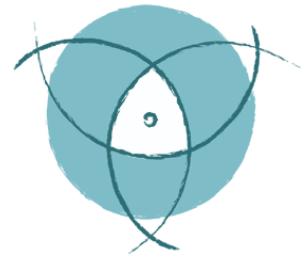


Victoria's Fisheries & Aquaculture  
Research & Development Strategy

2005-2010

Prepared by the  
Research Committee, FCC and  
Fisheries Co-Management Council, Victoria



## Acknowledgements

This Strategy was developed primarily by the FCC's Research Committee. In particular the efforts of David Smith and the Committee Chair, Ross Winstanley were central to its preparation. Council members (led by John Sherwood, Lance Lloyd and Roy Palmer) and staff (Nik Phizacklea, Jess Strickland and Alison Cobbledick) made significant contributions. Finally, individuals and the organisations listed in Appendix 1 made constructive comments on a draft of the Strategy to its benefit.

Where species names are listed these are in accordance with the Australian Fish Names List (AFNL) – refer [www.fishnames.com.au](http://www.fishnames.com.au).

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## **Ministers Foreword:**

This five-year strategy, developed by the Fisheries Co-Management Council, provides a framework for prioritising the research and development required to meet the needs of resource managers, industry and other stakeholders in Victoria's fisheries. This strategy replaces 'Research Needs and Priorities for Fisheries in Victoria 2001/02 – 2005/06' and provides a broad, strategic approach that acknowledges the dynamic nature of research and development.

Victoria's fisheries, and the habitats that support them, are valuable renewable resources with significant importance for both the economic and social wellbeing of Victorians.

The overall value of Victoria's fish resources is about \$100 million, which includes the commercial abalone and rock lobster fisheries and a developing aquaculture industry worth over \$23 million.

Recreational fishing is a popular pastime in Victoria and makes a significant contribution to the Victorian economy, particularly through regional tourism. Over 550,000 Victorians participate in recreational fishing each year.

This strategy was developed following broad consultation with stakeholder groups. The strategy encompasses research priorities for commercial and recreational fishing, marine and freshwater aquaculture and for aquatic ecology and environment.

Managing Victoria's aquatic resources in a way that ensures they are productive and sustainable, now and into the future, is a priority of the Victorian Government. I am therefore pleased that the principles of Ecologically Sustainable Development (ESD) and Ecosystem Based Fisheries Management (EBFM) have been used in the development of this strategy.

The research priorities of the five-year plan will be reviewed annually and progress in key areas assessed. The plan provides a valuable guide to government and other research providers, and will assist in ensuring that research is targeted, coordinated, timely and cost effective.

**BOB CAMERON**

Minister for Agriculture.

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## Executive Summary

This strategy sets out, as plainly as possible, the broad directions for Victorian fisheries research and development (R&D) for the period to 2010. It is strategic in that it leads R&D in the directions set by those stakeholders with direct interests and responsibilities in this area. It guides those who plan a specific project to consider how it fits into the bigger picture. Its purpose is to ensure that R&D is targeted, coordinated, cost effective and focused on achievable outcomes that meet the needs of resource management, industry development and present and future stakeholders.

This Victorian strategy is guided by ESD principles. Its objectives are to:

1. provide a logical framework for determining priority R&D needs for managing Victorian marine and freshwater fisheries, the aquaculture industry and protecting fish habitats.
2. increase the awareness of research providers and resource stakeholders of R&D requirements so that R&D proposed and undertaken is focused on outcomes that assist with industry development, management of Victorian fisheries and aquaculture and protection of fish habitats.
3. facilitate decisions on the allocation of funding to support R&D needs from conventional sources and encourage the supply of funding from alternative sources.

In preparing this Strategy the Fisheries Co-Management Council (FCC) has drawn on several sources of information - these are recognised within the document. All sources indicate the need for a broadening of the focus and scope of “fisheries management” from one focussed on target species to a full consideration of fisheries impacts on non-target species and aquatic ecosystems. The FCC believes that this broader Ecosystem Based Fisheries Management (EBFM) approach will set the direction for fisheries and aquaculture management, research and development over the term of this strategy.

As well as the broadening of fisheries R&D consistent with the emerging EBFM approach, the FCC recognises a number of realities and challenges to be faced in the next five years. These are:

- o Demand for seafood will increase, because of population growth and changing food preferences toward healthier food products. Consumption studies show that a minimum of 80% of people purchase their seafood.
- o Wild fisheries production is unlikely to increase. The impacts of stressed environments on fish populations, competition for fish and water, reservation of Marine Protected Areas, by catch reduction and climate change will all impact on the availability of wild fish stocks.
- o Between 2000 and 2005 the average return to Victoria through Fisheries Research and Development Corporation (FRDC) funding, has been greater than a 5:1 ratio. While it is expected that a positive return on investment will continue, it is unlikely that it will remain at this level.

- o Aquaculture, if it is to meet this extra demand, must deal effectively with the R&D challenges in areas including species selection, cost-efficient production, marketing and industry development and environmental impact mitigation.
- o Currently, Victoria is a net importer of seafood for consumption and bait. We need to explore ways for the import sector to contribute to Victoria's R&D efforts.
- o Cost recovery is being implemented across the industry and will impact upon the harvesting, production and R&D sectors.
- o Recreational fishers are a significant stakeholder group (in terms of catch, their numbers, and influence) and have specific R&D requirements.
- o Demand for passive uses of marine and freshwater environments is increasing and such use constitutes the special interest of legitimate stakeholder groups.
- o For EBFM approaches to fisheries management to be effective, cross-border co-operation, on specific fisheries is essential.

Today, managing industry, recreational fisher, environmental and seafood consumer expectations, and developing appropriate political responses, will require carefully planned social, economic and policy research as well as the more traditional biological and technological R&D. In order to meet these challenges, the FCC has adopted the following strategic R&D objectives for 2005 to 2010:

1. Further develop cost effective single species and multiple species management tools.
2. Provide for a shift from a single species/enterprise management focus to EBFM in line with national and international imperatives.
3. Improve the costs of production (efficiency) and value per unit (effectiveness) of wild fisheries and aquaculture through a "whole-of-chain" approach.
4. Provide for industry capacity building and industry development.
5. Enable the resourcing, provision and extension of quality assured R&D activities.

The strategy is aimed at a number of key fisheries stakeholder groups:

- Commercial fishers and aquaculture operators contribute substantially to R&D costs through the Victorian Government's cost recovery policy and annual contributions to FRDC;
- Recreational fishers contribute via the RFL annually towards R&D and other services;
- R&D providers include PIRVic, other Government agencies, museums, universities, colleges of TAFE, consultants, CSIRO;
- Fisheries and other natural resource managers have a key role in helping to focus R&D in directions set by State and national policies and on issues of local industry and wider community interest;
- All sectors who benefit from R&D but who do not currently contribute financially;

- The funding investors in fisheries R&D in Victoria. These include the Australian Government, Victorian Government, Fisheries Victoria, FRDC, the Fisheries Revenue Allocation Committee, Natural Heritage Trust, Seafood Services Australia, Catchment Management Authorities, Murray-Darling Basin Commission, Water Authorities and the Australian Research Council (ARC). Each of these organisations has their own R&D guidelines and strategic directions.

Given the potential for competition, as well as mutual benefits, between all these groups, the need for a shared strategic R&D investment framework is clearly in both industry's and the community's best interests. Investment decisions by any stakeholder that also fit within a comprehensive strategic framework endorsed by Victorian fisheries stakeholders will help to maximise returns to industry and community.

The process by which these partnerships work will differ from those that have characterised much of fisheries R&D funded in Victoria in the past. Collaboration and coordination are becoming increasingly important. Full cost recovery will mean that stakeholders will demand a greater input into priority setting and processes. Effective and cost-efficient R&D underpinning EBFM dictates the need for communication, collaboration and cooperation across regional and state borders. Better communication and marketing of R&D outputs and outcomes will be crucial.

This process can be strengthened further if each sectoral group determines its own R&D priorities based on the key opportunities and challenges it sees in the immediate future. Successful priority setting and project development will also depend on partners working over timeframes of at least 18 months ahead of funding application deadlines.

The industry or management agencies who are expected to implement R&D outcomes must be involved from the start of this process – the days of researchers developing proposals more or less in isolation, then seeking letters of endorsement from stakeholders at the last minute, are over.

