instead of the observed decline.

On a finer scale, catch rates have declined over the last year in each of the more important fishing blocks that contribute a cumulative 50% of the catch, with the exception of 4H3 in the NE (

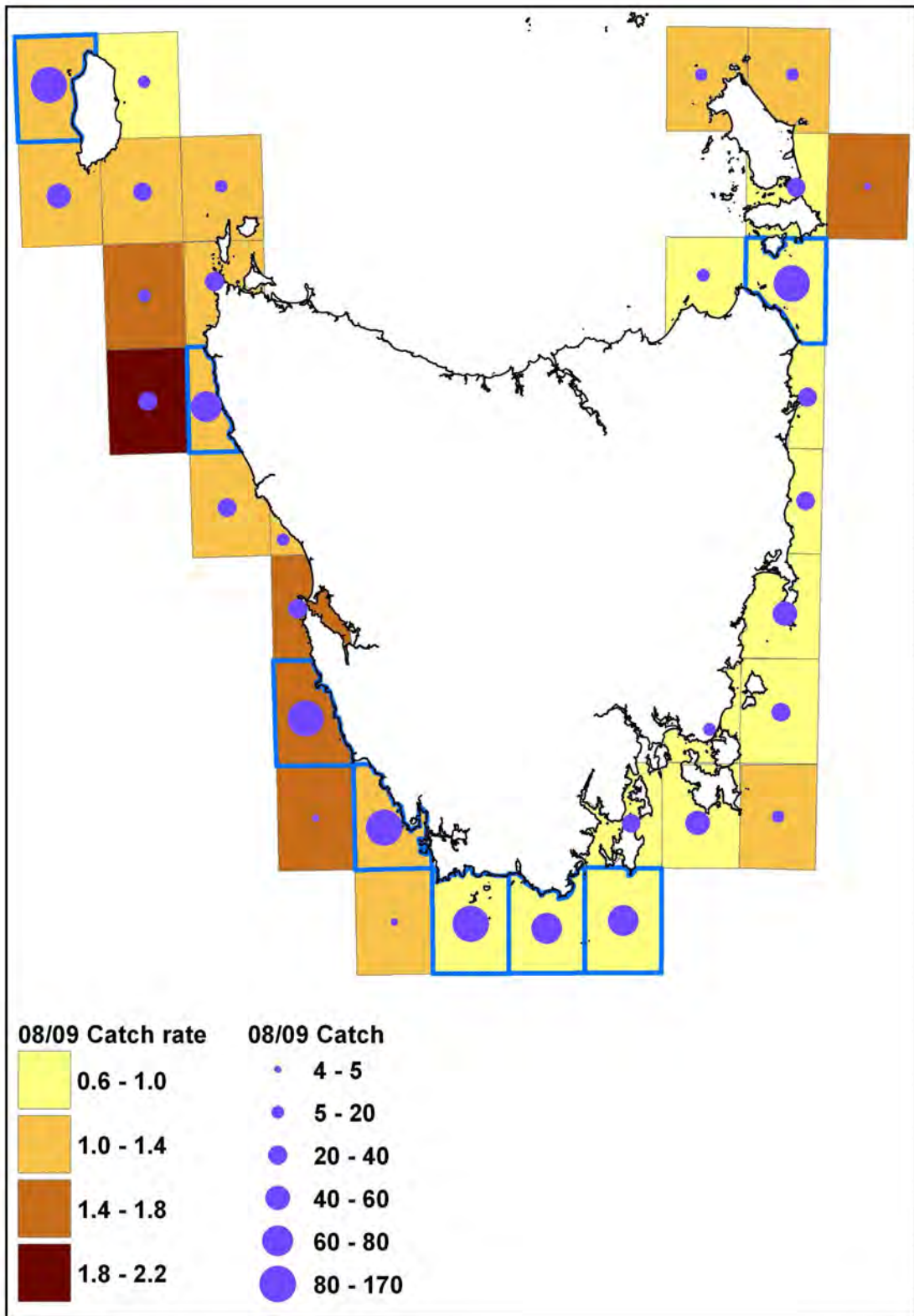


Figure 14 and

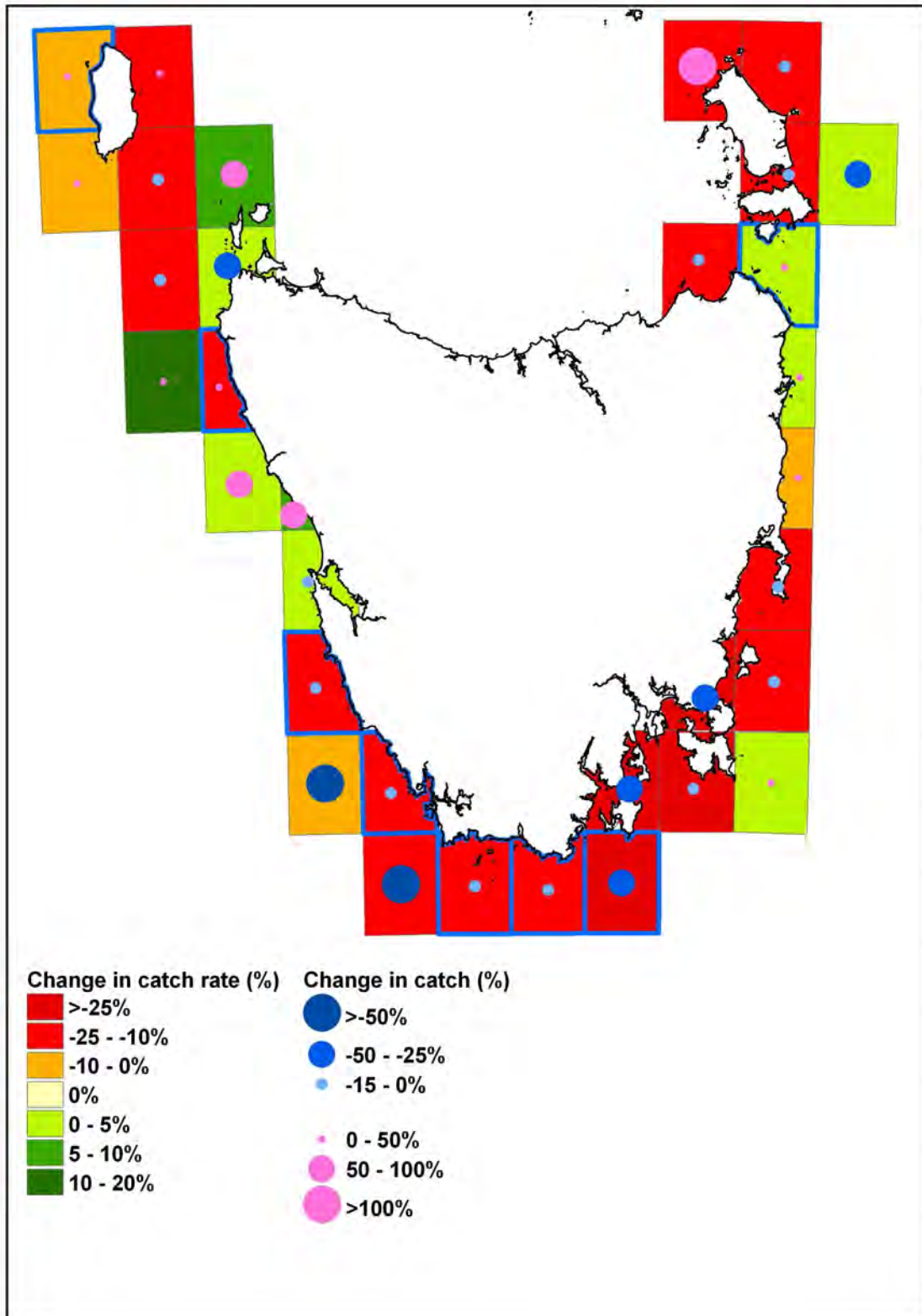


Figure 15).

These declines were not a function of change in fishing depth because decline occurred in deep and shallow areas (Figure 11), or seasonal timing of catch because catch rates were below average for almost all months (Figure 13).

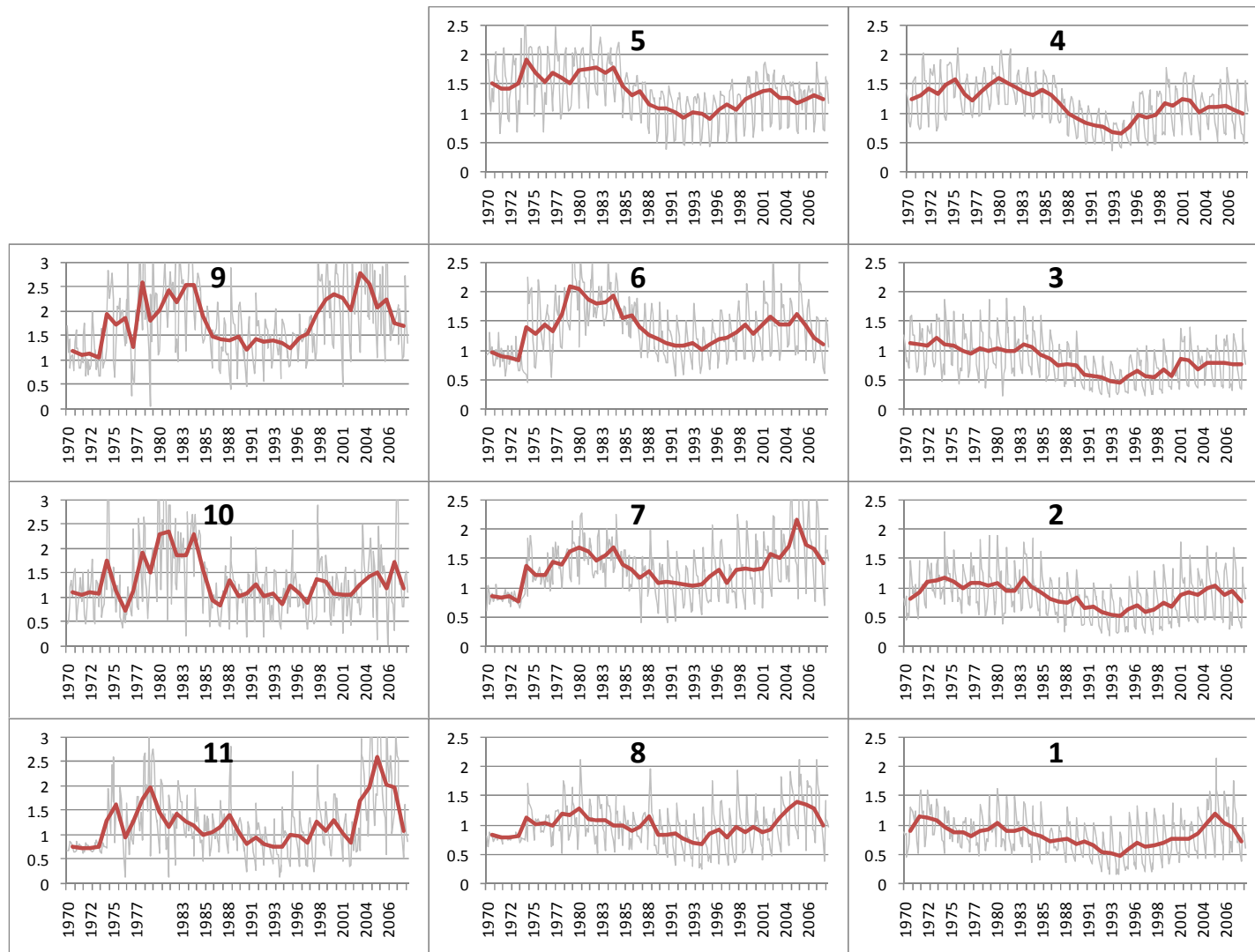


Figure 11. Regional ratio commercial catch rates since 1970. Data is presented on a quota year basis (i.e. March to February), so the last data point is for February 2009. The monthly trend in catch rate is shown by the pale grey line with a 12 month average shown by the heavy line.

