

**Commercial-In-Confidence**

**REVIEW OF WILD ABALONE R&D  
NEEDS IN AUSTRALIA**

**Prepared for:**



**F I S H E R I E S  
R E S E A R C H &  
D E V E L O P M E N T  
C O R P O R A T I O N**

***By:***

***Macarthur Agribusiness***

***January 1999***

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## EXECUTIVE SUMMARY

The Australian wild abalone industry contributes \$200 million annually to the national economy and directly employs an estimated 1,650 people across 5 States (NSW, Victoria, Tasmania, South Australia, and Western Australia). Over 99 percent of production is exported, primarily to north East Asia. It is a valuable native resource, increasingly so as world competitor fisheries decline from overfishing.

This Review has been commissioned by the Fisheries Research and Development Corporation to provide independent advice on the industry's current and strategic Research and Development directions, and the human, economic, technology and marketing infrastructure required to better manage the abalone resource. The Corporation intends to use the findings of the study as a base for making decisions in relation to the allocation of funds for abalone research and development over the next 3-5 years.

The study team finds both positive and negative aspects to the industry, going forward. Clearly there is the opportunity for strong commercial potential based on rising comparative advantage (bordering on monopoly) in world wild abalone markets. Abalone aquaculture will likely enhance this advantage over time rather than detract from it. While wild industry emergence and consolidation has been relatively stable over the last 30 years, future development is at risk of being constrained by this history. The industry is supported by a strong research base and ample technical expertise. But it appears slow to recognise the economic and environmental value of its resource and push collectively for the tools and critical mass that will secure its future in the face of increasing risks.

The Review considers risks and opportunities right along the value chain. It is clear that substantial risks are impacting the resource and the commercial stakeholders. But these are only variously recognised by industry, researchers and fishery

managers. Some risks are covert (eg. stock health, meta-population dynamics and genetic interactions, inappropriate diver behaviour, etc) and others are more obvious (eg. recruitment, reef contamination and pollution, the absence of consistent value adding and marketing, the variability of regulations across fisheries, the lack of consistent spatial methodologies and modelling tools across fisheries, the excess of marginal processor capacity, etc). Some large risks such as product theft are both overt and covert, (but always unquantified), depending on the location and the fishery.

Direct consultation with industry stakeholders – industry, researchers, and fishery managers - has been the core methodology used to complete the review. Meetings were held in all States, and where possible with active commercial participants in zonal fisheries. Approximately 85 people attended these meetings. Written submissions were received from two industry people and a further 10 – 20 have been contacted by telephone. The review team also undertook considerable desk research, particularly with regard to overseas fisheries, the management structures and regulations for each State's fisheries, the expertise and capability of researchers, and R&D projects - past, current and proposed. Much of this is documented in the report or its appendices.

While much of the industry's commercial information is confidential and therefore tightly held, the review team has been able to collate a representative picture of the industry, its value chain and its likely profitability. This has been achieved through iterative consultation with a number of commercial operators across all States. Preliminary drafts of the final report were widely distributed to industry organisations and managers for comment.

In terms of the **broad national industry** it is also clear that there is a lack of collective industry strategic thinking and cohesion. Many initiatives can be collectively addressed to improve the efficiency of the industry (eg. marketing "Australian"



abalone), both through collective R&D and industry management. This lack of planning tends to mirror the apparently moderate commercial returns to processors and marketers, and predisposes toward a benign acceptance of a hunter gatherer culture and the weak “seller” role.

The industry will benefit greatly through a more mature and cohesive approach to its future and the considerable opportunities available. It must think promptly and collectively about how it does commercial business and the long-term value it places on its resource. It is clear there is opportunity to focus R&D effort to enhance the competitive advantage of the resource.

The following exhibit represents the components and linkages across the wild abalone industry. Specific reference to research topics follows.

## **Exhibit A**

### **Status of the Stocks**

The managers of the 11 zonal fisheries across the five relevant States generally perceive their fishery stocks to be stable and the risk of significant stock declines to be low. These conclusions are based on assessment of fishery changes and some independent monitoring. However, little has been done to date on predicting the risks attached to increased catches, nor the potential for decline under current catch regimes. A model developed by the NSW fishery is an exception, allowing the

estimation of likely impacts from manipulation of catch volumes, size limits and other variables. The model provides a strong base upon which a national modelling capability should be collectively developed as soon as possible to confirm or refute currently held stock perceptions.

### **Fishery Management**

There is significant commonality among fishery management practices across the States. Management agreement across fisheries is particularly evident regarding:

- ✍ quota levels, zonation and minimum size limits;
- ✍ quota changes only being contemplated on the basis of reliable risk assessment modelling; and
- ✍ resource theft has a major direct impact on the resources and at the market.

Management currently has a zonal focus. However a finer spatial management focus is required both in terms of understanding and managing the dynamic resource variables, and also in terms of directing catch effort to sustainable and commercial ends. With approximately 50 percent of the national Total Allowable Catch (TAC), Tasmania's move to more intense management of its fisheries is particularly welcome.

<b>Exhibit B</b>						
<b>Summary of Size Limits and Catches</b>						
<b>State</b>	<b>Zone</b>	<b>Minimum Size</b>				<b>Implied Whole Abalone TAC (t)</b>
		<b>Blacklip</b>	<b>Greenli p</b>	<b>Brownlip</b>	<b>Roe</b>	
Tas	Northwest section	132	132			2,520
	West & South section	140	140			
	North & East section	132	140			
Vic	West	120	130			280
	Central	120	130			700
	East	110	130			460
SA	South East	125	130			542
	Central	130	130			185
	West	130	145			102
NSW	All areas	115				333
WA	Zone 1 (South Eastern)		140	140	60	148
	Zone 2 (South Western)		140	140	60	140
	Zone 3 (West)		140	140	60	108

The requirements to generally address the management issues which have been raised across State fisheries include:

- ✍ Modelling and risk assessment to guide decisions related to changing the quota and minimum size limits;
- ✍ Better compliance and resource theft estimates (dealt with in more detail in the compliance section of this report);
- ✍ Rationalisation of processing capacity;

- ✍ Extension of the current product tracking system, a topic which is dealt with in more detail in the compliance section of this report;
- ✍ Investigations to establish the efficacy of transferring or harvesting stunted stocks;
- ✍ Review of the conditions associated with quota transfer in some States;
- ✍ Evaluation of the benefits of rehabilitation of reefs through reseedling;
- ✍ Determination of the impacts of pollution, from run-off and other marine operations, on abalone habitat;
- ✍ Determination of the impact of disease on the abalone resource.

### **Research Competence and Skills**

The review team considers there is an experienced core of research skills available to the industry and across the States, to handle the current research or provide the basis for an expansion of programs.

In relation to the important area of modelling, expertise currently should be complemented by additional fisheries modelling experts from outside the abalone industry. In relation to biological aspects, a sound core of expertise exists. However, limited expertise is available to undertake economic assessments of the fishery, or to undertake studies related to compliance, marketing or value adding. Research on these topics will require additional expertise.

### **Value Adding and Marketing**

The industry is characterised by a generally negative view of value adding, punctuated by a number of processors who see considerable potential. The review team see moderate opportunity for value adding, predicated on industry cultural change, greater market cohesiveness and re-investment to achieve critical mass.



**Exhibit C High Priorities for R&D in Abalone**

Activity	Focus	Emphasised in State consultations				
		NSW	SA	Vic	Tas	WA
<b>Resource Modelling</b>						
Extension of NSW model/capability to other States	National		yes	yes	yes	yes
Determination of confidence limits and requirements	National		yes	yes	yes	
<b>Resource monitoring</b>						
Fishery independent surveys	National	yes	yes	yes	yes	yes
Standardisation of diver effort	National		yes		yes	yes
Better utilisation of diver information	National		yes	yes	yes+	yes
Estimates of illegal catch	National	yes	yes	yes	yes	yes
Estimates of recreational catch	National			yes		yes
<b>Compliance</b>						
Assessment of illegally taken abalone	National	yes		yes		
Tracking of product from capture to export	National	yes	yes		yes	
<b>Ecology and habitat</b>						
Sea urchin abalone interaction	State	yes				
<b>Economic assessments</b>						
Financial risks/returns associated with quota changes	National	yes	yes	yes		
Evaluation of cost recovery and community contribution	State	yes				yes
<b>Value adding and Marketing</b>						
Mechanisms for coordinating national marketing and promotion	National	yes	yes	yes	yes	yes

Activity	Focus	Emphasised in State consultations				
Coherent image for Australian abalone related to the clean, green advantage	National		yes	yes		

# 1. INTRODUCTION

## 1.1 Purpose of the Review

This study has been commissioned by the Fisheries Research and Development Corporation (FRDC) with the purpose of:

1. Assessing the status of the wild abalone fishery in New South Wales, South Australia, Tasmania, Victoria and Western Australia in relation to the status of the stocks, the current management strategies, the economic viability of the fishery and the impact of illegal fishing;
2. Reviewing abalone research and development and its the impact on resource management as well as the expertise available in Australia to conduct this research; and
3. Determining the Research and Development priorities for the fishery in respect of biological stock assessment, environmental impacts on and by the fishery, economic objectives, compliance, value adding and marketing.

The outcome of the review is designed to provide an indication of the future Research and Development directions required to better manage the abalone resource and hence assist the FRDC in making decisions in relation to the allocation of funds for abalone research and development.

An essential component of the review was the systematic collection of the views of industry, resource managers and researchers on the important issues faced by the abalone industry and an evaluation of how research could assist with the resolution of these issues. To achieve this a series of meetings were held in each of the States, in most cases at several localities to ensure that representatives of the zones had an opportunity to attend. Senior resource and research managers as well as industry representatives were



invited to attend meetings or to nominate persons to contribute to the review and attend meetings. The views collected at meetings were therefore regarded as authoritative.

The dates and locations of these meetings are listed in Appendix One.

Meetings were relatively informal so as to provide all participants with an opportunity to express their views on issues relevant to the review. The facilitators did however ensure that opinions were elicited on the following topics:

- |                                    |                         |
|------------------------------------|-------------------------|
| ✍ Nature and scope of the industry | ✍ Industry organisation |
| ✍ Status of the stock              | ✍ Fishery management    |
| ✍ Application of R&D to management | ✍ Economic assessment   |
| ✍ Compliance                       | ✍ Value adding          |
| ✍ Marketing                        | ✍ R&D required          |

The data collected during discussions was complemented by desk studies of material supplied by the various States agencies responsible for management of and research on abalone. This material included published information and draft reports on resource management, research publications, current research strategies, stock assessment reports and information on the current expertise and experience of researchers engaged in abalone research.

The review thus provided a unique opportunity to gather, within a short space of time, a complete spectrum of authoritative views on this important industry, as these relate to the catching, processing, value adding, marketing, compliance and resource management.

The spectrum of research requirements which has been identified is wide, ranging from the focused biological studies for modelling and better understanding ecology and habitat through to the need for economic studies, aspects of compliance as well as value adding and marketing. This broad spectrum makes it difficult to establish a strict hierarchy of priorities for all the research requirements that have been identified. The task of establishing priorities was further complicated by the fact that the level of information required for abalone management is different between States. Specific state legislation

prescribes specific management procedures which in turn demands specific information. This is apart from specific information required regarding the variability in species; urban, environmental and illegal catch pressure on the resource, and other variables across the fisheries.

Nevertheless it has been possible to establish a framework of priorities, based on analysis of stakeholder views, which should greatly assist the planning, funding and management of research to further improve an industry that generally has been conservatively managed and is based on stocks which appear to be stable.

## **1.2 World Abalone Fisheries**

To place the Australian abalone fishery in context in relation to its importance and management this section briefly reviews the history of some overseas abalone resources. This review indicates that in the absence of careful management stocks can undergo serious declines. The stability of the resources in Australia thus places our Industry in a potentially powerful position as a major supplier of a sought-after but scarce quality product.

Following the Second World War there was considerable development of abalone fisheries that saw the establishment of major fisheries in Australia, New Zealand, South Africa, Mexico and more latterly in South America. These developments complemented the long established fisheries in Japan, other South East Asian countries and California. Fishery growth has largely been in response to increased affluence and demand from North East Asia (Japan, China, Taiwan and Hong Kong).

A number of major abalone fisheries have however experienced serious declines in catches, to the extent that collapses have been experienced (Exhibit 1).

<b>Exhibit 1</b>								
<b>World Production of Abalone 1971 - 1992 (Kilotonnes)</b>								
<b>Year</b>	<b>Australia</b>	<b>Japan</b>	<b>Mexico</b>	<b>USA</b>	<b>Sth Africa</b>	<b>Korea</b>	<b>NZ</b>	<b>Chile</b>
71/72	8.0	5.8	5.4	1.4	0.9	1.0	0.7	6.7
72/73	6.3	5.8	4.7	1.4	0.9	2.4	0.8	5.4
73/74	6.0	5.0	6.1	1.2	1.0	0.5	0.4	6.1
74/75	5.0	5.4	6.4	1.0	1.1	0.6	0.5	9.6
75/76	5.3	5.7	6.4	0.8	1.0	0.6	0.6	10.0
76/77	6.3	5.2	6.0	1.0	0.7	0.6	0.8	14.2
77/78	5.1	5.4	4.6	1.2	0.8	0.5	0.6	12.3
78/79	6.2	4.9	3.7	1.3	0.7	0.7	0.5	16.6
79/80	6.9	4.9	2.8	0.4	0.7	0.6	0.7	24.9
80/81	7.3	4.7	1.8	0.7	0.7	0.7	1.3	17.5
81/82	7.0	4.6	1.2	2.5	0.7	0.5	0.8	20.1
82/83	no data	4.7	1.0	1.5	0.8	no data	1.2	collapsed
83/84	8.7	4.5	0.8	0.8	0.8	no data	1.4	collapsed
84/85	7.7	4.25	0.4	0.6	0.8	no data	1.5	collapsed
85/86	7.1	4.5	0.5	0.6	0.8	no data	1.1	collapsed
86/87	6.9	4.2	0.6	0.5	0.8	no data	0.7	collapsed
87/88	6.9	3.9	0.7	0.5	0.8	no data	1.0	collapsed
88/89	5.5	3.6	0.7	0.4	0.8	no data	1.2	collapsed
89/90	5.1	no data	0.8	0.5	0.8	no data	no data	collapsed
90/91	5.1	no data	0.8	0.5	0.8	no data	no data	collapsed
91/92	5.0	3.5	1.0	0.4	0.8	no data	1.0	collapsed
92/93	4.7	no data	0.9	no data	no data	no data	1.2	collapsed
93/94	4.7	no data	0.7	no data	no data	no data	no data	collapsed
94/95	5.2	no data	0.6	closed	no data	no data	no data	collapsed
95/96	5.4	no data	0.5	closed	no data	no data	no data	collapsed

96/97	5.1	no data	0.4	closed	no data	no data	no data	collapsed
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Source: Bureau of Agricultural Economics 1983, Australian Fisheries Statistics

The important **Mexican fishery** underwent a significant decline from a catch of 6,000 tonnes per annum in 1950 to 1,000 tonnes in 1982-83. The **Californian red abalone** catch in the mid 1930's was between 1,400 and 1,800 tonnes per annum, after which it fell to a lower but apparently stable level during the 1960's, that is between 1,000 and 1,200 tonnes. Subsequently it underwent a precipitous decline in the early seventies to a level below 200 tonnes in the late eighties. Other Californian abalone species have undergone serial depletion and the commercial fishery is currently closed.

The smaller **North-east Pacific Abalone Fishery** has shown a similar pattern of landings, with increased catches following the development of the fishery followed by a dramatic decline in annual landings and the fishery is now closed.

The **South African** abalone fishery commenced in the early fifties and, following an increase in catches to nearly 3,000 tonnes per annum, production fell to a level below 1,000 tonnes which then remained constant. Recent information suggests that, because of escalation in illegal fishing effort, the stock is deteriorating.

The status of the long established fisheries in **Japan, Korea and China** is not easy to ascertain due to a lack of stock assessment information and the nature of the fishery. In Japan for instance the fishery is supported in some areas by extensive stock enhancement programs and hence stock stability is difficult to ascertain. Likewise in China the fishery tends to be artisanal (ie based on craft skills and low levels of mechanisation and technology) in nature with culture of abalone being a dominant factor.

The nature of abalone resources is such that natural mortality of adults under normal conditions is low, and in the unfished state stocks accumulate to levels which can provide catches that far exceed those that can be sustained by the resource once it adjusts to fishing. This could explain the historical pattern of some of the more recent fisheries in

which large landings were initially made but in the absence of the introduction of constraints, or a delay in the introduction of these constraints, the stocks have crashed and the fishery essentially collapses.

The **Australian Industry** is based on catches made in south-east Australian States and Western Australia. The industry's operational chain is illustrated in Exhibit 2.

## **Exhibit 2**

### **Australian Abalone Industry Operational Chain**

The pattern of catches in these States has varied but generally, after an increase in catches, the annual harvest has declined to a stable but still substantial level. In general terms the Australian fishery has not undergone the dramatic declines experienced by North American fisheries. Similarly, since the early 1980's, the catch of paua in **New Zealand** has stabilised and shows no signs of an imminent substantial decline in production although there is a view that some sectors of this fishery are in decline.

In the Australian fishery it would appear that the introduction of catch constraints has enabled managers to stabilise a resource which, under less restrained conditions undergoes substantial declines, as shown by experiences in California and Mexico and more recently South Africa.

## 2. STATUS OF THE STOCK

The current status of the abalone stocks in all States was determined from reports published by State Fisheries Agencies. To complement this information the views of representatives from industry, resource management and research on the status of the abalone stocks were also canvassed at a series of meetings held in each State. The brief of the consultancy was to provide an overview of the state of the abalone resources. The spatial nature of the distribution of abalone is such that the fishery in each State could be based on a number of separate stocks, and in fact in most States there are two species involved. Detailed information on the performance of stocks in locations was not available, nor would it have been appropriate for the review to deal with this level of detail. The views of the responsible State agencies on the status of the resources were clearly put to the Review and these form the basis of this overview.

More specifically, the status of the abalone resource in each State is as follows:

The report concludes that blacklip stocks are generally healthy. More specifically, blacklip are reported to be fully fished or slightly underfished on a state-wide basis but regionally underfished, fully fished or overfished, depending on the location.

The report also concludes that the greenlip resource is fully fished on a statewide basis, with overfishing occurring in some regions, so much so that the Furneaux fishery for this species was closed for part of 1998. It has reopened in 1999. The greenlip resource is under greater pressure than blacklip due to the species being at the southern geographic extremity of its range. It also represents less than 10 percent of the Tasmanian catch and tends to attract only minimal management resources. While green lip prices are higher, black lip catch rates in Tasmania (approximately 150 kg/hr) are three times the catch rates for green lip. In an effort to limit overfishing of the green lip resource the fishery managers have recently introduced an upper catch limit of 148 tonnes, with the balance of the 2,520 tonne TAC to come from black lip. Data presented below suggests that this limit would reduce the green lip catch by approximately 33% from its 1998 rate.

<b>Exhibit 3</b>						
<b>Tasmanian Abalone Catch</b>						
<b>Year</b>	<b>Total TAC (tonnes)</b>	<b>Blacklip Catch (tonnes)</b>	<b>Greenlip Catch (tonnes)</b>	<b>Total Legal Commercial Catch (tonnes)</b>	<b>Average Beach Prices (A\$/kg)</b>	<b>Est. Fishery Value at Beach</b>
<b>1994</b>	2,100	1,767	146	1,913	31.14	\$59.6m
<b>1995</b>	2,100	1,768	149	1,917	22.70	\$43.5m
<b>1996</b>	2,100	1,778	191	1,969	25.60	\$50.4m
<b>1997</b>	2,520	2,210	215	2,425	33.54	\$81.33m
<b>1998</b> (to 30 Nov)	2,520	2,161	201	2,362	30.13	\$71.2m

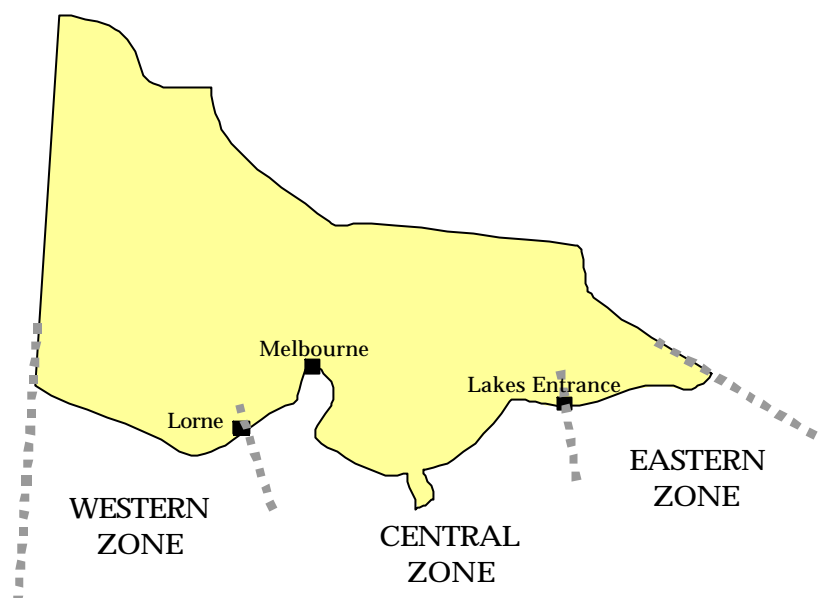
Source: Tasmanian DPIF; Average prices based on quarterly weighted average prices.

While this report predates these recent management initiatives, the report's conclusions were generally supported in discussions with industry, resource managers and researchers, whose views were that the abalone stocks were in a stable, fully fished condition on the east coast and probably underexploited on the west coast of Tasmania.

It is worth noting at this point the estimated variability in the beach value of our largest fishery and the commercial implications for fishery yield. Beach price variability has a large impact on the value of the fishery, apart from the changes in legal catch limits. This suggests a strong reason for divers seeking to integrate their activities down the value chain to quota ownership and processing in order to stabilise and secure their income streams. While these fishery values are based on nominal data (ie. the impact of inflation has not been high during these years), they also suggest that the return on investment for quota holders in particular will vary significantly on an annual basis. The market value of quota units per species is typically calculated based on gross forecast beach prices, less resource rent and other taxes, less harvest / dive costs, and the net balance multiplied by an expected marketable product yield for the fishery concerned. Yields vary from fishery to fishery according to a range of factors including resource condition, and competitive catch effort. Tasmanian Industry advice suggests that the nominal value (ie not adjusted for inflation) of quota units has remained relatively stable over the last 6 years (\$180,000 -

200,000) but the potential return on investment in these units has fallen by around 40%. This matter is considered in more detail later in the report.