## **Introduction**

Victoria's marine, estuarine and inland aquatic resources are important community assets that support major commercial and recreational fisheries and a developing aquaculture industry. They also support indigenous fishing, subsistence fishing and small-scale collection of live specimens for aquariums.

The overall value of Victorian fish resources is about 98 million, which includes the commercial abalone and rock lobster fisheries and a developing aquaculture industry worth over \$23 million. Victoria, however, is a net importer of seafood for both consumption and bait.

Recreational fishing is an important pastime in Victoria. In 2000/01, an estimated number of 550,000 people participated in recreational fishing in Victoria.

The development of a research and development (R&D) strategy is important to ensure research is relevant, conducted in a coordinated manner, cost-effective and, most importantly, meets the needs of resource management and industry development. It is important to ensure that other potential partners are considered in the development and prioritisation of R&D needs – this means we need to understand what R&D is being undertaken on a national scale by other States and other sectors. Specifically, R&D outputs should not duplicate work undertaken by Fisheries Research and Development Corporation (FRDC) or other funded projects. Projects should be consistent with Victorian Coastal Council (VCC), Catchment Management Authorities (CMAs), Murray-Darling Basin Commission (MDBC) and Department of Sustainability and Environment (DSE) Strategies.

This strategy replaces 'Research Needs and Priorities for Fisheries in Victoria 2001/02 – 2005/06' and takes a more strategic approach. The strategy sets broad directions and provides a framework for prioritising R&D. Research prioritisation will occur at an annual R&D Workshop facilitated by the FCC. This is seen as more effective than specifying particular projects in the Strategy. These may or may not have future relevance in what is a rapidly changing environment.

## Overview

### *Overview of the Commercial, Aquaculture and Recreational Fishing Industries*

#### **Commercial Fisheries**

Victoria is a major centre for the seafood industry in southern Australia. Landings at Victorian ports support significant fisheries managed by Victoria, the Commonwealth and to lesser extent Tasmania. The Victorian fisheries are grouped as Abalone, Rock Lobster, Giant Crab, Bay and Inlet, Eels, European Carp, Coastal and Scallop. Significant quantities of catches from the Federal Australian Fisheries Management Authority (AFMA) managed fisheries eg Southern & Eastern Scalefish and Shark (which now incorporates SE Trawl, Shark and Gill Net and Drop Line sectors), Southern Squid Jig and Bass Strait Central Zone Scallop are landed in Victorian ports. Some of the Commercial Scallops and Rock Lobsters harvested in Tasmanian waters are also landed in Victoria.

#### *Abalone*

Victorian Abalone resources support an export fishery that had a landed value of \$53 million during 2002/03. It continues to be the most valuable state-managed fishery.

The commercial fishery is subject to an intensive management regime comprising legal minimum lengths, zonation of the fishery (Central, Eastern and Western), limited entry, quotas, closed areas and catch docketing. As a consequence the fishery has been relatively stable and remunerative. The catching sector has developed effective fishing practices and equipment, and provides a quality landed product. The commercial catch is processed by a number of licensed processors, most of whom are concentrated in the Central Zone.

The fishery targets Blacklip Abalone, with only small and sporadic Greenlip Abalone catches. Planned legislative changes to comply with the Australian Governments *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) will result in separate Total Allowable Catches (TACs) for each species. During the past two years, the three zonal TACs that originally totalled 1440 tonnes (for Blacklip and Greenlip Abalone combined) have been reduced to 1359 tonnes to ensure that stock biomass is maintained. The proposed Greenlip Abalone TAC will be zero in recognition of the depleted status of this species.

Illegal and unauthorised harvesting of Abalone also occurs. The extent of this is not fully known but industry sources and recent convictions suggest that the quantities may be significant.

The 2001 National Recreational and Indigenous Fishing Survey estimated the recreational abalone catch as less than 8 tonnes. This is substantially less than the previous estimate of 30–60 tonnes, made using limited data in 1997.

#### *Rock Lobster and Giant Crab*

The commercial fishery for rock lobsters is managed in two zones, the Western Zone (85 licences) and Eastern Zone (52 licences). In November 2001, quota management was introduced, capping the catch at 450 tonnes in the Western Zone and 60 tonnes in the Eastern Zone. Since 2001, total annual landings have been about 500 tonnes worth about \$18 million. Input controls are used to limit the number of operators and the number of pots each operator can use. There are also separate closed seasons and minimum legal sizes for male and female Rock Lobsters.

Recent assessments show that the biomass in both Zones is rebuilding and egg production is increasing and that these trends will continue under the current regime.

Recreational fishers are subject to daily bag limits under a notional quota that equates to estimated total annual catches of 6 tonnes in the Eastern Zone and 20 tonnes in the Western Zone.

The Giant Crab fishery is now also managed by quota. There are 42 licences attached to Western Zone rock lobster licences. The total allowable catch is currently 25 tonnes. There is no Giant Crab fishery in the Eastern Zone at present.

These fisheries operate under 5-year management plans that came into effect in November 2003. Both fisheries have been assessed under the EPBC Act, with Rock Lobster gaining a 5-year exemption from requiring an export permit; and Giant Crab attaining a 3-year conditional export permit.

There is currently a developing fishery licence for Velvet Crabs. The R&D requirements for this fishery will be identified when the fishery licence is reviewed and a Management Plan written.

#### *Bay, inlet and coastal fisheries*

Victoria's bay and inlet fisheries are complex. The commercial fishery is multi-method, multi-species and operates in Port Phillip Bay, Westernport Bay, Corner Inlet and the Gippsland Lakes. It is managed by input controls regulating the number of operators and a range of other measures including size limits. The major species harvested are Black Bream, King George Whiting, Snapper and Pilchards. Large tonnages of European Carp are also taken in the Gippsland Lakes.

During 1999/2000, a voluntary buy-out (funded by Recreational Fishing Licence revenue) removed 52% of the licences from bay and inlet fisheries. Recently there has been a further buy-out of licences resulting in the closure of fisheries in Lake Tyers and Mallacoota Inlet to commercial fishing except for bait.

There are a number of small coastal fisheries including purse seining for Pilchards, inshore trawling, hand-lining for Wrasse, netting for Snapper and a developing fishery for Banded Morwong.

Total landings are valued at about \$12 million.

#### *Scallop*

The scallop fishery targets the Commercial Scallop in Bass Strait, mainly between Lakes Entrance and Wilsons Promontory and, occasionally, to the east of Lakes Entrance and off Apollo Bay. The fishing season occurs within the period generally around April to December with scallops normally being in best condition in terms of meat weight between August and October. Annual catches are extremely variable, ranging from over 1400 tonnes meat weight (11,000+ tonnes shell weight) in 1993 to zero in 1998 and 1999. In 2002/03 the value of scallops harvested from Victorian waters was \$1.4 million.

The Scallop fishery does not have a Management Plan because there are ongoing discussions regarding an Offshore Constitution Settlement (OCS) agreement for the fishery. R&D in this fishery has been minimal.

### *Eels*

The commercial Eel fishery is closely linked with Eel aquaculture. Currently there are 19 fully transferable licences to capture eels in southern Victoria. Approximately 15 public waters are allocated to licence holders for the purpose of extensive Eel culture. In previous years, average annual production was 280 tonnes, but recent catches have been considerably lower due to the drought. A management plan for the fishery was released in 2002. The fishery has been assessed under the EPBC Act, gaining a 5-year exemption from requiring an export permit.

### **Recreational Fisheries**

In 1999 an all-waters Recreational Fishing Licence (RFL) was introduced in Victoria. This replaced the licence previously only required for inland fishing and taking of Rock Lobsters. The RFL revenue provides a major and dedicated fund that provides for recreational fisheries management, services and research. The first significant application of these funds was the voluntary buy-out of bay and inlet commercial fishing licences.

A recent national survey highlighted the significant catches by recreational fishers in Victoria. During 2000/01, the major recreational species in marine and estuarine waters were Flathead species (597 t), Snapper (332 t), Australian Salmon (271 t), King George Whiting (215 t) and Black Bream (203 t). Other important species were Southern Calamari, Garfish, Wrasse, Barracouta and Silver Trevally. These figures indicate recreational catches of Flathead, Snapper, Black Bream and King George Whiting exceed the reported commercial catches of those species.

The major species taken in the inland recreational fishery are Redfin (950,000 fish caught and kept – 2000/01), Brown Trout (194,000) and Rainbow Trout (144,000), European Carp (328,000) and Golden Perch (142,000). Other species include Australian Bass, Murray Cod, Yabbies and freshwater crayfish.

