FISHERY ASSESSMENT REPORT

TASMANIAN ROCK LOBSTER FISHERY 1998/99

Compiled by Caleb Gardner

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Tasmanian Aquaculture
& Fisheries Institute
University of Tasmania

This assessment of the rock lobster resource is the second to be produced by the Tasmanian Aquaculture and Fisheries Institute (TAFI) and uses input from the rock lobster fishery assessment working group (RLAWG).

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The fishery description was obtained from the fish policy document (Anon,1997).

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Rock Lobster Fisheries Assessment: 1998/99

Summary

This report provides an assessment of the Tasmanian rock lobster resource to March 1999. This is the first assessment report after the introduction of quota management system (QMS) and performance indicators were generally positive. Despite positive overall trends, some regional indicators were negative which is a function of the large variation in biological and industry factors around the state.

License ownership was stable after the introduction of QMS with only slight increases in the proportion held by Tasmanian individuals and a slight decrease in the proportion held by interstate companies. The ability to lease off units of quota was widely adopted with approximately 22% of licenses leasing their quota.

Statewide catch rates have increased by around 5% from 1997 to 1998 although regional declines of up to 11% were observed in east coast areas 1,2 and 3 (see Figure 1, page 10).

Legal size biomass has increased in all areas relative to reference years and the statewide legal sized biomass increased by 11% from 1997 to 1998. However, declines of 7% and 3% were seen in areas 5 and 6 respectively from 1997 to 1998.

Egg production in the north of the state improved, primarily due to a recruitment pulse in area 4. Levels of egg production in areas 3,4 and 5 remain of some concern as estimates of egg production relative to virgin are 8%,15% and 9% respectively.

Three TACC scenarios were tested in this report: 1400, 1500 and 1600 tonnes. All scenarios predict stock rebuilding, although egg production in the north is not expected to reach targets of 25% of virgin within the life of the current plan.

Funding has been obtained for work on the stock assessment model that will address the effect of changing fishers behaviour due to quota management. This change, plus improvements to the growth matrix, is expected to improve the predictive capability of the model in the next assessment.

Estimates of recreational catch were higher than in previous assessments. Recreational catch in shallow water of areas 1,2 and 3 is greater than 50% of the total catch from this region.

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1. List of Management Objectives and Strategies

There are eight policy objectives and associated strategies in the current rock lobster fishery policy document (Anon, 1997). Note that while this plan remains current, opinion has shifted in some aspects and these are highlighted throughout by footnotes. Policy objectives listed in the plan are:

1.1 Maintaining biomass and fish recruitment.

To maintain fish stocks at sustainable levels by constraining the total catch and size of individual rock lobster taken by the commercial and recreational sectors. In particular, to ensure that:

- Rock Lobster are harvested at sustainable levels.
- Biomass and egg production do not decrease and that reasonable levels of egg production are maintained in all regions of the fishery.
- Biomass levels are increasing over time to the level required for producing the maximum yield from the fishery.

1.1.1 Strategies

- Limiting the commercial catch through setting a total allowable commercial catch (TACC) and using individual transferable quotas to allocate proportions of the TACC.
- To minimise the opportunity for illegal activity through a monitoring, compliance and enforcement strategy.
- Limiting the recreational catch through the use of daily bag limits and possession limits, requiring fishers to be licensed and limiting fishers to one rock lobster pot per person or other specified fishing gear or methods.
- Conserving egg production and constraining fishing mortality on spawning female lobster by the use of minimum size limits and the closure of the fishery for female lobster during the peak spawning period[1].

[1] Seasonal closures as a strategy for maintaining egg production is under review at the time of preparation of this assessment report. This is an industry initiative and initial steps involve a polling of industry opinion and model simulations.

1.2 Sustaining yield and reducing incidental fishing mortality

To take fish at a size likely to result in the best use of the yield from the fishery. To provide measures to protect undersized lobster. To minimise incidental fishing mortality as a result of fishing operations.

1.2.1 Strategies

- Maintenance of size limits.
- Restriction of size at first capture by requiring rock lobster pots to have escape gaps and to conform to size specifications.
- To reduce incidental mortality by limiting the set duration for rock lobster pots.
- Require rock lobster fishing vessels to be able to carry all pots on the vessel at any one time.

1.3 Managing commercial fishing interactions

To mitigate any conflict that results from competition between different fishing methods for access to shared fishing grounds.

1.3.1 Strategies

- Restrict the number of rock lobster pots that can be used from individual fishing vessels.
- Restrict the number of rock lobster fishing vessels in the fishery.

1.4 Ensuring access to fish stocks by recreational fishers

To maintain or provide reasonable access to rock lobster stocks for recreational fishers.

1.4.1 Strategies

- Encourage communication between the commercial and recreational sectors.
- Promote the development of a Code of Practice for recreational fishing for rock lobster.
- Maintain existing recreational fishing areas where no commercial rock lobster fishing will be permitted.

1.5 Providing marine farming opportunities for rock lobster

To provide for the development of a rock lobster aquaculture industry through the limited and controlled harvest of puerulus (juvenile rock lobster)[2].

1.5.1 Strategies

- Ensure that any harvest of puerulus is biologically neutral.
- Develop appropriate conversion ratios between puerulus and kilograms of quota[3].
- Ensure that the future development potential for the marine farming of rock lobster is achieved with no significant additional net mortality from the wild fishery.
- Ensure that any change in the TACC, and therefore the pot allocation, is matched with a corresponding change to the conversion ratio between puerulus and kilograms quota.
- Develop appropriate compliance mechanisms to ensure illegally taken undersized wild rock lobster do not enter the market.
- Identify methods of collecting puerulus that result in minimal incidental mortality and minimal damage to puerulus.
- Undertake research to assess possible impacts on the wild rock lobster fishery through the harvesting of puerulus
- Investigate opportunities to undertake research into growing puerulus from the egg stage[4].

1.6 Providing socio-economic benefits to the community

To recover a financial contribution from both commercial and recreational rock lobster fishers to contribute to the real costs of management, compliance and research. To ensure the rock lobster fishing fleet continues to provide employment and an economic return to coastal communities of Tasmania.

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[2] The Government position on this objective has changed since the completion of the current management plan. Although the current plan implies that puerulus harvest is to be undertaken for the development of a permanent industry, the current minister has stated that puerulus harvest is intended to be an interim activity until the viability of hatchery production can be more fully evaluated.
[3] Points 2 and 4 assume a quota buy-back option is implemented. Subsequent to the publishing of the rock lobster fishery policy document (Anon, 1997), concerns were expressed at the limited ability of this option to achieve biological neutrality due to a) loss of egg production from sub-legal females and b) effective shift of effort towards the east coast. Consequently, a reseeding option was proposed to overcome these problems.
[4] Research into phyllosoma culture has subsequently commenced (at T.A.F.I. in 1997). Larvae have survived to 400 days of age although there has been no survival to the first juvenile stage or puerulus.

1.6.1 Strategies

- Determine the real costs of management, compliance and necessary research costs for the rock lobster fishery.
- Equitably pass on management and research costs to participants in the rock lobster fishery, sufficient to achieve cost recovery over time. Full cost recovery will not be achieved during the term of this plan.
- Provide mechanisms to ensure that the rock lobster fleet continues to provide economic and social benefits to the Tasmanian community.

1.7 Accounting for environmental interactions.

To minimise the environmental impact of rock lobster fishing methods particularly on areas of special ecological significance and reduce bycatch of juveniles and non-target species.

1.7.1 Strategies

- Establish marine protected areas for the protection of valuable coastal habitats and to maintain biodiversity[5].
- Require rock lobster pots to be fitted with escape gaps.

1.8 Providing high quality produce

To promote and maintain handling and processing practices which ensure the highest quality rock lobster product for human consumption.

1.8.1 Strategies

- Promote quality carrying, handling and storage practices for rock lobster on board fishing vessels and by fish processors, through the use of codes of practice and industry initiatives.
- Undertake research to identify the differences between wild harvested rock lobster and rock lobster reared in an aquaculture facility.

[5] This strategy assumes no harm to biodiversity through the use of MPAs in conjunction with QMS in the rock lobster fishery. This has subsequently been questioned and FRDC funding has been obtained to research the issue. That study has not yet been completed.

2. List of Performance Indicators and Trigger Point Strategies

2.1 Performance Indicators

The performance indicators for the Tasmanian rock lobster fishery are identified in the rock lobster fishery policy document (Anon, 1997). These are:

2.1.1 Catch per unit effort (CPUE)

Catch per unit of effort (or catch rate) is commonly used as an index of abundance. For the purpose of the Management Plan, CPUE is defined as the kilograms of lobster caught per pot lift and will be calculated separately from both commercial catch returns and independent research surveys.

2.1.2 Biomass

- While CPUE can provide a relative index of abundance, it does not provide an actual estimate of biomass. For the purpose of the Management Plan, biomass will be defined as the estimated tonnage of legal sized lobster on the bottom at a stated point in time. Changes in the biomass are important because this will affect the catch rate, productivity, sustainable harvest level and egg production of the fishery.

- Biomass will be estimated by two different techniques. The first will be a length structured, spatial stock assessment model of the rock lobster fishery and the second method will be through independent research surveys in selected regions of the fishery. While these two techniques are different, the stock assessment model incorporates research data which implies that the two sources of biomass estimates are not completely independent.

2.1.3 Egg production

- Maintenance of sufficient levels of egg production is crucial to prevent declining recruitment and eventual recruitment failure of the fishery. Unfortunately there is a high degree of uncertainty in terms of both the level of egg production required and whether there are certain regions which are most important as the source of future recruitment. In light of this uncertainty, it is important to apply a precautionary approach and to ensure that both global and regional egg production does not fall below the lowest levels that have been experienced in the past.

- Both global and regional egg production will be estimated through the previously mentioned stock assessment model of the rock lobster fishery. For the purpose of this Management Plan, the term Egg_{low} will refer to the value of the lowest level of annual egg production experienced between 1970 and 1995 on a global or regional basis (depending on context). The Egg_{low} value will be used as a limit against which egg production in future years will be compared.

2.1.4 Relative abundance of undersized lobster

- CPUE, Biomass and Egg production reflect the performance of the fishery over the preceding fishing season. In contrast, a measure of the undersized component of the resource can give an indication of expected future harvests. This would allow for adjustments to catch levels to be made prior to problems being reflected in the fishery. For the purpose of the Management Plan, undersized lobster will be defined as the kilograms of lobster caught per pot lift in specified length classes. The size of the length classes will represent annual growth increments, taking into account the different regional growth rates.

- The relative abundance of undersized lobster will be estimated from independent and fishery dependent research surveys in selected regions of the fishery.

2.1.5 The total annual commercial catch

- The total annual commercial catch may fall below the TACC for a number of reasons, that must be accounted for before any action is taken. The total commercial catch will be monitored against the TACC for the fishery.

2.1.6 The size of the rock lobster fleet

- As the restructuring process occurs it is likely that the number of licenses and vessels operating in the rock lobster fishery will decline. It is important to monitor this decline to assess possible social and economic impacts on the coastal communities where rock lobster fishing is an important industry.

2.1.7 The recreational catch

- The recreational catch will be monitored through the continuation of recreational surveys. The recreational catch is not limited directly. While this is of little concern as the catch appears to have fallen over the past ten years, it is important to monitor the catch and to take corrective action if it increases above what it may have been in the past. In the last 10 years the recreational catch has ranged from 5% and 11% of the commercial catch.

2.2 Trigger Points

The trigger points for the Tasmanian rock lobster fishery are listed in the rock lobster fishery policy document (Anon, 1997).

2.2.1 Catch per unit effort (CPUE)

- Annual CPUE from commercial catch returns falls below 95% of the CPUE for the reference year with the lowest catch rate (ie. 1993, 1994, or 1995). For the first year of the Management Plan only, catch rate will be permitted to fall to 90% of that in the reference year with the lowest catch rate. The analysis to assess this trigger point must standardise CPUE to take account of possible biases caused by changing fishing patterns on at least a monthly and regional basis.

- Annual CPUE from commercial catch returns for any region falls below 75% of the CPUE for the reference year with the lowest catch rate for that region, unless at least three other years for the same region between 1970 and 1995 had a lower catch rate. The analysis to assess this trigger point must standardise CPUE to take account of possible biases caused by changing fishing patterns on at least a depth stratified and monthly basis. This analysis should also take into account any other mitigating factors which might artificially affect regional catch rates.

- CPUE from research surveys in available regions declines significantly from matching surveys (location and month) from that of the reference year with the lowest matching survey catch rate. The analysis of this trigger point should consider mitigating factors such as variations in catchability due to weather or variation in moult timing or seasonal influences.

2.2.2 Legal-sized biomass

- The estimate of global (state-wide) legal-sized biomass from the stock assessment model falls below 95% of that estimated for the reference year with the lowest biomass.

- The legal-sized biomass estimate from the stock assessment model for any region falls below 75% of that estimated for the reference year with the lowest biomass in the related region.

- Legal-sized biomass estimates from research surveys in available regions declines significantly from one survey year to the next (technique being developed). Biomass specific research surveys will not commence till the 1997/98 season, hence it is not possible to use a past reference year in the trigger point. An exception to this trigger can be invoked if the stock assessment model or other models can adequately demonstrate that the decline in biomass seen through research surveys results in a biomass that remains higher than that which existed in the reference years.

2.2.3 Egg Production

- The estimate of global (state-wide) egg production falls below that of Egg_{low}. An exception to this can be invoked if the estimated egg production is within 5% of Egg_{low} provided that the reduction is restricted to areas with egg production levels which exceed 40% of that of the estimated unfished (virgin) stock.

- Any regional estimates of egg production falls to less than 95% of the related egg_{low} unless the affected regions have egg production levels which exceed 40% of that of the estimated unfished stock.

- For regions in which the estimated value of Egg_{low} is less than 10% of that of the estimated unfished stock, no reduction in egg production below that of Egg_{low} is permissible.

2.2.4 Relative abundance of undersized lobster

- Annual CPUE of undersized lobster in the pre-recruit size class falls below 95% of that estimated for the reference years already mentioned, for the same sampling region and sampling period. The analysis of this trigger point should consider mitigating factors such as variations in catchability due to weather or variations in moult timing.[6]

2.2.5 The total annual catch

- The total annual commercial catch falls below 95% of the TACC for any year. The analysis will consider the reasons for the actual catch falling below the TACC, these may include weather factors, quota availability factors or market factors.

2.2.6 The size of the rock lobster fleet

- The number of licenses operating in the fishery falls below 220. The analysis will consider factors that have caused the number of licenses to fall to this level. Action may be taken to ensure there is no further decline in the number of licenses if it is considered necessary by the industry or the Government.

2.2.7 The recreational catch

- The recreational catch exceeds 10% of the TACC in a year there will be a review of the recreational management arrangements.

[6] The Tasmanian rock lobster stock assessment working group considered this trigger point to be of questionable value, given the large annual variation in natural recruitment (see Figure 6, page 19). It was suggested that future management plans incorporate a trigger based on trends in relative abundance of undersize lobsters over periods of several years.

3. General Introduction

The rock lobster commercial fishery dates back to the period of early European settlement in Hobart in 1804 and its early history is described by Winstanley (1973). Management restrictions were first imposed in the 1889 Fisheries Act after a Royal Commission on the Fisheries of Tasmania found "*the destruction of crayfish [rock lobster] is so serious in some localities as to threaten extermination at no distant date*". These first restrictions included a size limit, the ban on taking berried lobsters and a ban on the possession or sale of soft shelled lobsters. These regulations essentially still apply today although closed seasons on females and males supplement the berried and soft shelled regulations. Possession of soft shelled lobster is no longer banned.

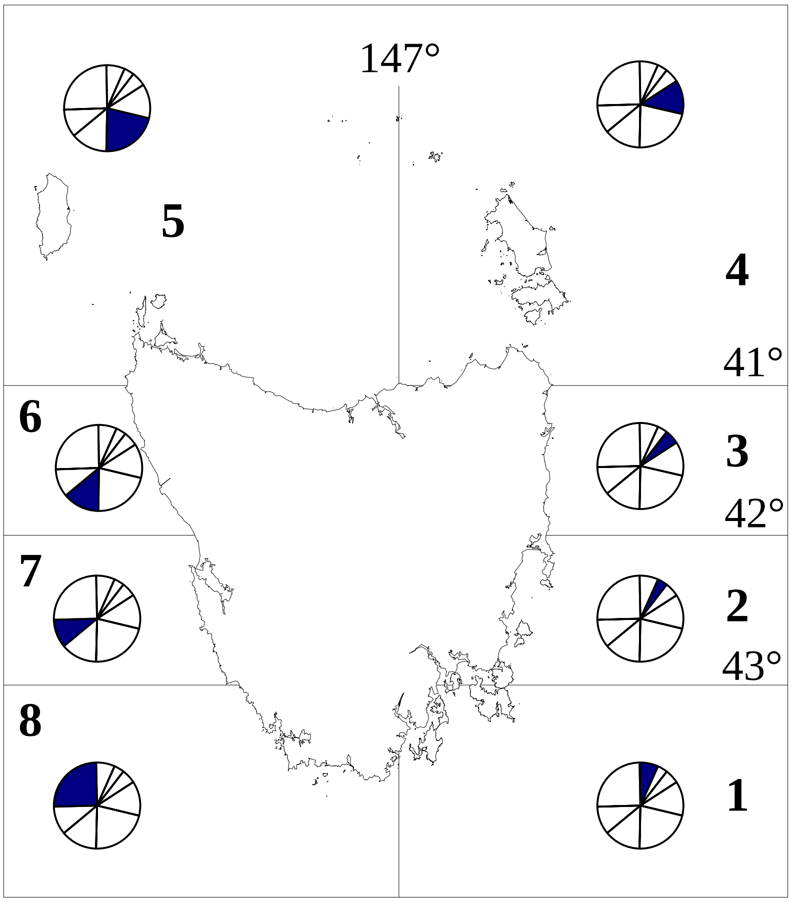
In the 1950's licences for commercial fishers (pots allocated according to vessel size with a maximum pot holding) were restricted to participants principally dependent on the sale of rock lobster for a livelihood. At the same time, recreational fishers were restricted to use of a single pot. In 1967 a policy of licence limitation was adopted and this was followed in 1972 by fixing the number of pots in the fishery to 10,993 (Winstanley, 1973).

In the mid to late 1980's concern over the resource was again expressed by fishers as catch rates declined. A working group of fishers and government representatives was formed in the early 1990's to evaluate options to stem this decline (Anon, 1993). The working group clearly identified increased effort as the major problem and expressed concern at the potential for further increases as latent effort was considerable. The lack of consensus on the appropriate management method to adopt resulted in a number of Industry polls. This culminated in a poll in 1996 which resulted in a marginal preference for quota management. In March, 1998 an individual transferable quota (ITQ) management system commenced.

Tasmanians have a long tradition of recreational lobster fishing and many associate summer holidays with lobster fishing. This was noted by Winstanley (1973) "There is probably no other State in Australia where rock lobster have for so long attracted the attention of so many amateur fishermen or where the general public has been more aware of the extent and economic worth of the rock lobster resource".

Rock lobsters are managed by size limits of 110mm and 105mm carapace length for males and females respectively.

Since 1970 fishers have recorded their daily catch in degree blocks around Tasmania which has allowed for regional trends to be documented. This report presents information for the 8 regions used in the rock lobster assessment model (Punt and Kennedy, 1997; Figure 1).