## 2.2 Victoria

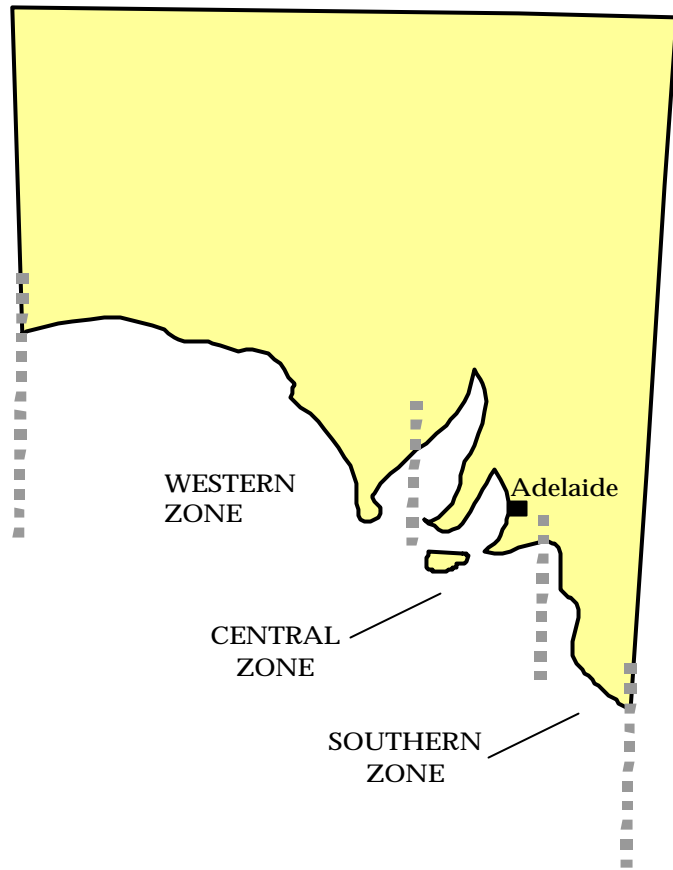


noted that the Abalone Stock Assessment Group, which was responsible for compiling the assessment, includes representatives from industry, resource management and research.

Discussions with industry generally confirmed this conclusion but confidence in resource stability had caveats in some zones. Whereas divers operating in the western zone were of the view that stocks in that zone were stable, representatives from the central zone believed that the level of resource theft was large and unknown and that this rendered the status of the resource uncertain. Eastern zone divers agreed that stocks were fully exploited but were concerned that increasing resource theft could result in overexploitation in the future.

## 2.3 South Australia





## 2.4 New South Wales



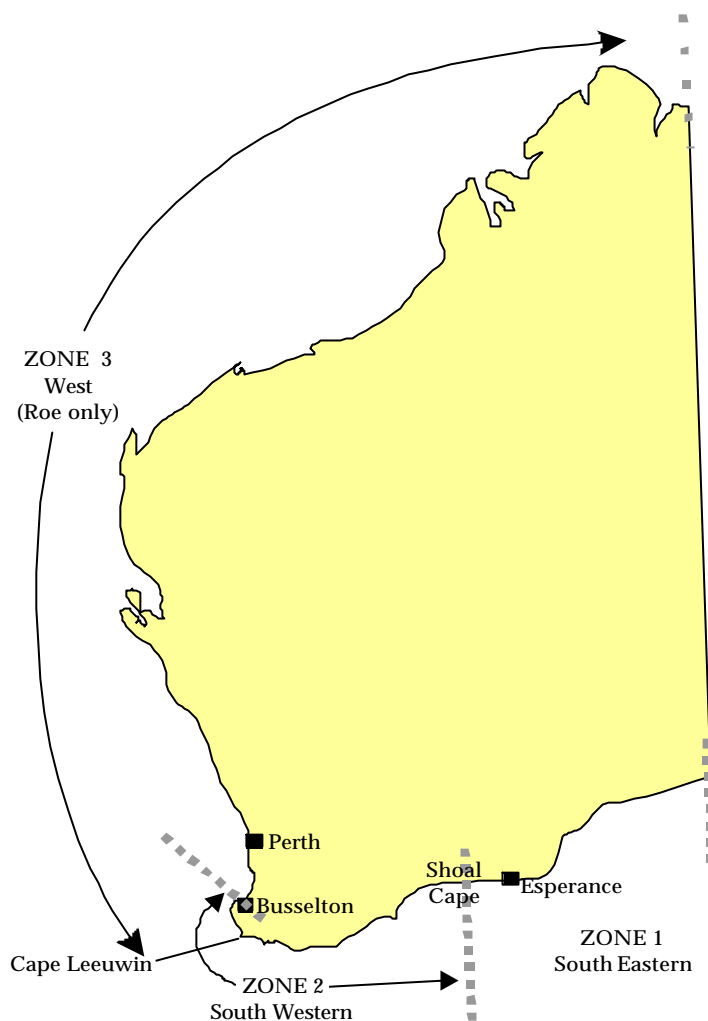
current catches are held constant for the next five years there is a less than 10 percent chance of the legal biomass increasing. The situation in relation to the increase in mature biomass is more optimistic, in that at current catch levels the probability of an increase in mature biomass is 60 percent (*Worthington, D.G. et al. 1997*).

The conclusion that the resource is stable was confirmed in discussions held with industry, resource managers and researchers, at which it was generally agreed that the NSW abalone resource is fished at an appropriate level.

There is, however, a significant and increasing impact of stock theft in the State and concerns about the impact of interaction with sea urchins.

## 2.5 Western Australia

An analysis of catch and effort information submitted by divers was undertaken by the Research Division of Fisheries Western Australia. The conclusion is that overall, abalone stocks are stable and that current controls on fishing for both Roe's and greenlip/brownlip



### Conclusions about the Status of the Stocks

Information in agency reports and provided during consultations suggested that the status of abalone stocks in all States is generally stable and the risk of significant stock declines is generally perceived to be low by resource managers and industry.

These conclusions are mainly based on an assessment of changes in fishery performance, and in some States fishery independent monitoring by the responsible Agencies.

There are no predictions of the risk attached to increasing the catches from these apparently stable stocks nor of the risk that stocks perceived to be stable could decline under current fishing regimes. An exception is the New South Wales fishery for which a

model exists. In the case of the NSW fishery there is thus some facility to estimate the stock changes associated with increasing or lowering the current total allowable catch or minimum size limits and to estimate the risk associated with such actions.

The lack of good information on stock abundance indices in some States and the means to assess stock risk places considerable emphasis on the need to confirm current perceptions with better data and modelling. Thus although current perceptions are that the fisheries are generally stable, responsible management requires that there be better confirmation of these conclusions.

<b>Exhibit 4</b>				
<b>Summary Of Stock Across Australia</b>				
<b>State</b>	<b>Fishery</b>	<b>Species</b>	<b>Stock Status Assessment</b>	<b>Current Risks and Issues</b>
Tas	East	Black Green	Fully fished Overfished	✗ Need to better direct fishing effort ✗ Depletion of green lip resources ✗ Need to evaluate increased catch from West coast
	West	Black Green	Underfished Underfished	
Vic	West	Black	Fishing effort appropriate	✗ Increase in stunted stock ✗ Theft – resource impact
	Central	Black	Fishing effort appropriate	✗ Theft – detrimental resource and price impacts
	East	Black	Fishing effort appropriate	✗ Theft – detrimental resource and price impacts
SA	South	Black Green	Fishing effort appropriate	✗ Disease ✗ Industrial Contamination ✗ Theft – detrimental resource and price impacts
	Central	Black Green	Fishing effort appropriate	
	West	Black Green	Fishing effort appropriate	
NSW	All zones	Black	Fully fished	✗ High theft impact – varies north to south
WA	South Eastern	Green/Brown Roe	Fishing effort appropriate	✗ Theft – detrimental resource and price impacts
	South Western	Green/Brown Roe	Fishing effort appropriate	✗ Theft – detrimental resource and price impacts
	West	Roe	Fishing effort appropriate	✗ Theft – detrimental resource and price impacts ✗ Competition from recreational catch

### 3. INDUSTRY MANAGEMENT

#### 3.1 Industry Organisation

The wild abalone industry is geographically spread along the coastline of southern Australia. The industry has grown in this coastal environment since the early 1960's based on strong demand from Asian consumers, particularly in Japan.

There are currently approximately 3,700 quota licences held by Australian residents allowing access rights to the Australian resource. The commercial size of these interests varies greatly from a right to harvest 720 kilograms per year, up to a single licence of 20.6 tonnes.

The number of people in the commercial industry does not readily tally with the number of diver or quota holder licenses held. Some quota entitlements have more than one dive license attached or endorsed (eg South Australia), while others such as in Tasmania have 125 divers to service the needs of the 3,500 quota licences, collectively held by approximately 400 people. Arrangements vary from state to state. Typically however, each diver operating inshore from a single small vessel has a support deck hand to assist with the harvest and handling to the beach and processor. Larger craft for the more remote and treacherous coastlines of western Tasmania have more support staff. Then there are the licensed processors who currently number nearly 80 in total. However it is misleading to say that all currently licensed processors are active across the season. Many come and go depending on prices, product availability and their own prospects. There are estimated to be around 35 processors who are active in the industry on an annual basis. Of course in addition to the above there are a significant but indeterminate number of illegal divers and processors.

In summary the estimated number of people either fully employed, have a part time interest or casually employed in the commercial industry, is estimated at 1,650 as follows:

<b>Exhibit 5</b>		
<b>Estimated Number of People Employed in the Commercial Abalone Fishing Industry</b>		
<b>Industry Sector</b>	<b>No. of Units</b>	<b>Est. No. of People</b>
Quota licence holders	3,700	600
Diver licences	340	340
Diver support staff / deckhands	-	300
Active Processors	35	350
Partially Active Processors	32	60
Estimated Total Employed		1,650

Researchers, fishery managers and others are also valued stakeholders in the industry but are not an integral part of the industry's own organisational structures. Researchers and fishery managers regularly gather to discuss issues of mutual interest and industry advantage. However, industry rarely joins these meetings or holds its own national gatherings for industry development.

There are currently a number of independent state based industry associations servicing the divers and processors. Attempts at forming a cohesive single national wild abalone industry organisation have so far been unsuccessful. Renewed efforts are currently under way to achieve this based on the growing realisation that such an organisation (possibly a joint effort of the relevant state organisations) could offer significant collective benefits to members, including:

- ⌘ single national body to represent the industry's collective commercial interests to governments, researchers, environmentalists, consumers, occupational health and safety managers, markets and other third parties,
- ⌘ a single forum to identify, discuss, present and debate issues and policy (eg residue surveys, generic promotion of Australian Abalone, quality assurance, diver training), and agree on the way forward for the industry,

- ✂ a body to communicate, administer, coordinate and disseminate relevant information to and from members for mutual benefit, and
- ✂ a means to coordinate collective resources to undertake projects of mutual advantage, from time to time.

The formation of a national abalone organisation has been stalled on at least two occasions by lack of participant support. Large processors dominate and must be the core of the industry body, as they represent many active diver/investors, link the industry to its markets, and hold the key to value adding. Vested interests are still evident, but fresh attempts to form a self-funded peak body are moving forward. The current efforts seek individual contributions of around \$800 per processor to fund industry planning and communication through a central professionally hired executive. Review Team experience in similar industry situations suggests this fee is too low to generate the \$120,000 odd necessary to really make a peak body effective and provide leadership to industry. It will then be in a strong position to develop and police its own Codes of Practice for professional processors and divers. This is a high and current priority in the industry given the lack of understanding of the motivation for overfishing and theft and the relatively large losses of product.

### **3.2 Industry Contribution to R&D**

Industry currently contributes a voluntary levy to the Federal Government for Research and Development for industry benefit, at the rate of .25 percent of the beach price. This contribution amounts to around \$398,000 at current catch rates and prices.

Exhibit 6 illustrates FRDC funded abalone R&D projects undertaken over the past six years. Research funds allocated from 1993 per annum are:

1993	\$ 1,062,477	1996	\$ 737,631
1994	\$ 547,223	1997	\$ 27,000
1995	\$ 506,048	1998	\$ 992,911

These figures include both wild and aquaculture abalone fishery research, and projects are marked accordingly in Exhibit 6. The table indicates approximately \$2 million of FRDC's \$3.5 million abalone research funding has been directed towards wild fisheries, with the other \$1.5 million for aquaculture. The relative spending on aquaculture is reasonably high (43 percent) given its smaller economic importance than the established wild fisheries.

However this investment in aquaculture (lead by commercial operators in the wild industry) must be seen as an important strategic commitment by industry and government in support of Australia's emerging dominance in the world abalone industry.



<b>Exhibit 6</b>					
<b>FRDC Funded Abalone Research 1993 - 1998</b>					
<b>Project No.</b>	<b>End Date</b>	<b>Total Project Budget</b>	<b>Organisation</b>	<b>Title</b>	<b>Objectives</b>
93/100 (Wild)	Aug 95	\$166,101	MAFRI	Evaluation of methods to assess abalone abundance	To compare methods of abundance estimation in determining the effects of stock depletion by pulse fishing a stunted blacklip abalone population.
93/102 (Wild)	Jun 97	\$387,076	NSW Fisheries	Interactions between the abalone fishery and sea urchins in NSW	<ol style="list-style-type: none"> <li>1 To quantify changes in the abundance of sea urchins and abalone on reefs in southern NSW.</li> <li>2 To describe the extent of the "barrens habitat" and the degree to which it is expanding on reefs in southern NSW.</li> <li>3 To describe the influence of habitat type on the abundance of abalone.</li> <li>4 To describe the effects of habitat type sea urchin density and harvest time on the quality of roe harvested from sea urchins.</li> <li>5 To gather preliminary data on the potential for a sustained fishery for this species in NSW.</li> </ol>
93/116 (both)	Feb 94	\$5,296	Tas DPIWE	The second international symposium on abalone biology fisheries & culture	<ol style="list-style-type: none"> <li>1 To organise the second International Symposium on abalone biology, fisheries and culture</li> <li>2 To organise workshops after the symposium on key topics relevant to abalone culture, stock assessment and management</li> </ol>
93/224.0 1 (Aqua-culture)	Jun 96	\$18,664	FRDC	Abalone aquaculture subprogram - FRDC secretariat file	Abalone aquaculture - ABALONE AQUACULTURE SUBPROGRAM
93/224.0 2 (Aqua-culture)	Oct 96	\$184,845	SARDI	Abalone aquaculture subprogram - artificial feeds development and systems design	<ol style="list-style-type: none"> <li>1 To establish a collaborative framework for coordinating Australian abalone aquaculture research.</li> <li>2 Develop an artificial food suitable for use in tank systems.</li> <li>3 Develop a tank design suitable for use with artificial food.</li> <li>4 Quantify the environmental requirements for abalone grown in intensive tank culture</li> <li>5 Hold regular workshops for research planning, to disseminate research outcomes and to gain feedback</li> </ol>
93/224.0 4 (Aqua-culture)	Sep 96	\$146,250	SA Mariculture	Abalone aquaculture subprogram - artificial feeds development and systems	<ol style="list-style-type: none"> <li>1 To establish a collaborative framework for coordinating Australian abalone aquaculture research.</li> <li>2 Develop an artificial food suitable for use in tank systems.</li> </ol>

culture)				design	<ol style="list-style-type: none"> <li>3 Develop a tank design suitable for use with artificial food.</li> <li>4 Quantify the environmental requirements for abalone growth in intensive tank culture</li> <li>5 Hold regular workshops for research planning, to disseminate research outcomes and to gain feedback.</li> </ol>
93/224.0 5 (Aqua-culture)	Sep 96	\$71,874	SA Abalone Development	Abalone aquaculture subprogram - artificial feeds development and systems design	<ol style="list-style-type: none"> <li>1 To establish a collaborative framework for coordinating Australian abalone aquaculture research.</li> <li>2 Develop an artificial food suitable for use in tank systems.</li> <li>3 Develop a tank design suitable for use with artificial food.</li> <li>4 Quantify the environmental requirements for abalone grown in intensive tank culture</li> <li>5 Hold regular workshops for research planning, to disseminate research outcomes and to gain feedback</li> </ol>
93/224.0 6 (Aqua-culture)	Sep 96	\$62,000	Marine Shellfish Hatcheries	Abalone aquaculture subprogram - artificial feeds development and systems design	<ol style="list-style-type: none"> <li>1 To establish a collaborative framework for coordinating Australian abalone aquaculture research.</li> <li>2 Develop an artificial food suitable for use in tank systems.</li> <li>3 Develop a tank design suitable for use with artificial food.</li> <li>4 Quantify the environmental requirements for abalone grown in intensive tank culture</li> <li>5 Hold regular workshops for research planning, to disseminate research outcomes and to gain feedback</li> </ol>
93/224.0 8 (Aqua-culture)	Mar 97	\$20,371	FRDC	Abalone aquaculture subprogram - Review of abalone aquaculture	
94/005 (Wild)	Jun 97	\$207,956	SARDI	The feasibility of enhancing & rehabilitating abalone stocks by larval re-seeding	<ol style="list-style-type: none"> <li>1 Determine the most appropriate transport and field deployment techniques to optimise survival of re-seeded larvae</li> <li>2 Determine whether larval re-seeding can enhance recruitment of abalone stocks over and above natural rates of recruitment</li> <li>3 Determine the true cost and benefit of undertaking larval re-seeding</li> <li>4 Determine the optimal habitat requirements for larval release within the Central Zone Reefs in New South Wales</li> <li>5 Determine the optimal habitat requirements for larval release within the Central Zone Reefs in Victoria</li> <li>6 Determine the influence of existing adults abundance on recruitment enhancement rates by larval re-seeding</li> </ol>
94/085	Jun 97	\$193,515	CSIRO	Abalone aquaculture	1 Determine baseline lipid class, essential fatty acid and sterol

(Aqua-culture)			Division of Marine Research	subprogram – Optimisation of essential lipids in artificial feeds for Australian abalone	<p>composition data of the local abalone (from the wild)</p> <p>2 Examine the amounts and proportions of nutritionally important lipid components of the abalone diet through growth rate bioassays. The feasibility of using radioactivity-labelled precursors will be examined as a means of examining uptake and possible bioconversion into biochemically-important compounds</p> <p>3 Determine is suitable supplements are required by determining assimilation rates and digestibility values of the lipid components oin fish oil based diets (which have compositions different to natural feeds) for abalone. Identify the fish oil, oil blend or modified oil which demonstrates the highest growth rates in abalone within economic constraints.</p>
94/167 (Wild)	Jun 98	\$136,752	SARDI	A data management & reporting system & temporal & spatial analysis of historical catch records in the SA abalone fishery	<p>1 To develop a data management and reporting system as detailed in B4 Objectives of the Project Application forming part of this Agreement</p> <p>2 Produce a historical analysis of catch and effort data as detailed in B4 Objectives of the Project Application forming part of this Agreement</p>
94/167.0 1 (Wild)	Jan 97	\$9,000	FRDC	A data management & reporting system & temporal & spatial analysis of historical catch records in the SA abalone fishery – FRDC secretariat file	To develop a data management & reporting system as detailed in B\$ Objectives of the Project Application forming part of this Agreement
95/004 (Wild)	Jun 98	\$249,980	University of Melbourne	In situ time-stamping of abalone shells to determine how abalone stocks can be aged	<p>1 This project will determine the timing and regularity of the calcite layers deposited under the spire of abalone shells, through extensive field based tagging and "timestamp" marking of abalone.</p> <p>2 We propose to achieve objective 1 for populations of blacklip abalone at three sites in Victoria, three sites in Tasmania and one site in New South Wales; and also for populations of greenlip abalone at two sites in South Australia.</p> <p>3 We aim to determine how to interpret the layers in abalone shells, how reliable such interpretations are, and how layer formation may vary between localities.</p> <p>4 We will use this information to determine the age distribution of abalone at a number of sites.</p> <p>5 We aim to be able to predict where and how layers can be used to age abalone in stocks in Southern Australia.</p>
95/143	Jun 98	\$140,000	Fisheries WA	Stock assessment & modelling	1 To improve the fishery database by providing data on catch and effort

(Wild)				for management of the WA greenlip abalone fishery	<p>on a finer spatial scale</p> <p>2 To provide in-water estimates of stock abundance and status</p> <p>3 To improve the understanding of the biology of greenlip abalone (particularly the effects of high growth rates on size at maturity and egg production and the influence of seasonal condition changes on length-weight relationships</p> <p>4 To develop simulation models which can be used to assist in management decisions</p>
95/165 (Wild)	Dec 96	\$116,068	Marine & Freshwater Resources Institute	Movement & re-aggregation of blacklip abalone in response to intensive fishing	<p>1 To determine the extent of migration and re-aggregation of a blacklip abalone population in response to fishing</p> <p>2 To describe differences between pre and post-fishing spatial distribution patterns in blacklip abalone population</p> <p>3 To determine the growth rates of a "stunted" abalone sub-stock</p>
96/321 (Wild)	Dec 97	\$66,113	Diving Medical Centre	Prevention of long-term medical complications in abalone divers	<p>1 Follow up of the otological (hearing/balance) problems already identified in the abalone divers of 1985;</p> <p>2 Determine the degree of hearing loss sustained since 1985, both in the older divers and in the new entrants;</p> <p>3 Ensure that all divers are instructed as regards the methods of prevention of the otological damage;</p> <p>4 Determine the prevalence of dysbaric osteonecrosis (bone rot), as far as is possible;</p> <p>5 Instruct the diving population as to the current concepts regarding the aetiology and prevention of dysbaric osteonecrosis;</p> <p>6 Instruct the diving population as to the current concepts regarding the aetiology and prevention of dysbaric osteonecrosis;</p> <p>7 Investigate dive profiles to determine any association between the diving exposures and the development of this disorder;</p> <p>8 Survey the extent of oxygen usage by divers in the industry, both underwater and on the surface, for routine decompression;</p> <p>9 Survey the extent of oxygen usage by the divers in the industry, both underwater and on the surface, for recompression therapy;</p> <p>10 Supply information regarding the current concepts and practices, related to oxygen toxicity;</p> <p>11 Conduct a cross sectional study on the other consequences of long exposure diving as regards a variety of clinical features (confusional states, respiratory difficulties, minor decompression symptoms, etc.)</p>
96/385	Jun 99	\$512,132	SARDI	Abalone aquaculture program	1 Diet Project:

(Aqua-culture)				- manufactured diet development	<p>1: INGREDIENT EVALUATION AND DIET FORMULATION</p> <p>a) To evaluate the nutritional value of a variety of local and cheap ingredient alternatives.</p> <p>b) To develop a database of the full nutritional contribution of ingredients.</p> <p>c) To formulate new diets based on information derived from all nutritional projects and evaluate under controlled conditions.</p> <p>d) To understand the link between diet composition and water quality and how this interacts with growth.</p> <p>e) To determine the nutritional processes, if any, by which algal supplements improve the production performance of artificial feeds.</p> <p>2: MANUFACTURING PROCESSES</p> <p>a) To manufacture diets using different manufacturing methods and evaluate their performance.</p> <p>3: DIET EVALUATION USING A VARIETY OF COMMERCIAL FARMING METHODS</p> <p>a) To evaluate diets at commercial farms using a variety of growout technologies.</p> <p>b) To better understand the relationship between diet performance and growout system.</p> <p>c) To trial diets developed specific for different growout systems.</p> <p>2 SUB-PROGRAM ADMINISTRATION</p> <p>1) To develop an effective and efficient sub program that has as its main goal to serve industry research requirements.</p> <p>2) To develop an administrative structure that allows industry and researchers to collaborate on the management of the Sub-Program.</p> <p>3) To promote and develop the abalone aquaculture industry.</p> <p>4) Provide a mechanism for ensuring that results are transferred to industry and are available to the broader public in a form that is readily understood.</p> <p>5) The multi-disciplinary and multi-project nature of the Abalone Aquaculture Sub-Program</p>
96/385.0 1 (Aqua-culture)	Jun 99		FRDC	Abalone aquaculture subprogram – FRDC secretariat file	
96/386	Jun 99	\$159,386	CSIRO	Abalone aquaculture	1 Use information on the nutritional and attractant factors present in

