

ASSESSING THE ECOLOGICAL SUSTAINABILITY OF THE TASMANIAN ABALONE FISHERY



May 2001



Tasmania

DEPARTMENT *of*
PRIMARY INDUSTRIES,
WATER *and* ENVIRONMENT

Disclaimer

This submission has been prepared by the Department of Primary Industries, Water and Environment. The views and opinions expressed in this publication are those of the authors and do not necessarily reflect those of the Department of the Environment and Heritage, the Minister for the Environment and Heritage or the Commonwealth Government. The Commonwealth does not accept responsibility for the accuracy or completeness of the contents, and shall not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on, the contents of this publication.

Assessing the ecological sustainability of the Tasmanian abalone fishery

A report prepared for Environment Australia as required for assessment under guidelines for Schedule 4 listing under the *Wildlife Protection (Regulation of Exports and Imports) Act 1982*

CONTENTS

A	INTRODUCTION	3
A.1	History of the fishery	3
A.2	Context of the current management plan	11
A.3	Objectives of the management plan	12
A.3	Availability of the management plan	14
A.4	Consultative process for developing a management plan under the Act	14
A.5	Stakeholder involvement in the development and assessment of a management plan	15
A.6	Assessment documentation	16
B	ESD ASSESSMENT	17
B.1	PRINCIPLE 1.	17
B.1.1	Objective 1.	
B.1.1.1	Information requirements	17
B.1.1.2-5	Assessment	21
B.1.1.6-9	Management responses	30
B.1.2	Objective 2.	
B.1.2.1-2	Management responses	34
B.2	PRINCIPLE 2.	36
B.2.1	Objective 1.	
B.2.1.1	Information requirements	36
B.2.1.2	Assessments	36
B.2.1.3-6	Management responses	36
B.2.2	Objective 2.	
B.2.2.1	Information requirements	37
B.2.2.2-3	Assessments	37
B.2.2.4-6	Management responses	37
B.2.3	Objective 3.	
B.2.3.1	Information requirements	38
B.2.3	Assessment	39
B.2.3.3-5	Management responses	40
C	REFERENCES	42
D	A brief history of the management measures introduced for the abalone fishery in Tasmania	45

A INTRODUCTION

A.1 History of the fishery

Two species of abalone are harvested in the Tasmania abalone fishery: *Haliotis rubra* (blacklip abalone) and *Haliotis laevis* (greenlip abalone). Both species are mobile bottom dwellers that graze on drift seaweeds and algae on rock surfaces. They occur on rocky bottoms, mainly within the littoral zone from depths of five to thirty meters, although they can be found down to around 40 meters (DPIWE 2000a).

Blacklip abalone are distributed around Tasmania and across southern Australia on suitable rocky bottoms. Blacklip abalone occur on rocky reefs in both exposed and sheltered waters. Their distribution is variable but less patchy than greenlip abalone (DPIWE 2000a).

Greenlip abalone are very patchy in their distribution and occur across southern Australia. Greenlip abalone in Tasmania tend to frequent less complex and patchy reefs and are most abundant along the north coast and around the Bass Strait islands (McNee 1993a, 1993b).

Prior to 1963 commercial exploitation of abalone in Tasmania was minimal. In the 1950s a small-scale fishery was attempted but was not a commercial success. By 1963, however, modern diving equipment and the identification of Asian markets provided the basis of the modern fishery (Harrison 1983, 1986b).

The fishery continues to operate as a dive fishery with most diving undertaken using 'hookah' gear, whereby compressors pump air through hoses down to the diver. Most divers operate from dinghy sized vessels launched from shore or larger mother boats.

Catches rose sharply from 1963 to a maximum of 4,500 tonnes in 1984 (the year prior to the introduction of quota as explained later in this document). Unreported catches prior to the introduction of quota monitoring systems probably saw the catch higher than the reported level.

A cap on the number of divers (i.e. limited entry - as explained later) introduced in 1969 to cap the catch at 1,000 tonnes of 'cleaned meat' placed a brake on expansion and (together with a drop in prices) was effective in stabilising the catch close to the target level.

A number of factors have influenced catch levels, providing some possible rationale for fluctuations through the 70s and 80s.

Strong catches in 1971 are reportedly related to a 'good' summer of extended calm weather. These conditions allowed prolonged fishing on the west coast with large catches being made in areas where previously effort had been minimal. Conversely, the hot water conditions experienced in that year may have adversely affected abalone stocks (abalone were reputedly 'falling off the rocks' in high water temperatures) so that catches were lower in the next year or two.

During the mid 1970s there were a number of inactive divers who retained licences, but could not sell them off as they were non-transferable at that time. The introduction of transferability was probably a factor in a rise in the catch through the

early 1980s. The drop in catches in 1982 was associated with an oversupply of abalone and poor prices in that year. Processors and divers placed monthly limits on each diver for the latter half of that year.

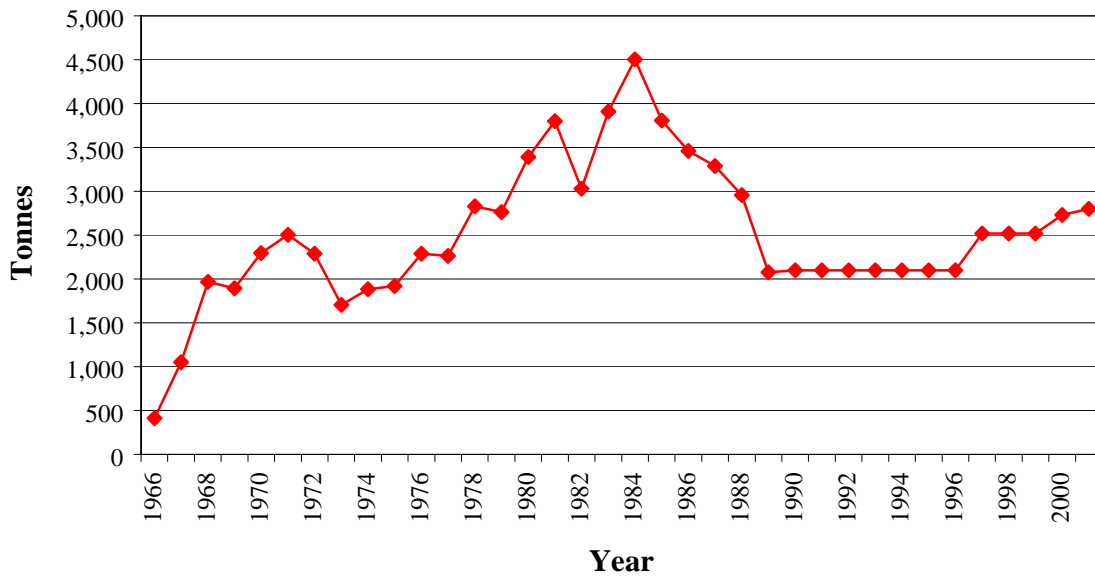


Fig 1: Annual landings from the Tasmanian abalone fishery (diver returns)

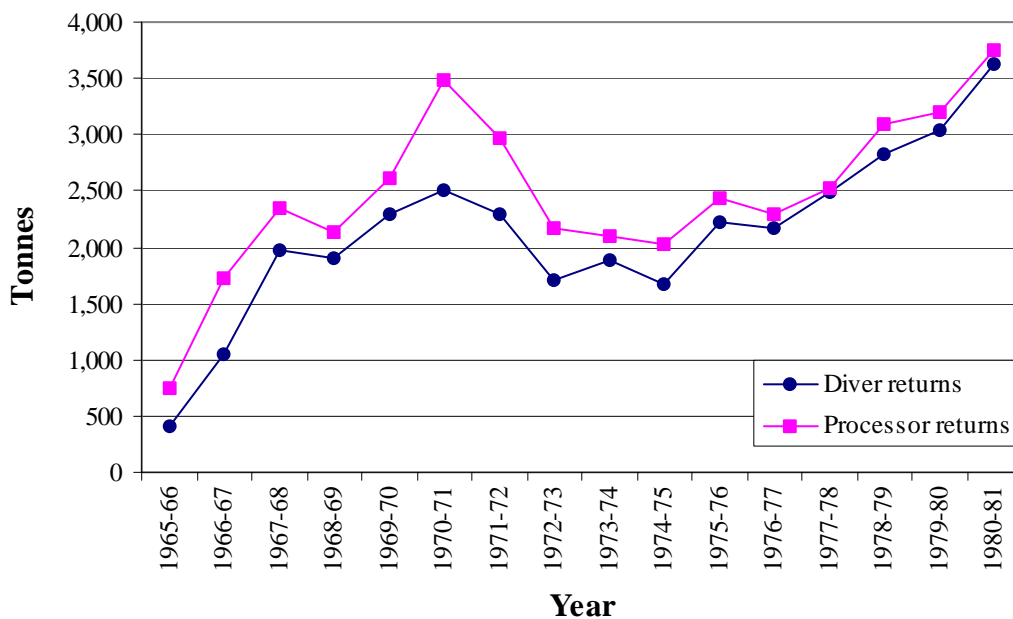


Fig 2: Comparison of diver and processor abalone returns pre-quota fishing

Comparisons of processor and diver returns suggest that divers underestimated somewhat the catch in the early years of the fishery until a more rigorous quota monitoring system was introduced in 1985. Figure 1 presents the catch from diver returns from 1966 to the present (calendar years). Figure 2 provides the catch from both diver and processor dockets for the years prior to quota as published by Harrison (1983) (by financial year). The major discrepancy between diver and processor

returns is associated with the high catches in 1970-71 from the episode of west coast fishing. As catches rose post 1975, these figures show stronger correlation.

A minimum size limit was the first management measure imposed on the fishery (i.e. in 1962). This was followed in 1965 by the introduction of a licence for commercial divers with a requirement for monthly catch returns. Abalone had to be landed alive, thereby preventing processing at sea, to assist with the enforcement of the new size limit restrictions.

In 1969, to prevent excessive fishing, the number of diving licences was limited to the 120 licences that were then current. In 1972, to encourage the exploitation of the abalone resources around the islands of the Furneaux Group (off the north east of Tasmania), five special abalone licences were issued exclusively for the use of residents of the Furneaux Group. These special licences were restricted to operating around the Furneaux Group. The 120 other 'mainland licences' were prevented from diving around the Furneaux Group when quota was introduced in 1985.

Between 1972 and 1985, additional changes were made to the regulations governing the commercial abalone fishery, mainly involving progressive increases in the size of penalties. Also, during this time, several changes were made in how a commercial abalone diver's licence could be transferred (as discussed later).

During the early 1980's there were some concerns regarding potential overfishing of Tasmania's abalone resource. The industry and Government decided to implement a quota system from 1985 onwards.

The total allowable catch for the commercial abalone fishery was to be divided into 3,500 equal quota units and each diver was to be allocated an equal share of the units. Thus, the 125 divers were to have had 28 units each. The proposed total allowable catch was to be 3,500 tonnes, or one tonne per abalone quota unit.

However, the abalone fishery was still divided into two parts, the mainland of Tasmania with 120 divers and the Furneaux Group with five divers. When the potential annual catch for the five Furneaux divers of 140 tonnes, was compared with the long term average catch for the area, it was found to be 40 tonnes greater. To keep the new catch level within the long term average it was agreed to decrease the allocation to the five Furneaux divers to only 20 units each.

Thus, in 1985 a total allowable catch of 3,806 tonnes was set, with a system of individual quotas, being 3,460 quota units at 1.1 tonnes each. Each mainland diver was allocated 28 abalone quota units, of which up to 12 units could be transferred to another diver for the season, thereby allowing for limited transferability of the quota. The Furneaux Group divers received 20 quota units and they could only seasonally transfer their quota to other Furneaux Group divers.

Industry and Government continued to have concerns that overfishing might be occurring, and in the four seasons from 1986 to 1989 they agreed to a series of reductions in the total allowable catch down to 2,076 tonnes.

In 1990, the Tasmanian commercial abalone fishery was made a single fishery when the division between the mainland divers and the Furneaux Group divers was

removed. To put the five Furneaux divers on an equal basis with the mainland divers, the Furneaux divers where each (conditionally) granted an additional eight quota units to bring their level of access to 28 quota units. The forty extra quota units brought the total allowable catch up to 2,100 tonnes, where it remained until 1997, when there was a 20% increase to 2,520 tonnes.

A further increase occurred in the total allowable catch in 2000 when the catch increased to 2,730 tonnes (together with the first fishing zones as explained later).

For 2001, the total allowable catch was set at 2,800 tonnes. This increase was associated with the introduction of a third blacklip zone and a reduction in the size limit in the north (also as explained below). The allocation of this quota between the zones saw a small decrease to that taken from the east coast and an increase in the north calculated as being equal to the additional fish becoming vulnerable to the fishery between the previous and new size limits.