Region	% of catch
1	6.6
2	4.6
3	4.7
4	12.5
5	21.7
6	13.5
7	10.4
8	26.0

Figure 1. Location of the eight regions used in this report and their percentage contribution to the 1998/99 commercial catch (March to February inclusive).

The distribution of the catch clearly shows the importance of the west coast, particularly areas 5 and 8.

Although lobsters have been recorded from depths greater than 200m, few lobster are caught in depths below 125m (Figure 2). With the exception of area 6 where over 40% of the catch comes from waters deeper than 62m, most of the catch comes from waters less than 62 m. Shallow water grounds less than 18 m are especially important in areas 2 and 3 with greater than 30% of the catch from this depth range.

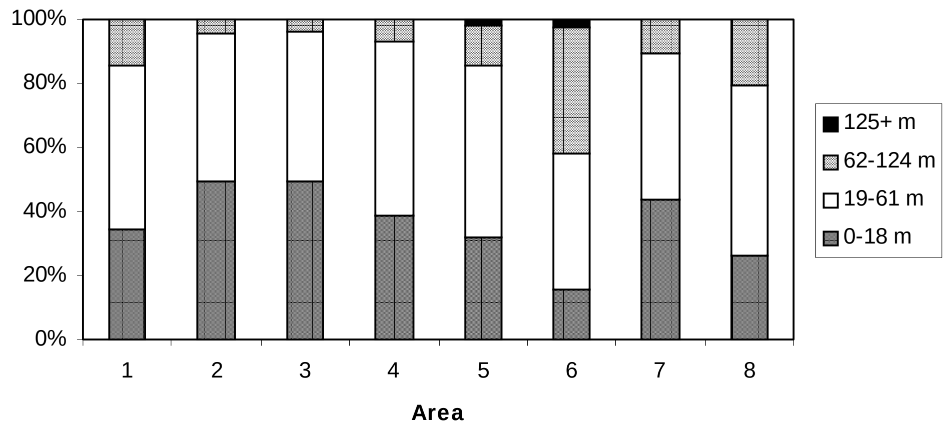


Figure 2. Regional depth distribution of catch from March 1998 to February 1999.

4. Fishery Description

4.1 Commercial Rock Lobster Fishery

The Tasmanian rock lobster fishery targets the southern rock lobster (*Jasus edwardsii*) in the waters adjacent to Tasmania. Tasmania has jurisdiction for the fishery in waters generally south of 39 12', and out to 200 nautical miles from the coastline. This jurisdiction is provided to Tasmania by way of the Offshore Constitutional Settlement agreement of 1996, for invertebrates (see Commonwealth Gazette 31/12/1996 No. S531 for full details).

4.1.1 Fishing methods

The only commercial fishing method for rock lobster is the use of rock lobster pots. These are generally made from steel and mesh netting or from wooden "sticks" and steel mesh. Similar pots are used by recreational fishers. Recreational fishers can also dive for lobster or use hoop style lift nets (rock lobster rings).

Lobster pots are baited, usually with fish, such as jack mackerel, barracouta or Australian salmon. Pots are set for a number of hours, normally overnight or from dawn to dusk. The rock lobster are attracted by the bait and crawl into the pots. The neck of the pot is designed in such a way that it is difficult for the lobster to get out of the pot. Pots are required to have escape gaps to allow undersized rock lobster to escape from the pot.

Commercial pots are hauled by hydraulic lifters which is one factor contributing to the ability of commercial vessels to operate in deeper water than recreational fishers. After lobsters have been removed and checked against size restrictions, the pots are re-baited and either reset or stored on the vessel to be set later in the day.

The commercial sector uses colour echo sounders, radar and global positioning systems to assist them in locating suitable areas to set their pots.

4.1.2 Catching sector

In January 1997 the rock lobster fishing fleet comprised 321 vessels and this had reduced to 314 vessels in February 1999, and further reduced to 270 for the period November 1998 to September 1999. Vessels range in size from 6-26 metres in length. The majority of vessels are used primarily for rock lobster fishing but have the capacity to diversify into other fisheries on a seasonal basis. The vessels are a mixture of wooden and steel hulls with a few fibreglass vessels. The majority of the fleet is of the displacement hull style with a small number of planing hull vessels. The average age of the fleet exceeds 15 years, with very few new vessels operating.

Each licence has a quota allocation ranging from 5 to 100 rock lobster quota units. Each vessel has a rock lobster pot allocation based on either the length or tonnage of the vessel. The pot allocation varies between a minimum of 15 and a maximum of 50 pots. A total of 10,507 pots were able to be used throughout the fleet in February 1999, however under quota less pots than this are being used. The majority of vessels are owner operated, but there is a trend toward the leasing of vessels and licences.

The market value of vessels participating in the fishery varies between approximately $15,000 to $750,000. Licences vary in price according to the types of fishing licenses on the licence package.

All rock lobster are landed live from the catching vessel and are generally purchased by a processor at the wharf, with most product destined for live export.

4.1.3 Ownership of licences

Licences can be held by individuals, partnerships or companies. New participants must buy an existing licence to enter the fishery and no additional licences are issued. As at November 1999, 83.2% of the 315 licences were held by Tasmanian owners, this proportion has remained the same since January 1997. The break down of ownership of the licences is summarised in Table 1.

Table 1. Ownership of rock lobster licences by Tasmanian residents and Interstate residents and by company or individual, January 1997 and November 1999.

Licence holder group	**No. of licences (Jan 97)**		**No. of licences (Nov 99)**	
Tasmanian individuals	230	71.6%	230	73.1%
Tasmanian companies	39	12.1%	37	11.7%
Interstate individuals	32	10.0%	32	10.1%
Interstate companies	20	6.2%	16	5.1%

The interstate owners are mainly from Victoria or South Australia.

The industry is made up of fishers who own and operate a licence, family operations, investors who lease quota and fishers who lease licences and quota. In January 1997, 188 licences were operated by the owner or by the nominated person if the holder is a company or partnership. 21 licences are operated by a family member of the owner, usually a son, brother, or husband. At that time 112 licences were leased or operated by someone other than the owner or the owner's family. Since quota has been introduced there has been a decrease in the number of owner operators and leased licences because of the number of licence holders who only lease out their quota. The relative numbers of different forms of operation are shown in Table 2.

Table 2. The break down of how rock lobster licences are operated, January 1997 and November 1999.

Licence holder group	No. of licences (Jan 97)		No. of licences (Nov 99)	
Tasmanian owner operators	166	51.7%	140	44.4%
Tasmanian family operators	20	6.2%	8	2.5%
Tasmanian owned, leased licences	83	25.9%	64	20.3%
Interstate owner operators	22	6.9%	8	2.5%
Interstate family operators	1	0.3%	2	0.6%
Interstate owned, leased licences	29	9.0%	21	6.7%
Tasmanian owned and quota only leased			55	17.5%
Interstate owned and quota only leased			17	5.4%

Table 3 shows that the most licences are owned in the Hobart region, however considering this covers suburbs from Kingston to Richmond, this is not surprising. The port with the greatest number of licences is St Helens, closely followed by King Island.

Table 3 The regional distribution of where the rock lobster licences are owned, January 1997 and November 1999.

Region where the owner lives	Number of licences (Jan 97)	Number of licences (Nov 99)	Region where the owner lives	Number of licences (Jan 97)	Number of licences (Nov 99)
HOBART REGION	53	60	FLINDERS ISLAND	10	6
ST HELENS	29	30	STRAHAN	9	9
CHANNEL REGION	27	33	TASMAN PENINSULA	9	10
KING ISLAND	25	22	SOUTH AUSTRALIA	9	12
BICHENO	20	19	NORTH WEST COAST	6	6
SMITHTON	19	18	PORT LINCOLN (SA)	5	2
LAUNCESTON REGION	17	20	LAKES ENTRANCE (Vic)	4	4
TRIABUNNA REGION	17	18	QUEENSLAND	4	3
PORTLAND (Vic)	13	9	STANLEY	4	4
VICTORIA	13	14	NSW	3	2
DOVER REGION	12	7	WESTERN AUSTRALIA	1	1
NORTH EAST COAST	12	6			

4.1.4 The structure of the rock lobster fishing fleet

In 1997, approximately a third of the fleet or 112 licence holders had an entitlement to use 40 pots and 34 licence holders had a 27 pot entitlement as shown in the previous stock assessment report (T.A.F.I., 1999). After the change to ITQ management and associated changes in restrictions on pot holdings, many licence holders upgraded their quota holdings to maintain catch levels. Twenty one licences had been upgraded to 50 pot licences as at February 1999, however this does not include those who have increased their holding by leasing additional quota. The overall number of entitlements with large pot holdings has increased during this period with 112 licences with 40 pots in 1997 and 124 licences with 40 or more pots in 1999. The minimum number of quota units per entitlement that can be fished is 15 and the number of licences in this category increased from 3 in 1997 to 9 in 1999.

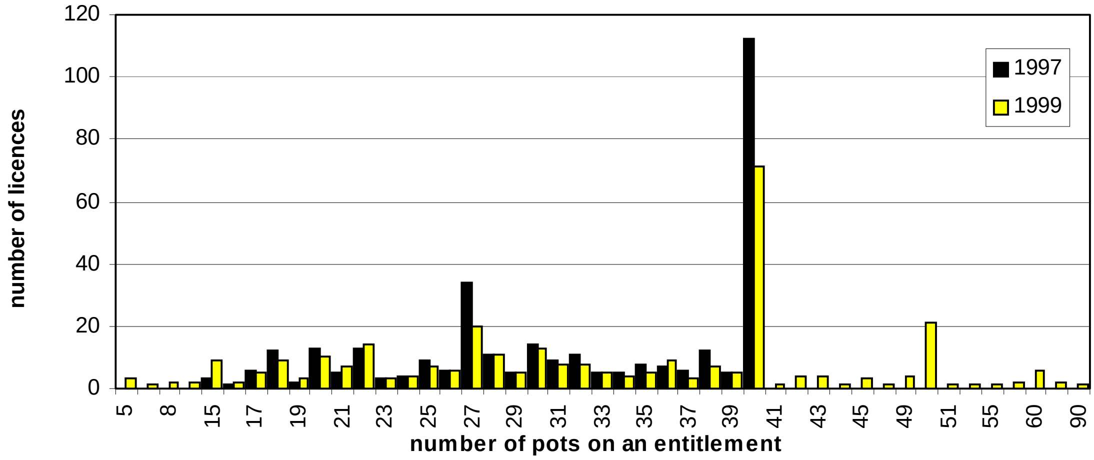


Figure 3. The distribution of the number of pots on rock lobster licences, as at January 1997 and February 1999.

The size of vessels in the fleet ranges from 6 metres to over 26 metres in length. About 90 vessels are less than 11m in length. The 40 pot vessels account for the majority of the vessels greater than 15m in length (T.A.F.I., 1999).

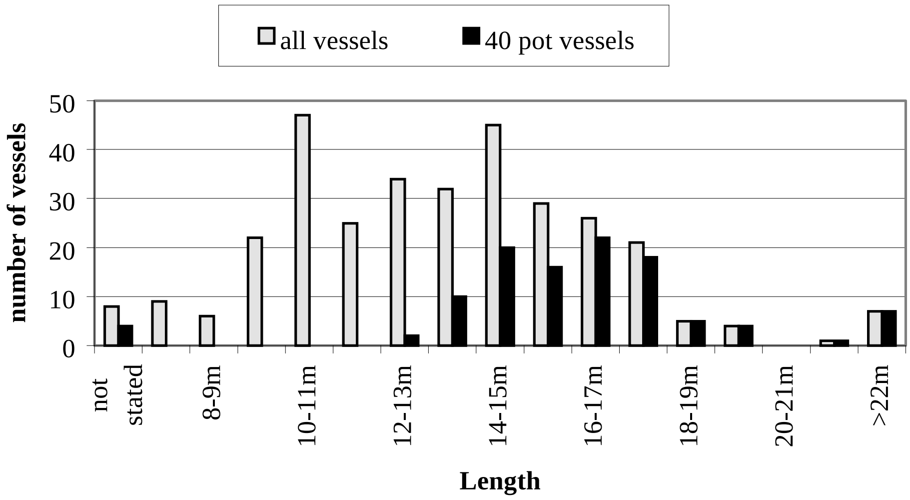


Figure 4. The distribution of the fishing vessels by length, as at January 1997.

4.1.5 Processing sector

There were 60 licensed processors in December 1996, these processors purchased 73% of the catch taken in the 1995/96 season. The remaining 27% of the catch were sold in one of the following ways: directly by fishers to the public; or sold to retail outlets (which are not required to be licensed); or landed outside Tasmania; or sold directly to interstate buyers. In the last seven years the licensed processors have typically purchased between 70% and 80% of the landed catch.

4.1.6 Level of activity of processors

Of the 60 licensed rock lobster processors in 1996, only 37 reported processing any rock lobster, while there were 73 licensed processors of fish handlers in 1998/99 who all processed rock lobster. Table 4 below shows the number of processors that process large and small quantities of lobster. Table 5 shows the break down of how the fishers sold the rock lobster.

Table 4. The number of licensed rock lobster processors and the volume of product processed; 1994 - 1999.

Quantity of Lobster processed	Number of Processors 1994	1995	1996	1998/99
more than 40 tonnes	5	9	8	10
20 - 30 tonnes	7	5	5	6
10 - 20 tonnes	5	4	4	17
1 - 10 tonnes	6	10	13	22
less than 1 tonne	9	9	7	18
total	32	37	37	73

Table 5. The first points of sale of rock lobster sold by fishers; 1994 - 1996.

First point of sale of lobster	Total landings of rock lobster (%) 1994	1995	1996	1998/99
Fish processors or fish handlers licensed in Tasmania.	69.6%	72.6%	74.1%	82%
Export by fisher (either on a vessel or directly)	23.1%	19.4%	20.3%	7%
Restaurants in Tasmania	0.3%	0.3%	0.1%	11% across these categories
Private consumption or direct sales	0.7%	0.5%	0.0%	
Fish punt or food retailer in Tasmania	0.7%	1.2%	0.6%	
Not specified	5.60%	6.00%	4.90%	

4.1.7 The beach price of rock lobster

The price paid to fishers, or the beach price, varies within the fishing season (

Figure 5). The beach price usually starts at about $20-$23 per kilogram in November, at the start of the season, and increases to $40-$50 per kilogram in July/August. Prices have been relatively stable between years, with seasonal changes being more important. The beach price is largely controlled by the international market for rock lobster, with the price paid in Asia and the international supply strongly influencing the world market price.

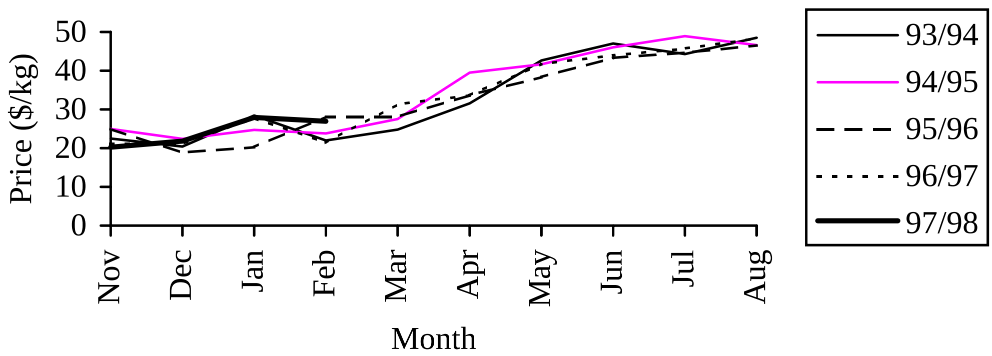


Figure 5. Beach price of lobster from November 1993 to February 1998.

4.1.8 Markets

It is difficult to obtain accurate data on the ultimate destination of much of Tasmania's lobster production. The catches may be landed direct from the vessel into mainland ports, transhipped by the fisherman landing at local ports, moved between company premises, or more recently, sold to middlemen.

Export markets are predominantly live lobsters to Asian markets and frozen tails to USA. In 1997/98 the main Asian market was China.

The majority of the remaining 54% is sold interstate, where it is sold on the domestic market or held interstate prior to being exported.

Recent changes in markets over the last year have been an increased tariff barrier into China and an increased push by Australian exporters to gain market share in Europe.

4.1.9 Economic data and employment

Production figures for the 1995/96 season show a declared catch of 1,836 tonnes, with an average price of $27.00, which put the value of production at $49.6 million. However, the catch for that season was well in excess of a sustainable harvest level, therefore it cannot be expected that the value of the fishery will remain as high as in 1995/96. The landed catch in 1998/99 was about 1480 tonnes at a monthly weighted average price of $32 per kilograms and a production value of $45 million.

5. Biology of the southern rock lobster

While it is beyond the scope of this report to go into any detail of the biology of rock lobsters there are aspects of the biology which will make interpretation of this report easier.

5.1 Reproduction

Development of the ovaries of the females commences almost immediately after the previous egg mass is extruded - so reproductive processes are virtually continuous year round. Female rock lobsters moult in Autumn and shortly after the moult are receptive to males for mating. During mating males deposit a sperm mass known as a spermatophore underneath the body and between the walking legs. Almost immediately after deposition of the spermatophore the eggs are extruded from the ovaries, passed across the spermatophore where they are fertilised, and then attached to the pleopods (swimmerets) under the tail. The eggs are incubated under the tail for the next 3 to 5 months before the first larval stage hatches and swims to the surface. During the incubation period, lobsters are commonly referred to as being ‘berried’. The number of eggs a lobster incubates relates to her size with larger females carrying over 600,000 eggs compared with 35,000 for smaller females.

5.2 Larval Period

In spring the eggs hatch into the first larval stage called a naupliosoma. In a matter of minutes, this stage moults to the second stage (phyllosoma) and moves to the surface layers of the sea. Over the following months phyllosoma larvae grow and are carried away from coastal areas to the adjacent oceans. During their larval development they pass through 11 stages and have been recorded from depths greater than 200 metres and over a thousand kilometres from land.

Recent work by CSIRO with support from fisheries organisations in Tasmania, South Australia and Victoria has shown that most rock lobster larvae are found in the upper 100m of water within a limited temperature range (around 12.2-15C).

Most larvae tend to be found around the convergence zone of major currents which is thought to be a factor influencing the variation in recruitment between years. The predominantly west to east current flow around Tasmania suggest that there is ample opportunity for larvae to be carried from the west coast. Oceanographic information from satellites and drifters have shown that the movement of currents around Tasmania is complex. It appears that it is also possible for rock lobster larvae to be carried from the east coast to the west or to recruit back to the area where they originated from. This implies that the traditional strategy of managing egg production on a regional basis is appropriate on a precautionary basis.

The final larval stage is known as the puerulus stage and this is the first time that the shape of the larvae resembles that of the adult lobster. The puerulus swims from ocean waters across the continental shelf and settles on coastal reefs. At this stage the lobster is approximately 25mm long with a carapace length of 10-12mm.

Because of the dispersed distribution of larvae, the puerulus settling stage is the first point where future levels of recruitment to regional populations can be estimated. T.A.F.I. (formerly DPIF) has been running a puerulus settlement monitoring project since 1991. There has been considerable variation in puerulus catches during the ten years that this project has been running which is useful for evaluating any link to future catch . However, at a recent workshop on puerulus settlement it was suggested that up to 20 years of data was required before a link between settlement and future catches from the fishery could be established.