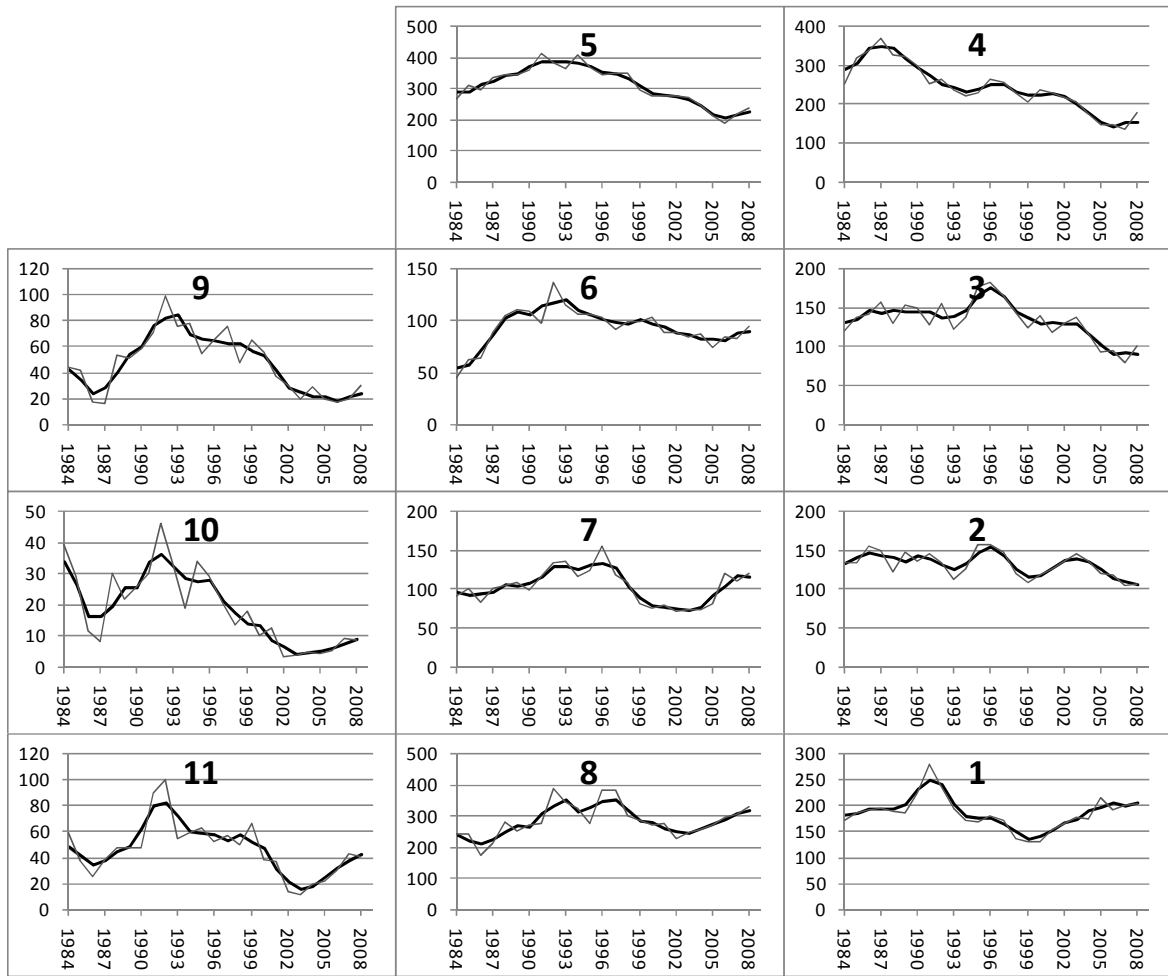


Figure 12. Regional effort (potlifts). Dates shown are quota years with the first part of the year indicated. Each plot shows the 3 year moving average (heavy line) and yearly total (light line).

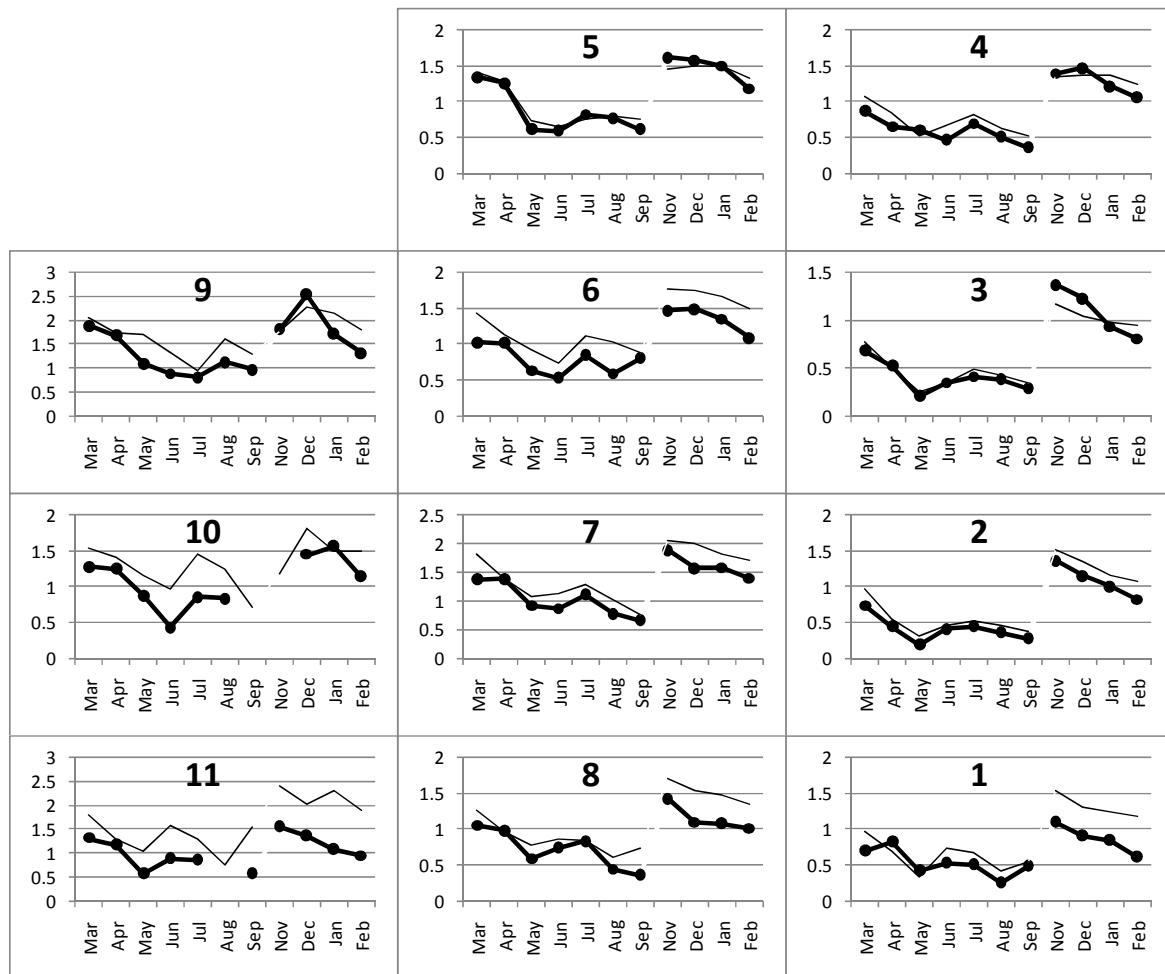


Figure 13. Change in ratio commercial catch rate (CPUE, kg/pot lift) between months for 2008/09 (the heavy line) and the mean of the quota years 2003/04 – 2007/08 (thin line).

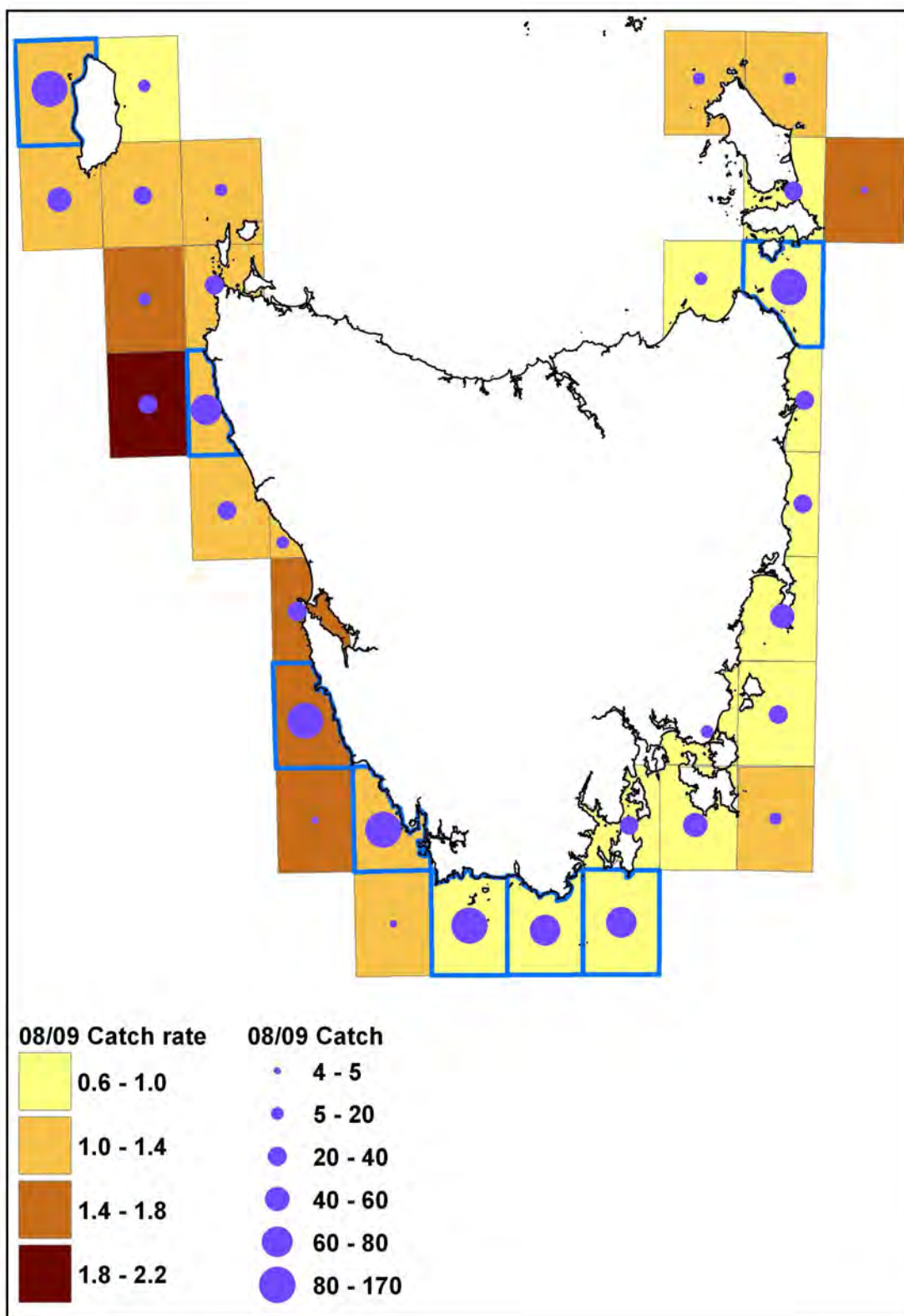


Figure 14. Catch rates and catch by fishing block. Total catch for the 2008/09 quota year is illustrated by the circles within each block. Blocks with catch of less than 2.5 tonnes were excluded. Eight blocks contributed 60% of the total catch and are marked with a blue border.

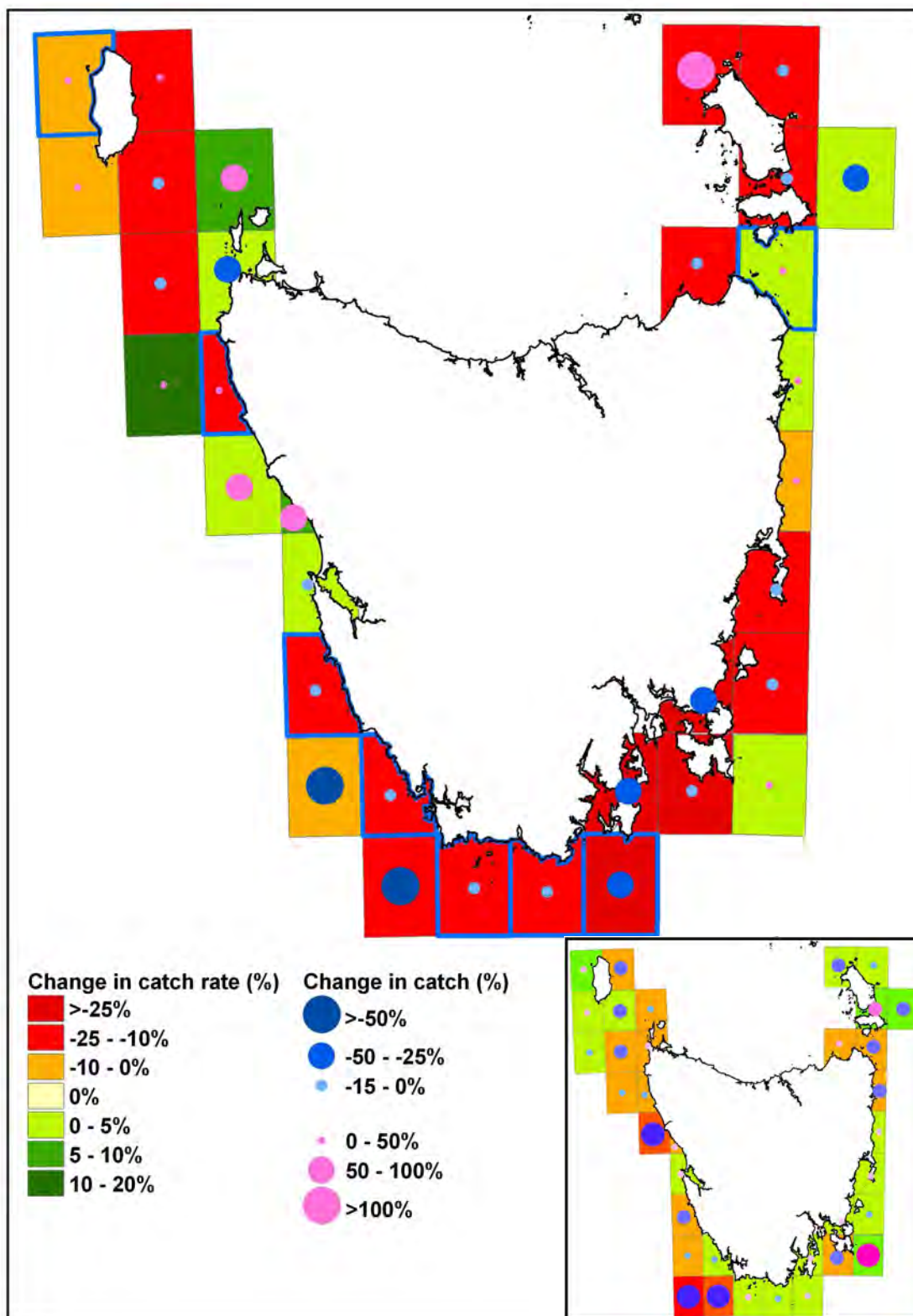


Figure 15. Change in catch rates and catch by fishing block from 2007/08 to 2008/09. Blocks with catch of less than 2.5 tonnes were excluded. Note that a large percentage change in catch and catch rate is more common where the total catch is very small (e.g. 4H2 off Flinders Island). Insert shows same figure from previous year (i.e. change from 2006/07 to 2007/08). Eight blocks contributed 60% of the total catch and are marked with a blue border.