Under the *Fisheries Act 1959*, personal licences, such as the abalone diving licence (that is a licence which authorised the holder to personally go fishing) could not be transferred, thus several pseudo transfer methods were developed for the commercial abalone diver's licence. Initially, a diver if retiring from the fishery due to health reasons could nominate his replacement. This was subsequently withdrawn and replaced with an unofficial system whereby a diver who is retiring for any reason could nominate his replacement.

In 1990, after pressure from the abalone industry, the Government conducted a review of the abalone licensing system (DPIF 1990). A commercial abalone licence was then worth around one million Australian dollars, which meant that it was beyond the means of most people to enter the fishery without financial backing. Most formal financial institutions would not lend such money with a commercial abalone licence as the sole or main collateral.

As a result of the review, from the beginning of the 1991 quota year (January - December) the commercial abalone licence was divided into two licences, to dive for abalone and to hold abalone quota units. This system was a reflection of the changes that had already occurred in the Tasmanian commercial abalone fishery where increasing numbers of divers were leasing their licences from former divers, processors or other financiers. The splitting of the entitlement allowed those arrangements to be officially recognised. Only the holder of a commercial abalone diving licence could dive from a fishing vessel to take abalone for commercial purposes. A diver needed to be authorised by the holder of an abalone quota unit to take the abalone which the abalone quota unit represented.

Holders of abalone quota units did not need to be commercial abalone divers and the number of units that could be held by an individual or company was unrestricted, in terms of both minimum and maximum holdings. Many of the commercial abalone divers owned all or part of the 28 abalone quota units originally attached to the licence.

During 1993, the *Fisheries Act 1959* was amended to allow for the transfer of personal licences such as commercial abalone diving and abalone quota licences.

Thus, the management arrangements for the commercial abalone fishery could be called an individual transferable quota system.

In 1994 contracts, called the Abalone Deed of Agreement, were introduced that increased the level of security for quota holders and their financial backers, whilst potentially increasing the return paid to the Tasmanian Government. Over 95% of quota units are under Deeds of Agreement, with the remaining units being under annual licences. The Deed is for ten years with an automatic right of renewal, thus, the Deeds are essentially for perpetuity.

Jurisdictional issues in the fishery were simplified in 1996 through implementation of an Offshore Constitutional Settlement (OCS). Generally, this arrangement cedes jurisdiction of abalone in 'Commonwealth waters' to Tasmania south of 39° 12'. As most (if not all) abalone are taken within 'three miles', this is a rational move to prevent any complications in, or undermining of, the management arrangements in the fishery.

A further review was undertaken in 1999 mooting changes for the 2000 fishing year. The major change in 2000 involved the introduction of fishing zones into the fishery. This move was in response to a trend of catches becoming increasingly concentrated in certain parts of the State, mainly the east and south east coast. Correspondingly, catches were becoming less targeted towards the west and north of the State.

The greenlip abalone was made a separate fishery or 'zone' and blacklip abalone was broken into two geographic zones, i.e. the east and west zones.

The total allowable catch for this first year of the operation of discrete zones was 2,730 tonnes. The allocations for each zone in 2000 was: the greenlip zone – 140 tonnes; the western blacklip zone – 1,400 tonnes; and the eastern blacklip zone – 1,190 tonnes.

Measures to additionally spread the catch of greenlip abalone somewhat and protect spawning aggregations were also introduced in 2000. A rule closing the Franklin Sound each year from October to the following March was introduced, along with a trigger of 42 tonnes on the total catch in the Furneaux Group at which time the Minister will consider closing those waters for greenlip fishing (this closure was implemented in October 2000).

Greenlip abalone size limits were also modified in 2000 to provide additional protection in some areas.

The fishing zones were modified in 2001 with the introduction of a new northern blacklip abalone fishing zone (Arthur River to Great Musselroe River). Within this zone a new reduced size limit for blacklip was also introduced from Woolnorth Point to Great Musselroe River.

The total allowable catch for the year 2001 is 2,800 tonnes. The allocations for each zone in 2001 are: the greenlip zone – 140 tonnes; the western blacklip zone – 1,260 tonnes; the eastern blacklip zone – 1,120 tonnes; and the northern blacklip zone 280 tonnes.

A suite of operational restrictions on fishing this new zone and reduced size limit were also introduced to protect the integrity of the other zones and larger size limits. These include pre-reporting requirements, single zone fishing trips and starting and finishing a 'northern trip' within the zone. Some measures to allow mother boats greater operational freedom were also introduced.

Size limits were modified for both recreational and commercial fishers in 2001. The reduced size limit for blacklip was not introduced into the recreational fishery so as not to undermine the integrity of larger size limits. Rather, the increasingly complicated measures were simplified for recreational fishers. This provides a number of advantages including ease of enforcement and education relating to recreational abalone fishing.

For commercial fishers, the minimum size limit for blacklip abalone is 127 millimetres, which applies in the north of the State (Woolnorth Point to Great Musselroe River). For a region around the south and west coasts (Wild Wave River to Whale Head) the minimum size limit for blacklip is 140 mm. For the remainder of State waters 132 mm applies.

The minimum size limit for commercial greenlip abalone is 140 mm, which applies along the north west coast between Arthur River to Three Mile Bluff. Around King Island the minimum size is 155 mm. A size limit of 145 mm applies around the rest of the State.

A rigorous set of reporting requirements to protect the integrity of the quota system applies to both fishers and processors, this includes a range of telephone reports and log returns.

During 2001, preliminary results from the 2000 stock assessment suggested a trend of declining catch per unit of effort in a portion of the south east coast. Further research suggests that the size limit in this area may not provide the level of protection anticipated. A review of the size limits in the area will be undertaken.

In the interim, for the 2001 fishing year, a cap on the catch in a portion of this key area (block 13) will be implemented. This cap is divided into a quarterly catch limit to minimise disruption in the fishery.

The 2000 catch figures also indicated that greenlip catches became increasingly concentrated in the north east and north west areas, with a correspondingly lower catch being taken around King Island. To ensure that this trend is not recurring, catch limits for greenlip abalone in the north west and north east have also been approved. This measure will determine a lower limit on the catch which must be taken around King Island (as the Furneaux Group already has a catch limit).

The value of the fishery has fluctuated due to changes in landings, but has also fluctuated markedly due to changes in the beach price paid to fishers.

Lower landings during the late 1980s saw a correspondingly lower value of the fishery, however, despite stable landing during the early 1990s the beach price, and correspondingly the value of the fishery, increased.

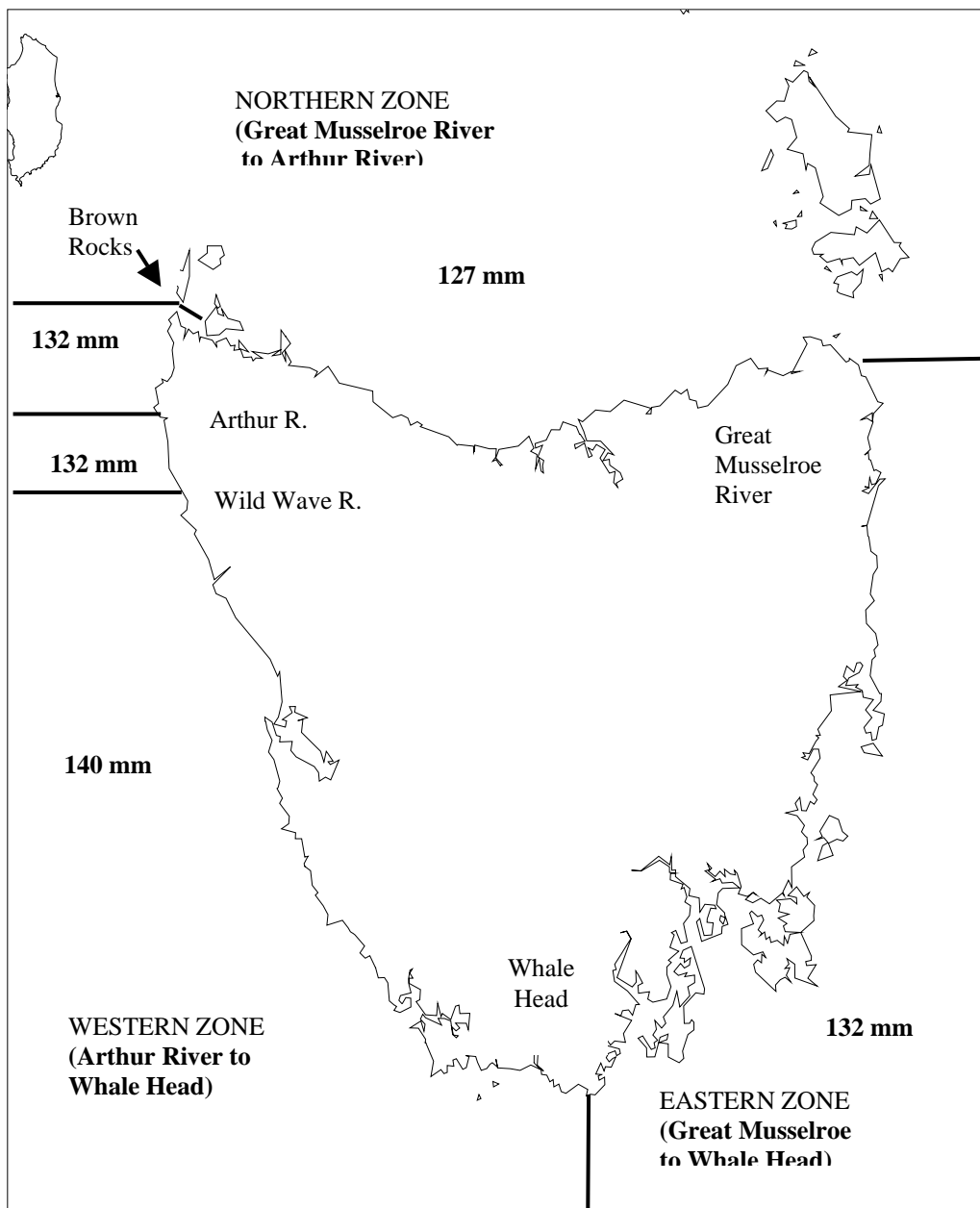


Fig 3: Fishing zones and size limits for commercial abalone fishing in 2001

In 1994, beach prices again dipped with the beach prices reaching as low as \$18 per kilogram in 1995.

Prices have improved since 1997 with very strong prices being achieved in 2000, when the beach price exceeded the \$50 per kilogram mark late in the year. The beach price calculated for the last quarter of 2000 was \$52 per kilogram.

The landed value of the fishery in 2000 was A\$128 million.

To take abalone for recreational purposes, a person must hold a fishing licence (recreational abalone). The number of recreational abalone licences has been increasing over the past few years. This increase could be due to the higher catch rates for abalone against the declining catch rates for rock lobster by recreational fishers, plus an increasing appreciation for the taste of abalone among Tasmanians.

For recreational fishers, a State wide size limit for blacklip abalone of 132 mm was introduced in 2001. For greenlip abalone the size limit is 145 mm except along the north and north west coast between the Arthur River to Three Mile Bluff where 140 mm applies.

Divers (commercial and recreational) must carry a measuring tool and immediately replace undersized fish from the location they were taken.

A bag limit of ten abalone per day applies to licensed divers, with a possession limit of 20 abalone. Non-licensed persons have a possession limit of five abalone without proof of purchase.

Year (ending Oct)	No. abalone dive licences
1996	4,151
1997	4,806
1998	5,511
1999	6,024
2000	6,664

Table 1: Number of Recreational Abalone Diving Licences

Results of a survey of recreational fishing activities between December 1996 and April 1998 indicated that the total catch of recreational abalone for 1997 was approximately 37.5 tonnes, which is approximately equal to 1.5% of the total combined catch. The divers took an average of 5 abalone per days dived.

The *Living Marine Resources Management Act 1995* exempts an Aboriginal person from having to hold a fishing licence whilst participating in Aboriginal cultural fishing. Size limits and bag limits still apply to such fishing activities.

A. 2 Context of the current management plan

The management plan for the abalone fishery is a set of statutory rules titled the *Fisheries (Abalone) Rules 2000*, which have been made under Part 3 of the *Living Marine Resources Management Act 1995* (the Act). The management plan is supported by the fishery policy document (*The Tasmanian Abalone Fishery Revised Policy Paper*, DPIWE 2000a) and policy revisions for 2001 (*Summary of changes to the abalone fishery management plan for the 2001 fishing season*, DPIWE 2000b).