(Aqua-culture)			Division of Marine Science	subprogram – formulated feeds for newly settled juvenile abalone based on natural feeds (diatoms & crustose coralline algae)	<p>natural food items to develop a variety of recipes for formulated feeds for very young juvenile abalone (&lt;15 mm)</p> <p>2 Manufacture and evaluate the feeds for water stability and palatability for the different feed delivery mechanisms including gels, pellets, pastes, adhesion feeds (on plates) and others.</p> <p>3 Produce formulated diets of high nutritional value which produce high growth rates in very young abalone (&lt;15mm), as verified by growth rate trials.</p> <p>4 Provide information to the groups in the FRDC subprogram involved in the formulated feed development, so as to improve the existing formulated feed used for the "grow out" phase (15mm+)</p> <p>5 Identify the nutrients incorporated into the actively growing tissues of abalone fed diatoms by assessing fatty acid metabolism and carbon and nitrogen retention in juvenile abalone using stable isotopes</p>
97/407 (Aqua-culture)	Feb 98	\$27,000	Live Tech Pty Ltd	Development of transport systems for abalone	1 To develop a self-contained, self-monitoring system which allows the transport to factory holding facilities in Perth of live abalone from the south-west and south coast of Western Australia with minimal levels of mortality or stress
98/170 (Wild)	Nov 98	\$50,000	Macarthur Agribusiness	Wild Abalone fisheries R&D needs review	<p>1 Review current status of the wild abalone fishery in NSW, Vic, Tas, SA &amp; WA with respect to:</p> <p>i. Health of the fishery in each state, in particular the status of the stocks and the level of risk in regard to maintaining current stock levels.</p> <p>ii. Management strategy for each fishery.</p> <p>iii. Economic viability of the industry and how it is structured.</p> <p>iv. The impact of poaching and how it is being addressed by the industry and management.</p> <p>2 Review R&amp;D, including:</p> <p>i. Type of R&amp;D that has been undertaken in the different fisheries for the past 15 years (FRDC can provide this info with respect to FRDC projects)</p> <p>ii. The level of adoption of results and reasons for non-adoption</p> <p>iii. Identify the R&amp;D that has resulted in the most benefit in terms of ecological sustainability and industry development</p> <p>iv. Document the expertise of the research providers, including, record of involvement, publications in the area and external funds gained etc.</p> <p>3 Determine the R&amp;D priorities for each fishery, and in particular focus on:</p> <p>i. Biology, stock assessment and modelling.</p>

					<ul style="list-style-type: none"> <li>ii. Reference points and/or sustainability indicators.</li> <li>iii. Environmental impacts both from the fishery and on the fishery.</li> <li>iv. Economic objectives.</li> <li>v. Fisheries compliance, including, poaching, stock and product identification efficiency of methods used.</li> <li>vi. Post harvest, including, marketing, processing.</li> <li>vii. Performance indicators for R&amp;D.</li> </ul>
98/219 (Wild)	Jul-01	\$458,856	NSW Fisheries	Enhancement of populations of Abalone in NSW using hatchery-produced seed	<ul style="list-style-type: none"> <li>1 Produce seed from wild, blacklip abalone at a range of sizes and ages throughout the year.</li> <li>2 Develop techniques to enable the successful deployment of seed to coastal reefs in NSW.</li> <li>3 Develop techniques to maximise the settlement, survival and growth of seed on coastal reefs in NSW.</li> <li>4 Complete large-scale deployment of fluorochrome-marked seed to depleted coastal reefs in NSW.</li> </ul>
98/307 (Aqua-culture)	Jul-01	\$139,505	CRC for Aquaculture	Development of an integrated management program for the control of spionid mudworms in cultured abalone	<ul style="list-style-type: none"> <li>1 In general, to develop methods for the control of mudworms in farmed abalone, based on the principles of sustainable aquaculture.</li> <li>2 To thoroughly investigate the ecology and reproductive biology of spionid mudworms and their interaction with abalone, through monitoring, field and laboratory experiments.</li> <li>3 To gather long term data on the efficacy of the chemical treatment(s) throughout the production cycle</li> <li>4 To develop a protocol of chemical treatment within the production cycle to optimise the efficiency of chemical control in relation to abalone survival, growth and marketability, cost, and responsible chemical use.</li> <li>5 To gather information on the epidemiology of mudworm infestation in relation to ecological and hydrodynamic characteristics of sites, cage design and deployment and stock husbandry.</li> <li>6 To use information collected to refine culture methods so as to minimise the level and consequences of mudworm infestation, preferably without the use of chemical treatments.</li> </ul>





### 3.3 Industry Statistics

Industry statistics are collated by state on an annual basis by the Australian Bureau of Agricultural Research Economics (ABARE).

Comparison of the latest data available for the Bureau with data generated by this study reveals a 10 percent discrepancy in values.

<b>Exhibit 7</b>						
<b>Comparison of Data Sources for Abalone Production</b>						
	<b>NSW</b>	<b>Vic.</b>	<b>WA</b>	<b>SA</b>	<b>Tas.</b>	<b>TOTAL</b>
<b>VOLUME (t) (Implied whole-in-shell weight)</b>						
ABARE	333	1,422	326	812	2,360	5,253
This Study	333	1,440	367	830	2,520	5,490
Variance from ABARE	0	+ 1.3%	+ 12.6%	+ 2.2%	+ 6.8%	+ 4.5%
<b>VALUE (\$m)</b>						
ABARE	9.99	50.858	10.703	26.883	77.923	176.357
This Study	11.891	49.985	17.100	30.016	88.870	197.862
Variance from ABARE	+ 19%	- 1.7%	+ 59.7%	+ 11.7%	+ 14.0%	+ 12.2%

Source: ABARE Commodity Statistics and Macarthur Agribusiness

Comparison of the figures indicates that the industry's commercial catch value is 4.5% greater than ABARE estimates, excluding fishdowns, recreational and illegal catch.

Calculation of the value of the commercial catch is more difficult to establish, partly due to the fact that prices vary significantly from week to week. The current economic crisis in Asian markets has compounded this inherent price variability. These value estimates should be considered a guide only.

## 4. CURRENT FISHERY MANAGEMENT

The current management arrangements for the Australian wild abalone fisheries were determined using documentation available from State fisheries agencies and through discussions held with industry, resource managers and researchers in each State.

There was a great deal of commonality in the management strategies adopted by the various States.

The management arrangements and issues associated with each of the States are discussed in the following sections, but some generalisations can be made about the management of the fishery as a whole:

- ✂ The primary tools adopted for management of the abalone fishery are licence limitation to control excessive participation in the fishery, quota systems to limit the catch and minimum size limits to protect recruitment sources and biomass.
- ✂ The heterogeneous distribution of abalone emphasises the need for management to focus on a spatially restricted scale. Zonation of fisheries has been a response to this need, but finer scale spatial management is required to fully take this aspect of abalone resources into account.
- ✂ Management of the fisheries is generally guided by well-defined legislation and in all States with the exception of Victoria there are management plans for the fishery. Mechanisms for ensuring industry inputs to the decision making process also exist in all States.
- ✂ Resource theft is a cause for concern, as is the fact that its impact cannot be measured.

Current management arrangements in each of the States are as follows:

## **4.1 Tasmania**

Management of the Tasmanian Abalone Fishery is outlined in an Abalone Management Plan and Policy Document produced by the Department of Primary Industries, Water and Environment (DPIWE). This information was supplemented during discussions with industry, resource managers and researchers.

### ***Management Agency:***

The Tasmanian abalone resource is managed by the Department of Primary Industries, Water and Environment in accordance with the *Living Marine Resources Management Act 1995*.

### ***Species:***

The fishery is based on blacklip abalone (*Haliotis rubra*) and greenlip abalone (*Haliotis laevigata*).

### ***Zonation of the Fishery:***

There is no zonation of the fishery as this relates to licensing or quotas but legal minimum size limits vary in different parts of the coast.

### ***Licence Arrangements:***

Currently the number of licenses issued to take abalone commercially is 125. Licenses are issued to persons and are transferable. They may also be leased to other individuals.

### ***Quotas:***

The quota is held by individuals or enterprises through a system of contracts called the Abalone Deed of Agreement. The total number of quota units issued under the system is 3,500, each unit representing 1/3,500<sup>th</sup> of an annually adjusted Total Allowable Catch. Quota holders are therefore entitled to a share of the Total Allowable Catch in proportion to the number of units held. In cases where the licensed divers do not hold quota units,

and there are many of these, the divers need to negotiate with quota holders to take abalone. The TAC in 1999 is 2,520 tonnes.

***Minimum size limits:***

Minimum size limits vary by locality in response to the observations that growth rates vary around the coast and management should reflect these differences.

Minimum size limits are as follows:

<b>Exhibit 8</b>		
<b>Minimum Abalone Size Limits for Tasmania</b>		
<b>Section</b>	<b>Minimum size limit (mm)</b>	
	<b>Black</b>	<b>Green</b>
North West	132	140
West and South	140	150
North and East	132	150

Minimum size limits have been adjusted in the course of the fishery and the changes are listed in Attachment 2. Greenlip abalone size limits are scheduled to be reviewed in 1999.

***Management Decision Mechanisms:***

Management of the fishery is determined by the Management Plan. The Minister may request the Secretary to review the Plan if new information becomes available or circumstances change to an extent which reduces the efficiency of the rules set by the Plan. The process for review is set out in the Act.

Changes can be made in the event of an emergency, in accordance with the process set out in the Act.

The Plan may be revoked if the Minister receives advice from the Secretary that this is necessary or desirable on ecological, economic or other grounds which make it impossible, difficult or unsafe for fishing to be conducted in accordance with the plan.

The Minister also receives advice from an Abalone Fishery Advisory Committee (AbFAC) which includes representatives from industry (processors, divers and quota holders), the Tasmanian Fishing Industry Council, the Marine Police, the Tasmanian Conservation Trust, resource management, and research and assessment.

### ***Compliance Arrangements:***

Under current arrangements in the Management Plan, divers:

- ✂ Lodge a pre-fishing report via a telephone paging service;
- ✂ Record the weight of fish on landing;
- ✂ Lodge a post fishing report via a telephone paging service; and
- ✂ Submit a paper docket, within 48 hours of landing, detailing fish landed.

Under the Plan, processors:

- ✂ Maintain stock on hand and daily totals of in and out going stock;
- ✂ Undertake an annual audit of stock on hand;
- ✂ Use a abalone transfer docket when moving abalone between processors anywhere in Australia; and
- ✂ Lodge a report of all consignments into and out of the operation via a telephone paging service.

### ***Recreational Catch Management:***

To take abalone for recreational purposes a person must have a fishing license (recreational abalone) which permits the holder to take 10 abalone per day by diving. Provisions also exist to prevent recreational divers stockpiling abalone or transferring them to someone else who stockpiles them. A provision exists for the taking of abalone for Aboriginal cultural fishing at the rate of 10 abalone per day, with a maximum of 20 in possession at any one time. The recreational catch in 1998 is estimated by fishery

managers to be 35 tonnes (1.4% of the TAC). This catch is not evenly distributed around the fishery.

## 4.2 Victoria

Management of the Victorian Abalone Fishery is described in the Fisheries Assessment Report Series Abalone 1996 compiled by the Abalone Stock Assessment Group. This information has been supplemented by information collected during discussions with industry, resource managers and researchers.

### **Management Agency:**

The Victorian abalone resource is managed by the Department of Natural Resources and Environment under the Fisheries Act 1995. Within the Department Fisheries Victoria is the agency responsible for implementation of the legislation.

### **Species:**

The fishery is based on blacklip abalone (*Haliotis rubra*) although small catches of greenlip abalone (*Haliotis laevigata*) are made.

### **Zonation of the Fishery:**

The fishery is separated into three zones, each of which is managed separately in relation to licence restrictions and total allowable catch. These are the Western, Central and Eastern Zones.

### **Licence Arrangements:**

Currently the number of licences and their distribution is as follows:

<b>Exhibit 9</b>	
<b>Victorian Abalone Licence Allocation by Zones</b>	
<b>Zone</b>	<b>Licences</b>

Western	14
Central	34
Eastern	23
<b>Total</b>	<b>71</b>

Licenses are issued to persons and are transferable. Licences may also be leased to other individuals by the licence holder. Transfer arrangements need to be renewed at the start of each new quota year.

**Quotas:**

TACs and Individual quotas (ITQ) are currently as follows:

<b>Exhibit 10</b>			
<b>Victorian Abalone Catch Limits and Diver Number by Zone</b>			
<b>Zone</b>	<b>TACs in tonnes</b>	<b>ITQ's in tonnes</b>	<b>Number of Divers</b>
Western	280	20	14
Central	700	20.58	34
Eastern	460	20	23
<b>Total</b>	<b>1440</b>		<b>71</b>

The transfer of quota is permitted but limited to 50 percent of the quota holding within the quota year.

**Minimum Size Limits:**

Minimum size limits for blacklip abalone are applied in each of the zones and are as follows:

<b>Exhibit 11</b>	
<b>Minimum Abalone Size Limits for Victoria</b>	
<b>Zone</b>	<b>Black abalone minimum size limit (mm)</b>
West of Lorne	120

East of Lakes Entrance	120
Between Lorne and Lakes Entrance	110
Port Phillip Bay	100

The size limit for Greenlip is 130 mm for all Victorian waters.

***Closed Season:***

There is a closed season for greenlip abalone from 1 October to 31 March for commercial and recreational divers.

***Management Decision Mechanisms:***

Fisheries Victoria is the Agency responsible for implementing fisheries management under the Fisheries Act 1995

The Victorian Fisheries Co-management Council is appointed by the Minister under the Fisheries Act 1995 and has, as some of its functions:

- ⌘ Overseeing the preparation of management plans under section 28 and to advise the Minister in respect of proposed management plans; and
- ⌘ Advising the Minister on state-wide priorities for fisheries management and fisheries research, and on matters relating to inter-governmental recommendations to the Minister for Agriculture and Resources for the management of marine resources.

The Council comprises persons who have experience and knowledge in commercial fishing, fish processing, fish marketing, recreational fishing, traditional fishing uses, aquaculture, conservation and fisheries science.

To assist with the provision of advice to the Minister the Council has an Abalone Committee appointed by the Minister on the basis of their individual expertise in the abalone capture and processing sectors.



Seafood Industry Victoria is the peak body for commercial fishing in Victoria and as such acts as an advocate for the industry in relation to resource management by Government. The peak body receives advice from an Abalone Committee appointed from within its membership.

***Compliance Arrangements:***

A diver docket system is applied. This requires the diver to complete dockets on landing the catch and these dockets are required to accompany the catch in sealed containers to the processor who confirms receipt of the catch and its weight and provides this information to Fisheries Victoria. An audit system for processors is also in place.

***Recreational Catch Management:***

No licence is required for recreational fishers to take abalone but a daily bag limit of 10 abalone applies with the proviso that no more than 2 of these be greenlip abalone.

### **4.3 South Australia**

Management of the South Australian Abalone Fishery is documented in the Management Plan for the South Australian Abalone Fishery prepared by the Abalone Fishery Management Committee. Information from this source was supplemented by discussions held with industry, resource managers and researchers.

***Management Agency:***

The South Australian abalone resource is managed by the Primary Industries South Australia (PIRSA) under the Fisheries Act 1982. Regulations for the management of the fishery are located in the Scheme of Management (Abalone Fisheries) Regulations 1991 and the Fisheries (General) Regulations 1984. The Act requires that the resource be used in a sustainable manner and in an economic fashion.

**Species:**

Two species, the greenlip abalone (*Haliotis laevis*) and the blacklip abalone (*Haliotis rubra*) comprise the commercial fishery. Three species are not yet considered commercial – *Haliotis roei*, *Haliotis cytlobatos*, and *Haliotis scalaris*. The potentially commercial size of the roe stocks were estimated to be approximately 12 tonnes in 1993.

**Zonation of the Fishery:**

The fishery is separated into three zones, each of which is managed separately in relation to licence restrictions and total allowable catch. These are the Western, Central and Southern Zones. The Western zone has two regions (“A” and “B”) with the latter comprising a Far Western region of both greenlip and blacklip species.

**Licence Arrangements:**

Currently the number of licenses and their distribution is as follows:

<b>Exhibit 12 South Australian Abalone Licence Allocation by Zone</b>	
<b>Zone</b>	<b>Licences</b>
Western	23
Central	6
Southern	6
<b>Total</b>	<b>35</b>

Licences are issued to persons, partnerships or companies and each licence is allocated an individual quota which is an equal proportion of the TAC for blacklip and greenlip abalone for that zone.

Each licence holder may have up to two master divers registered to operate under the licence but only one diver may operate on any day.

**Quotas:**

Quotas are allocated on a calendar year for the Western and Central zones but for the period September to August in the southern Zone.

The quotas in 1997 were as follows:

<b>Exhibit 13</b>						
<b>South Australian Abalone Catch Limits by Zone - 1998</b>						
<b>Zone</b>	<b>ITQ's* in tonnes</b>		<b>TACs in tonnes</b>			<b>Number of Divers</b>
	<b>Green</b>	<b>Black</b>	<b>Green</b>	<b>Black</b>	<b>Total</b>	
Western - meat weight**	3.6	4.25	82.8	97.75	180.55	23
Central - meat weight	7.95	2.35	47.7	14.1	61.8	6
Southern - whole weight	1	16	6	96	102	6
<b>Total</b>						<b>35</b>
Southern Fishdown - whole weight		8		48	48	

\* Individual Transferable Quota

\*\* Note that 600 kg of the ITQ greenlip volume in the Western zone relates to region "B" (Far west) and may be taken as either greenlip or blacklip.

The Southern zone fishdown quota is to accommodate catches of stunted blacklip abalone which do not reach the minimum size limit. Since introduced in 1984/85 in the Central zone, and subsequently in other zones, the quotas have been adjusted periodically but not in a major fashion. Quota may be transferred between holders within any one year but revert to the original arrangements at the beginning of the new year.

Quota / TAC tonnage is for whole abalone in shell in the southern zone, and for "shucked" or fresh abalone meat weight in the Central and Western zones. The shucked meat weight is approximately one third of the fresh whole in-shell weight.

**Minimum Size Limits:**

Minimum size limits were first introduced to the fishery in 1971 and reviewed in 1984. Currently these restrictions are as follows:

<b>Exhibit 14</b>		
<b>Minimum Abalone Size Limits for South Australia</b>		
<b>Zone</b>	<b>Minimum size limit (mm)</b>	
	<b>Green</b>	<b>Black</b>
Western	145	130
Central	130	130
Southern	130	125

***Management Decision Mechanisms:***

Responsibility for management of the fishery lies with PIRSA Fisheries who take advice from the Abalone Fishery Management Committee.

To assist the Management Committee in its decisions a number of reference points and performance indicators have been established. These relate to catch rates, size composition of certain stocks and indices of abundance.

When one or more reference points are reached or exceeded the Management Committee undertakes specific actions which include informing the Minister and participants in the industry, examining the causes and implications of the triggering, consulting about the need for alternative management strategies and actions and providing a report on the outcomes of actions to the Minister and Industry.

The membership of the Abalone Fishery Management Committee comprises:

- ✍ Independent Chair
- ✍ 2 Western Zone representatives
- ✍ 1 Central Zone representative
- ✍ 1 Southern Zone representative
- ✍ Fishery manager (PIRSA) - non voting
- ✍ Research Scientist (SARDI) - non voting

- ✂ South Australian Fishing Industry Council - non voting
- ✂ South Australian Recreational Fishing Advisory Committee - non voting

***Compliance Arrangements:***

A fishery logbook must be completed on a daily basis and lodged monthly to monitor compliance with quota arrangements. This is complemented by a catch and disposal record which must be completed immediately on landing abalone, accompany the catch to the processor and then be forwarded to PIRSA Fisheries to monitor the fishing of allocated quota by each diver. All catch must be landed in shell and processed in registered facilities.

***Recreational Catch Management:***

The recreational fishery is open to all members of the public but with a daily bag limit of five abalone or a boat limit of ten. Minimum size limits as for the commercial fishery apply to the recreational catch.

#### **4.4 New South Wales**

Information on the management of the New South Wales abalone fishery was provided in draft documentation supplied by the NSW Fisheries Department, and supplemented during discussions with industry, resource managers and researchers.

***Management Agency:***

The NSW abalone resource is managed by NSW Fisheries under the Fisheries Management Act 1994 and subordinate regulations. The Act requires that the resource be used in a sustainable manner and in an economic fashion.

***Species:***

The fishery is based on the blacklip abalone (*Haliotis rubra*).

***Zonation of the Fishery:***

The fishery is separated into sixteen zones which in turn are divided into 83 sub-zones. These zones are not restrictive in terms of the licences which can be operated within them nor are there catch restrictions which apply to the specific zones. Zonal closures are used for the rehabilitation of the resource in cases where resource theft, disease or localised legitimate overfishing has adversely affected stocks.

***Licence Arrangements:***

Access to the fishery is provided through holding the right to take abalone for sale through ownership of a share of the TAC. There are currently 37 shareholders each having an allocation of 100 shares which entitles each shareholder to take 9 tonnes of abalone. Shareholders currently pay an annual fee of \$22,500 which is not based on full cost recovery but the intention is to move towards full cost recovery over a number of years. Each shareholder can nominate one commercial fisher to take abalone on their behalf on any one day but there are no other restrictions on nominees.

***Quotas:***

The TAC for 1998 was 333 tonnes and all shareholders receive an equal share of this allocation. The TAC is annually reviewed by a TAC Committee which is independent of Government.

***Minimum Size Limits:***

The minimum size limit for abalone is 115 mm.

***Management Decision Mechanisms:***

An Abalone Management Advisory Committee (AbMAC), which comprises Government, industry, recreational and conservation representatives, is the main body with which the Department consults in relation to its management recommendations to the Minister.

***Compliance Arrangements:***

Endorsed fishers are required to validate their catch upon landing and forward the docket to NSW Fisheries within 24 hours. A monthly reconciliation sheet is also required.

#### 4.5 Western Australia

Management of the Western Australian abalone fishery is outlined in a draft document *Abalone Managed Fishery Overview 1998 (Western Australia)* dated 22 September 1998. This information was supplemented during discussions with industry, resource managers and researchers.

##### **Management Agency:**

The abalone resource is managed by Fisheries Western Australia. Legislation determining the management of the fishery includes the Fish Resources Management Act 1994, the Fish Management Regulations 1995, The Abalone Managed Fishery Management Plan 1992 and subsequent amendments, and Recreational Abalone Fishery Notices.

##### **Species:**

The fishery is based on the greenlip abalone (*Haliotis laevigata*), the brownlip abalone (*Haliotis conicopora*) and Roe's abalone (*Haliotis roei*).