3.4 Discussion

The rock lobster fleet and fishery continued to follow clear spatial trends. Catches over a three-year period are now around record highs in Areas 1 and 8 and record lows in Areas 3, 4 and 5. These patterns are of concern, as northern catches appear reduced by prolonged poor recruitment, yet the TACC continues to be taken through record high harvests from the south. It is unlikely that catches in the south can be maintained at such high levels.

Catch rates declined by 13% in 2008/09 compared to the previous year which suggests a severe decline in the standing stock.

The decline in catch rates in 2008/2009 was widespread and occurred in all areas except Area 3 (which was stable and already very low). The decline in catch rate occurred:

- in all significant fishing blocks except one (in Banks Strait);
- in both deep and shallow fishing grounds;
- in data restricted to day shots only (to avoid possible data errors from multiple nights).

Catch per vessel day has declined by 8% so fishers now need to spend an average 14 days extra per year to take the same catch as last year and 25 days extra compared to three years ago. This means running costs and risk of exposure to bad weather has increased for no gain in catch. Increased beach price over the last two years has reduced the financial impact of lower catch rates, but not enough to stop profitability sliding – as seen in falling lease prices.

Declines in catch rates that have occurred for the last three years have undone much of the rebuilding that has occurred since ITQ management was introduced.

3.4.1 Management Advice

Catch and effort data from the commercial fishery indicates that there has been a consistent decline in the stock for the last three years. This is consistent with abnormally low recruitment – under more average recruitment this decline should not have occurred.

Current management thus appears to have high risk of continued stock decline. Further stock decline would be expected to continue to erode profitability and increase risk of recruitment and ecological overfishing.

In summary, the signals in catch effort data point to the need for a reduction in total catch. Regional management options should also be explored. Alternate management is explored further in this assessment through stock modelling.

3.5 Biomass

Estimates of legal sized biomass are produced for the start of the month of November because stocks then represent the status at the opening of the fishing season following closures. Estimate legal sized biomass declined in all areas compared to 2007/08 (

Figure 16,

Table 3.5). Particularly Areas 1 and 2 exhibited significant declines, but declines were above 10% in Areas 3, 6, 7 and 9. The slightly positive signs in Areas 3 and 5 last year were not continued into this latest year. Statewide biomass decreased in 2008/09 by about 8.2%.

These recent declines undid all increases in legal size biomass observed since the start of the QMS system in 1998 in the Areas 5, 6 and 9, while in the other areas legal size biomass increased by up to 75% of its levels prior to the introduction of the quota system. Nevertheless, all areas show a some increase in legal biomass relative to that estimated for the reference year (1993/94; 13 years earlier), although again Areas 5 and 6 had the lowest increase of all areas at less than 20% (

Table 3.5).

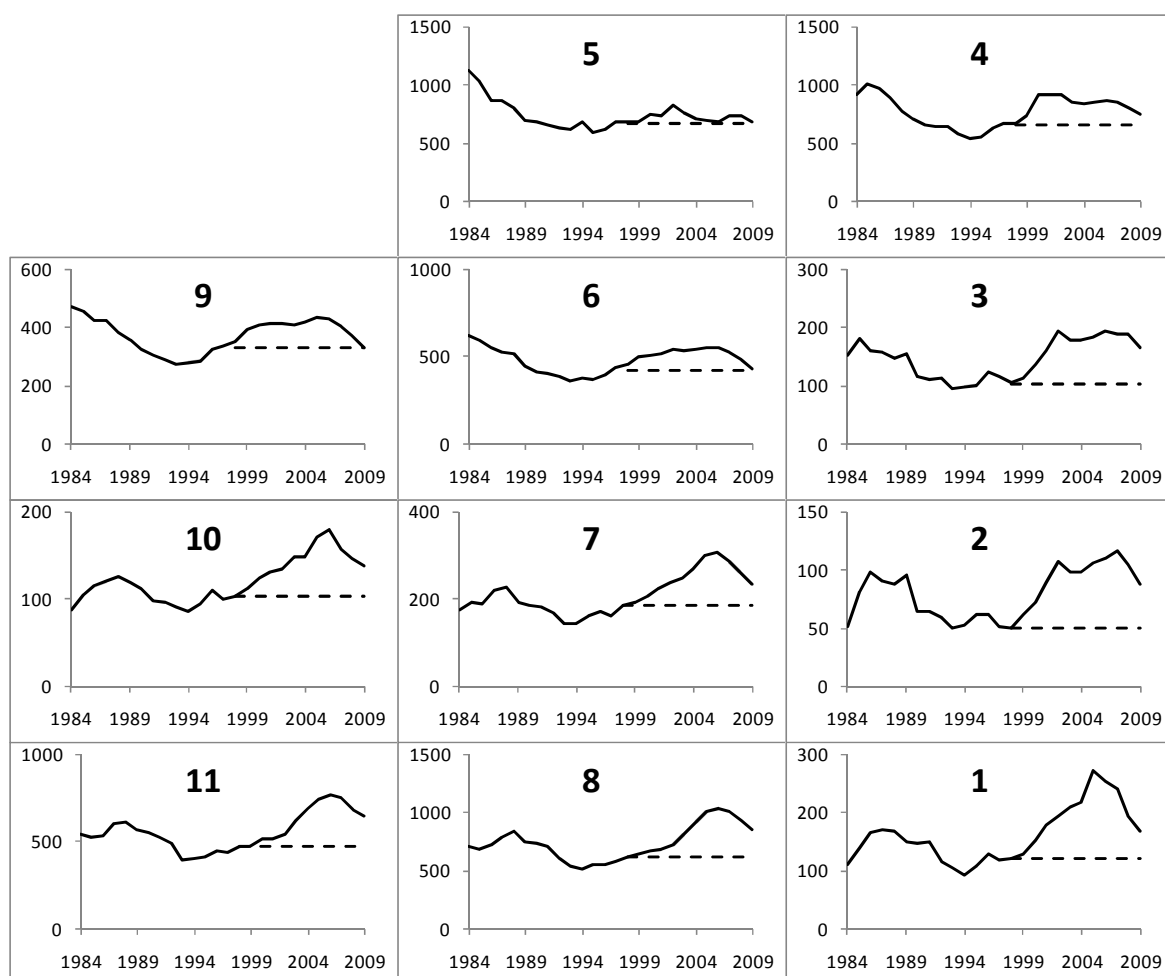


Figure 16. Legal-sized biomass estimates (tonnes) for the rock lobster fishery from 1984 to 2009. Note the plots have different vertical scales. Larger total legal-sized biomass in Areas 5 and 8 is mainly a function of size of habitat. The dashed line is the lowest estimated legal sized biomass since February 1998, the first month of QMS.

Table 3.5. Change in legal-sized biomass in February with reference year equal to lowest year since 1984.

| Area | Ref Year | Sized biomass estimate (tonnes) | | | % change in 2009 | |
|-----------|----------|---------------------------------|------|------|------------------|---------|
| | | Ref. Year | 2008 | 2009 | vs Ref. Year | vs 2008 |
| Statewide | 1993 | 3229 | 4866 | 4465 | 38.3 | -8.2 |
| 1 | 1994 | 92 | 193 | 168 | 82.1 | -13.2 |
| 2 | 1993 | 50 | 105 | 88 | 74.7 | -16.0 |
| 3 | 1993 | 94 | 187 | 165 | 75.5 | -11.4 |
| 4 | 1994 | 533 | 792 | 747 | 40.1 | -5.6 |
| 5 | 1995 | 586 | 733 | 676 | 15.4 | -7.7 |
| 6 | 1993 | 358 | 476 | 424 | 18.5 | -10.9 |
| 7 | 1993 | 144 | 260 | 234 | 61.8 | -10.3 |
| 8 | 1994 | 510 | 920 | 851 | 66.8 | -7.4 |
| 9 | 1993 | 275 | 372 | 331 | 20.5 | -11.0 |
| 10 | 1993 | 86 | 147 | 138 | 60.1 | -6.3 |
| 11 | 1993 | 396 | 682 | 643 | 62.6 | -5.7 |

Table 3.6. Change in legal-sized biomass in February with reference year equal to lowest year since QMS.

| Area | Ref Year | Sized biomass estimate (tonnes) | | | % change in 2009 | |
|-----------|----------|---------------------------------|------|------|------------------|---------|
| | | Ref. Year | 2008 | 2009 | vs Ref. Year | vs 2008 |
| Statewide | 1998 | 3791 | 4866 | 4465 | 17.8 | -8.2 |
| 1 | 1998 | 120 | 193 | 168 | 39.7 | -13.2 |
| 2 | 1998 | 50 | 105 | 88 | 74.7 | -16.0 |
| 3 | 1998 | 104 | 187 | 165 | 59.3 | -11.4 |
| 4 | 1998 | 659 | 792 | 747 | 13.4 | -5.6 |
| 5 | 1998 | 673 | 733 | 676 | 0.5 | -7.7 |
| 6 | 2009 | 424 | 476 | 424 | 0.0 | -10.9 |
| 7 | 1998 | 187 | 260 | 234 | 25.1 | -10.3 |
| 8 | 1998 | 613 | 920 | 851 | 38.9 | -7.4 |
| 9 | 2009 | 331 | 372 | 331 | 0.0 | -11.0 |
| 10 | 1998 | 104 | 147 | 138 | 32.7 | -6.3 |
| 11 | 1998 | 471 | 682 | 643 | 36.5 | -5.7 |

3.6 Egg production

Rock lobster egg production has no clear link to future recruitment to the fishery but is considered in management nonetheless. This is because very low levels of egg production are expected to affect recruitment at some point. Responding to information on egg production requires an understanding of the following points:

- The planktonic larval stage is very protracted (1.5 – 2 years)
- Larvae collected in plankton tows are not retained inshore but are invariably from off the continental shelf except for very early stages and the final puerulus stage
- There is no pattern in historical stock data between levels of egg production and future recruitment
- Modelling of larval dispersal suggest Tasmanian recruits mainly originate from elsewhere (SA and Vic.)
- Variation in current movement between years suggests that no one region is consistently important for larval supply as this varies between years.

These points suggest that management of Tasmanian egg production may have little impact on future recruitment; certainly at the level of region (i.e. low egg production in a region does not mean it will have low future recruitment).

It is also true that lobster stocks can experience recruitment failure across broad regions at low levels of egg production. The accepted management response to this is to maintain egg production at reasonable levels in all regions of the State - the eggs in many baskets approach.

Similarly to legal-sized biomass, statewide spawning biomass has fallen over the last few years (

Figure 17). The decline in spawning biomass is less pronounced than the decline in legal-sized biomass because undersized lobsters contribute a considerable proportion of the total egg production. Statewide spawning biomass in 2009 was 8% higher than the lowest year in 1990, but 1.7% lower than at the start of QMS and 3% lower than in 2008 (

Table 3.7 and Table 3.8).

Declines in spawning biomass have been widespread so that regional levels are now at their lowest levels for a decade in all areas except 1 and 4 (

Figure 18). Despite the declines in spawning biomass over the last few years, levels in southern areas remain very high to the unfished state with greater than 25% production in Areas 1, 2, 7, 8, 10, and 11. This suggests more than adequate egg production in these regions (

Figure 19,

Table 3.7 and Table 3.8).