Table 2: Objectives of the *Living Marine Resources Management Act 1995*

<p>7(1) The purpose of this Act is to achieve sustainable development of living marine resources having regard to the need to -</p> <ul style="list-style-type: none">(a) increase the community's understanding of the integrity of the ecosystem upon which fisheries depend; and(b) provide and maintain sustainability of living marine resources; and(ba) take account of a corresponding law; and(c) take account of the community's needs in respect of living marine resources; and(d) take account of the community's interests in living marine resources. <p>7(2) A person must perform any function or exercise any power under this Act in a manner which furthers the objective of resource management.</p> <p>SCHEDULE 1 - OBJECTIVES OF THE RESOURCE MANAGEMENT AND PLANNING SYSTEM OF TASMANIA</p> <p>1. The objectives of the resource management and planning system of Tasmania are -</p> <ul style="list-style-type: none">(a) to promote the sustainable development of natural and physical resources and the maintenance of ecological processes and genetic diversity; and(b) to provide for the fair, orderly and sustainable use and development of air, land and water; and(c) to encourage public involvement in resource management and planning; and(d) to facilitate economic development in accordance with the objectives set out in paragraphs a, b and (c); and(e) to promote the sharing of responsibility for resource management and planning between the different spheres of Government, the community and industry in the State. <p>2. In clause 1a, "sustainable development" means managing the use, development and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic and cultural well-being and for their health and safety while -</p> <ul style="list-style-type: none">(a) sustaining the potential of natural and physical resources to meet the reasonably foreseeable needs of future generations; and(b) safeguarding the life-supporting capacity of air, water, soil and ecosystems; and(c) avoiding, remedying or mitigating any adverse effects of activities on the environment.
--

The Act sets out the objectives for the sustainable management of living marine resources in Tasmania and provides the framework for developing and implementing management plans for each of the State's fisheries. The objectives of the legislation

are provided in Section 7 and Schedule 1 of the Act, they are consistent with the objectives of the resource management planning system of Tasmania (Table 2).

A.3 Objectives of the management plan

In addition to meeting the objectives of sustainability prescribed by the Act, the management plan addresses a number of objectives provided in the Tasmanian Abalone Fishery Revised Policy Paper (DPIWE 2000a). These are summarised in the following table (Table 3).

Table 3: Objectives of the abalone policy document

OBJECTIVE	STRATEGIES
<p>MAINTAIN BIOMASS AND RECRUITMENT</p> <p>To maintain fish stocks at sustainable levels by constraining the catch and size of individual abalone taken by the commercial and non-commercial sectors. In particular, to ensure that:</p> <ul style="list-style-type: none"> • Abalone are harvested at sustainable levels. • Biomass and egg production do not decrease below the chosen proportion of pre-fishing egg production and that reasonable levels of egg production are maintained in all regions of the fishery. <p>To allow abalone to grow to a size where they have two breeding seasons through the use of appropriate size limits.</p>	<ol style="list-style-type: none"> 1. Limit the catch of the commercial sector and restrict catching potential of the non-commercial sector. 2. To prohibit the taking of abalone at a size below which the fish have not had adequate opportunity to reproduce through the enforcement of minimum legal sizes, whilst ensuring that the minimum size limits reflect differences in both growth rates and harvesting rates around Tasmania.
<p>SUSTAINING YIELD AND ECONOMIC RETURN</p> <p>To take abalone at a size likely to result in the best use of the yield from the fishery.</p> <p>To protect abalone below the minimum legal size.</p> <p>To maintain economic returns by restricting the level of catch and the number of participants in the commercial fishery.</p>	<ol style="list-style-type: none"> 1. To prohibit the taking of abalone below minimum legal size limits. 2. Restricting the number of divers in the fishery and limiting their catches within the Total Allowable Catch.
<p>COMMERCIAL FISHING INTERACTIONS</p> <p>To separate the activities of abalone divers from those of other commercial fisheries, particularly the commercial diving and rock lobster fisheries,</p> <p>To limit the harvesting of seaweeds until there is a better understanding of the ecological implications of such harvest.</p>	<ol style="list-style-type: none"> 1. Prohibit access to abalone by holders of fishing licence (commercial dive).. 2. Prohibit access to other species, such as rock lobster and sea urchins, by holders of fishing licence (abalone dive). 3. Limit entry to the harvesting of marine plants.
<p>ACCESS TO FISH STOCKS BY NON-COMMERIAL FISHERS</p> <p>To provide reasonable access to abalone</p>	<ol style="list-style-type: none"> 1. Limit the catch of the commercial sector 2. Maintain individual daily catch limits for recreational

<p>stocks for recreational fishers and Aboriginal people.</p> <p>Restrict daily catches of rec. fishers such that it is not a cover for illegal fishing.</p>	<p>divers and Aboriginal people.</p> <p>3. Maintain possession limits for all person.</p>
<p>MARINE FARMING INTERACTIONS</p> <p>To enable both the farming of abalone and the harvesting of wild stocks to co-exist without posing a threat to the other.</p>	<p>1. Maintain a record of the movement of abalone onto and off marine farms to reduce the possibility of such operations illegally passing wild abalone through their farms..</p> <p>2. Encourage marine farmers to have visually distinct abalone so that they are distinguishable from wild abalone, thereby preventing the transfer of wild abalone onto a marine farm.</p> <p>3. Conduct research into parasites and disease of abalone on farms and in the wild, to reduce the introduction and spread of diseases.</p>
<p>ENVIRONMENTAL INTERACTIONS</p> <p>To maintain the marine ecosystems upon which Tasmania's abalone stocks depend and minimise the impact of other fisheries on the ecosystems.</p> <p>To maintain a robust abalone stock around Tasmania.</p>	<p>1. To control the harvesting of native seaweeds.</p> <p>2. To reduce the impact of introduced seaweeds.</p> <p>3. Set the TAC for the commercial fishery at a conservative level, thereby minimising the impact of population declines on the ecosystems.</p> <p>4. Establish a series of Marine Resources Protected Areas so that representative Tasmanian ecosystems are reserved under a no-take policy.</p> <p>5. Set minimum legal size limits to reduce the potential for local depletion and disruption of community structure.</p>
<p>ENFORCEMENT</p> <p>To prevent the combined take of abalone by licensed commercial and recreational divers, Aboriginal people and unauthorised persons from exceeding the sustainable productivity of the Tasmanian abalone stocks.</p> <p>To prevent recreational divers, Aboriginal people and unauthorised persons from selling abalone.</p> <p>To prevent unauthorised persons from taking or possessing abalone.</p> <p>To prevent any person from possessing commercial quantities of abalone without suitable documentation.</p>	<p>1. Prohibit licensed commercial and recreational divers, and Aboriginal people undertaking Aboriginal cultural fishing, from taking more abalone than they are authorised to harvest.</p> <p>2. Prohibit recreational divers and Aboriginal people undertaking cultural fishing from selling abalone.</p> <p>3. Prohibit unauthorised persons from taking, possessing and selling abalone.</p> <p>4. Prohibit any person from possessing commercial quantities of abalone without suitable documentation.</p> <p>5. Require that documentation is maintained for all abalone moving through the processing system.</p>
<p>COST RECOVERY AND RETURN TO THE COMMUNITY</p> <p>To recover the Government's operating costs for the abalone fishery (commercial and recreational) from the participants through fees agreed in the Abalone Deed of Agreement, and licence fees from holders of abalone quota, commercial abalone divers and recreational licences.</p> <p>To recover a portion of the resource rent</p>	<p>1. Set licence fees for holders of abalone quota, and commercial and recreational abalone divers at such a level that operating costs are met.</p> <p>2. Set fees in accordance with the schedule under the Abalone Deed of Agreement and set licence fees for holders of fishing licence (abalone quota) in accordance with the level of fees under the Abalone deed of Agreement.</p>

generated by the commercial fishery through fees agreed in the Abalone Deed of Agreement and licence fees from holders of abalone quota licences.	
<p>QUALITY ASSURANCE</p> <p>To maintain the high level of quality assurance for abalone</p> <p>To promote best practice in the handling and processing of marine resources for human consumption.</p>	<ol style="list-style-type: none"> 1. To maintain carrying, handling and storage practices for fish at a high level aboard fishing vessels and by processors. 2. Require all fish processors to operate to the export standard set by the Australian Quarantine Inspection Service.

The policy document for the abalone fishery, together with these objectives will be updated in 2002. At that time these objectives may be revisited, together with consideration of an objective addressing broader ecosystem objectives in relation to the maintenance of ecosystem processes.

A.3 Availability of the management plan

The abalone management plan is a public document and is available from the Printing Authority of Tasmania or at the legislation website (www.thelaw.tas.gov.au).

The Tasmanian Abalone Fishery Revised Policy Paper (DPIWE 2000a) and policy revisions for 2001 contained within *Summary of Changes to the Abalone Fishery Management Plan for the 2001 Fishing Season* (DPIWE 2000b) are also public documents and can be obtained from the Department or from the web (www.dpiwe.tas.gov.au).

Stock assessment reports and a number of technical reports compiled by TAFI are also available from TAFI or on their website. (www.utas.edu.au/docs/tafi/TAFI_Homepage.html).

A.4 Consultative process for developing a management plan under the Act

The Act prescribes a consultative process for the development of a management plan. However, in practice the consultation process is more comprehensive than the minimum requirements prescribed in the Act. The process used includes:

- consulting with the relevant Ministerial Fishery Advisory Committees, in this case the Abalone Fishery Advisory Committee (AbFAC) and the Marine Recreational Fishery Council (MRFC);
- consulting with any appointed fishing body, in this case the Tasmanian Abalone Council (TAC) (including Annual General Meeting(s));
- having the draft plan approved by the Minister for release for public comment;
- a public comment period of at least 60 days;
- providing divers, quota holders and processors with the draft management plan;
- publicising to the wider community the release of a draft plan;
- a report submitted to the Minister on issues raised during the public comment period;

- once approved the management plan is tabled in Parliament for 15 sitting days and is considered by the Standing Committee on Subordinate Legislation, which may disallow all or part of the rules. This committee may take submissions and conduct a hearing if satisfied the rules are not in the interest of the public, or can not be justified, or have not been made lawfully.

A.5 Stakeholder involvement in the development and assessment of a management plan

The management and assessment process for the abalone fishery in Tasmania is reliant upon a number of advisory groups, each includes industry and conservation/community representatives.

The Act stipulates a process for approving formal ‘fishing bodies’. The Act then stipulates a range of consultative requirements with relevant fishing bodies when any management measures are being formed for a particular fishery.

In the case of the commercial abalone fishery, the formally constituted fishing body is the Tasmanian Abalone Council.

The Act also provides for the formation of Fishery Advisory Committees for a particular fishery. Such committees are formally appointed by the Minister and report directly to the Minister. Membership is generally appointed to provide a cross section of expertise of the fishery and different sectors of that fishery.

The Abalone Fishery Advisory Committee (AbFAC) provides advice to the Minister about the management of the abalone fishery. The committee includes representatives from the industry, conservation/community, processors, Marine Police, research scientists, the Department’s fishery managers, and an independent Chairman.

Industry members include participants in the catching sector (divers), processors and quota holders. The committee currently comprises 3 divers (although divers may also hold quota), 2 processor representatives, 1 quota holder (non-diver), 1 researcher from the Tasmanian Aquaculture and Fishery Research Institute, 1 representative from Tasmania Police, 1 community/conservation member, the Senior Executive Officer of the Tasmanian Fishery Industry Council and 1 member from the Wild Fisheries Management Section of the Department of Primary Industries, Water and Environment.

The Marine Recreational Fishery Advisory Council is the peak recreational fishery advisory body created and appointed by the Minister. It is the objective that members provide expertise on the wide diversity of Tasmanian recreational fishing. This Council advises the Minister on all issues related to recreational fishing, including recreational abalone diving.

The Abalone Research Advisory Group provides strategic research planning advice to the Tasmanian Aquaculture and Fisheries Institute (TAFI) and the Tasmanian Fisheries Research Assessment Board. This group includes research scientists from

TAFI, CSIRO and the Australian Maritime College, the fishery manager, industry and community representatives.

The Stock Assessment Group is an informal group under the auspices of TAFI to assist the research scientist in completing the yearly stock assessment for the fishery. This group meets to discuss the data collected and provide their assistance in interpreting relevant data. This group may make recommendations on the setting of the total allowable catch (TAC), however the AbFAC makes a formal, recommendation on the next years TAC directly to the Minister.

The Department also provides advice to the Minister relating to the TAC before the Minister formally determines the TAC for the next fishing season (calendar year starting 1 January).