##### **Zonation of the Fishery:**

The commercial fishery is divided into three licensing zones:

<b>Exhibit 15</b>	
<b>Abalone Fishing Zones for Western Australia</b>	
Zone 1 – South Eastern	WA/SA border to Shoal Cape on south coast
Zone 2 – South Western	Shoal Cape to Busselton Jetty
Zone 3 - West	Cape Leeuwin to WA/NT border

##### **Licence Arrangements:**

Currently the number of licences and their distribution is as follows:

<b>Exhibit 16</b>	
<b>WA Abalone Licence Allocation by Zone</b>	
<b>Zone</b>	<b>Licences</b>
Zone 1	6
Zone 2	8
Zone 3	12
<b>Total</b>	<b>26</b>

Licences in Zones 1 and 2 can take greenlip, brownlip and Roe's abalone but licences in Zone 3 may only take Roe's abalone. All licences are transferable and license holders can apply to have their license endorsed to allow a nominated diver to fish on their behalf. All abalone taken under license may only be consigned to a licensed processing facility or the holder of an abalone aquaculture license. Boats used for commercial abalone fishing must be licensed and endorsed on the abalone license.

#### **Quotas:**

A TAC is applied to each zone of the fishery. The zonal TACs for greenlip and brownlip are combined while separate TACs apply to Roe's abalone. Licences are entitled to an IQ Allocation which is an equal portion of the TAC. Greenlip and brownlip quotas are specified in fresh meat weight; Roe's abalone are whole in-shell weights.

The TACs for the 1997/98 season were:

<b>Exhibit 17</b>			
<b>Western Australia Abalone Catch Limits by Zone</b>			
<b>Zone</b>	<b>Number of licences</b>	<b>Greenlip/brownlip (meat weight in tonnes)</b>	<b>Roe's (whole weight in tonnes)</b>
Zone 1	6	40.2	9.96
Zone 2	8	40.0	8.0
Zone 3	12	N/A	108



<b>Total</b>	<b>26</b>	<b>80.2</b>	<b>125.96</b>
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***Minimum Size Limits:***

The minimum size limit for greenlip and brownlip abalone in all waters for the commercial fishery is 140 mm. The limit for Roe's abalone is 60 mm except for an area between the Moore River and Cape Bouvard where a 70 mm limit applies.

***Management Decision Mechanisms:***

The commercial fishery is managed in accordance with the Abalone Managed Fishery Plan 1992. The Minister makes decisions about amendments to the Plan but must consult with the AbMAC prior to any amendments. The AbMAC has representation from the commercial abalone sector the recreational sector, processors and the community as well as a representative of Fisheries WA.

***Compliance Arrangements:***

All abalone taken under commercial licence arrangements must be consigned to registered processors or to the holder of an abalone aquaculture license for the particular species.

***Recreational Catch Management:***

The recreational fishery in Western Australia is subject to species specific restrictions with special arrangements applying to the metropolitan and mid-west coasts where recreational fishing pressure is highest.

Recreational fishers are restricted to personal possession limits of 10 greenlip or brownlip and 20 Roe's abalone. The size limits are respectively 140 mm and 60 mm. Fishing can take place year round, except along the Metropolitan (Perth) and mid-west (Geraldton) coast where fishing for Roe's abalone is restricted to Sundays between 7.00 – 8.30 am between 1 November and 6 December.

#### 4.6 Summary of State Fishery Management Arrangements

All the States have in place limited entry, minimum size limits and quotas, measures which have played a part in preventing the overfishing of a resource which is particularly prone to this problem. The industry sectors in all States have mechanisms which allow input into the management process and by and large industry and resource managers were satisfied with current management, with the exception of compliance, better assessment of the risks associated with management change and in Victoria the lack of an agreed Management Plan.

At present management is focussed on zones and species within each State. Management on a finer scale is desirable because of the spatial aspects of the resource, but many resource managers are of the view that, with some specific exceptions, there are practical constraints on finer scale management.

Exhibit 18 details the size limits and implied whole TAC volumes across all States and fisheries.

<b>Exhibit 18</b>						
<b>Summary of Minimum Size Limits per State</b>						
<b>State</b>	<b>Zone</b>	<b>Minimum Size</b>				<b>Implied Whole Abalone TAC (t)</b>
		<b>Blacklip</b>	<b>Greenli P</b>	<b>Brownlip</b>	<b>Roe</b>	
Tas	Northwest section	132	132			2,520
	West & South section	140	150			
	North & East section	132	150			
Vic	West	120	130			280
	Central	120	130			700
	East	110	130			460
SA	South East	125	130			543

	Central	130	130			185
	West	130	145			102
NSW	All areas	115				333
WA	Zone 1 (South Eastern)		140	140	60	131
	Zone 2 (South Western)		140	140	60	128
	Zone 3 (West)		140	140	60 *	108
<b>TOTAL</b>						<b>5,490</b>

\* 70 mm size limit applies for Perth metropolitan area.

## 5. AUSTRALIAN ABALONE RESEARCH EXPERTISE

### 5.1 Background

Assessment of the research expertise available to conduct studies on abalone requires consideration of the number of persons involved, the level of their involvement, their experience and training as well as the number of papers published in both abalone and other research fields.

To gather information for this review questionnaires were sent to State research agencies. Agencies were asked to provide information on the persons currently engaged in research. The survey was not extended to Universities and other research providers as perusal of published data indicates that the major portion of research is undertaken in State facilities. In assessing the information no distinction was made between research directed to abalone culture as opposed to wild stock management as both activities generate biological information which assists the management of both of these activities.

The Agencies were requested to identify individual staff within the categories which are commonly applied in State Agencies, that is:

- ✍ Project manager
- ✍ Senior researcher
- ✍ Researcher
- ✍ Senior technical officer
- ✍ Technical officer

To estimate the actual current effort deployed on abalone research, agencies indicated the proportion of each persons time spent on abalone, thus allowing for the calculation of the person years actually being currently applied.

Evaluation of the adequacy of the expertise available is made difficult because there are no benchmarks.. In addition, the adequacy of the research skills requires a mix of experience and new talent, thus simplistic evaluation of years of experience and number of publications can be misleading.

## 5.2 Evaluation of Information on Current Staff Engaged in Abalone Research in State Agencies

The responses from each of the States indicates that a total of 30 people are involved in abalone research at various levels. A number of these people are not fully committed to abalone research and this was reported by the Agencies for each individual as the percentage of that individuals time devoted to abalone. Making adjustments for this degree of commitment, the current commitment to abalone research by State agencies is estimated to be 23 person years per annum.

Exhibit 19 indicates the levels at which these staff operate, with research the primary activity undertaken. The proportion of technical to research staff is low.

<b>Exhibit 19</b>		
<b>Nationwide Staff Allocation to Abalone Research in State Agencies</b>		
<b>Level</b>	<b>Persons</b>	<b>Person years</b>
Project manager	3	2.05
Senior researcher	4	2.75
Researcher	11	8.3
Senior technical officer	3	2.7
Technical officer	9	7.6
<b>Total</b>	<b>30</b>	<b>23.4</b>

Each State maintains a core team of abalone research staff devoted to its fisheries. The largest group is in South Australia, the smallest in Victoria. Victoria does however rely

on contractors to undertake fieldwork and, if these were included, the Victorian team would be of the same order as those in NSW and Tasmania.

Staff numbers by State are shown in Exhibit 20.

<b>Exhibit 20</b>		
<b>Staff Allocation to Abalone Research by State</b>		
	<b>Persons</b>	<b>Person years</b>
<b>Tasmania</b>		
Project manager	1	1
Senior researcher	1	1
Senior technical officer	1	1
Technical officer	2	2
<b>State Total</b>	<b>5</b>	<b>5</b>
<b>Victoria</b>		
Project manager	1	.85
Researcher	2	1.15
<b>State Total</b>	<b>3</b>	<b>2</b>
<b>South Australia</b>		
Project manager	1	0.20
Senior researcher	2	1.25
Researcher	8	6.15
Senior technical officer	2	1.7
<b>State Total</b>	<b>13</b>	<b>9.3</b>
<b>Western Australia</b>		
Senior researcher	1	.5
Technical officer	4	3.1
<b>State Total</b>	<b>4</b>	<b>3.5</b>
<b>NSW</b>		
Researcher	1	1
Technical officer	3	2.5
<b>State Total</b>	<b>5</b>	<b>3.6</b>
<b>Grand Total</b>	<b>30</b>	<b>23.4</b>

Exhibit 21 details the experience in years of the current staff engaged in abalone research. The mode for both research and abalone research experience is five to ten years, but at least 12 of the 30 scientists involved in abalone research have general research experience of ten years or more.

<b>Exhibit 21</b>		
<b>Research Experience of Scientists Currently Involved in Abalone Research</b>		
<b>Years of experience</b>	<b>Number of Researchers</b>	<b>Number of Abalone Researchers</b>
>20	2	1
15 - 19	1	1
10 - 14	9	2
5 - 9	14	10
0 - 4	4	15
<b>Total</b>	<b>30</b>	<b>29</b>

Each of the States retains experienced teams to undertake abalone research (Exhibit 22).

<b>Exhibit 22</b>			
<b>The Experience of Staff Currently Involved in Abalone Research by State</b>			
<i>* Numbers in brackets represent the average experience in years</i>			
	<b>Total Research Experience in years</b>	<b>Total Abalone Research Experience in years</b>	<b>Persons</b>
<b>NSW</b>			
Researcher	10	6	1
Technical officer	24 (8)	9 (3)	3
<b>State total</b>	<b>34 (8.5)</b>	<b>15 (3.8)</b>	<b>4</b>
<b>South Australia</b>			
Project manager	20	15	1
Senior researcher	44 (22)	29 (14.5)	2
Researcher	42 (5.3)	26.5 (3.3)	8
Senior technical officer	17 (8.5)	16.5 (8.3)	2
<b>State total</b>	<b>123 (9.5)</b>	<b>87 (6.7)</b>	<b>13</b>
<b>Tasmania</b>			
Project manager	8	3	1
Senior researcher	8	5	1
Senior technical officer	8	5	1
Technical officer	18(9)	15 (7.5)	2
<b>State total</b>	<b>42 (8.4)</b>	<b>28 (5.6)</b>	<b>5</b>
<b>Victoria</b>			
Project manager	15	10	1
Researcher	18 (9)	6 (3)	2
<b>State total</b>	<b>33 (11)</b>	<b>16 (5.30)</b>	<b>3</b>
<b>Western Australia</b>			
Senior researcher	10	3	1
Technical officer	24 (6)	14 (3.5)	4
<b>State total</b>	<b>34 (6.8)</b>	<b>17 (3.4)</b>	<b>5</b>
<b>Australian Total</b>	<b>266 (8.9)</b>	<b>163 (5.4)</b>	<b>30</b>



Exhibit 23 examines the academic qualifications of the staff currently involved in abalone research. A high proportion, (28 of 30), were technically qualified, with nineteen of these staff having post graduate qualifications.

<b>Exhibit 23</b>	
<b>Qualifications of Staff Currently Involved in Abalone Research</b>	
<b>Highest Qualification</b>	<b>Number of Staff</b>
Ph D	6
Honours	13
Bachelors	7
Diploma	2
No formal qualifications	2
<b>Total</b>	<b>30</b>

To explore competence the publication record of staff currently involved in abalone research was examined. This was measured by establishing the number of scientific and abalone publications staff had authored or co-authored. Data on all publications rather than only refereed publications are presented, as a number of reports relevant to resource management may not necessarily appear in refereed journals. It must be noted that multi-authorship of papers by abalone research staff in agencies occurs and the figures in Exhibit 24 cannot be used to derive the total number of papers produced by those agencies.

The information in Exhibit 24 confirms the generally experienced nature of the staff currently engaged in abalone research.

<b>Exhibit 24</b>			
<b>Average Publication Record of Staff Currently Involved in Abalone Research</b>			
	<b>Number of Publications</b>	<b>Number of Abalone Publications</b>	<b>Persons</b>
<b>Tasmania</b>			
Project manager	19	3	1
Senior researcher	1	1	1
Senior technical officer	0	0	1
Technical officer	2	2	2
<b>State Total weighted avg.</b>	<b>5</b>	<b>2</b>	<b>5</b>
<b>Victoria</b>			
Project manager	19	13	1
Researcher	11	1	2
<b>State Total weighted avg.</b>	<b>14</b>	<b>5</b>	<b>3</b>
<b>South Australia</b>			
Project manager	100	71	1
Senior researcher	80	32	2
Researcher	3	1	8
Senior technical officer	1	1	2
<b>State Total weighted avg.</b>	<b>22</b>	<b>11</b>	<b>13</b>
<b>Western Australia</b>			
Senior researcher	19	4	1
Technical officer	1	0	4
<b>State Total weighted avg.</b>	<b>5</b>	<b>1</b>	<b>5</b>
<b>NSW</b>			
Researcher	29	13	1
Technical officer	7	3	3
<b>State Total weighted avg.</b>	<b>12</b>	<b>6</b>	<b>4</b>
<b>Australian Total weighted avg.</b>	<b>14</b>	<b>7</b>	<b>30</b>

Note: Totals are average figures weighted by the number of persons applicable.

### **5.3 Conclusions on the Competence and Skills of Staff Currently Engaged in Abalone Research Within State Agencies**

The information collected as part of this Review suggests that the abalone fishery has the services of teams of scientists and technical staff with experience both in research in general and abalone research in particular. The teams have published a number of papers, with some members being particularly prolific.

The overall impression is that in each of the States there is a core of scientific experience and expertise to handle the current research or provide the basis for an expansion of programs.

Flexibility in terms of transfer of expertise to meet fluctuating needs has been and can continue to be achieved through the movement of scientists between States. For instance current project managers or senior researchers in South Australia, Tasmania and Western Australia have all worked in other States during the course of their career.

In relation to modelling, which would appear a future priority, the expertise currently available within abalone teams could be complemented by highly regarded fisheries modelling experts who are not involved in abalone research at the present time. Such expertise is well represented in CSIRO, and most State agencies also have such specialists.

This evaluation suggests that, in relation to biological aspects, a sound core of expertise exists to undertake the abalone research required, more especially if projects have access to the very specialist modelers who are available but not necessarily working on abalone issues at the present time.

The information supplied to the Review provided little evidence of expertise required to undertake economic assessments of the fishery, or to undertake studies related to compliance, marketing or value adding. Victoria has recently appointed an economist to

deal with fisheries matters and some compliance research is being undertaken in NSW. If this research on these topics is to be escalated, the expertise required will have to be sought elsewhere.

## 6. REVIEW OF MANAGEMENT AND ASSOCIATED R&D

To evaluate the impact which research has had on management of the abalone fishery the sequence of past management actions in each State was documented as was the research undertaken as evidenced by publications of this research.

The Australian abalone industry appears to have benefited from the fact that a number of significant management actions were taken fairly early in its development, and these have prevented the overexploitation which has plagued major abalone industries in a number of other countries.

The early introduction of key management measures, such as minimum size limits, limited entry through licence restriction and limitations on catch by means of quotas appears to have stabilised the abalone fisheries in most States. The introduction of zoning in at least three of the five States has assisted in ensuring that fishing effort has been more evenly spread across the resources, which has mitigated against zonal depletion, but is reported to be inadequate to deal with serial depletion of reefs in some zones.

Abalone fishing commenced in Australia between 1962 and 1965 and the early application of management measures is illustrated by Exhibit 25.

<b>Exhibit 25</b>				
<b>Years in Which Major Abalone Management Measures Were First Introduced by Abalone Fishing States</b>				
<b>State</b>	<b>Minimum size</b>	<b>Licence limits</b>	<b>Zonation</b>	<b>Quotas</b>
NSW	1973	1980		1989
South Australia	1971	1971	1971	1985 - 89
Tasmania	1962	1969	None	1985
Victoria	1968	1970	1968	1988
Western Australia	Early 1970's	1973 - 1975	1973 - 1975	1988

It is clear that minimum size limits were first introduced between 1962 and 1973, licences limitation occurred as early as 1969 – 1971 in three States but later in others and that the introduction of quotas took place between 1985 and 1988.

Details of the sequence of management changes for each of the States throughout the history of the fishery are summarised in Attachment 2.

The availability of scientific information to resource managers throughout the history of the fishery is very broadly reflected by the number of research publications on abalone over the period of the fishery. To illustrate this Australian abalone publication numbers have been tabulated over the period 1967 to 1998 (see Exhibit 26). The information is drawn from a bibliography of Australian abalone research and includes publications in refereed journals as well as those in agency journals, series and internal reports.

<b>Exhibit 26</b>		
<b>Research Papers on Australian Abalone Published Since Commencement of the Fishery</b>		
<b>Period</b>	<b>Number of Publications</b>	<b>Average / Year</b>
1960 – 1969	3	< 1
1970 – 1979	16	1.6
1980 – 1989	48	4.8
1990 – 1998 *	78	7.9

\* to October 1998

From Exhibits 25 and 26 it is clear that the initial important management decisions taken in the late sixties and early seventies were made in the absence of extensive research, as evidenced by the small number of publications at that time. This was confirmed during the series of discussions with industry, resource managers and researchers. At these meetings it was maintained that major management measures, including the introduction of quotas in the late eighties, were the result of commonsense concern about the resource rather than the outcome of rigorous research designed to provide clear-cut management advice.

Nevertheless the increase in research papers on abalone in the last two decades suggests that the scientific basis for refining management must be improving as scientists have responded to the need to confirm the important management decisions which have been made and provide managers with advice to refine management.

In order to evaluate the research information which is available, published research was collated within the following eight broad categories:

1. Abundance estimates
2. Disease
3. Fishery economics
4. General
5. Growth, recruitment and mortality
6. Movement/dispersion
7. Stock assessment
8. Stock separation

The outcome of this collation appears in Attachment 3, which lists the year of publication and the titles of the papers falling under each category and the author or authors. The bibliography from which the information in Attachment 3 was derived appears in Attachment 4. Attachment 3 thus provides a convenient sequencing of the published research available within specified categories and, together with Attachment 2, allows for the cross referencing of management decisions with the availability of published scientific information.

Since their inception there have been a number of changes made in relation to the major management measures:

- ✍ Minimum size limits have increased between 1980 and 1998 in particular in NSW, South Australia and Tasmania.
- ✍ The number of licences has been reduced in NSW and Victoria over the period 1985 to 1992, with this being most systematically tackled by NSW.

✍ Quota levels have undergone a number of changes since the introduction of this major management measure. Quotas were systematically reduced in Tasmania over the period 1986 to 1989 but increased in 1997. Greenlip sub-quotas in Tasmania have recently been established within the total TAC. Quota reductions have also occurred in New South Wales and West Australia during 1988 to 1992. The quota in Victoria has remained constant since its inception as abundance estimates have indicated no trend in the resource.

In summary some States have taken the following actions:

- ✍ Minimum size limit reduction, 1980 and 1990;
- ✍ Licence reduction, 1985 to 1992; and
- ✍ Quota reduction, 1986 to 1992.

The above changes appear to have been introduced to fine tune the management of the resource and in almost all cases have been moves towards a more conservative approach to stock conservation. Discussions with industry, resource managers and researchers indicated that many of these initiatives to adopt more conservative management were driven by the perceptions of industry or resource managers and as such were not research driven.

Nevertheless perusal of Attachment 3 shows that a number of papers dealing with stock assessment were published from the mid eighties to the early nineties and presumably information and expertise was thus available to resource managers during the period in which quotas were being introduced or adjusted. Likewise it was during this period that there was an upsurge in papers dealing with growth, recruitment and mortality and presumably these insights contributed towards some evaluation of the proposed actions, as these relate to minimum size limits and quota changes.

The degree to which scientific advice was sought or given could not be determined with any rigour, for this would have required access to and analysis of historical Agency



reports which was not feasible within the scope of the study, nor was there certainty that these records were available.

The documentation of the adoption of research results and the reasons for non adoption during the development of the management of the fishery is further complicated by the fact that important management measures such as minimum size, licence limits and zonation were introduced in the late sixties and early seventies and it was acknowledged that these decisions were the outcome of commonsense insights rather than research. Quotas were a phenomena of the mid to late eighties and at that stage assessment and modelling of the abalone resources was not a strong feature of research.

Nevertheless there was clear recognition by resource managers and industry that the more recent upsurge in research was worthwhile in that it provided reassurance that the measures adopted were appropriate. In particular the future need for better modelling and risk assessment to fine tune resource management is a high priority with all States, as was the continued monitoring of resources.

Likewise the contribution of research to the broader issue of ecological sustainability must be considered to be a relatively recent phenomena. In Victoria and South Australia research has contributed towards a better understanding of the interactions and behaviour of abalone on certain reefs and detailed research has been conducted in NSW on species interactions. Whereas the early adoption of size limits, limited entry and quotas has avoided gross overfishing and hence contributed to ecological sustainability the impact of fishing on the ecology of abalone is less well understood.

Research has contributed little to industry development in terms of new quality products and markets. Industry stakeholders are divided as to the scope for this. Nevertheless, conservative management of the resource has provided a constant supply of material which has allowed the industry to develop a reputation as a reliable supplier of quality product.

The degree of trust between industry, researchers and fishery managers is critical to effective funding and delivery of R&D changes that are adopted by industry. Where data collated and presented by researchers has some industry ownership and concurs with industry's own observation, then there is likely to be greater uptake of consequent R&D in management and industry decisions. However, where scientific opinion has no apparent bearing on industry observation or viability then little change will occur. The risks for researchers are obvious, as are the potential for discounts in the benefits of R&D to industry. Communication between the parties of data management must be given high priority.

## 7. MAJOR ISSUES ASSOCIATED WITH INDUSTRY, MANAGEMENT AND RESEARCH

### 7.1 Management Issues

Major management issues were identified during discussions with industry, resource managers and researchers and in many cases these were fairly specific to particular States. This specificity depended on the circumstances of the State's fishery, the nature of the coastline in terms of its remoteness, weather exposure, the state of the resource and the proximity of the fishery to other marine based activities.

There were however some commonalities in respect to important management issues, including:

- ✍ Agreement that quota levels, zonation and minimum size limits were generally appropriate and had played an important role in securing the resource;
- ✍ Increased quotas should not be contemplated in the absence of reliable risk assessment estimates based on sound models. Modelling was required to confirm the current status of the resource and no increases in quota could be contemplated without such assessment;
- ✍ Resource theft has a major direct impact on the resources in some zones and States but also adversely affects the market for all producers;
- ✍ There was generally a surplus of processing capacity which was handicapping economies of scale and product development and enhancement;
- ✍ In a number of States or zones, stock enhancement through reseedling or translocation was nominated as a means of increasing yield from the fishery.

The specific management issues raised by States during consultations were:

**Tasmania**

- ⌘ Zonation or some other form of diverting effort from the east to the west coast is required to safeguard the resource on the east coast and increase the size and revenue of the fishery on the west coast.
- ⌘ Increases in the minimum size limits of both black and greenlip abalone need to be considered to further safeguard the resource.
- ⌘ Decisions on the current quota and diversion of effort from the east to the west coast require establishment of a model for the fishery.
- ⌘ There needs to be a clearer separation of the management of the black and greenlip fishery.

**Victoria**

- ⌘ Minimum size limits are appropriate.
- ⌘ Quotas are appropriate and increases should only be contemplated once the associated stock risks have been ascertained.
- ⌘ Reef rehabilitation using reseeding and effective compliance could improve returns from the fishery.
- ⌘ Manipulation of stocks by transfer of stunted individuals and fishdowns are perceived as a further means of increasing returns from the fishery.
- ⌘ There is an excess of processors which jeopardises product development and does not allow for economies of scale.
- ⌘ Resource theft is the major threat to the fishery, both in terms of its impact on the resource and its adverse effect on the market and compliance needs to be significantly improved.
- ⌘ The fishery is in urgent need of a management plan.
- ⌘ The permanent transfer of quota is required to allow quota holders to adjust their operations to suit their circumstances and commit the capital investment required.