### *Inland commercial fishery*

All commercial inland licenses, except for European Carp and Eel, have been purchased via the RFL-funded licence buy-out program. Apart from the Eel fishery, commercial fishing in inland waters is now restricted to European Carp.

### **Aquaculture**

The aquaculture industry in Victoria is currently small relative to other States. Over the past 5 years the total value of Victorian aquaculture production has risen from \$13 million to \$21 million. This is less than 3% of the national total of about \$743 million.

Victoria has the largest freshwater salmonid sector in Australia and this is currently the highest valued of the Victorian aquaculture sectors. Rainbow Trout is the major species, with small quantities of Brown Trout and Atlantic Salmon produced. Current production is about 1500 tonnes per annum valued at over \$12 million. The next most significant production varies between the ornamental fish sector and Mussels, depending upon yearly production as a result of environmental conditions. Both sectors are valued between \$2.5 and \$3.5 million per annum.

Freshwater aquaculture includes warm-water native species such as Murray Cod, Barramundi, Silver Perch and Yabbies. Eel culture is also a small sector with some potential, particularly export. Yabby and Eel production has decreased over the last few years as a result of the drought.

Marine aquaculture in Victoria has been hampered by lack of access to suitable water and designated sites. The declaration of almost 1700 hectares of new waters for marine aquaculture has the potential to significantly increase aquaculture production when those waters become available. The established sector is Mussel farming but there is potential for production of other filter feeders such as Scallops and finfish.

Abalone aquaculture has increased considerably over the last five years and the State now has five major land-based facilities and some at-sea grow-out. There is a long lead-time associated with abalone aquaculture but a rapid increase in production and value is expected over the next five years.

### **Fisheries Management in Victoria**

The primary responsibility for fisheries management in Victoria lies with Fisheries Victoria, a division of the Department of Primary Industries. The legislative framework for management is the *Fisheries Act 1995*, which was proclaimed in 1998. A fundamental premise of the Act is that Victorian fisheries are managed according to the principles of Ecologically Sustainable Development (ESD). The specific objectives of the Act are to:

- provide for the management, development and use of Victoria's fisheries, aquaculture industries and associated aquatic resources in an efficient, effective and ecologically sustainable manner.
- protect and conserve fisheries resources, habitats and ecosystems including the maintenance of aquatic ecological processes and genetic diversity.
- promote sustainable commercial fishing and viable aquaculture industries and quality recreational fishing opportunities for the benefit of present and future generations.
- facilitate access to fisheries resources for commercial, recreational, traditional and non-consumptive uses.
- promote the commercial fishing industry and to facilitate the rationalisation and restructuring of the industry.
- encourage the participation of resource users and the community in fisheries management.

A key outcome of the 1995 Act was the establishment of the Fisheries Co-Management Council (FCC). The FCC's primary role is to promote co-management, to oversee the preparation of management plans and, more generally, to advise the Minister on all matters relating to Victoria's fisheries. The FCC has eight expertise-based Fishery Committees which provide it with advice and assistance.

Victoria has three Government recognised peak bodies representing the interests of most primary stakeholder groups. These are Seafood Industry Victoria (commercial), VRFish (recreational) and the Victorian National Parks Association (conservation).

During 2000, Australia implemented a new national reporting and assessment framework for ESD in fisheries. At the same time the Department of Environment and Heritage (DEH) developed new guidelines under the EPBC Act requiring export fisheries to demonstrate that they are ecologically sustainable. Both approaches have seen a broadening of the focus and scope of fisheries management from one based on target species to a consideration of wider ecological issues and impacts. This broader

approach is referred to as Ecosystem Based Fisheries Management (EBFM) and will form the basis for fisheries management, research and development in the foreseeable future.

### **Fisheries Research and Development in Victoria**

Fisheries R&D in Victoria is undertaken by a number of agencies including Primary Industries Research Victoria (PIRVic), other government departments, universities, colleges of TAFE, consultants, CSIRO and industry.

Major funding sources include Fisheries Victoria, FRDC, RFL funds, Natural Heritage Trust (NHT), Seafood Services Australia (SSA), CMAs, the Australian Research Council and other departments in both the Australian and Victorian Governments.

PIRVic's Marine and Freshwater Systems, on behalf of Fisheries Victoria, convenes fishery specific assessment groups with participants representing the commercial sector, recreational fishers, conservationists, resource managers and research providers. The groups provide a formal process by which the fishery, stock or habitat is assessed and management implications and research needs are determined.

In Victoria, extensive and ongoing databases for commercial and recreational fisheries are available. Although the basic biology is known for many species there are still major gaps in knowledge of the dynamics of some key species. Research on environmental impacts and fishery-habitat interactions is being undertaken for some species but "routine" monitoring of key habitats has only just commenced.

Currently, most Victorian aquaculture R&D is focussed on the development component but, increasingly, research is being directed at determining and reducing the environmental impacts of aquaculture. Simplifying regulatory and administrative arrangements and mitigating environmental impacts are seen as key challenges for aquaculture development.

Implementation of ESD and EBFM principles in fisheries will form the basis for Victorian R&D during the next decade and this is reflected in this strategy.

Other issues which will impact on fisheries R&D include the establishment of Marine Protected Areas (MPAs) in Victoria, National Oceans Policy and Regional Marine Planning. The commercial sector's interest in Environmental Management Systems, eco-labelling and environmental accreditation, food safety, supply chain development, Occupational Health and Safety (OH&S) and trade and market development will also increase. Climate change, ozone depletion and global warming all have the potential to markedly affect fish stocks and productivity and to change the course of fisheries R&D.

## **FCC Objectives for Fisheries Management 2005-2010**

Complex and challenging issues face Victoria's fisheries and aquatic resources, including increasing pressures from commercial and recreational fishing, and modification and degradation of aquatic habitats. Assessment of the status of fishery resources has inherent uncertainty, with naturally variable populations and often unpredicted dynamics. There is often incomplete knowledge of particular life history stages and environmental interactions. Consequently fisheries science is moving towards explicitly recognising this uncertainty in risk assessments and other sophisticated quantitative assessment models.

In addition, fisheries science and management is under increasing community scrutiny. There are widely held opinions that fisheries management in many parts of the world has been unsuccessful and there is concern for the status of fish stocks worldwide.

In response to these concerns there has been an increased focus on protection of aquatic ecosystems as well as fish stocks. In Victoria and nationally, ESD principles have been adopted as the underlying basis for fisheries management:

*Using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased.*

(National Strategy for Ecologically Sustainable Development, 1992)

Consistent with this approach, EBFM is being adopted within Victoria. EBFM shifts the primary management focus to the ecosystem rather than the target species. The State's export fisheries must be demonstrated to be ecologically sustainable under the Australian Government's EPBC Act.

The activities of other stakeholders also impact upon fisheries and aquatic resources, particularly in freshwater and estuarine systems. Fisheries agencies and industry representative bodies must engage with other relevant authorities. There is increasing interest in multiple-use management strategies that explicitly take into account the cumulative impacts of multiple and often competing interests. Transparent multiple use management strategies and the various assessments needed to support them are likely to become increasingly important. They allow more effective management of these resources in a manner that allows the trade-offs between management objectives to be considered explicitly and quantitatively. This forms the basis of EBFM.

In order for the EBFM approach to be successful cross-border co-operation, collaboration and communication on specific fisheries is essential.

There are other challenges facing managers and industry. It is unlikely that total commercial catches from Victorian waters will increase significantly as most species are fully exploited. Aquaculture production is expected to increase substantially during the next few years, provided that it can meet a number of significant challenges. Further work is needed to decrease the cost of harvest/production and to increase the value of the product in order to improve the economic viability of the fishing and aquaculture industries. There is a continuing need for Victoria to develop the capabilities and capacity to meet these challenges.

Finally, the climate under which R&D is undertaken is changing. The scope of R&D is becoming broader and assessing fishery impacts on the environment is becoming a

core component of fisheries research. Importantly, full cost recovery is being implemented in Victoria. This will mean that stakeholders will demand a greater input into priority setting and processes. Better communication and marketing of R&D outputs, outcomes and initiatives is essential.

