NORTHERN ZONE ROCK LOBSTER FISHERY

A MANAGEMENT REVIEW DISCUSSION PAPER

4 July 2002

Prepared by the Northern Zone Rock Lobster Fishery Management Review Sub-committee, in partnership with PIRSA Fisheries

Contents

1. Executive Summary

This paper was prepared by the Northern Zone Rock Lobster Fishery Management Review Sub-committee, in association with PIRSA Fisheries. The paper draws on all available information including, information provided by the wider industry through the survey circulated in June 2002 (see APPENDIX I), scientific information provided by SARDI Aquatic Sciences and the independent scientific review undertaken by the National Institute of Water and Atmospheric Research, New Zealand (NIWA).

The purpose of this paper is to build on industry survey responses and generate informed industry-wide discussion of potential future management approaches for the commercial sector of the Northern Zone Rock Lobster Fishery (NZRLF). The paper is intended to stimulate innovative thinking about the future management of the fishery; it is not intended to draw conclusions on the most suitable way forward. In this sense, the paper aims to review where the fishery has come from, where it is today and where it could go in the future, in a management context.

It is intended that further opportunities to have input into the development of future management approaches will be available at the industry workshop and/or through interviews with the review project team. When this consultation is completed the Review sub-committee will finalise an options paper for consideration by licence holders.

Information presented in this paper demonstrates that the stock size has contracted in recent years and that the current amount of effort being expended in the fishery exceeds that which can be sustained by the stock in the long term. A conclusion that must be drawn is that the Northern Zone rock lobster stock has declined to a low level and that some form of precautionary management response to correct this decline is required. Sentiments expressed by licence holders in the survey have highlighted widespread concerns about fishing pressure being the cause of the decline in the fishery.

Responding to the stock decline will involve consideration of short and long term solutions for managing the fishery. A number of options for the future management of the fishery are presented and analysed for discussion at the industry workshop. The industry survey requested feedback on what future management approaches should be considered during the review process. As a result of feedback obtained through the industry survey, the following management approaches emerged as options and have been considered in this preliminary paper:

- status quo;
- refined fishing time management system;
- quota system;
- pot reduction; and
- licence reduction.

The Fisheries Management Committee and Review Sub-committee will use the information gained at the industry workshop to consider suitable future management options for the fishery, that meet the requirements of the *Fisheries Act 1982* and the broader ESD criteria set out in APPENDIX III.

2. Purpose

The purpose of this paper is to build on the survey responses and generate informed industry-wide discussion of potential future management approaches for the commercial sector of the Northern Zone Rock Lobster Fishery (NZRLF). The paper is intended to stimulate innovative thinking about the future management of the fishery; it is not intended to draw conclusions on the most suitable way forward. The information contained within this paper should not be taken to represent the individual views of review committee members.

The survey represents only one method used to collect information and feedback from the wider industry. An 80 percent response to the survey was received. It is intended that further opportunities to have input into the development of future management approaches will be available at the industry workshop and/or through interviews with the project team. When this consultation is completed the Review sub committee will finalise an options paper for consideration by licence holders.

3. Introduction

The Northern Zone Rock Lobster Fishery Management Committee (NZRLFMC) initiated this review process because of concerns related to progressive stock decline, and in response to wider industry concerns about the need for a more strategic, and less reactive, approach to management.

For many years the fishery has been managed by an input control regime, based principally on a time management system that allows commercial operators to select flexible and fixed closures that best suit individual business needs. Other important restrictions include those placed on: the number of fishing licences; individual pot holdings; vessel size and engine capacity; areas fished; the fishing season; a minimum size limit; double pulling; and the retention of egg-bearing females.

The Management Plan (1997) incorporates a series of performance indicators that are used to assess the performance of the fishery against established management objectives, on an annual basis. These performance indicators are used to guide management decision-making and include: exploitation rate; egg production; mean size; catch rate; and pre-recruit index. Other indicators used for management purposes include the annual total catch and the estimated total biomass.

The Management Plan refers to a list of management actions that should be carried out, should any of the performance indicators fall outside of the 'historical range' for the fishery. The historical range set out in the Management Plan is taken to be the period between 1992 and 1997. To this end, an implicit goal of the existing Management Plan is to maintain the estimated values of the performance indicators within the 1992 to 1997 range. A set of proposed management objectives for the fishery are outlined later in this document (Appendix II).

The existing five year Management Plan is due for review in 2002 and will be amended as a result of the outcomes from this review process. A revised Management Plan for the fishery will incorporate any additional measures needed to ensure that the fishery performs well against the assessment and reporting

requirements set out in the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act).

The EPBC Act requires all Australian export fisheries (State and Commonwealth) to meet a set of comprehensive sustainability guidelines (by December 2003), in order to gain export exemption. These guidelines require all State fisheries to demonstrate that individual species and ecosystems are being managed within an ecologically sustainable development (ESD) framework. This paper has aimed to evaluate potential future management options against this ESD reporting framework (see Appendix III).

4. The Fishery

There are currently 69 fishing licences endorsed to take rock lobster in the Northern Zone. This number has been reduced from 81 licences in 1983, through structural adjustment and licence 'split-ups'. A total of 3,950 pots are licensed for use in the fishery. In the 2001/02 fishing season a total catch of 674 tonnes was taken with 600,000 pot-lifts, producing an average nominal catch rate (the actual catch rate recorded through logbooks) of 1.07 kg/pot-lift. For the purposes of this document, 'nominal' catch rate will be referred to as 'actual' catch rate. The total catch and actual catch rate were the lowest recorded since the 1985 fishing season.

Table 1. Performance Indicator estimates (and other fishery data); Source, SARDI Aquatic Sciences.

Fishery Performance Indicators	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Exploitation rate	0.28	0.27	0.27	0.28	0.27	0.27	0.27	0.27	0.26	*
Egg production (% of virgin stock)	27.58	24.93	23.86	23.15	23.43	24.35	25.53	25.54	23.10	*
Pre-recruit abundance (per pot lift)	0.18	0.16	0.25	0.25	0.29	0.35	0.38	0.34	0.25	0.18
Catch rate (kg per potlift)	1.43	1.29	1.26	1.25	1.26	1.31	1.41	1.43	1.23	1.07
Mean weight (kg)	1.07	1.12	1.10	1.13	1.06	1.00	0.99	1.01	1.11	1.21
Annual Catch (tonnes)	1064	930	892	903	892	942	1,016	1,001	846	674
Annual Potlifts (000's)	746	719	705	724	718	722	721	700	687	600
Boats	81	79	79	77	75	73	71	70	69	69
Avg. catch/boat (tonnes)	13	12	11	12	12	13	14	14	12	9.4

* Figures not available at time of print.