**South Australia**

- ✂ Current quota levels, minimum size limits and zonation arrangements are appropriate.
- ✂ The impact of finfish and abalone aquaculture effluent on abalone habitat and stocks is of concern.
- ✂ Pollution, including oil spills proximate to Spencer Gulf, is considered to have a potentially detrimental impact on abalone habitat.
- ✂ Effective management of disease needs consideration.
- ✂ Financial returns to industry could be increased by resource management measures which improve catch rates, reduce resource theft and improve product quality.
- ✂ Resource theft impacts on markets and seriously depletes localised areas which are easily accessible to illegal operators. Overfishing may also contribute to this extinction.
- ✂ Western zone divers do not favor fishdowns as they believe the undersize abalone concerned contribute to recruitment of juveniles.

**New South Wales**

- ✂ Current quota levels, effort restrictions and minimum size limits were judged to be appropriate.
- ✂ The need to quantify and control resource theft was an urgent requirement as theft is perceived to be a major threat to the resource.
- ✂ Surplus processing capacity obviates economies of scale which would otherwise be enjoyed.
- ✂ The interaction between abalone and sea urchins has consequences for resource management.
- ✂ Land based runoff and pollution is detrimentally affecting abalone habitat and needs to be managed.
- ✂ Management of disease in abalone wild stock has been neglected.
- ✂ Compliance penalties need to be increased as does the efficacy with which charges can be laid.

- ✂ The current docketing system to track landings needs to be extended from processors to exporters to better control resource theft, with the objective being a national docketing scheme.

### **Western Australia**

- ✂ Quotas and minimum size limits are appropriate.
- ✂ The impact of full cost recovery on industry requires careful evaluation.
- ✂ Manipulation of the resource through transfer of stunted abalone to areas where fast growth occurs could benefit the fishery.
- ✂ The recreational catch needs to be accounted for when setting TACs.
- ✂ Stock enhancement through reseeded could benefit the resource.

The requirements to generally address the management issues which have been raised across State fisheries include:

- ✂ Modelling and risk assessment to guide decisions related to changing the quota and minimum size limits.
- ✂ Better compliance and resource theft estimates (dealt with in more detail in the compliance section of this report).
- ✂ Rationalisation of processing capacity.
- ✂ Extension of the current product tracking system, a topic which is dealt with in more detail in the compliance section of this report.
- ✂ Investigations to establish the efficacy of transferring or harvesting stunted stocks.
- ✂ Review of the conditions associated with quota transfer in some States.
- ✂ Evaluation of the benefits of rehabilitation of reefs through reseeded.
- ✂ Determination of the impacts of pollution, from runoff and other marine operations, on abalone habitat.
- ✂ Determination of the impact of disease (eg. *Perkinsus*) on the abalone resource.

## 7.2 Marketing

Marketing was a major consideration raised in the consultations.

The majority of wild abalone caught is sold to the food service market with the trend away from retail increasing. The food service market offers lower returns to the Australian industry than the retail market.

Industry representatives from all States except Tasmania have highlighted the need for better marketing and processor coordination on a national scale, to assist marketing and sales of wild abalone in both the domestic and more importantly the export market. One State has suggested national collaboration will be hampered by the mistrust and competition that is characteristic of the industry. Many industry representatives recognise that they are in fact not marketing the product at all – they are simply selling product and are price takers with the buyers controlling the terms of trade.

The industry generally has expressed the view that there is limited scope for the domestic abalone market. Current overseas abalone markets are largely the traditional customers in East Asia. A potential target market has been suggested as the ethnic communities in non-traditional markets (eg. United States, Europe). This would reduce the exposure of the Australian industry to the East Asian economies.

Pertinent points raised in consultation with industry include:

- ✂ The live produce market is expanding, with the potential for live Roe the most promising in terms of Western Australia's industry.
- ✂ The demand is limited for new products. The current small economies of scale that exist detract from any substantial product development.
- ✂ The farmed abalone industry is not considered a threat to the wild industry, with farmed abalone smaller in size and possessing a different, distinguishable taste.
- ✂ Branding of product by Australian processors / exporters met with a mixed reaction.

The distribution of Australian abalone products by species to their respective markets is detailed below in Exhibit 27. Further details by State and fishery are presented in Attachment 5.

This data and related fishery value estimates in Section 7.5 of this report have been compiled from numerous discussions with quota holders, divers, processors and marketers, fishery managers and researchers. The data does not include fishdowns, including the only current fishdown of 48 tonnes (estimated Beach Value of \$1.5 million) underway in the southern zone of South Australia.

Key points from the table include:

- ≈ 37 percent of products by weight go to the Japanese market, 35% by value;
- ≈ 82 percent of product is based on the black lip abalone, and
- ≈ 59 percent of product is canned for export.

Marketing / selling activities are typically undertaken by processors who also act as shippers / exporters of the final free-on-board product.



**Exhibit 27 Markets for Australian Abalone**

### 7.3 Value Adding

The Australian abalone industry has established a relatively large number of processing facilities to add value to their catch. Value adding takes many forms, from product grading, cleaning and gutting, bleeding, chilling, freezing, canning, vacuum packing, drying and powdering. Beyond this there are innovations in package design such as canning in clear plastic cans to enhance presentation and eye appeal. Processing more of the catch is also value adding, for example making soups from canning process waste meat. These and other innovations are typically designed to meet specific consumer preferences in dominant Asian markets.

It is claimed by many industry operators there is only limited potential for value adding in the abalone industry. A number of reasons are put forward to support this view, including:

- ✍ The traditional food cultures in the primary abalone markets (Japan, Taiwan, Hong Kong, and other North East Asian markets) detracts from product development and the potential for value adding;
- ✍ The very low penetration by abalone products in retail outlets acts as a constraint as this requires suppliers to distribute primarily through food service outlets where value adding can be customised to suit consumers and the highly specific nature of traditional cuisines;
- ✍ The seasonality of supply together with the relatively small volumes of abalone that are available to markets, compared to other seafood, means that branding of abalone at the consumer level is not a viable marketing strategy;
- ✍ The extreme over capacity in processing (ie low plant utilisations) that overhangs the Australian industry means that processor margins are low and there is limited commercial incentive to invest in product innovation where the outcomes are uncertain and the rewards easily lost to sub economic competitors. Comments included “One hundred tonne is needed for a

processor to break even, yet we have six processors in NSW competing for 333 tonnes” and “this plant works only 120 days each year”.

- ✍ Asian consumer preferences and requirements for abalone are so market niche specific that overseas importers and food service operators prefer that only limited value adding is done by Australian processors. “Scope for value adding is slim as clients prefer to do it.”

By contrast a number of processors foresee real potential for value adding to Australian abalone. Some direct comments from industry include:

- ✍ “Final product could be significantly enhanced through R&D, marketing & product development”,
- ✍ “Flavour, taste etc will really come out when aquaculture comes on stream”,
- ✍ “Long term chance of holding live in tanks and selling to niches”,
- ✍ “Product quality in this largely live export fishery has and is being improved through better fishery practice”,
- ✍ “Product development focus on presentation of in-shell produce provides some opportunity”.

The emergence of growing market niches of high net worth Asian consumers in Asian societies (eg. China), but also in western economies (USA, Canada, Australia, Europe) are attractive to abalone marketers over the next 20 – 30 years. McDonalds and other global food service companies are seeing the strong emergence of new food cultures that blend traditional cuisines with western food styles and cultures. As these innovative consumers are typically young, time poor and therefore looking for convenience, and enjoy high disposable incomes they are very attractive to food service operators. While it is currently quite a conceptual leap from the mass market of McDonalds to the abalone industry, the big picture trends driving Asian food service over the next 20-30 years will impact both industries in similar ways.

A further reason offered in support of the potential for value adding is the increasing importance of the Australian fisheries to the world markets. Relative scarcity of wild product will lead to investment in aquaculture substitutes, currently emerging here and overseas. In marketing terms this will differentiate the superiority of the wild product, especially in traditional markets where quality and tradition go hand in hand. Strong branding is essential to capitalize on the benefits of product differentiation. Together, differentiation and scarcity will present the Australian industry with some global abalone monopoly power and therefore the ability to extract premium prices for products which are highly value added. It will be the role of R&D conducted by the processors to seek, capture and reinvest these price premiums on behalf of divers and quota holders who are dedicated to protecting and sustaining their resource base.

In summary, the industry is characterised by a generally negative view of value adding, punctuated by a number of processors who see considerable potential.

In its broadest meaning value is added to the catch at a number of places along the abalone value chain, either through improved practices, application of specific technology or in cooking, grading, packaging and presentation to a market.

### **Exhibit 28 Abalone Value Chain**

The following table identifies the complex range of meats produced by the Australian industry. In addition, quantities of shell (used for ornaments and decorative inlays) and viscera / gut are produced, typically as a by-product with limited commercial value.

**Exhibit 29 Abalone Meat Products**

	Key Product Categories	Species Options	Size Options	Preparation Options	Cooking Options	Packaging
1	Live abalone	green, black, brown, Roe's	all legal sizes	live in shell	not applicable	packed in 10 or 12 kg polystyrene carton
2	Chilled Fresh Meat	<ul style="list-style-type: none"> <li>green</li> <li>black</li> <li>brown</li> <li>Roe's</li> </ul>	all legal sizes	<ul style="list-style-type: none"> <li>unbled</li> <li>bled</li> <li>gutted</li> <li>shucked</li> <li>on shell</li> </ul>	not applicable	packed in 10 or 12 kg waxed cartons
3	Canned abalone meat	<ul style="list-style-type: none"> <li>green</li> <li>black</li> <li>brown</li> <li>Roe's</li> </ul>	<ul style="list-style-type: none"> <li>all legal sizes</li> <li>1 whole abalone</li> <li>1 whole + 1 cut</li> <li>1 whole + 2 cuts</li> <li>1 whole + 3 cuts</li> <li>2 whole abalone</li> <li>2 whole + 1 cut</li> <li>2 whole + 2 cuts</li> <li>2 whole + 3 cuts</li> </ul>	<ul style="list-style-type: none"> <li>unbled</li> <li>bled</li> <li>gutted</li> <li>shucked</li> </ul>	<ul style="list-style-type: none"> <li>cooked</li> <li>parboiled</li> </ul>	clear plastic or metal cans packed in cartons
4	Frozen (IQF) abalone meat (individually quick frozen)	<ul style="list-style-type: none"> <li>green</li> <li>black</li> <li>brown</li> <li>Roe's</li> </ul>	all legal sizes	<ul style="list-style-type: none"> <li>unbled</li> <li>bled</li> <li>gutted</li> <li>on shell</li> <li>shucked</li> </ul>	<ul style="list-style-type: none"> <li>raw</li> <li>cooked</li> <li>parboiled</li> </ul>	frozen blocks packed in waxed cartons
5	Vacuum Packed abalone meat	<ul style="list-style-type: none"> <li>green</li> <li>black</li> <li>brown</li> <li>Roe's</li> </ul>	all legal sizes	<ul style="list-style-type: none"> <li>unbled</li> <li>bled</li> <li>gutted</li> <li>on shell</li> <li>shucked</li> </ul>	<ul style="list-style-type: none"> <li>cooked</li> <li>parboiled</li> </ul>	frozen blocks packed in waxed cartons
6	Dried abalone meat	<ul style="list-style-type: none"> <li>green</li> <li>black</li> <li>brown</li> <li>Roe's</li> </ul>	all legal sizes	<ul style="list-style-type: none"> <li>unbled</li> <li>bled</li> <li>gutted</li> <li>shucked</li> </ul>	<ul style="list-style-type: none"> <li>raw</li> <li>cooked</li> <li>parboiled</li> </ul>	
7	Powdered abalone meat	<ul style="list-style-type: none"> <li>green</li> <li>black</li> <li>brown</li> <li>Roe's</li> </ul>	all legal sizes	<ul style="list-style-type: none"> <li>unbled</li> <li>bled</li> <li>gutted</li> <li>shucked</li> </ul>	<ul style="list-style-type: none"> <li>raw</li> <li>cooked</li> <li>parboiled</li> <li>variously treated</li> </ul>	<ul style="list-style-type: none"> <li>plastic shelf stable packs - ingredient use</li> <li>individual dosage capsules - medication use</li> </ul>

Uses for the shell and gut are not large or promising. Shell can potentially be used for medicinal / health products or for decoration. Getting rid of sand from the gut at present appears to be a constraint.

There has reportedly been a concerted effort made over the past 5-6 years to improve quality from capture through to processing and export. Value adding can be hampered by the lack of care taken by divers during harvesting. One State indicates that up to 15 percent of abalone collected have nicks / marks due to poor chipping from the sea floor. Value adding at the wholesale level could be significantly enhanced through better treatment of the catch. This could be addressed through industry based training programs to improve diver / deck hand practices, eliminate damage to live product, and ensure delivery of live animals in good condition to processors.

Industry has repeatedly advised that under-utilised processing capacity exists, and a rationalisation of the processing sector would be beneficial. Typical plant utilisation across the industry is suggested by industry to be 30 percent. It has been suggested that rationalisation of the sector, and / or coordination of processors would reduce industry costs and therefore improve viability. The reality is that the wild abalone harvest is highly seasonal and processing facilities adding value to such a high value (by weight) perishable food product must be able to handle peak supply periods across a very short harvest season. Any rationalisation of processor capacity will have to come from industry. In the current national regulatory environment that promotes increased competition between companies across all industries, no government is going to regulate to seek greater efficiencies through industry rationalisation.

The key to rationalisation and therefore capturing the premium returns of scarcity and Australian brand power through value adding, will be a willingness by industry to work together to develop, optimise and reinvest in state-of-the-art processing

facilities that can consistently deliver superior quality Australian product to traditional and new markets. The case studies of the Australian beef and pork processing (currently rationalising) and dairy industries (late 1980s rationalisation) are highly relevant to the future of the Australian abalone industry.

While a number of operators in the industry appear to be moving this way, such a change will have a number of implications, including:

- ✍ Greater market power for the Australian industry, and the accompanying price premiums;
- ✍ Greater profitability of the processing sector, allowing it to achieve a stable and acceptable return on investment;
- ✍ Greater focus on product quality and market preferences; and
- ✍ Greater reinvestment by processors in R&D which will deliver a whole range of new value adding options currently not contemplated.

It will be a challenge for the abalone industry which is largely dominated by a hunter production culture to get its people and finance together and rationalise its investment so that it becomes a part of the innovative and dynamic food industry.

#### **7.4 Compliance**

***"The Orientals have moved in and now while one dives from the beach the other keeps guard with an AK-47."***

*Tony McEwan, a Cape Town conservationist, on the latest methods employed by abalone poachers in South Africa. Demand for the mollusc - a Chinese delicacy - is huge, and Hong Kong triads are in on the action, with some 10 times the official quota poached each year.*

Source: Far Eastern Economic Review, December 10 1998.



Resource theft of abalone is a major concern in all States. Theft is particularly serious in the case of fishing grounds in proximity to major metropolitan areas and where the resource is easily accessible from the shore. There are also a number of sophisticated resource thieves, particularly in Victoria, who run operations analogous to those of the legitimate fishers in terms of their size and efficiency. In these instances more remote and productive abalone areas can be illegally fished with little risk of discovery.

In all States the Industry were dissatisfied with the level of enforcement and the adverse impact that resource theft was having either directly on the fishing grounds or less directly through impacts on the market. In some States, ad hoc advice from industry indicates that some theft is also undertaken by licensed fishermen, and is euphemistically referred to as "overfishing". Five percent of the TAC was the industry's estimate of overfished volume proposed in a number of fisheries.

Based on data from fishery managers and advice from numerous industry sources, the estimated total catch (1998) for the Australian wild abalone fishery is as follows:

<b>Exhibit 30</b>								
<b>Australian Wild Abalone Estimated 1998 Total Catch</b>								
<b>STATE</b>	<b>Fishery</b>	<b>Quoted TAC tonnes</b>	<b>Implied Whole Abalone TAC tonnes</b>	<b>Implied Whole Black tonnage</b>	<b>Implied Whole Green/ Brown</b>	<b>Implied Whole Roe tonnage</b>	<b>Est Theft, Overfishing, Recreational &amp;</b>	<b>Est. Total Annual Catch (tonnes)</b>
Column No.	1	2	3	4	5	6	7	
<b>Tasmania</b>	2,520	2,520	2,310	210	0	150	2,670	
<b>Victoria</b>	1,440	1,440	1,440	0	0	220	1,660	
Western	280	280	280	0	0	65	345	
Central	700	700	700	0	0	120	820	
Eastern	460	460	460	0	0	35	495	
<b>SA</b>	345	830	432	399	0	92	922	
Western	181	543	294	249	0	7	550	
Central	62	185	41	145	0	32	217	
Southern	102	102	97	5	0	53	155	
<b>WA</b>	206	367	0	241	126	83	450	
South Eastern	50	131	0	121	10	10	141	
South Western	48	128	0	120	8	18	146	
West	108	108	0	0	108	55	163	
<b>NSW</b>	333	333	333	0	0	135	468	
<b>TOTAL</b>	4,844	5,490	4,515	849	126	680	6,170	

Source: Industry

It is not possible to precisely quantify the impact of resource theft (including overfishing) as no State could supply information on the tonnage of product removed by unlicensed operators. However aggregated estimates by fishers, managers and processors itemised by fishery above suggest a figure greater than eight percent of the total whole-in-shell catch, with a current beach value of \$13 million. This is twice the estimated catch rate for recreational and fishdowns together.

The major points regarding theft raised during discussions were:

- All States acknowledged that although accurate figures were not available, resource theft was a significant factor, especially in those zones which were easily accessible to both large and small scale unlicensed operators. Exhibit 31 illustrates the potential monetary impact on the Australian Industry of resource theft at a series of levels.

<b>Exhibit 31</b>	
<b>Potential Monetary Impacts of Wild Abalone Resource Theft</b>	
<b>Theft as percentage of catch</b>	<b>Total beach price value</b>
5	\$7.9 million
10	\$15.9 million
15	\$23.9 million
20	\$31.8 million

- In some areas, notably in NSW, the south east and central zones of South Australia and the central and eastern zones in Victoria resource theft causes the stripping of reefs of abalone of all sizes. There is grave concern about the subsequent rehabilitation of these areas which can then be more easily colonised by species other than abalone (eg sea urchin). In NSW sea urchins are a dominant species and are present in an estimated 50 percent of inshore reefs. Their impact on abalone is not certain, although indicators suggest that urchins are more competitive in feeding on brown algae than abalone. These replacement species act then as a barrier to rehabilitation of the reef and restocking of abalone. The potential adverse effect is not quantified but there is the perception that abalone potential could be seriously reduced in convenient fishing areas if compliance is not effective.
- The impact on the market is another important adverse consequence of resource theft. The concerns were that the reduced costs which are borne by illegal operators encourage undercutting of the price on export markets and in some instances poor quality of illegal product can effect the image of Australian abalone in these markets. Zones in which theft is at a low level, due

to remote locations, are nevertheless also concerned about market impacts thus there was unanimous support for better compliance. There was also a view that the local market was difficult to develop because illegal product was being supplied to restaurants at reduced prices.

- ✍ Most States had docketing systems in place and these are generally regarded as effective in monitoring the catches of legitimate divers. Strong views were expressed in NSW and South Australia that the docket system should be extended so as to allow product to be monitored until such time as it was exported and that a National Docketing System was required.
- ✍ There were concerns that the extent of resource theft could not be estimated and that this could be affecting the resource and its assessments. Establishing the extent of resource theft was accorded a high priority in most States although it was acknowledged that this was a difficult task.
- ✍ There was general agreement that resource theft was a very serious concern and that better compliance was a major issue to be resolved.

Requirements to address the issues raised in relation to compliance were:

- ✍ Better estimates of resource theft, and incorporation of this information into stock assessment.
- ✍ Further development and evaluation of the efficacy of current docketing system and the extension of this to track product until it was exported.
- ✍ Evaluation of the costs and benefits of better compliance and benchmarking of this activity so as to better manage compliance resources.
- ✍ Determination of the impact which resource theft has on market prices and market perceptions of the quality of Australian abalone quality.

## **7.5 Economic Assessment**

Whereas there have been considerable attempts to establish biological parameters relevant to understanding the dynamics of the abalone fishery, and this has permitted some modelling, concomitant studies of the economics of the fishery have not had the same emphasis. The economic consequences of management action require a better understanding of the economics of the fishery.

Published reports on abalone fishery economics are restricted to three papers from NSW and one from Victoria, all of which were produced during the eighties.

The need for an economic assessment was recognised in NSW, South Australia and Victoria and in some cases this had been initiated within these States by either industry or Government.

Of concern to industry was the need to determine the value of the abalone industry to coastal communities, some of which are remote, and to determine contribution of the fishery to the economy of these centres through an understanding of multipliers and other economic parameters.

Assessments are also required to establish a basis for calculating the contribution which sectors of the abalone fisheries should make towards full cost recovery as well as to evaluate an appropriate resource rent and the consequences such payments would have on the fishery.

Some States, notably Tasmania and Western Australia, were of the view that biological resource modelling was more urgent at the present time than economic assessments and models.

It appears that at least in NSW and Victoria steps are being taken to obtain a better understanding of the economics of the abalone fishery. This information is required to better decide upon cost recovery and resource rent issues. Economic information

is also needed to measure the contribution which abalone fisheries make to the coastal communities as well as to assist in evaluation of the consequences of management changes and the risks and returns associated with these decisions.

There has been minimal economic assessment of the national industry across all fisheries.

Aggregate data sourced from fishers, processors fishery managers, researchers and other industry sources suggests an estimated Gross Value of Commercial Production at the Beach of A\$159 million, excluding fishdowns valued at approximately \$1.5 million in 1998 (Exhibit 32).

Taking this analysis further and considering species by fisheries, the FOB wholesale value of the total wild Australian fishery is estimated to be \$197.9 million. Exhibit 33 details these values; further details for individual fisheries are presented in Attachment 5.

**Exhibit 32 Wild Abalone State Data**

**Exhibit 33 Value of Australian Abalone Fisheries**

The market for wild abalone quota units shows limited trade over the last five years. Quota entitlements are tightly held as they are the only legal rights to access the resource. It appears unlikely that additional “new tonnage” access entitlements will be created.

The cost of acquiring a one kilogram unit of legal quota varies considerably across the eleven State / zonal fisheries.

### **Exhibit 34**

The comparison is based on subjective independent advice from industry across all fisheries and should only be used as a guide. However it is clear that commercial operators / investors place a higher value on accessing the Tasmanian resource than all others, as anticipated.



The Review Team frequently heard the comment from industry that the processing sector is inefficient and under-utilized. This has been noted previously in the section dealing with Value Adding. While commercial data is not readily available, estimates provided by industry and earlier analysis by the University of Tasmania have enabled indicative analysis of value added by divers, quota holders and processors. Tasmania and NSW were selected for this comparative analysis as:

- ✍ Their resources are both dominated by Blacklip abalone, thus eliminating any price variability in the analysis based on species;
- ✍ They represent both ends of the resource spectrum – NSW under significant urban and theft pressure and Tasmania reportedly underfished on the west coast; and
- ✍ Tasmania has the largest commercial catch, and NSW the smallest.