Patterns of puerulus settlement at monitoring sites around Tasmania are shown in Figure 6. Note that puerulus settlement is characterized by occasional pulses of very high settlement such as the 1995 peak at Bicheno and the 1999 peak at King Island. These peaks appear to be relatively localized in that they are not recorded simultaneously in different monitoring sites.

Underlying patterns of recruitment appear to be consistent between sites which implies that puerulus catches on monitoring sites are broadly representative of regional trends. Settlement at Flinders Island is loosely correlated with that at Bicheno when peak years are excluded (r^2=0.78, P=0.22 (deep Bicheno site)). Likewise, settlement at South Arm is correlated with that at Bicheno when peaks are excluded (r^2=0.85, $P<0.05$).

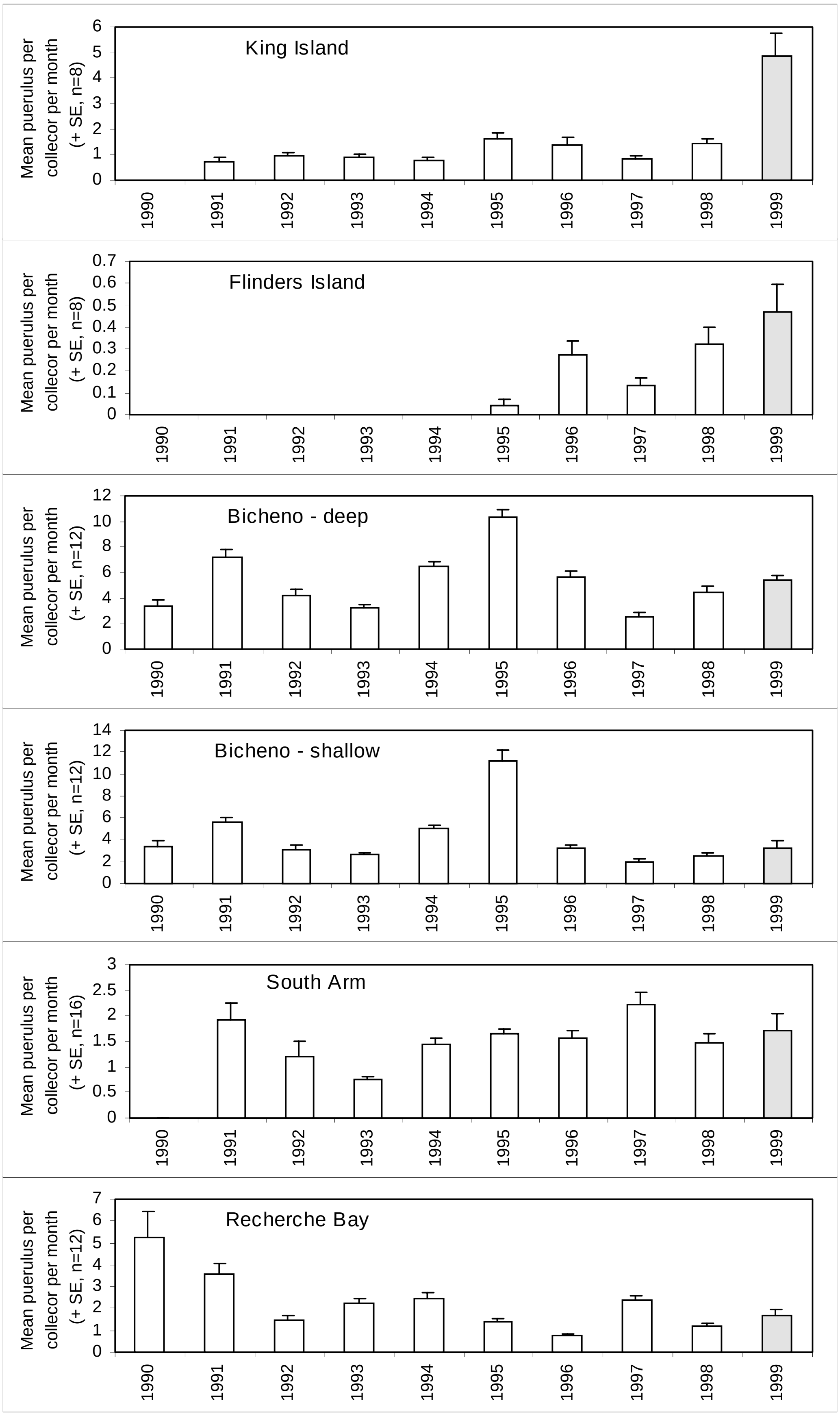


Figure 6. Puerulus settlement at monitoring sites around the Tasmanian coast. Monitoring of some sites did not commence in 1990 so data is missing for early years. Data is incomplete for 1999.

5.3 Growth

Rock lobsters grow by a process called moulting. Like most crustaceans (which includes crabs), rock lobsters have an external skeleton or shell.

For a lobster to grow, the shell has to be shed which is followed by the expansion and hardening of the new soft shell over a period of weeks.

This ‘moulting process’ can be described in more detail as follows. The lobster forms a new flexible shell under the old shell. When the new flexible shell is fully formed the lobsters seeks a refuge and sheds the old shell. Once the old shell is shed, the lobster expands its body size to a larger size by absorbing water into its body tissue. The new flexible shell also expands and at this enlarged size the shell gradually hardens. Once the new shell has hardened the lobster leaves the refuge and begins foraging.

In terms of this stock assessment report, the moulting process has some important points. Firstly, during the moulting process the lobster is very vulnerable until the shell (its body armour) has hardened. As such, lobsters will not leave their refuge during moulting and are not catchable by pots. Also, the appetite of lobsters decreases prior to moulting so they are less attracted to baits. However, once the shell has hardened at the completion of the moult, the tissues within the lobster contain a large proportion of water. This causes the lobster to become extremely hungry and vulnerable to being caught in pots.

Moulting is relatively synchronised in rock lobsters with similar sized lobster moulting at approximately the same time in the same region. Male lobsters moult from August to November in southern Tasmanian and a little later in northern Tasmania. Because of this, the opening of the rock lobster season in November[7] just after the majority of male lobsters have moulted, is often classified by fishers as the ‘run of new shellers’. Female lobster generally moult in April and May after which mature female lobsters carry eggs. The season for female lobsters is closed from the 1st of April to mid November of each year. Because of the male moult prior to the start of each season, catchability of lobsters is highest during this period. These changes in catchability implies that some estimates of abundances such as catch per unit effort will vary seasonally. The problem is overcome in the stock assessment model by incorporating this effect as a “catchability coefficient” which varies between months.

The second point of note is that the moulting process is considered stressful and recently moulted lobsters are more fragile than lobsters caught later in the season (and before the next moult). Due to this fragility, fewer lobsters are acceptable for live shipment as the added stress of shipping (airfreight) lobsters often results in increased mortality.

[7] Prior to quota implementation in March 1998, the fishing season was from November to August of the following year. The season now runs from March to February of the following year.

Growth of lobsters is normally expressed in terms of an increase in their carapace length. The carapace is the hard shell which extends from the base of the antennae to the start of the tail. As the carapace is a solid structure its measurement is fixed. In contrast, measurement of the tail which has six segments connected by soft integument can vary as the tail can be stretched and contracted. This is also the reason that the carapace length is the official minimum legal size limit measurement. The term used in this document as ‘mm CL’ refers to the length of the carapace in millimetres.

Growth rates of lobsters show substantial differences around the State with growth rates fastest in the north. At the legal size limit, male and female lobsters in the north undertake two moults annually compared to a single moult for lobsters in southern waters. The growth increment (change in the length of the carapace with each moult) is also substantially different with northern males at approximately the legal size limit increasing their carapace length by 11 to 13mm whereas their southern counterparts grow less than 6mm. Thus on an annual basis northern lobsters are growing up to 4 times faster than southern lobsters. Lobsters also grow faster in shallower waters than deeper waters. The main factors considered to influence lobster growth are water temperature (lobster grow faster in warmer waters) and food availability.

The size at which lobsters become mature appears to be related to age rather than size and thus faster growing lobsters mature at a larger size than slower growing lobsters. In southern waters greater than 40m in depth, female lobsters mature at 60 to 65mmCL. In contrast, in shallower (<40m) water in northern regions of the fishery, female lobsters mature at sizes greater than 110mmCL (Figure 7).

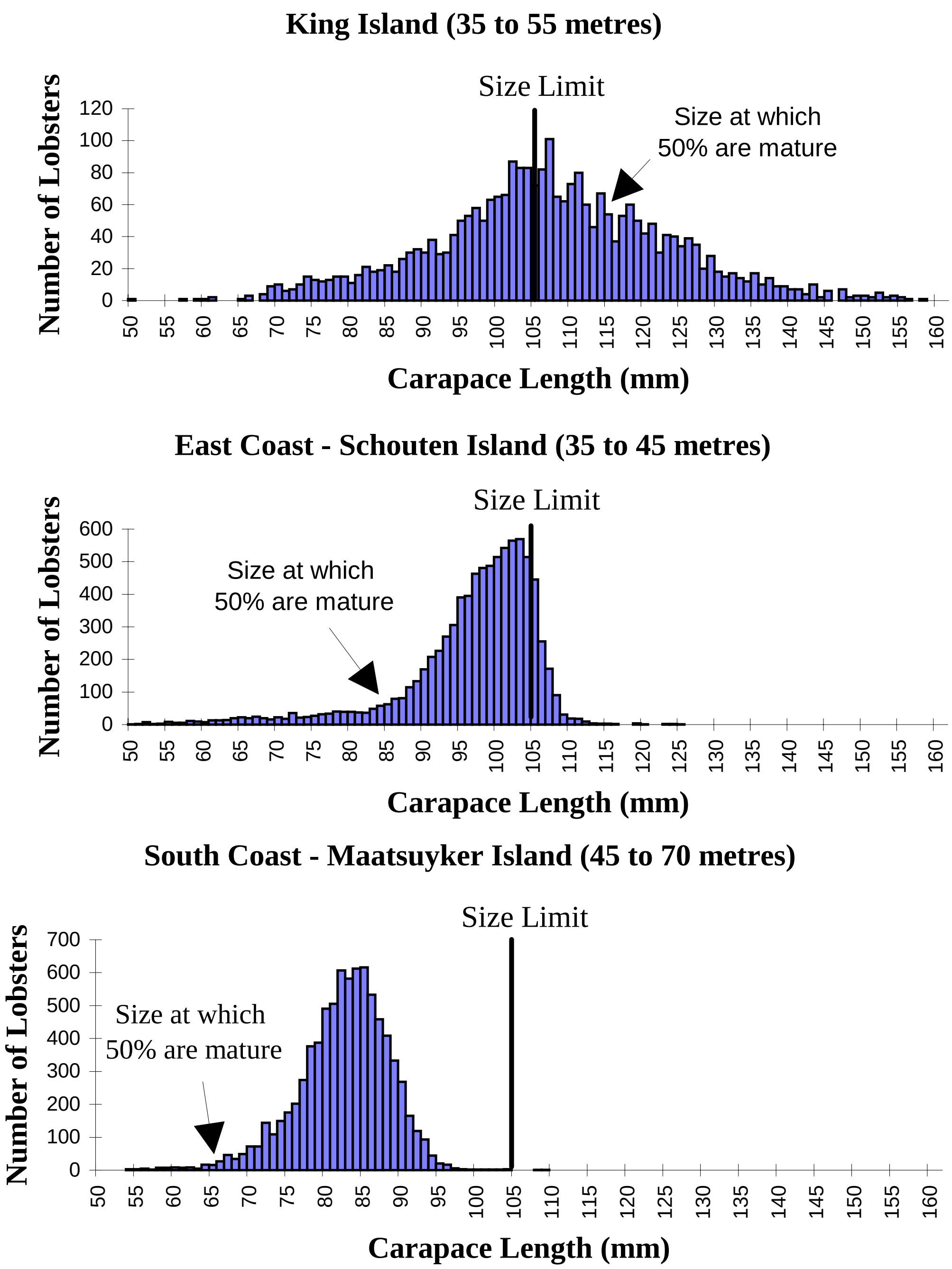


Figure 7. Size structure and size at maturity of female lobsters caught at three locations in Tasmania.

6. Previous Assessments

The first stock assessment of the fishery was produced in July 1997 (Frusher, 1997a). This report used data available up until December 1995. An update to the first assessment was produced in December 1997 (Frusher,1997b). That report included an application of the rock lobster assessment model with data to December 1996 and a description of the 1996/97 fishing season up to July 1997.

The first T.A.F.I. rock lobster assessment report used data available up until the 1st March 1998 (T.A.F.I., 1999). The report presented here is the second T.A.F.I. rock lobster assessment report and uses data available up until the 1st March 1999. This is the first stock assessment report to be conducted after the implementation of ITQ management.

7. Recent Developments

7.1 Fishery

On the 1st March 1998, the Tasmanian rock lobster fishery changed management from an input controlled fishery to an output controlled fishery. Output was based on a 1500 tonne total allowable commercial catch. The catch was distributed amongst the fishing fleet as individual transferable quota units. For the 1998/99 fishing season (1st March 1998 to 23rd February 1999), approximately 91% of the quota was allocated on a per pot basis which equated to 130 kilograms per pot. The remainder of the quota was allocated as rock lobster catch history units. The *Living Marine Resources Management Amendment (Rock Lobster Quota) Act 1997* details the method of calculating the catch history.

7.2 Assessment Model

The rock lobster assessment model underwent a number of enhancements between the assessments of Frusher (1997a, 1997b) and the 1997/98 report (T.A.F.I., 1999). These were documented by Kennedy (1998) and were also detailed in the 1997/98 report (T.A.F.I., 1999).

Work on improving the model to incorporate standardised effort is underway through FRDC funding and this is considered especially important after introduction of ITQ management. Standardisation will enable us to directly compare catch rates of fishers in 1999 with those from the 1970's, even though there has been improvement in technology during this period. Associated with this work is revision of the fleet dynamics component of the model. The fleet dynamics component is used to predict movement of fishers when conducting projections. We expect that the decision making processes that fishers use when choosing to shift to another area will be different under ITQ management. For these reasons, the model to be used in the next assessment for the 1999/2000 season is expected to have further enhancements.

8. Fishery Assessment

8.1 Evaluation of Trigger Points

8.1.1 Catch per unit effort (CPUE)

Standardisation procedures are currently being investigated so this report does not contain standardised CPUE data. Standardisation of CPUE data is an important step in overcoming the bias from technology change although the extent of this bias is unknown for the Tasmanian fishery. We expect this problem to be significant as Fernandez et al. (1997) found that technologies such as colour echo sounders and global positioning systems had increased the efficiency of effort by 35% over the last 25 years for the deeper water lobster stocks in Western Australia. Fishing efficiency increases would imply that true declines since 1970 would be steeper than those observed in raw catch and effort data.

There are significant seasonal trends in catches with over 85% of the catch being caught by the end of March. Seasonal trends are further exacerbated by the movement of the fishing fleet to different regions during the season. In general, the majority of the fleet commences fishing in southern regions prior to dispersing to fishing zones closer to their home port. Towards the end of the fishing season there is often an increase in effort around the Bass Strait Islands.

To decipher seasonal trends, regional catch rates are presented for the reference year and for 1998 (Figure 8).

8.1.2 Commercial catch rates

All changes in the commercial catch rates both Statewide and on a regional level show an increase in catch rates since the reference year of lowest catch rate (Table 6). Relative to 1997, catch rates have declined in eastern areas. However, statewide catch rates were marginally higher, mainly due to much higher catch rates in the south west (Area 8).

Table 6 Change in annual commercial catch rates. Negative values indicate a decline. The reference year is defined as the year with lowest CPUE among 1993, 1994 and 1995. Statewide catch rate data is the total catch/total potlifts.

Region	**Reference Year**	**Commercial catch rates**			**% change in 1998**	
		Ref. Year	**1997**	**1998**	**vs Ref. Year**	**vs 1997**
Statewide	1994	0.82	0.90	**0.94**	14	4
1	1994	0.52	0.67	**0.70**	35	4
2	1994	0.54	0.62	**0.55**	2	-11
3	1994	0.44	0.53	**0.48**	9	-9
4	1994	0.63	0.92	**0.81**	29	-11
5	1995	0.90	1.0	**1.0**	11	0
6	1995	1.21	1.31	**1.36**	12	4
7	1994	1.11	1.16	**1.21**	9	4
8	1993	0.77	0.88	**1.05**	36	19

Monthly comparisons between the reference year and 1998 show that catch rates had improved for most months in all areas (Figure 8). The only notable exception was during May in area 8 where an uncharacteristic catch rate occurred. The magnitude of any difference between 1998 and the reference years was generally small except for the months of November and December. These months were the first months of fishing under ITQ management where new recruits were present (ie animals captured in January-August 1998 had already been legal sized and subjected to fishing pressure under input control only management).

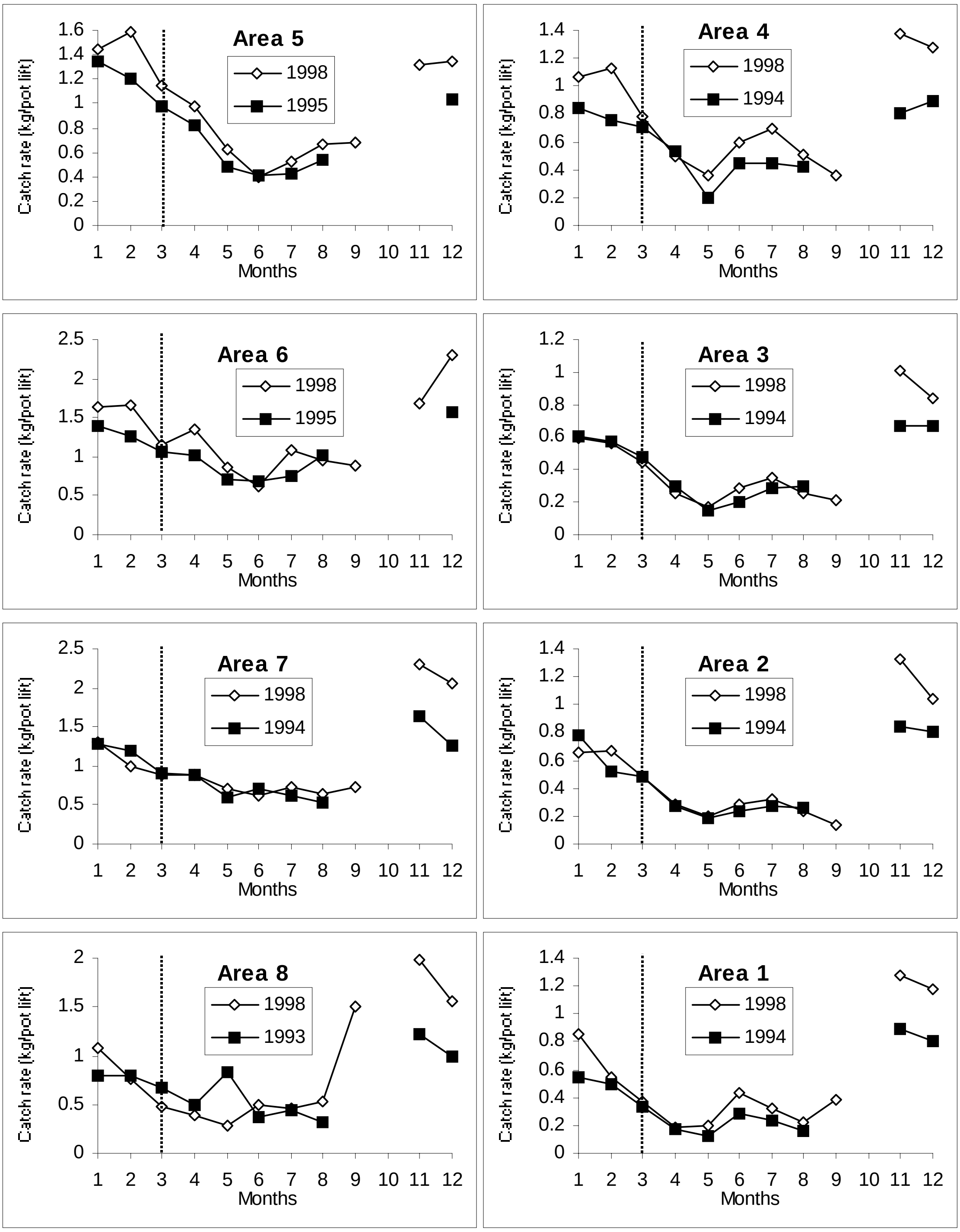


Figure 8. Monthly catch rates of rock lobster for 1998 (grey) and the reference year in Table 6 (black) for 8 areas around Tasmania. Months are from January to December. Quota management was introduced in March 1998 which is represented by the dashed line. Note that most legal sized biomass available for exploitation during the first few months of QMS had also been exploited under input controls. After the closed season from September to November, new recruits entered the fishery and catch rates immediately increased in all regions. This is attributed to a change in fishers behaviour in that they appeared less willing to expend quota during this period of lower beach prices unless catch rates were very high.