## **Victoria's Fisheries & Aquaculture R&D Strategy**

### **R&D Objectives**

Today, managing industry, recreational fisher, environmental and seafood consumer expectations, and developing appropriate political responses, will require carefully planned social, economic and policy research as well as the more traditional biological and technological R&D. In order to meet these challenges, the FCC has adopted the following strategic R&D objectives for 2005 to 2010:

1. Further develop cost effective single species and multiple species management tools.
2. Provide for a shift from a single species/enterprise management focus to EBFM in line with national and international imperatives.
3. Improve the costs of production (efficiency) and value per unit (effectiveness) of wild fisheries and aquaculture through a “whole-of-chain” approach.
4. Provide for industry capacity building and industry development.
5. Enable the resourcing, provision and extension of quality assured R&D activities.

### **Strategy Overview**

The purpose of this strategy is to provide the framework for prioritising the R&D required to address the pressing needs for good management and industry development. The strategy addresses the FCC's strategic objectives as well as the R&D needs identified through existing processes.

This strategy replaces ‘Research Needs and Priorities for Fisheries in Victoria 2001/02 – 2005/06’. Unlike that document a more strategic approach is taken here. The strategy sets broad directions and provides a framework for prioritising research and development. This is seen as more effective than specifying particular projects, that may or may not have future relevance in what is a rapidly changing environment. Whilst some R&D needs are listed under each area these are illustrative or highlight projects previously identified as high priority. R&D needs are dynamic and funding is becoming more difficult to obtain. In this climate R&D projects need strong partnerships and cooperation. Prioritisation of research projects will occur at an annual R&D Workshop which will also provide opportunities for development of partnerships.

This strategy does not cover the basic monitoring requirements essential to fisheries assessment. Such information, including catch and effort data, fishery independent abundance surveys, size and age composition of catches, is collected on an ongoing basis, usually annually. However, the strategy does encompass research required to develop or improve the techniques used for data acquisition and monitoring.

The strategy was developed from a rigorous examination of R&D issues and needs identified in:

- outcomes of the R&D workshop, sponsored by FRDC and convened by the FCC during 2004;
- the *Status of Victoria's Fisheries Resources* reports (in FCC Annual Reports);
- the national reporting and assessment framework for ESD in fisheries (2000);
- fishery management plans and fisheries assessment, stock assessment and habitat assessment workshops and reports;
- FCC's specialist Fisheries Committees;
- FRDC strategies and programs;
- Victoria's natural resource management strategies;
- The Federal Department of Environment and Heritage strategic assessments of major Victorian fisheries;
- the *National Research Strategic Plan for Australian Fisheries and Aquaculture, 2005-2010* prepared by the Research Committee of the Australian Fisheries Managers Forum, and
- responses of stakeholders to earlier drafts of the strategy (see Appendix 1).

### Strategy Objectives

The objectives of this Victorian strategy, guided by ESD principles, are to:

1. provide a logical framework for determining priority R&D needs for managing Victorian marine and freshwater fisheries, the aquaculture industry and protecting fish habitats.
2. increase the awareness of research providers and resource stakeholders of R&D requirements so that R&D proposed and undertaken is focused on outcomes that assist with industry development, management of Victorian fisheries and aquaculture and protection of fish habitats.
3. facilitate decisions on the allocation of funding to support R&D needs from conventional sources and encourage the supply of funding from alternative sources.

The Strategy is organised into programs and sub-programs that cover the key areas of ESD and EBFM. These programs relate to the FCC's strategic R&D objectives (previous page) as follows:

FCC R&D Objective	R&D Program
1	1
2	1,2,4,5
3	2,3,6
4	7
5	8

### **Strategy Audience**

A group of fisheries stakeholders has been identified which is broader than in the past, to encompass the expanded needs in fisheries R&D:

- Commercial fishers and aquaculture operators contribute substantially to R&D costs through the Victorian Government's cost recovery policy and annual contributions to FRDC;
- Recreational fishers contribute annually towards R&D and other services via the RFL;
- R&D providers include PIRVic, other government agencies, universities, museums, colleges of TAFE, consultants and CSIRO.;
- Fisheries and other natural resource managers. These have key role in helping to focus R&D in directions set by State and national policies and on issues of local industry and wider community interest;
- All sectors who benefit from R&D but who do not currently contribute financially;
- The funding investors in fisheries R&D in Victoria. These include the Australian Government, Victorian Government, Fisheries Victoria, FRDC, the Fisheries Revenue Allocation Committee, Natural Heritage Trust, Seafood Services Australia, Catchment Management Authorities, Murray-Darling Basin Commission, Water Authorities, the Australian Research Council (ARC) and Industry itself. Each of these organisations has their own R&D guidelines and strategic directions.

Given the potential for competition, as well as mutual benefits, between all these groups, the need for a shared strategic R&D investment framework is clearly in both industry's and the community's best interests. Investment decisions by any stakeholder that also fit within a comprehensive strategic framework endorsed by Victorian fisheries stakeholders will help to maximise industry and community returns. The process by which these partnerships will work will differ from those that have characterised much of fisheries R&D funded in Victoria in the past.

## **Program 1: Commercial and Recreational Fisheries**

The management of Victoria's commercial and recreational fisheries is supported by soundly based and robust research and scientific information. Traditionally, research has focussed on single species or fisheries. The broadening of the focus and scope of fisheries management from the target species to full consideration of fisheries impacts on non-target species, by-product and by catch species, and aquatic ecosystems is now widely implemented. This emphasis has increased since the original R&D plan.

### **Sub-program 1.A: Sustainability of Target Species**

Previous research has provided a good basis for management of Victoria's commercial and recreational fisheries. There have been considerable improvements to our understanding of the biology and dynamics of many of the key species. There have also been significant advances in predictive quantitative stock assessment models for some species, notably Rock Lobster and Abalone.

#### *Data, Biology and Dynamics*

While there is a substantial body of information on most target species, there are still some key gaps. There is much less biological information about the less valued species. In addition, the shift towards more sophisticated stock assessments at a finer spatial scale has increased data and monitoring requirements.

#### **R&D Needs:**

- Evaluation of cost-effective means to obtain annual recreational catch estimates

- Evaluation of the efficacy of new and emerging technologies for data acquisition and management

- Development of recruitment indices for key freshwater, estuarine and marine species

- Development and evaluation of cost-effective fishery independent surveys

- Evaluation of catch and effort analysis, particularly following changed management arrangements

- Improved understanding of the basic biology of lower value species such as Yellow-Eye Mullet, Garfish, European Carp and Redfin

- Periodic surveying of technological changes and changes in fishing practices for major commercial and recreational fisheries and their influence on fishing effort estimation

- Evaluation of current and alternative methods to assess the stock structure and migratory dynamics of key species, as appropriate

- Understanding of the ways in which exploited stocks (eg Abalone) may respond as they are fished down

- Identification of under-utilised fish resources

- Understanding of behavioural (eg Abalone emergence), reproductive (eg Rock Lobster mating success) and oceanographic influences (eg King George Whiting, Abalone) on recruitment.

Determination of movement rates and patterns of major fish species, within and between bays, estuaries and coastal waters.

Investigation of the potential of restocking to rehabilitate depleted fish stocks (eg Greenlip Abalone and freshwater crayfish).

#### *Fishery/stock assessment*

Significant advances in predictive quantitative stock assessment models have been made for some species. Such approaches have been particularly useful where there are high quality long term data sets. Methods for many species remain limited and there is an urgent need to develop new approaches that may be less data reliant. The development of indicators, reference points and performance measures reflects the confidence level of stock assessment. For Rock Lobster and Abalone these are well defined, providing the basis for management strategies and decision rules as outlined in the relevant management plans. Further work is required for most other species/fisheries.

#### R&D Needs:

Continued refinement of existing stock assessment methods, particularly developing models that include finer spatial resolution.

Enhancement of stochastic models to improve use of tag-recapture data to define dynamics and regional variability of growth

Conduct of sensitivity analyses and full diagnostics for predictive Bayesian approaches

Development of risk-based models for predicting the responses of stocks to alternative management regimes

Development of quantitative stock assessment methods for high value bay and inlet species such as Black Bream, Snapper and King George Whiting

Development of cost-effective models with predictive capacity for lower value species (eg Yellow-Eye Mullet, Garfish and Flounder) and developing fisheries (eg Wrasse and Sea Urchins)

Development and refinement of methods to apply indicators and reference points to key species and test the effectiveness/efficacy of those already in place.

Development of quantitative stock assessment methods for freshwater systems.

Development of quantitative stock assessment methods for the Bass Strait Scallop and Giant Crab fisheries.

Development of methods to incorporate the impacts and management of protected seal and other wildlife populations in fisheries assessments.

#### **Sub-program 1.B: Sustainability of Bycatch and Byproduct Species**

Previous research has focussed on the more valuable harvested species. Consequently there is only limited knowledge of low value byproduct (i.e. retained) species and less on bycatch (i.e. discarded) species.