Note that the Tasmanian data are for 1994 and NSW data are for 1998 season. The comparison is therefore a guide only.

Exhibits 35 and 36 suggest that returns to divers, quota holders and processors differ significantly.

### **Exhibit 35**

### **Exhibit 36 Wild Abalone Value Chain Analysis**

Divers in NSW contribute far more to wholesale prices than their counterparts in Tasmania. Put simply, NSW divers must work much harder to contribute an equivalent value to wholesale prices. While some of this differential is assumed to come from higher diver wage rates in Tasmania, the primary variance results from higher hourly catch rates in the more abundant Tasmania fishery.

Each NSW diver must spend five (5) times as long to catch each kilogram of commercial quota; a contribution to wholesale prices of only \$429 per hour compared to \$1,561 per hour by Tasmania divers.

Conversely Tasmanian quota holders contribute approximately 44 percent of wholesale values compared to NSW quota holders at 33 percent. Tasmanian quota holders are prepared to pay 1.6 times more per kg to access quota (\$250 compared to \$156), for which they receive a higher estimated return on their investment (5.3 percent) compared to NSW quota holders (5.0 percent). If financing costs are excluded from the analysis these figures are 7.1 percent and 6.7 percent respectively.

These returns on investment look comparatively modest for an industry that faces seasonal risks, resource sustainability risks, harvest risks and dramatically increasing resource theft risks. However the infrequency of trade in quotas also indicates that many of the investments in quota are long standing and well before any fiscal capital gain regulations were imposed by the Federal Government in 1985. Relatively strong cash income flows are likely to be far in excess of any cash outflows for debt servicing or quota maintenance costs. In addition, quota holders would have only minimal non-cash costs such as depreciation.

Industry advice suggests that many quota holders have substantial investments in processing facilities. This no doubt provided a ready and willing pool of capital to develop the processing capacity required in the last 20 years or so. However if the apparent investment returns to processors calculated above are accurate (as

confirmed with industry), quota acquisition appears to offer only modest financial returns per se. In strategic terms it makes more sense. Clearly, divers wish to capture more of the returns down the processing chain and to consolidate their positions by integrating down the value chain towards the consumer. The likely impacts are that the whole Australian industry revenue pie has not grown as a result; and the culture of the industry becomes dominated by production, rather than maturing and developing strategically as part of a market driven food industry.

A number of industry members have cited the apparent marginal returns to processors as a major constraint to industry development. It is suggested the traditional downstream investment in the processing sector by fisherman / quota holders results in a processing culture and sectoral ownership structure that:

- ✍ Maintains the traditional dominance of fisheries rather than evolution of a food processing culture;
- ✍ Reduces processor margins to levels that limited investment in processing, product development and food value adding, R&D and new technology;
- ✍ Promotes the “weak seller” position of the processors relative to their overseas buyers as it constrains marketing and promotion initiatives in favour of “selling” activities;
- ✍ Maximises the competition between processors for catch at the beach in place of a more balanced approach to develop strategies that will enable processors to increase the wholesale value of the Australian Industry; and
- ✍ Encourages illegal and disreputable processor practices that can undercut processors operating according to regulations.

The above analysis compares estimates for two fisheries with substantially different resource and operational constraints. Further analysis needs to be undertaken across all fisheries to establish a clearer picture of the industry’s value adding status and capacity.

The following scenario analysis (Exhibit 37) provides a summary of many of the issues raised in Chapter 7 and analyses some basic scenarios and their R&D implications for the industry.

**Exhibit 37 Abalone Industry Scenario Analysis**

## **8. R&D PRIORITIES FOR EACH STATE AND THE FISHERY AS A WHOLE**

### **8.1 Research Priorities**

The current status of management of the wild abalone fishery and the review of past management and associated research provides a basis upon which to consider the future research needs of the industry.

An important meeting on Abalone Fisheries Research and Development was held at SARDI in July 1998 and was attended by abalone researchers, resource managers and industry representatives. The meeting recognised interstate collaboration as a positive means of consolidating expertise, knowledge and experience and focusing it to address the needs of the valuable Australian abalone industry.

The meeting endorsed a suite of collaborative research projects aimed at establishing closer links between stock assessment and management of Australia's abalone fisheries.

The series of meetings with industry, resource managers and researchers conducted as part of this review was a further source of information on the research required for better management of abalone, as perceived by the industry, resource managers and senior researchers in each State.

Whereas the focus of the SARDI meeting was on research required to better understand biological issues, the needs raised during the Review meetings in each State covered a wider spectrum of issues that could benefit from research. Nevertheless it was reassuring that, in terms of the biological research required, a

number of the priorities identified at the SARDI meeting were confirmed during the course of meetings held in the States.

In Section 7 of this report the major issues associated with the industry, management and research were identified within the following categories:

- ✍ Management
- ✍ Marketing
- ✍ Economic assessment
- ✍ Value adding
- ✍ Compliance

The priorities identified arise from both the lack of past research on these topics as well as developments or refinements in management opportunities that require additional research.

An analysis of FRDC funded approved proposals since 1984, within specific abalone research categories, provides the following information:

<b>Exhibit 38</b>		
<b>FRDC Abalone Funding Allocation by Research Category</b>		
<b>Research Category</b>	<b>Funding Allocation</b>	<b>Percentage</b>
Disease	\$ 27,885	1%
Diver welfare	\$ 85,116	2%
General	\$ 55,296	1.5%
Growth	\$ 492,542	13%
Recruitment	\$ 1,209,425	32%
Species interaction	\$ 387,076	10.5%
Stock assessment	\$ 1,273,204	34%
Value adding	\$ 231,095	6%
<b>TOTAL</b>	<b>\$3,761,639</b>	<b>100%</b>

Source: FRDC, 1998

Resource management issues, requiring information on growth, recruitment, species interaction and stock assessment have received \$3,362,247 or about 90 percent of the allocation, with 6 percent spent on value adding and no funds allocated to marketing, compliance or economic assessment issues.

The provision of similar information on research expenditure other than from FRDC sources, that is from State, industry and other sources, was not available. However, perusal of the documentation available reveals no research reports on compliance, marketing or value adding, and very few reports on economic assessments of the industry.

The broad nature of this review has provided an opportunity to evaluate research needs over the full spectrum of requirements for abalone resource management. In doing so, important requirements for compliance, economics and marketing research have been identified. Meeting these needs will require some redirection of resources to study areas, which have previously received little support.

## **8.2 Resource Modelling**

All States emphasized the importance of modelling to generate scenarios for different management options with emphasis on risk and return. The major focus was on the need for information to either confirm or change the level of the current TACs and determine the risks associated with such actions.

NSW has developed a model for this purpose and there was support for extension of the NSW model to other States as a high priority. This model has enabled NSW to estimate the likelihood of biomass changes under the current management regime. In Victoria modelling has been undertaken to evaluate the risks attached to quota changes but this study is still under review. In some other States important



decisions about quotas are made on the basis of catch statistics or fishery independent surveys. The latter have been shown to be important but are not currently utilized in Western Australia or Tasmania. It can therefore be concluded that extension and development of a spatially-structured model for stock assessment and TAC decision analysis, based on the NSW model, is a major priority for all States except NSW where resource managers are satisfied with the current information.

Application of the model will require an assessment of its validity and the quality of information available in each State for modelling. The importance of empirical validation of the model is therefore an important issue and was emphasized at the SARDI meeting.

With regard to modelling projects in general, industry has highlighted the need for critical design and determination of costs and benefits, up front. Two projects are of note regarding modelling:

1. The Abasim model was developed as a routine to demonstrate the behaviour of abalone populations under different management strategies. As such it was an educational rather than an analytical tool. The model was used to demonstrate the impact which changes in effort or size limits could have on stocks such as abalone but was not capable of predicting these in relation to the actual fishery.

Industry have advised that the model had little appeal as a management tool for their purposes as foreshadowed above, and were critical of the cost effectiveness of the expenditure on the model's development.

2. A project that developed a data management / reporting system for temporal and spatial analysis of South Australian historical catch records (Project 94/167)

was also viewed poorly by industry. The industry confirm they are “still waiting for some output and benefit from their investment in this project”.

It is clear that industry believes these two projects did not adequately seek industry input in their design stages with inadequate definition up front of the project benefits to be derived as management tools.

There was support in some but not all States for a study of small scale spatial processes to better understand the small-scale distribution of abalone on reefs, their movement and recruitment and the manner in which abalone distribution on reefs changes in response to fishing and the behaviour of divers in response to these changes. A purpose of this work would be, for instance, to determine the consequences for fishers operating at the reef scale, from an increase in the number operators in the event of an increase in the TAC.

The Review Team are of the view that there is sufficient existing knowledge to enable the development of models for effective management of all fisheries. Industry, fishery manager and researcher collaboration on a national scale is critical to achieving this.

### **8.3 Resource Monitoring**

To continue to facilitate the management of fisheries and to formulate and calibrate assessment models, currently available in NSW but not other States, it was agreed that the established monitoring programs based on catch statistics, sampling and fishery independent surveys need to continue. There was a strong view in Victoria that it was important to estimate the take of recreational fishers.

In relation to resource monitoring the needs were:

- ✍ Initiating fishery independent surveys in States which do not conduct these and further improving the precision of this important assessment tool where required. The Review Team is of the view that fishery independent surveys are essential to effective resource monitoring across all fisheries. Surveys must encompass the activities of all fishery participants (divers, managers, researchers, etc) to ensure the overall behaviour of the fisher and the fishery is considered and monitored. Surveys by researchers alone will not necessarily signal the impending collapse of a fishery. Preliminary results show that current surveys may lack the precision to detect the changes nominated in the management plan. Research aimed at improving precision, or identifying alternative performance indicators is therefore required if this management technique is to be applied;
- ✍ Ensuring the standardisation of diver effort; and
- ✍ Better utilisation of diver information through the design of returns, realistic demands for information and quality control to ensure that the information is valid.

Reference points are applied in NSW, Tasmania and South Australia for abalone resource management.

The NSW planning process provides the best example of the application of these techniques (*Worthington, D.C; Chick, R. et al 1998*). Taking 1994 as a base year, the trigger point for management action in the assessment year (1997) is invoked if legal and mature biomass estimates fall below 85 percent of the 1994 level. The NSW assessment process allows scientists to calculate the probability of this being the case in the assessment year.

A second trigger point relates to forecasts over the next five years and is invoked if there is a less than 50 percent chance of the legal and mature biomass remaining at 85 percent of that 1994 level.

South Australia applies a series of target reference points, with defined management actions invoked when these are achieved (Rodda, K.C. et al 1997). The reference points are specific for blacklip and greenlip abalone in the three fishing zones and they have been initially set as rates of change which can be observed from commercial catch data and catch sampling and fishery independent surveys. The reference points used in South Australia include:

- ✍ Catch rates (kg / hrs dived);
- ✍ Changes in abundance of legal sized abalone;
- ✍ Changes in abundance of pre-recruits;
- ✍ Changes in size composition of populations;
- ✍ Densities of juvenile abalone;
- ✍ Fishing mortality;
- ✍ Levels of *Perkinsus* infection; and
- ✍ Other derived indicies (eg. Spawning biomass).

When one or more of the reference points described above are reached the following actions are taken:

1. Notify the Minister for Primary Industries and appropriate fishery participants;
2. Undertake an examination of the causes and implications of 'triggering' a reference point;
3. Consult with the abalone industry and PIRSA Fisheries on the need for alternative management strategies or actions; and
4. Provide a report to the Minister for Primary Industries and industry on the outcomes of a review of the effect of triggering a reference point (within three months of initial notification).

In the other States potential reference points have been established but these have not been applied in a formal sense nor has there been any identification of the management actions which should flow from these. With the exception of Victoria,

reference points have all been associated with **biological** sustainability. Victoria has emphasised the need for reference points to include both **economic** and **social** sustainability indicators (*Gorfine, H.K. & Walker, T.I; 1996*). It is clear to the Review Team that reference points for all three should be established for all fisheries.

The purpose of reference points is to ensure that management actions are taken when selected indicators of the status of the resource reach a predetermined level. As such indicators can be established in situations where there is little precise understanding of stock dynamics and, as this understanding increases, more precisely defined indicators can be defined.

Better resource modelling and monitoring have been accorded priority and focus on these activities should ensure that the understanding and selection of reference points improves. The monitoring programs currently in place provide a range of sustainability indices, which together with improved modelling will also allow managers in each State to consider the range of potential reference points and evaluate the usefulness of these in relation to current understanding of the resource and the risks associated with the adoption of reference points as a trigger for management action.

#### **8.4 Resource Manipulation**

Abalone exhibit variable growth rates, attributed to either location or genetics. In addition the nature of diving is such that local depletion can occur and this is particularly the case with intense illegal operations which harvest abalone irrespective of size. A number of management measures to accommodate these issues were raised and these have implications for research.

The better utilisation of so-called stunted abalone in certain localities has been encouraged through fishdowns and in some cases the translocation of stunted stocks to areas which support faster growth rates. There has been little rigorous evaluation of the significance of the benefits of these practices, with the exception of before and after studies made of fishdowns undertaken in the Tasmanian Bass Strait fishery.

The effectiveness of reseeded depleted abalone beds was emphasised by industry and resource managers in NSW, and an FRDC project to investigate this is in place.

In NSW area closures were commonly applied to assist with the recovery of localised areas which had been depleted, mainly through illegal fishing activities. Scientific evaluation of this management technique was thus identified as a high priority in NSW and is being accommodated within normal sampling procedures.

In Victoria in particular there was industry concern that the continual selection of faster growing individuals, due to minimum size limits and the benefits of harvesting in high growth areas, would genetically advantage slow growing abalone. An evaluation of the genetic and environmental aspects of abalone growth is thus required to resolve this issue.

## **8.5 Compliance**

A number of research requirements emanated from compliance issues which were raised at State meetings.

The assessment of the volume of abalone illegally taken was a high priority in all States as this practice was potentially affecting stock assessments as well as benefit cost evaluations about the correct level of compliance resource allocation. It was however acknowledged that this would be an extremely difficult task, with some

States in which the illegal take was low, finding it difficult to justify allocation of expenditure on this research.

Better tracking of product through the processing chain, from capture to export was seen as a means of improving compliance and research and development to explore administrative and genetic tracking is required. In particular, the feasibility of a national docketing system, to monitor product from capture to export needs to be studied. The application of DNA fingerprinting of product was suggested as a particularly useful technique by some members of industry and researchers. Advanced beef industry players in Australia and north America are now assessing similar computer based DNA technologies as a means of rapid animal traceability from birth to retail shelf. Based on recent dramatic increases in food safety (*E. coli* in USA hamburgers; mad cow disease in the UK) the next decade will likely see an explosion in the use of these food sourcing technologies demanded by consumers.

Evaluation of the costs and benefits of better compliance, and benchmarking of this activity, is required to manage compliance resources and indicate appropriate resourcing levels. Compliance is an expensive component of fisheries management yet very little rigorous research has been done to indicate how to improve the efficacy of this complex and difficult task.

## **8.6 Fisheries Ecology and Habitat**

A number of issues which required research were raised in relation to the adverse impact of land and marine based activities on abalone habitat and consequently the productivity of the resource.

Particularly in NSW the interaction between sea urchins and abalone was a matter for concern, as these species co-occur and the link between the dynamics of the two

resources, under conditions of exploitation can have both stock assessment and fishery potential consequences.

There is also evidence from South Australia that life history changes in exploited populations has occurred with consequent loss of productivity. There is uncertainty as to whether this is a genetic effect or a phenotypic compensatory effect. This problem requires measurement of the rates of change and determination selection coefficients in different populations.

The impacts of ocean out-falls on abalone stocks were raised as a matter of concern at two meetings but the information was mainly anecdotal. Subsequent information received from Management Agencies indicated that this was not an issue which warrants serious attention.

In South Australia there were serious concerns about the impact of effluents from large-scale fin fish and abalone aquaculture operations on adjacent abalone fishing grounds. The effect of these aquaculture activities on water quality and subsequently habitat was suggested as a research priority as was the increasing incidence of disease affecting the abalone wild stock.

In South Australia and Tasmania the view was expressed that the impact of fishing on the benthic habitat needed investigation. In other States the need to understand the general changes which can take place as a result of fishing was acknowledged as having some contribution to better management of the process but was not rated as a high priority.

The Victorian industry was particularly concerned about the recovery of reefs after heavy legal fishing or resource theft.



The potential for marine parks impacting on abalone fisheries was of most concern to South Australian, Tasmanian and Victorian stakeholders. The major risk is loss of access to existing and potential resources. The potential declarations of marine parks along the inshore coast of Australia will directly impact on the existing rights of the abalone industry. The possibility of new declarations is increasing, driven by the community's rising awareness of and desire for preservation of the environment.

It is clear that industry feel threatened by any discussion on this matter. A more thorough consultation with industry and fishery managers is required to determine an accurate national response. This matter aside, more work (R&D / modelling) needs to be done to determine the impacts of adjacent marine parks and wild abalone fisheries. Only limited data exists to support a broad range of interactions. For example there is no evidence that marine parks will export abalone spat to adjacent commercial abalone fisheries, as is the case with other species such as lobster. However it is in the industry's interests to support the early development of this research before political decisions take the matter further beyond the control of fishery managers.

## **8.7 Economic Assessments**

Issues associated with economic assessments were raised in all States and potential research topics have been identified as:

- ✍ Evaluation in economic terms of the risks and returns associated with changes in quota levels;
- ✍ Provision of a basis for calculating the contribution which sectors of the abalone fisheries should make towards full cost recovery as well as an appropriate resource rent;

- ✍ The need to determine the value of the abalone industry to coastal communities, through an understanding of multipliers and other economic parameters, and
- ✍ Management and viability issues faced by divers carrying different levels of debt, and the range of harvest strategies they may adopt to maximize returns.

## **8.8 Value Adding**

The abalone export market was reported as being very traditional and most product is acquired by the food service sector. This, in the opinion of many industry participants, provides relatively little scope for value adding and for the associated research.

It was also stated at a number of meetings that value adding development is best undertaken by individual industry participants as part of their normal business function. The commercial benefits so derived are then part of a captive commercial competitive advantage. The ongoing changes in Asian consumer preferences must be monitored by the industry to ensure maximum value is captured by legal operators from the resource. It is clear that much of the value adding continues to be lost from Australia to the foodservice operators in the market place.

Research required to better manage seasonal availability and quality was suggested as essential by a number of industry representatives although the need for overall quality assurance was variable.

In most States there was reported to be a surplus of processing capacity, a sector which was regarded as inefficient and a handicap to product development in some cases. It is also apparent that the economic business of the industry is severely discounted directly due to low processing plant utilisation, and indirectly though

limited reinvestment of retained earnings in market based innovation and development. Appropriate economic and market analyses, jointly with industry, could provide some indication how best these problems could be addressed, within the constraints of National Competition Policy.

Industry has attempted a number of innovative packaging techniques and has explored the utilisation of by-products such as shells and guts but there has not been significant value adding from these products and research on these issues cannot be accorded a high priority.

In summary, the focus on value adding research would be:

- ✍ Improved catching and processing practices and systems to provide better product at lower cost;
- ✍ Assessment of mechanisms and benefits of the management of seasonal availability and quality; and
- ✍ Economic assessment of the optimal relationship between catching, processing and marketing capacity.

## **8.9 Marketing**

Major issues which have been identified include the better integration of marketing of Australian product to improve quality and quality perceptions, to ensure reliable supply and to take advantage of economies of scale in promotion of Australian abalone and ensure the coherence of the promotional messages. The bottom line is that Australian industry has much to gain by actively positioning and promoting itself as the clear leader in the world market, both in volume and product quality terms. A family of Australian brands owned by industry and using a common food

quality accreditation regime (eg. HACCP for resource management, harvesting and processing) would create and build a strong export position for years to come.

Aquaculture abalone offers a positive long term advantage to the wild industry. This emerging sector will prove up its technologies in the next few years and should then be incorporated into the premium image of Australian products. As average income levels rise across the mass of traditional Asian markets, higher income consumers will seek specialist foods that reflect a mix of their traditional cuisines with western influences. Aquaculture (possibly partially integrated with wild farming) is the only way the abalone industry will be able to confidently seek these new customers and meet their volume needs in the long term. Wild and aquaculture products will be complementary in the market place and Australia must lead this development.

Market research typically delivers specific competitive advantage. Therefore it is usually best done by the individual enterprises, and institutionally funded research may not be appropriate. However because a major issue relating to promotion and marketing on a national scale has been identified, strategic research to assist with this has some priority. The research would require strong joint participation and financial contribution from industry, likely to be facilitated via a national peak industry body representing industry. The research should be strategic in nature and focussed on:

- ✍ Development of effective mechanisms for coordinating national marketing and promotion which can be adopted and operated by industry;
- ✍ Identification and evaluation of potential additional markets, (possibly niches of residents from Asia) such as USA, U.K. and Canada, and new primary markets (eg China) which could be developed in the medium term. (what do new and existing markets want?, what are the food culture trends for each?, how will these trends affect product specification in ten years time?, etc);

- ✎ Determination of a coherent quality image for Australian abalone related to the clean, green advantage our fisheries generally have and which will ensure some differentiation between wild caught and cultured product;
- ✎ Analysis of the competitive market environment and the complex implications for managing and maximizing the returns to the Australian industry, (who are the competitors in our chosen markets?, what are their strategies to overcome Australia's existing competitive advantages? Why is Calmex brand reportedly getting premiums of 40-50% against Australian product in the market? How much Australian product is ultimately sold under Calmex and other competitor brands and how is this achieved? What are the species substitution (e.g. black for green) practices undertaken relating to Australian product and what are the implications for Australian revenues? etc, etc); and
- ✎ Strategic evaluation on changing trends in the demand for canned, frozen and live export product in various markets.

### **8.10 Summary of Research and Development Priorities**

The Review has provided a unique opportunity to examine the full spectrum of issues associated with the wild abalone fishery, as perceived by industry, resource managers and researchers in each of the States within which this fishery is undertaken.

The spectrum of research requirements which have been identified is wide, ranging from the focused biological studies for modelling and better understanding ecology and habitat through to the need for economic studies, aspects of compliance as well as value adding and marketing. The breadth of this spectrum makes it difficult to establish a strict hierarchy of priorities for all the research requirements that have been identified. The task of establishing priorities was further complicated by the fact that the level of information available for abalone management varies across States and therefore fisheries.

All the issues, which have been identified, were brought to the attention of the Review Team as being of importance. In some cases these were the agreed view of resource managers, industry and researchers in all States whereas other issues were State specific or expressed as a concern by a specific group. Issues of importance to some States were often not perceived as such in other States because of different circumstances.

In some cases it was possible to evaluate, at least in broad terms, the monetary benefits which could accrue from management decisions which could be influenced by research.

Drawing on the information presented in Exhibit 33, Exhibit 39 outlines the Review Teams' estimated Net Present Value (NPV) of benefits from management actions which achieve specified targets.

