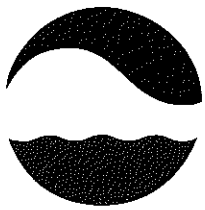
FISHERY ASSESSMENT REPORT

TASMANIAN ROCK LOBSTER FISHERY 1998

Compiled by S. D. Frusher and C. Gardner

March 1999



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This assessment of the rock lobster resource is the first 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 rock lobster fishery policy document (Anon,1997).

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Rock Lobster Fishery Assessment:1998

Summary

This report provides an assessment of the rock lobster stock to February 1998, prior to the introduction of quota. That the assessment found mixed results is not surprising as the fishery has significant different biological characteristics on a regional scale.

While the report found that none of the trigger points listed in the rock lobster fishery policy document (Anon, 1997) had been reached, there is concern about trends in several regions.

Both CPUE and biomass trends have shown declines in southern regions in recent years after a period of favourable recruitment to legal size in 1995/96. CPUE has also declined in some regions of the east coast.

Egg production is still a concern in the north of Tasmania and measures in addition to quota will need to be introduced if egg production is to improve to recommended levels. These measures would need to be implemented if predicted improvements in yield are to be harvested in the future years (ie. beyond the current Management Plan).

Of the three long term harvest scenarios tested in this report (1400, 1500 and 1600 tonne TACC's), only the 1400 and 1500 tonnes TACC predicted biomass building, particularly within the period of the current Management Plan which finishes in February 2001.

With a change to individual transferable quota (ITQ) management in March 1998, there is concern that fishers behaviour will change and that this will alter the 'meaning' of effort. With a fixed catch, individual effort will be directed from maximising catch (kilograms per year) to maximising return per unit of catch (dollars per kilogram). Trends in catch and effort data will therefore need to be interpreted carefully. Change in effort may not only bias comparisons of future and past trends, but may also alter the dynamics of the fishing fleet (where and when they fish). As the fleet dynamics is an important component of the risk assessment undertaken by the rock lobster assessment model, future predictions will need to take into account any changes in effort. This is a high priority for research.

Table of Contents

SUMMARY I

1. LIST OF MANAGEMENT OBJECTIVES AND STRATEGIES 1

1.1 MAINTAINING BIOMASS AND FISH RECRUITMENT 1
1.1.1 Policy objectives 1
1.1.2 Strategies 1
1.2 SUSTAINING YIELD AND REDUCING INCIDENTAL FISHING MORTALITY 1
1.2.1 Policy objectives 1
1.2.2 Strategies 2
1.3 MANAGING COMMERCIAL FISHING INTERACTIONS 2
1.3.1 Policy objective 2
1.3.2 Strategies 2
1.4 ENSURING ACCESS TO FISH STOCKS BY RECREATIONAL FISHERS 2
1.4.1 Policy objective 2
1.4.2 Strategies 2
1.5 PROVIDING MARINE FARMING OPPORTUNITIES FOR ROCK LOBSTER 3
1.5.1 Policy objective 3
1.5.2 Strategies 3
1.6 PROVIDING SOCIO-ECONOMIC BENEFITS TO THE COMMUNITY 3
1.6.1 Policy objective 3
1.6.2 Strategies 3
1.7 ACCOUNTING FOR ENVIRONMENTAL INTERACTIONS 4
1.7.1 Policy objective 4
1.7.2 Strategies 4
1.8 PROVIDING HIGH QUALITY PRODUCE 4
1.8.1 Policy objective 4
1.8.2 Strategies 4

2. LIST OF PERFORMANCE INDICATORS AND TRIGGER POINT STRATEGIES 4

2.1 PERFORMANCE INDICATORS 4
2.1.1 Catch per unit effort (CPUE) 5
2.1.2 Biomass 5
2.1.3 Egg production 5
2.1.4 Relative abundance of undersized lobster 5
2.1.5 The total annual commercial catch (TACC) 6
2.1.6 The size of the rock lobster fleet 6
2.1.7 The recreational catch 6
2.2 TRIGGER POINTS 6
2.2.1 Catch per unit effort (CPUE) 6
2.2.2 Biomass 7
2.2.3 Egg Production 7
2.2.4 Relative abundance of undersized lobster 7
2.2.5 The total annual catch 8
2.2.6 The size of the rock lobster fleet 8
2.2.7 The recreational catch 8

3. GENERAL INTRODUCTION 8

4. FISHERY DESCRIPTION 10

4.1 COMMERCIAL ROCK LOBSTER FISHERY 10
4.1.1 Fishing methods 10

4.1.2 Catching sector 11
4.1.3 Ownership of the licences 11
4.1.4 The structure of the rock lobster fishing fleet 13
4.2 PROCESSING SECTOR 14
4.2.1 Level of activity of processors 14
4.2.2 The beach price of rock lobster 15
4.2.3 Markets 15
4.3 RECREATIONAL SECTOR 16

5. BIOLOGY OF THE SOUTHERN ROCK LOBSTER 16

5.1 REPRODUCTION 16
5.2 LARVAL PERIOD 17
5.3 GROWTH 17

6. PREVIOUS ASSESSMENTS 20

7. RECENT DEVELOPMENTS 20

7.1 FISHERY 20
7.2 ASSESSMENT MODEL 20

8. FISHERY ASSESSMENT 21

8.1 EVALUATION OF TRIGGER POINTS 21
8.1.1 Catch per unit effort (CPUE) 21
8.1.2 Legal - sized biomass 23
8.1.3 Egg production 25
8.1.4 Relative abundance of undersized lobster 26
8.1.5 The total annual catch 30
8.1.6 The size of the rock lobster fleet 30
8.1.7 The recreational catch 30
8.2 TRENDS IN COMMERCIAL CATCH, EFFORT AND CATCH RATE DATA 30
8.3 INFORMATION ON RECREATIONAL CATCH AND/OR EFFORT 32
8.4 TRENDS IN ABUNDANCE INDICES 33
8.4.1 East coast - shallow 33
8.4.2 East coast - medium 34
8.4.3 South coast - medium to deep 35
8.5 OTHER ANALYSES INCLUDING RISK ASSESSMENTS 36
8.5.1 Biomass 36
8.5.2 Egg Production 38

9. INDUSTRY ISSUES 40

9.1 RECREATIONAL CATCH 40
9.2 SCALE OF ASSESSMENTS 41

10. UNCERTAINTIES 41

11. IMPLICATIONS FOR MANAGEMENT 42

12. RECOMMENDATIONS FOR FUTURE ASSESSMENTS 42

REFERENCES 43

1. List of Management Objectives and Strategies

There are eight policy objectives and associated strategies in the rock lobster fishery policy document (Anon, 1997). They are:

1.1 Maintaining Biomass and Fish Recruitment

1.1.1 Policy objectives

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.

1.1.2 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 containing 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.

1.2 Sustaining yield and reducing incidental fishing mortality

1.2.1 Policy objectives

- 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.

1.2.2 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.
- Limiting the duration that rock lobster pots can be set to reduce incidental mortality
- 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

1.3.1 Policy objective

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

1.3.2 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

1.4.1 Policy objective

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

1.4.2 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

1.5.1 Policy objective

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

1.5.2 Strategies

- Ensure that any harvest of puerulus is matched by a compensatory reduction in the commercial catch by way of purchase or lease of quota.
- Develop appropriate conversion ratios between puerulus and kilograms of quota
- 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 to 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.

1.6 Providing socio-economic benefits to the community

1.6.1 Policy objective

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.

1.6.2 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.

1.7.1 Policy objective

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.

1.7.2 Strategies

- Establish marine protected areas for the protection of valuable coastal habitats and to maintain biodiversity.

- Require rock lobster post to be fitted with escape gaps.

1.8 Providing high quality produce

1.8.1 Policy objective

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

1.8.2 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.

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 is a measure of the catch rate and is also 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 separate 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.

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 (ie state-wide) 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 (TACC)

The total annual commercial catch may fall below the TACC for a number of reasons, which 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 state-wide 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. External factors like beach prices also need to be taken into account.

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 Biomass

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

The 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.

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} and 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 fall 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.

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. If this occurs, there will be a review of the recreational management arrangements.

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.

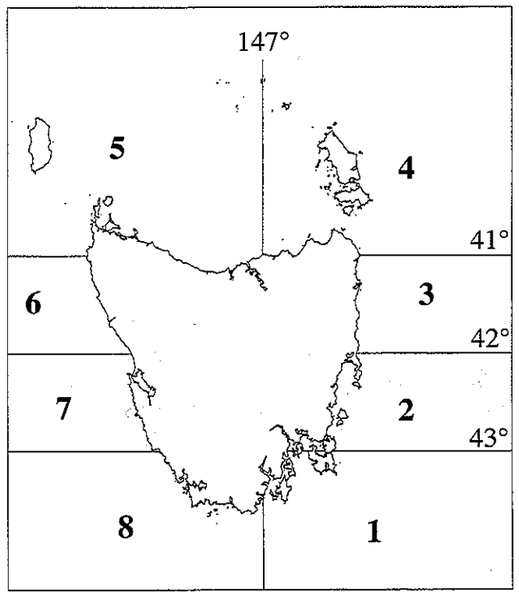
In the 1950's licences for commercial fishers (pots allocated according to vessel size with a maximum pot holding) were restricted to participants principally dependent on the sale of rock lobster for a livelihood. At the same time, recreational fishers were restricted to use of a single pot. In 1967 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 concenus 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 fishing recreationally for rock lobster (often referred to as crayfish) and many Tasmanians associate summer holidays with recreationally caught lobster. 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	7.0
2	5.2
3	5.0
4	13.2
5	22.7
6	14.4
7	9.4
8	23.1

Fig. 1. Location of the eight regions used in this report and their percentage contribution to the 1997/98 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 below 125m (Figure 2). With the exception of area 6 where almost 50% of the catch comes from waters deeper than 62m, over 80% of the catch comes from waters less than 62m. In most regions the bulk of the catch comes from waters between 18 and 61 metres although shallower water catches comprise a greater percentage in southern Tasmania.