It is noteworthy that industry participation in the development and management of the fishery has been an integral facet of the fishery since 'day one'. Long term management measures were considered as the fishery developed rather than being imposed after the fact. At the inception of fishing, industry leaders were well informed and took a pro-active role in the future of the fishery. The virtual collapse of the Californian fishery through lack of management was well understood and later reports of the fishery from NSW reinforced pro-active management.

Industry has continued to push the strategic direction of the fishery and played an integral role in the fishery first coming under quota management with associated catch reductions, and refinement of the quota system through zoning.

The Act stipulates the process for public consultation which must be carried out for both the development or the review of a management plan.

Both processes involve a formal public consultation process whereby draft measures are released for comment. This process is important for receiving wider feedback from those involved in the fishery, but also provides an opportunity for the broader community to have some involvement in the process.

Formal submissions must be incorporated in a report which is submitted by the Secretary to the Minister. This report document is a public document.

A.6 Assessment Documentation

The following sections of this assessment report are presented to address 'Guidelines for assessing the ecological sustainability of fisheries management regimes' approved by the Minister for the Environment, Senator Hill, in August 2000. The headings, principles and objectives are presented using the same numbering as Environment Australia's guidelines.

B ESD ASSESSMENT

B.1 PRINCIPLE 1.

A fishery must be conducted in a manner that does not lead to over-fishing, or for those stocks that are over-fished, the fishery must be conducted such that there is a high degree of probability the stock(s) will recover .

B.1.1 Objective 1.

The fishery shall be conducted at catch levels that maintain ecologically viable stock levels at an agreed point or range, with acceptable levels of probability.

B.1.1.1 Information requirements

1.1.1 There is a reliable information collection system in place appropriate to the scale of the fishery. The level of data collection should be based upon an appropriate mix of fishery independent and dependent research and monitoring.

Information for assessing the Tasmanian abalone fishery is collected from a number of sources, both fishery dependent and fishery independent.

A time series of catch effort data extends back unbroken to the commencement of the fishery. This data set continues to play an integral role in the assessment of the fishery. Monitoring of the fishery, together with targeted management measures, has been ongoing from a virtually virgin state. This data set is probably one of the best long term data sets of any fishery in Australia.

Since 1962, however, data storage systems have been modified and superseded. As a result, data from 1975 to the present is most readily available in electronic format. The status, storage format and accessibility of data prior to 1975 is not clear at this time. Therefore, fishery data used in the assessment process generally comprises data from 1975 to the present. These data provide a time series of data (26 years) for the yearly comparisons undertaken in the stock assessment.

Importantly, this time series also encompasses periods of fluctuations in the 'health' of the fishery providing marked contrast between these years. As such, it is considered that this time series is robust for the purpose used.

It is considered that the accuracy of data was improved from 1985 when quota was introduced, together with more rigorous quota monitoring systems. Activities by the Australian Taxation Office around 1982 reputedly reduced non-reporting of 'cash fish', also increasing the reliability of the data from that time.

As discussed further in 1.1.4, a rigorous catch management and reporting system is in place within the fishery. This system is designed to ensure the integrity of the quota system through reporting requirements from the time before a diver goes to

sea, through the process of transfer to a processor, and until the processor dispatches the processed product. This process may be summarised as:

- Diver - pre-fishing report (phone report);
- Diver - post fishing report (phone report);
- Diver - Part A of Diver's Docket Book (i.e. the logbook);
- Processor - prior movement report (phone report of intention to take fish);
- Processor - Part B of Diver's Docket Book (i.e. the divers logbook);
- Processor - movement report (phone report);
- Processor - receipt report (phone report);
- Processor - fish receipt docket (hard copy dockets);
- Processor - dispatch report (phone report);
- Processor - fish dispatch docket (hard copy dockets).

This (complex) system allows the tracking of abalone and verification of data by cross referencing reports at different stages in the system. Thus the sophisticated process designed to ensure the integrity of the quota system has a spin off benefit in ensuring that the catch data (used for stock assessment) is of a high quality.

The Tasmanian system is also supplemented by the National Docketing System.

The relatively small number of buyers (processors) has also assisted monitoring the fishery post fishing.

Effort data is collected by divers as part of the logbook system. The abalone fishery has evolved over the years into a mature fishery, particularly in terms of industry participation in management issues. Divers are familiar with the assessment system in which this data is utilised. Industry has input into TAC recommendations through the Tasmanian Abalone Council and debate such issues in some detail at industry meetings and the Annual General Meeting. This high degree of understanding and participation adds incentive for participants to provide accurate information.

Some uncertainty arises if the practice of recording dive times has changed over the years, particularly since the introduction of dive computers. Dive time can also be difficult to resolve for those blocks where greenlip and blacklip may be taken on the same dive. Such practices may confound this data somewhat in these cases.

It should also be remembered that the impetus for significant decreases in the TAC post 1985 stemmed largely from diver concerns. Thus there is some confidence that most divers take a responsible attitude to completion of logbook data.

The results of catch effort monitoring is also continually cross referenced with the direct observations of divers, particularly those more experienced divers who have participated in the fishery for many years. Such divers may have fished the stock at near virgin levels and also at differing levels of fishing pressure over the history of the fishery. As time goes on, however, the number of participating divers from the early days of fishing will decrease.

The logbook divers complete is called the Diver's Docket Book, which records the catch effort details of all fishing activity and landings of abalone.

Divers record information on date, location (fishing block), (estimated) catch, dive time and depth. A total weight from each trip must be accurately weighed at landing.

Prior to 2000, the resolution of the fishing blocks used for reporting logbook data was a series of 49 fishing blocks Statewide. However, the resolution of the logbook data was improved in 2000 following further subdivision of those fishing blocks. This move was made to more finely monitor activities at a scale relevant to diver activity and abalone biology. This move should increase the quality of the catch effort data and its utility in the stock assessment process.

The blocks are not uniform in size, but were drawn up to attempt to represent a particular 'part' of the fishery or abalone habitat at a meaningful level of resolution.

For assessment purposes, cross referencing research data, such as size composition information, with catch effort data provides additional rigour to the process. For example, a sign of decreasing CPUE in an area may or may not also be associated with a shift in the size composition in the area. 'Danger signals' from two different data sources would compound concerns for any particular area.

As one of Tasmania's major fisheries, targeted research on abalone has been ongoing for many years, at least since the mid 1970s. In this time a substantial bank of knowledge on the two species involved has been built up. As stated previously, an unbroken fishery data set has been recorded, while the type and scope of fishery independent data collected has changed with the aims and objectives of research programs over this period.

A comprehensive market measuring program operated for many years. Measurements of length frequency data (i.e. size composition) was conducted by hired contractors operating at ports and processing premises. After an assessment of the utility of this program it had been discontinued.

However, commercial catch sampling recommenced in 1998. Voluntary catch sampling is undertaken by divers and/or 'deckies' whereby photographs are taken of abalone on a grid. The size of the abalone in each photo can be calculated by calibration to the grid size.

As this is a relatively new data set, its utility will increase as the spatial and temporal spread is increased. A problem identified has been getting a good geographical spread of meaningful data. To address this weakness, targeted population sampling will be undertaken by research staff so that the necessary spatial and temporal spread, together with meaningful sample numbers, can be assured.

The bank of data compiled includes results from targeted population surveys, information on life history (including early life history), spawning behaviour, age and growth, mortality and egg/recruit production.

As explained in 1.1.2, the thrust of the current research effort is the development of more robust quantitative assessment techniques for assessing the status of the fishery and determining an appropriate TAC.

The research programs currently underway at TAFI, and the objectives of each are listed below.

Population monitoring

Objectives:

1. To obtain representative population samples from a range of localities around the State for analysis.
2. To obtain from these samples information on morphometrics, sex and age.
3. To derive estimates of growth rate, mortality and maturation rates (inter alia) from this information.
4. To provide advice to management using the findings of this program.

Abundance Monitoring (Fishery Independent)

Objectives:

1. To develop a fishery independent method of assessing abalone abundance.
2. To concurrently describe the spatial distribution of abalone populations.

Evaluation of performance Indicators

Objectives:

1. To determine the variability and sensitivity of existing population survey data.
2. To recommend appropriate and meaningful performance indicators.
3. To recommend an appropriate population sampling strategy that incorporates performance indicators.
4. To publish these recommendations as a technical report.
5. To tag abalone at two strategic locations that have already been identified in the southeast.

Development of a spatially-structured model for stock assessment and TAC decision analysis for abalone

Objectives:

1. To establish a generic, spatially-explicit, size-structured stock assessment model for blacklip abalone.
2. To develop the necessary software for this assessment and to tailor it for each abalone-producing state.
3. To evaluate the capabilities of the modelling framework.
4. To compile the necessary data and complete a preliminary assessment of each state's abalone fishery.
5. To transfer the technology to each state.

Evaluation of size-limits in western Tasmania

Objectives:

1. To determine appropriate size limits for blacklip abalone in western Tasmania.

Generally speaking, these projects incorporate the collection of the necessary raw data flowing into assessment and modelling programs. A specific program has also been developed to assess and develop more meaningful and robust performance indicators for the fishery.

Another issue which is increasingly being recognised as important is habitat mapping of the marine environment. Funding is being sought for more comprehensive mapping around the Actaeon Islands (in the south east, block 13). Successful pilot mapping has already been undertaken in this area and in the south east generally. This area is probably the most productive abalone area in the State, hence this program would increase knowledge in this critical region.

B.1.1.2-5 Assessment

1.1.2 There is a robust assessment of the dynamics and status of the species/fishery and periodic review of the process and the data collected. Assessment should include a process to identify any reduction in biological diversity and /or reproductive capacity. Review should take place at regular intervals but at least every three years.

The abalone fishery is formally assessed annually through the preparation of a fishery assessment report. The assessment is undertaken by the abalone research scientists at TAFI, in consultation with the stock assessment sub-committee. This assessment forms the basis for setting the TAC for the coming year.

Assessment techniques used through the course of the fishery include analysis of: catch effort data; catch at length data; yield per recruit; transect abundance estimates; and, trends in size/age composition from population surveys.

Much research effort has been targeted towards developing more rigorous and robust assessment techniques for the fishery (particularly fishery independent techniques). This effort results from concerns that the assessment is overly reliant on catch effort data, which may in fact not provide a reliable indication of abundance and/or stock status.

Development of such assessment techniques has been an objective of abalone researchers Australia wide. However, this task has proven very difficult given the nature of abalone biology.

Some of these difficulties and attempts to develop more robust techniques are outlined by Nash (1995) in the final report to the Fisheries Research and Development Corporation for the project titled '*The development of new techniques for assessing and managing the Australian abalone fisheries*'.

Providing more quantitative assessment techniques is probably the major objective of the research effort currently underway in Tasmania.

Two interconnected programs strive to this end, i.e. the projects titled: *Abundance Monitoring (Fishery Independent)*; and, *Development of a spatially-structured model for stock assessment and TAC decision analysis for abalone*.

The modelling project aims to develop novel abundance estimation techniques to overcome the problems identified in the past. This model will draw upon the data collected from several ongoing and past programs in a holistic and quantitative manner.

The abundance monitoring program aims to develop and undertake population surveys to develop abundance estimation techniques using spatial distribution data in addition to density estimates.

The abalone fishery has a strategic research plan which is formulated by the Abalone Research Advisory Group under the auspices of TAFI. As stated previously, this committee comprises researchers from a number of research institutions, industry, conservation/community and DPIWE. This research plan is a public document providing an explicit strategic research plan for the fishery for a five year period. The strategic plan is a 'living' document which is reviewed annually by the group.

A difficulty for the stock assessment is interpretation of data as further management measures are introduced which may confound the data somewhat. This factor reinforces the need for fishery independent data to supplement interpretation of trends in CPUE for example.

A benefit of the fishery operating as a hand collection dive fishery is that divers may continually compare the results from the assessment process with what they observe on the bottom on a day to day basis.

1.1.3 The distribution and spatial structure of the stock(s) has been established and factored into management responses.

The distribution and the population parameters of the population are well documented. This data set includes good information on the (marked) spatial variation in biological parameters.

This spatial variability in populations, together with a short larval dispersal, is an important facet of the fishery which must be considered in the management of the fishery.

As explored below, and further in 1.1.6, growth and hence size at maturity varies markedly around the State. Further, our understanding of early life history is that the pelagic larval phase of abalone is relatively short, with limited scope for wide dispersal and advection. This facet of abalone biology suggests that they may be susceptible to localised depletion which could lead to serial depletion. Thus the 'scale' upon which management is implemented in the fishery is of importance.