<b>Exhibit 39</b>		
<b>Net Present Value of Benefits from Management Actions</b>		
<b>Action</b>	<b>NPV benefit*</b> <b>\$ Millions</b>	<b>NPV benefit per annum*</b> <b>\$ Millions</b>
<b>Quota increase</b>		
5%	\$61	\$6.1
10%	\$122	\$12.2
<b>Value adding or Market price increase</b>		
5%	\$61	\$6.1
10%	\$121	\$12.2
<b>Resource theft reduction</b>		
20%	\$17	\$1.7
40%	\$35	\$3.5

\* over 10 years, 10% discount rate

Thus research which could provide managers with the justification to increase quotas with acceptable risk could reap benefits worth between \$61 million and \$122 million in NPV terms over 10 years. Likewise if these benefits accrued through value adding or better marketing, for which there is no stock risk, monetary benefits of the same order would accrue.

Data on resource theft are not available, but on the basis of anecdotal information an estimate of this has been made in Exhibit 31. The shortcomings of this data should be well understood. Nevertheless the calculations made in the above table suggest NPV benefits over 10 years of between \$17 million and \$35 million associated with reasonable improvements in compliance.

Research issues have been identified as being of high, medium or low priority and the allocation of these priorities is discussed below. The information is summarised in Exhibit 40. The Review Team consider that FRDC State and industry funding has

been generally well spent in the past. However we believe that the focus must shift to achieve balance across the industry's value chain. This will require a move away from biological research, towards enhanced awareness and development of tools to better manage fisheries and product delivery to market. Industry must actively improve its own communication and management to achieve real gains.

### ***Resource Modelling***

There was very strong support for extending the application of the model developed in NSW to all other States. Although there was agreement that quotas and levels of fishing were such that the stocks appear to be secure, in all States other than NSW, these conclusions were based on monitoring past performance or short term data sets rather than the generation of future scenarios. It was furthermore stressed that models were required to provide information on risk assessment. In some States there was the perception that the quota could be increased but industry, resource managers and researchers were unanimous that this could not be contemplated without a risk analysis. The monetary benefits of even small increases in quota are significant in relation to the required investment in research.

Associated with the provision of such a model is the empirical testing of the model to determine the degree of confidence with which it can be applied. This testing should take into account the spatial nature of the resource and hence the parameters used in the model.

Because of the clear recognition by resource managers and industry of the need for this tool the provision and empirical testing of the model based on that applied in NSW is accorded a **high priority** for all States except NSW which has a model which provides managers with the information they require.

The degree to which States other than NSW can currently satisfy the model's data requirements is variable. The NSW assessment is based on catch and effort of the



commercial fishery and other fishery derived indices and independent surveys of abundance and size distribution. Growth parameters and maturity information is also used. Other important features on the information are the length of the time series of information and its spatial distribution to take into account differences in fishing intensities and patterns. The biological parameters required can also vary with locality within the fishing zones.

Victoria has catch, effort and biological information that is suitably stratified by area as well as fishery independent information over a comprehensive number of sites and should be in a position to model its fishery. South Australia has similar information for some components of its fishery, but independent surveys have commenced fairly recently. Tasmania has commercial and biological information but does not have fishery independent surveys, with a similar situation prevailing in Western Australia.

Extending the NSW type model to other States would therefore entail applying the model in States where the information is deemed to be adequate, and using the process to identify the specific information needs for modelling in those States in which the data is judged to be inadequate. Thus, the application of the model, or assessment of the feasibility of its application where the information needs are lacking should enjoy early scheduling and should be done in a collaborative fashion by the States concerned.

The study of small-scale spatial processes to better understand the behaviour of the resource and the consequences at the scale of reefs was raised in consultations and at the SARDI meeting. One objective of this work was to determine the consequences, at the scale of reefs, of an increase in the number operators in the event of an increase in the TAC. The issue had strong support only in South Australia. There were doubts on the part of some South Australian divers that the project was feasible in terms of projecting diver behaviour. The study could be useful in fine tuning

management decisions, but by comparison the need to extend the NSW model to other states, this requirement rated as **low priority**, to be addressed once States have attempted to raise the standard of their understanding of the resource to that which prevails in NSW.

### ***Resource Monitoring***

Resource monitoring has been acknowledged as being the safeguard of the resources to date in that the rigorous collection and objective analysis of diver and research information has provided some confirmation that the management measures undertaken have been appropriate. This information is required for modelling and refinements in the form of fishery independent surveys, standardisation of diver effort, better utilisation of diver information and estimates of recreational and illegal catch should continue to be pursued in States which do not have this information at a satisfactory level of detail. This collection of this information is regarded as a **high priority**

In particular the amount of resource theft is poorly understood and in view of the benefits of better control the feasibility of obtaining estimates of this should be addressed as a matter of urgency. Likewise fishery independent surveys have been shown to be important and those States, which lack this source of information, should consider early application of this technique.

The NSW experience has shown that once population models have been established meaningful reference points can be established. Reference points have been established in South Australia but their application is complicated by sampling issues. Resource managers indicated the need to establish formal reference points and the establishment of these has been rated as a **low priority**, recognising that good modelling and monitoring information should provide strong guidance on the establishment of reference points. Addressing this issue should thus not have precedence over modelling and other monitoring issues.

### ***Resource Manipulation***

This category of research is essentially focused on improving or safeguarding the yield of the fishery in a manner which goes beyond the conventional management measures of limitation of catch, effort and minimum size. As such the process includes fishdowns, translocation, reseeding and area closures.

Research is required to verify the efficacy of innovative, and usually localised measures to take full advantage of fairly localised characteristics of the resource. As such the priority of the research depends on the conditions prevailing in a particular State, or even a zone within that State. Studies of these issues are accorded a **medium priority** because they are seen as a means of increasing the capacity of the resource to provide product, with the caveat that justification of research will depend on the localised conditions which would determine the magnitude of the potential benefit.

More particularly if fishdowns, translocation and area closures are to be undertaken on a significant scale the collaboration of industry will be required. Research in these areas thus needs to be opportunistic in the sense that when these measures are contemplated by resource managers there should be a scientific evaluation of the outcomes to build up an understanding of the efficacy of the approach.

A review of all seeding experiments in Australia is in preparation for an international meeting in early 1999 in Canada on stock enhancement. Assessment of the value of this technique for the Australian fishery should take the outcome of this meeting into account.

### **Compliance**

Compliance emerged as a major issue in relation to the management of wild abalone in all States. Current research on this topic is negligible. There are a number of clearly defined research and development priorities within this category.

Scientific studies to estimate illegal abalone catches are difficult to achieve but are urgently required to dimension this perceived problem. The development of innovative techniques to estimate resource theft must be accorded a **high priority**.

It is recognised that some industry and resource management representatives were of the view that the problem seemed intractable and were doubtful that expenditure on this problem was justified. Nevertheless, until some better estimates are made of the magnitude of resource theft doubt can be cast on stock assessments and compliance resourcing decisions and compliance performance measurement must remain uncertain. The Review Team is of the opinion that the rate of theft will increase unless industry and fishery managers take clear and collective action to secure and value the resource.

The need for better tracking of product, through an extension of the docketing system to the point of export and the co-ordination of State systems within a National process was a strong concern of industry and resource management in most States and accordingly investigation into how this could be achieved has a **high priority**. These above two topics (determination of illegal catch, and product tracking) should be scheduled for early attention.

Innovative techniques for assisting enforcement and tracking of product using genetic and other techniques can assist and need to be encouraged as a **medium priority**.

Expenditure on compliance is considerable and yet there have been no estimates of the costs and benefits of this activity nor any attempts to benchmark it so as to better utilise the considerable information and experience which exists within the States. This activity has been accorded a **medium priority** overall, but it should be noted that NSW have attributed a high priority to benchmarking to manage compliance resources.

The nature and consequences of life history changes, as studied in South Australia are complex and important. The feasibility of collecting appropriate information to determine the nature of the compensatory needs to be investigated and is accorded **medium priority**.

### ***Ecology and Habitat***

The research identified as being important within this category related either to the impact of pollutants on abalone beds or the effect of abalone fishing on the ecology of the seabed. The establishment of Marine Protected Areas (MPAs) has consequences for the fishery as well as the habitat of abalone. To some extent the priority accorded to research within this category depends upon the circumstances prevailing in the particular State.

The consequences of interaction between abalone and sea urchins were identified as important by resource managers in NSW. Work on this is being conducted and this issue is accorded a **high priority** in NSW, on the assumption that the findings could be transferred to the fisheries in other States, initially Tasmania. Likewise there was concern in Victoria about the potential effects of species interaction on recovery of abalone beds subject to intense fishing.

Studies of the more general impact of fishing on the benthic habitat had little support other than in South Australia and this issue is rated as a **low priority**.

There is significant concern about the potential impact of aquaculture activities on important adjacent abalone beds in South Australia and Tasmania. The seriousness of this potential effect is uncertain and this research need is accorded a **low priority**.

The establishment of MPAs is being considered in a number of States and depending on location these have the potential to reduce the availability of the abalone resource to the industry. Information on the impacts of these closures requires information on abalone distribution, productivity and fishing intensity within these areas to establish the impact of closure on catches. Protagonists of MPAs stress the contribution, which these areas can potentially make through enhanced recruitment to the fishery. Information on larval and adult dispersal of abalone is available and this combined data on abalone distribution, productivity and fishing intensity collected at the appropriate spatial level will be required to assess the impact of proposed MPAs on the fishery and advise on the attributes of the MPA in respect of the abalone population in the area and the habitat which is intended to be protected. This is regarded as a **medium** priority issue the scheduling of which needs to occur when required.

### ***Economic Assessments***

Although some economic assessments have been instigated by both industry and Government in NSW, South Australia and Victoria it is clear that economic assessment of the abalone fishery has not been supported to the same extent as research on its biological aspects. Nevertheless both industry and resource managers recognize the need to extend biological trends and scenarios to incorporate the economic consequences of management decisions. This type of research must be a **high priority** to provide industry and resource managers with information on the financial risks and returns associated with management change and a basis for debating issues such as full cost recovery and resource rent. The acquisition of this information should be scheduled for early attention.

In some States the Industry believes assessment of the value of the abalone industry to coastal communities was required for future planning, an activity which was accorded a **low priority**.

### ***Value Adding***

Value adding is a process which is usually best undertaken at the enterprise level, for it is the core of the abalone processing system, and it contributes to the marketing, competitive and financial success of the particular enterprise. As such the contribution which research and development can make to the industry in general is limited.

There is potential to enhance value adding, both by doing new things, and by doing what is currently done differently. This can be achieved by:

- ✍ Facilitating and testing improved catching and processing systems;
- ✍ Implementing diver training programs to increase catch quality;
- ✍ Advising on management measures which would improve the seasonal availability and quality of the landed product;
- ✍ Facilitating the development and adoption of quality assurance systems that target premium market niches. Without some proactive cultural and procedural change to quality management from reef to market the industry will not capture the obvious competitive potential it has for premium prices in world markets;
- ✍ Through broad-scale studies to determine and encourage the correct balance between the catching and the processing sectors; and
- ✍ Facilitating new product development and processing innovation in existing enterprises.

These research needs are however rated as being **low to medium priority**.

### ***Marketing***

Marketing is in some ways similar to value adding as research and development needs mainly to take place at the enterprise level. However the need for better marketing and promotion on a national scale emerged as a priority which was supported in all States.

This being the case, a **high priority** should be accorded to developing mechanisms for coordinating national marketing and promotion.

The key to greater market power in an industry that harvests a native species under strict regulation is a commitment by industry (divers, quota holders, processors, exporters) to a shared national peak body – without better national industry and fishery manager coordination and communication there is little chance that Australia will optimize the value of its resource, now and into the future. The Australian cotton and wine grape industries are both relevant current case studies where fierce competitors have gained substantial export market benefits by collaborative market development and generic promotion. Austrade provides funding support for such approved groups through its Export Market Development Grants Scheme.

Based on good communication, and an element of trust and mutual respect, industry players should then jointly investigate the best means of promoting the image of Australian abalone as a **high priority**. While industry should ultimately seek to own the final strategies and any intellectual property developed there is much to be gained by collaboration with government in the early stages. Communication, marketing and promotion should be explored as a matter of urgency.

The identification and evaluation of potential additional, non traditional markets was identified by some Industry representatives as a requirement and this is accorded a **low priority** at this stage. Once industry has its collective house in order, new markets could then be progress. However it is probable that the best firms in



the Australian industry are already identifying new market and product opportunities in their own right.

**Exhibit 40 Research Priorities**

Activity	Priority	Focus (National or State)	Scheduling emphasis	Emphasised in State consultations				
				NSW	SA	Vic	Tas	WA
<b>Resource modelling</b>								
Extension of NSW model to other States, incorporation of risk assessment	High	National	Early		yes	yes	yes	yes
Empirical testing to determine confidence limits and requirements	High	National	Early		yes	yes	yes	
Small scale spatial processes to evaluate the consequences of changes in fishing pressure	low	State	Later	yes	yes			yes
<b>Resource monitoring</b>								
Fishery independent surveys	High	National	Early	yes	yes	yes	yes	yes
Standardisation of diver effort	High	National	Early		yes		yes	yes
Better utilisation of diver information	High	National	Early		yes	yes	yes	yes
Estimates of illegal catch	High	National	Early	yes	yes	yes	yes	yes
Estimates of recreational catch	High	National	Early			yes		yes
<b>Resource manipulation</b>								
Fishdowns	Medium	State	Opportunistic	yes	yes	yes		yes
Translocation	Medium	State	Opportunistic	yes		yes		yes
Reseeding	Medium	State	Later	yes	yes	yes		
Area closures	Medium	State	Opportunistic	yes		yes		

Activity	Priority	Focus (National or State)	Scheduling emphasis	Emphasised in State consultations				
				NSW	SA	Vic	Tas	WA
<b>Compliance</b>								
Assessment of illegally taken abalone	High	National	Early	yes	yes	yes	yes	yes
Tracking of product from capture to export	High	National	Early	yes	yes		yes	
Costs and benefits of better compliance	Medium	National	Early	yes				
Benchmarking compliance	Medium	National	Early	yes				
<b>Ecology and habitat</b>								
Sea urchin abalone interaction	High	State	Early	yes				
Fishery induced life history changes	Medium	State	Early		yes			
Impact of effluents from large-scale fin fish and abalone aquaculture operations	Low	State	Later		yes			
Impact of fishing on the environment	Low	State	Later		yes		yes	
Assessment of MPAs	Medium	State	Opportunistic				yes	
<b>Economic assessments</b>								
Financial risks and returns associated with changes in quota	High	National	Early	yes	yes	yes		
Evaluation of full cost recovery and community contribution	High	State	Early	yes				yes
The value of the abalone industry to coastal communities	Low	State	Later	yes	yes			

Activity	Priority	Focus (National or State)	Scheduling emphasis	Emphasised in State consultations				
				NSW	SA	Vic	Tas	WA
<b>Value adding</b>								
Improved catching and processing systems	Medium	State	Early	yes		yes		
Economic assessment to optimise catch and processing sector balance	Medium	State	Later	yes		yes	yes	yes
Assessment of mechanisms and benefits of the management of seasonal availability and quality	Low	State	Early			yes		yes
<b>Marketing</b>								
Mechanisms for coordinating national marketing and promotion	High	National	Early	yes	yes	yes	yes	yes
Coherent image for Australian abalone related to the clean, green advantage	High	National	Early		yes	yes		
Identification and evaluation of potential additional markets	Low	National	Later			yes		yes

**ATTACHMENT 1:**

**DATES AND LOCATIONS OF ABALONE INDUSTRY  
MEETINGS**

### **Dates and Locations of Abalone Industry Meetings**

12/10/98	Tasmania.....	Hobart
13/10/98	Victoria, Western Zone.....	Port Fairy
13/10/98	Victoria, Central Zone.....	Melbourne
14/10/98	South Australia, Eastern and Central Zone...	Adelaide
14/10/98	South Australia, Western Zone.....	Port Lincoln
15/10/98	Victoria, Eastern Zone.....	Mallacoota
15/10/98	NSW.....	Eden
16/10/98	NSW.....	Batemans Bay
19/10/98	Western Australia, Zones 1, 2 and 3.....	Perth

**ATTACHMENT 2:**

**THE SEQUENCE OF IMPORTANT MANAGEMENT  
CHANGES**

## NSW

### License

License introduced	1980	59 of 100 divers fishing granted access to fishery
Licenses reduced	1985	Two for one license transfers introduced
Licenses reduced	1990	Five licenses removed through buy back scheme
Licenses reduced	1992	Licenses reduced to 37 from 59 in 1980

### Minimum size limit

Minimum size introduced	1973	100mm minimum size limit introduced
Minimum size adjusted	1980	Minimum size limit raised to 108mm
Minimum size adjusted	1986	Minimum size raised to 111mm
Minimum size adjusted	1987	Minimum size raised to 115mm

### Quotas

Quotas introduced	1989	Quota of 10 tons per diver introduced
Quotas transferable	1990	Limited transfer of quota introduced
Quotas transferable	1991	Quota transfer halted except under exceptional circumstances
Quotas reduced	1992	Annual quota reduced from 10 to 9 tons
Quotas transferable	1996	License holders each issued with 100 provisional shares

### Zonation

	1990	Zonation suggestion rejected by Industry
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## South Australia

### License

License introduced	1971	License restriction introduced
Licenses reduced	1972	Licenses reduced over a number of years due to non transferability
License transferable	1980	Licenses become transferable

### Minimum size limit

Minimum size introduced	1971	Minimum legal length of 130 mm for blacklip and greenlip abalone.
Minimum size adjusted	1984	Minimum legal length reviewed for greenlip 145mm in Western Zone and 130mm in Central and Southern Zones
Minimum size adjusted	1984	Minimum legal length reviewed for blacklip 130mm in Western and Central Zones and 125mm in Southern Zone

### Quotas

Quotas introduced	1985	Quotas introduced in Western Zone.
Quotas introduced	1988	Quotas introduced into Southern Zone.
Quotas introduced	1989	Quotas in Central Zone
Quotas introduced	1996	Fishdown quota separated into two TAC's on the basis of area

### Zonation

1971 Zones introduced

### Fishdown

1984 Since 1984 periodic fishdowns in Southern Zone have been permitted to harvest populations presumed to be stunted.

## Tasmania

### License

License introduced	1969	Licenses restricted to 120 divers who operated in 1968
License transferable	1972	Transfer of license to nominee permitted on grounds of health
Licenses increased	1972	Annual license fee of 1.5% of mean annual production value for previous three years. Five additional licenses granted for exclusive use in the Furneaux Group. No other divers permitted to take abalone in the Furneaux waters
License transferable	1974	Approval for transfer of license from retiring diver to his nominee

### Minimum size limit

Minimum size adjusted	1987	Minimum size increased to 132mm
Minimum size adjusted	1990	Minimum size limit for blacklip abalone increased to 140mm west and south west coast
Minimum size adjusted	1990	Minimum size for greenlip increased to 140 mm in Furneaux, King Island and North-east waters
Minimum size adjusted	1998	Minimum size for greenlip increased to 150 mm in Furneaux, King Island and North-east waters and to 140 mm in North-west waters

### Quotas

Quotas introduced	1985	Individual quotas introduced. 120 Tasmanian divers 28 units each, Quota unit 1.1tons live weight. Five Furneaux Divers 20 units each
Quota reduced	1986	Quota unit reduced to 1 ton, 9%
Quotas reduced	1987	Quota unit reduced to .950 ton, 5%
Quotas reduced	1988	Quota unit reduced to .855 ton, 5%
Quotas reduced	1989	Quota unit reduced to .6 ton, 30%
Quota increased	1990	Furneaux boundary removed and Furneaux divers get 8 extra units of non-transferable quota. Quota now comprised of 3500 units, the weight entitlement which can be adjusted to meet TAC requirements
Quotas increased	1997	Value of quota unit increased to .720 ton, an increase of .120 ton

### Fish down

	1989	Undersized blacklip fishery in April in Bass Strait, minimum size 110mm, maximum 132mm with catch limit 2.4 tons per diver, total landings 198 tons
	1991	Undersize fishery for blacklip abalone in May in Bass Strait waters, minimum size 118 mm, TAC 110 tons and \$1.40 per kilo fee
	1993	Undersize blacklip fishery in May/June in Bass Strait minimum size limit 110 mm, TAC 100 tons, fee \$5 per kilo
	1995	Special fishery for undersize blacklip abalone from eastern Bass Strait in April, minimum size 110 mm, TAC 100tons, fee \$10 per kilo. Only 21 tons taken by 12 participants
	1995	Second special fishery for undersized black abalone held in November, minimum size 100 mm, TAC 140 tons, fee \$10 per kilo

## Victoria

### License

License introduced	1970	Abalone fishing license introduced, \$200 fee. 108 divers purchased this non-transferable license
License transferable	1984	Transferability of licenses introduced on a two for one basis.
Licenses reduced	1988	License transferability and consolidation reduced divers to 23 Eastern, 34 Central and 14 Western.
License introduced	1995	Abalone processor license introduced.

### Minimum size limit

Minimum size introduced	1968	Legal Minimum size limit introduced for greenlip abalone of 13cm in all areas.
Minimum size introduced	1968	Legal Minimum size limits introduced for blacklip abalone of 10cm for Port Phillip Bay, 11cm for other areas between Lake Entrance and Lorne and 12cm elsewhere.

### Quotas

Quotas introduced	1988	TAC for fishery introduced, with TAC's of 460 tons Eastern, 700 tons Central and 280 tons Western.
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### Zonation

Zonation	1968	Fishery divided into eastern and Western Zones.
Zonation	1970	Third management zone introduced that is Central.