Egg production is below target levels in northern Areas 3, 4, 5, 6 and 9. Further, each of these areas has declined over the last year so that the stock is moving away from the target level of spawning stock biomass. In Areas 3, 6, and 9 the spawning stock biomass is now at the lowest point since the introduction of the QMS (

Figure 19).

Note that targets for spawning stock biomass differ between northern areas. The ultimate goal is for all areas to have production above 25% of the unfished state but this is unattainable with current size limits in Areas 5 and 6 so a target of 20% is used instead. Any target is arbitrary as the level of spawning biomass required to maintain the fishery is unknown without dropping to the level that crashes the fishery. The 25% target used in Tasmania is different to that used in Victoria (20%) and South Australia (no formal limit, but management considers the current level of ~12% to be acceptable).

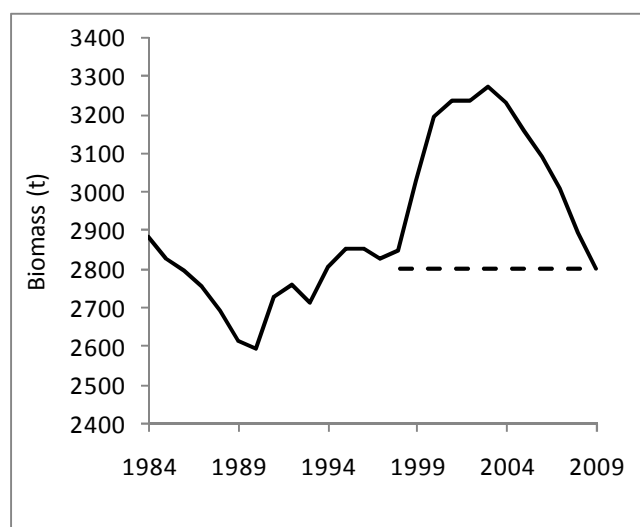


Figure 17. Total statewide female spawning biomass at the end of the February period. Note the Y-axis begins at 2,400 tonnes. The dashed line shows the lowest level of spawning biomass since QMS.

Table 3.7. State-wide and regional spawning biomass relative to lowest levels in early 1990's. Virgin spawning biomass is the estimated level prior to commercial exploitation, assuming average recruitment is the same as that from 1982 to the present. Change in spawning biomass between years is less important for management guidance than the level relative to the virgin state. Areas of concern are in bold.

| Area | Ref. Year | Relative Spawning biomass | | Virgin Spawning biomass | % Change in 2009 vs | | % Virgin Prod. in 2009 | |
|-------|-----------|---------------------------|------|-------------------------|---------------------|-----------|------------------------|-------|
| | | Ref. Year | 2008 | | 2009 | Ref. Year | | 2008 |
| State | 1990 | 2592 | 2893 | 2800 | 4378 | 8.0 | -3.2 | 64.0 |
| 1 | 1993 | 176 | 217 | 203 | 281 | 15.0 | -6.8 | 72.3 |
| 2 | 1994 | 50 | 68 | 57 | 147 | 12.9 | -16.1 | 38.7 |
| 3 | 1994 | 43 | 54 | 49 | 246 | 14.8 | -10.1 | 19.9 |
| 4 | 1994 | 96 | 130 | 127 | 632 | 32.0 | -2.6 | 20.1 |
| 5 | 1993 | 84 | 83 | 81 | 582 | -2.8 | -2.4 | 14.0 |
| 6 | 1993 | 131 | 129 | 128 | 797 | -1.9 | -0.8 | 16.1 |
| 7 | 1993 | 132 | 141 | 131 | 210 | -0.7 | -7.0 | 62.4 |
| 8 | 1993 | 1041 | 1088 | 1070 | 1041 | 2.7 | -1.7 | 102.7 |
| 9 | 1994 | 94 | 100 | 94 | 615 | -0.2 | -5.9 | 15.2 |
| 10 | 1993 | 80 | 86 | 78 | 128 | -3.0 | -9.1 | 61.0 |
| 11 | 1992 | 755 | 796 | 782 | 762 | 3.6 | -1.7 | 102.7 |

Table 3.8. State-wide and regional spawning biomass relative to the start of QMS.

Virgin spawning biomass is the estimated level prior to commercial exploitation, assuming average recruitment is the same as that from 1982 to the present. Change in spawning biomass between years is less important for management guidance than the level relative to the virgin state. Areas of concern are in bold.

| Area | Ref. Year | Relative Spawning biomass | | Virgin Spawning biomass | % Change in 2009 vs | | % Virgin Prod. in 2009 | |
|-------|-----------|---------------------------|------|-------------------------|---------------------|-----------|------------------------|-------|
| | | Ref. Year | 2008 | | 2009 | Ref. Year | | 2008 |
| State | 1998 | 2848 | 2893 | 2800 | 4378 | -1.7 | -3.2 | 64.0 |
| 1 | 1998 | 170 | 217 | 203 | 281 | 19.5 | -6.8 | 72.3 |
| 2 | 1998 | 55 | 68 | 57 | 147 | 4.3 | -16.1 | 38.7 |
| 3 | 1998 | 50 | 54 | 49 | 246 | -1.8 | -10.1 | 19.9 |
| 4 | 1998 | 113 | 130 | 127 | 632 | 12.2 | -2.6 | 20.1 |
| 5 | 1998 | 88 | 83 | 81 | 582 | -7.6 | -2.4 | 14.0 |
| 6 | 1998 | 174 | 129 | 128 | 797 | -26.5 | -0.8 | 16.1 |
| 7 | 1998 | 152 | 141 | 131 | 210 | -13.9 | -7.0 | 62.4 |
| 8 | 1998 | 1061 | 1088 | 1070 | 1041 | 0.8 | -1.7 | 102.7 |
| 9 | 1998 | 122 | 100 | 94 | 615 | -22.9 | -5.9 | 15.2 |
| 10 | 1998 | 86 | 86 | 78 | 128 | -9.0 | -9.1 | 61.0 |
| 11 | 1998 | 778 | 796 | 782 | 762 | 0.6 | -1.7 | 102.7 |

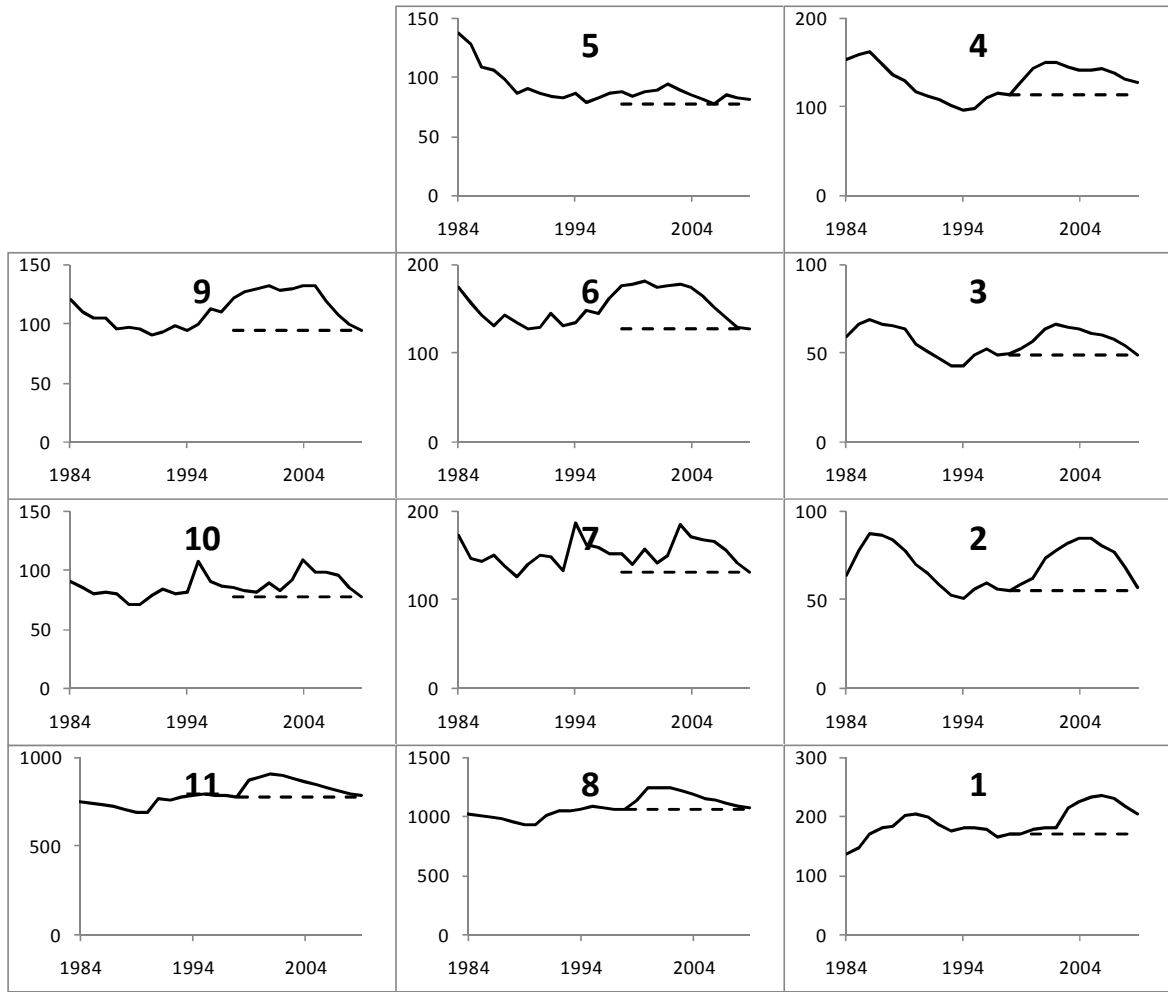


Figure 18. Spawning stock biomass from assessment areas around Tasmania. The horizontal dashed line in each plot represents the lowest level since QMS in 1998.

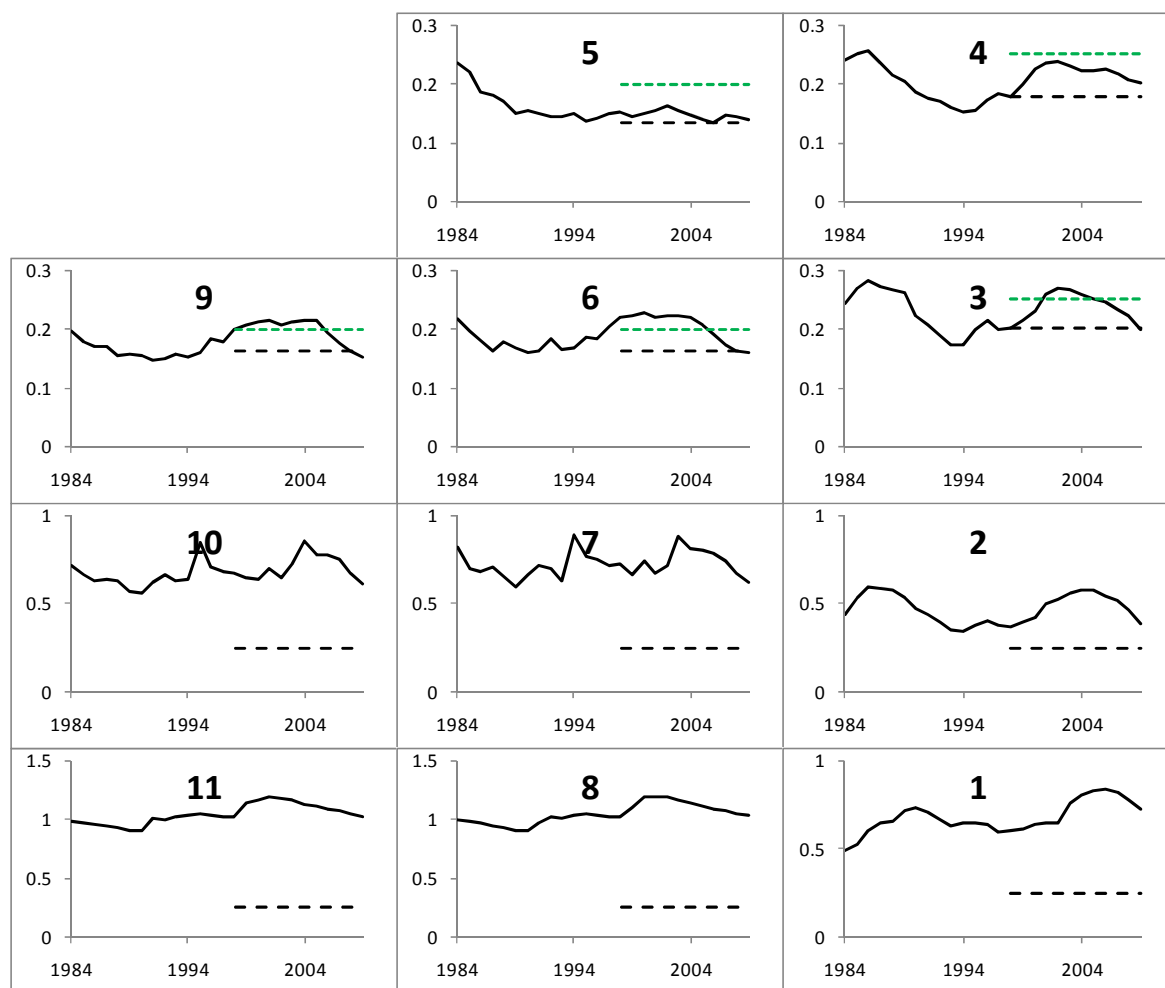


Figure 19. Percentage of virgin (unfished) spawning stock biomass from around Tasmania. The black horizontal dashed line in each plot represents the management limit for each area. This is either 25% (southern areas 1, 2, 7, 8, 10, 11) or the lowest level in the decade 1998 to 2008 for northern areas, which are all currently below 25%. A management target is specified for northern areas (upper green line), which is 25% for areas 3 and 4, and 20% for areas 5, 6 and 9. Certainty in spawning stock biomass estimates from area 9 is much lower than for inshore areas due to less data, so less emphasis should be given to this area.