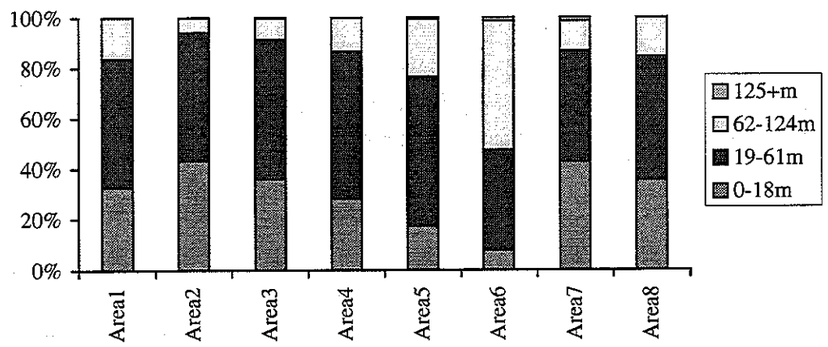


Fig. 2. Regional depth distribution of catch from March 1997 to February 1998.

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 (refer 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 during the day. 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. The pots are required to have escape gaps to allow undersized rock lobster to escape.

Commercial pots are hauled by a hydraulic hauler. After the lobster have been removed and measured, 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 ranging in size from 8-26 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 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 40 pots. In March 1998, at the commencement of the initial quota year, fishers were allowed to upgrade their pot allocations by 25%. To upgrade fishers had to purchase pots from the existing pool of pots. A total of 10,507 pots are distributed throughout the fleet. 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 from a low of $15,000 to more than $750,000. Licences vary in price according to the types of fishing licences included in the licence package.

Most vessels are fitted with wet wells and lobsters are landed live and generally purchased by the processor at the wharf. Lobsters are processed and marketed in a variety of ways (eg. live, frozen tails, fresh cooked).

4.1.3 Ownership of the 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 January 1997, 84% of the 321 licences were held by Tasmanian owners. The break down of licence ownership is summarised in Table 1.

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

Licence holder group	Number of licences	Percentage
Tasmanian individuals	230	71.6%
Tasmanian companies	39	12.1%
Interstate individuals	32	10.0%
Interstate companies	20	6.2%

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 and lease holders. In January 1997, 188 licences were operated by the owner or by the nominated person if the holder was a company or partnership. 21 licences were operated by a family member of the owner, usually a son, brother, or husband. Currently there are 112 licences that are leased or operated by someone other than the owner or the owner's family. The break down of the operators is shown in table 2.

Table 2. The break down of how rock lobster licences are operated, as at January 1997.

Licence holder group	Number of licences	Percentage
Tasmanian owner operators	166	51.7
Tasmanian family operators	20	6.2
Tasmanian owned, leased licences	83	25.9
Interstate owner operators	22	6.9
Interstate family operators	1	0.3
Interstate owned, leased licences	29	9.0

The above two Tables indicate that 69% of the Tasmanian owned licences are either owner operated or run by family members while only 40% of mainland owned licences are either owner operator or run by family members.

Table 3 shows that the most licences are owned in the Hobart region. 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, as at January 1997.

Region where the owner lives	Number of licences	Region where the owner lives	Number of licences
Hobart Region	47	Flinders Island	10
St Helens	29	Strahan	9
Channel Region	27	Tasman Peninsula	9
King Island	25	South Australia	9
Bicheno	20	North West Coast	6
Smithton	19	Outer Hobart	6
Launceston Region	17	Port Lincoln (Sa)	5
Triabunna Region	17	Lakes Entrance (Vic)	4
Portland (Vic)	13	Queensland	4
Victoria	13	Stanley	4
Dover Region	12	Nsw	3
North East Coast	12	Western Australia	1

4.1.4 The structure of the rock lobster fishing fleet

In 1997, approximately one third of the fleet or 112 licence holders had an entitlement to use 40 pots and 34 licence holders had a 27 pot entitlement. The remainder of the fleet were distributed between 15 and 40 pot entitlements (Figure 3).

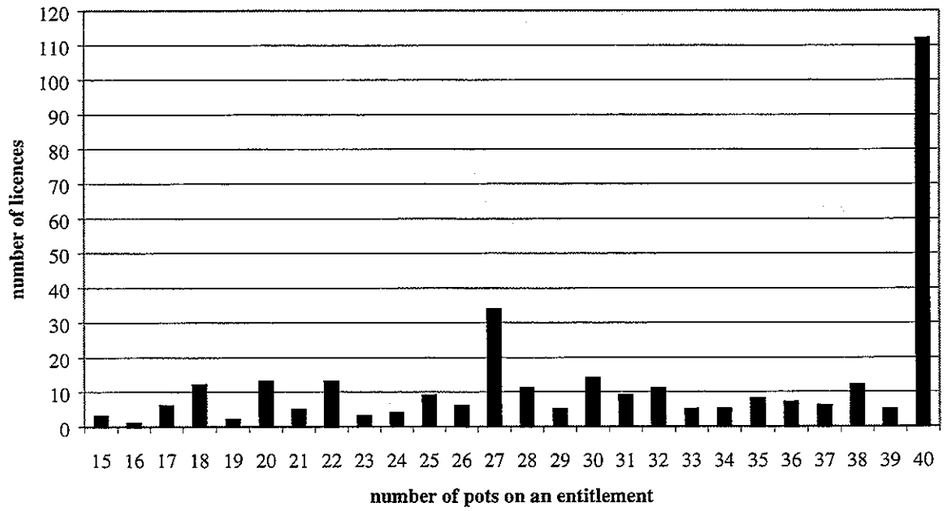


Fig. 3. The distribution of the number of pots on rock lobster licences, as at January 1997.

The size of vessels in the fleet ranges from 8 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 (Figure 4).

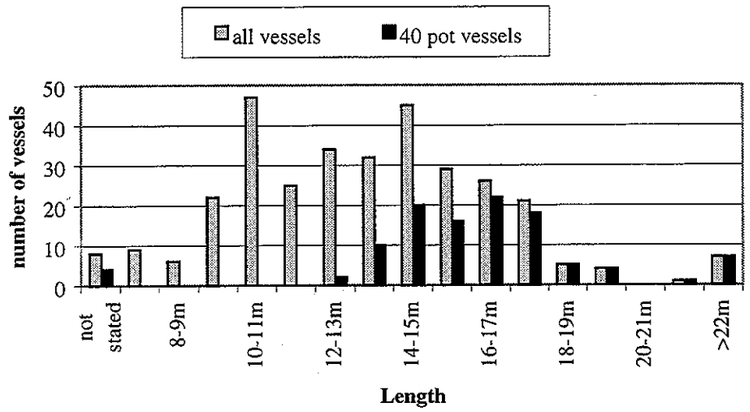


Fig. 4. The distribution of the fishing vessels by length, and pot endorsement as at January 1997.

4.2 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 was sold either directly to the public, to retail outlets (which are not required to be licensed), or directly to interstate buyers. Lobsters landed outside Tasmania in interstate ports are also included the 27%. In the last seven years licensed processors have typically purchased between 70 and 80% of the landed catch.

4.2.1 Level of activity of processors

Of the 60 licensed rock lobster processors in 1996, only 37 reported processing any 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 - 1996.

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

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
Fish processors in Tasmania.	69.6	72.6	74.1
Export by fisher (either on a vessel or directly)	23.1	19.4	20.3
Restaurants in Tasmania	0.3	0.3	0.1
Private consumption or cash sales	0.7	0.5	0.0
Fish punt or food retailer in Tasmania	0.7	1.2	0.6
Not specified	5.6	6.0	4.9

4.2.2 The beach price of rock lobster

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

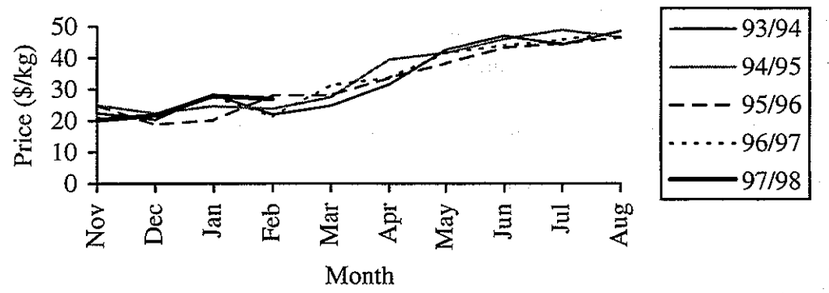


Fig. 5. Average monthly beach price of lobster from November 1993 to February 1998.

4.2.3 Markets

It is difficult to obtain accurate data on the ultimate destination of much of Tasmania's lobster production. The catches may be landed directly 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 remaining 54% is sold interstate, where it is sold on the domestic market or held interstate prior to being exported.