The need for this information is a key component of ESD and to meet EPBC Act requirements. Only in recent years has much attention been paid to these species. The discarded (bycatch) component of catches of target species is considered in a number of assessments in Victoria however.

Fishery interactions with Protected, Endangered and Threatened (PET) species are also little studied in Victoria.

Management Plans and assessments under the EPBC Act all identify the need to monitor and assess the fishery impacts on bycatch and byproduct species and interactions with PET species.

#### *Biology and dynamics*

In Victoria, there are a large number of low value byproduct and bycatch species for which there is little understanding in terms of their biology and population dynamics. Consequently, assessment of the sustainability of catches and their ecological impacts is limited. Part of the bycatch comprises high value species that are undersized or are caught during closed season or while in unfit condition for sale (eg berried Rock Lobsters).

#### R&D Needs:

- Determination of basic biological parameters for low value byproduct and bycatch species

- Development of rapid techniques for determining productivity, catch susceptibility and other parameters for byproduct and bycatch species

- Determination of spatial and temporal strategies for minimising bycatch of high value species

- Conduct of ecological risk assessments to determine species that might be of concern or at risk and to identify the most critical risk factors.

- Development of market knowledge regarding the saleability of byproducts.

#### *Monitoring and assessment*

The need to monitor and measure fishery performance in relation to byproduct and bycatch and interactions with PET species is now included in management plans for a number of fisheries to meet ESD and EPBC Act requirements. Estimates of bycatch levels are available for some but not all fisheries and less is known about the survival of discarded components of the catch. Even less is known about the non-capture impacts of fishing, such as disturbance of benthic habitats and scattering of spawning aggregations.

#### R&D Needs:

- Robust estimation of bycatch levels and interactions with PET species.

- Development of cost-effective means of monitoring byproduct, bycatch and interactions with PET species.

- Estimation of mortality of discarded components of commercial and recreational catches.

Risk-based assessment of sustainability of bycatch species and ecological impacts of all removals, discards and indirect impacts of fishing

Assessment of the impact of recreational catches of species listed under the *Flora and Fauna Guarantee Act 1988*.

*Improvements to gear technology and fishing practices to minimise discarding*

There have been studies on the impact of some fishing gear and means to minimise bycatch and discard mortality (eg haul seines). However, further work is required for other fishing gear and also recreational gear. There has also been interest in developing gear to minimise direct interaction with PET species.

**R&D Needs:**

Conduct of gear selectivity studies for bay and inlet fisheries

Development of fishing gear that reduces discarded catches

Review of existing strategies for minimising the catch of undersized target species eg, escape gaps

Further development of gear and fishing practices that minimise direct impacts with PET species, eg seals

Evaluation of recreational fishing gear to reduce mortality of released and undersized fish

**Sub-program 1.C: Sustainability of Fish Habitats and the Ecosystem**

Management of fisheries also requires knowledge of key habitats and anthropogenic (including fishing) impacts upon them. The shift in emphasis to fishery impacts on ecosystems has accelerated since the previous R&D plan was released.

*Interactions between fish, habitats and fisheries*

Although a number of significant studies have been completed, there is still a lack of understanding in this area, particularly in marine waters. There are two issues here. First, knowledge of the functional relationships between harvested species (at all life history stages) and the habitats that support them is needed for informed decision making on human modification such as proposed developments. Second, knowledge of the impact of fishing on aquatic environments more generally is needed so that mitigation measures such as changed fishing practices can be implemented.

**R&D Needs:**

Definition and mapping of critical habitats and linkages with commercial and recreational species

Application of GIS-based habitat mapping methods for ongoing monitoring of important habitats

Ongoing development of innovative technologies such as stable isotope analysis, otolith microchemistry and real-time data acquisition of environmental parameters to help identify relationships between fish and their supporting ecosystems

Assessment of ecological impacts of active demersal fishing gears such as scallop fishing

Characterisation of benthic communities in fished and unfished areas

Development of fishing gear and practices that minimise impacts on biodiversity and habitats

Identification of the ecological interactions between reef species affecting maintenance of productive reef systems

Investigation of the effectiveness of artificial reefs in meeting their planned objectives.

Evaluation of freshwater fish habitat improvement works (eg fish passages, riparian restoration)

Alignment of freshwater fisheries R&D needs with priorities and actions of CMA's and regional River Health Strategies

### *Ecosystem Based Fisheries Management*

Fisheries research and management has traditionally been directed at target species or fisheries and did not consider the broader ecological implications of fishing. Even then, managing target species alone has not always been successful. The recent shift in focus toward managing fisheries with a more ecosystem-based approach highlights the need for a better understanding of ecosystem function and the role of harvested species. It requires assessing and monitoring the ecosystem impacts of fishing and inclusion of a wider range of expertise in fisheries assessment. Thus new data sets may be required and new modelling approaches developed to provide management advice. Ecosystem indicators, reference points and performance measures, must also be developed.

#### R&D Needs:

Identification of key ecosystem indicators and development of cost-effective monitoring protocols

Determination of the trophic relationships within key commercial and recreational fisheries.

Development of ecological modelling capabilities and approaches that have predictive capacity

Assessment of the ecological impacts of fishing, particularly as identified in management plans

Development of meaningful and practicable ecosystem indicators, reference points and performance measures for key species and fisheries.

Assessment of the biological interactions between fisheries and PET species.

Determination of the connectivity between freshwater (including catchments), estuaries and coastal systems

Evaluation of the use of new and emerging technologies for cost-effective environmental data acquisition and management.

## **Program 2: Aquaculture and Stocking**

Recently the national research agenda has shifted to studies that focus on economic viability (eg, reduce production costs and increase effectiveness/value), environmental

impacts (eg, monitoring wildlife interactions), regulation (eg, Productivity Commission review, unblocking the regulatory blockages) and social issues. There is a clear need to secure and grow established or high priority industry sectors. Thus the focus is primarily on improving efficiencies, maximising returns and industry productivity through creation of new platform technologies, knowledge and information systems designed to facilitate investment as well as sustainable resource management.

### **Sub-program 2.A: Aquaculture Production Technology**

The focus for Aquaculture should be primarily on improving efficiencies and post-production issues such as food safety, value adding and whole-chain management. When they become available, the new offshore sites should provide considerable potential for industry expansion. The emphasis of Victorian aquaculture R&D must shift from production-driven to being market or demand driven. Perhaps more than in other areas covered by this strategy, priority setting and conduct of aquaculture R&D should be led by industry. This recognises the private sector nature of this industry and the combination of knowledge and incentives needed to focus investment where the prospects of commercial application are greatest.

#### *Development of improved growout systems and husbandry techniques*

There has already been considerable research on technology and husbandry techniques for aquaculture. Much of this has been focussed on new species. In Victoria the requirements for new species are likely to be limited to key resource opportunities e.g. access to the new offshore marine zones and integrated agri-aquaculture.

#### R&D Needs:

- Development of more efficient growout and husbandry methods
- Market driven assessment of potential new high-value species
- Evaluation of new technology for innovative production and husbandry systems for high-value species
- Assessment of existing and new growout and husbandry methods to maximise opportunities provided by the new aquaculture fishery reserves
- Development of systems to enhance agri-aquaculture production

#### *Assurance of broodstock supply and stock improvement methods (including selective breeding)*

In Victoria, a number of projects have recently commenced that are using genetic selection technologies to improve broodstock and stock production. These methods can be used to develop broodstock with specific characteristics such as increased growth rates.

#### R&D Needs:

- Development of programs to ensure maintenance of the genetic diversity of broodstock
- Initiation of cost-effective selective breeding programs for growth, disease resistance and other preferred traits to produce high performance strains

Development of closed life cycles for high-value species

*Development of improved food and feeding practices*

There have been many studies looking at nutrition in aquaculture in Australia. Focus is also directed at developing cost-effective feeds and feeding strategies, investigating methods to reduce the dependence on fish protein in feeds, and, more recently, using under-utilised fish product.

R&D Needs:

Development of more efficient and economical foods and feeding strategies

Replacement of fish oil in aquaculture feeds

**Sub-program 2.B: Aquaculture and the Environment**

A major constraint to development of the aquaculture industry in Victoria is a lack of suitable sites and environmental restrictions. A recent Bureau of Rural Sciences report has highlighted many issues relating to public perceptions that the aquaculture industry and government will need to attend to.