8.1.3 Research catch rates

Catch rates from research surveys showed an increase from the reference year to 1998 in the south coast sites (area 8) and in medium depths on the east coast (area 2). However, there was a decline in catch rates in shallower water (Table 7) on the east coast. This decline is of less concern than in the last stock assessment as catch rates have increased since 1997.

Table 7 Change in catch rates of legal sized lobsters from pre-season (Oct/Nov) research surveys on the East and South Coasts of Tasmania.

Region	**Depth (metres)**	**Reference Year**	**Catch Rates**			**% change**	
			Ref. Year	**1997**	**1998**	**vs Ref. Year**	**vs 1997**
Area 8	45 - 100	Nov'93	1.18	1.78	2.35	99	32
Area 2	30 - 50	Nov'94	1.36	2.03	1.43	5	-30
Area 2	< 30	Nov'94	1.35	0.85	1.30	-4	53

The shallow water, east coast site is the only site where there is concern about the trigger point. To determine if this decline is specific to the site being sampled or whether it is reflective of the east coast shallow area, additional sites have been added to the east coast sampling regime.

Catch rates from research surveys are limited by spatial coverage although they are valuable due to the fact that surveys are conducted in the same region with the same gear. The fact that catch rates in research sampling are consistently higher than those of the commercial industry is partially a reflection of the ability to sample before the season opens in November.

8.1.4 Legal-Sized Biomass

Biomass estimates refer to the legal sized biomass in October of each year. This month was chosen as it is at the first month of fishing after the spring closure so the legal-sized biomass is at its peak for the year. This is because it includes animals that moulted into legal size during closed periods in the preceding months. Biomass estimates from October also permit comparisons with estimates derived from research sampling which commences in October/November.

Legal sized biomass has increased compared to the reference years both Statewide and for the eight individual areas (Table 8). Relative to the previous year (1997), there was a general trend of increasing legal sized biomass although declines were observed in areas 5 and 6.

It was considered that these declines in areas 5 and 6 may have been caused by increased fishing pressure prior to the introduction of quota in March 1998. This issue has been raised for area 5 where industry reported relatively high effort in the last weeks of an uncapped fishery in January and February 1998. However, reported effort data (potlifts) does not confirm this (Figure 9). Consequently, the decline in estimates of legal-sized biomass in area 5 cannot be attributed to increased fishing effort before QMS.

Table 8. Change in legal sized biomass in October. Negative values indicate a decline in the percentage change.

Region	Reference Year	Sized biomass estimate (tonnes)			% change in 1998	
		Ref. Year	1997	1998	vs Ref. year	vs 1997
Statewide	1993	2497	2912	3232	**29**	11
1	1993	244	312	382	**57**	22
2	1993	175	179	224	**28**	25
3	1994	77	91	91	**18**	0
4	1994	392	500	615	**57**	23
5	1993	647	760	709	**10**	-7
6	1995	253	279	271	**7**	-3
7	1994	280	298	329	**18**	10
8	1993	405	492	610	**51**	24

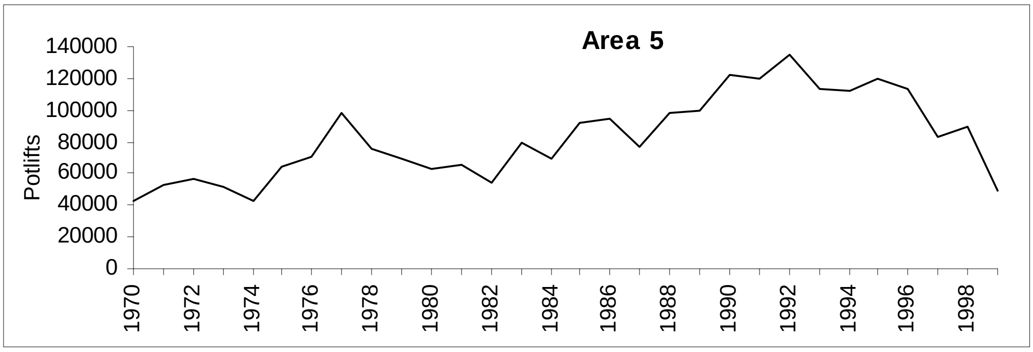
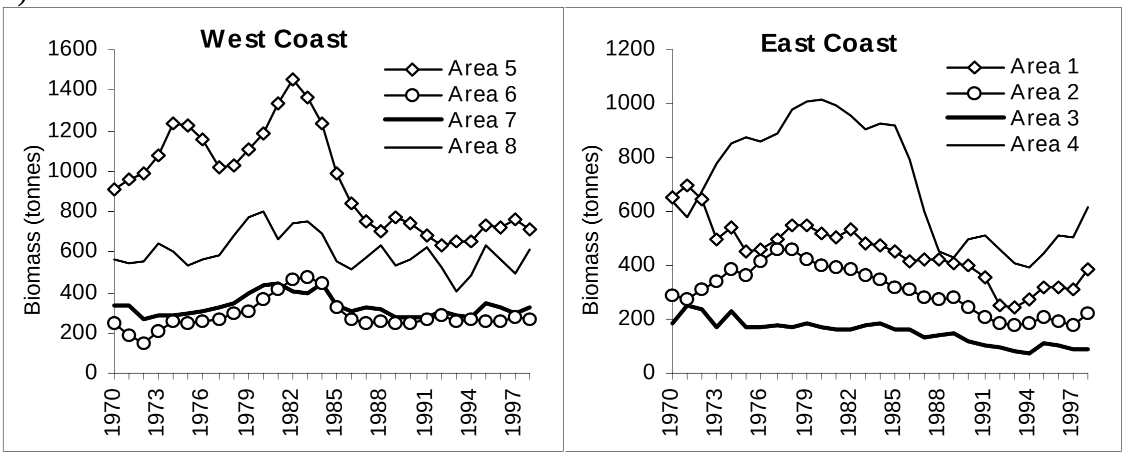


Figure 9. Trends in effort during the months of January and February in area 5 (NW and King Island). Although effort in January and February in 1998 was higher than in 1997, it was lower than any of the reference years. Consequently, there is no evidence of increased effort immediately prior to the introduction of QMS. Effort subsequently declined in January and February of 1999 to the lowest for this period since 1974.

Trends in regional biomass estimates since 1970 are shown in Figure 10. In most regions there has been a decline from the early eighties to the early nineties. The declines are most pronounced in northern Tasmania (areas 4 and 5).

a)



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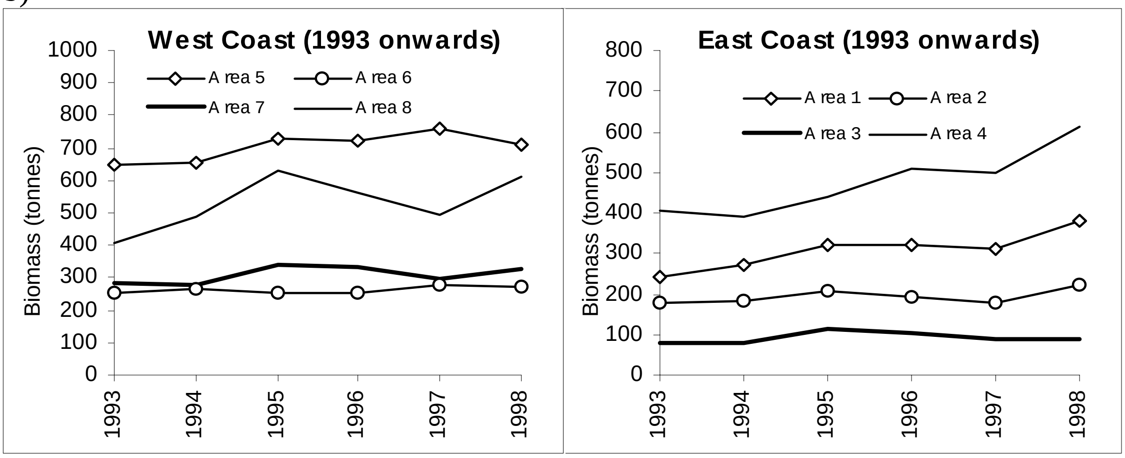


Figure 10. Regional legal-sized biomass estimates for the Tasmanian rock lobster fishery from a) 1970 to 1998 and b) from 1993 to 1998. All estimates are for October.

All areas have shown an improvement in legal sized biomass since the reference year (Figure 10b).

Biomass estimates are obtained from dividing the commercial catch by the exploitation rate. Since 1992, fisheries independent research has tested techniques for determining exploitation rates in the south (area 8) and east coast (area 2) regions of the fishery (Frusher et al, 1997, Frusher et al, 1998). The techniques are still being evaluated for the east coast and no east coast data is presented.

Biomass estimates for area 8 using south coast exploitation rates derived from change-in-ratio (CIR) and index removal (IR) estimates are presented in Figure 11. Biomass estimates derived from the commercial catch data using the Leslie depletion method (DEP) (Leslie, 1945), biomass estimates from the model and, the commercial catch are also included in Figure 11.

There is close agreement between the trends for all estimates. The similarity between estimates has increased since the previous stock assessment report where the relationships between various estimates were difficult to explain. For instance, biomass estimates from the model were reported as being lower than the catch for one year. These problems have been overcome by: i) the use of model biomass estimates from the same month as research estimates (November), and ii) the use of improved catch data based on weight for deriving biomass from exploitation rate.

The biomass estimate from the IR technique in 1997/98 was exceptionally low and similar to the total catch for that fishing season. This seems to have been caused by an early moult in September as processors reported problems with soft fish and lowered prices. Despite these occasional problems, trends were similar between all estimates, and this similarity between CIR, IR and model estimates continues into the 1998/99 season. This is important as it suggests that the model is continuing to produce realistic results in the new environment of catch and effort data derived from a quota managed fishery. CIR and IR estimates are independent of commercial data and would not be expected to vary in response to management changes.

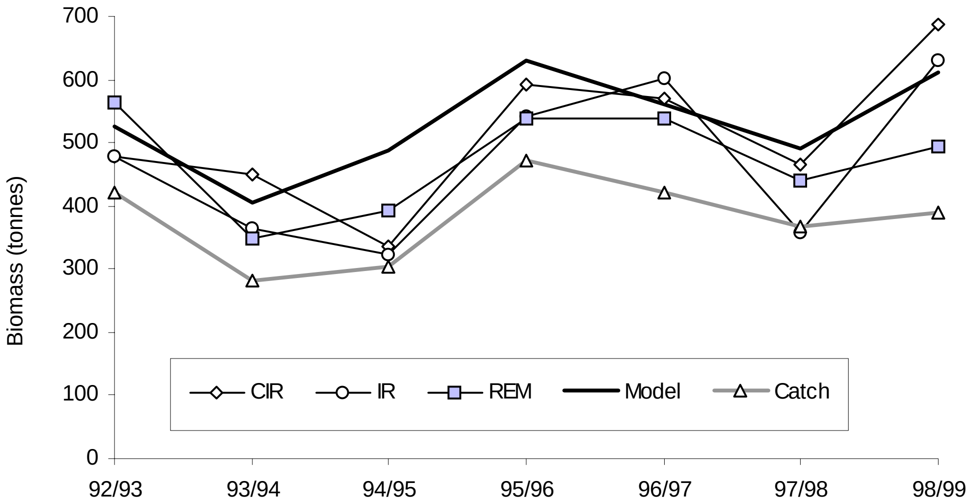


Figure 11. Estimates of legal sized biomass in area 8 using change-in-ratio (CIR), index removal (IR), depletion (DEP) techniques and from the rock lobster assessment model (Model). The commercial catch (Catch) is also shown. All biomass estimates are at the beginning of the open season in November and catch is for the period from that November until the following August. IR and CIR estimates for 98/99 are based on partial year sampling to March 1999. Catch data for 1998/99 may change as data does not include all commercial returns. Despite the increase in biomass from 1997/98 to 1998/99, catch did not increase proportionally which implies exploitation rate is reduced.

Legal sized biomass estimates from the 1997/98 fishing season from research surveys are higher than the lowest estimate which occurred in the 1994/95 fishing season. The downward trend in biomass from 96/97 to 97/98 is of less concern given the biomass estimates from the first half of research sampling in 98/99. Although there is variation between these estimates based on partial year data, they all show an increase in biomass.

The biomass trigger point gives no cause for concern.

8.1.5 Egg Production

The increase in egg production above the virgin level for area 8 is currently unexplainable (Table 9). This was also noted by Kennedy (1998), who concluded that further modelling work was required to sort out this problem. Possible causes of the estimates of egg production in area 8 being above virgin levels include: i) expansion of fishing grounds, and ii) changes in growth and abundance of females due increased food availability through harvest of males. Due to the slow growth rate and small size at maturity of females in area 8, egg production is high and not of concern.

Table 9. Change in relative egg production from the reference year to 1998, and the level of egg production in 1998 as a percentage of virgin egg production. Virgin egg production is the estimated egg production prior to commercial exploitation, assuming average recruitment the same as that from 1970 to the present. Relative egg production is a numerical (linear) index of egg production so that relative egg production of 200 implies twice as many eggs are being produced compared to a relative egg production of 100.

Region	Reference Year	Relative Egg Production			% change in 1998		% Virgin prodn. in 1998
		Ref. Year	1997	1998	vs Ref. year	vs 1997	
Statewide	1993	891	973	1007	**13**	3	28
1	1995	157	151	150	**-4**	-1	59
2	1992	77	87	88	**14**	1	30
3	1993	23	28	30	**30**	7	8
4	1993	63	86	116	**84**	35	15
5	1992	61	85	86	**41**	1	9
6	1986	52	77	73	**40**	-5	19
7	1989	110	137	135	**23**	-1	48
8	1994	309	323	330	**7**	2	111

The only decline in egg production was from area 1 where egg production compared to virgin production is high and not of concern (Table 9). With the exception of areas 6 and 7 in the south west, egg production has declined since the late 1970’s to the early 1990’s (Figure 12).

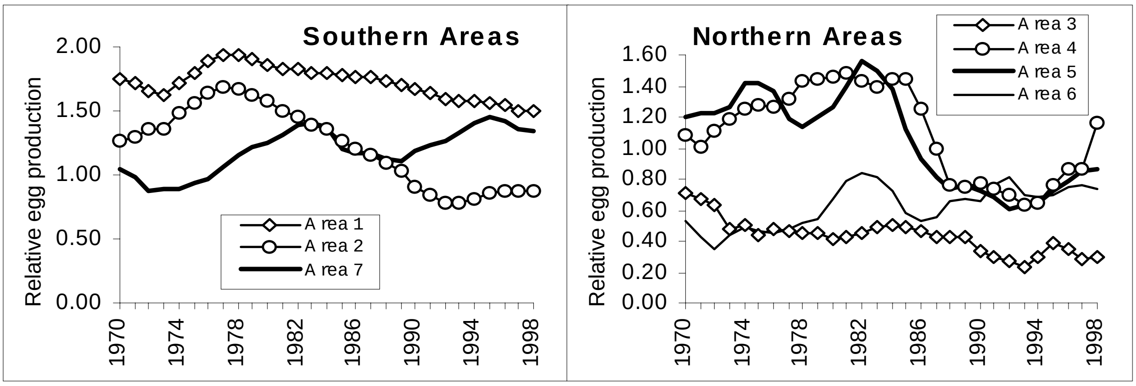


Figure 12. Relative egg production from 7 areas around Tasmania. Area 8 is not included due to problems mentioned in the text.

Although increases in relative egg production have been achieved in the northern regions (Figure 12), they are still low compared to virgin stocks and below the recommended level of 25% (Figure 13) (Frusher, 1997a). Although areas 4 and 5 still provide reasonable numbers of eggs compared to other regions (Figure 12), the low percentage of egg production compared to the virgin (unharvested) production indicates the dominance which areas 4 and 5 would have had in contributing to overall egg supply prior to exploitation (Figure 13).

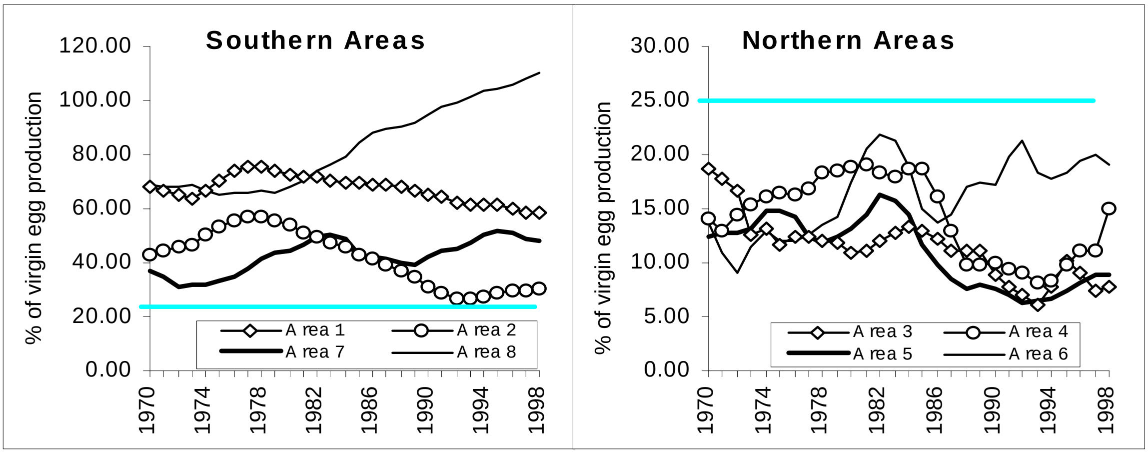


Figure 13. Percentage of virgin egg production from eight areas around Tasmania.