4.3 Recreational Sector

Rock lobsters are mainly caught by recreational fishers using pots and rings baited with fish, or taken by diving on reefs. Divers can use SCUBA and surface air supply in addition to snorkel.

A recreational fishing licence is required for rock lobster diving, potting and ringing. The recreational rock lobster potting licence entitles the user to fish with one pot only and a recreational ringing licence entitles the operator to use a maximum of up to 4 rings daily. Rock Lobster ring licences were introduced for the first time for the 1998/99 licensing year.

The recreational rock lobster licences entitle the owner to a daily catch limit of 5 legal sized lobsters per day with a possession limit of 10. The size limits and seasons for the recreational fishery are the same as for the commercial fishery with the exception that the recreational fishery does not close from the 23 February to the 28th February. A summary of the regulations are given in Rock Lobster Fishery Policy Document (Anon, 1997).

The most comprehensive study of the recreational rock lobster fishery commenced in 1996 and a summary of the initial findings are presented in Lyle and Smith, 1997. This study found that approximately 64% of the recreational catch was taken by potting and 31% by diving. The remaining 5% were caught by netting. In 1996 cray rings did not require a licence and thus are underestimated in this survey. In a preliminary analysis, 81% of the potting catch came from the east coast from South East Cape to Eddystone Point. In comparison, only 57% of the dive catch was attributable to this region.

A detailed analysis of the survey data for 1997 and 1998 is in progress.

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

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 ventrally on the thoracic plates 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 and the first larval stage called a naupliosoma moves to the surface layers of the sea. The nauplisoma stage only lasts for several hours before becoming the phyllosoma stage. This stage is carried away from coastal waters to the adjacent oceans where it lives for periods of up to 2 years. During the phyllosoma stage the larvae undertake 11 moults and have been recorded from depths greater than 200 metres and over a thousand kilometres from land. After the phyllosoma stage the larvae metamorphoses into the puerulus stage which swims from the ocean across the continental shelf to coastal reefs where it settles as a miniature lobster. The puerulus stage is the first time that the shape of the larvae resembles that of the adult lobster. At this stage the lobster is approximately 25mm long with a carapace length of 10-12mm. Knowledge on the distribution and behaviour of the larval stage is limited and Tasmania together with South Australia and Victoria have supported CSIRO in obtaining funding to review previously collected plankton samples. This project will hopefully give the first preliminary insight into phyllosoma distribution of southern rock lobster in Australian waters. A final report from this project is due in early 1999.

Because of the potential broad distribution of larvae, the puerulus settling stage is the first point where future levels of recruitment to regional populations can be estimated. TAFI (formerly DPIF) has been running a puerulus settlement monitoring project since 1991. While this project is still in its infancy there has been considerable variation in puerulus catch during this time. It is suggested that up to 20 years of data is required before a link between settlement and future catches from the fishery can be established (Anon, 1997b).

5.3 Growth

Rock lobsters grow by a process called moulting. Like all crustaceans, rock lobsters have an external skeleton most commonly referred to as the shell. When a lobster grows, the shell has to be shed and a new shell formed.

This 'moulting process' can briefly be described 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. When the shell is hard, the lobster expels the water and regains its former size. It is now ready to grow to the new shell size. Once the new shell has hardened the lobster leaves the refuge.

In terms of this stock assessment report, the moulting process has two important points. Firstly, during the moulting process lobsters are 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. However, once the shell has hardened at the completion of the moult, the lobster forages actively and becomes very vulnerable to being caught in pots.

Moulting is fairly 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[1] 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.

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

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 being 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.

[1] Prior to quota implementation in March 1998, the fishing season was from November to August of the following year. After quota implementation the season will be from March to February of the following year.

Lobster maturity 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 6).

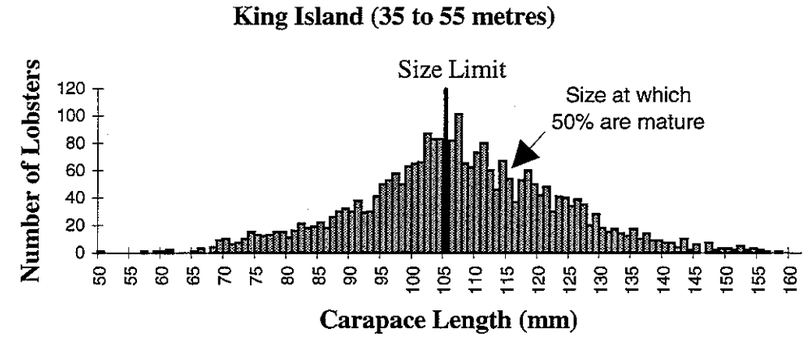


Fig. 6. Size structure and size at maturity of female lobsters caught at three locations in Tasmania on research surveys.

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). This report included a reanalysis 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 current rock lobster assessment used data available up until the 1st March 1998.

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 has undergone a number of enhancements since the previous assessments of Frusher (1997a, 1997b). These are documented by Kennedy (1998) and are listed below:

- Incorporation of information on area specific recreational catches (see Punt and Kennedy, 1997).
- Incorporation of new growth parameters including size selectivity details as estimated by Punt *et al.* (1977). Furthermore, growth parameters for Area 8 were taken from Area 1 as it was considered that tag-recapture data for Area 8 was insufficient (probably due to very slow growth rates) to adequately describe growth in Area 8. Previously Area 8 growth parameters were derived from tag-recapture data for that area. See Punt and Kennedy (1997) for a description of how growth parameters were averaged between areas to handle situations in which there was insufficient data to estimate area specific growth.
- The ability to fit the model to undersized lobsters from scientific sampling. Previously model fits were conducted only with data on legal sized lobsters. Undersized data is only available for five areas (1, 2, 4, 5 and 8). This enhancement to the model is still being trialed and is not incorporated in this report.

- The ability to fit the model to a partial year of catch data (for the last year of data). Previously, the model could only be fitted to a complete calendar year of data which limited the ability to provide up to date interim assessments.
- The ability to conduct forward projections (risk assessments) on time frames other than a calendar year. This enables assessments to be conducted for the same time scale which is used in management of the fishery. In the present case, the time scale is a "quota year" which commences in March of one year and finishes in February of the next year.

8. Fishery Assessment

8.1 Evaluation of Trigger Points

8.1.1 Catch per unit effort (CPUE)

Standardisation procedures are currently being investigated and trialed and this report does not contain standardised CPUE data. In particular, it is noteworthy that Fernandez *et al.* (1998) found that technology change (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. The actual amount by which effort could have become more efficient in the Tasmanian rock lobster fishery is unknown. Most fishers consider that technology change has improved the ability to catch lobsters. Fishing efficiency increases would act to increase CPUE and thus, in real terms, declines in CPUE since 1970 would be steeper than indicated by the above 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 the last year of available data (Figure 7).

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).

Table 6. Change in annual commercial catch rates.

Region	Reference Year	Commercial catch rates		% change
		Ref. Year	1997	
Statewide	1994	0.82	0.90	10
1	1994	0.52	0.67	29
2	1994	0.54	0.62	15
3	1994	0.44	0.53	20
4	1994	0.63	0.92	46
5	1995	0.90	1.00	11
6	1995	1.21	1.31	8
7	1994	1.11	1.16	5
8	1993	0.77	0.88	14

Monthly comparisons between the reference year and 1997 show that catch rates had improved for most months in all areas (Figure 7). The only notable exception was during May in area 8 where uncharacteristically low catch rates occurred.

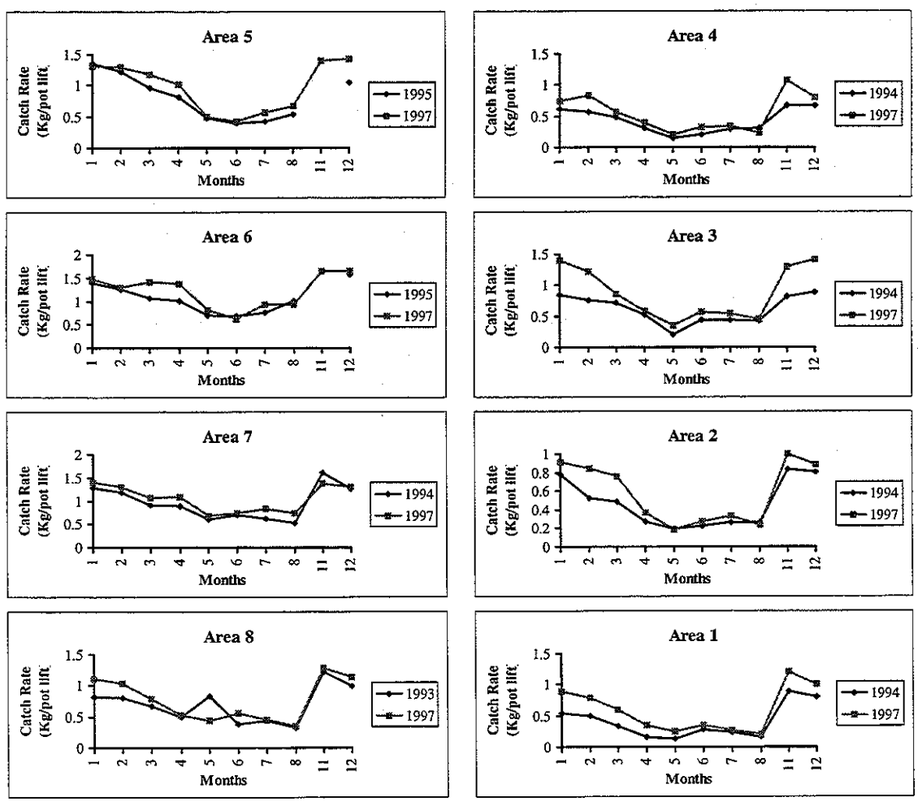


Fig. 7. Monthly catch rates of rock lobster for 1997 (grey) and the reference year in Table 6 (black) for 8 areas around Tasmania

Research catch rates

Catch rates from research surveys showed an increase from the reference year to 1997 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) in the east coast. This decline is of concern as it is reflective of the trend in catch rates since sampling commenced in November 1992 (see section on trends in catch rates).