In Victoria, the opening up of almost 1700 hectares of new waters for marine aquaculture has the potential to significantly increase marine aquaculture production but the proposed Port Philip Bay dredging operation and other water quality impacts may have an effect on this. A key aim of R&D should be to assess the actual environmental impacts and the risks associated with aquaculture operations. Research should also aim to assist the preparation of best practice environmental management frameworks that ensure public confidence and environmental sustainability and link with CMA water quality and/or RHS.

R&D Needs:

Further development of ESD principles for aquaculture at the enterprise and regional level

Development of cost-effective baseline studies and environmental monitoring protocols

Development of environmental indicators, reference points and performance measures for aquaculture operations

Development of guidelines and protocols for assessing marine aquaculture sites outside proclaimed zones

Documentation of wildlife interactions and development of strategies to minimise them

Determination of methods to minimise nutrient discharges

Assessment of the carrying capacity of aquatic systems in relation to the impact of aquaculture activities

Evaluation of nitrogen offsets as a means to assist industry meet environmental requirements

### **Sub-program 2.C: Translocation and Stocking**

Victoria has a long history of stocking freshwater species not only for recreational fishing opportunities but also for increasing populations of threatened or endangered species. No large scale stocking of estuarine or marine waters has been undertaken although interest has been expressed in the potential to enhance depleted stocks.

Deliberate translocations of species can present both costs and benefits to aquaculture operations. The Victorian Government has developed 'Guidelines for Assessing Translocation of Live Aquatic Organisms in Victoria' to meet its obligations under the 'National Policy for the Translocation of Live Aquatic Organisms 1999'. These guidelines form the basis for protocols for assessing proposals to stock public and private waters. Further protocols are being developed to address translocation risks in other sectors such as aquaculture and private waters.

Research in this area is limited. Only a few studies have evaluated the efficacy of stocking and there is little research that addresses the risks associated with translocation.

#### **R&D Needs:**

- Evaluation of the effectiveness of stocking (in terms of survival and cost)
- Development of methods for cost-effective discrimination between fish from hatchery, translocated and wild population origins
- Evaluation of the efficacy of the stock enhancement of marine (eg Greenlip Abalone) and estuarine (eg Black Bream) species
- Assessment of the ecosystem impacts of stock enhancement, including genetics and biodiversity
- Development and promotion of best hatchery practice to ensure genetic integrity and heterogeneity of stocking-enhanced fish populations
- Assessment of risks associated with translocation.
- Assessment of risks associated with the escape of aquaculture species into the environment.

### **Program 3: Economic and Social Assessments of Fisheries and Aquaculture**

Economic and social assessments are clearly important to inform governments regarding policy decisions on resource management and to provide industry with information vital to investment decisions. They are both key components of ESD. However, it has proved difficult to "value" different sectors. All sectors have a range of social values that can be attributed to them, such as: cultural, generational and various flow-on effects, particularly in rural and regional areas for the commercial sector; wellbeing and enjoyment of fishing for the recreational sector and customary and totemic values, as well as subsistence for the indigenous sector.

Data on the economic performance of specific fisheries or aquaculture also assist business decisions.

Allocation is a complex issue which requires a greater understanding of the resource, environment, social and economic status of fisheries. Useful and meaningful research in such issues is urgently required to provide an objective basis for decision-making.

### **Sub-program 3.A: Economic Assessment of Fisheries and Aquaculture**

For aquaculture there has been a tendency to consider and assess new species in terms of their biological attributes with little focus on whether the culture of the particular species could be economically viable.

#### *Economic performance of fishery and aquaculture sectors*

Assessment of economic performance is important to ensure that community-owned resources are efficiently utilised and that information is available to facilitate resource and business management decisions.

A number of economic surveys and economic impact assessments have been undertaken on some commercial sectors but generally these have not been undertaken within a systematic framework and results have often been controversial or not widely accepted. Previously, economic assessment of recreational fisheries has focussed on expenditure. There have been no studies on the economic performance of aquaculture.

#### **R&D Needs:**

- Periodic assessment of the economic performance of major fishery and aquaculture sectors

- Economic evaluation of prospective aquaculture species and integrated aquaculture systems

- Development of methods that enable meaningful economic comparison between all sectors

- Evaluation of methods that incorporate the environmental costs into economic assessments

#### *Cost-recovery*

Cost-recovery has only recently been introduced into Victoria and there have been no studies that assess the impact of this upon fishery and aquaculture management or assessment processes.

#### **R&D Needs:**

- Assessment of the impact of cost-recovery on fishery management and assessment processes.

- Assessment of the impact of cost-recovery on the cost of administration and compliance with regulations.

- Assessment of the impact of cost-recovery on setting R&D priorities

- Evaluation of current fishery monitoring to ensure that it is statistically robust and cost-effective

### **Sub-program 3.B: Social Assessments of Fisheries and Aquaculture**

Social assessments are a key component of ESD but there have been few studies that focus on the social attributes of fisheries and aquaculture. Social values may be difficult to measure but they are important considerations in resource management.

Public perception of fisheries is poor and there is also increasing concern regarding animal welfare issues.

#### **R&D Needs:**

Refinement of methods of social assessment that have greater relevance to fisheries and aquaculture

Assessment of the social benefits of fisheries and aquaculture and the social costs of management decisions

Investigation of public perceptions of fisheries and aquaculture, and their origins, and development of methods to influence and improve perceptions

Investigations into humane handling and harvesting of aquatic species and development of acceptable Codes of Practice.

## **Program 4: Environmental and Human Effects**

Fisheries and aquatic resources are under threat from a range of human activities including pollution, residential and industrial development, catchment activities, introduction of pest species and climate change. Among their other potential impacts, exotic pests, discarded food and bait, translocation of aquatic species and aquaculture activities all increase the risk of disease outbreaks.

There have been many studies in Victoria of human impacts on aquatic resources, in areas such as water quality, nutrient recycling and environmental flows. Generally, however, long-term data sets are required to enable anthropogenic impacts to be distinguished from natural environmental variability.

This information is crucial for informed policy decisions even though fishery agencies generally do not have responsibility for management of the factors described.

### **Sub-program 4.A: Exotic Pests**

Several studies have been undertaken on exotic pests in Victoria including the distribution of pests, their biology and methods to minimise incursions. Recent major studies include monitoring the distribution of the Northern Pacific Seastars in Port Phillip Bay and the population biology of European Carp. There have also been exotic species surveys in most major ports.

#### **R&D Needs:**

Continued monitoring of the distribution of significant incursions

Development of strategies to reduce the risk of new incursions

Design and development of cost-effective early warning monitoring systems

Assessment of the ecological interactions between exotic species and fishery resources

Studies on the biology of pest species to assist with control or eradication methods

Assessment of strategies for eradication or long term control of pest species

Assessment of the risks associated with the translocation of pest species by fisheries and aquaculture operations.

#### **Sub-program 4.B: Pollution**

Pollution remains a significant issue for commercial and recreational fisheries and aquaculture. Catchment practices and agriculture, and urban development along the coastal fringe all have the potential to increase the levels of nutrients and toxicants in aquatic systems. Polluters should be made responsible for their actions and contribute in a fair and equitable manner to the cost of this R&D and remediation. Government has a role to contribute in this area from a public good perspective as the responsibility should not be the entire burden of commercial and recreational fishers.

R&D Needs:

Monitoring water quality parameters in key Victorian waters.

Development of methods to identify diffuse sources of pollution

Assessment of nutrient levels, flows and re-cycling in key waters

Development of predictive modelling approaches to assess nutrient flows and impacts on fisheries and aquatic resources

Identification of high risk species in terms of toxicants such as heavy metals

Development of methods to reduce the impact of increased levels of nutrients and toxicants.

#### **Sub-program 4.C: Fish Health and Disease**

Aquaculture, the discharge of ballast water and discarded food and bait increase the risk of disease incursions. The development of disease prevention protocols, rapid diagnostic techniques, risk assessments and emergency response contingencies are all required.

Victoria has fish health expertise as well as high-level capabilities in animal health in agriculture that can assist in this area. However, research is often extremely expensive and a coordinated, national approach, such as through the FRDC Sub-program, provides a cost-effective means of developing the appropriate diagnostic tests and treatments.

A national contingency plan has been established for disease outbreaks and the management of disease emergencies (AQUAPLAN 2005-2010). FRDC also operate the Aquatic Animal Health Subprogram which has it's own R&D Plan 2002-2008 (to be updated July 2005).