8.1.6 Relative abundance of undersized lobster - research estimates

For the abundance of pre-recruit lobsters (undersized lobster equivalent to one growth increment below legal size) to be relevant as a performance indicator, a relationship between the catch rate of pre-recruits and the catch rate of newly recruited lobster in the following year needs to be established. This relationship is currently being evaluated in collaboration with the Virginia Institute of Marine Science.

A link between the abundance of undersize and subsequent catch rates has only been defined on the south coast (see section on trends in catch rates) where undersize males of greater than 105 mm CL are assumed to moult to legal size in the following season.

Catch rates of undersize lobsters is reported for only a small size band below the minimum legal size. The width of this band is based on a single moult increment so that it provides some indication of abundance of animals the following season. For the south coast, undersize catch rates refer only to males between 105 and 110 mm CL..

The lowest catch rate of undersized achieved in the pre-season surveys undertaken in October/November was in 1995. The catch rate of 1.45 undersized lobsters per pot lift in 1995 increased to 2.14 in 1997 and to 2.51 in 1998. The 1998 catch rate of undersize is 73% higher than the reference year so the undersize trigger gives no cause for concern.

8.1.7 Relative abundance of undersized lobster - model estimates from commercial data

Undersized biomass estimates obtained from the model reflect undersized lobsters from 80mmCL to the legal size limit (Figure 14).

Biomass estimates are derived from catch and effort data by region and season. This data relates only to the area being fished at the time and does not take into account non-fished or unknown fishing grounds. Thus as new grounds were being developed on the west coast during the seventies and eighties, increases in biomass would occur. This is consistent with the observed increase in biomass in areas 5, 6 and 7. The rapid increase in area 6 during the 1980’s is attributed to the discovery and then exploitation of a new and productive ‘patch’ of fishing grounds which fishers often refer to as the ‘Golden Mile’ patch.

As mentioned in the sections on biomass and egg production there is uncertainty in the model estimates for area 8. Interpretation of undersize biomass trends from the model in this area need to be treated with caution.

In areas 2,3,5,6, and 7 undersized biomass has declined for both sexes in recent years and is at or below 95% of the reference years in areas: 1(females only); 5 (both sexes); 6 (both sexes); and 7 (both sexes). Although undersized biomass is not a trigger, these trends are of some concern and require monitoring. Undersize biomass is a volatile index and there has also been sharp increases in some areas, particularly in area 4.

a)

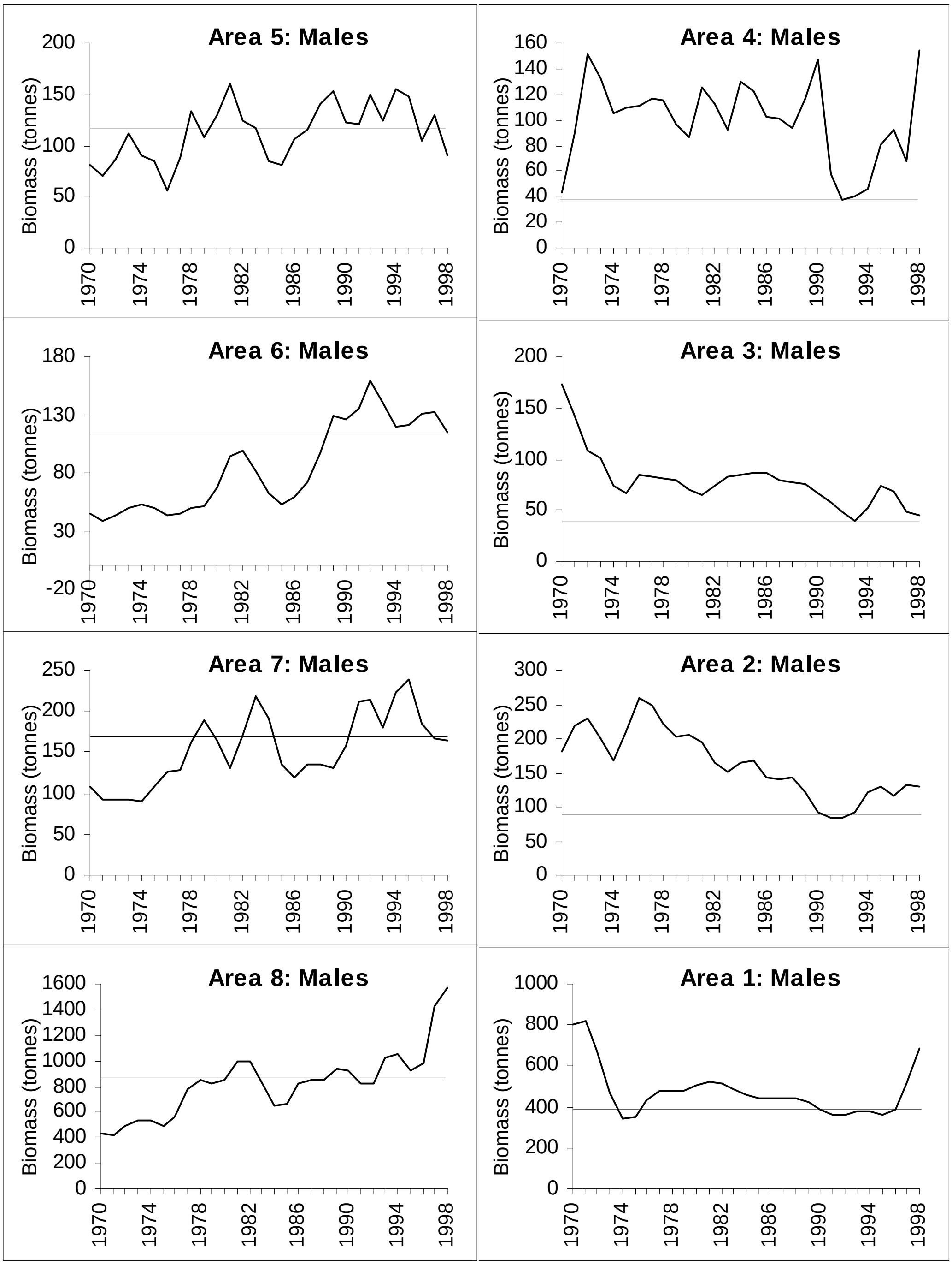


Figure 14. Undersized biomass estimates of a) male lobsters from 80mmCL to 110mmCL and b) female lobsters from 80mmCL to 104mmCL. The horizontal line represents the value of 95% of the reference year.

b)

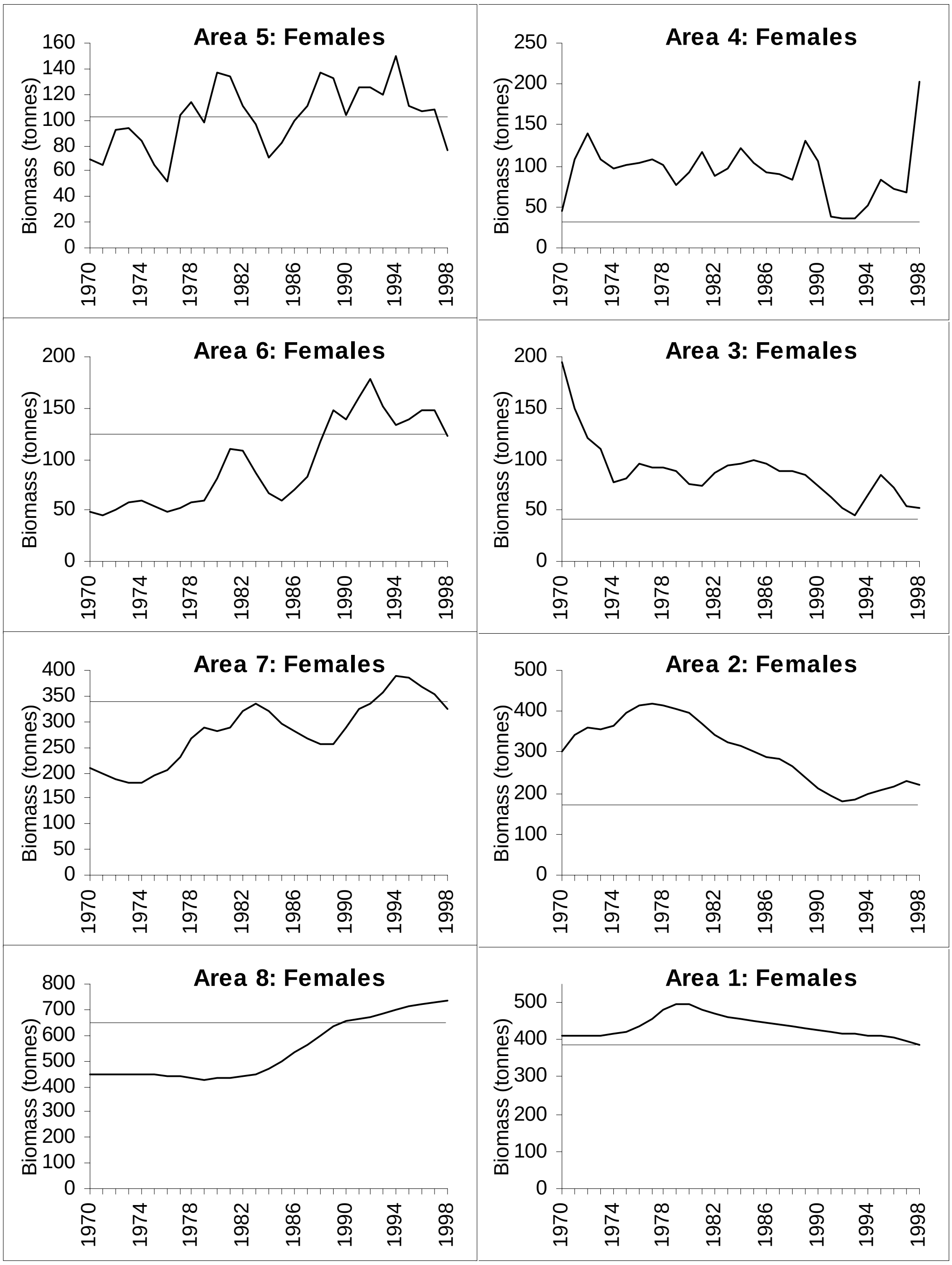


Figure 15 (cont.). Undersized biomass estimates of a) male lobsters from 80mmCL to 110mmCL and b) female lobsters from 80mmCL to 104mmCL. The horizontal line represents the value of 95% of the reference year.

8.1.8 The total annual catch

The total annual commercial catch performance indicator is subject to a total annual commercial catch controlling the output of the fishery. A TACC of 1500 tonnes was introduced for the first time in March 1998 and the trigger is 95% of this amount (=1425 tonnes). The total catch for the period March 1998 to February 1999 (inclusive) was 1482 tonnes which is greater than the trigger. Several fishers have reported that they retained a small amount of quota unfished as it was not worth returning to sea for this small catch. This contributes to the 18 tonne shortfall from the TAC.

8.1.9 The size of the rock lobster fleet

The average number of licenses in the fishery can be determined by the number of returns processed. It is mandatory for each license holder to submit a monthly catch return irrespective of whether the person was fishing or not. The average annual number of licenses in the fishery since 1993 has declined marginally each year with 314 licenses operating in the fishery in 1999 (Table 10). The proportion of these licenses that were active (that is, they recorded a catch) has decreased at a more rapid rate. It appears that the introduction of QMS has reduced the number of active licenses with a partial year decrease of 14.8% from 1998 to 1999. This would be expected as a function of the increase in maximum number of pots from 40 to 50.

The number of operators is still above the 220 required to trigger this performance indicator.

Table 10. Changes in the number of operators in the Tasmanian rock lobster fishery in calender years from 1993 to 1999. Licenses cannot be created so the 1999 value cannot change although it is based on partial year data. Active licenses are those that recorded catch. It possible that the number of active licenses in 1999 is an underestimate as it is based on partial year data.

Year	Number of operators	% change	Number of active licenses	% change
1993	337	-	330	-
1994	334	-0.9	329	-0.3
1995	331	-0.9	326	-0.9
1996	321	-3.0	315	-3.4
1997	316	-1.5	309	-1.9
1998	314	-0.6	304	-1.6
1999	314	0	259	-14.8

8.1.10 The recreational catch

Recreational catches of rock lobster are by both potting and diving, with divers using surface supply, scuba, and snorkel techniques. Most recreational rock lobsters are taken by potting (around 65%, Frusher 1997b) and effort is concentrated in shallow water of less than 18 m due to the constraints of safe diving and the ability to pull pots by hand.

The recreational catch has been estimated by diary and recall techniques as described by (Lyle and Smith, 1998). Results from the two larger scale surveys are shown in Table 11 and Table 12. The two surveys estimated number of animals captured by recreationals which was converted to weight using average weights from the commercial fishery (split by depth and region).

Recreational catch is significant in some regions, especially in shallow water on the east coast. The high proportion of total catch in areas 1-3 taken by recreationals is of some concern given that recreational effort is not capped and estimates of egg production relative to virgin are lowest from area 3. However, recreational catch does not cause concern relative to the trigger as overall statewide catch by recreational fishers is around 5% of the commercial catch and thus less than the trigger of 10%.

Table 11 Recreational catch estimates for the eight month period December 1996-August 1997.

Area	Number of lobsters	Weight of lobsters (t)	% total catch[1] from area	% total catch[1] from <10 fm	% commercial[2] taken in <10 fm
1 to 3	66854	54.3	20.4	78.4	43.9
4	3834	4.5	2.1	15.0	13.1
5	7598	9.4	3.0	25.8	20.5
6 to 8	11584	9.3	1.3	5.5	5.2
TOTAL	**89870**	**77.5**	**5.2**	**25.4**	**20.2**

[1] This is the proportion of the total catch from both commercial and recreational sectors that was taken by recreationals.
[2] This is the proportion of the total commercial catch that was taken in less than 10 fathoms in that area.

Table 12 Recreational catch estimates for the six month period November 1997-April 1998

Area	Number of lobsters	Weight of lobsters (t)	% total catch[1] from area	% total catch[1] from <10 fm	% commercial[2] taken in <10 fm
1 to 3	53036	41.4	20.7	54.0	117.1
4	3158	3.5	2.4	19.0	23.5
5	5843	6.6	2.4	21.6	27.5
6 to 8	8224	6.3	1.1	6.9	7.4
TOTAL	**70261**	**57.8**	**4.79**	**26.5**	**36.1**

[1] This is the proportion of the total catch from both commercial and recreational sectors that was taken by recreationals.
[2] This is the proportion of the total commercial catch that was taken in less than 10 fathoms in that area.

Recreational catch data on rock lobster fishing is currently collected sporadically. The rock lobster stock assessment working group considered that this data is required regularly as recreational catch is uncapped and may undo attempts at stock rebuilding. Consequently, they support the allocation of research resources for the initiation of long term monitoring of recreational catch.

8.2 Trends in Commercial Catch, Effort and Catch Rate Data

Catch rates in Tasmania were relatively constant or increasing in the 1970's or early 1980's prior to a decline to record lows in the mid 1990's (Figure 16). This has been followed by minor improvements. While this trend is reflected in all regions of the fishery, there are differences which are worth noting.

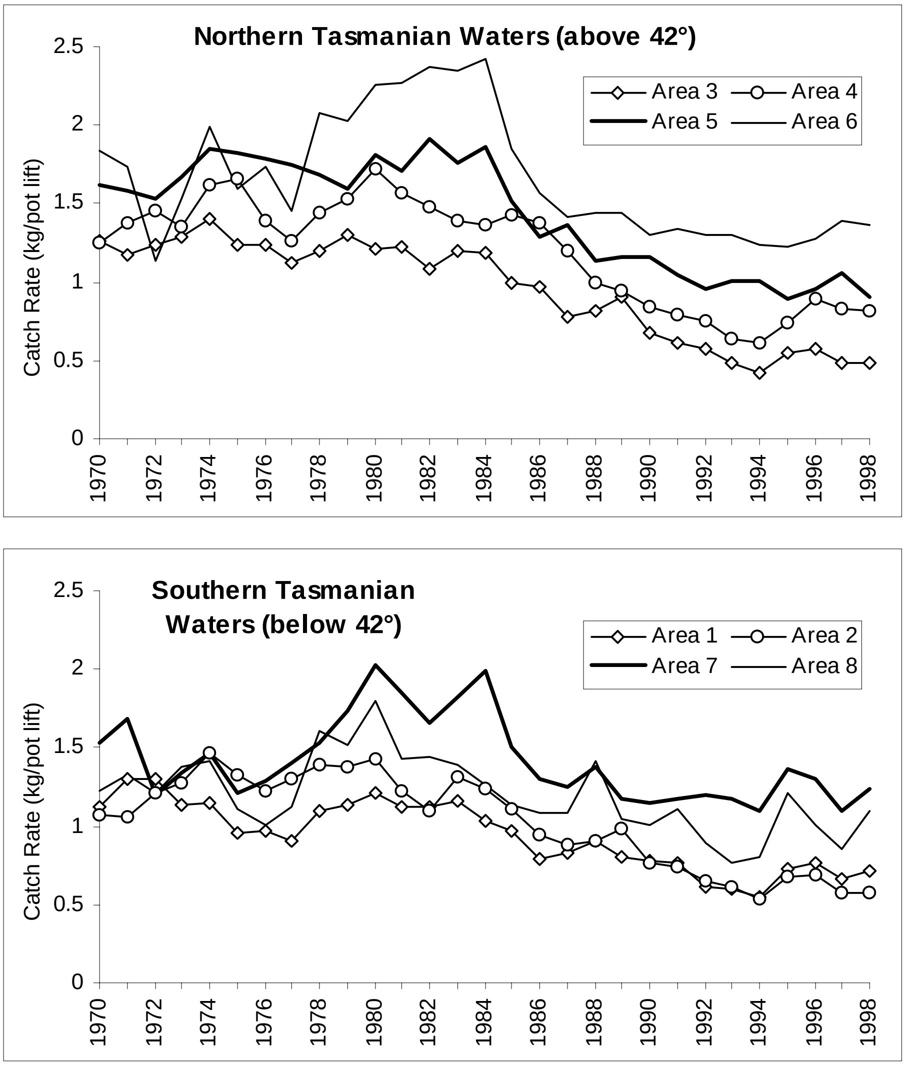


Figure 16. Regional catch rates from southern and northern Tasmania since 1970. Data is presented on a quota year basis (ie March to February) so the last data point is for March 1998 to February 1999 inclusive.

Table 13. Comparison of highest and lowest commercial catch rates regionally around Tasmania from 1970. Comparisons are between years on a quota year basis (ie March to February).