3.7 Recruitment

Recruitment to the fishery drives future production and is thus of great importance to management of the fishery. Management regimes have limited ability to influence recruitment but large control on how the recruits are utilised. For example, different choices in TAC and size limits can produce vastly different outcomes with equivalent recruitment.

Recruitment to the 60 mm CL size class is estimated in the stock assessment model using commercial catch and effort data plus onboard catch sampling of undersize lobsters (Figure 20). Additional information on recruitment trends is obtained from puerulus data (Figure 21).

The model is fitted to catches of legal sized lobsters and catches rates, with the catch rates providing the index of relative abundance through time. This means that estimates of re-

cruitment can only be determined once the animals have grown into the minimum legal sizes (105 mm for females and 110 mm for males) from the size of recruitment represented in the model (60 mm). For this reason the recruitment levels in the most recent years appear to revert back to the average due to the fact that it takes several years for new recruits to enter the legal sized fishery. Because growth rates differ so much around the State each assessment area has a different time-lag between recruits entering the modelled stock at 60 mm and the animals growing into legal sizes. It takes the longest in Area 8 and the shortest time in Areas 4 and 5. Note that the model assumes that growth is constant through time – increases in growth would appear to the model (and fishers) as a spike in recruitment.

Absolute recruitment levels are very variable around the State with very high average levels occurring in Area 8 and the lowest average levels occurring in Areas 3 and 6 (

Figure 20). The spikes in recruitment seen in Areas 1, 7, and 8 in the late 1990s related directly to the increases of legal sized biomass in these areas prior to the recent decline. Conversely, the low levels of recruitment in Areas 3, 4, and 6 reflect the lowered catches and catch rates from those areas.

Recruitment data have some more notable points:

Puerulus data at Bicheno, which has the most powerful data set, peaked in 1995/96 (

- Figure 21). In the late 1990's, a few years after this peak, very record high recruitment to the 60 mm CL category was predicted by the model in Areas 1, 2, 3, 4, 5 and 8.
- This recruitment pulse drove rapid increase in legal sized biomass under the QMS.
- The decrease in recruitment in years after this peak was expected to lead to slowing of rebuilding given a TAC of 1700 t (as noted in the 2005 stock assessment and each year since).
- Recruitment data in recent years up to 2007 (the most recent affecting catch) has been below average.
- The level of decline in recruitment is extreme and unlike anything seen over the last few decades because: (i) it is at or near record lows in most areas; (ii) declines have occurred simultaneously in all areas (declines in one area are usually balanced by a pulse somewhere else); (iii) the decline has been more protracted than previously.
- Puerulus settlement data over the last year has been around average at 3 of the 4 sites, which is an improvement on previous years.

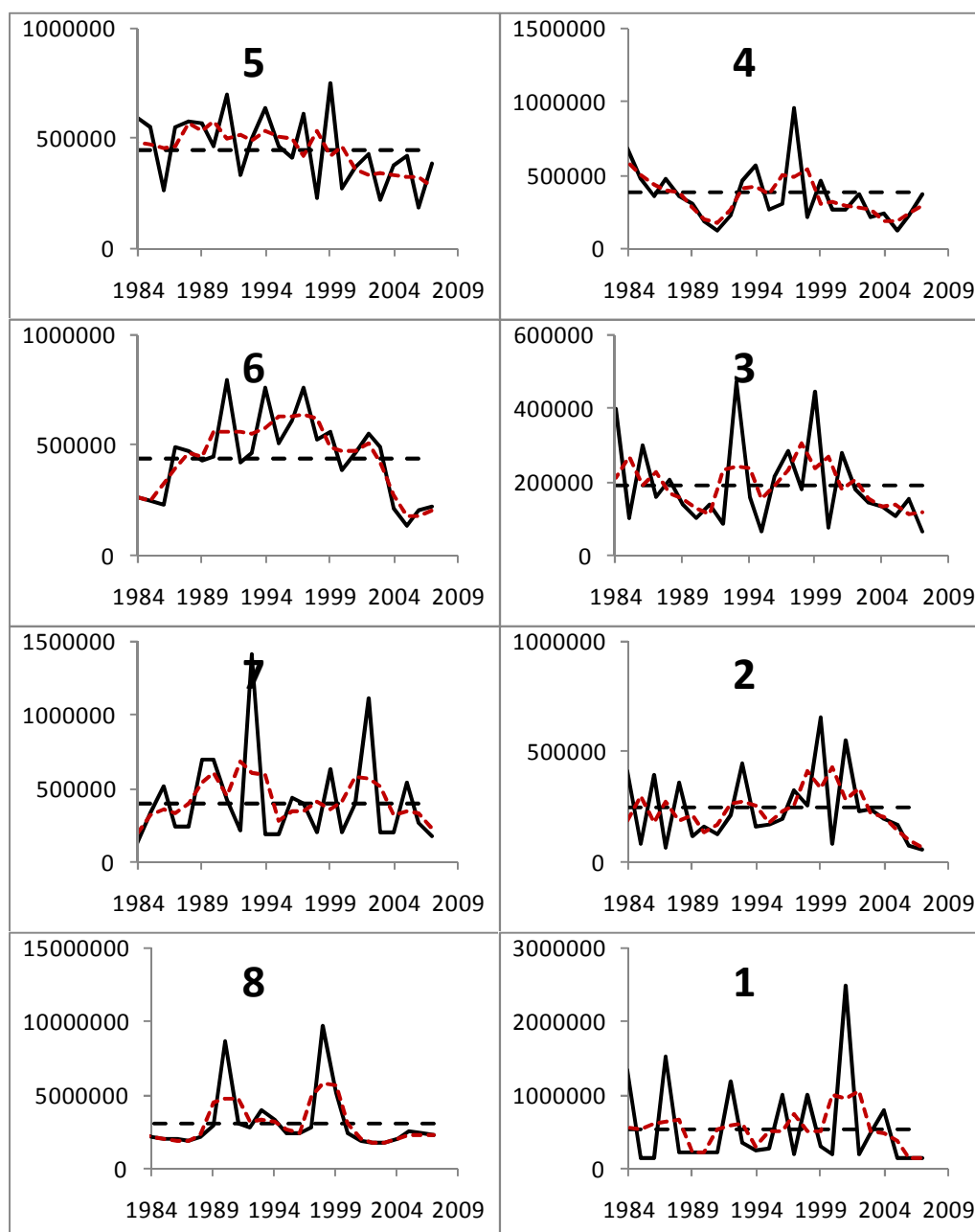


Figure 20. Absolute recruitment levels within each region through time to the 60 mm CL size class (this is the first size category in the stock model and the first size class where reasonable numbers are captured in catch sampling surveys). Note the y-axes vary greatly. The average recruitment for the time period is shown by the dashed line while the 3-year rolling average is shown by the dotted red line. Deep water Areas 9, 10 and 11 are included with the shallow water data here as the recruitment is shared for these areas.

The value of egg production as a guide for management is often debated by industry as there is uncertainty about the fate of larvae produced in different regions. This issue was addressed in an FRDC funded project 2002/007 by Bruce *et al.* (2007). It showed that although larvae could self-recruit to most regions around Tasmania, the relative importance of areas differed. Eggs produced in the NW had the lowest probability of contributing to stocks as they could be lost into the shallow waters of Bass Strait. Larval production from outside Tasmania was also important, especially that produced in SE South Australia.

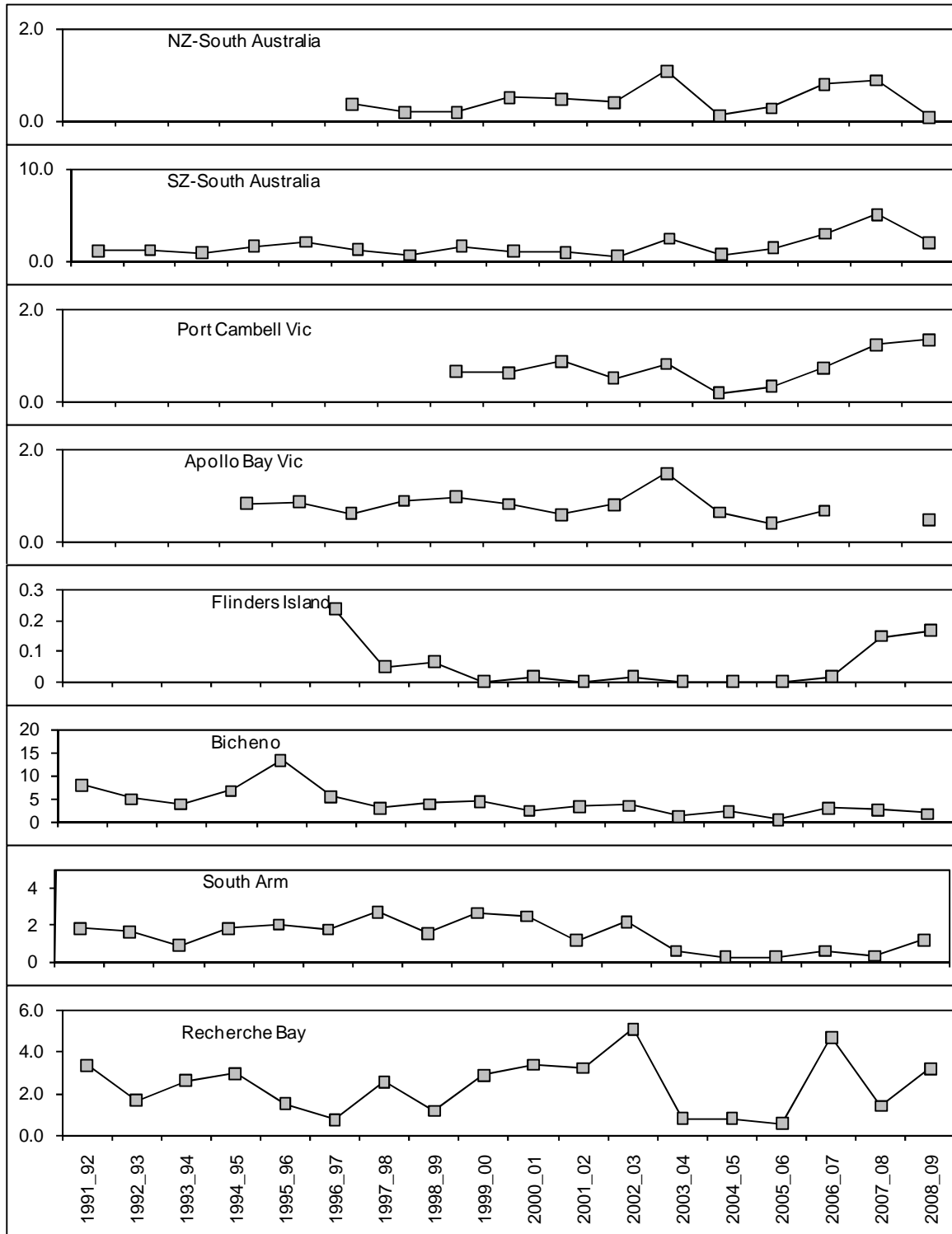


Figure 21. Puerulus catches from long term monitoring sites across southern Australia. Units are the average number of puerulus per individual collector check. “Pueurlus years” run from July to June, excluding low catch months where collectors are not serviced (Bicheno –March to June; South Arm – March to May; Recherche Bay – April to June). South Australian and Victorian data provided by Adrian Linnane (SARDI) and David Hobday (DPI Victoria).

3.8 Active vessels

A Limit Reference Point of 220 active licences was put in place at the start of the QMS to track participation in the fishery (

Figure 22; Table 3.9). As stocks improved in the fishery through the first decade of the QMS the number of vessels declined. In addition, a change in the maximum number of pots per vessel from 40 to 50 in 1998, intended to increase efficiency, reduced the number of active vessels.