The distribution and spatial structure of the abalone fishery continues to be one of the primary management issues in the fishery. There has been an increasing trend of a

concentration of effort in key areas and a corresponding decrease in catch and effort in other (often less assessable) areas.

Since quota was introduced there has been an increasing concentration of fishing effort in the east and south east of the State. In 2000, fishing zones were introduced into the fishery so that portions of the TAC must now be taken from within certain areas. In 2001 three zones for blacklip abalone and one zone for greenlip are in place.

The greenlip fishing zone is supplemented by an additional 5 month closure in Franklin Sound each year and a pre-determined trigger point for the Furneaux Group of Islands in total (i.e. 42 tonnes).

The cap in the Furneaux group was supplemented in May 2001 by additional caps in the north east and north west. These caps were implemented to spread the catch more evenly following compilation of 2000 data which indicated little catch came from King Island in that year. The triggers are designed to ensure that an appropriate portion comes from around King Island and that other areas do not carry an additional 'share' of the catch.

It is worth noting that the size limit around King Island has recently been increased. Thus greenlip abalone in that region may have been less vulnerable to fishing for a period as abalone grew up to the new size limit. In 2001, with an additional years growth, this should not be a factor in fishing. However, it was considered that greenlip abalone may be less resilient than blacklip, due to the biology and behaviour, and therefore the implementation of new triggers was considered a prudent precautionary move.

As explained further in 2.3.1, there are also four existing marine reserves where no abalone (or other fish) may be taken (a fifth reserve has recently been declared around Macquarie Island which is of no relevance to the abalone fishery). These are reserves at Ninepin Point, Tinderbox, Maria Island and Governor Island (Bicheno).

A research area is in place at George III Rocks in the south east of the State, where no abalone may be taken. With implementation of the new 'northern zone' in 2001, a further four research areas will be declared in that area. The objective of the research areas is to provide baseline and comparison data so the effects of management changes can be measured. The boundaries of these areas have now been finalised and it is envisaged these areas will be implemented by the end of June 2001.

An inherently interconnected issue with a concentration of fishing effort is the spatial variability in growth rates (and size at maturity) around the State. An objective of the management arrangements for abalone is to provide at least two years protection post sexual maturity, before abalone become available to exploitation. Along with the TAC, size limits remain one of the most important tools for protecting the stocks from over exploitation.

A deal of research effort has been expended determining growth rates, together with the size at maturity of abalone around the State.

For blacklip abalone, the general trend is that abalone grow faster and mature at a larger size in the south than in the north.

A size limit on abalone was the first management restriction placed upon the fishery in 1962 (127 mm). Since then, size limit regulations have been fine tuned to provide additional protection to areas of faster growth.

This process of fine tuning size limits now sees three size limits in place for both blacklip and greenlip abalone.

The most recent example of the utilisation of such growth data in the management decision process was a review of size limits in the north of the State. The issue arose in response to concrete evidence that some blacklip abalone received many years protection above the 'two year protection rule', or indeed may never reach the minimum size limit.

A model (and associated technical report (Officer 2000b)) was developed by TAFI to assess the level of protection afforded under differing size limit and boundary scenarios. The model draws upon historic catch data, size at maturity data and size composition data of the population in that region. The compilation of the model followed an intensive sampling program in the region.

The model was developed in an interactive format so that industry, managers and the advisory committee could more easily develop and assess alternate scenarios.

After extensive consultation a reduction in the blacklip size limit was introduced in the north, however, a conservative size limit was implemented (127 mm) which still provides most fish significantly more than two years protection post maturity.

In most cases the size limits are not set utilising the two year rule alone. Egg per recruit simulates have generally been used to assess the level of egg production that is protected under any size limit scenario.

Thus, the thrust of management measures, which include size limits being imposed at an increasing resolution and the introduction of zoning, are designed to address the compounding issues of susceptibility to localised depletion, concentration of fishing effort and variable growth rates.

In any area the size limit implemented quarantines the portion of the population which will not be subjected to any (legal) fishing pressure. The total allowable catch for a zone determines the amount of the exploitable population above the size limit which will be taken.

The biology of blacklip abalone also provides some protection from exploitation at different parts of the life cycle. Immature abalone are generally highly cryptic and shelter in small crevices and cracks, making them very difficult to find (this factor also makes research difficult). As blacklip mature, they emerge making them easier to find, however, depending on the type and topography of reef habitat, significant quantities are still probably not vulnerable to hand fishing techniques. Also, a portion

of the population in deeper water may be less vulnerable to fishing than in shallow waters.

Apparently limited capability for widespread dispersal through larval advection raises the issue of susceptibility to serial depletion, and a corresponding alteration to the genetic diversity or composition.

As suggested above, and in sections 1.1.6-9, management in the fishery has progressively moved to an increasing level of finer resolution. While the TAC is segregated into three fishing zones (for blacklip) additional management measures can (and have) been implemented at a scale of region (e.g. north west or north east), block or sub block (e.g. sub blocks in block 13).

These tools provide mechanisms to minimise the likelihood of serial depletion and a corresponding depletion of genetic diversity.

The CSIRO has been studying the genetic diversity of abalone in south eastern Australia. Despite an expectation that discernible differences in populations would be detected at a relatively small scale, preliminary results have found relatively heterogeneous genetic composition across a wide area. Little differentiation has been detected across distances as wide as between Tasmania and Victoria.

The similarity between populations over relatively long distances could be due to a relatively small amount of genetic mixing over time, or indeed advection may occur further than has been thought.

1.1.4 There are reliable estimates of all removals, including commercial (landings and discards), recreational and indigenous, from the fished stock. These estimates have been factored into stock assessments and target species catch levels.

There is good time series of data describing the commercial catch since exploitation began. The catch effort data collected from the fishery is described in 1.1.1. As described, the data from 1975 to date is most readily accessible in electronic format, hence the stock assessment generally encompasses these data post 1974.

As discussed later in this section, and in 1.1.1, there is a sophisticated system of quota management which protects the integrity of the quota system, and also ensures that this data set is of high quality. Few fisheries would have as rigorous a range of reporting requirements and cross referencing through the catching and production chain.

Some difficulties arise separating greenlip from blacklip catches from some of the historical data when catches were recorded just as 'abalone'. This is only an issue in the very north of the State as the distribution of greenlip is limited to this area. When both species are taken on the same dive this also makes meaningful interpretation of CPUE data more difficult.

Additionally, it has been suggested that diving practices have generally improved over the years with effort becoming more effective (e.g. the use of drop lines rather than the diver surfacing with a full bag may improve efficiency, also dive computers may allow more efficient dive profiles to be implemented), raising the issue of effort creep and the need for standardisation of the CPUE data. Some older divers, however, suggest that in fact older divers from the early days of the fishery were 'better' and more efficient.

TAFI is currently trialing effort standardisation techniques to determine if these techniques have application for abalone. Preliminary results to date have not shown any marked difference between raw CPUE and standardised CPUE.

An emerging issue for such effort standardisation is differing catch rates achieved for the live fish market rather than abalone used for canning. 'Live fishers' may spend more time carefully removing each abalone from the rock, thus apparently reducing CPUE. It is noteworthy that the area in the south east of the State (the Actaeon Islands) discussed in section 1.1.5 is popular for live fish divers.

Divers targeting live abalone may also fish to a size preference changing the pattern of the fishing from other less discriminating fishing practices.

Discarding is not an issue in the fishery.

The spatial distribution of the catch is derived from catch estimates (when only one fishing block is fished on a trip, which is often the case, an absolute weight is derived from the trip total). However, given the value of the catch and method of harvesting, estimated catch figures are considered highly accurate.

The absolute catch figures are very reliable as all landings must be weighed by the diver/processor. Given the value of the catch, there is strong incentive for the diver and the processor (i.e. the seller and buyer) to ensure figures are precise. Landing reports can also be cross referenced between diver and processor records.

Rigour arises from the close scrutiny of the quota system and cross checking of the paper trail.

Over the last five years it has been identified that estimates of the recreational catch in most Tasmanian fisheries were lacking. To fill this void, surveys (telephone & diary) of recreational fishers were trialed and then implemented. For abalone, these surveys are assisted by the fact that a recreational dive licence is required to take abalone (i.e. the pool of fishers to be surveyed is easily identified).

Results of a survey of recreational fishing activities between December 1996 and April 1998 indicated that the total catch of recreational abalone for 1997 was approximately 37.5 tonnes, or around 1.5% of the total combined catch. Divers took an average of 5 abalone per day dived (Lyle & Smith 1998).

Further surveys are currently underway as part of a national survey of recreational (and cultural) fishing activity.

No information about indigenous fishing activity is currently available, but it is thought that the aboriginal cultural take is very small. The national survey mentioned above will provide a quantitative assessment of this take.

The recreational and commercial catch is incorporated in the stock assessment report. Any fishery independent data/assessment is representative of the population *per se*, irrespective of the relative take by the recreational, commercial, Aboriginal and illegal sectors.

For example, catch effort data is a measure or indicator reflecting the abundance of abalone in that particular area (i.e. fish on the bottom), this abundance is not an indicator of the level of commercial activity but of the result of all extractions from all sources. Similarly, information on the size/age composition of an area provides information relating to that population irrespective of the take from any particular sector.

It is also worth noting that the recreational catch is a small proportion of the catch.

Due to the high monetary value of abalone, illegal fishing is a issue, however, estimating the size of the illegal take is problematic. Significant resources are expended by DPIWE, Tasmania Police and mainland enforcement agencies to tackle illegal activity.

The quota monitoring system, designed to ensure those within the fishery do not 'cheat', is a rigorous series of pre and post activity reporting (i.e. a paper trail) from before the diver goes to sea until the point where the processor consigns the abalone away (as described in 1.1.1). This system is then supported by a national docketing program.

The quota system is monitored by a dedicated unit within DPIWE, i.e. the Quota Audit Unit. This unit is responsible for Tasmanian quota fisheries (i.e. abalone, rock lobster and giant crab) and currently comprises 7 staff (not including licensing or statistics sections). The salary costs estimated to be attributable to abalone are \$159,088.

Tasmania Police also expend considerable resources towards policing both the legal fishery and illegal activity by unlicensed divers (i.e. 'illegal and unreported fishing' in Commonwealth terminology). Within the Marine and Rescue Division there is a special Abalone Task Force which is dedicated to abalone policing. Tasmania Police and DPIWE also liase and cooperate with enforcement agencies from other jurisdictions and may conduct joint operation with other jurisdictions.

Estimated policing costs by the Police Marine Division are \$1,140,000 (not including corporate overheads). One of the advantages of the enforcement responsibilities lying within the Police rather than within the Department is that all Police in the State may undertake fisheries duties, not just those routinely involved in fisheries policing.

The Department has a service agreement with Tasmania Police prescribing the minimum level of enforcement activities to be undertaken in relation to divers,

processors, recreational and unlicensed fishing. The Police record and report activities against the agreed level of service and report against milestones.

For example, there is a predetermined number of at sea inspections of commercial divers to be made each year. In addition, the spatial distribution of such inspections is also prescribed. Similarly, the number of boat ramp inspections, processor checks, together with a range of other performance indicators are also agreed. This process adds additional rigour to the enforcement process.

The benchmark system is a relatively new initiative and refinement of the targets will be undertaken as the system evolves over time. For example, the 2000/2001 service agreement provides for 118 at sea inspections, 1,426 large vessel patrol hours, 17 small vessel patrol hours and 100 land inspections.

Tasmania Police supports a database system (*Mermaid*) recording police activity which is then summarised and reported against activity groupings. Reports indicate progress against the predetermined benchmarks and tracks pro rata comparisons to the target levels.

The Australian Institute of Criminology is currently undertaking a project to attempt to estimate the illegal take of abalone in Australia. This project should, for the first time, provide a reliable quantitative estimate of the size of the problem.

The penalties for abalone offences in Tasmania are now very significant (including mandatory 'special penalties'). The first person under Tasmanian law to serve a jail sentence for fisheries offences was recently jailed for charges relating to abalone. This same person has also been banned from being in State in a vessel under a prescribed size by a special provision within the *Living Marine Resources Management Act 1995* (i.e. Division 7 – Control orders).

The penalties provide a significant disincentive to those within the fishery from breaking the rules. Most have substantial investments in the fishery, which can be placed in jeopardy if a person attracts 200 demerit points.

If a person is found guilty of offences worth 200 demerit points, that licence (except quota) must be surrendered and that person may not operate in the (any) fishery. Effectively, 1 demerit point equals \$100 worth of fines, thus a \$20,000 fine equals 200 points.

In addition, the monetary penalties for licensed and un-licensed activity are significant. Above what a judge may award for different grades of offences, the legislation provides for 'special penalties' which are mandatory prescribed penalties for different offences.