Area	Highest Catch Rate		Lowest Catch Rate		% difference in Catch Rate	1998/99 Catch Rate	% difference 1997/98 to 1998/99
	Year	Catch Rate	Year	Catch Rate			
All	1981/82	1.66	1995/96	0.82	51	0.93	+4.9
1	1971/72	1.31	1994/95	0.54	58	0.71	+8.3
2	1974/75	1.47	1994/95	0.54	63	0.57	-1.0
3	1974/75	1.40	1994/95	0.43	69	0.49	+0.4
4	1980/81	1.72	1994/95	0.61	65	0.82	-1.7
5	1982/83	1.92	1995/96	0.89	54	0.91	-13.6
6	1984/85	2.43	1972/73	1.14	53	1.37	-1.7
7	1980/81	2.03	1997/98	1.09	46	1.24	+13.7
8	1980/81	1.80	1993/94	0.77	57	1.10	+28.1

East coast regions recorded their highest catch rates in the early to mid seventies, whereas the west coast regions were developed later with highest catches occurring in the early to mid 1980’s (Table 13). An exception to this is area 4 (NE) which recorded its highest catch rate later than the other east coast areas.

The rapid increase and subsequent decrease in area 6 resulted from the discovery of relatively virgin ground during the early 1980’s. In almost all regions catch rates have halved since the eighties.

The extent of decline, and the timing of peaks in catch rates reflect the nature of the east and west coast operations. The east coast, which has greater infrastructure and population combined with more settled weather, was developed and exploited earlier. In contrast, fishing on the more weather dependent west coast grounds was stimulated by the declining east coast catch rates, improved technology including ‘bottom lock’ echo sounders, and availability of larger vessels.

Since the lows of the mid-1990’s, last year’s catch rates are little changed except in areas 7 and 8 which have had large increases in catch rate and area 5 which has had a similar decline in catch rate. It is important to understand that these are non-standardised annual CPUE values so they will be influenced by the change to quota management. This change will affect the timing and spatial distribution of commercial effort so annual comparisons of CPUE may be affected. For this reason, the biomass trends (Figure 10) and monthly CPUE data (Figure 8) are a more useful indicator of stock abundance. Research is underway though FRDC funding to overcome this effect of management change on stock assessment.

8.3 Trends in abundance indices

A fishery independent catch sampling project has been conducted at a number of sites around the southern half of the State since 1992. Three groups of sites have been surveyed on all occasions and thus provide a time series of data. The groups correspond to shallow (<30 metres) and medium (35 to 45 metres) regions around southern Maria Island and south west Schouten Island respectively on the east coast, and medium to deep (45 to 100 metres) sites south of Maatsuyker Island on the south coast.

8.3.1 East Coast Shallow

Pre-season research catch rates of sized lobsters declined from 1992 to 1997 but recovered in 1998 (Figure 17). The commercial catch rate for the months of November in the same area has remained relatively stable during this period although it also showed a sharp increase in November 1998. Trendlines for this data plotted in Figure 17 do not show any clear pattern and linear regression indicates that the slopes are not significantly different from 0 ($P>0.10$).

Research data may also have the potential to predict catches as the abundance of undersize lobsters is recorded. To evaluate this, the catch rates of sized and undersized lobster were compared by shifting the undersize data forwards one year (ie we compare catch rate of sized lobsters this year with catch rate of undersize last year). Undersize classes used for this analysis were restricted to those considered likely to moult in the next 12 months: 6mm CL for females and 8mm CL for males below the legal size limit (Figure 18). The catch rate of under sized lobsters was a good predictor of catch rates of commercial sized lobsters except for one sample taken of undersize lobsters in 1996 (Figure 18). Given the large deviation in this one year, pre-recruits from research surveys can not be used in this region to predict future catches with the method used here. However the method does appear to predict catches on most occasions and warrants further investigation - the divergence in 1996/97 may be due to atypical moult timing or increment which could be assessed with tag-recapture data.

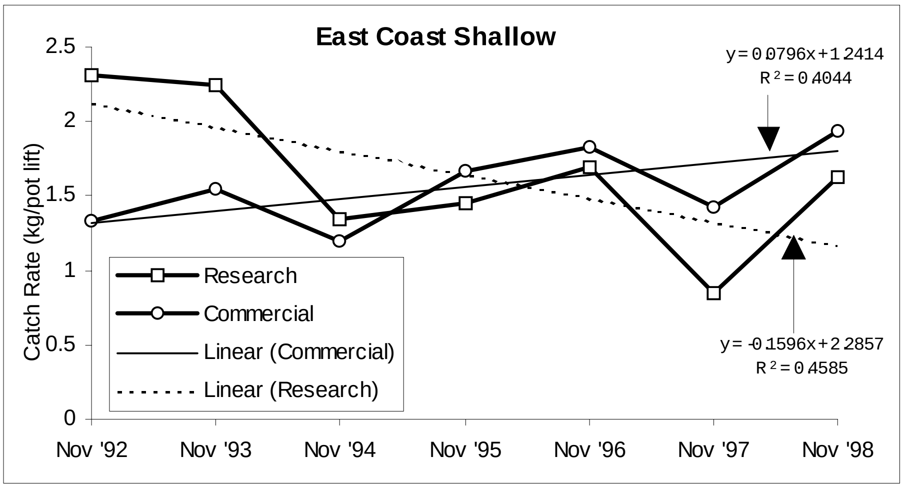


Figure 17. Shallow water catch rates from the east coast of legal sized lobsters from research surveys and commercial fishing. Linear regressions illustrate the trend in research and commercial catch rates.

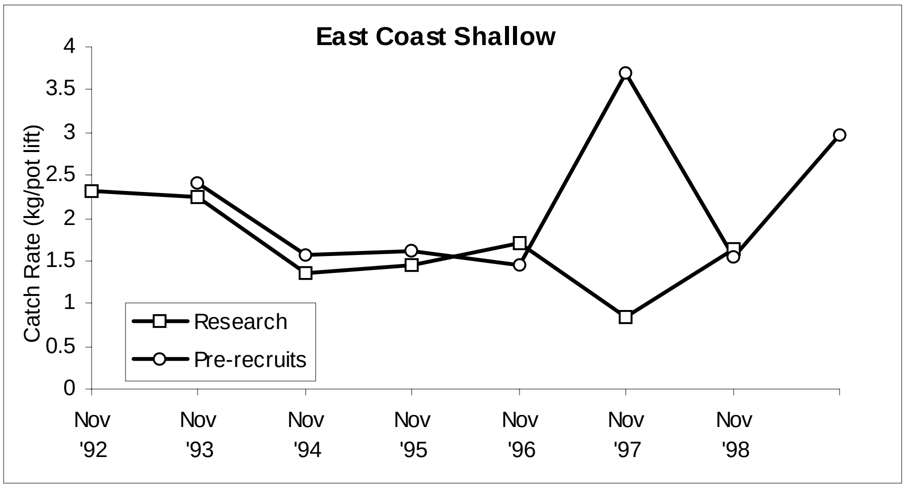


Figure 18. Shallow water catch rates from the east coast of legal-sized and pre-recruit lobsters from 1992 to 1998 survey periods. The pre-recruit lobsters have been advanced by 1 year to simulate growth of undersized lobsters to legal size.

8.3.2 East Coast - Medium

There is no evidence of a change in the medium depth research catch rates in Area 2 (Figure 19). Commercial catch rates have tended to increase since 1992 in this area although the magnitude of this trend is small and linear regression indicates that the slopes of both data sets are not significantly different from 0 (P>0.10). Both the commercial and research catch rates show substantial annual variation, although trends are broadly similar. The catch rate of pre-recruits is a poor predictor of catch rate of legal size lobsters the following season in this region (Figure 20).

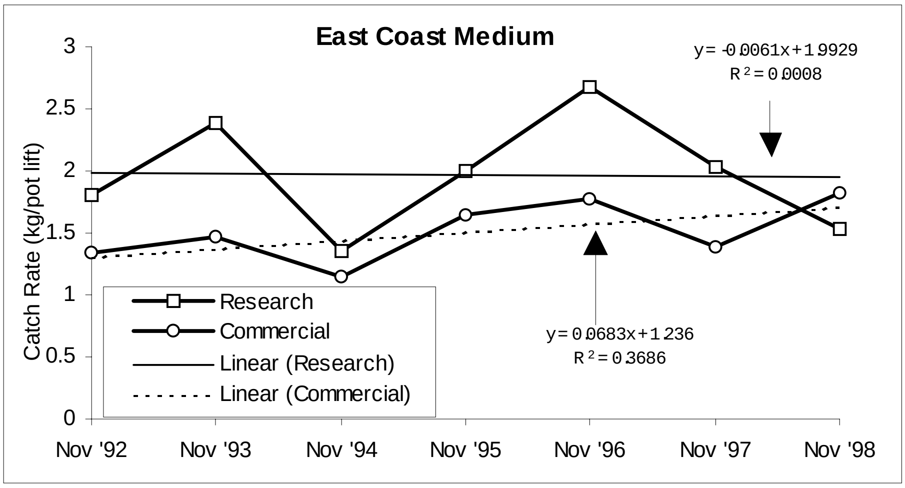


Figure 19. Medium depth catch rates for the east coast of legal sized lobsters from research surveys and commercial fishing for the start of the fishing season. Linear regressions are plotted as trendlines although the slope is not significantly different from 0 (P>0.10).

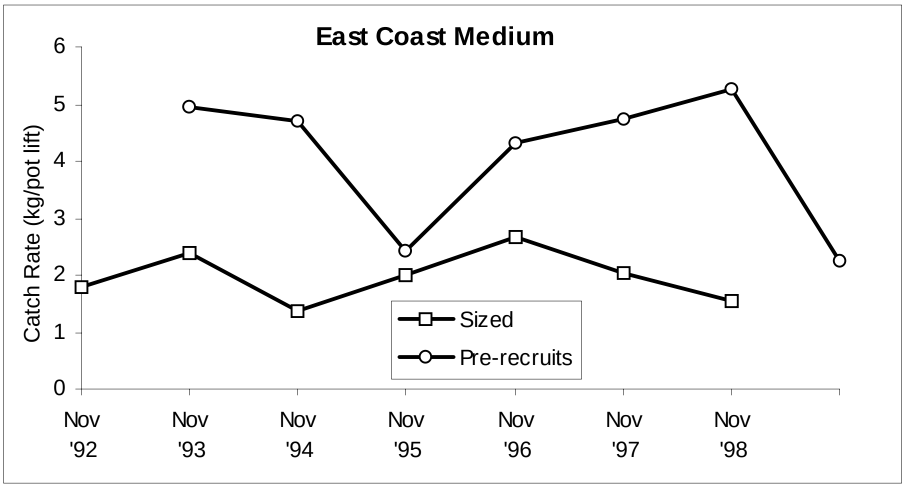


Figure 20. Medium depth catch rates from the east coast of legal-sized and pre-recruit lobsters for the 1992 to 1997 survey periods. The pre-recruit lobsters have been advanced by 1 year to simulate growth of undersized lobsters to legal size.

8.3.3 South Coast - Medium to Deep

The catch rates in area 8 of sized lobsters from commercial fishing and research surveys have similar patterns although there is a lack of correlation over all years (pairwise correlation = 0.57, P > 0.10)(Figure 21). Trendlines of both data sets are of increasing catch rates although the slopes are not significantly different from 0 (P>0.10). As catch rates from research sites south of Maatsuyker Island were not reflecting regional trends in commercial catch rates in 1997, new sites around Port Davey in the south west were established in 1998. This appears to be successful with both data sets showing a similar trend of increasing catch rates in 1998.

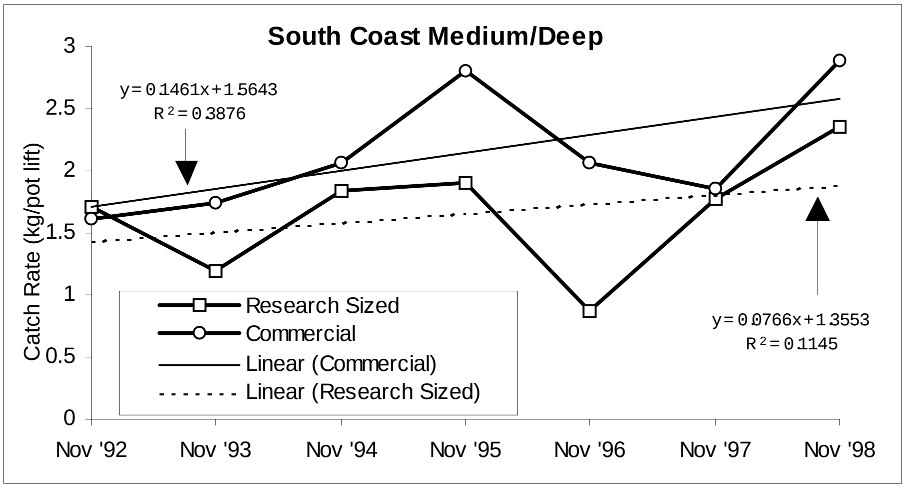


Figure 21. Medium to deep water catch rates for the south coast of legal sized lobsters from research surveys and commercial fishing for the start of the fishing season.

Despite only 6 years of overlapping data between the catch rates of pre-recruit and sized lobsters from research sampling (Figure 22), there are indications of an approximate link between the undersized catch rates and sized catch rates in the following year. The relationship was quite close until the last 2 seasons and overall the link is not significant (pairwise correlation = 0.61, P > 0.10). The apparent similarity of trends in Figure 22 indicates that the use of undersize index may have value in predicting catch. However, it is clearly influenced by other factors such as interannual variation in growth and behaviour. As noted for the East coast shallow samples, incorporation of data from tagging may improve the value of this index.

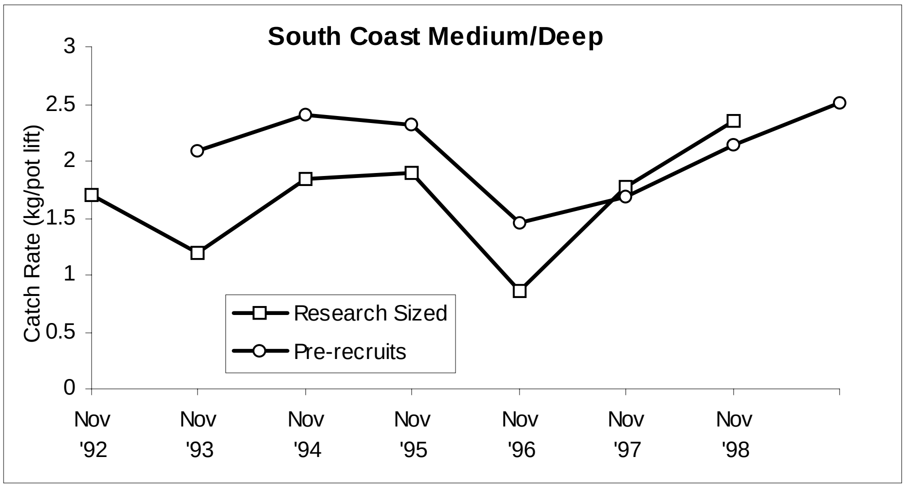


Figure 22. Medium to deep water catch rates from the south coast of legal-sized and pre-recruit lobsters for the 1992 to 1997 survey periods. The pre-recruit lobsters have been advanced by 1 year to simulate growth of undersized lobsters to legal size.

8.4 Other analyses including risk assessments

8.4.1 Biomass

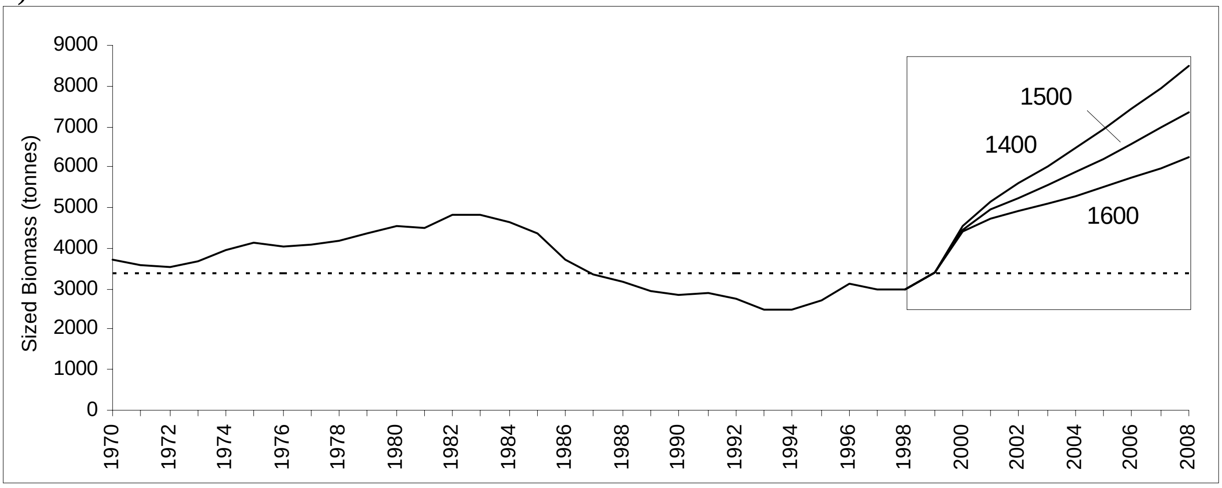
Projections of legal sized biomass in the month of November under 3 scenarios - 100 tonne increase, 100 tonne decrease and maintaining the current TACC of 1500 tonnes are presented in Figure 23 and Figure 24. The most important observation from this assessment is the trend of increasing biomass, predicted to be especially sharp on a statewide basis over the next year.

The increase in biomass estimates from 1970 to the early 1980s is considered to be an artefact of expansion of effort into new grounds, rather than an actual increase in statewide legal sized biomass.

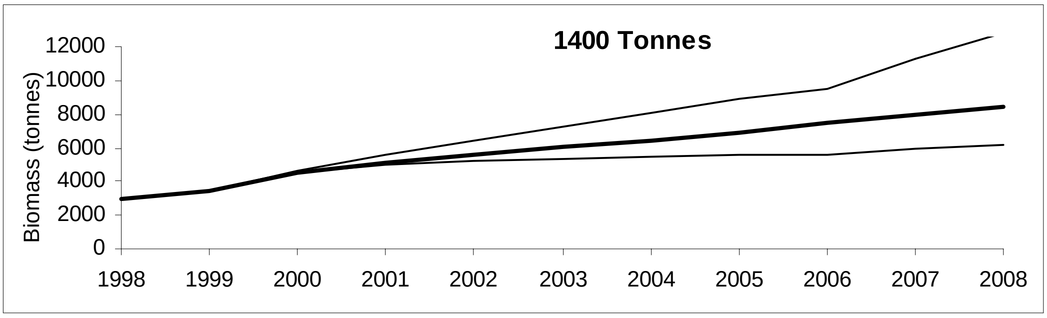
Biomass levels in the first year prior to quota management (QMS, 1997) are well below the levels of the early 1980's (Figure 23). Maintaining the current 1500 tonne TACC should result in an improvement in legal sized biomass during the current management plan with greater increases expected during the next management plan. The rapidly increasing biomass under all average projection scenarios (Figure 23a)at first appears improbable, given that sized biomass estimates are projected to rise well above that estimated for the early 1980s. However, we know from research in marine protected areas that sized biomass can become several fold higher under these extreme situations of zero fishing mortality. Consequently, it is feasible that sized biomass could become considerably higher than that estimated in the 1980s through the effort constraints imposed by QMS.