Table 7. Change in catch rates from research surveys on the East and South Coasts of Tasmania.

Region	Depth (metres)	Reference Year	Catch Rates		% change
			Ref. Year	1997	
Area 8	45 - 100	Nov'93	1.18	1.78	51
Area 2	30 - 50	Nov'94	1.36	2.03	49
Area 2	< 30	Nov'94	1.35	0.85	-37

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.

8.1.2 Legal - sized biomass

Biomass estimates refer to the available legal sized biomass in December of each year.

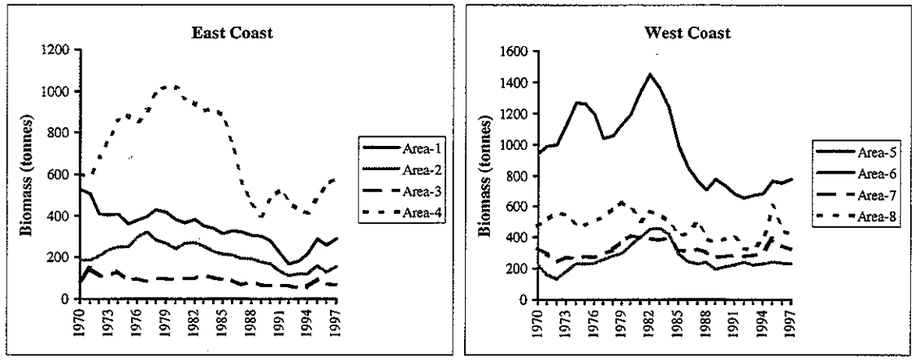
Biomass has shown an increase compared to the reference years both Statewide and for the eight individual areas (Table 8).

Table 8. Change in legal sized biomass (negative values indicate a decline in the change).

Region	Reference Year	Biomass estimate (tonnes)		% change
		Ref. Year	1997	
Statewide	1993	2284	2598	14
1	1993	180	285	58
2	1993	119	153	29
3	1993	56	67	20
4	1994	417	585	40
5	1993	671	775	15
6	1993	223	231	4
7	1993	286	326	14
8	1993	323	425	32

Trends in regional biomass estimates since 1970 are shown in Figure 8a. In most regions there has been a decline from the early eighties to 1993, the reference year for all areas except area 4 which had a further minor decline in 1994. The declines are more pronounced in northern Tasmania (areas 4 and 5).

a) 1970 to 1997



b) 1993 to 1997

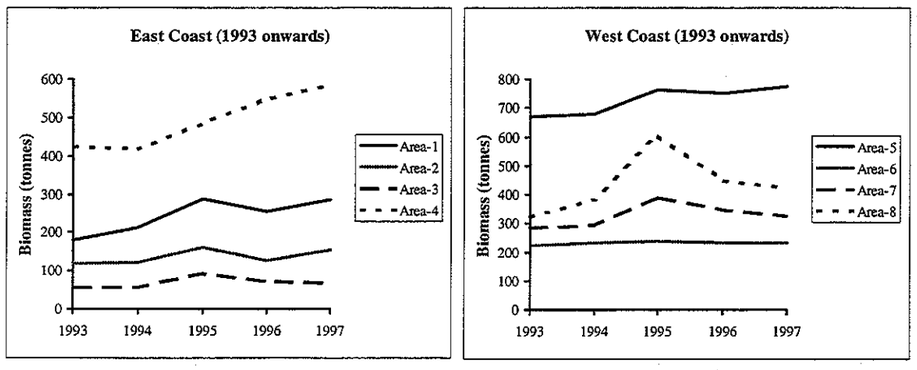


Fig. 8. Regional legal-sized biomass estimates derived from the rock lobster assessment model for the Tasmanian rock lobster fishery from a) 1970 to 1997 and b) from 1993 to 1997.

All areas have shown an improvement in legal sized biomass since the reference year (Fig. 8b). Despite improvements in the biomass in 1997 compared to 1993, there is a trend of declining biomass in areas 3, 7 and 8 since 1995 when a large recruitment pulse entered the fishery. (Frusher, 1996).

Biomass estimates from research surveys are obtained by 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) are presented in Figure 9. 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 9. There is reasonable agreement between the trends for all estimates with the exception of the 1992/93 model estimate.

In general, absolute biomass estimates from the model are lower than those from the other methods and this may be caused by the methods being used or the time periods evaluated (CIR, IR and DEP use the traditional fishing season from Nov/Dec to Aug/Sept whereas the model estimates are for March to February). However, note that trends are similar between all estimates.

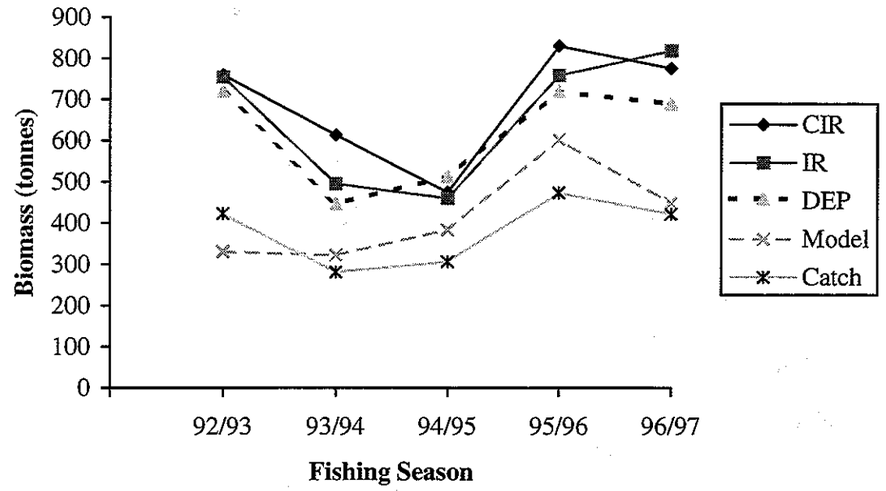


Fig. 9. Estimates of legal sized biomass in area 8 using change-in-ratio (CIR), index removal (IR), depletion (DEP) techniques and from the rock lobster assessment model (Model). The commercial catch (Catch) is also shown.

Biomass estimates from the 1996/97 fishing season from research surveys are higher than the lowest estimate which occurred in the 1994/95 fishing season. Compared to the 1994/95 estimates, biomass has increased by 35%, 64% and 78% using the DEP, CIR and IR methods respectively.

The biomass trigger point gives no cause for concern.

8.1.3 Egg production

Table 9. Change in relative egg production from the reference year to 1997, and the level of egg production in 1997 as a percentage of virgin egg production.

Region	Reference Year	Relative Egg Production		% change	% of virgin egg prod. in 1997
		Ref. Year	1997		
Statewide	1993	916	1014	11	28
1	1995	153	147	-4	64
2	1992	69	106	52	35
3	1993	19	23	19	7
4	1993	72	104	45	12
5	1992	68	92	36	9
6	1986	49	61	25	16
7	1990	127	143	13	55
8	1994	320	337	6	103

The increase in egg production above the virgin level for area 8 is currently unexplainable. This was also noted by Kennedy (1998), who concluded that further modelling work was required to sort out this problem. Due to the slow growth rate and small size at maturity of females in area 8 egg production is high and not of concern.

The only decline in egg production in relation to the reference year was from area 1, however in this area estimated egg production compared to virgin production is still high (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 10).

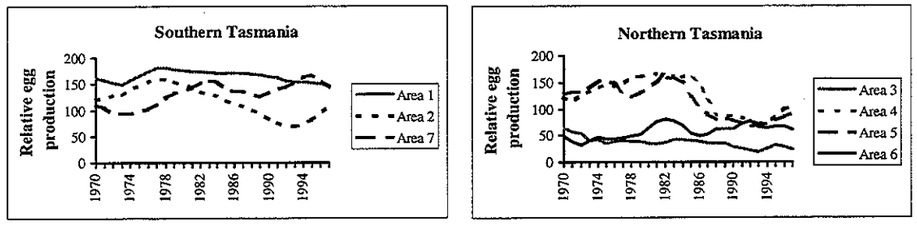


Fig. 10. Relative egg production from 7 areas around Tasmania. Area 8 is not included due to problems mentioned in the text.

Although increases in relative egg production have been achieved in the northern regions (Figure 10), they are still low compared to virgin stocks and below the recommended level of 25% (Figure 11) (Frusher, 1997a). Although areas 4 and 5 still provide reasonable numbers of eggs compared to other regions, the low percentage of egg production compared to the virgin production indicates the dominance which areas 4 and 5 would have had in contributing to overall egg supply prior to exploitation.