For example, if a recreational diver was caught with 5 undersized abalone this would attract a penalty in excess of \$700. A poacher found with 500 kg of abalone would attract \$135,000 in special penalties in addition to what a judge may award.

A licensed diver found with 75 kg of illegal abalone (e.g. undersized or out of quota) would attract \$20,250 special penalties (202 demerit points) in addition to those

awarded by a judge, have the dive licence cancelled, and if also a quota holder, could have to divest that quota.

It is considered that the monitoring, enforcement and penalty framework in place provides a rigorous system of checks and cross checks, a realistic expectation of apprehension and significant penalties for offences that are adequate to ensure the integrity of the fishery, both licensed and unlicensed.

Local demand for abalone is also probably far less than in some other States. With a limited market within the State, poachers must export fish themselves, or find a way of getting the abalone into the 'system', thus increasing the complexity and risk of this activity.

1.1.5 There is a sound estimate of the potential productivity of the fished stock/s and the proportion that could be harvested.

As mentioned previously, estimating the productivity of abalone stocks is problematic. Significant resources have been expended in Tasmania, Australia wide and internationally to develop methodologies to undertake such assessments.

The absence of a quantitative model for assessing the fishery has seen the development of an alternate suite of assessment methods both fishery dependent and independent. These techniques have been used in conjunction to provide indicators of the status and health of abalone stocks.

These indicators suggest that the fishery has shown significant rebuilding since the reductions in quota post 1985. Catch rates are generally well above those for the pre quota reference years and still generally higher than the post quota reference years. Size composition trends, together with catch rate trends, have generally provided little evidence of either growth overfishing or recruitment overfishing.

Preliminary figures from the 2000 fishing year to be utilised in the stock assessment have now become available. These data show that catch rates on the east coast have now plateaued, or even fallen somewhat in the last year or two, suggesting the trends in this area should be carefully monitored to assess if management changes (i.e. zoning) will see stable catch rates eventuate, or if catch rates continue to decline.

In particular, the concentration of effort in the south east has seen very significant quantities of abalone come from this area. While this area has very extensive reef habitat and is highly productive, the CPUE in this area has plateaued and has trended downwards in block 13 over the last few years.

Because this area is such a critical fishing ground, the size composition of abalone is sampled by TAFI on a monthly basis. This data suggests that fishing in the area (block 13) may now be reliant on the amount of abalone growing past the size limit each year.

Abalone in this area are fast growing (perhaps in response to exploitation and good growing conditions) and may not be receiving the full two years protection from harvesting post maturity.

A review of the size limit in this area will be undertaken during 2001 to determine if size limits are appropriate, or if size limits needs further refinement in that area.

A precautionary interim measure to cap the catch in block 13 in 2001 has been implemented in May 2001. The catch in sub blocks 13C, 13D, and 13E (combined) will be capped at 300 tonnes. The cap will be implemented in quarterly portions to minimise disruption in the fishery.

In relation to greenlip, the advisory committee has considered the desirability of further catch caps to ensure that the catch is more evenly spread over the distribution of the greenlip abalone. In particular, the catch around King Island in 2000 was relatively small. This catch was redistributed to the north east and north west (as the Furneaux Group was capped at 42 tonnes). Greenlip abalone may be more susceptible to overfishing than blacklip abalone, thus more precautionary management may be appropriate for this species. For this reason, it was considered prudent to introduce caps for the north east and north west regions to supplement the Furneaux cap already in place.

As of 2001, the north west region will be capped at 40 tonnes , while the south east is capped at 30 tonnes. This means a minimum of 28 tonnes must be taken from King Island.

Together with the two years spawning post maturity guideline, the analysis of appropriate size limits has usually been assessed further through yield/egg per recruit analysis. Egg per recruit analysis was the basis of increasing size limits for greenlip abalone in 2000 aimed at ensuring egg production is maintained across the distribution of the species.

For blacklip abalone, a comparison of virgin stock egg production to egg production at several sites around Tasmania indicated that egg production at those sites was relatively high (>40% of virgin stock egg production). These results suggest there is good protection for the population (and egg production) in those areas, and correspondingly little concern regarding the likelihood of recruitment failure in those areas.

B.1.1.6-9 Management responses

1.1.6 There are reference points (target and/or limit), that trigger management actions including a biological bottom line and/or a catch or effort upper limit beyond which the stock should not be taken.

Appropriate reference points for the Tasmanian abalone fishery have been examined in detail through the stock assessment processes, the stock assessment sub-committee, the Abalone Fishery Advisory Committee, and in detail in the 1997/98 stock

assessment report (Officer 1999a) which reviewed the reference points used to date. A number of conclusions and recommendations resulted from that review.

In regards to the most appropriate periods to act as 'reference years', Officer (ibid) suggested two periods should be utilised in assessing the ongoing status of the fishery. It was suggested that maximum or minimum values from the reference years did not take allowance of inter-annual variability, it was recommended that the average of the reference years should be utilised.

Two periods have been chosen as reference years, these being identified as 1979 to 1982 as years when the fishery was under the heaviest levels of exploitation, and 1992-95 as years of stable catches after a period of quota reductions.

Significant problems have been encountered developing meaningful triggers for the fishery. It was determined that decision triggers may be misleading within the existing data set. Given concerns regarding the usefulness of CPUE data in particular, it was considered more useful to review the performance of the fishery during the year, together with the annual stock assessment report and if considered necessary, undertake a management review.

The performance of the fishery is assessed each year on a block by block and region by region basis specifically against the reference years, and the time series of data generally. Thus the fishery is 'reviewed' at a fine resolution each year prior to the TAC being set. This process is ongoing without necessarily triggering a formal review as defined by the *Living Marine Resources Management Act 1995*.

When other quantitative assessment techniques are developed appropriate trigger points relative to the output from those techniques will be developed.

There is also an ongoing process to identify issues in the fishery, rather than waiting for an 'alarm bell' to ring. Pro-active measures have been taken to address the concentration of effort in the fishery and this process will evolve further at a finer level 'post zoning'.

Analysis of the fishery is conducted through the annual stock assessment process through an (initial) strategy by examination of:

1. Changes in catch per unit effort;
2. Egg production; and
3. Size composition;

In more detail, these three facets will be examined as follows.

1. Changes in 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 stock abundance. The use of CPUE for abalone, however, must be used with caution. For the purpose of the Management Plan, CPUE is defined as the kilograms of abalone caught per hour dived and will be calculated from the information supplied by divers on the Abalone Divers' Docket.

CPUE needs to be used in conjunction with changes in the level of catch being taken from areas. Areas which produce a large catch are of greater concern, along with areas where the level of catch is significantly different to previous levels (either higher or lower).

2. Egg production

Maintenance of sufficient levels of egg production is crucial to prevent declining recruitment and eventual recruitment failure of the fishery. Unfortunately, there is a high degree of uncertainty in terms of both the level of egg production required and whether there are certain regions which are most important as the source of future recruitment. In light of this uncertainty, it is important to apply a precautionary approach, and to ensure that both global and regional egg production is maintained above the lowest levels that have been experienced.

During late 1998 data on levels of egg production was collected from greenlip abalone stocks across northern Tasmania, King Island and the Furneaux Group, whilst this data was collected to help set appropriate size limits, this information will be useful when the sampling is repeated in the future. The time scale may be in terms of five to ten year periods, but such time scales are necessary to detect significant changes in the egg production in abalone populations.

This information is also useful for simulations to set appropriate size limits.

3. Size composition

With the recent introduction of the voluntary photo sampling of the commercial catch, a new and ongoing data source is becoming available to monitor the size composition of the commercial catch. It is hoped that over the years, this data source will continue to grow, in terms of both the number of fish sampled and the areas covered. At this stage, as the database is small and limited in its coverage of blocks and time, the data may not be representative of the commercial catch as a whole. As the database increases in time and size, issues of biases can be dealt with. This data, in conjunction with information from processors, will enable trends in the size composition to be detected and followed.

In addition, there will be periodic intensive sampling of areas around the State that will produce fisheries independent estimates of the size composition of the abalone in these areas. Such data will be extremely useful for comparisons with the commercial catch size composition.

Size composition and growth information has been integral in the discussion and decision making process surrounding the fishery in the south east. This data has been invaluable for added information on conditions in that area.

With additional fishery independent data collection now being implemented together with the 'modelling program', results from these projects, especially the quantitative analysis of harvesting strategies, will flow in to the formal assessment as they become available.

The problems encountered formulating trigger points has seen the development of a research program explicitly aimed at assessing trigger points utilised, and produce

meaningful quantitative trigger points in the fishery. Within the Research Advisory Group process, this program was identified as 'high priority'. It is the objective that this project will provide a quantitative platform for determining trigger points in future years.

As previously mentioned, a key issue in assessing the fishery is the spatial scale of assessment and management measures. In response, management has become increasingly sophisticated with finer resolution of the major 'weapons' in the management armoury; i.e. size limits and the TAC.

It is envisaged that both the assessment and ongoing management measures will continue to be refined in response to this issue to ensure key areas do not become overfished.

It should also be recognised that the yearly assessment does not rely on a single model with a definitive quantitative output, rather the assessment and resulting decisions are made 'on balance' given the best information available at the time.

1.1.7 There are management strategies in place capable of controlling the level of take.

The take in the commercial abalone fishery is controlled by quota management together with an annual TAC. For blacklip abalone, this TAC is then segregated to three geographic zones from which a certain level of catch must be taken.

Further catch caps for specific areas have also been implemented. Any portion of the fishery can be closed at short notice by special order if so required.

The quota is divided equally between the 3,500 quota units in the fishery.

A formal licence is required to take abalone for recreational purposes. Daily bag limits and possession limits apply to those recreational fishers. Possession limits also apply to non-licensed persons without proof of purchase.

Size limits apply for all sectors.

1.1.8 Fishing is conducted in a manner that does not threaten stocks of by-product species.

The abalone fishery (both commercial and recreational) is a dive fishery whereby individual abalone are collected by hand. As such, no bycatch is taken.

1.1.9 The management response, considering uncertainties in the assessment and precautionary management actions, has a high chance of achieving the objective.

Quota management has controlled the level of catches since 1985. The catch was reduced in a stepwise manner to 1989, allowing for the recovery of stocks and subsequent TAC increases. The first increase in the TAC occurred in 1997 some 8 years after the first initial reductions under quota.

It is recognised that the TAC is set within the best information available at that time.

The setting of the TAC for 2001 was carried out in conjunction with the quantitative modelling as reported by Officer & Tarbath (2000b). The increase in the TAC for 2001 results from additional abalone previously unavailable entering the fishery (i.e. the fish in the north between the new 127 mm size limit and the previous 132 mm limit). Otherwise, the TAC is the *status quo* from the previous year.

Further precautionary catch limits have been implemented for greenlip abalone in the north and north east. Caps are now in place for three of the four broad regions for greenlip. This provides fine resolution restrictions on the distribution of the greenlip catch.

A cap on the catch in part of the south east has been implemented for the 2001 fishing year while the size limit in the area is reviewed.

The current rules for the management plan expire in December 2004. The plan will require full formal review before expiration of the rules.

B.1.2 Objective 2.

Where the fished stock(s) are below a defined reference point, the fishery will be managed to promote recovery to ecologically viable stock levels within nominated timeframes.

B1.2.1-2 Management responses

1.2.1 A precautionary recovery strategy is in place specifying management actions, or staged management responses, which are linked to reference points. The recovery strategy should apply until the stock recovers, and should aim for recovery within a specific time period appropriate to the biology of the stock.

Not applicable. It is considered that the fishery has been through a period of recovery since 1985, which has now seen the fishery in a state such that the TAC has risen over the last few years. The effects of changes to the TAC over the last few years together with the introduction of zoning will need to be monitored carefully in coming assessments.

The TAC is set annually by the Minister following completion of the yearly stock assessment process. The Minister takes advice from DPIWE, the abalone industry and the Abalone Fishery Advisory Committee.

To comply with the objectives of the Act the Minister must take appropriate action to ensure a fishery is managed sustainably. The Act provides powers to review or revoke management plans or to take emergency action to rectify threatening actions.

1.2.2 If the stock is estimated as being at or below the biological and / or effort bottom line, management responses such as a zero targeted catch, temporary fishery closure or a 'whole of fishery' effort or quota reduction are implemented.

Currently not applicable.

B.2 PRINCIPLE 2.

Fishing operations should be managed to minimise their impact on the structure, productivity, function and biological diversity of the ecosystem.

B.2.1.1 Objective 1.

The fishery is conducted in a manner that does not threaten bycatch species.

B.2.1.1 Information requirements

2.1.1 Reliable information, appropriate to the scale of the fishery, is collected on the composition and abundance of bycatch.