The deterioration of the stocks over the last few years has stabilised and reversed the decline in number of active vessels. Thus there were 229 vessels that reported catch in 2009/10, up by 19 vessels from the previous year.

The number of active vessels is a function of stock size. As the stock rebuilds through constraints on the TACC, catch rates increase and the number of days a boat needs to fish decreases. This creates an economic pressure on the fishing fleet to rationalise. Since the stock has declined over the last few years, vessels and fishers need to work more days to take the same catch. This created an undersupply of vessels and new vessels have entered the fleet (

Figure 23).

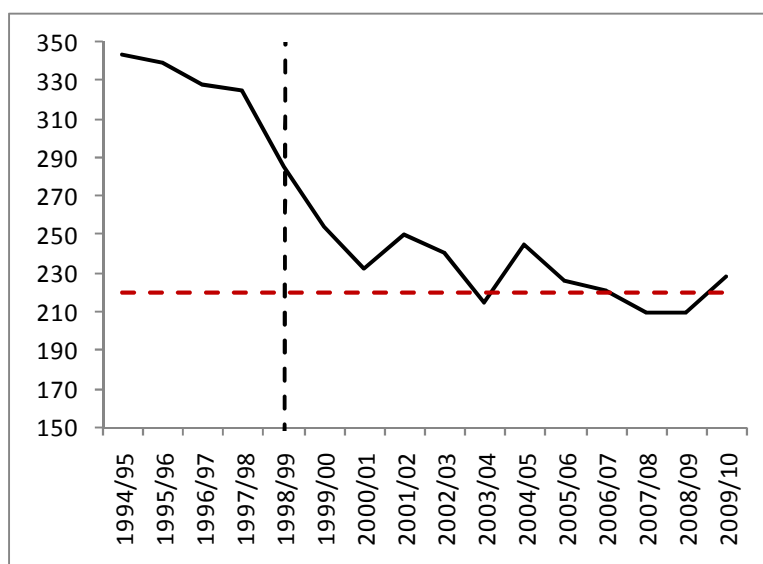


Figure 22. Number of vessels around the State reporting any rock lobster catch. The dashed red line is the Limit Reference Point (220), while the dashed black line marks the start of the QMS.

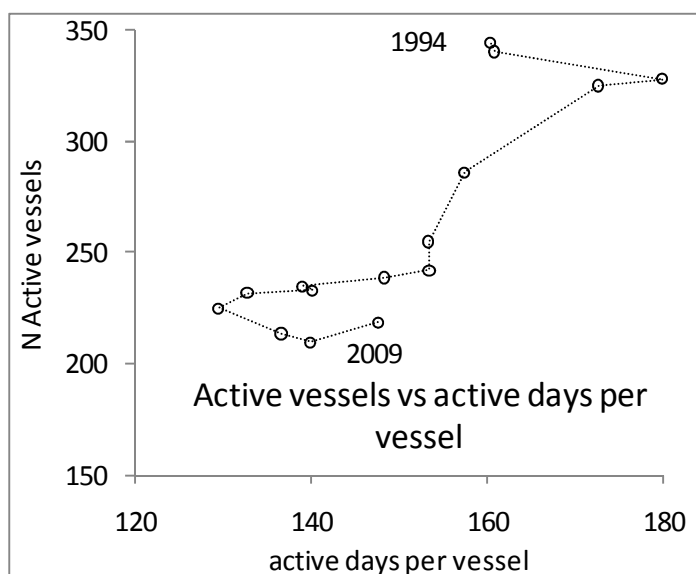


Figure 23. Number of vessels around the State reporting any rock lobster catch in relation to the days fished per vessel. Upper and lower constraints on vessel activity affect the overall fleet size.

Table 3.9. Number of active vessels reporting any catch of rock lobsters across the State.

| Quota Year | Total |
|------------|-------|
| 1994/95 | 344 |
| 1995/96 | 340 |
| 1996/97 | 328 |
| 1997/98 | 325 |
| 1998/99 | 286 |
| 1999/00 | 255 |
| 2000/01 | 233 |
| 2001/02 | 250 |
| 2002/03 | 241 |
| 2003/04 | 215 |
| 2004/05 | 245 |
| 2005/06 | 227 |
| 2006/07 | 221 |
| 2007/08 | 210 |
| 2008/09 | 210 |
| 2009/10 | 229 |

3.9 Mean Weight

The mean weight of lobsters in catches has slowly increased in recent years in most areas, with minimum values sometime between the mid and late 1990s (

Figure 24). This is a complex performance measure to interpret because an increase in average weight could be due to either of increased landing of larger lobsters or reduction in

recruits. Nonetheless, trends in the NE are consistent with the low recruitment discussed elsewhere.

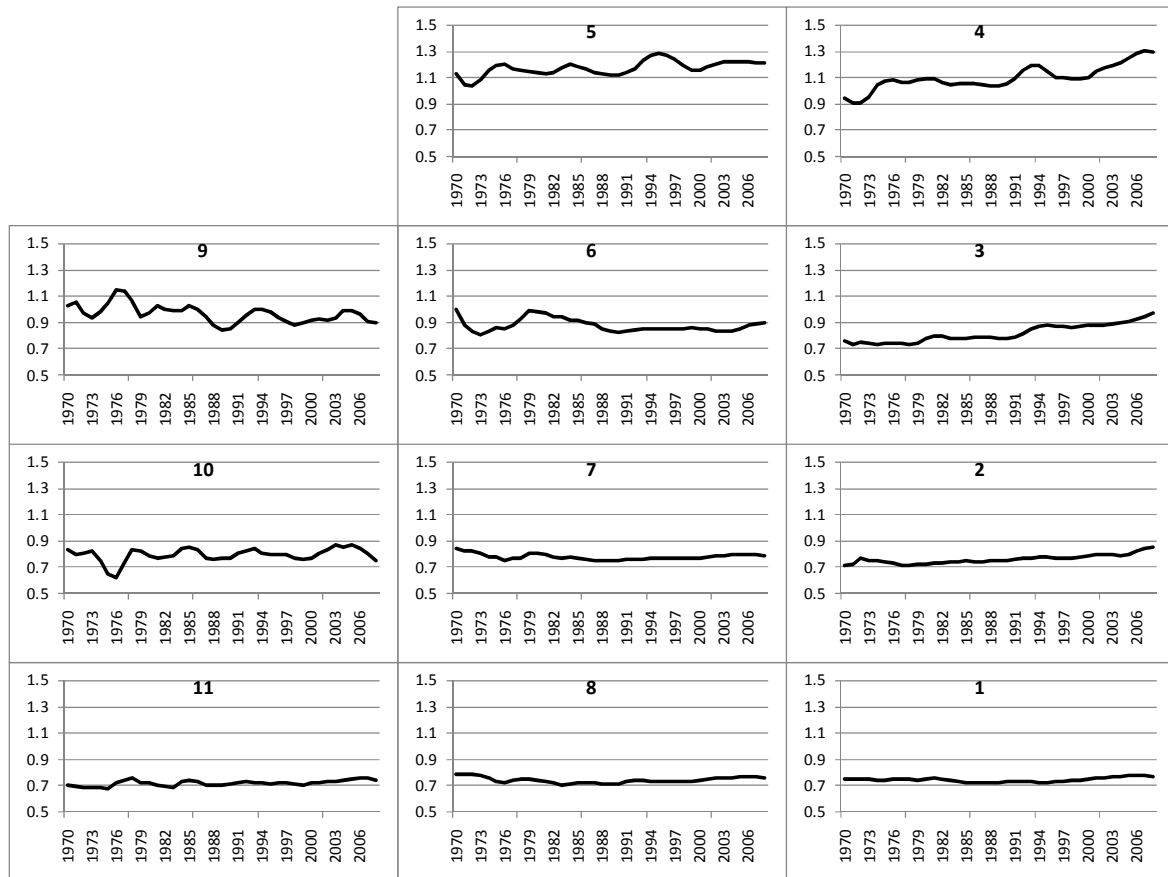


Figure 24. Mean weight of lobsters caught as kg by quota year and assessment area.

4 Risk Assessments

Risk assessments for the Tasmanian lobster fishery were conducted by projecting the dynamics of the stock forward under different TAC arrangements and determining the consequences. Economic information on cost and price data from 2008 is also included in these projections. Economic yield in this analysis is the earnings from the fleet after costs have been paid. This does not include lease payments in costs of fishing because these are a rent payment which increase as the fishery becomes more profitable.

Detailed documentation on the modelling procedure and data inputs is available from TAFI. Assumptions are listed in that documentation but critically include:

- (i) that recreational and illegal catch does not increase as catch rates rise through stock rebuilding;
- (ii) that the commercial fleet continues to move between areas in response to catch rates in the same manner as they have done since 1998;
- (iii) that the biology of lobsters (especially growth and mortality) is constant through time; and
- (iv) critically, that future recruitment will fall within the range of previous observed recruitment levels for data fitted from 1984 to 2009, i.e. that the recent period of low recruitment was a random event rather than a regime shift.

Projections of the fishery are based upon randomised recruitment series. If such projections are repeated many times it becomes possible to address questions such as the proportion of legal biomass projections in five years that will be greater than the legal biomass in 2008/09, given a particular TACC. If the result is 50% or less this suggests that the chance of the stock rebuilding is equal to or less than the chance of the stock declining.

Under the status quo scenario (TACC = 1470 t, recreational catch unchanged), the expectation is for continued decline in the fishery, and loss of community benefit in terms of economic yield from the commercial sector. Catch rates would be expected to continue falling which implies loss of utility to commercial, recreational and non-extractive users.

Reductions in the TACC will reduce risk of stock decline although regional issues remain even with very significant cuts. Egg production and legal sized biomass are expected to remain low in northern regions, over a 5 year period, even with the largest TACC cuts proposed.

Alternative management strategies were evaluated which were status quo management (i.e. the TACC remaining at 2009/10 levels, plus a range of options with the TACC reduced, either in the first year of projections or stepwise over several years. All of the analysed TACC changes are expected to increase the net present value (discounted flow of future earnings) of the fishery relative to the status quo (**Error! Reference source not found.**, 4.2, 4.3 and 4.4). The conclusion is that the fishery would become more profitable by reducing catch because costs would fall due to higher catch rates (i.e. the same process that's driven fishery earnings since 2006). This fall in costs outstrips the loss of revenue from a smaller catch. All of the TACC scenarios presented provide a reasonable probability of catch rates reaching 1.4 kg/potlift, which is an industry defined target intended to approximate maximum economic yield.

Benefit from the resource for the recreational fishery is not measured here but would be expected to follow similar trends to the commercial sector, i.e. lower catch rates should be avoided because they involve greater cost for the same benefit (enjoyment). Thus all the TACC changes examined would be expected to increase recreational utility because catch rates are higher relative to the status quo.

Table 4.1. Stock projections under different TACC scenarios in relation to biomass. Examined scenarios were the status quo, and different levels or TACC reductions in the first years of the projection period. Recreational catches are assumed to stay approximately at 2007/2008 levels and recruitment is assumed to vary within ranges seen since 1984.

| | | | | | | | | |
|--|---------------|------------|-----------|-----------|-----------|-----------|-----------|-----------|
| TACC scenarios | Year 1 | Status quo | -7% | -10% | -15% | -20% | -20% | -25% |
| | Year 2 | Status quo | -7% | -5% | -1% | 0% | -1% | 0% |
| | Year 3 | Status quo | -7% | -5% | -1%* | 0% | -1%* | 0% |
| % probability that Legal biomass remains above 10 year low point, after 5 years | State | 19 | 74 | 75 | 76 | 86 | 89 | 97 |
| | Area1 | 86 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Area2 | 51 | 90 | 91 | 92 | 96 | 96 | 99 |
| | Area3 | 61 | 87 | 89 | 92 | 95 | 95 | 97 |
| | Area4 | 6 | 20 | 22 | 24 | 28 | 30 | 39 |
| | Area5 | 13 | 44 | 44 | 46 | 55 | 57 | 69 |
| | Area6 | 32 | 65 | 65 | 67 | 70 | 72 | 83 |
| | Area7 | 60 | 98 | 98 | 99 | 100 | 100 | 100 |
| | Area8 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

*1% reduction per annum was ongoing each year for the remainder of the decade.

Table 4.2. Stock projections under different TACC scenarios in relation to egg production. Examined scenarios were the status quo, and different levels or TACC reductions in the first years of the projection period. Recreational catches are assumed to stay approximately at 2007/2008 levels and recruitment is assumed to vary within ranges seen since 1984.

| TACC scenarios | Year 1 | Status quo | -7% | -10% | -15% | -20% | -20% | -25% |
|--|---------------------|------------|-----|------|------|------|------|------|
| | Year 2 | Status quo | -7% | -5% | -1% | 0% | -1% | 0% |
| | Year 3 | Status quo | -7% | -5% | -1%* | 0% | -1%* | 0% |
| % probability that Egg production is above limit after 5 years | State (>25%) | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Area1 (>25%) | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Area2 (>25%) | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Area3 (>25%) | 91 | 97 | 97 | 97 | 99 | 99 | 100 |
| | Area4 (>decade low) | 31 | 50 | 50 | 53 | 57 | 59 | 68 |
| | Area5 (>decade low) | 43 | 70 | 73 | 73 | 79 | 80 | 85 |
| | Area6 (>decade low) | 58 | 74 | 74 | 75 | 79 | 79 | 82 |
| | Area7 (>25%) | 97 | 100 | 100 | 100 | 100 | 100 | 100 |
| | Area8 (>25%) | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

*1% reduction per annum was ongoing each year for the remainder of the decade.