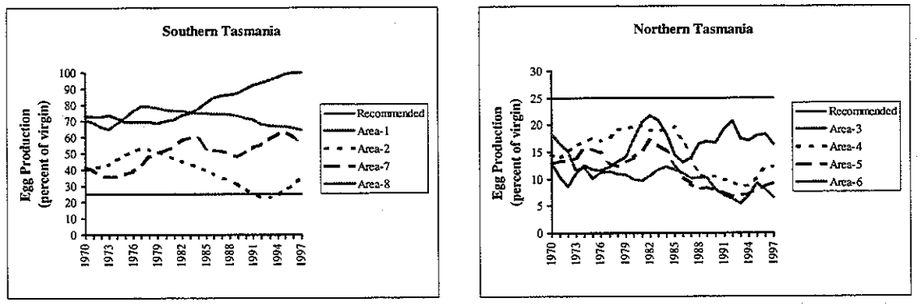


Fig. 11. Percentage of virgin egg production from 8 areas around Tasmania.

8.1.4 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 currently appears only to be the case on the south coast (see section on trends in catch rates). 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 has increased by 48% to 2.14 in 1997.

Model Estimates

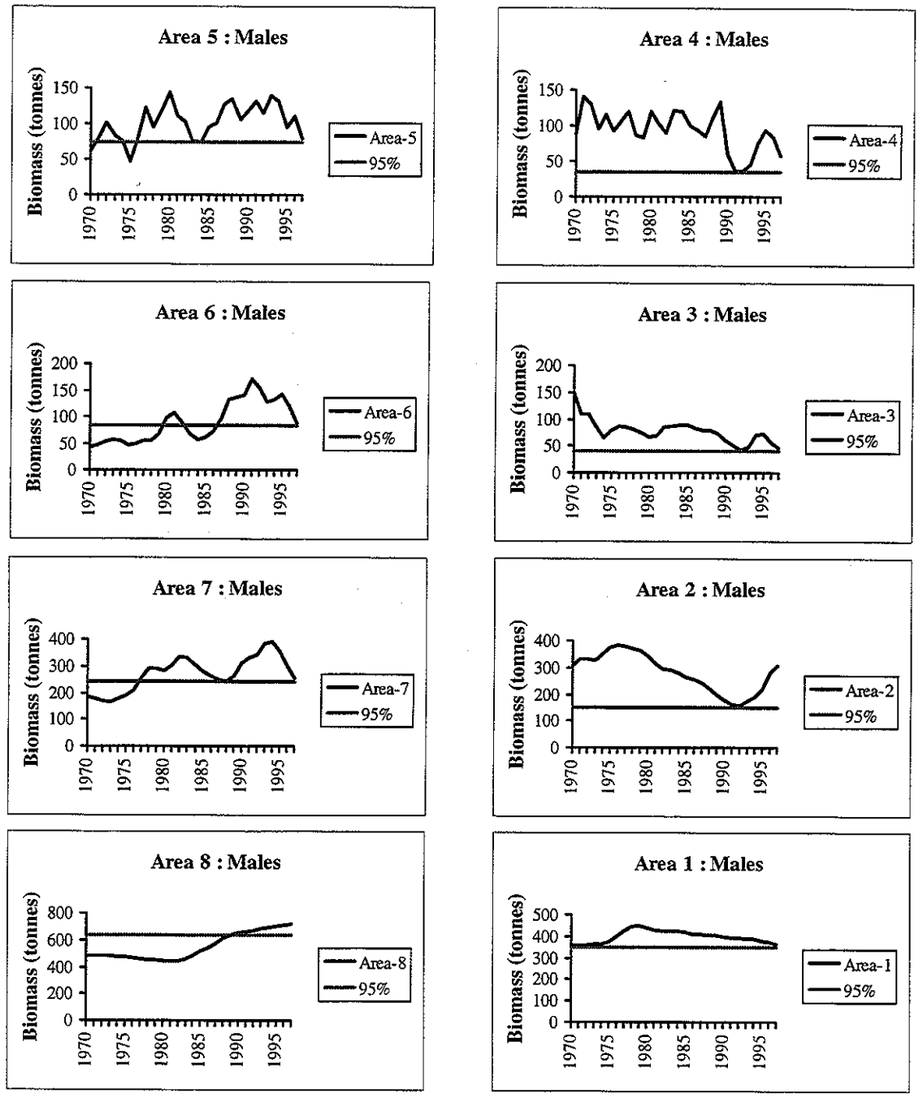
Undersized biomass estimates obtained from the model reflect undersized lobsters from 80mmCL to the legal size limit (Figure 12).

Biomass estimates are derived from catch and effort data. This data is pertinent 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 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 figures for area 8. Interpretation of trends in this area need to be treated with caution.

In areas 3 to 7 undersized biomass has declined for both sexes in recent years and, if recent trends continue, undersized biomass is likely to be less than 95% of the reference years in most of these areas (3, 5, 6 and 7). Although undersized biomass is not a trigger, these trends need to be monitored against regional undersized and sized CPUE data.

a) Undersized biomass estimates of male lobsters from 80mmCL to 110mmCL.



b) Undersized biomass estimates of female lobsters from 80mmCL to 110mmCL

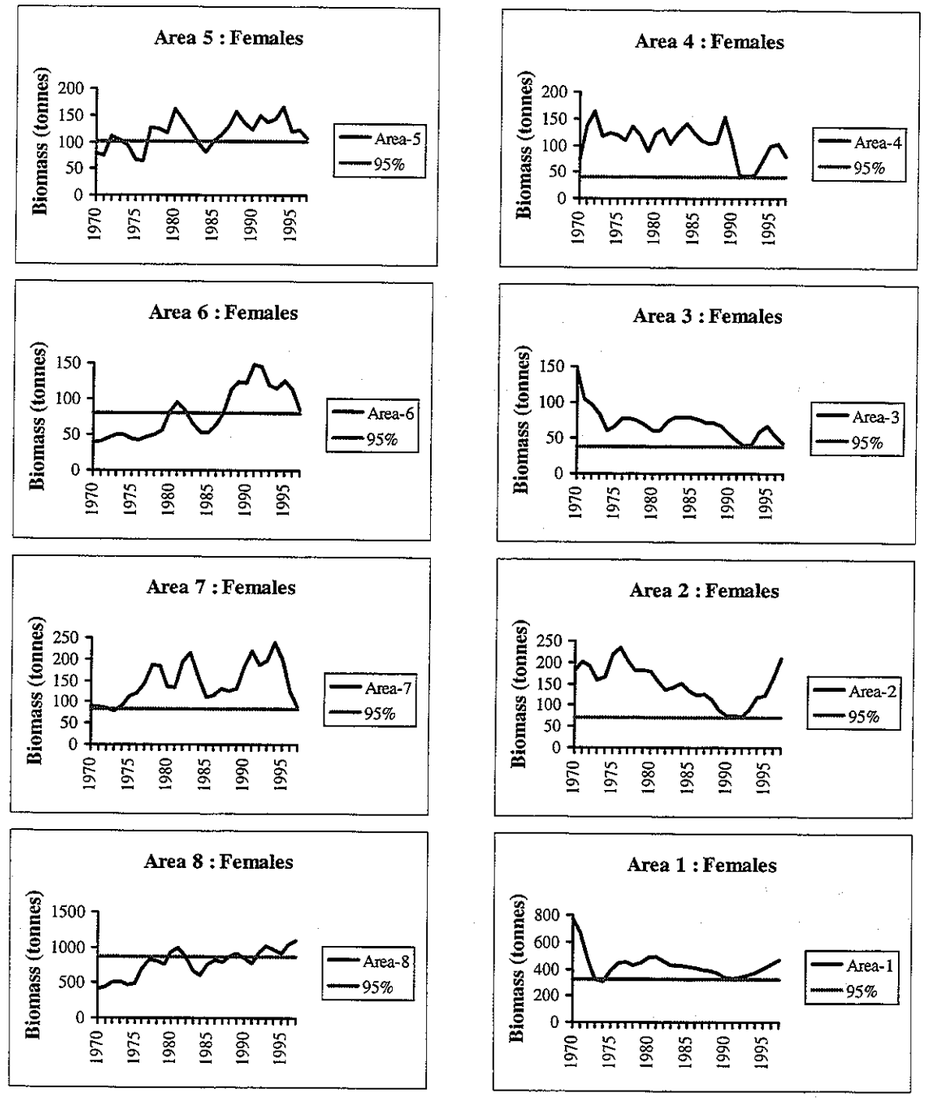


Fig. 12. Undersized biomass estimates of a) male lobsters from 80mmCL to 110mmCL and b) female lobsters from 80mmCL to 104mmCL. The value of 95% of the reference year used in the trigger point for abundance of undersized lobsters in shown in grey.

8.1.5 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. This report only considers information available until the end of February 1998. A TACC was introduced for the first time in March 1998 and thus this trigger can not be assessed.

8.1.6 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 operating in the fishery since 1993 has declined marginally each year with 311 licenses operating in the fishery in 1997 (Table 10).

Table 10. Changes in the number of operators in the Tasmanian rock lobster fishery from 1993 to 1997.

Year	Average number of operators	% change
1993	331	-
1994	327	-1.2
1995	323	-1.2
1996	321	-0.6
1997	311	-3.1

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

8.1.7 The recreational catch

The recreational dive and pot catch for 1997 was estimated at 83,507 lobsters (J.Lyle, TAFI, pers. comm.) which equates to 4.4% of the total catch in 1997. If a TACC of 1500 tonnes had applied to the 1997 catch (actual catch 1,662 tonnes), then the recreational catch of 83,507 lobsters would equate to 4.9% of the restricted catch. This would still be below the trigger point of this performance indicator.