R&D Needs:

Development of cost-effective surveillance and reporting protocols

Risk assessment to identify priority areas for development of diagnostic tests

Development of rapid diagnostic capacity and technology, and staff training programs

Disease risk assessments and emergency response planning

Determination of causes of “fish kills” in aquatic systems and advice to ameliorate causative factors

Development of training resources relevant to AQUAPLAN 2005-2010.

#### **Sub-program 4.D: Impacts of Habitat Modification**

There are many human activities that impact directly on fish habitats and aquatic resources. These are most evident in freshwater, estuarine and near shore coastal systems. The integrity of aquatic resources is under threat from, for example, land management in catchments that alter flow regimes and increase sedimentation, and foreshore and coastal developments that may modify/destroy fish habitats.

There has been considerable research on environmental flows and barriers in freshwater systems but understanding the links between freshwater, estuarine and marine systems has not been adequately addressed.

##### **R&D Needs:**

Assessment of the critical linkages between freshwater, estuarine and marine systems for sustainable fishery resources and the impacts of changes to flow regimes

Investigation of the impacts of modifications such as re-snagging and restoration of riparian and instream habitats

Determination of the impact of dams and barriers on river flow, thermal pollution and water quality, and on aquatic resources

Development of science-based guidelines for water management to maintain fishery resources

Assessment of the effectiveness of restoration and rehabilitation of fish habitats, particularly in freshwater systems

Assessment of the responses of fish populations to human-induced disturbances, eg oil spills, dredging and urban development.

Investigation of the relationship between sedimentation, turbidity and seagrass dieback

Investigation of the influence of man-made structures in the marine environment on fish behaviour and productivity

Investigation of the influence of seismic surveys on fish behaviour and distribution

#### **Sub-program 4.E: Impacts of Climate Variation**

Many species demonstrate considerable variation in recruitment and availability that appears to be independent of fishing. Research has shown that year-class strength is often correlated with certain environmental conditions but reasons for these relationships, in most cases, have yet to be determined. For fisheries assessments it is

important to be able to distinguish between natural variation in fish stocks and changes caused by harvest.

Major events such as drought and bushfires, and the way we manage them, also significantly impact on fishery resources

In addition to natural variability, “greenhouse-induced” changes to climate have the potential to significantly affect fisheries and aquatic resources.

R&D Needs:

- Development of cost-effective monitoring protocols for collecting long-term environmental and biological data sets for key species

- Determination of the relationships between environmental factors and reproductive success, recruitment and availability of key species and assessment of the mechanisms that drive them

- Evaluation of the use of new technologies for data acquisition and management

- Development of methods to enable “natural” versus anthropogenic changes to be distinguished

- Development of modelling approaches that explicitly account for natural variability in fish stocks

- Development of drought management strategies for fishery resources,

- Assessment of the responses of fish stocks following major bushfires

- Risk assessment on the impact of climate change on Victoria’s aquatic resources to identify high-risk species/areas and future research requirements

## **Program 5: Aquatic Planning and Management**

Aquatic planning and management takes a broad approach that seeks to coordinate policy development and natural resource management. This is a substantial element of EBFM. Examples include catchment management strategies, integrated coastal zone management and Regional Marine Planning.

Research to support aquatic planning and management is of necessity multi-disciplinary.

### **Sub-program 5.A: Multiple Use Management Strategies**

Natural resources occur within complex biophysical and socio-economic systems and multiple users/sectors interact strongly and impact cumulatively on these systems. Fisheries are but one user of these resources. Transparent multiple use management strategies and the various assessments needed to support them are likely to become increasingly important as a means of more effectively managing these resources in a manner that allows the trade-offs between management objectives to be considered explicitly and quantitatively.

The focus should be on identifying appropriate management units in marine systems, assessment of spatially based management strategies, cost-effective monitoring protocols and development of quantitative decision support tools.

*Understanding the spatial dimensions of aquatic systems*

Generally, management units for multiple-use are well defined for freshwater systems (i.e. catchments). These units, however, are less clear for marine systems. Most regional management units have been based largely on physico-chemical rather than biological data.

R&D Needs:

Inclusion of more biological data, particularly habitat, community and process information, in refining multiple-use management units in marine systems

Assessment of the reliability of surrogates for habitats and biodiversity

Development of rapid-assessment and cost-effective methods to measure changes in species, habitats and biodiversity

Investigation of the movement of individuals of key species (at important life history stages), particularly between areas with different management strategies

Assessment of the efficacy of new technology for its application to Victoria's marine ecosystems and management questions.

Development of rapid and cost-effective methods to identify the source of breeding adults and the spawning locations that contributes to recruitment in particular areas

Investigation of the biologically relevant scales for freshwater fisheries management measures (eg catch, season and size limits)

*Spatially-based management strategies*

The governance arrangements for fisheries management are based on the use of spatial structures and management measures, such as jurisdictional boundaries, management plans and zoning of fishing type and intensity. These spatially-based arrangements are manifest at various scales and so there is a growing interest in assessing the relative roles of different spatial components in achieving desired outcomes for marine systems as a whole. This includes the use of MPAs in the management of fisheries and the ecosystem more generally.

Key uncertainties remain about the use of spatial management approaches and these are a significant constraint on decision-making to achieve ESD objectives.

There has also been growing interest in assessing and in some case managing fisheries at much finer spatial scales than was traditionally the case. Management of the Eel fishery has gone some way towards placing a high level of responsibility for managing fishing in specific waters in the hands of individual operators. There may be potential for moving management of other fisheries in a similar direction, for example, reef-by-reef management in the Abalone fishery

R&D Needs:

Development of indicators and performance measures for spatial management of marine systems

Development of methods to allow use of spatial zoning (including MPAs) as reference areas to measure impacts and benefits of spatial management

Use of MPAs as reference areas to assess fishery impacts and sustainability

Spatial interpretations of target and limit reference points for fisheries management

Assessment of the risks, benefits and pre-requisites for industry self-management at various spatial scales

Evaluation of spatial management strategies for control of by catch, PET interactions and habitat protection

Evaluation of the cost-benefit of assessing and managing fisheries at finer spatial scales

Assessment of the influence of catchment practices on the health of freshwater, estuarine, and marine ecosystems and dependent fisheries

#### *Management Planning Models*

Management planning models are required to enable risk assessments and management strategies to be evaluated. Fisheries models, although explicitly taking into account risk and uncertainty, have traditionally been single species models. Fisheries ecosystem models are being developed but, at present, these have a strategic rather than predictive focus. In Australia, there have been recent advances in the development of quantitative decision support tools for multiple use management in aquatic systems.

#### R&D Needs:

Development of spatial models of aquatic populations, ecological processes and fishery impacts, including the observation program required to meet ongoing information needs

Collection of long-term data sets that provide the ability to undertake predictive modelling

Conceptual framework and modelling methods for spatially nesting physical and ecological processes, and linkages to the human socio-economic system

Risk assessment and management scenario prediction

Inclusion of fisheries and aquatic resources explicitly in catchment models

Bio-physical modelling to determine larval dispersal of key species

Development of methods to model and assess performance in data poor systems

Development of models to assess management strategies for cross-jurisdictional species and straddling stocks

#### **Sub-program 5.B: Resource Sharing**

A better understanding of what the community as a whole and various users require or want from the resource is required in order to better manage these competing requirements. Similarly, the impact of different users on aquatic resources also needs to be determined. This information is crucial so that resource managers can make informed and defensible decisions about resource sharing and allocation. The Victorian Government has recently endorsed the FCC's policy options advice for sharing wild fish resources between competing interest groups.

The values of fisheries resources (both recreational and commercial) have been the subject of a number of studies but definitive comparative studies have not been undertaken. Little or no work has been done that focuses on indigenous and passive users of aquatic resources.

#### R&D needs

Development of methods to determine comparative values of different uses (social, economic, cultural, ecological, passive uses)

Investigation of new economic policy instruments for resource allocation decisions

Development of methods for modelling the impacts of shifts in access and allocation arrangements

## **Program 6: Industry Development**

It is unlikely that total commercial catches from Victorian waters will increase significantly as most species are fully exploited. There are some opportunities for a number of low value species eg Sea Urchins, Barracouta and Australian Salmon. Aquaculture, if it is to meet the extra demand, must substantially increase production. Victoria is a nett importer of seafood for consumption and bait. The infrastructure of the post harvest sector is not well organised or developed. Little is known about the post harvest sector, as an example there are no figures available about the numbers of people employed, etc.