The Northern Zone is characterised by regular but highly variable recruitment patterns and generally patchy and discrete reef formations that are known to limit the amount of suitable habitat for lobster. Restricted lobster habitat, coupled with environmental changes mean that peurulus settlement and subsequent recruitment strength is highly unpredictable. On average, the growth rate of lobster is known to be higher in the waters of the Northern Zone, than it is in the south eastern waters of the State.

In the past these uncertainties have been considered sufficient to question the reliability of a sustainable catch range estimate for the Northern Zone. In addition, there have been concerns raised over the higher compliance costs and operational difficulties of enforcing a catch limit (quota) over such a vast area of coastline (approximately 207,000 km^2). These characteristics have underpinned the high level

of Industry and Government support for a management system based on input controls, including time management (days fished).

Under the current approach, the productivity of the stock and the economic viability of the fleet will continue to fluctuate in line with environmental factors that drive recruitment. Put simply, the fishery will continue to face good and bad seasons. With existing effort levels and the current estimated low stock size, it is likely that stock recovery will be slow, or in the worst case non-existent, even with favourable environmental conditions and stronger recruitment.

An important consideration for management of the Northern Zone is the capacity for the stock to withstand sustained levels (current levels) of exploitation over time. Of particular concern is the level of fishing effort being expended during the 'down' cycles of recruitment. As constant (or increasing) fishing pressure is applied during such periods, the ability of the stock to accommodate that pressure, or unexpected environmental change, is reduced. At some point, continued heavy fishing comes at the cost of lower sustainable harvests in the future.

5. Environmental Factors

The effect of environmental, oceanographic and climatic influences on catchability is well documented in many fisheries. Please refer to the NIWA scientific review report (APPENDIX V) for a brief overview of environmental studies that relate to lobster fisheries in South Australia and other States.

Northern Zone catch rates are widely acknowledged to be affected by environmental influences, particularly swell (Prescott 2001 – Northern Zone Status Report). Environmental conditions such as wind strength and water temperature are also known to have affects on larval settlement patterns and growth rates across the Northern Zone. Although environmental, oceanographic and climatic factors have an influence on stock abundance and catch rates, their affect is not thought to be solely responsible for the recent lower catch rates being experienced in the Northern Zone.

Understanding the critical role that environmental influences have on recruitment, subsequent stock abundances and catch rates is a significant challenge in all fisheries. It is possible that some of the uncertainty associated with the relationship between environmental factors and catch rates in the Northern Zone could be minimised through further research into some of the critical environmental variables, particularly those that drive or influence recruitment.

However, it should be noted that this sort of research can be very costly and usually requires collaboration between fisheries biologists, oceanographers and meteorologists. The Western Rock Lobster Fishery is an example of where the relationship between fishery performance and environmental conditions is well understood.

In a broad sense, the hydrological regime (distribution of water) throughout the Northern Zone is not considered to be uniform or consistent. West coast waters are considered to be significantly influenced by the Great Australian Bight water body, while the waters south of the Eyre Peninsula and Kangaroo Island are considered to

be influenced by the more open oceanic waters of the Southern Ocean (Lewis 1981). The following paragraphs provide more detailed information on the oceanographic water circulation found in waters off South Australia.

The southern Australian continental shelf is storm-dominated with high (>2.5 m) modal deep-water wave heights (James *et al.* 2001). Winds are predominantly south easterly during summer and westerly during winter.

During summer, currents flow north westerly along the coast of the eastern Great Australian Bight and south easterly over the shelf break (Evans and Middleton, 1998; Hertzfeld and Tomczak, 1997; 1999). The Flinders Current (Bye, 1972) flows from east to west along the continental slope, which leads to the upwelling of cold, nutrient rich water from depths of around 600m onto the continental shelf.

The mean wind direction over the shelf in summer is upwelling favourable from Robe to the Great Australian Bight. South easterly winds drive the transport of warmer water offshore in the surface layer and the cold, nutrient rich water is then upwelled from below (Middleton and Platov, 2002).

The water layer above the thermocline is characterised by medium salinity, low nutrient levels and high temperatures (18 to 19°C). Water below the thermocline has lower salinity, higher nutrient levels and low temperature (~14°C). Sea surface temperatures are lower near the coast (e.g. 14-15^{o}C) especially along the western Eyre Peninsula and off the western tip of Kanagroo Island and higher offshore (18-20^{o}C) (Ward and McLeay 1998, 1999; Ward *et al.* 2000, 2001).

During winter, water over the continental shelf is well mixed and homogenous and is characterised by low nutrient levels, high salinities and medium temperatures (~17°C). Westerly, downwelling-favourable winds lead to the formation of an eastward coastal current along the shelf break from Cape Leeuwin to the east coast of Tasmania (Cirano and Middleton, 2002).

The presence of this coastal current suppresses the upwelling associated with the Flinders current, which flows underneath the coastal current in winter, at around 600m depth (Middleton and Cirano, 2001). Sea surface temperatures are lower inshore than offshore in winter (Ward and McLeay 1998, 1999; Ward *et al.* 2000, 2001).

6. Fishery Data

The following figures include the most up-do-date information available on the Northern Zone at the time of publishing this document. The figures presented will be analysed and discussed in more detail by SARDI Aquatic Sciences during the industry workshop presentation of the 2001/02 Northern Zone Rock Lobster Fishery Stock Assessment Report. This information has also been provided to NIWA. The basic take home message from the following information is that the fishery appears to have reached historically low levels of abundance.

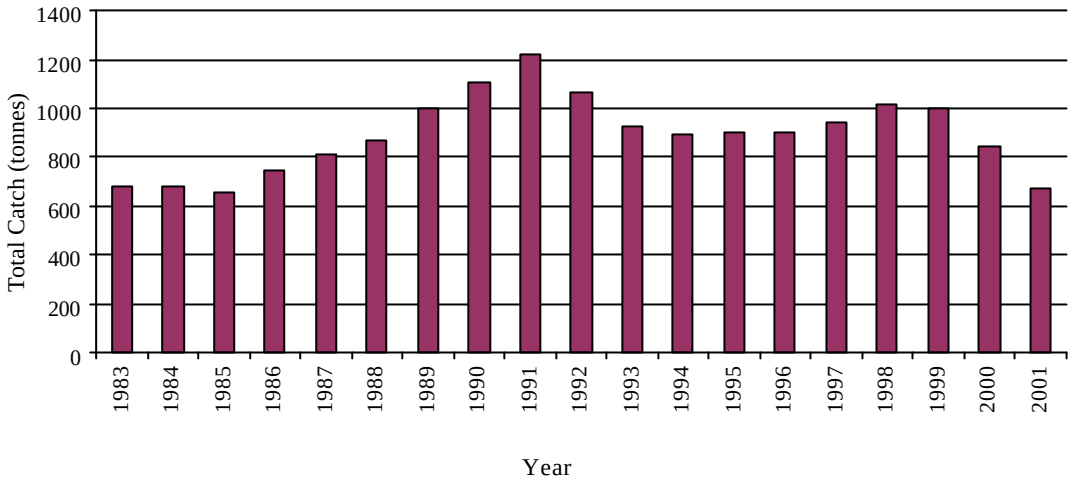

Figure 1. Total Catch in the Northern Zone Rock Lobster Fishery (1983 to 2001).