No bycatch is taken in the fishery.

B.2.1.2 Assessments

2.1.2 There is a risk analysis of the bycatch with respect to its vulnerability to fishing.

Not applicable.

B.2.1.3-6 Management responses

2.1.3 Measures are in place to avoid capture and mortality of bycatch species unless it is determined that the level of catch is sustainable (except in relation to endangered, threatened or protected species). Steps must be taken to develop suitable technology if none is available.

Not applicable.

2.1.4 An indicator group of bycatch species is monitored.

Not applicable.

2.1.5 There are decision rules that trigger additional management measures when there are significant perturbations in the indicator species numbers.

Not applicable.

2.1.6 The management response, considering uncertainties in the assessment and precautionary management actions, has a high chance of achieving the objective.

Not applicable at this stage. However, the Act provides for amendments to management plan and emergency responses which would be used to protect a species that was perceived to be under threat.

B.2.2 Objective 2.

The fishery is conducted in a manner that avoids mortality of, or injuries to, endangered, threatened or protected species and avoids or minimises impacts on threatened ecological communities.

B.2.2.1 Information requirements

2.2.1 Reliable information is collected on the interaction with endangered, threatened or protected species and threatened ecological communities.

As detailed above, the abalone fishery is a dive fishery whereby the target species is collected by hand.

The interactions with endangered or threatened species could be considered analogous to 'normal' boating activities.

B.2.2.2-3 Assessments

2.2.2 There is an assessment of the impact of the fishery on endangered, threatened or protected species.

Not applicable.

2.2.3 There is an assessment of the impact of the fishery on threatened ecological communities.

Not applicable.

B.2.2.4-6 Management responses

2.2.4 There are measures in place to avoid capture and/or mortality of endangered, threatened or protected species.

Not applicable.

2.2.5 There are measures in place to avoid impact on threatened ecological communities.

There are no identified impacts for threatened species or threatened ecological communities.

Issues of greater concern to ecological communities in Tasmania include the spread of introduced species (seaweed - *Undaria*, the North Pacific seastar - *Asterias*) and new invasions (long spined sea urchin - *Centrostephenious*). Research is currently underway to evaluate the impact of these species.

2.2.6 The management response, considering uncertainties in the assessment and precautionary management actions, has a high chance of achieving the objective.

Any impact identified on threatened ecological communities will be managed under various sections of the Act, either by direct controls on the fishing activity or by the introduction of a habitat management plan.

B.2.3 Objective 3.

The fishery is conducted, in a manner that minimises the impact of fishing operations on the ecosystem generally.

B.2.3.1 Information requirements

2.3.1 Information appropriate for the analysis in 2.3.2 is collated and/or collected covering the fisheries impact on the ecosystem and environment generally.

As a hand collection fishery, interactions with the marine environment are limited. Any impact would generally result from the removal of a portion of the population of a molluscan herbivore from the ecosystem.

The likely effects of such a removal are difficult to estimate or quantify.

While ecosystem effects of the removal of abalone are hard to assess, Tasmania is developing a framework for the implementation of a representative system of Marine Protected Areas, to supplement the existing four marine reserves.

Four marine reserves have been implemented around mainland Tasmania to date. These marine reserves are located at Ninepin Point, Tinderbox, Maria island and Governor Island (Bicheno).

Such marine reserves may serve a variety of purposes, but may include benefits from preserving ecosystem biodiversity and as baseline reference points for ongoing research.

The existing marine reserves have been monitored since 1991 when first implemented. The basic objective of this research is to monitor changes since implementation and attempt to quantify any differences inside and outside the reserves.

An area in the south west of Tasmania (George III Rocks) has been set aside (since 1996) as a research area where no abalone may be taken. This area has provided a 'laboratory' for much of the research undertaken by TAFI.

Similarly, following the formation of the northern zone with a new size limit, it is proposed that several areas should set aside as research areas from which no abalone may be taken (these areas are still to be fine tuned before implementation). These areas will provide baseline data to be used to measure the effects of changed management arrangements. The fine detail of four such research areas in the north has recently been finalised, it is envisaged they will be implemented by the end of June 2001.

Further areas around the State to provide baseline comparisons may also be considered.

B.2.3 Assessment

2.3.2 Information is collected and a risk analysis, appropriate to the scale of the fishery and its potential impacts, is conducted into the susceptibility of each of the following ecosystem components to the fishery.

1. Impacts on ecological communities

- *Benthic communities* As a hand collection fishery impact is minimal.
- *Ecologically related, associated or dependent species.* There is no impact in relation to bycatch or physical damage to the substrate or sessile species. Impacts on the ecosystem are restricted to the impact of the removal of abalone as discussed further in 2.3.3.
- *Water column communities.* No impact.

2. Impacts on food chains

- *Structure.* Impact as discussed in 2.3.3.
- *Productivity/flows.* Impact as discussed in 2.3.3.

3. Impacts on the physical environment

- *Physical habitat.* Hand collection fishery, no physical effect.
- *Water quality.* Not applicable.

Little or no information of the effects of the removal of abalone from the ecosystem *per se* are available. Continued monitoring and comparison of ecosystems inside marine reserves and outside reserves (and research areas) may provide information in future on such ecosystem effects. TAFI has continued to monitor the four existing marine reserves since their inception. Detailed survey work to identify and assess possible new reserve locations has also been ongoing.

However, such ecosystem wide research on the possible effects of abalone removal is complex, particularly in terms of separating different causes and effects.

B.2.3-5 Management responses

2.3.3 Management actions are in place to ensure significant damage to ecosystems does not arise from the impacts described in 2.3.1.

As suggested in 2.3.1, the most likely cause of any ecosystem effects from the abalone fishery would be the effect of the removal of some of the population from the system.

Management measures to ensure abalone stocks are maintained at sustainable levels will ameliorate impacts on the ecosystem and prevent a significant and unsustainable portion of the abalone population being removed.

In particular, the TAC and size limits provide the major tools for protecting abalone stocks. The TAC caps the total quantity which may be removed, and with the addition of fishing zones, determines the spatial distribution of catches.

The implementation of zoning was in direct response to the interlinked issues of the danger of localised depletion and increasing concentration of effort in the east and south east. Further measures to spread effort to minimise the likelihood of such depletion have also been implemented. Trigger points for individual blocks will be assessed as a meaningful tool to increase the resolution of management measures.

Size limits protect that portion of the abalone population below those limits and ensure that egg production (and hence recruitment) is protected.

These two measures (i.e. the TAC and size limits) protect the portion of the population below the size limits and determine the portion of the population above size limits which may be extracted.

Existing marine reserves provide areas of refugia with numerous objectives. However, in reference to this assessment criteria they provide protection for biodiversity, but also areas which may be very important as research baseline or reference points.

Tasmania has joined the national framework for introduction of a national representative system of marine reserves. However, this issue has proven contentious in terms of the scope, placement and size of any new marine reserves.

To address this issue in a structured manner, the Tasmanian Government charged the Marine and Marine Industries Council to develop a strategy for the introduction of a representative framework for marine reserves.

A draft strategy was released in 2000 for public consultation (MMIC 2000). That period of consultation is now closed and Cabinet will consider the strategy to be implemented.

Research areas have already proven valuable research tools. George III Rocks has been utilised intensively since first implemented in 1986 as a field 'laboratory'. Additional sites in the north will be valuable in monitoring/measuring the impact of changes to management measures in the north of the State.

The possible encroachment and impact of the long spined sea urchin (*Centrostephenious*) has also arisen as an ecosystem wide issue. This has been identified as a high priority by the Research Advisory Group, and a pilot program to ascertain the distribution and abundance of *Centrostephenious* in State waters was recently funded by FRDC.

2.3.4 *There are decision rules that trigger further management responses when monitoring detects impacts on selected ecosystem indicators beyond a predetermined level, or where action is indicated by application of the precautionary approach.*

No such current triggers or rules

2.3.5 *The management response, considering uncertainties in the assessment and precautionary management actions, has a high chance of achieving the objective*

No such response.

REFERENCES

- Australian Bureau of Agricultural and Resource Economics, 2000, *Australian Fisheries Statistics 1999*, Canberra.
- Bryant, S. and Jackson, J. 1999. Tasmania's Threatened Fauna Handbook: what, where and how to protect Tasmania's threatened animals. Threatened Species Unit, Parks and Wildlife Service, Department Primary Industries, Water and Environment, Tasmania.
- Department of Primary Industry, 1990; *Options For Amending The System Of Licensing Commercial Abalone Divers: A Report From The Ministerial Working Group Into Tasmanian Abalone Licensing*; Department of Primary Industry, Hobart.
- Department of Primary Industry and Fisheries, 1996; *Management Options for Tasmania's Stocks of Greenlip Abalone: A Discussion Paper*; DPIF, Hobart.
- Department of Primary Industry and Fisheries, 1997; *Draft Fishery Management Plan and Policy Document for the Tasmanian Abalone Fishery*; DPIF, Hobart.
- Department of Primary Industries, Water and Environment, 1999; *Management Options for the Greenlip Abalone Fishery*; DPIWE, Hobart.
- Department of Primary Industries, Water and Environment, 2000a, *The Tasmanian Abalone Fishery Revised Policy Paper*, DPIWE, Hobart.
- Department of Primary Industries, Water and Environment, 2000b, *Summary of Changes to the Abalone Fishery management Plan for the 2001 Fishing Season*, DPIWE, Hobart.
- Edgar, G.J.; 1997; *Australian Marine Life, the plants and animals* Department of Primary Industry and Fisheries, 1998; *Review of the Tasmanian Abalone Fishery Management Plan: the Greenlip Abalone Fishery around the Furneaux Group and the Rest of Tasmania, and Some Minor Clarifications*; DPIF, Hobart.
- Edgar, G.J., Barrett N.S. and Graddon D.J. 1999. A Classification of Tasmanian Estuaries and Assessment of their Conservation Significance using Ecological and Physical Attributes, Population and Land Use. Technical Report No. 2 Tasmanian Aquaculture and Fisheries Institute.
- Ford, W and Nicol, D. 2000 (in press). The Initial Allocation of Individual Transferable Quotas in the Tasmanian Abalone and Rock Lobster Fisheries. Food and Agriculture Organisation Technical Series.
- Harrison, A.J., 1983; The Tasmanian Abalone Fishery; *Tasmanian Fisheries Research No. 26*; Tasmanian Fisheries Development Authority.

- Harrison, A.J., 1986; Gastropod Fisheries of the Pacific with Particular References to Australian Abalone, pages 14-22, In Jamieson G.S. and Bourne, N., (eds); *North Pacific Workshop on Stock Assessment and Management of Invertebrates; Canadian Special Publication of Fisheries and Aquatic Sciences 92*.
- Jones, R., 1971; *Rocky Cape and the problem of the Tasmanians*; PhD Thesis, University of Sydney, NSW.
- Lyle, J. M. and Smith, J. T. 1998. Pilot survey of licensed recreational sea fishing in Tasmania - 1995/96: Department of Primary Industry and Fisheries Technical Report No. 51.
- Marine and Marine Industries Council, 2000, Draft Tasmanian Marine Protected Areas Strategy, Crown in Right of the State of Tasmania, Hobart.
- McNee, A., 1993a; Greenlip Abalone: in Kailola, P.J., Williams, M.J., Stewart, P.C., Reichelt, R.E., McNee, A. and Grieve, C. (eds); *Australian Fisheries Resources: Bureau of Resource Science, Department of Primary Industry and Energy, and Fisheries Research and Development Corporation, Canberra, 78-80pp.*
- McNee, A., 1993b; Blacklip Abalone: in Kailola, P.J., Williams, M.J., Stewart, P.C., Reichelt, R.E., McNee, A. and Grieve, C. (eds); *Australian Fisheries Resources: Bureau of Resource Science, Department of Primary Industry and Energy, and Fisheries Research and Development Corporation, Canberra, 81-83pp.*
- Nash, W., 1990a; Abalone mature with age not size; *Fishing Today 3 (2)*, 38-39.
- Nash, W., 1990b; Abalone mortality (death) rates in Tasmania; *Fishing Today 3 (3)*, 35 and 37.
- Nash, W. 1994; *Fisheries Status Report 1993: Abalone*; Unpublished report; Research and Assessment, Sea Fisheries Division, Department of Primary Industry and Fisheries
- Nash, W. J., Sellers, T.L., Talbot, S.R., Cawthorn, A.J. and Ford, W.B., 1994; The Population Biology of Abalone (*Haliotis* species) in Tasmania. 1. Blacklip Abalone (*H. rubra*) from the North Coast and the Islands of Bass Strait, *Department of Primary Industry and Fisheries Technical Report Series No. 48*, Sea Fisheries Division, Department of Primary Industry and Fisheries, Hobart.