8.2 Trends in Commercial Catch, Effort and Catch Rate Data

Catch rates in Tasmania were relatively constant or increasing in the 1970's and early 1980's prior to a decline to record lows in the mid 1990's (Figure 13). This has been followed by minor improvements in more recent years. While this trend is reflected in all regions of the fishery, there are differences which are worth noting.

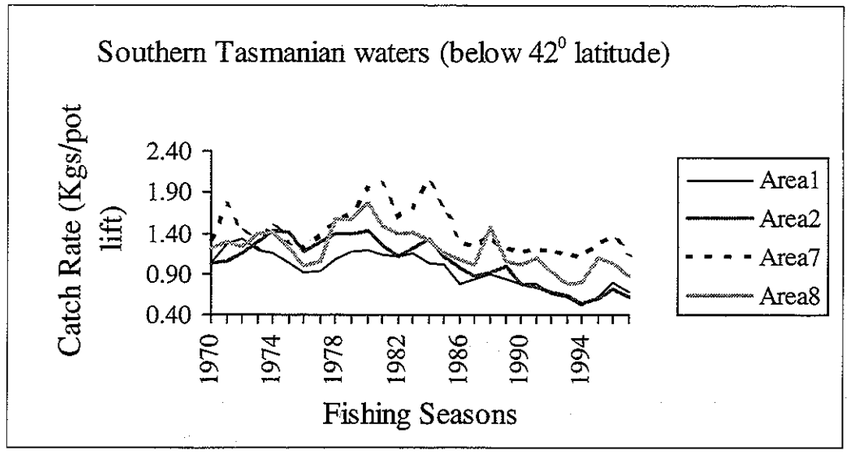


Fig. 13. Regional catch rates from southern and northern Tasmania since the 1970/71 fishing season.

Table 11. Comparison of highest and lowest commercial catch rates (kg/pot lift) regionally around Tasmania from 1970.

Area	Highest Catch Rate		Lowest Catch Rate		%decline in Catch Rate	1997 Catch Rate	% difference '96 to '97
	Year	Catch Rate	Year	Catch Rate			
1	1972	1.33	1994	0.52	61	0.68	-15.4
2	1974	1.44	1994	0.54	63	0.62	-13.2
3	1974	1.46	1994	0.44	70	0.53	-14.9
4	1975	1.74	1994	0.63	64	0.92	+12.4
5	1983	1.88	1995	0.90	52	1.00	+2.9
6	1984	2.61	1995	1.21	54	1.31	+2.8
7	1984	2.02	1994	1.11	45	1.16	-13.8
8	1978	1.57	1993	0.77	51	0.88	-15.3

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 11). An exception to this is area 8 which recorded its highest catch rate between these periods.

The rapid increase and subsequent decrease in area 6 resulted from the discovery of the 'golden mile patch' which was relatively virgin ground until the early 1980's.

In almost all regions catch rates have halved since the 1980's with the greatest decline in the east coast.

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' echosounders, and availability of larger vessels.

Since the lows of the mid-1990's, the last year's catch rates have only shown a slight improvement and this was primarily due to a strong recruitment pulse which occurred in 1995/1996 (Frusher, 1996). In southern and eastern regions catch rates have declined over the last year by over 13%, whereas northern regions, with the exception of area 4, have shown only minor improvements (Table 11).

8.3 Information on Recreational Catch and/or Effort

The recreational catch estimates for 1997 are 53,682 lobster caught by pot and 29,824 lobsters caught by diving (J.Lyle, TAFI, pers. comm.). This is a decline compared to the 111,000 lobsters estimated for the 1995/96 fishing season although a different method of estimating catch was involved in the two years. The proportion of lobster caught by pots was 64% and is similar to previous estimates of 65% (Frusher, 1997b).

The 1997 recreational catch is equivalent to 4.4% of the 1997 commercial catch. However, due to the constraints of pulling pots by hand and the safety limits of diving, the majority of the recreational catch would be expected to come from shallow water (<18 metres). The recreational catch is equivalent to 14% of the shallow commercial catch.

Lyle and Smith (1997) found that approximately 80% of the recreational pot catch and 60% of the recreational dive catch comes from the east coast of Tasmania. The 1997 recreational catch from the east coast is equivalent to 42% of the shallow commercial catch on the east coast. Although a significant component of the catch in this region, the shallow commercial catch on the east coast represents only 7.7 % of the total commercial catch.

8.4 Trends in abundance indices

A fishery independent catch sampling project has trialed a number of sites since its inception in 1992. Only 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) depth 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.

8.4.1 East coast - shallow

Pre-season catch rates of sized lobsters have declined from 1992 to 1997 (Figure 14). In contrast, the commercial catch rate for the months of November in the same area has remained relatively stable from 1992 to 1997, although the trend line for this data is strongly affected by the very low catch in November 1992. If the low catch rate in November 1992 was not included then the commercial catch rate would also show a declining trend.

The ratio of sized to undersized lobster of the previous season (6mmCL for females and 8mmCL for males below the legal size limit), is relatively flat from Nov'93 to Nov'96 indicating a relationship between these categories. The decline in the ratio in Nov'97 is due to an increase in the catch rate of pre-recruit lobsters in October 1996 was followed by a decrease in the catch rate of sized lobster in 1997 (Figure 15). The relationship between recruits and pre-recruits from research surveys is complex and currently can not be used in this region to predict future catches.

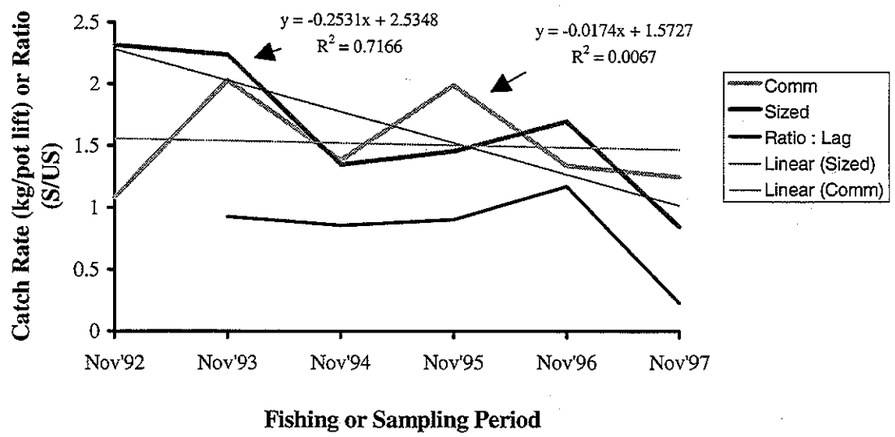


Fig. 14. Shallow water catch rates from the east coast of legal sized lobsters from research surveys (Res. Survey) and commercial fishing (Comm) compared with the ratio of legal sized lobsters to pre-recruit lobster lagged by 12 months (Ratio:Lag). Linear regressions demonstrating the trend in research surveys and commercial fishing are shown.

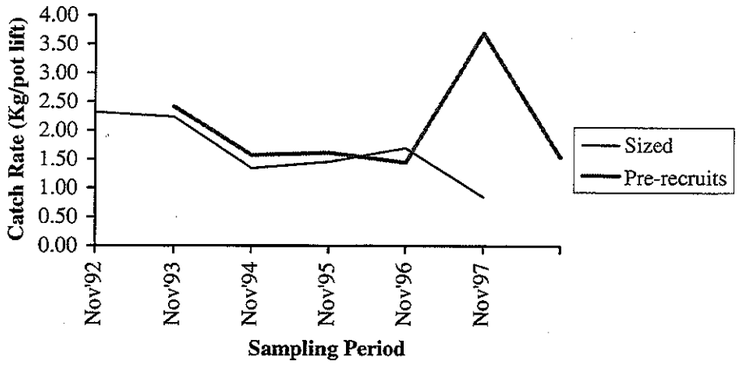


Fig. 15. Shallow water catch rates from the east coast of legal-sized and pre-recruit lobsters from 1992 to 1997 survey periods. The pre-recruit lobsters have been advanced by one year to simulate growth of undersized lobsters to legal size.

8.4.2 East coast - medium

There is no evidence of a decline in the medium depth catch rates since November 1992 in Area 2 (Figure 16). Both the commercial and research catch rates show substantial annual variation, although trends appear similar. The variability in the ratio of catch rates for sized to pre-recruit lobsters of the previous season would indicate the lack of any relationship between pre-recruits and the following years sized component (Fig. 17).

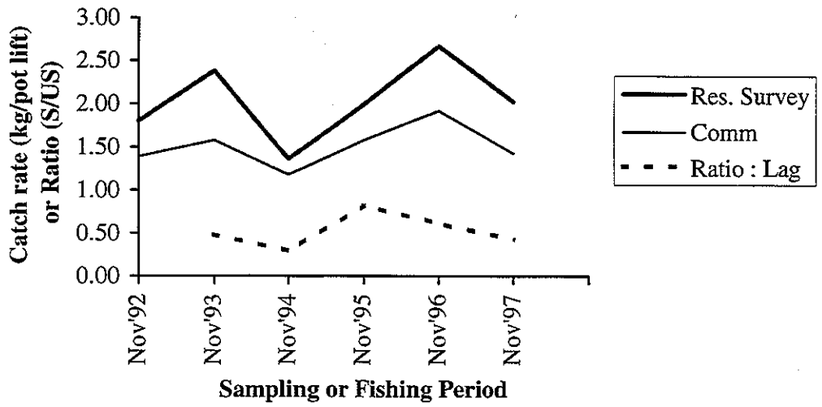


Fig. 16. Medium depth catch rates for the east coast of legal sized lobsters from research surveys and commercial fishing for the start of the fishing season. Ratios of legal sized lobster to pre-recruit lobsters of the previous season is also shown.