## Western Australia

### Minimum size limit

Minimum size introduced	1970	Size limit for greenlip and brownlip introduced in early 1970's
Minimum size adjusted	1975	Minimum size limit expressed as meat weight in mid 1970's
Minimum size introduced	1979	Minimum size limit of 60mm introduced for Roe's abalone
Minimum size adjusted	1993	Minimum size limit reverts to 140mm for greenlip and brownlip abalone

### Quotas

Quotas introduced	1985	Voluntary quota of 8 tons per diver per season introduced in Zone 1 for Greenlip and brownlip
Quotas introduced	1985	TAC's and IQ's introduced in mid to late 1980's
Quotas introduced	1986	Quota for greenlip and brownlip introduced in Zone 2, TAC 64 tons, IQ 6 tons
Quotas introduced	1988	Quota for Roe's abalone of 114 tons whole weight introduced and allocated along the coast within Zone 3
Quotas reduced	1988	Quota from brownlip and greenlip reduced after 1985 progressively to 6 tons in Zone 1
Quotas reduced	1989	Quota for brownlip and greenlip abalone reduced to TAC 40 tons in Zone 2 and subsequently fluctuates between 35 and 40 tons
Quotas reduced	1989	Quota for Roe's abalone in Zone 3 reduced to TAC 108 tons whole weight and subsequently remains constant
Quotas introduced	1993	TAC for Roe's abalone introduced to Zone 2

### Zonation

Zonation	1970	Series of rolling closures introduced in Zone 3 to allow harvest recovery
Zonation	1975	Three zones established for the fishery

### Other measures

	1978	Trip limits and weekend closures introduced in Metropolitan area of Zone 3
	1978	restrictions on commercial divers in metropolitan area of Zone 3 to avoid clashes with recreationals
Fishdown	1988	Fishdowns take place occasionally in the Augusta area of Zone 2 since 1988

**ATTACHMENT 3:**

**PUBLISHED ABALONE MATERIAL**

	<b>Abundance estimates</b>	
1979	Fishing power of divers in the abalone fishery of Victoria, Australia.	Beinssen, K.
1985	Use of anaesthetic to standardise efficiency in sampling abalone populations (genus <i>Haliotis</i> ; Mollusca: Gastropoda).	Prince, J.D. and Ford, W.B.
1986	Abalone reefs in Victoria: a resource atlas.	McShane, P.E., Beinssen, K.H.H. and Foley, S.
1987	A survey of abalone stocks of the Kent and Hogan Groups in Bass Strait.	Prince, J.D., Sellers, T.L., Ford, W.B. and Talbot, S.R.
1993	What is an abalone stock: Implications for the role of refugia conservation.	Shepherd, S.A. and Brown, L.D.
1994	Estimating the abundance of abalone ( <i>Haliotis</i> spp.) stocks: examples from Victoria and southern New Zealand.	McShane, P.E.
1994	Victorian air fill survey '93-'94.	McDonald, W.K.D.
1995	Evaluation of methods to assess abalone abundance	Harry Gorfine
1998	Improved indices of catch and effort in the NSW blacklip abalone fishery..	Worthington D.G., N.L. Andrew and N. Bentley (1998)
	<b>Disease</b>	
1977	Blue spot in abalone: possible causes and solutions.	Thrower, S.J.
1981	A new <i>Perkinsus</i> species (Apicomplexa, Perkinsea) from abalone <i>Haliotis ruber</i> .	Lester, R.J.G. and David, A.H.G.
1985	No evidence of contamination of abalone stocks in western St Vincent Gulf.	Shepherd, S.A.
1986	Protozoan parasite ( <i>Perkinsus</i> ) infection in abalone: a progress report.	Lewis, R.K., Shepherd, S.A., O'Donoghue, P., and Phillips, P.H.
1989	The chemical causes of discolouration of Australian abalone flesh	Dr RB Johns
1990	Abalone disease under the microscope.	Shepherd, S.A. and Branden, K.L.
1990	Veterinary Pathology Report No. 6510.90, (abalone from Port Phillip Bay),	Phillips, P.H.
1990	Diseases of abalone	Bob Lester
1991	Infections by <i>Perkinsus</i> (Protozoa: Apicomplexa) in abalone from South Australian waters.	O'Donoghue, P., Phillips, P.H. and Shepherd, S.A
	<b>Fishery economics</b>	
1977	Abalone: market situation and outlook report.	DPI Fisheries Division
1978	Abalone sales prospects may be on the mend.	Stanistreet, K.
1980	Costs and incomes in the New South Wales abalone fishery.	Waugh, G.
1981	Costs and incomes in the New South Wales abalone fishery: the first year of licence limitation.	Waugh, G.
1988	Bioeconomic assessment in an economically depressed fishery.	Waugh, G. and Hamer, G.D.
1988	An economic assessment of the impact of regulations upon the Victorian abalone fishing industry.	Forte, F.

	<b>General</b>	
1967	Abalone culturing experiments.	Harrison, A.J.
1969	Australian abalone industry.	Harrison, A.J.
1971	Progress in abalone research.	Harrison, A.J. and Grant, J.F.
1972	Licence limitation in the Victorian abalone fishery.	Sanders, M.J. and Beinssen, K.H.H.
1973	Studies on southern Australian abalone (genus <i>Haliotis</i> ) I. Ecology of five sympatric species.	Shepherd, S.A.
1973	Studies on southern Australian abalone (genus <i>Haliotis</i> ) IV. Growth of <i>H. Laevigata</i> and <i>H. ruber</i> .	Shepherd, S.A. and Hearn, W.S.
1975	The abalone divers.	Hamer, G.D.
1979	The escape response of abalone (Mollusca, Prosobranchia, Haliotidae) to predatory gastropods.	Parsons, D.W. and MacMillan, D.L.
1982	Effects of length and locality on the mercury content of blacklip abalone, <i>Notohaliotis ruber</i> (Leach), blue mussel, <i>Mytilus edulis planulatus</i> (Lamarck), sand flathead, <i>Platycephalus bassensis</i> (Cuvier and Valenciennes), and long-nosed flathead, <i>Platy</i>	Walker, T.I.
1983	The South Australian abalone fishery: a case study.	Rohan, G.
1983	The Tasmanian abalone fishery.	Harrison, A.J.
1985	Abalone divers' health and safety survey	Carl Edmonds
1985	Microprocessor controlled passive sonar for fisheries studies	Peter Hanna
1986	Gastropod fisheries of the Pacific with particular reference to Australian abalone.	Harrison, A.J.
1988	The crab fauna of West Island: their abundance, diet and role as predators of abalone.	Mower, A.G.J. and Shepherd, S.A.
1989	The fisheries biology of the Tasmanian stocks of <i>Haliotis rubra</i> ..	Prince, J.D.
1989	New size limit for west coast abalone.	Nash, W.J.
1990	The fisheries ecology of Victorian abalone,	McShane, P.E.
1991	The nutritional biology of the blacklip abalone, <i>H.rubra</i> .	Fleming, A.E.
1991	An artificial diet for hatchery-reared abalone, <i>Haliotis rubra</i> .	Gorfine, H.K.
1992	Recognizability of algae ingested by abalone.	Foale, S. and Day, R.
1992	Food preferences of three Australian abalone species with a review of algal food of abalone.	Shepherd, S.A. and Steinberg, P.D.
1992	Some recent findings and future directions for abalone research in Tasmania.	Nash, W.J.
1993	Future plans for abalone research.	Nash, W.J.
1993	The development of new techniques for assessing and managing the Australian abalone fisheries	Warwick Nash
1994	Factors influencing food selection in the abalone <i>Haliotis rubra</i> (Mollusca: Gastropoda).	McShane, P.E., Gorfine, H.K. and Knuckey, I.A.
1996	Review of the South Australian Abalone Research and Management Plan.	Andrew N. L. (1996)

1997	Prevention of long term medical complications in abalone divers	Carl Edmonds
1998	Development of transport systems for abalone	Vance Squires
	<b>Growth, recruitment and mortality</b>	
1967	Australia's abalone industry on the rise.	Harrison, A.J. and Grant, J.F.
1974	Studies on southern Australian abalone (genus <i>Haliotis</i> ) II. Reproduction of five species.	Shepherd, S.A. and Laws, H.M.
1975	Sizes in the Tasmanian commercial catch of blacklip abalone ( <i>Haliotis ruber</i> ): possible effects of changing habitat on growth.	Witherspoon, N.B.
1979	The estimation of fishing mortality of abalone based on experiments to measure the rate of reef coverage by the fishing fleet.	Beinssen, K.
1979	Measurement of natural mortality in a population of blacklip abalone. <i>Notohaliotis ruber</i> .,	Beinssen, K. and Powell, D.
1982	Studies on southern Australian abalone (genus <i>Haliotis</i> ) III. Mortality of two exploited species.	Shepherd, S.A., Kirkwood, G.P. and Sandland, R.L.
1984	Recruitment and stock density studies of the greenlip abalone ( <i>Haliotis laevigata</i> )	0 Shepherd
1984	Investigation of growth, feeding and mortality of Victorian abalone	Gregory Jenkins
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1986	Nursery and container culture of blacklip abalone	Colin Sumner
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1988	Growth and morphometry in abalone ( <i>Haliotis rubra</i> Leach) from Victoria.	McShane, P.E. and Smith, M.G.
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1989	Reproduction and Feeding of the Abalone <i>Haliotis roei</i> Gray.	Wells FE, Keesing JK



1989	Direct measurement of fishing mortality in abalone ( <i>Haliotis rubra</i> Leach) off southeastern Australia.	McShane, P.E. and Smith, M.G.
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1990	Abalone mature with age not size.	Nash, W.J.
1990	The relationship between age and growth of the blacklip abalone, <i>Haliotis rubra</i> (Leach) in Port Phillip Bay, Victoria	de Jong, J.
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1991	A new technique for tagging abalone.	Prince, J.D.
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1991	Evolution genetics and population structure in abalone (genus <i>Haliotis</i> ).	Brown, L.D.
1991	Genetic variation and population structure in the blacklip abalone, <i>Haliotis rubra</i> .	Brown, L.D.
1992	Population genetics, gene flow and stock structure in <i>Haliotis rubra</i> and <i>Haliotis laevigata</i> .	Brown, L.D. and Murray, N.D.
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**ATTACHMENT 4:**

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**ATTACHMENT 5:**

**AUSTRALIAN ABALONE INDUSTRY STATE DATA**



**ATTACHMENT 6:**

**PEOPLE WHO CONTRIBUTED TO THIS REVIEW**

**People who have contributed their industry knowledge and expertise to this review (excluding focus group participants) include:**

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ESTIMATED MARKET SEGMENTATION OF AUSTRALIA WILD ABALONE SALES																	
TASMANIA			Unit Sales Price A\$/kg FOB	Estim. Yield: live to product	Estim. Equiv. Quota kg / unit	IMPLIED Value per quota A\$/kg FOB	TAC / Quota tonnes (t)	% of Prod.	Japan	Taiwan	HKG	Singapore	China	USA/Can.	Europe	Domestic	TOTAL
<i>Note: This TAC comprises both black and green lip abalone - in unspecified v</i>							2,520										
1 Live abalone	kg	green															
		black	\$36.00	100%	1	\$36.00	227	9%	20%	15%	35%		30%				100%
2 Chilled fresh meat		green					-										
		black															
3 Canned ab. meat	carton	green															
	(24X213g)	black	\$639.34	28%	18	\$35.02	1,957	78%	30%	40%	14%	12%		3%	1%		100%
4 Frozen (IQF) meat	carton	green	\$1,200.00	32%	31	\$38.40	210	8%	50%		50%						100%
	(10 kg)	black	\$990.00	32%	31	\$31.68	76	3%	50%		50%						100%
5 Frozen (IQF) on sh	carton	green															
	(raw)	(10 kg)	black	\$350.00	85%	12	\$29.75	25	1%	100%							100%
6 Frozen (IQF) on sh	carton	green															
	(par boiled)	(10 kg)	black	\$380.00	100%	10	\$38.00	25	1%	100%							100%
7 Vacuum pack meat		green															
		black															
8 Dried abalone meat		green															
		black															
9 Powdered meat		green															
		black															
							2,520	100%	826	817	496	235	68	59	20	0	2,520
Total Value of Fishery			\$88,870,004					\$ mill	29.13	28.64	17.68	8.22	2.45	2.06	0.69	0.00	

<b>VICTORIA</b>		Unit Sales Price A\$ - FOB	Estim. Yield: live to product	Estim. Equiv. Quota kg / unit	IMPLIED Value per quota Kg A\$ - FOB	TAC / Quota tonnes (t) 280	% of Prod.	Japan	Taiwan	HKG	Singapore	China	USA/Can.	Europe	Domestic	TOTAL	
unit	Western Zone																
1	Live abalone	black	\$36.00	100%	1	\$36.00	140	50%	100%								100%
2	Chilled Fresh meat	black															
3	Canned ab. meat	carton black (24X213g)															
4	Frozen (IQF) meat	carton black (10 kg)	\$990.00	32%	31	\$31.68	140	50%	34%	33%	33%						100%
5	Frozen (IQF) on sh	carton black (raw) (10 kg)															
6	Frozen (IQF) on sh	carton black (par boiled) (10 kg)															
7	Vacuum pack ab. meat	black															
8	Dried abalone meat	black															
9	Powdered meat	black															
Total Value of Fishery		\$9,475,200					280	100%	188	46	0	46	0	0	0	0	280
								\$ mill	6.55	1.46	0.00	1.46	0.00	0.00	0.00	0.00	

<b>VICTORIA</b>		unit	Unit Sales Price A\$ - FOB	Estim. Yield: quota to product	Estim. Equiv. Quota kg / unit	IMPLIED Value per quota Kg A\$ - FOB	TAC / Quota tonnes (t) 700	% of Prod.	Japan	Taiwan	HKG	Singapore	China	USA/Can.	Europe	Domestic	TOTAL
<b>Central Zone</b>																	
1 Live abalone	green black		\$36.00	100%	1	\$36.00	154	22%	100%								100%
2 Chilled Fresh Meat	green black																
3 Canned ab. meat carton (24X213g)	green black		\$639.34	27%	19	\$33.77	455	65%	25%	20%	25%	25%		5%			100%
4 Frozen (IQF) meat carton (10 kg)	green black		\$990.00	32%	31	\$31.68	70	10%	50%		50%						100%
5 Frozen (IQF) on sh carton (raw) (10 kg)	green black																
6 Frozen (IQF) on sh carton (par boiled) (10 kg)	green black																
7 Vacuum pack ab. meat	green black					\$125.50	7	1%		100%							100%
8 Dried abalone meal kg	green black		\$300.00	30%	3	\$90.00	14	2%		25%	25%	25%	25%				100%
9 Powdered meat	green black																
Total Value of Fishery			\$25,264,623				700	100%	303	102	152	117	4	23	0	0	700
								\$ mill	10.49	4.27	5.26	4.16	0.32	0.77	0.00	0.00	

<b>VICTORIA</b>		Unit Sales Price A\$ - FOB	Estim. Yield: quota to product	Estim. Equiv. Quota kg / unit	IMPLIED Value per quota Kg A\$ - FOB	TAC / Quota tonnes (t) 460	% of Prod.	Japan	Taiwan	HKG	Singapore	China	USA/Can.	Europe	Domestic	TOTAL	
<b>Eastern Zone</b>	unit																
1 Live abalone	black																
2 Chilled Fresh Meat	black																
3 Canned ab. meat carton (24X213g)	black	\$639.34	27%	19	\$33.77	322	70%	50%	16%	17%	17%						100%
4 Frozen (IQF) meat carton (10 kg)	black	\$990.00	32%	31	\$31.68	138	30%	100%									100%
5 Frozen (IQF) on sh carton (raw) (10 kg)	black																
6 Frozen (IQF) on sh carton (par boiled) (10 kg)	black																
7 Vacuum pack ab. meat	black																
8 Dried abalone meat	black																
9 Powdered meat	black																
Total Value of Fishery		\$15,245,195				460	100%	299	52	55	55	0	0	0	0	0	460
							\$ mill	9.81	1.74	1.85	1.85	0.00	0.00	0.00	0.00		





<b>SOUTH AUSTRALIA</b>		unit	Unit Sales Price A\$ - FOB	Estim. Yield: quota to product	Estim. Equiv. Quota kg / unit	IMPLIED Value per quota Kg A\$ - FOB	TAC / Quota tonnes (t) 62	% of Prod.	Japan	Taiwan	HKG	Singapore	China	USA/Can.	Europe	Domestic	TOTAL	
<b>Central Zone</b>																		
1 Live abalone	green black																	
2 Chilled Fresh Meat	green black																	
3 Canned ab. meat carton (24X213g)	green black	\$631.15	80%	19.2	\$32.92	37	60%	20%	20%	25%	20%		10%			5%	100%	
4 Frozen (IQF) meat carton (10 kg)	green	\$1,200.00	100%	30	\$40.00	11	18%			100%							100%	
	black	\$990.00	100%	30	\$33.00	7	12%			100%							100%	
5 Frozen (IQF) on sh carton (raw) (10 kg)	green																	
	black																	
6 Frozen (IQF) on sh carton (par boiled) (10 kg)	green																	
	black																	
7 Vacuum pack ab. meat	green																	
	black	\$1,500.00	100%	30	\$50.00	6	10%		33%	33%	34%						100%	
8 Dried abalone meat	green black																	
9 Powdered meat	green black																	
Total Value of Fishery		\$6,658,498				62	100%	7.4	9.5	29.8	9.5	0.0	3.7	0.0	1.9		62	
hole in shell to Meat weight Multiplier		3	Implied Whole In Shell Quota			185.4	\$ mill	0.73	1.04	3.29	1.05	0.00	0.37	0.00	0.18			

<b>SOUTH AUSTRALIA</b>		unit	Unit Sales Price A\$ - FOB	Estim. Yield: quota to product	Estim. Equiv. Quota kg / unit	IMPLIED Value per quota Kg A\$ - FOB	TAC / Quota tonnes (t) 181	% of Prod.	Japan	Taiwan	HKG	Singapore	China	USA/Can.	Europe	Domestic	TOTAL
<b>Western Zone</b>																	
1	Live abalone	green black															
2	Chilled Fresh Meat	green black															
3	Canned ab. meat carton (24X213g)	green black	\$639.34	80%	19	\$33.35	93	52%	10%	50%	30%			10%			100%
4	Frozen (IQF) meat carton (10 kg)	green black	\$1,200.00 \$990.00	100% 100%	30 30	\$40.00 \$33.00	83 5	46% 3%			95% 65%	5%					100% 100%
5	Frozen (IQF) on sh carton (raw) (10 kg)	green black															
6	Frozen (IQF) on sh carton (par boiled) (10 kg)	green black															
7	Vacuum pack ab. meat	green black															
8	Dried abalone meat	green black															
9	Powdered meat	green black															
Total Value of Fishery			\$19,760,010				181	100%	9.30	46.50	110.0	4.15	0.00	11.05	0.00	0.00	181
hole in shell to Meat weight Multiplier			3	Implied Whole In Shell Quota			543	\$ mill	0.93	4.65	12.58	0.50	0.00	1.10	0.00	0.00	

<b>WESTERN AUSTRALIA</b>		unit	Unit Sales Price A\$ - FOB	Estim. Yield: quota to product	Estim. Equiv. Quota kg / unit	IMPLIED Value per quota Kg A\$ - FOB	TAC / Quota tonnes (t)* 131	% of Prod.	Japan	Taiwan	HKG	Singapore	China	USA/Can.	Europe	Domestic	TOTAL
<b>Zone 1 -Southern East</b>																	
1	Live abalone	green brown Roei															
2	Chilled Fresh Meat	green brown Roei															
3	Canned ab. meat carton (24X213g)	green brown Roei	\$870.00	27%	19	\$45.95	9.96	7.6%	25%	25%	25%	25%					100%
4	Frozen (IQF) meat carton (10 kg)	green	\$1,400.00	100%	30	\$46.67	96.48	73.9%			95%	3%				3%	100%
		brown Roei	\$1,350.00	100%	30	\$45.00	24.12	18.5%			95%	3%				3%	100%
5	Frozen (IQF) on sh carton (raw) (10 kg)	green brown Roei															
6	Frozen (IQF) on sh carton (par boiled) (10 kg)	green brown Roei															
7	Vacuum pack ab. meat	green brown Roei															
8	Dried abalone meat	green brown Roei															
9	Powdered meat	green brown Roei															
Total Value of Fishery			\$6,045,468				131	100%	2.5	2.5	117.1	5.5	0.0	0.0	0.0	3.0	131
* Note: This figure is the implied whole-in-shell weight								\$ mill	0.11	0.11	5.42	0.25				0.14	

<b>WESTERN AUSTRALIA</b>																	
<b>Zone 2-Southern West</b>		unit	Unit Sales Price A\$ - FOB	Estim. Yield: quota to product	Estim. Equiv. Quota kg / unit	IMPLIED Value per quota Kg A\$ - FOB	TAC / Quota tonnes (t)* 128	% of Prod.	Japan	Taiwan	HKG	Singapore	China	USA/Can.	Europe	Domestic	TOTAL
1	Live abalone	green brown Roei															
2	Chilled Fresh Meat	green brown Roei															
3	Canned ab. meat carton (24X213g)	green brown Roei	\$870.00	27%	19	\$45.95	8.00	6.3%	25%	25%	25%	25%					100%
4	Frozen (IQF) meat carton (10 kg)	green brown Roei	\$1,400.00 \$1,350.00	100% 100%	30 30	\$46.67 \$45.00	115.66 2.89	90.4% 2.3%			95% 100%	3%				3%	100% 100%
5	Frozen (IQF) on sh carton (raw) (10 kg)	green brown Roei															
6	Frozen (IQF) on sh carton (par boiled) (10 kg)	green brown Roei															
7	Vacuum pack ab. meat	green brown Roei															
8	Dried abalone meat	green brown Roei	\$500.00	28%	36	\$140.00	1.45	1.1%			100%						100%
9	Powdered meat	green brown Roei															
Total Value of Fishery			\$6,097,726				128	100%	2.0	2.0	116.2	4.9	0.0	0.0	0.0	2.9	128
* Note: This figure is the implied whole-in-shell weight								\$ mill	0.09	0.09	5.55	0.23	0.00	0.00	0.00	0.13	

<b>WESTERN AUSTRALIA</b>		unit	Unit Sales Price A\$ - FOB	Estim. Yield: quota to product	Estim. Equiv. Quota kg / unit	IMPLIED Value per quota Kg A\$ - FOB	TAC / Quota tonnes (t)* 108	% of Prod.	Japan	Taiwan	HKG	Singapore	China	USA/Can.	Europe	Domestic	TOTAL
<b>Zone 3 - West</b>																	
1	Live abalone	Roei	\$44.00	100%	1	\$44.00	1	1%	100%								100%
2	Chilled Fresh Meat	Roei															
3	Canned ab. meat carton (24X213g)	Roei	\$870.00	27%	19	\$45.95	107	99%	8%	42%	41%	9%					100%
4	Frozen (IQF) meat carton (10 kg)	Roei															
5	Frozen (IQF) on sh carton (raw) (10 kg)	Roei															
6	Frozen (IQF) on sh carton (par boiled) (10 kg)	Roei															
7	Vacuum pack ab. meat	Roei															
8	Dried abalone meat	Roei															
9	Powdered meat	Roei															
Total Value of Fishery			\$4,957,049				108	100%	9.6	44.9	43.8	9.6	0.0	0.0	0.0	0.0	108
* Note: This figure is the whole-in-shell weight								\$ mill	0.44	2.06	2.01	0.44	0.00	0.00	0.00	0.00	

NEW SOUTH WALES	unit	black	Unit Sales Price A\$ - FOB	Estim. Yield: quota to product	Estim. Equiv. Quota kg / unit	IMPLIED Value per quota Kg A\$ - FOB	TAC / Quota tonnes (t) 333	% of Prod.	Japan	Taiwan	HKG	Singapore	China	USA/Can.	Europe	Domestic	TOTAL
1 Live abalone	black		\$36.00	100%	1	\$36.00	300	90%	67%			4%	22%	3%	4%		100%
2 Chilled Fresh Meat (10 kg)	carton	black	\$1,000.00	32%	31	\$32.00	3.33	1%	100%								100%
3 Canned ab. meat (24X213g)	carton	black	\$639.34	28%	18	\$35.02	6.66	2%	100%								100%
4 Frozen (IQF) meat (10 kg)	carton	black	\$990.00	32%	31	\$31.68	16.65	5%	100%								100%
5 Frozen (IQF) on sh (raw)	carton	black															
6 Frozen (IQF) on sh (par boiled)	carton	black															
7 Vacuum pack ab. meat		black															
8 Dried abalone meat		black	\$1,100.00	32%	31	\$35.20	6.66	2%	25%	25%	25%	25%					100%
9 Powdered meat		black															
							333	100%	229.1	1.7	1.7	13.7	65.9	9.0	12.0	0.0	333
Total Value of Fishery			\$11,890,890					\$ mill	8.15	0.06	0.06	0.49	2.37	0.32	0.43	0.00	