- Nash, W. J., 1995, *The Development of New Techniques for Assessing and Managing the Australian Abalone Fisheries*. Department of Primary Industry and Fisheries. Final report to the Fisheries Research and Development Corporation.
- Officer, R., 1999a; *Tasmanian Abalone Fishery 1997/1998 Fishery Assessment Report*; Tasmanian Aquaculture and Fisheries Institute, University of Tasmania, Hobart.
- Officer, R., 1999b; *Size Limits for Greenlip Abalone in Tasmania, Technical Report Series (Draft)*, Tasmanian Aquaculture and Fisheries Institute, University of Tasmania, Hobart.
- Officer, R., & Tarbath, D., 2000a; *Tasmanian Abalone Fishery 1999, Fishery Assessment Report*; Tasmanian Aquaculture and Fisheries Institute, University of Tasmania, Hobart.
- Officer, R., & Tarbath, D., 2000b unpub.; *Size-limits and Yield for Blacklip Abalone in Northern Tasmania*; Tasmanian Aquaculture and Fisheries Institute, University of Tasmania, Hobart.
- Smith, P., Dann, T., Tram, Q.T. and Lancaster, A., 1993; *Australian Fisheries Statistics 1993*; Australian Bureau of Agricultural and Resource Economics, Canberra.
- Standen, R., Campbell, D., Pollard, G. and Brown, D., 1995; *Australian Fisheries Statistics 1995*; Australian Bureau of Agricultural and Resource Economics, Canberra.
- Tarbath, D., 1999a; *A Population Assessment of Blacklip Abalone (Haliotis rubra) in the Hogan and Kent Group, Bass Strait*; Tasmanian Aquaculture and Fisheries Institute, University of Tasmania, Hobart.
- Tarbath, D., 1999b; *Estimates of Growth and Natural Mortality of the Blacklip Abalone (Haliotis rubra) in Tasmania*, Tasmanian Aquaculture and Fisheries Institute, University of Tasmania, Hobart.

A Brief History of the Management Measures introduced for the Abalone Fishery in Tasmania.

Year	Management Action
1962	Minimum size limit of 5 inches (127 mm) maximum shell diameter introduced.
1964	Minimum size limit increased to 6 inches (152 mm).
1965	Minimum size limit reduced to 5 inches (127 mm). Introduction of commercial abalone diving licences. All abalone to be landed live (no processing to be done at sea). Divers required to provide monthly catch statistics as part of their licence conditions.
1966	Abalone processing factories required to record the number of persons from whom abalone were bought.
1967	Abalone divers required to carry a measuring device to measure the abalone before taking them. Special penalty introduced for possession of undersized abalone at \$1 per fish. Abalone to be sold in live condition to registered processors only.
1969	Because of rapid expansion of the fishery, only those divers fishing in 1968 were licensed to fish in 1969. This figure (120 divers) was maintained in subsequent years.
1971	Only licensed abalone divers allowed to dive from a boat engaged in abalone fishing.
1972	Approval given for the transfer of licences from a retiring diver to his nominee (if based on health problems). Annual licence fees calculated as 1.5% of the mean annual production value for the previous three years. An additional five licences were issued to divers living in the Furneaux Group of islands to the north-east of Tasmania. These divers were required to take their abalone from Furneaux waters. The original 120 divers were not prevented from fishing in Furneaux waters. Penalties for breaches of regulations in relation to abalone fishing increased. Permit to transfer licences between divers revoked.
1974	Approval given for the transfer of licences from a retiring diver to his nominee.
1979	Penalties for breaches of regulations in relation to abalone fishing increased, with special penalties rising to \$2 per fish. Identification cards for licensed abalone divers introduced.

Year	Management Action
1982	Penalties for breaches of regulations in relation to abalone fishing increased, with special penalties rising to \$10 per fish.
1983	Penalties for breaches of regulations in relation to abalone fishing increased.
1985	Individual quotas introduced. Each of the 120 Tasmanian divers was allocated 28 units of quota and the five Furneaux divers 20 units. A quota unit was equivalent to 1.1 tonnes of live abalone caught. The proportion of the value of the landed catch to be paid as an annual licence fee was increased to 2.5%. Quota unit transfers between Furneaux divers and non-Furneaux divers was prevented, and only Furneaux divers allowed to dive in the Furneaux Group. Divers were required to take a minimum of 16 quota units each year.
1986	The proportion of the value of the landed catch to be paid as an annual licence fee was increased to 5%. The value of a quota unit was reduced to 1 tonne (a reduction of 9 percent).
1987	Minimum size limit increased by 5 mm to 132 mm. The value of a quota unit was reduced to 0.950 tonne (a reduction of 5 percent).
1988	The value of a quota unit was reduced to 0.855 tonne (a reduction of 5 percent). A minimum legal meat weight of 90 gm for all abalone introduced.
1989	The value of a quota unit was reduced to 0.600 tonne (a reduction of 30 percent). Undersized blacklip abalone fishery in April in the Bass Strait region, at a minimum size limit of 110 mm and maximum of 132 mm, with a catch limit of 2.4 tonnes per diver and a total landing of 198 tonnes. No fee charged for participation in this fishery. Minimum meat weight amended to apply only to blacklip abalone.
1990	Minimum size limit for blacklip abalone increased to 140 mm on the west and south-west coast (between Sandy Cape and Whale Head). Furneaux boundary removed. Furneaux divers granted an extra 8 units, which could only be fished by the divers themselves and are non-transferable. Minimum size limit for greenlip abalone increased to 140 mm in Furneaux waters.

Year	Management Action						
1991	<p>Undersized blacklip abalone fishery in May in Bass Strait waters, at a minimum size limit of 118 mm, with a TAC of 110 tonne and a fee of \$1.40 per kilogram of quota.</p> <p>Licence system was restructured: the diving entitlement was uncoupled from the entitlement to hold quota units; no lower or upper limit on the number of quota units that may be possessed by a single individual.</p>						
1992	<p>Minimum meat weight of 70 gm for greenlip abalone was introduced.</p>						
1993	<p>Undersized blacklip abalone fishing exercise in May/June in Bass Strait waters, at a minimum size limit of 110 mm, with a TAC of 100 tonnes and a fee of \$5 per kilogram of quota.</p> <p>Minimum meat weight amended to apply the 90 gm level to all abalone other than greenlip abalone</p> <p>Penalties reviewed and significantly increased, with the option of prison terms introduced for serious and repeat offenders. Special penalties increased to \$50 per fish.</p>						
1994	<p>The quota holders had the option of continuing with their annual abalone quota licences or entering into an abalone Deed of Agreement, for 10 years with right of renewal for perpetuity (90% of quota then under Deed of Agreement).</p> <p>The Deed of Agreement set a fee structure that included both management costs and return to community, on an increasing proportion of beach price from 0% at \$6/kg through 10% at \$35/kg to 33% at \$200/Kg.</p>						
1995	<p>Special fishery for undersized blacklip abalone from eastern Bass Strait was held in April, at a minimum size limit of 110 mm, with a TAC of 100 tonnes and a fee of \$10 per kilogram of quota. Only 21 tonnes taken only 12 participants.</p> <p>A second special fishery for undersized blacklip abalone from eastern Bass Strait was held during November, at a minimum size limit of 110 mm, with a TAC of 140 tonnes and a fee of \$10/kg. Only 106 tonnes was taken before the fishery was closed because catch rates fell very low and there was concern that a very high proportion of biomass had been removed.</p>						
1996	<p>The <i>Living Marine Resources Management Act 1995</i> was introduced, thus translating the existing licences, as follows:-</p> <table border="0"> <thead> <tr> <th>OLD LICENCE</th> <th>NEW LICENCE</th> </tr> </thead> <tbody> <tr> <td>Commercial abalone diver's</td> <td>fishing licence (abalone dive)</td> </tr> <tr> <td>Abalone quota</td> <td>fishing licence (abalone quota)</td> </tr> </tbody> </table>	OLD LICENCE	NEW LICENCE	Commercial abalone diver's	fishing licence (abalone dive)	Abalone quota	fishing licence (abalone quota)
OLD LICENCE	NEW LICENCE						
Commercial abalone diver's	fishing licence (abalone dive)						
Abalone quota	fishing licence (abalone quota)						

Year	Management Action
1997	The TAC was increased to 2520 tonnes, thus the value of a quota unit was increased to 0.720 tonne (an increase of 20 percent).
1998	Abalone Fishery Management Plan introduced, with the following major changes:- <ol style="list-style-type: none"> 1. Pre-fishing reporting by divers, 2. Post-fishing report of catch by divers and processors, 3. Processors required to maintain daily balance of stock in, stock on hand, and stock out, 4. Processors report prior to movement of stock out and on receipt of stock, 5. All reporting via telephone paging service which is immediately available to DPIF's Quota Audit Team and Tasmania Police, 6. Special arrangement for greenlip abalone, including increasing size limit to 140 mm state wide (except the north west coast), bi-monthly limits on catch for the Furneaux Group and a trigger point for the greenlip abalone catches from the rest of the State, thus capping landings of greenlip whilst allowing access throughout the year.
1999	Special arrangements for the greenlip abalone were altered as follows: <ol style="list-style-type: none"> 1. For the commercial fishery only, the minimum size limit was increased to 150 mm state wide, except for the north west coast where the size limit was 140 mm; 2. A catch limit was imposed for the whole greenlip abalone fishery, which was allocated at 68 tonnes for the eastern and 80 tonnes for the western sectors; and 3. The catch limits were then allocated on a quarterly basis, with adjustments in subsequent quarters for any under or over runs in catches.
2000	The Total Allowable Catch is increased by 9% to 2730 tonnes. Zoning system introduced with greenlip (140 tonnes), eastern blacklip (1190 tonnes) and western blacklip (1400 tonnes) zones. Owners of fishing licence (abalone dive) allowed to hold more than one licence and place alternate supervisors on dive licence. Franklin Sound (between Flinders and Cape Barron Islands) is closed from 1 October to following 31 March, each year), plus a catch limit of 20 tonnes for greenlip abalone catches from the area (annual closure in rules – tonnage cap to be implemented by closure through Public Notice). The catch limit of 42 tonnes is maintained for greenlip abalone from the Furneaux Group (cap to be implemented by closure through Public Notice).

Year	Management Action
2000 cont.	<p>The size limit for greenlip abalone was altered bringing all sectors in line with</p> <ol style="list-style-type: none"> 1. Overall limit of 145 mm 2. Northwest and most of north coast limit of 140 mm and 3. King Island limit of 155 mm. <p> Holders or supervisors of FLAD able to obtain abalone only fishing licence vessel without holding unrestricted FLV (must surrender if not supervising FLAD).</p>
2000	<p>Draft measures relating to a new northern zone for blacklip released for public consultation 2nd October to 2nd November 2000.</p>
2001 May	<p>Introduction of northern blacklip zone (Arthur River to mouth of Great Musselroe River)</p> <p>Within northern zone a new 127 mm blacklip size limit from Woolnorth Point to Great Musselroe River.</p> <p>Single zone fishing in northern zone.</p> <p>Pre-report to fish northern zone at 132 mm or the 127 mm zone at 127 mm.</p> <p>Launch and retrieve in the northern zone unless on a mother boat (ie either the whole area if fishing 132 mm or the smaller area if fishing at 127 mm).</p> <p>May start a fishing trip for northern zone outside the zone on a mother boat if pre-reporting for diver and mother boat is fulfilled.</p> <p>Mother boats may leave the northern zone at the eastern boundary (only) to unload if finishing trip north of St Helens Point and a leaving area report is completed.</p> <p>TAC of 2,800 tonnes as follows: eastern zone 1,120 tonnes, western zone 1,260 tonnes, northern zone 280 tonnes, greenlip 140 tonnes.</p> <p>Quota numbers on duplicate pages of divers docket book not to be ‘blacked out’.</p> <p>Green page of divers docket book omitted.</p> <p>Processors receiving blacklip abalone from the northern zone where 127 mm applies to mark all containers and bins before fish are processed.</p> <p>New measure that all abalone received by a processor must be taken to a processing premises before export.</p> <p>Recreational size limit for blacklip changes to 132 mm State wide.</p> <p>Recreational greenlip size limits to 145 mm except in the north west coast 140 mm area where 140 mm applies.</p> <p>Cap on blocks 13C, 13D & 13E of 300 tonnes (combined). Cap set quarterly – 160 tonnes for first half then 70 tonnes for third and fourth quarters.</p> <p>Greenlip caps for north east (30 tonnes) and north west (40 tonnes).</p>