The upward trend in biomass projections under both 1500 and 1600 TACC implies that an increase in quota is feasible, however, this should be tempered by other factors. First, while the projections indicate that an increase in biomass under a TACC of 1600 is probable, the decline in the lower 96% confidence interval indicates that there is some risk of a decline given a series a poor recruitment years. Secondly, these probabilities are based on recruitment patterns that have been observed since 1970 and we have been surprised previously by recruitment that was outside that observed previously (see Frusher, 1997b). Given that egg production during the early 1990's was at a historic low, there is a risk of lower recruitment during the projected years than we have seen previously. This would result in a lower sized biomass than projected. Thirdly, the change to QMS can be expected to influence fishers behaviour and thus the meaning of effort in terms of estimating biomass. The implications of this effect on current projections are unknown but the uncertainty implies that quota should be raised cautiously (note that research on the effect of change to QMS on the rock lobster stock assessment model is underway).

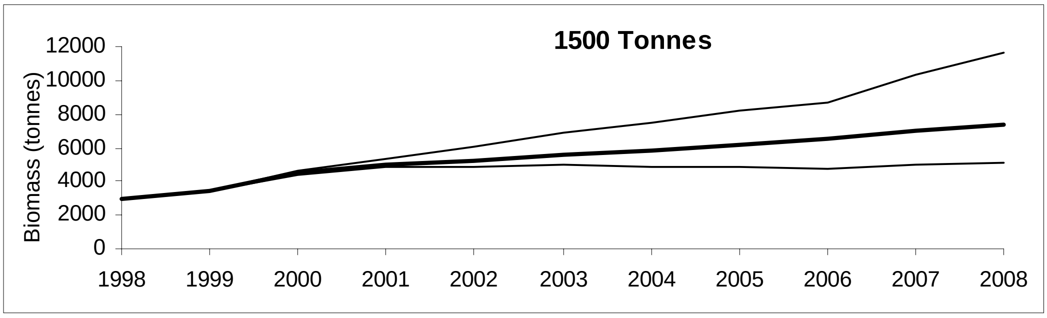
a)



b)



c)



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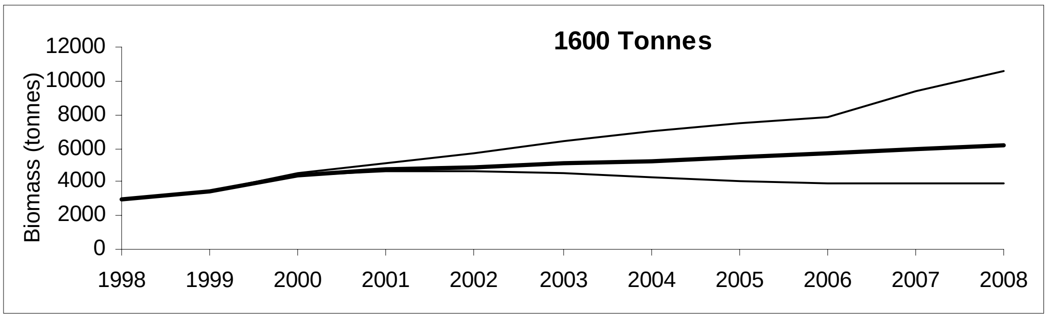

Figure 23. Biomass estimates from November 1970 to November 1998 with averaged trajectories of biomass for 1400 (upper line), 1500 (medium line) and 1600 (lower line) tonnes TACC's. The trajectories in a) have been expanded to show the 96% confidence limits for b) 1400 tonne, c) 1500 tonne and 1600 tonne TACC's. All average projections are based on 100 simulations. The dotted line in (a) is the biomass estimate for November 1998. Note the increase in predicted biomass in November 1999.

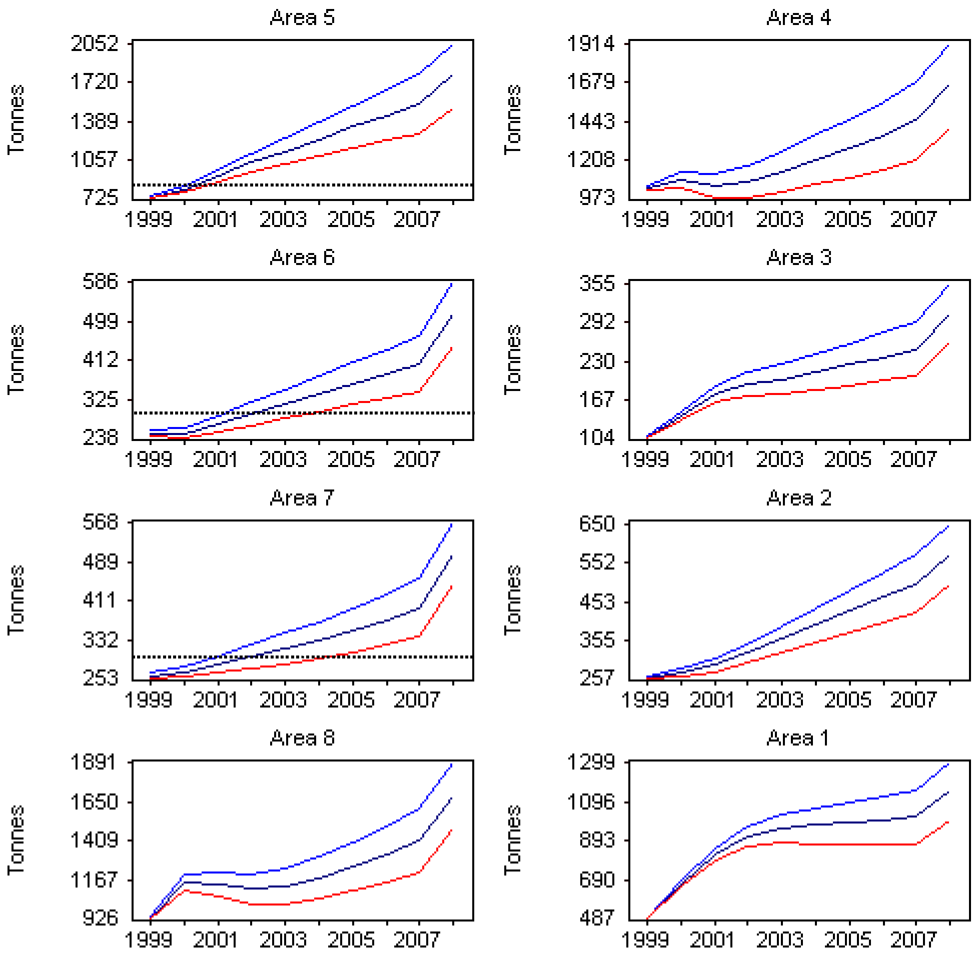

Figure 24. Averaged legal sized biomass trajectories on a per area basis. All estimates are for November and are the average of 100 simulations. In each plot, the upper trajectory is for a TACC of 1400 tonnes, the middle is for 1500 tonnes, and the lower is for 1600 tonnes. Sharp increases in the final year (2008) are an artefact of the simulation process and should be discounted. Dashed horizontal lines represent the biomass in 1997 and assist in interpreting Figure 25; no lines are shown where biomass estimates for 1999 exceed those of 1997 (which results in a 0 probability of the biomass not reaching the 1997 level in Figure 25).

An objective of the current management plan is that 'biomass levels are increased over time to a level required for producing the maximum yield from the fishery'. To evaluate if biomass trends are meeting this objective, November 1997, the year prior to quota implementation, is the reference point for the term of this Management Plan. Thus a less than 50% probability of decline in biomass by 2000, the last year of the current management plan, would approach the management objective.

All TACC scenarios meet the management objective - the probability of decline in biomass in 2000 to below that of 1997 is estimated to be zero. The three problems in applying these projection scenarios listed above also apply to the estimates of probability - clearly biomass could decline below that of 1997 if recruitment was exceptionally low so the zero probability estimate is not inviolable. The main conclusion from these estimates of probability is that given typical recruitment over the next few years, a decline in legal size biomass to that estimated in 1997 is unlikely. This is mainly a function of the increase in the estimate of legal sized biomass after the first year of QMS.

On a regional basis, biomass increases are predicted in all areas under all TACC scenarios (1400, 1500 and 1600 tonnes; Figure 24). However, there is an initially high probability of decline in legal size biomass in areas 5, 6 and 7 due to predicted fall in biomass from 1997 to 1999 in these areas (Figure 25). The projections indicate that this fall will be reversed in the future, but the probability for lower legal size biomass remains high nonetheless. As would be expected, recovery of legal sized biomass is most rapid under the scenario with smallest harvest (1400 tonnes TACC; Figure 25).

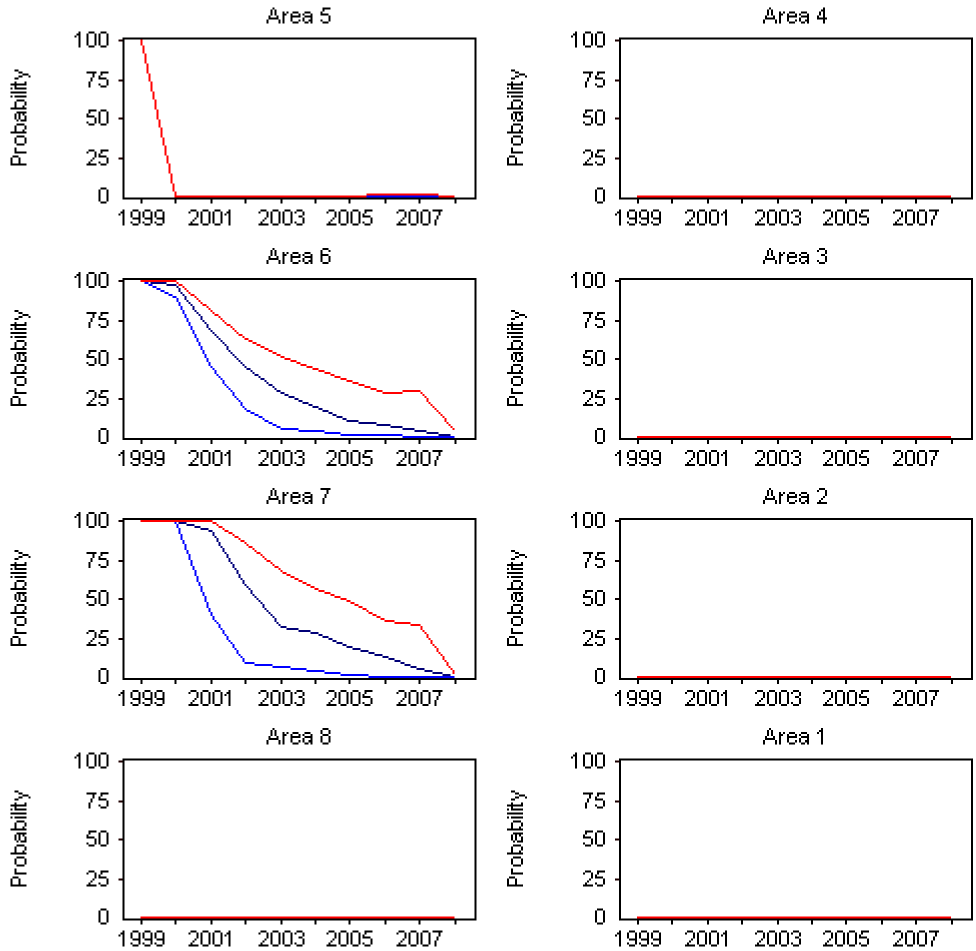

Figure 25. Probability of legal sized biomass not attaining the 1997 level (0 is preferred). Biomass estimates are for November and probabilities are based on 100 simulations. Upper trajectories are for TACCs of 1600 tonnes, the middle are for TACCs of 1500 tonnes, and the lower are for TACCs of 1400 tonnes.

8.4.2 Egg Production

Projections of statewide egg production indicate that egg production is likely to increase under current management (Figure 26). Total statewide egg production is currently around 28% of virgin (Table 9) which is high relative to most rock lobster fisheries so this increasing trend only strengthens egg production. While statewide egg production is high, it is concentrated in southern areas with northern areas at relatively low levels of virgin egg production (Table 9).

Recent research on the larval dispersal of rock lobsters around Tasmania has compared drift patterns of drogues over the periods of larval duration determined from plankton samples (Pers. comm. B. Bruce, CSIRO). This has indicated that egg production in North Eastern Tasmania may influence recruitment back to the same region. This supports the concerns of Frusher (1997a) who stated that a target of at least 25% of virgin egg production should be maintained in each region[8].

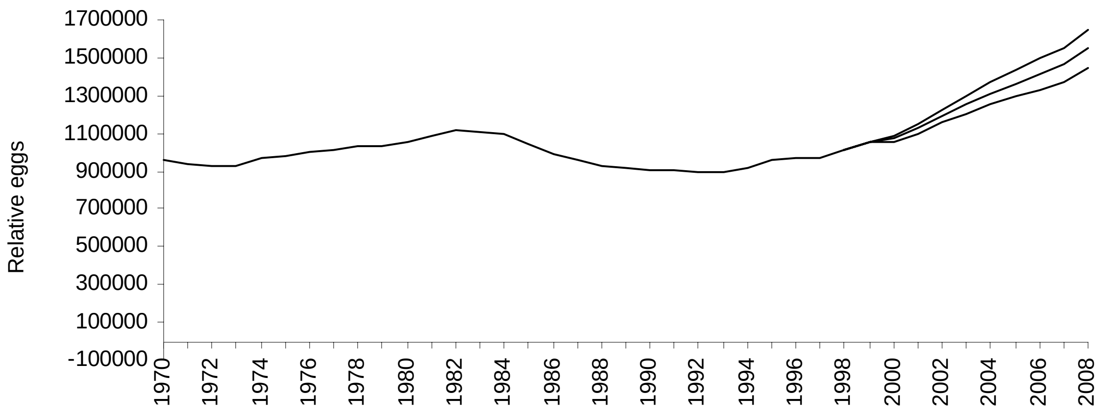

Figure 26. Averaged relative egg production under 3 TAC scenarios: 1400 tonnes (upper); 1500 tonnes (middle); and 1600 tonnes (lower). All trajectories are the average of 100 simulations.

Although egg production is eventually expected to increase in all northern regions at the current TACC (Figure 27), egg production will still be below the recommended level until the year 2005 in all areas. Also, egg production in area 6 is expected to be in decline relative to 1998 until the year 2003. The risk associated with these estimates is summarised in Figure 28, Figure 29, Figure 30 and Figure 31.

[8] Although it appears possible that larvae can return to the same region from where they were released, the extent to which greater larval supply results in increased biomass available for exploitation is unknown.

The forward projections of legal sized biomass estimates indicate that under the current 1500 tonne TACC there is a high probability that biomass will increase. With an increased biomass there is the potential to increase the TACC. While this indicates that the QMS will be effective at rebuilding biomass, it is less effective at rebuilding egg production in the north of the state. An increase in the TACC to gain economic benefit from the raised biomass will further dampen recovery of egg production in the north (1600 tonne scenario: Figure 28, Figure 29, Figure 30 and Figure 31). To either meet the recommended level of egg production in the short term, or to raise the TACC, additional measures to increase egg production need to be implemented in northern regions of Tasmania. These need not be at the expense of the TACC - the objective should be to shift effort southwards, rather than remove it.

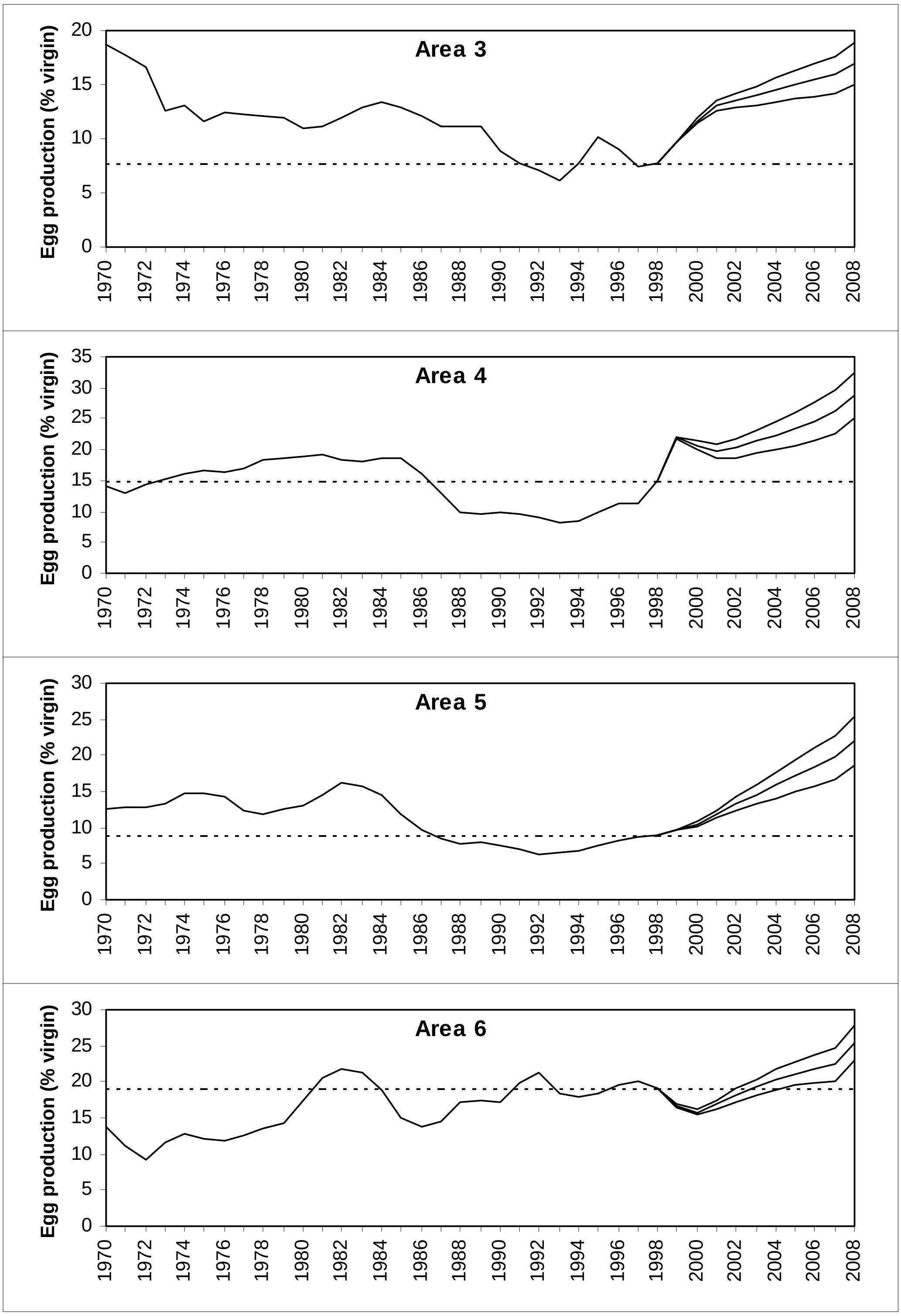

Figure 27. Historical egg production and average trajectories under 3 TACC scenarios for northern regions (1400 tonnes- upper trajectory; 1500 tonnes - middle trajectory; 1600 tonnes - lower trajectory). Each trajectory is the average of 100 simulations. The dashed line represents egg production in 1998. These projections were based on a model fit up to March 1999 so the simulations only span a period of one month in projecting egg production in 1999. For this reason, data points for 1999 display little variation between TACC scenarios and do not follow smooth trends with trajectories further in the future.