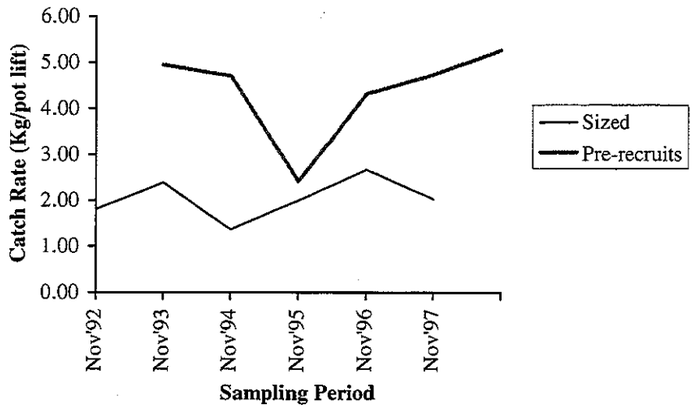


Fig. 17. Medium depth catch rates from the east coast of legal-sized and pre-recruit lobsters for the 1992 to 1997 survey periods. The pre-recruit lobsters have been advanced by 1 year to simulate growth of undersized lobsters to legal size.

8.4.3 South coast - medium to deep

Although the catch rate of sized lobsters from commercial fishing in area 8 and research surveys showed a peak in November 1995, there is a lack of correlation over all years (Kendall's coefficient of rank correlation, $P > 0.10$)(Figure 18). As catch rates from research sites south of Maatsuyker Island are not reflecting regional trends in commercial catch rates, new sites around Port Davey in the south west have recently been established.

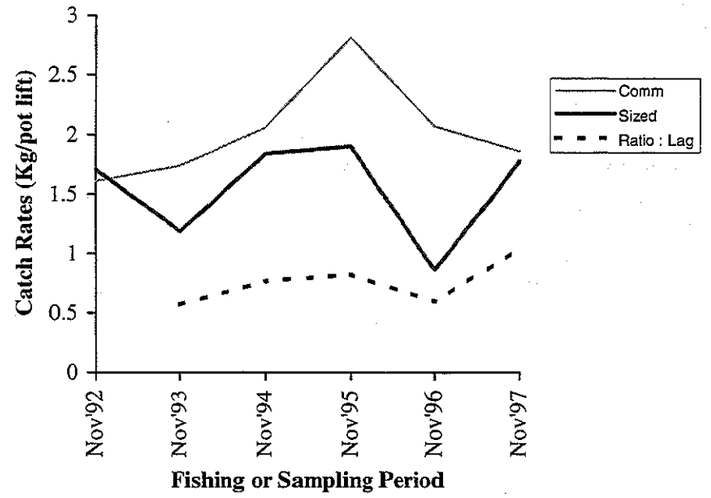


Fig. 18. Medium to deep water catch rates for the south coast of legal sized lobsters from research surveys and commercial fishing for the start of the fishing season. The ratio of legal-sized to pre-recruit lobsters of the previous season is also shown.

Despite only 5 years of overlapping data between the catch rates of pre-recruit and sized lobsters from research sampling (Figure), there are indications of correlation between the undersized catch rates and sized catch rates in the following year (Kendall's coefficient of rank correlation, P = 0.10). This is also indicated by the decreased variability of the ratio shown in Fig. 18.

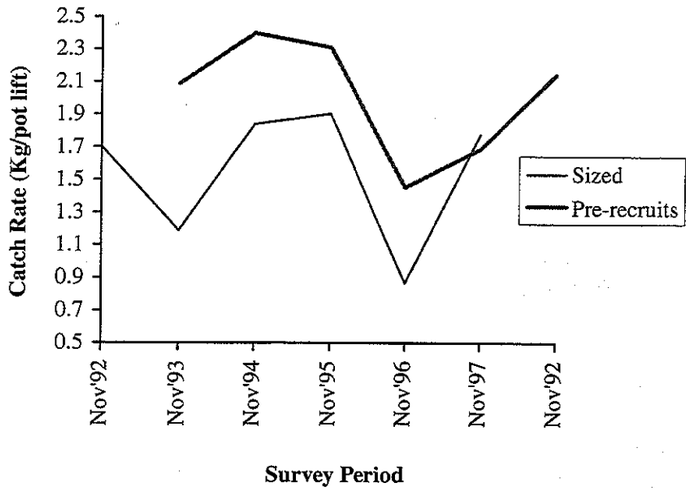


Fig. 19. Medium to deep water catch rates from the south coast of legal-sized and pre-recruit lobsters for the 1992 to 1997 survey periods. The pre-recruit lobsters have been advanced by 1 year to simulate growth of undersized lobsters to legal size.

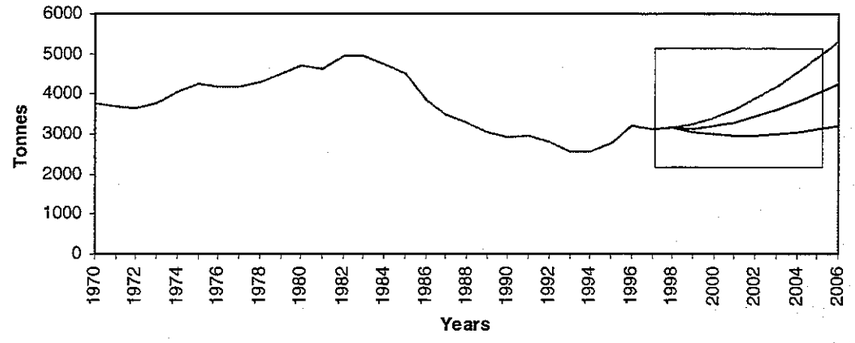
8.5 Other analyses including risk assessments

8.5.1 Biomass

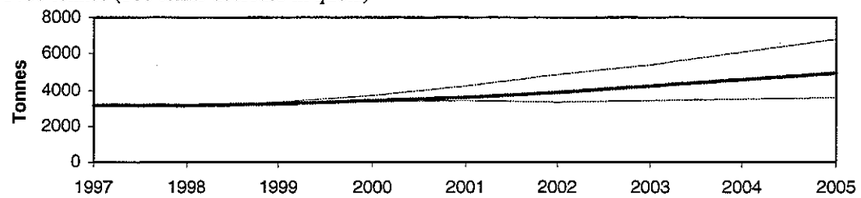
The probability of legal sized biomass decline under 3 scenarios - 100 tonne increase, 100 tonne decrease and maintaining current TACC, are presented in Figure 20. These probabilities use December 1997 as the reference point. An objective of the current management plan is that 'biomass levels are increased over time to a level required for producing the maximum yield from the fishery'. To evaluate if biomass trends are meeting this objective, December 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 meet the management objective.

Biomass levels in 1997 are well below the levels of the 1970's and early 1980's (Figure 20a). A 100 tonne increase in the TACC to 1600 tonnes is unlikely to increase the biomass and, by the end of the current management plan biomass is expected to have declined (Figure 20c). Maintaining the current 1500 tonne TACC should result in a small improvement in biomass during the current management plan with greater increases expected during the next management plan. The declining lower 96% confidence limit for the 1500 tonne scenario (Figure 20b) indicates that there is a small probability that biomass could decline.

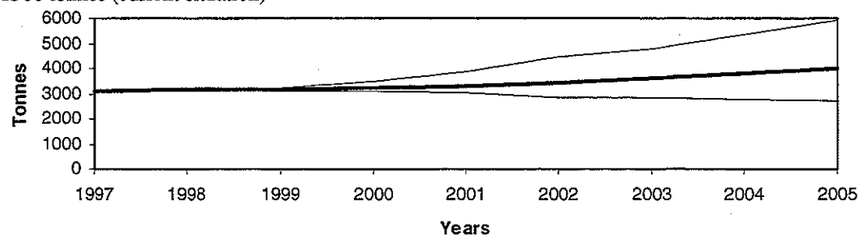
a) Historical legal sized biomass levels



b) 1400 tonnes (100 tonne decrease in quota)



c) 1500 tonnes (current situation)



d) 1600 tonnes (100 tonne increase in quota)

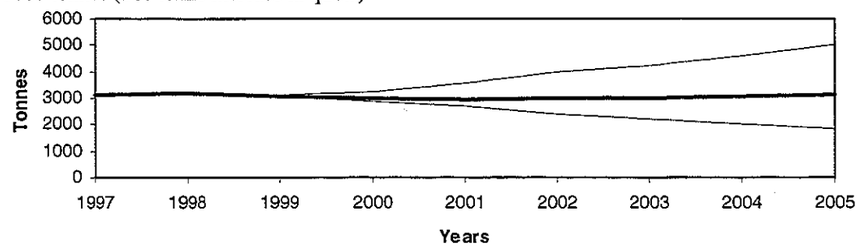


Fig. 20. Biomass trends from 1970 to 1998 with projections of biomass trends for 1400, and 1600 tonnes TACC's. The trajectories in a) have been expanded to show the 96% confidence limits for b) 1400 tonne, c) 1500 tonne and d) 1600 tonne TACC's.