Table 4.3. Stock projections under different TACC scenarios in relation to biomass. Examined scenarios were the status quo, and different levels or TACC reductions in the first years of the projection period. Recreational catches are assumed to stay approximately at 2007/2008 levels and recruitment is assumed to vary within ranges seen since 1984. (For example, the first cell with red border indicates a 50% probability (median projection) that biomass in 2009/10 (Y1) is at 96% of the 2008/09 level.)

| TACC scenarios | Year 1 | Status quo | -7% | -10% | -15% | -20% | -20% | -25% | -7% |
|--|-------------|------------|------|------|------|------|------|------|------|
| | Year 2 | Status quo | -7% | -5% | -1% | 0% | -1% | 0% | -7% |
| | Year 3 | Status quo | -7% | -5% | -1%* | 0% | -1%* | 0% | -7% |
| | Probability | | | | | | | | |
| State exploitable biomass Y1 vs 2008/09 | 50% | 96% | 96% | 96% | 96% | 96% | 96% | 96% | 96% |
| State exploitable biomass Y2 vs 2008/09 | 50% | 94% | 96% | 97% | 98% | 100% | 100% | 101% | 101% |
| State exploitable biomass Y3 vs 2008/09 | 50% | 93% | 99% | 100% | 102% | 105% | 105% | 108% | 108% |
| State exploitable biomass Y4 vs 2008/09 | 50% | 91% | 103% | 104% | 106% | 110% | 110% | 115% | 115% |
| State exploitable biomass Y5 vs 2008/09 | 50% | 89% | 108% | 109% | 110% | 115% | 116% | 121% | 121% |
| State exploitable biomass Y6 vs 2008/09 | 50% | 88% | 113% | 114% | 115% | 120% | 122% | 128% | 128% |
| State exploitable biomass Y7 vs 2008/09 | 50% | 87% | 119% | 119% | 120% | 126% | 128% | 136% | 136% |
| State exploitable biomass Y8 vs 2008/09 | 50% | 86% | 124% | 124% | 126% | 131% | 134% | 143% | 143% |
| State exploitable biomass Y9 vs 2008/09 | 50% | 84% | 129% | 129% | 131% | 136% | 139% | 149% | 149% |
| State exploitable biomass Y10 vs 2008/09 | 50% | 82% | 134% | 133% | 136% | 141% | 145% | 155% | 155% |

*1% reduction per annum was ongoing each year for the remainder of the decade.

Table 4.4. Stock projections under different TACC scenarios in relation to catch rate and economic measures. Examined scenarios were the status quo, and different levels or TACC reductions in the first years of the projection period. Recreational catches are assumed to stay approximately at 2007/2008 levels and recruitment is assumed to vary within ranges seen since 1984.

| TACC scenarios | Year 1 | Status quo | -7% | -10% | -15% | -20% | -20% | -25% |
|--|--------|------------|-------|-------|-------|------|-------|------|
| | Year 2 | Status quo | -7% | -5% | -1% | 0% | -1% | 0% |
| | Year 3 | Status quo | -7% | -5% | -1%* | 0% | -1%* | 0% |
| State CPUE Y1 (kg/potlift) | 50% | 0.92 | 0.93 | 0.94 | 0.95 | 0.96 | 0.96 | 0.97 |
| State CPUE Y2 | 50% | 0.91 | 0.96 | 0.97 | 0.99 | 1.02 | 1.02 | 1.04 |
| State CPUE Y3 | 50% | 0.89 | 1.01 | 1.02 | 1.04 | 1.08 | 1.09 | 1.13 |
| State CPUE Y4 | 50% | 0.88 | 1.07 | 1.08 | 1.09 | 1.15 | 1.16 | 1.22 |
| State CPUE Y5 | 50% | 0.86 | 1.13 | 1.14 | 1.15 | 1.21 | 1.23 | 1.30 |
| State CPUE Y6 | 50% | 0.84 | 1.19 | 1.20 | 1.21 | 1.27 | 1.29 | 1.38 |
| State CPUE Y7 | 50% | 0.83 | 1.26 | 1.26 | 1.27 | 1.33 | 1.36 | 1.46 |
| State CPUE Y8 | 50% | 0.81 | 1.31 | 1.31 | 1.32 | 1.38 | 1.42 | 1.53 |
| State CPUE Y9 | 50% | 0.79 | 1.36 | 1.35 | 1.38 | 1.43 | 1.47 | 1.59 |
| State CPUE Y10 | 50% | 0.77 | 1.41 | 1.40 | 1.44 | 1.48 | 1.53 | 1.66 |
| Projected profit (NPV; \$millions; 15 y; 7.5%) | 50% | 127 | 259 | 261 | 260 | 269 | 269 | 270 |
| Kilos per quota unit after 10 y | | 140 | 112.6 | 113.7 | 109.8 | 112 | 109.8 | 105 |

*1% reduction per annum was ongoing each year for the remainder of the decade.

5 Ecosystem Based Management

5.1 Protected Species Interactions

Protected species interaction data is collected through the commercial logbooks and also through research sampling, which provides validation of logbook data.

5.1.1 Research sampling data

Research sampling data on protected species interactions has traditionally recorded only significant interactions where the protected species was harmed.

A total of seven harmful interactions with protected species have occurred in research sampling from 1990 to the end of 2007, each involving the drowning of a cormorant. This has occurred with a total of 69441 potlifts and thus represents an incidence of around 0.000101 cormorant deaths per potlift in research pots. If similar rates were experienced by commercial and recreational fishers then the average annual number of cormorant deaths in lobster pots would be around 140 (given estimated potlifts). However, this estimate presumably significantly overstates probable cormorant deaths as research sampling is biased to shallow water.

From 2008, the proportion of research sampling conducted aboard commercial boats was far greater than previous years. Numerous protected species interactions were recorded although these were entirely benign interactions and mainly with seabirds. Seabird interactions were either eating discard bait or roosting on vessels.

Table 5.1. Protected species interactions from observer sampling 2008-2009. All interactions were benign or positive, such as roosting on deck, eating discarded bait, or swimming up to stationary boat.

| Species | Shots with interactions |
|---|-------------------------|
| ALBATROSS GREY-HEADED | 1 |
| ALBATROSS LIGHT MANTLED | 1 |
| ALBATROSS SHY | 11 |
| ALBATROSS UNIDENTIFIED | 70 |
| ALBATROSS WANDERING | 6 |
| AUSTRALIAN FUR SEAL | 14 |
| CORMORANT | 4 |
| DOLPHIN COMMON | 15 |
| DOLPHIN UNIDENTIFIED | 1 |
| FAIRY PENGUIN | 6 |
| GANNET | 21 |
| MIGRATING TERRESTRIAL BIRD UNIDENTIFIED | 2 |
| NZ FUR SEAL | 1 |
| OTHER SEABIRD | 2 |
| OYSTERCATCHER | 1 |
| PACIFIC GULL | 10 |
| PETREL UNIDENTIFIED | 8 |
| PETREL BLUE | 1 |
| PETREL NORTHERN GIANT | 1 |
| PETREL WILSON'S STORM | 1 |
| SEAL - UNIDENTIFIED | 4 |
| SHEARWATER UNIDENTIFIED | 5 |
| SHORT TAILED SHEARWATER | 4 |
| TERN UNIDENTIFIED | 1 |
| WADING BIRD UNIDENTIFIED | 1 |
| WHALE HUMPBACK | 2 |
| WHALE UNIDENTIFIED | 3 |

5.1.2 Commercial logbook data

DPIPWE records protected species interactions through the catch and effort database. Fishers are now required to record species and the nature of interaction in their logbooks to provide greater detail than was available in previous years. However, there is still confusion amongst fishers about what needs to be reported with many reporting benign interactions like sightings of whales, leopard seals or rarer species of seabird. This shows intent to participate but that further work is required.

Yearly data on the number of reported interactions shows no clear trend although decline seems to have occurred over the last two years (Figure 25). Most records relate to seals taking bait or released lobsters.

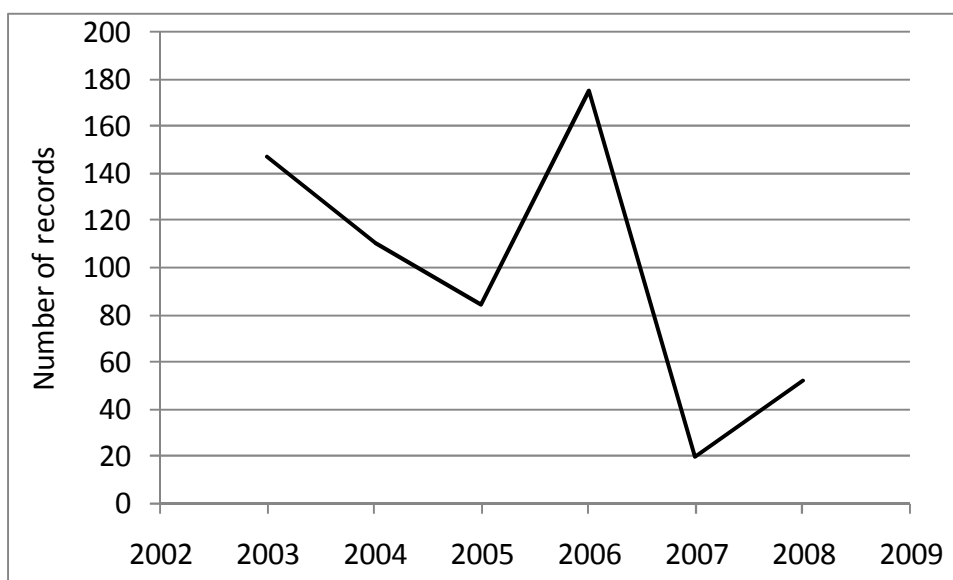


Figure 25. The number of reported interaction events between commercial fishers and protected species.

5.2 By-catch Survey Results

Bycatch information is collected through research trips and also with observers aboard commercial vessels. These fishing trips are identical except that commercial fishers use pots with open escape gaps whereas research close these gaps to increase the number of undersize lobsters in catches. This difference in gear type allows the effect of escape gaps to be evaluated. Table 5.2 shows that escape gaps produce a large reduction in catches of most bycatch species. Discard mortality of individuals captured varies between species with very low or no mortality of velvet crabs, draughtboard sharks, conger eels and leatherjackets. Consequently the species of most impact for bycatch monitoring are wrasse, octopus and leatherjackets, which are also reported under byproduct.

Table 5.2. By-catch observed in research sampling and extrapolated to the commercial fishery for major taxa.

| Species | Research Catch CLOSED Gaps Retained No/potlift | Research Catch OPEN Gaps Retained No/potlift | Fishery OPEN gaps Retained No | Fishery OPEN gaps Estimated No releases by Gaps |
|------------------------|--|--|-------------------------------------|--|
| Velvet Crab | 0.9983 | 0.0071 | 9'000 | 1'291'000 |
| Wrasse Spp. | 0.3559 | 0.0073 | 10'000 | 454'000 |
| Leatherjacket Spp. | 0.1516 | 0.0079 | 10'000 | 187'000 |
| Draughtboard Shark | 0.1013 | 0.0884 | 115'000 | 17'000 |
| Conger Eel | 0.0666 | 0.0027 | 4'000 | 83'000 |
| Octopus | 0.0185 | 0.0084 | 11'000 | 13'000 |
| Striped Trum- peter | 0.0006 | 0 | 0 | 700 |

5.3 Byproduct

Byproduct is now reported within the lobster logbook, which has improved the rate of reporting. Retained product is also differentiated into bait vs. product for sale. All reported byproduct from lobster pots was of a trivial volume, the largest being octopus, draught-board shark and conger eels, each with a total catch of less than 5 tonnes (Table 5.3).

Byproduct is clearly under-reported by the fishery, especially for animals used as bait. For example, research sampling indicates that around 10 t of wrasse are likely to be captured by fishers, yet only 1 t is reported on average each year as byproduct. Likewise research sampling indicates that catches of Maori octopus are under-reported. There is no apparent improvement in rate of reporting between years.