The total catch recorded for the 2001/02 fishing season was 674 tonnes; the lowest since 1983 when 678 tonnes was taken; the current catch level falls outside (below) the historical range set out in the Management Plan. The 2001/02 total catch represented an approximate 20% reduction in catch from the 2000/01 fishing season when 846 tonnes was taken; a 7% effort reduction was taken in the fishery during this period. A number of effort reductions have been taken since 1983 to offset increases in effective effort levels, reducing the number of pot lifts in the fishery; these must be taken into account when assessing the current status of the fishery.

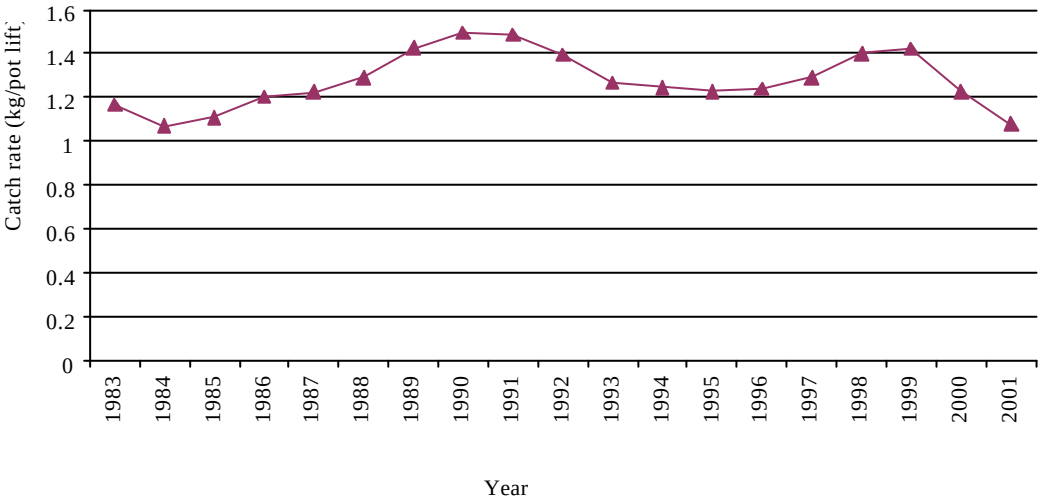

Figure 2. Nominal catch per unit effort (kg/pot lift) in the Northern Zone Rock Lobster Fishery (1983 to 2001), as reported in logbooks

The actual catch rate (kg per pot lift) reflects the average catch per pot lift recorded in fishing log books in the Northern Zone; no analysis of this data has been undertaken. The average nominal catch rate recorded for the 2001/02 fishing season was 1.07 kg. per pot lift; this represents the second lowest catch rate recorded in the fishery since 1983. The current nominal catch rate falls outside (below) the historical range set out in the Management Plan. The average actual catch rate over the period 1983 to 2001

is 1.27 kg. per pot lift. The actual average catch rate recorded in the 2001/02 fishing season was approximately 12% less than that recorded in the 2000/01 fishing season.

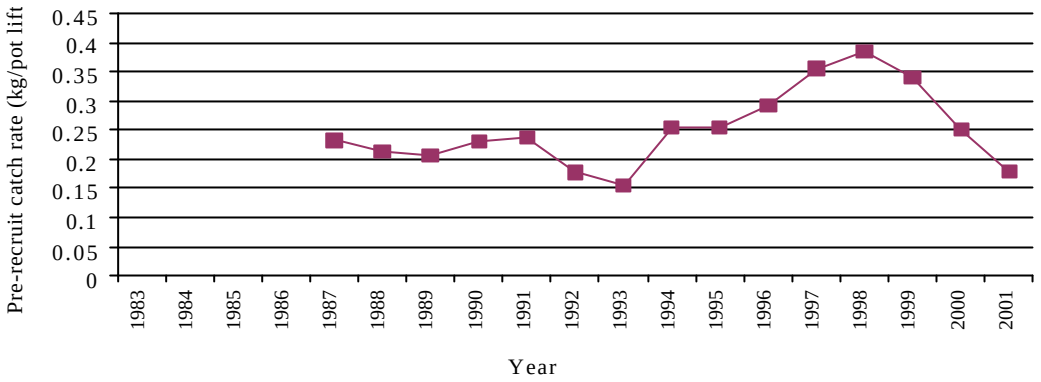

Figure 3. Pre-recruit catch rate in the Northern Zone Rock Lobster Fishery (1983 to 2001).

The actual catch rate of undersized lobster (pre-recruits) has decreased to a level (0.17 undersize lobster per pot lift) which is the third lowest, in the recent history of the fishery. The current pre-recruit catch rate is not outside the historical range set out in the Management Plan, although it is very close to being so. This low level of recruitment indicates that future catch rates of legal sized lobster can be expected to continue to decrease. It should be noted that the increased use of escape gaps has affected the number of undersize in pots. For a closer assessment of this affect, please refer to the SARDI Northern Zone Rock Lobster Fishery Status Report for the 2000 fishing season (Prescott 2001).

The other notable influence on pre-recruit abundance was the increase in the minimum legal size limit from 102 to 105mm in the 2000/01 fishing season. In theory, this should have had the affect of increasing the pre-recruit abundance. It should be noted that in the 2000 Northern Zone Status Report (Prescott 2001) speculation was made on a possible recruitment spike in the 2002 Northern Zone fishing season, as a result of good larval settlement recorded on collectors at Kingston, Cape Jaffa and Beachport.