8.5.2 Egg Production

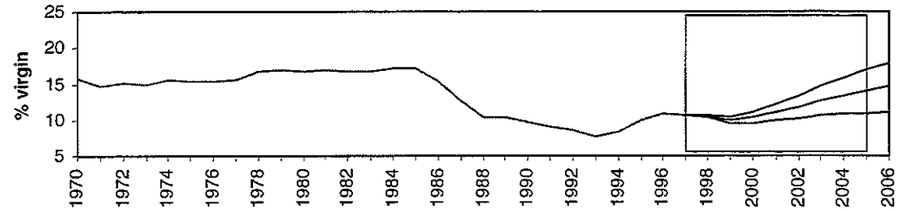
Frusher (1997a) found egg production to only be of concern in the northern half of Tasmania (areas 3, 4, 5 and 6) and stated that a target of at least 25% of virgin egg production should be maintained in each region.

Although egg production is expected to increase in all northern regions as quota constrains catch (figures 21 and 22), egg production will still be below the recommended level in the year 2006. Of more concern is the decline in egg production in areas 4, 5 and 6 until the year 2002. This concern is based on two uncertainties:

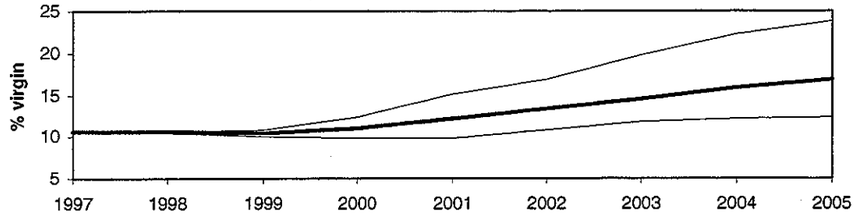
Firstly, it is uncertain to what extent regional egg production is derived from specific regions including other States (ie. South Australia and Victoria) and secondly, it is uncertain the extent to which puerulus recruitment has been declining with declining egg production.

The forward projections 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. However, an increase in the TACC is likely to limit the probability of increasing egg production in the north of the state. 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.

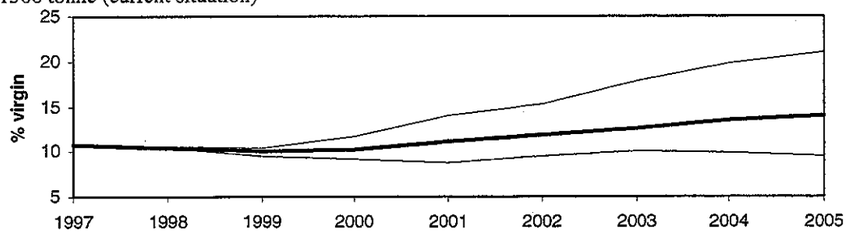
a) Historical levels of egg production, expressed as a percentage of virgin production, in areas 3 and 4.



b) 1400 tonne (100 tonne decrease in quota)



c) 1500 tonne (current situation)



d) 1600 tonne (100 tonne increase in quota)

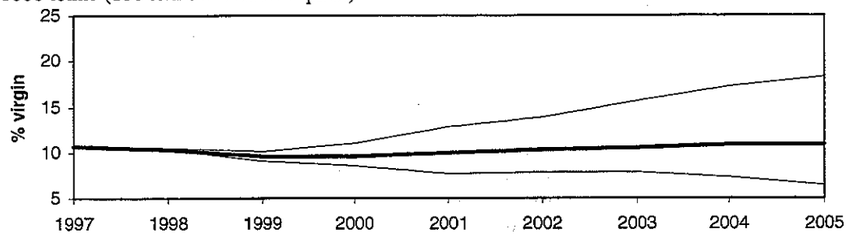
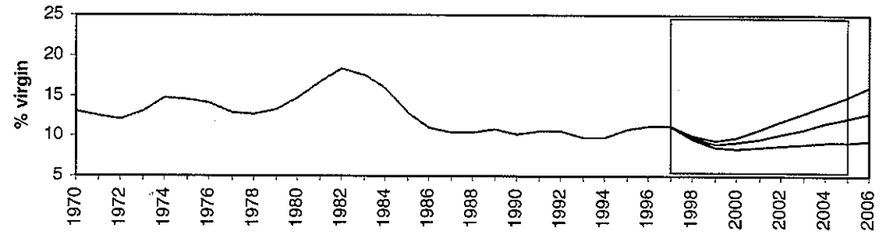
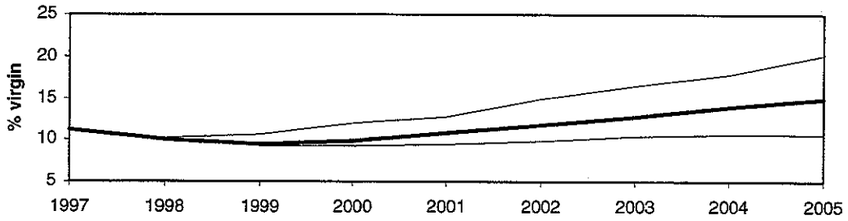


Fig. 21. Egg production trends from 1970 to 1998 in northeastern Tasmanian (areas 3 & 4) and projections under different TAC scenarios. The trajectories in a) have been expanded to show the 96% confidence limits for b) 1400 tonne, c) 1500 tonne and d) 1600 tonne TACC's.

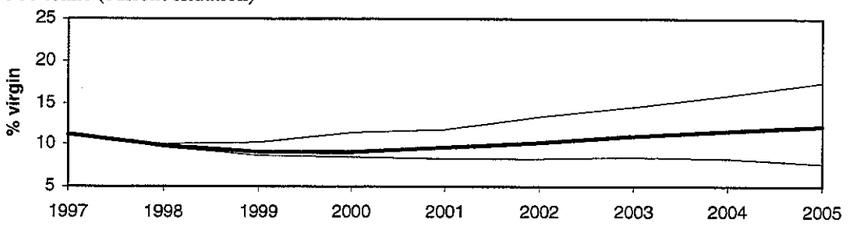
a) Historical levels of egg production, expressed as a percentage of virgin production, in areas 5 and 6.



b) 1400 tonne (100 tonne decrease in quota)



c) 1500 tonne (current situation)



d) 1600 tonne (100 tonne increase in quota)

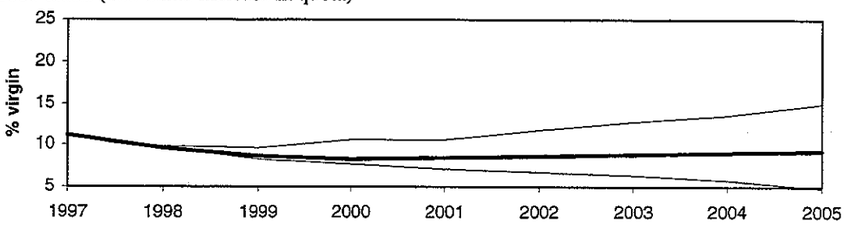


Fig. 22. Egg production trends from 1970 to 1998 in northwestern Tasmanian (areas 5 & 6) with projections of egg production under different TAC scenarios. The trajectories in a) have been expanded to show the 96% confidence limits for b) 1400 tonne, c) 1500 tonne and d) 1600 tonne TACC's.

9. Industry Issues

9.1 Recreational Catch

Industry was concerned that the trigger point for the recreational catch was a state-wide figure. They highlighted the recent survey (Lyle and Smith, 1998) which showed that while the catch can be low state-wide, it can be significant at the regional level.

Because recreational effort has strong regional associations there is the potential for substantial impacts on the inshore shallow water component of the resource. Currently there is no cap on recreational effort.

Industry stated that the trigger point for the recreational catch should be regional rather than state-wide and that in areas of substantial impact there should be a cap on the recreational catch.

9.2 Scale of assessments

Industry had concerns about how representative the data was for each of the eight areas being assessed in the fishery. In particular, in area 4 where egg production is low, fishers claim that there is still substantial numbers of large mature females which would not be seen in the regions currently being sampled by TAFI. They claim that there are major differences in size structure, growth rates and catch rates between regions within an area which need to be accounted for in the assessment model. As a starting point, they suggested that each of the areas should be further sub-divided into 3 depth zones (shallow, medium and deep).

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. There is a two and one half fold increase in lobster price from summer when catch rates are high to winter where catch rates are low (Figure 5). A recent trend in the fishery has been splitting of the price 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 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.

As highlighted by fishers (section 10), there is uncertainty as to how representative the data is of each area. This is particularly the case for the recent data which is derived from sampling regimes aimed at obtaining either exploitation rates or biomass estimates, or comparing catch rates with previous (1960's) catch rates.

11. Implications for Management

The risk assessments show a high probability that the current TACC of 1500 tonnes will commence 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. Unfortunately several years of data will be required after implementation of an ITQ management system before the impact of this change on effort and fishers behaviour can be incorporated.

12. Recommendations for Future Assessments

Future assessments need to standardise CPUE data.

This report presents the assessment up to March 1998, when the management of the fishery changed from input to output controls. The impact which this change has on the fishery, particularly effort data needs to be monitored.

Research needs to evaluate ways of improving the representativeness of regional data and determine the requirements, including costs, of obtaining the data and incorporating it into the assessment model.

A proposal submitted to FRDC has a component which looks at evaluating the change in fishers behaviour due to introduction of an ITQ management system. Both the interpretation of CPUE data and the suitability of the fleet dynamics component of the assessment model will be investigated.

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