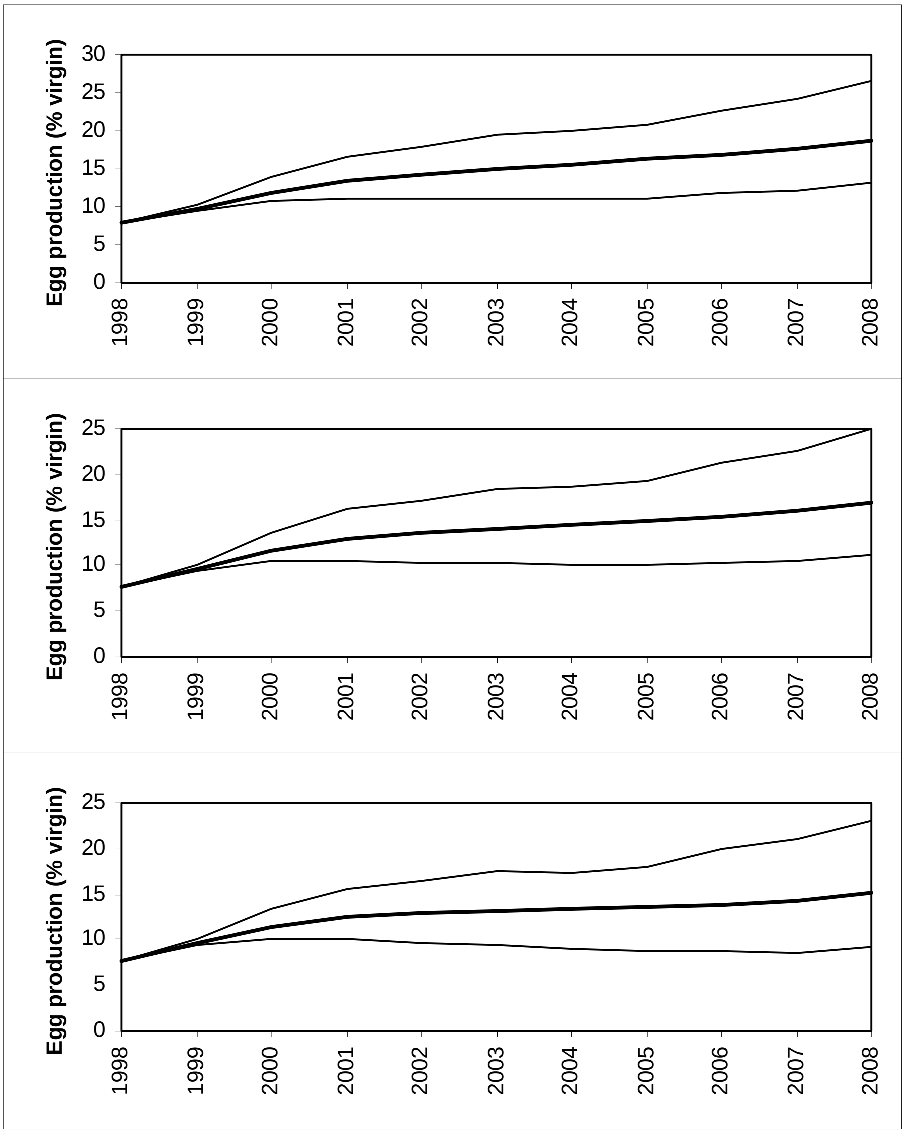

Figure 28. Projections of egg production as a percentage of virgin for **Area 3** under three TACC scenarios: 1400 tonnes (upper); 1500 tonnes (mid); and 1600 tonnes (lower). These plots are essentially the same as those shown in Figure 27 but are restricted to the period 1998-2008 and with 96% confidence limits shown.

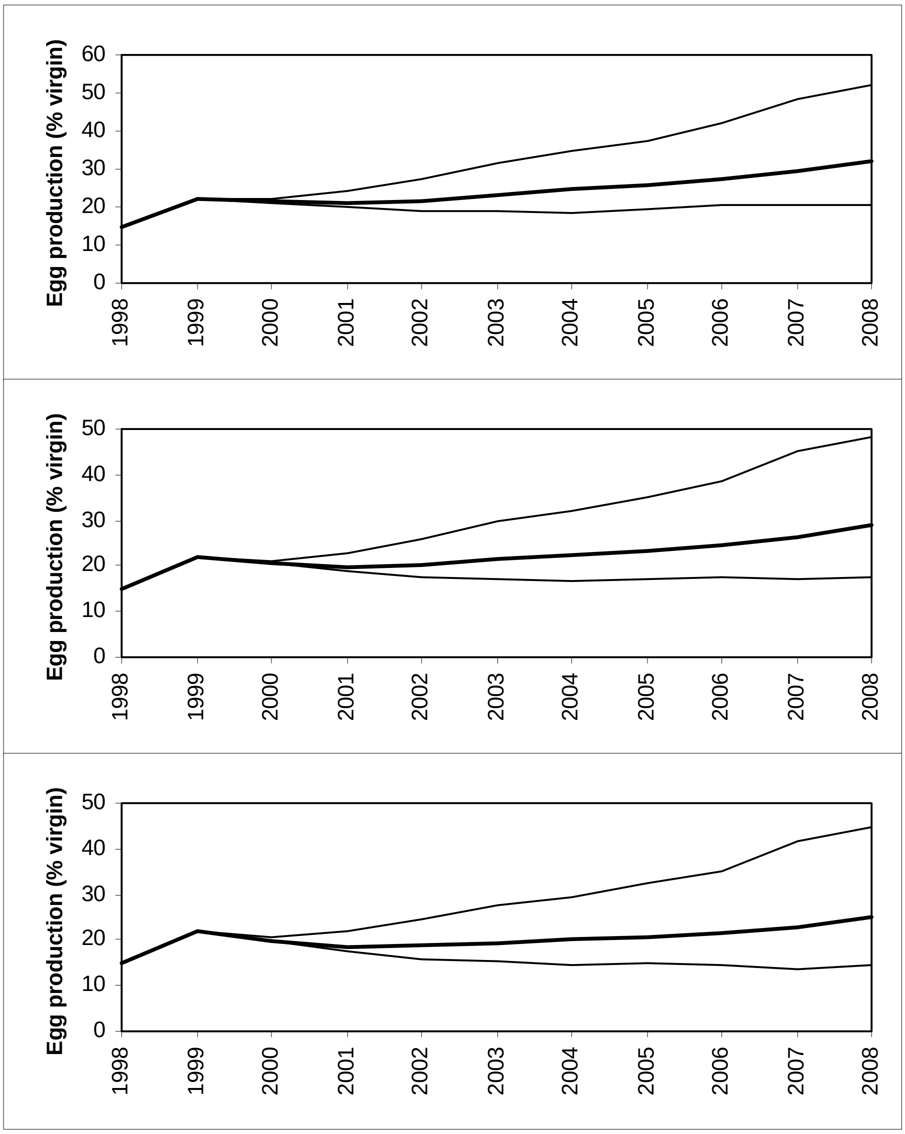

Figure 29. Projections of egg production as a percentage of virgin for **Area 4** under three TACC scenarios: 1400 tonnes (upper); 1500 tonnes (mid); and 1600 tonnes (lower). These plots are essentially the same as those shown in Figure 27 but are restricted to the period 1998-2008 and with 96% confidence limits shown.

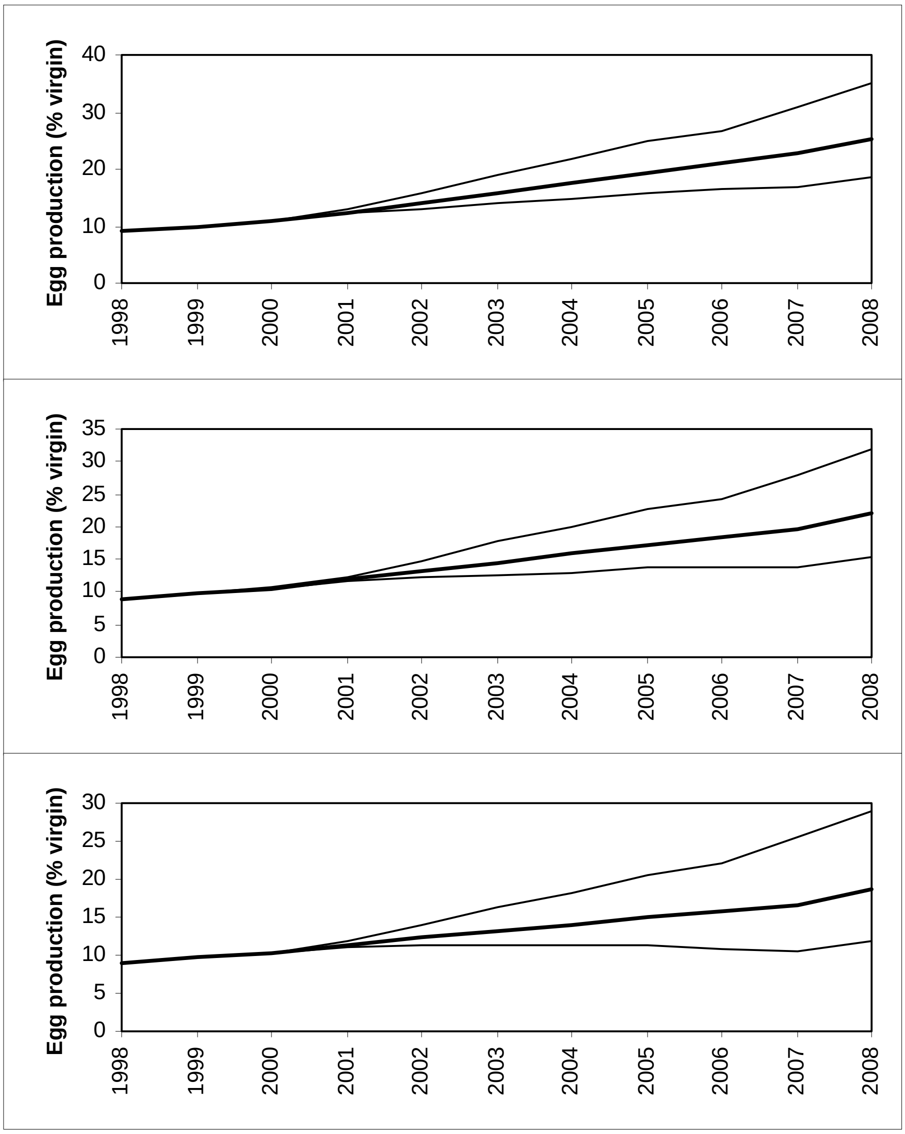

Figure 30. Projections of egg production as a percentage of virgin for **Area 5** under three TACC scenarios: 1400 tonnes (upper); 1500 tonnes (mid); and 1600 tonnes (lower). These plots are essentially the same as those shown in Figure 27 but are restricted to the period 1998-2008 and with 96% confidence limits shown.

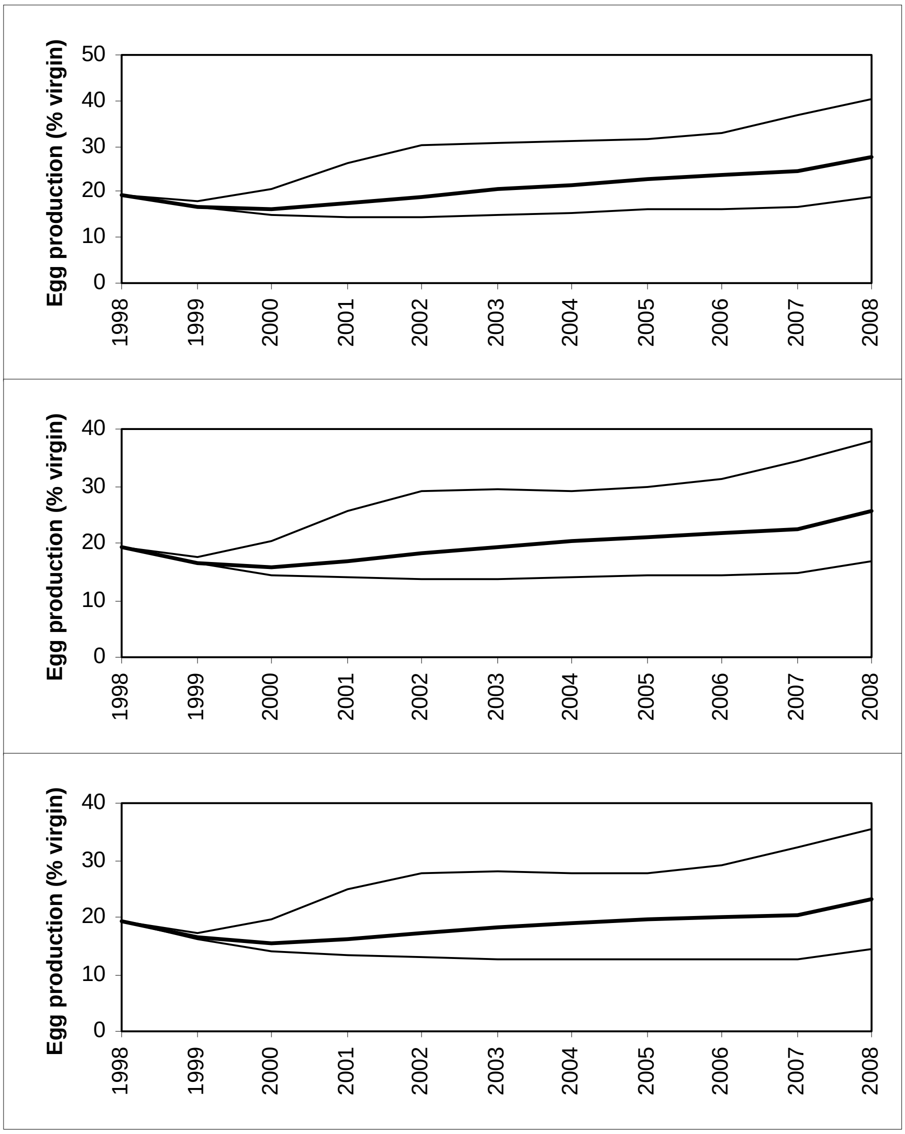

Figure 31. Projections of egg production as a percentage of virgin for **Area 6** under three TACC scenarios: 1400 tonnes (upper); 1500 tonnes (mid); and 1600 tonnes (lower). These plots are essentially the same as those shown in Figure 27 but are restricted to the period 1998-2008 and with 96% confidence limits shown.

9. Industry Issues

9.1 Alternative management strategy evaluation

Indications of stock rebuilding under the quota management has prompted industry to question the need for some of the current management restrictions. They were specifically interested in i) the removal of input controls of seasonal closures (while retaining restrictions on harvest of berried females) and ii) restrictions on pot numbers.

Industry acknowledged that removal of these restrictions may affect population dynamics of the resource and requested that the effects of these changes be modelled if possible. Impacts they felt should be considered were the effects of 12 month open season on sex ratios and discard mortality. The possible effect of effort shift towards the east coast was of concern if there was an increase in the maximum number of pots permitted. The aim of both of these potential management changes is to allow fishers to concentrate their effort during the period of the year when prices are highest (see Figure 5, page 16). Ideally, this would lead to increased economic yield from the resource with no impact on the standing stock.

9.2 Rock lobster aquaculture

The commercial fishing industry noted their concern about the management issue of extraction of puerulus for marine farming. This concern has been discussed at management forums, most notably the Crustacean Fishery Advisory Committee (CFAC). In relation to the stock assessment report, it was noted that areas 3, 4 and 5 (Table 9, page 31) had egg production lower than 25% and were thus vulnerable to further reduction in egg production is reseeding failed. Areas 3 and 4 are on the east coast where more sheltered conditions would favour puerulus collection so these areas were considered especially vulnerable.

9.3 Recreational fishing

The commercial fishing industry expressed concerns about the management of the recreational fishery in relation to the new survey data presented in Table 11 and Table 12 (page 37). Key issues were:

- recreational fishing is uncapped which is counter-productive to the stock rebuilding strategy adopted for the current management plan;

- the recreational trigger point stipulated in the management plan is approximately double of the current catch which emphasises the lack of restriction of catch from this sector;

- whilst recreational catch is minor relative to the commercial fishery on a statewide basis (~5%), it is regionally important on the east coast (areas 1,2 and 3) with over 50% of the catch from shallow waters being taken by recreationals. Egg production in area 3 is the lowest in the state (relative to virgin) so this is off concern given the attempts of the commercial fishery to rebuild egg production in this region (Table 9, page 31).

- Section 8.1.10 (page 36) of the stock assessment report assumes that most recreational effort is directed towards shallower water areas due to constraints on diving and hauling pots by hand. Industry representatives consider that this pattern is gradually changing as more recreational boats are fitted with pot haulers and depth sounders. Recreational fishers are thus able to move to deeper grounds which were previously unexploited by this uncapped sector. Their seasonal patterns of effort also changing and becoming more sophisticated. For instance, recreational potting effort early in the season is increasing directed towards off-shore reef.

- Industry considered monitoring of recreational catch to be an important component of the stock assessment process and support the establishment a continued monitoring program.

9.4 Northern egg production

Egg production in the north of the state has been of concern for many years although this appears to have recovered to some extent in the current assessment due to large recruitment into area 4. In previous assessments (T.A.F.I., 1999) industry reported observations of sub-populations of large females that did not appear to be included in research surveys. This has been partially addressed by extended sampling in area 5 (by W.J. Ramsden, AMC) although the recommendation of splitting the model into separate depth classes has not been undertaken.

10. Uncertainties

The rock lobster assessment model is based on a variety of data sources and provides very good fits to the historical data (Frusher, 1997a; Punt and Kennedy, 1997). However, in undertaking forward projections, the model can only assume that what has happened in the past will occur in the future. Thus if there is a change in lobster behaviour (eg. catchability, recruitment) which is caused by biological and or physical events (eg. improved growth from either elevated water temperatures or improved food availability), then these can not be predicted by the model.

A special case is the fleet dynamics model that is built into the assessment model. The fleet dynamics model predicts changes in fishing patterns based on the area, month and biomass level. (Kennedy, 1998). With change to an output controlled fishery based on ITQ’s, fishers will no longer be maximising their profits by maximising catch. As the fishers catch is fixed, profit maximisation is derived by maximising the unit price of the lobsters. In the Tasmanian rock lobster fishery, there is considerable potential for changing fishing patterns to improve economic return. This opportunity exists in price differences between seasons and also different prices for different size grades. Premium lobsters in the size range of 0.8 to 2kg have obtained prices of up to $10 per kg greater than lobster on either side of this range. Lobsters in the premium size range are fewer in southern regions of Tasmania.

As changes in fishing patterns (effort) are likely to change under the ITQ management system, two important impacts on future assessments need to be determined. Firstly, to maintain continuity between previous effort and CPUE trends, effort data obtained after ITQ implementation will need to be standardised against pre-ITQ implementation. Secondly, forward projections will need to incorporate a fleet dynamics model which describes fishers behaviour as they maximise unit price rather than total catch.

11. Implications for Management

The risk assessments show a high probability that the current TACC of 1500 tonnes will continue rebuilding of the biomass. However, egg production in the north of the state needs additional management measures.

Caution needs to be exercised in using the forward projections as the change to an ITQ management system may change the dynamics of the fishery. This is currently under investigation through an FRDC on the implications of change to ITQ management.

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