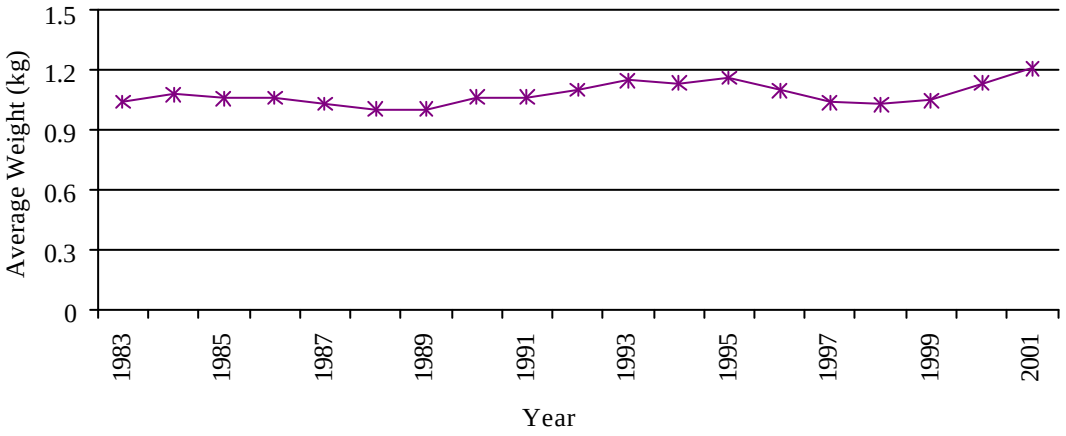

Figure 4. Average size (weight) of lobster in the Northern Zone Rock Lobster Fishery (1983 to 2001).

The average weight of lobster caught in the fishery has increased to 1.2 kg, which is the highest recorded in the recent history of the fishery, since 1983. The current mean weight is outside (above) the historical range set out in the Management Plan. This is indicative of the progressive low levels of recruitment that have been experienced in the fishery over the past three years. It should be noted that the increase in legal size will have acted to marginally increase the average weight of lobster landed.

In summary, it is clear that the stock size has contracted and that the current amount of effort being expended in the fishery exceeds that which can be sustained by the stock in the long term. Sentiments expressed by licence holders in the survey have highlighted widespread concerns about fishing pressure being the cause of the decline in the fishery.

7. Effective Fishing Effort

Under the Management Plan should any stock related concerns arise with the current input control system, scope exists to reduce the total number of pot lifts (and therefore the number of lobster caught) in the fishery through adjustments to:

- the number of available fishing days, through fixed and flexible closures or a change to the fishing season; and

- the total number of pots used.

Adjustments to the number of licences, days and pots over time have reduced the actual (or nominal) effort level in the fishery[1]. In addition, pot lifts have been reduced due to some fishers not fishing all available fishing days for economic or other reasons.

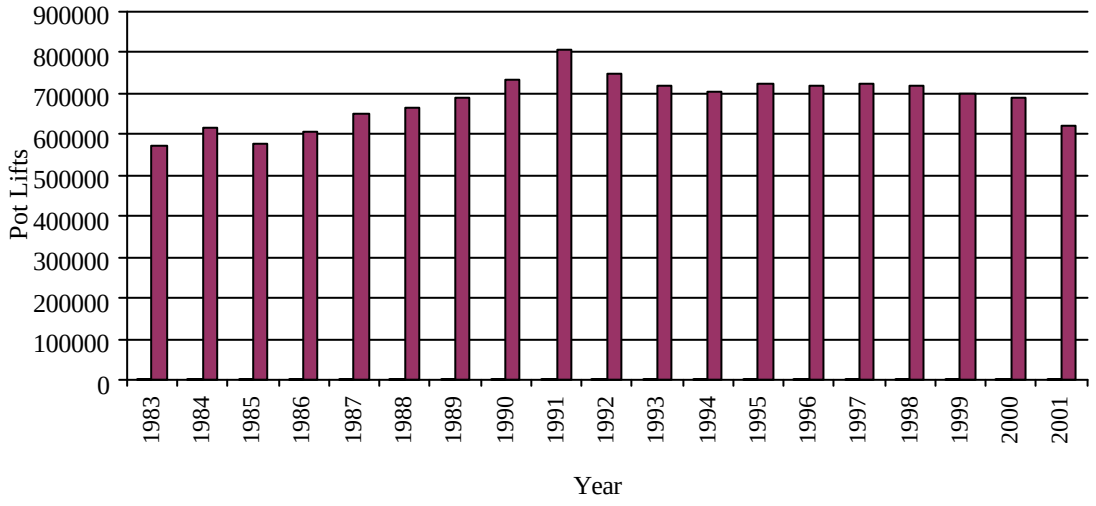

Figure 5. Nominal (actual) pot lifts recorded in the Northern Zone (1983 – 2001).

Put simply, increases in effective effort levels can be attributed to any improvements in the fleet's capacity to catch lobster with the existing number of boats, pots and

[1] The minimum legal size limit can also be adjusted.

days. The survey results have validated that a large number of licence holders believe that the current state of the fishery is due to increased fishing pressure. Such increases are known to occur in all input control managed fisheries, as fishers have an incentive to replace restricted inputs (eg. pot numbers) with greater use of unrestricted inputs (eg. new boats, new sounders or sonar equipment etc).

Improvements in effort take many forms and may include changes in: the technology used to locate and catch lobster; bait effectiveness; vessel design and capacity; and individual motivation and skill levels. It is recognised that changes in effective effort levels are both incremental (large sudden steps, eg. GPS) and constant (steady and more unpredictable, eg. skipper skill levels). Information provided through the industry survey has indicated that many of these factors have, and are expected to continue to contribute to increased effort in the Northern Zone.

The current Management Plan does not include measures to specifically address increases in the effective level of fishing effort over time. As the fishery is managed with input controls, this has become an increasingly important management issue and is recognised to have contributed significantly to the current status of the fishery. An ongoing challenge in the Northern Zone has been for management measures (effort reductions) to effectively match the likely increases in efficiency of the fleet that have occurred over time, and the changes in stock size. To this end, an important question for management of the Northern Zone is:

Have the previous reductions in fishing effort been adequate to address the expansion in effective fishing effort levels and reductions in the stock size?

In the Northern Zone, this means that the percentage of the population currently being harvested by one unit of effort, is likely to be significantly higher than the percentage of the population harvested by one unit of effort 10 years ago. The upshot of this from a management perspective is that any reduction in the relative abundance of lobster (decline in the stock), as measured by CPUE data, is likely to be masked by the increases in effective effort over time, and hence make things appear more stable than they actually are.

It is very difficult to quantify effective effort levels and because of this there is uncertainty over the precise amount that effort has actually increased in the fishery, and the offsetting effect of effort reductions, over time. From a management perspective, it is clear that if the current approach is maintained, future arrangements must include some scope to reduce fishing capacity to match the impact of the progressive expansion in effort.