Table 5.3. By-product reported by the commercial fishery (tonnes). All species with catch less than 100 kg in any one year have been excluded.

| SPECIES | BAIT, 2007/08 | BAIT, 2008/09 | CONSUMPTION, 2007/08 | CONSUMPTION, 2008/09 |
|-----------------------------|------------------|------------------|-------------------------|-------------------------|
| BARRACOUTA | 0.1 | 0.5 | 0 | 0 |
| BEARDED ROCK COD | 2.1 | 2.3 | 0.2 | 0.1 |
| CLEFT FRONTED SHORE CRAB | 0 | 0 | 0.3 | 0 |
| CONGER EEL | 1.8 | 2 | 0.6 | 0.6 |
| DRAUGHTBOARD SHARK | 0.5 | 0.1 | 3.1 | 5.7 |
| GIANT CRAB | 0 | 0 | 0.2 | 0.3 |
| GUMMY SHARK | 0 | 0 | 0.1 | 0.2 |
| GURNARD PERCH | 0.4 | 0 | 0 | 0 |
| LEATHERJACKET | 0.9 | 0.7 | 0.4 | 0.4 |
| MORWONG | 0.1 | 0 | 0 | 0 |
| OCTOPUS | 0.7 | 0.6 | 5.3 | 5.2 |
| STRIPED TRUMPETER | 0.1 | 0.2 | 0.4 | 0.9 |
| WRASSE | 0.9 | 0.5 | 0.2 | 0.6 |

6 Bibliography

- Bruce, B, R, Griffin, D., Booth, J., Gardner, C, , Hobday, D., Linnane, A., 2007. Oceanographic dispersal of southern rock lobster, Draft *Final Report to FRDC 2002/007*, CSIRO, Hobart.
- Burnham, K.P. and D.R. Anderson (1989) *Model Selection and Inference. A Practical Information-Theoretic Approach*. Springer-Verlag, New York.
- Frusher, S. D. (1997a). Stock Assessment Report : Rock Lobster. Dept. Prim. Ind. Fish. Internal Report No. 35, 79pp.
- Frusher, S.D. (1997b,) Update to the July 1997 Rock Lobster Stock Assessment Report, December 1997. Dept. Prim. Ind. Fish. Internal Report No. 37, 25pp.
- Frusher, S. and C. Gardner (1999) Tasmanian Rock Lobster Fishery 2001/02. *Fishery Assessment Report* Tasmanian Aquaculture and Fisheries Institute, University of Tasmania. 43 p.
- Frusher, S., Gardner, C., Hirst, A., MacKinnon, C., and M. Haddon (2003) Tasmanian Rock Lobster Fishery 2001/02. *Fishery Assessment Report* Tasmanian Aquaculture and Fisheries Institute, University of Tasmania. 92 p.
- Gardner, C. (1999) Tasmanian Rock Lobster Fishery 1998/99. *Fishery Assessment Report* Tasmanian Aquaculture and Fisheries Institute, University of Tasmania. 58 p.
- Gardner, C., Frusher, S., and L. Eaton (2001) Tasmanian Rock Lobster Fishery 1999/00. *Fishery Assessment Report* Tasmanian Aquaculture and Fisheries Institute, University of Tasmania. 90 p.
- Gardner, C., Frusher, S., Eaton, L., Haddon, M. and C. MacKinnon (2002) Tasmanian Rock Lobster Fishery 2000/01. *Fishery Assessment Report* Tasmanian Aquaculture and Fisheries Institute, University of Tasmania. 117 p.
- Gardner, C., Frusher, S., Barrett, N.S, Haddon, M. and C. Buxton (2006). Spatial variation in size at onset of maturity of female southern rock lobster *Jasus edwardsii* around Tasmania, Australia. *Scientia Marina* **70**(3): 423-430.
- Gardner, C., MacKinnon, C., Haddon, M., and S. Frusher (2004) Tasmanian Rock Lobster Fishery 2002/03. *Fishery Assessment Report* Tasmanian Aquaculture and Fisheries Institute, University of Tasmania. 81 p.
- Gardner, C., Hirst, A., and M. Haddon (2005) Tasmanian Rock Lobster Fishery 2003/04. *Fishery Assessment Report* Tasmanian Aquaculture and Fisheries Institute, University of Tasmania. 79 p.
- Haddon, M. and C. Gardner (2007) Tasmanian Rock Lobster Fishery 2005/06. *Fishery Assessment Report* Tasmanian Aquaculture and Fisheries Institute, University of Tasmania. 63 p.

Kimura, D.K. (1981) Standardized measures of relative abundance based on modelling log(cpue), and their application to Pacific Ocean perch (*Sebastes alutus*). *Journal du Conseil Permanent International pour l'Exploration de la Mer* **39**: 211-218.

Maunder, M.N. and A.E. Punt (2004) Standardizing catch and effort data : a review of recent approaches. *Fisheries Research*. **70**: 141-159.

Neter, J., Kutner, M.H., Nachtsheim, C.J., and W. Wasserman (1996) *Applied Linear Statistical Models*. 4th edition. Irwin Chicago. 1408 pp.

Punt, A.E. and R.B. Kennedy (1997) Population modelling of Tasmanian rock lobster, *Jasus edwardsii*, resources. *Marine and Freshwater Research* **48**: 967-980.

Semmens, J., Haddon, M., and C. Mackinnon (2006) Tasmanian Rock Lobster Fishery 2004/05. *Fishery Assessment Report* Tasmanian Aquaculture and Fisheries Institute, University of Tasmania. 78 p.

Venables, W.N. and C.M. Dichmont (2004) GLMs, GAMs, and GLMMs: an overview of theory for applications in fisheries research. *Fisheries Research*. **70**: 319-337.

Winstanley R.H. (1973) Rock Lobster fishing in Tasmania, 1904-1972. *Tasmanian Fisheries Research* **7**, 1-29.

7 Appendix 1: Historical overview

The following section is based largely on a synopsis of the history of the fishery compiled by Tony Harrison

(<http://www.users.on.net/~ahvem/Fisheries/Tasmania/Tasmania.html>).

Tasmania's rock lobster resource is distributed around the coast although fewer animals are found along the central north coast bordering Bass Strait due to limited opportunity for recruitment.

Aborigines fished lobsters around the State and a small indigenous harvest continues, mainly in the northeast. The resource has been harvested commercially since European settlement with fishing effort initially focused on the East Coast. Accounts of historical catches provide insight into the abundance of lobsters in conditions with very low fishing pressure. When James Kelly called at Port Davey in 1815 he traded swans he had shot for crayfish; the local Aborigines quickly collected 3 tons (at least 1000 lobsters) by hand from the waters edge. In 1905, James Rattenbury caught 480 lobsters from the *Rachel Thompson* in six hours using only 6 "cray" rings in Wineglass Bay.

The commercial and recreational fisheries initially proceeded without records but the need for management of the fishery was recognised nonetheless. The first Act for the protection of Rock Lobster was passed by Parliament in 1885. This Act prohibited the possession of soft-shelled "crayfish" and egg-carrying females and introduced a minimum legal-size of 10 inches. This size limit is essentially equivalent to that used today and remains one of the main management constraints.

Some commercial catch information was collected in the late 1880's with around 60,000 lobsters a year landed into Hobart. This remains around the average annual commercial harvest from shallow waters in the SE of the State today (average of 39 tonnes in <10 fathoms for the period 2000-2003, Area 1; although it should be noted that now the recreational catch could match the commercial harvest).

In 1888 fisheries matters were placed under the control and management of a single Fisheries Board comprising 23 commissioners. Much of their time was spent debating the merits of different gear types.

Hemispherical cane pots (based on pots used for taking clawed lobsters in Cornwall, England) were used in Victoria while in Tasmania a baited hoop ("cray" ring) was the traditional (and preferred) method of catching rock lobsters. The two methods led to two quite different commercial fishing industries; one using larger, more robust boats that could operate pots and the other using smaller boats sufficient for operation of "cray" rings. These two fleets came into contact and conflict during periods around the moult when lobsters were too soft for freight to Victoria. Pots were subsequently banned in Tasmania in November 1902, later amended to latitudes south of 39° 31' S in February 1904 and subsequently south of 40°38'S (*i.e.* north of St Marys) in July 1904. The Fishing Board ratified this ban in November 1905.

In response to further pressure from northern commercial fishers, a Parliamentary enquiry conducted by Joseph Lyons considered that pots were not destructive and recom-

mended that pots be legalised. However, it wasn't until 1925 that pots were finally legalised as part of a new fisheries bill that placed responsibility for the management of sea fisheries with a newly appointed Sea Fisheries Board. The centrepiece of this new bill was the allocation of varying numbers of pots to commercial vessels depending on their size. For example, a limit of 30 pots was adopted for larger vessels with proportionately fewer pots allowed for smaller vessels. Inevitably, the use of pots led to dramatic increases in commercial catch due to greater efficiency, halted fleetingly by reduced market demand during the depression years (1930s) and the Second World War. Markets have adapted to change in technology throughout the development of the fishery.

The adoption of diesel engines during the Second World War meant that more product could be shipped to mainland Australia, which led to expanded markets. Soon after this, the development of refrigeration enabled a rapid expansion into the American frozen tail market. Most of the commercial catch is now transported live into Asia, the world's premium market for lobsters. The increased value of lobsters that has resulted from the development of these markets along with growing recognition of rock lobster as a preferred seafood is considered to be a motivating factor for the steadily increasing recreational effort.

The annual commercial catch reached its historical maximum in 1984 at 2250 tonnes, prior to falling to a recent historical low of 1440 tonnes in 1994, a reduction of 400 tonnes from the 1992 year.

Concerns about declining future catches led to a shift away from a commercial fishery managed by input controls (*i.e.* number of pots and licences etc.) to one managed through control of fishery outputs (or total catch limits). This resulted in the adoption of an individual quota system in March 1998 for the commercial fishery.

8 Appendix 2: Management

Management regulations were first introduced in 1885 and included a minimum legal size, and a prohibition on taking soft shelled (recently moulted) lobsters or berried female lobsters. These input controls still play a role in management of the resource although soft-shelled lobsters are now largely protected by a seasonal closure.

Since the inception of catch records in the 1880's, the reported annual catch steadily increased in the commercial rock lobster fishery to a high in 1984 of over 2,250 tonnes. During this period of growth in catches, concerns were expressed about overfishing in the commercial fishery, which resulted in changes in regulations. The most important changes were the legislation of design of pots in 1926, introduction of closed seasons to limit the harvest of soft-shelled lobsters in 1947, the restriction of the number of licenses in 1966, and a ceiling on the number of pots in the fishery set at 10,993 in 1972. From the record high catch of 1984, the reported annual catch declined to a low of 1,440 tonnes in 1994 reflecting a decline in the available biomass. In recognition of the declining trend in biomass, an individual transferable quota (ITQ) management system was introduced for the commercial fishery in March 1998 following an industry ballot to decide whether to accept the system.

Management of the commercial fishery has remained relatively stable since the introduction of quota. Quota was initially set at 1503 tonnes for the 1998/99 fishing season. After three years of successive improvements in biomass, the quota was increased to 1523 tonnes for the 2001/02 fishing season. As catch is now constrained by quota, seasonal controls in the fishery have been relaxed. Lengths of seasonal closures have varied since their introduction in 1926 but complete closure of September and October was in place from 1963 to 1998. In 1998, the first 2 weeks of September were opened, to provide fishers with flexibility to take hard-shell lobsters that command a high price or fish for the lower priced soft new-shell lobsters that have a higher catchability after their moult. Timing of the September closure has changed regularly since 1998 with complete access in 2000. There remained some concern about fishing in September due to negative impacts on markets.

Management of the recreational fishery has proceeded in parallel with that for the commercial fishery. A rock lobster license is required to take lobsters recreationally or to deploy gear. Many regulations are shared by both sectors, such as size limits, closed seasons, and pot specifications. Key differences included the ability of recreational fishers to harvest lobsters by diving, a cap on the daily bag limit of 5 lobsters, and the absence of an output control mechanism.

9 Appendix 3: Summary of Rules

Table 9.1. Summary of rules for the Tasmanian Rock Lobster Fishery.

| COMMERCIAL | |
|----------------------------|--|
| Management zone | one management zone for the State |
| Limited entry | 314 licenses |
| Limited seasons | Males: season open from mid November to end September. Females: season open from mid November to end April. (Actual dates change slightly from year to year.) |
| Limits of pots on vessels | minimum of 15 pots, maximum of 50 pots |
| Quota | Total allowable catch of 1523 tonnes |
| 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 |
| Minimum size limits | 105 mm CL for females, 110 mm CL for males |
| Berried females | taking of berried females prohibited |
| RECREATIONAL | |
| License requirements | rock lobster potting licence - 1 recreational pot per person, rock lobster |
| Daily limit | 5 per recreational license holder |
| Limited seasons | Males: season open from start November to end September. Females: season open from start November to end April. (Actual dates change slightly from year to year.). |
| Restrictions on gear | Pots as per commercial fishers, rings no more than 1 m in diameter, capture by glove only when diving. |
| Escape gaps | as per commercial fishers |
| Minimum size limits | as per commercial fishers |
| Berried females | as per commercial fishers |
| Sale or barter of lobsters | prohibited |
| Marking | All recreational lobsters must be tail clipped within 5 minutes of landing. No tail-clipped lobsters to be sold. |