It is important to note that this issue is not peculiar to the Northern Zone. All input controlled fisheries face similar challenges unless steps are taken to ensure that catching capacity (number of vessels, fishing days and amount of gear) are matched with long term resource availability. In practice, this is very challenging to achieve. The large number of structural adjustment processes that have been undertaken by fisheries management agencies in Australia (eg. Western Rock Lobster and Northern Prawn) and worldwide is evidence of this.

For a more detailed analysis of the likely stock related impacts of the effective effort increases in the Northern Zone, please refer to Prescott (2001) – Northern Zone Rock Lobster Status Report and the NIWA Science Review document (APPENDIX V).

8. Setting Targets and Limits – What Should we be Aiming For?

It is important to recognise that approaches to managing fisheries are continually changing and being improved. In recent times the trend has been towards establishing targets and limits, or "pegs in the sand", which management aim to achieve or avoid. Indeed for many years licence holders in the Northern Zone have sought to know:

"what are we aiming for?"

One of the first steps is to gain an understanding of what the desirable long term annual sustainable harvest range is, bearing in mind the changes in stock size due to variation in recruitment strength and fluctuating environmental conditions. Once there is an understanding of the long term sustainable harvest range, management systems can be developed that work towards achieving a given target harvest range or harvest rate, either through controlling the amount of effort or constraining the total catch.

In most fisheries, gaining a reliable understanding of the long term annual sustainable harvest level is extremely difficult, because of the many parameters associated with environmental variability. In many cases, the only way to truly understand where the boundaries of sustainability are is to allow fishing pressure to continue beyond that which is sustainable in the long term, and to observe how the stock responds to continued fishing pressure. This approach is not advocated, but is often how better understandings are gained.

For quota managed fisheries, the estimated sustainable harvest range (or level), is usually translated to the Total Allowable Catch (TAC) – this represents a *constant catch strategy* (explained further in section 9). For effort controlled fisheries (if the sustainable harvest range is understood), an additional step must be taken, which is to determine the amount of harvesting capacity (pots, days and licences) that is required to catch the sustainable yield.

The existing Northern Zone management system uses a *constant exploitation rate strategy* (aim is to harvest a constant fraction of the available biomass). Under this system, the total catch increases when the stock size increases, due to increased recruitment, and if the stock size declines so does the catch. Under this approach, it is assumed that a stable relationship exists between the exploitation rate (fraction of the biomass harvested) and fishing effort (total pot-lifts). In theory, this approach negates the need to estimate stock size, because it assumes a firm understanding of the relationship between catch and effort. Note that under this approach, the suspected increases in effective effort and spatial expansion act to confound the relationship between catch and effort, and complicate stock assessment work.

This said, the fishery has arguably progressed to a different position in 2002, where the environmental carrying capacity (and possible sustainable yield) of the Northern Zone region is better understood. Very basic evidence to support this notion is the

fact that the total annual catch has remained between 600 and 1200 tonnes over the past 20 years. It is noted that over the last ten years regular effort reductions have taken place (approx 160,000 pot lifts).

The average catch over the past 19 years is estimated to be approximately 890 tonnes; this has lead to the position of the fishery today – a 674 tonne catch. During this same period, the exploitation rate has been estimated to have remained stable at about 27%.

Taking into account the known uncertainty associated with these estimates, if you accept that there is a problem with the stock, it is a fair and reasonable assumption that the current level of fishing pressure (exploitation rate) is too high and expectations about the long term sustainable catch range should be less than 890 tonnes; and the short term sustainable catch range should be considerably less, probably in a range between 600 and 700 tonnes.

The fishery needs to be managed to enable a larger and more stable stock size to be achieved in the long term. Achieving a larger stock size will allow a buffer to be created, affording greater protection for the stock, and the large financial investment in the fishery, during extended periods of low recruitment.

This will mean that a 'precautionary approach' will have to be adopted in setting an annual sustainable harvest range for the short term future of the fishery, regardless of what management regime is adopted in the future.

There are a number of ways of arriving at an informed estimate of what the optimal sustainable harvest level is, for both now (given that stock re-building must occur) and in the future. All of the following approaches are associated with some level of uncertainty, which has not been quantified:

- the average total catch over a given period;
- the total catch at a given base year when all parameters were considered to be stable;
- a sustainable yield estimate based on estimates from the qR model; and
- a sustainable yield estimate based on estimates from the new integrated model.

Rather than rely on one of these approaches in isolation, one way of dealing with estimating the potential sustainable yield from the fishery may be to draw on information from all of the above methods to arrive at a collective understanding of what the sustainable yield is most likely to be.

It is intended that these concepts be explored further at the workshop to enable a determination of a sustainable catch range for the fishery.

9. Management Tools

There are two main types of management tools that can be used in fisheries – input (effort) controls and output (catch) controls. Output controls are almost never used in isolation and various input controls (vessel numbers and closures to protect spawning animals) are often used to compliment a catch limit (quota).

The following summary provides a broad explanation for each of the approaches, and is intended to assist in considering the analysis of the various management approaches.

Input Controls

Input-based controls are the most commonly used fisheries management tool used in Australia and throughout the world. Management systems based primarily on input controls rely on restricting the range of inputs used to catch fish, to control total fishing effort and ultimately the total catch.

Commonly used input controls include: limits on the number of fishing licences; limits on vessel numbers; restrictions on the size and capacity of fishing vessels; restrictions on vessel replacement; owner/operator restrictions; restrictions on the number of crew members; restrictions on the type and amount of gear that can be used; restrictions on the amount of time that can be spent fishing each day or each year; restrictions on the areas that can be fished, restrictions on licence transferability and restrictions on the technologies that can be used, etc.

Advantages

Input controls are generally simpler and cheaper to administer than output controls. A simple analysis of the costs per tonne associated with managing the southern and northern zones highlights this. Input control management systems allow the fishing fleet to capture the short term benefits, in terms of increased catches, that may arise through annual variation in the size of fish stocks that coincide with good recruitment and good environmental conditions. Effort control systems allow highly skilled fishers to operate more efficiently and take larger catches than less efficient fishers and hence, realise greater profits.

Disadvantages

Effort control management systems provide an incentive for fishers to compete for a greater share of the total catch. One of the major problems faced when using effort controls is the inherent difficulty in attempting to control all facets of fishing effort. Restrictions placed on particular inputs tend to stimulate fishers to increase their use of other uncontrolled dimensions of fishing effort to maintain a certain catch level. Other effort parameters that need to be considered include, among other things, the introduction of new technologies, skipper skill and efficiency, the different motivations of individual fishing businesses, crews, changes in vessel size, capacity and power, changes in bait effectiveness and the potential effect of new entrants to the fishery.

No matter how good an approximation for the total catch an effort control system provides, competition among fishers remains, and individual fishers still have an incentive to maximise individual catches at the expense of others in the fleet. For this reason continued adjustments to total effort levels are generally required in input control managed fisheries. Structural adjustment does not occur automatically under input controls, it has to be driven by regulatory changes to licence numbers or restrictions on gear entitlements (maximum and minimum pot holdings).

Output Controls

In recent times, output controls have become increasingly more popular in Australia and throughout the world. Management systems that directly control the amount, sex or size of fish that may be harvested are generally referred to as output controls. Management systems based primarily on output controls rely directly on restricting the total quantity of fish that may be harvested to a pre-defined limit. Total catch limits are usually, but not always, established on an annual basis and can include over-catch and under-catch provisions.

Commonly used output controls include: a competitive total allowable catch (TAC); vessel catch limits on a per day or per trip basis; minimum and maximum fish size regulations; rejection of females or spawning females; and individual catch quotas, which can be made transferable (ITQ's). The simplest situation for introducing a quota management system, in a fisheries context, is that of a single species captured by a single type of fishing gear.

For a range of reasons (bycatch, gear interactions, economic reasons etc), most output control managed fisheries usually have limits on boat numbers, as well as closed seasons and area closures.

Advantages

Output controls diminish the incentive for fishers to compete for a share of the total catch. Output controls provide a direct control over catch, and therefore the ability to respond effectively to overfishing. A total allowable catch, allocated to fishers as individual transferable quota shares (ITQ's) provides, in brief, the following benefits: maximum operational flexibility for fishers, in terms of when and how much fishing takes place; maximum administrative flexibility for fisheries management agencies through direct catch controls; a stronger and more secure access right, to the extent that the rights to a specific quantity of fish are not threatened by other fishers within the fishery; lower risks of over-capitalisation in the longer term; greater capacity to contribute to stock rebuilding through a more direct control on the harvest; and more potential for autonomous adjustment of the fleet size and structure over time, and less requirement for Government driven restructure.

Disadvantages

As with effort controls, output controls are not without problems, many of which relate specifically to implementation as opposed to the actual management system. For example, the likely business adjustments associated with quota allocation. An incentive is created for individuals to find ways to take more than the allocated share of the total catch. The main difficulties experienced with output controls can be sorted into six categories, the extent of which varies with each application to a particular fishery: quota monitoring costs and effectiveness; data corruption issues; TAC setting; socio-economic impacts; high-grading; and management costs. Issues associated with TAC setting and quota monitoring can be significant ongoing issues. These issues are addressed in the analysis presented in Appendix III.

10. Management Options

This section of the paper outlines possible future management options for the Northern Zone and is the most important section for the wider industry to consider. The industry survey requested feedback on what future management approaches should be considered during the review process. As a result of feedback obtained through the industry survey, the following management approaches emerged as options and have been considered in this preliminary paper:

- status quo;
- refined time management system;
- quota system;
- pot reduction; and
- licence reduction.

The refined time management and quota systems emerged as the options most favoured by licence holders in the industry survey. However, each of the above options have been benchmarked against the current time management system, to assist in identifying some of the future costs and benefits of each approach.

A three step process has been taken to examine each option. The first step is to examine each system against a comprehensive set of ESD criteria – the FMC and Review Sub-committee will be evaluating any recommendations against these criteria. The second step has been to look at specific design characteristics of each option (table below) and the final step is to look at implementation issues. For a full assessment of the management options against ESD criteria, refer to Appendix I.

A Refined Fishing Time Management System

The main issue with the current time management system expressed in the survey was the lack of opportunity to fish when the conditions and prices are attractive; more flexibility to select fishing time in a refined time management arrangement was a clear message. Therefore a refined time management approach should involve removing fixed closures entirely (including 14 March and 1 April cut off dates) and allowing each individual licence holder to fish for a set number of days, with total flexibility during the season.

To allow this flexibility, the total fishing days available for each licence holder would need to be based on the assumption that fishing would take place during high catch rate periods, while accounting for the total number of pots in the fishery and the target catch range set by management. Fishing the available days could then be permitted at any time during the current season. With upgraded compliance and administrative support, it may be possible to implement a refined and more flexible time management system prior to the beginning of the 2002/03 fishing season. However, a significant number of days would have to be removed from the fishery.

A Quota System

This approach would involve setting a total allowable catch limit (TAC) and allocating catch shares to individual licence holders. There would be no restriction on

fishing time, and a longer fishing season could be explored, providing greater operational flexibility. A monitoring system that focussed on counting numbers of lobster as opposed to weight could be explored, possibly in conjunction with an individual numbered lobster tag system identified to the Northern Zone, or each licence.

It should be noted that while it would not be impossible, it is unlikely that a quota management system could be implemented at the beginning of the 2002/03 fishing season, because of the complexities associated with establishing a cost-effective compliance program and the required amendments to fisheries regulations.

There are a number of issues associated with quota allocation that would need to be addressed, if this option is considered. However, it is worth noting that the allocation method used in the Southern Zone Rock Lobster Fishery has been subjected to critical legal review in the Federal Court and could be used as a basis for allocation discussions in the Northern Zone.

A Pot Reduction

This approach is simple and has been used on two previous occasions in the Northern Zone. It would involve reducing the total number of pot lifts in the fishery through a reduction in the number of pots. This could be achieved by reducing the total number of pots by a given percentage or by requiring a given number of pots to be surrendered by each licence (either permanently or temporarily). Generally, no industry funds are required to facilitate a pot reduction. Tax-effective options to deliver this option could be explored. It is considered that this option could be introduced relatively easily prior to the beginning of the 2002/03 fishing season. Note that a pot reduction has the dual effect of reducing effort and restructuring the fleet, as many licence holders will automatically seek to re-adjust their pot holdings. Note that structural adjustment issues are considered later in this document under section 11.

A Licence Reduction

This approach was used in the Southern Zone Rock Lobster Fishery and involved a pot levy through licence fees to buy out 42 licences in the late 1980's. In the Northern Zone, effort could be managed by reducing the total number of pot lifts in the fishery through a reduction in the number of licences. This could be achieved by using industry funds to 'buy back' a given number of fishing licences, at current market prices, as they become available on the open market..

The main issue with this option is that it is contingent upon licences being available for buy out. As such, while it may be a suitable long term option, it may be an inferior mechanism where large and immediate management action is needed.

Tax-effective options to execute this option could be explored and it should be noted that, similar to a pot reduction, a licence reduction has the dual effect of reducing effort and restructuring the fleet. Structural adjustment issues are considered later in this document under section 11.

The following table outlines some of the issues that will need to be addressed at the workshop. Please give these issues some thought prior to the workshop.

Table 2a. Management option design characteristics (long term).

Design	**Status Quo**	**Flexible Fishing Time Management**	**Pot Reduction**	**Licence Reduction**	**Quota**
Season	210 day 1 Nov - 31 May	Current season could be reviewed	Current season could be reviewed	Current season could be reviewed	Current season could be reviewed
Transferability	Yes – pots	Yes – pots	Yes pots	No – to buy back only until completed?	Yes – quota and pots Should quota be attached to pots?
Decision rules to fish to target catch range	Time closure adjustments required on an ongoing basis. Other forms of effort reductions may be required	Fishing day adjustments required on an ongoing basis.	Ongoing pot reductions to offset effort would be required.	Difficult to have responsive management Other adjustments in effort likely to be required.	TAC is usually maintained for a set period. TAC can be adjusted in response to stock decline.
Long term cost - Research - Management - Compliance	 $240,000 $260,000 $250,000	 -expect a marginal increase -expect an increase	-No change expected	-No change expected	 -expect marginal increase -expect marginal increase -expect an increase
Potential Business impacts	Income reduced through less fishing days at sea. Ongoing inefficiency of operations imposed.	Income reduced through less fishing days at sea but flexibility to select for price and conditions.	Income reduced through less pots on each boat. Costs associated with 'buying up' pots	Cost of buy back payments – balance of operation maintained.	Income constrained to tonnes and price, depending on quota holding limits. Lower cost operations
Target catch range for 2002-03	Likely to be 600 - 700 tonnes (tba)	Likely to be 600 - 700 tonnes (tba)	Likely to be 600 - 700 tonnes (tba)	Likely to be 600 - 700 tonnes (tba)	Likely to be 600 - 700 tonnes (tba)
Long term sustainable catch range	tba	tba	tba	tba	tba

Table 2b. Implementation considerations

Implementation	**Status Quo**	**Flexible Fishing Time Management**	**Pot Reduction**	**Licence Reduction**	**Quota**
Allocation	nil	Nil	% of total or set number of pots per boat	$ per pot or per licence	- Average kg per pot? - Catch history? - Mix history and average per pot? - Phased in from history to average over number of years e.g. SE and Tasmania. - Catch history period?
Timing	- 200/03 - Ongoing reductions	- 2002-2003 or later - Ongoing reductions	- 2002/03 - Ongoing reductions	2002/03 Additional buy backs and/or other measures?	2003-2004? 2004-2005? Ongoing TAC adjustments
	nil	Year 1 & 2 Extra administration Extra consideration of compliance strategy	nil	Extra administrative costs	Year 1 & 2 Extra administration Extra consideration of compliance strategy

11. Economic Performance and Fleet Structural Adjustment

While in many cases it could be said that biological sustainability and good economic performance go hand in hand, it should be noted that sustainability comes first. In a fisheries management context, economic (and other) objectives can only be pursued to the extent that sustainability objectives have been (or are being) achieved.

Capacity in any fishery to allow restructuring of operations in response to ever changing economic conditions is essential if adequate returns on individual's investment and from the fishery resource as a whole to the community of South Australia are to be achieved. Indeed the emerging ESD guidelines now include provisions for economic considerations involved in fisheries performance assessment.

Even from a most basic position the Northern Zone industry is a very minor supplier on a world stage facing competition not only from other South Australian fleets, but other States and New Zealand in terms of *Jasus edwardsii* and of course the other estimated 80,000 tonnes of other lobster species traded annually. As well the very nature of the fishery (its size and the distances travelled) involve higher costs of fishing than some of the competitors.

So from many different angles, it is important that future management arrangements keep an eye on the global economic settings with the aim of ensuring individual businesses have scope to improve the economic performance of their operations and capture efficiencies on offer over time. This is fundamental to remaining competitive and also to the delivery of adequate economic returns on the resources employed in the Northern Zone to the South Australian community.

Set in out in Table 3 is a snap shot of economic indicators for the fishery up until the previous season. Important underlying trends to note in previous years, particularly the last two years are:

- Increasing costs;
- Increasing Gross revenue due to price increases;
- Static to declining earnings before interest and tax (EBIT);
- Declining return on investment on boats and gear;
- Static to declining return on investment; and
- Increases in capital value.

Table 3. Economic Performance 1997/98 – 2000/01: Source EconSearch (2000/01)

	1997/98	**1998/99**	**1999/00**	**2000/01**
	All Boats	All Boats	All Boats	All Boats
Av. Beach Price (Nominal)	$29.96	$27.08	$29.79	$32.29
Gross Income	$373,813	$371,014	$383,627	$400,432
Total Cash Costs (excluding labour)	$134,518	$125,756	$136,814	$174,959
Labour	$130,937	$129,957	$134,374	$154,877
Total Cash Costs (including labour)	$265,455	$255,713	$271,188	$329,836
Earnings Before Interest & Tax (Profit)	$85,169	$87,450	$85,454	$49,156
Fishing Gear & Equipment	$398,105	$424,093	$435,711	$545,164
Licence Value [c]	$1,494,667	$1,534,684	$1,499,672	$2,160,000
Total Capital	$1,892,772	$1,958,777	$1,935,383	$2,705,164
Rate of Return to Fishing Gear & Equip	21.4%	20.6%	19.6%	9.0%
Rate of Return to Total Capital	4.5%	4.5%	4.4%	1.8%

It is apparent that the Northern Zone industry is currently facing a declining economic situation . The 2001/02 decline in catch was offset by further increases in beach price, but this should be viewed with caution given the uncertainty of market conditions, exchange rates, behaviour of competitors and potential for species substitution by consumers.

The survey indicated that about 75% of respondents sought more than 11 tonnes per licence and 55% indicated 13 tonnes or more was needed. The current year average catch per boat was 9.75 tonnes.

It is estimated that a 10-15% drop in the 2001/02 beach price could see average EBIT in the industry drop to around zero if catches remain around the 2001/02 levels.

In the Northern Zone fishery the structural mechanisms (ie. excluding internal business costs savings) to improve economic performance significantly could include:

- More pots per licence and less units (licences);
- More catch per licence and less units (licences);
- Same number of pots per licence but less units (licences) in the fishery; and
- More licences operating from each; this would allow less investment in boats only.

To capture improved economic performance some form of fleet and licence restructuring would be needed.

Since entry was limited to the fishery in the 1960's, ongoing fleet restructuring has occurred. In the last 10 years about 1 licence each year has been split and the pots transferred to other licences. Licence numbers have fallen from 81 in 1992 to 69 in 2001.

The current average pot holding is 57 per licence and potential exists for 3 more licences to be split across the fishery. It would be fair to say there is limited scope for ongoing internal structural adjustment of the fleet unless the upper pot limit changes.

The industry survey highlighted both increased pots per licence and less fishing units (licences) as favoured measures to improve the economic performance of the fishery.

It is from this perspective that the following basic assessment is provided as a starting point for considerations about industry structure and how alternative management arrangements might be used to contribute should it be decided a restructure is needed.

Table 4. Assessment of Management Options and Structural Adjustment

Structural Adjustment	**Status Quo**	**Flexible Fishing Time Management**	**Pot Reduction**	**Licence Reduction**	**Quota**
Action to allow adjustment	Could increase upper pot limit Could allow more licence s to operate from one boat	Could increase upper pot limit Could allow more licence s to operate from one boat	Pot Reduction creates capacity for further adjustment. Could increase upper pot limit Could allow more licence s to operate from one boat.	Removes units form the fishery Could also increase upper pot limit Could allow more licences to operate from one boat.	If quota attached to pots – increase upper pot limit. If quota not attached to pots remove maximum quota holding restriction or set maximum quota holding above the maximum initial allocation. Could allow more licences to operate from one boat.
Business Impacts	No forced changes. Buy up using after tax $	No forced changes. Buy up using after tax $	Forces loss of pots on all. Buy up using after tax $ Could explore a tax effective individual pot buy out via licence fees.	Forces expense on all via licence fees. Could explore a tax effective buy out via licence fees.	No forced changes. Buy up quota using after tax $

12. Conclusions

This paper does not aim to draw any specific conclusions on the most suitable way forward for managing the fishery in the long term; this is intended to be canvassed at the industry workshop and at subsequent Review Sub-committee meetings and FMC meetings.

A conclusion that must be drawn from the information contained within this document is that the Northern Zone rock lobster stock has declined to a low level and that some form of precautionary management response to correct this decline is required.

Responding to the stock decline will involve consideration of short and long term solutions for managing the fishery.

The Fisheries Management Committee and Review Sub-committee will use the information gained at the industry workshop to consider suitable future management options, that meet the requirements of the *Fisheries Act 1982* and the broader ESD criteria set out in APPENDIX III.

APPENDIX II – Proposed Management Objectives

The following draft objectives provide a strategic framework for the future management of the fishery. They have been constructed with the national ESD reporting structures in mind (Environment Australia and the Standing Committee on Fisheries and Aquaculture). The revised objectives will be explicitly linked to the annual stock assessment process and a set of decision rules for future management.

It is recognised that the revised approach is very specific and prescriptive, and that a balance between the national ESD reporting requirements and the day to day practicalities of fisheries management needs to be achieved. This said, the following draft objectives will need to be discussed further, following the management review process and adjusted to suit the future management arrangements.

It is important to note that the biological objectives that relate to ESD provide the baseline against which all other objectives can be pursued. To this end, economic and social objectives can only be pursued to the extent to which biological imperatives have been achieved. An ongoing challenge for management is to strike the right balance between sustainability and utilisation of fisheries resources.

1. To pursue the Ecologically Sustainable Development of the Northern Zone Rock Lobster Fishery, and in doing so:

    - Avoid overexploitation (as defined by limit reference points);
    - Maintain exploitation rate at (% of biomass)
    - Maintain the spawning biomass within an agreed range to ensure adequate recruitment to the fishery;
    - Maintain egg production within an agreed range
    - Maintain the total catch above an agreed level; and
    - Maintain the catch rate within an agreed range.

2. To pursue economic efficiency in the exploitation of the rock lobster resource, and in particular:

    - Minimise overcapitalisation;
    - Provide commercial and administrative flexibility in management arrangements;
    - Capture return on investment between 5% - 10%;
    - Recover an economic return from licence holders, sufficient to cover the attributed costs of management, research and compliance.

3. To have regard to the range of social values attached to the fishery, and in particular:

    - the regional development nature of the fishery;
    - Maintain reasonable levels of public access and recreational opportunities;
    - Maintain high levels of support for the management arrangements; and
    - Encourage a high level of responsibility for management to stakeholders.

4. To minimise any disruption to the structure, productivity, function and biological diversity of the marine ecosystem, and in doing so:

    - Minimise any adverse impacts of the fishery on ecologically related species;
    - Minimise bycatch in the fishery;
    - Avoid or minimise the incidental mortality of endangered or threatened species; and
    - Avoid or minimise adverse impacts on endangered or threatened ecological communities.

5. To pursue cost-effective mechanisms for managing the Northern Zone Rock Lobster Fishery:

    - management
    - compliance
    - science

APPENDIX III - A Framework for Assessing Management Options

The criteria outlined below provided the framework to objectively compare and assess each of the potential future management options for the fishery.

1. Ecologically Sustainable Development

The criteria used to assess management options against the ESD objectives include the capacity of each option to:

- contribute to any stock rebuilding/recovery;
- directly control or constrain the total catch or effort level within an agreed precautionary range;
- ensure accurate data collection for stock assessment;
- address bycatch issues and broader ecosystem impacts; and
- address the expansion in effective fishing effort.

2. Economic Efficiency

The criteria used to assess management options against the economic efficiency objectives include the:

- Relative strength of the access right provided;
- Level of operational flexibility provided;
- Capacity to deal with inter-annual variability in abundance and therefore the ability to maximise the return from the available fish resources;
- Autonomous adjustment in the fishery; and
- Wealth Redistribution.

3. Social Values

The criteria used to assess management options against the social objectives include the immediate and long term impacts on:

- regional communities and regional development;
- the level of industry and community support for the option;
- equity between and within each sector;
- broader community access to the resource; and
- recreational opportunities.

4. Marine Environment

The criteria used to assess management options against the environmental objectives includes the capacity of each option to:

- Minimise any adverse impacts on the broader marine environment, in particular, threatened ecological communities;
- Minimise incidental mortality on endangered and threatened species; and
- Minimise bycatch in the fishery.

5. *Cost Effective Management*

The criteria used to assess management options against the cost effectiveness objectives include the capacity of each option to provide:

- an effective mechanism to pursue all established management objectives; and
- a mechanism that minimises costs, while not compromising effectiveness.