Better use of low value species by potentially value-adding, improved marketing and promotion of fishery and aquaculture products to obtain higher margins is necessary. In Victoria, R&D has been limited with whole-of-supply chain industry development projects only recently being considered. The Victorian Food Industry Council does not recognise seafood in any way – refer [www.food.vic.gov.au](http://www.food.vic.gov.au).

The FCC has taken a lead role in assisting industry through the draft ‘Victorian Seafood Industry Strategy’ and this will be an important focus for future R&D.

### **Sub-program 6.A: Value adding and product development**

With scope for increased wild fisheries production limited to only a few species it is important that the value from existing fisheries and aquaculture is maximised. For those species for which there is some potential for increased production a through-chain approach is necessary. There are also opportunities for increased value through the establishment of niche markets and utilisation of fish wastes and by catch species.

#### R&D needs

Conduct of industry development projects with a through-chain focus

Investigation of methods to add-value to existing and developmental fisheries

Development of new products to maximise returns from fisheries and aquaculture production

Improvement of fish quality by enhanced handling and management throughout the chain

Development of research on consumer attitudes towards new products.

### **Sub-program 6.B: Market development**

Market R&D is important to industry development. Little attention has been focussed on marketing in Victoria; however, a FRDC funded project is under way on the 'Consumption and Retail Study of Seafood in Melbourne'. Seafood, as a healthy food choice, should be included in the Victorian Food Industry Council's plans to ensure that it obtains a fair and equitable share of resources allocated in that area. Additional partnerships should be forged with the Victorian Tourism and Hospitality Industry and government sectors to maximise opportunities for marketing seafood.

R&D needs:

- Conduct of generic market research regarding consumer demands for Victorian seafood both locally and overseas.

- Development of marketing and promotion strategies to maximise the value of fisheries and aquaculture products

- Development of methods for more innovative marketing to creating niche products

- Investigation of methods to promote cultural changes to take market from being price driven to quality driven.

- Conduct of education programs for the post harvest sector on marketing/promoting seasonal aspects of Victoria's fisheries and highlighting the specific benefits for consumers.

- Investigation with Victoria Government, FRDC, SSA, VFFMA, Restaurant & Catering and other associations representing post-harvest interests as to how this sector can invest in R&D most effectively.

- Conduct of a study to establish the size, extent and capabilities of the post harvest sector and its economic and social contribution to the Victorian seafood industry.

## **Program 7: Improved Governance Arrangements**

This program covers a number of activities that are extremely important for fisheries management. Unproductive competition, illegal activities, poor practices, inadequate representation and lack of involvement in co-management processes all have negative impacts on community perceptions and sustainability of resources. OH&S and food safety provide protection for industry and consumers alike.

### **Sub-program 7.A: Compliance Research**

Given the importance of management rules to the sustainability of resources and the importance of compliance activities in ensuring these rules are followed, it is surprising that it is only recently that research has been directed to formally assessing the effectiveness of compliance and the education activities that support it.

R&D Needs:

- Further development of collaborative relationships with other law enforcement agencies and technical specialists

Development of methods to present, analyse and compare compliance data that do not compromise compliance goals

Development of cost-effective methods for compliance data collection and analyses

Development of performance measures for, and assessment of, compliance strategies

Evaluation of enforcement, surveillance and education strategies to improve compliance outcomes

Determination of the extent and impact of organised crime on Victorian fisheries

Development of strategies to more effectively incorporate information and experience from criminal law and tax compliance in fishery compliance issues

### **Sub-program 7.B: Industry Standards**

The Australian Seafood Standard (ASS) is a voluntary standard which deals with food safety and quality. It has been developed by industry with government and other interested sectors through the resources of SSA. The standard is currently being trial audited by a number of seafood businesses throughout Australia. The ASS is JASANZ approved and one of its aims is to eliminate the number of required audits and relevant costs .

In recent years there has been increasing interest by the fishing industry in Environmental Management Systems (EMS) that demonstrate to the community the industry's responsible fishing activities, compliance with regulations, participation in management and sustainable harvesting practices. Standards range from codes of practice to third party-audit certification and eco-labelling.

SSA are involved in piloting a number of EMS programs and one of the outcomes will be to obtain a cost and benefit analysis of an EMS so that this can be used as a promotional tool for other fisheries. One of these pilot programs has been implemented in Victoria – the Victorian Bay & Inlet Fisheries Association has already won a Victorian Coastal Council award for their EMS.

Standards Australia are currently considering an application to establish an Australian Standard for Fish Names based on the AFNL and the processes involved. This is expected to provide a solid foundation for seafood marketing in Australia.

#### **R&D Needs:**

Continued development of the skill base necessary to support Industry Standards.

Development of programs that involve and educate the community on Industry Standards and general information on industry

Evaluation of the effectiveness of these approaches in meeting stated objectives

### **Sub-program 7.C: Leadership and Education**

Leadership among users of aquatic resources is crucial to ensure their effective engagement in management processes and to ensure the future stewardship of fish resources. A number of leadership and training courses are available in Victoria and

Australia – these need to be supported by participation from all sectors. Participatory management does require significant commitment by peak bodies, their attendant committees, individual operators and others involved in resource management.

Communication issues are major impediments for all sectors. As an example, in industry the retail sector is often effectively excluded from communications of latest developments in fishing and aquaculture which means they cannot pass those issues onto consumers. In recreational fishing, communication regarding management decisions is difficult due to the dispersed nature of the sector.

**R&D Needs:**

Development of mechanisms that demonstrate the value of industry representation within industry sectors

Improved implementation of succession planning for industry representation

Evaluation and if necessary improvement to industry training programs ensuring that they are aligned to National Training Packages.

Development of more effective methods of communicating within and between sectors

Development of capacity building in all sectors of fisheries to ensure future stewardship of fish resources.

**Sub-program 7.D: Occupational Health & Safety and Food Safety**

Fishing is one of the more dangerous occupations and effective training programs are required to minimise risks to participants, reduce WorkCover payments and provide professional employment opportunities. Product handling and food safety are also important requirements across the fishery supply chain. Skills development in these areas is continuously needed.

The Australian Seafood Industry Council (ASIC) and FRDC currently support an Occupational Health & Safety (OH&S) initiative which is assisting primary producers to understand the issues involved and to undertake specific training. Victoria has the opportunity to join this program through SIV.

The Primary Product and Processing Standard for Seafood (PP&PSS) has been developed through the Australian Government's Food Standards Australia and New Zealand (FSANZ) processes. This, in effect, fills the gap on Food Safety ensuring that there is now a whole-of-chain process. Along with the Food Standards Code, this creates the minimum entry level for business operators.

**R&D Needs:**

Development of Codes of Practice for all sectors of fisheries that take into account core competency requirements for priority training

Continued development of industry-based training programs that especially take into account OH&S and Food Safety.

Development of quality assurance programs

Development of a generic post-harvest plan for OH&S and checklist for all operators

Research into documented OH&S and Food Safety incidents in order to monitor how the current systems handle the issues and identify new or refined management and training requirements.

## **Program 8: R&D Management**

Considerable resources are committed to fisheries research and assessment on an ongoing basis. This requires effective R&D management to ensure research outputs and outcomes are maximised. The shift in focus from single-species to ESD and EBFM is increasing the needs of fisheries R&D. These needs increase the pressure on research budgets and human capital. Different skills will be required to meet many of our future R&D strategies. The R&D underpinning EBFM will also require a multi-disciplinary approach. Collaboration and coordination are becoming increasingly important. Full cost recovery will mean that stakeholders will demand a greater input into priority setting and processes. Effective and cost-efficient R&D underpinning EBFM dictates the need for communication, collaboration and cooperation across regional and state borders. Better communication and marketing of R&D outputs and outcomes will be crucial.

### **Sub-program 8.A: Coordination and Collaboration**

Coordination of fisheries R&D has occurred through the Australian Fisheries Managers Forum, FRDC, professional associations and various formal and informal research groups such as are in place for Rock Lobsters and Abalone. In Victoria, the Victorian Marine Science Consortium (comprising tertiary institutions with marine science interests) provides a degree of coordination of marine research. However, further work is required to develop processes for better coordination and partnerships between funding bodies to maximise cost-effectiveness of R&D and minimise duplication. This is particularly important as fisheries research will need to become more multi-disciplinary. Additional partners will be required as EBFM is implemented and fisheries management is integrated into wider natural resource management initiatives. The FCC has highlighted this as a priority in order to maximise the return on R&D investment for Victoria.

In addition, mechanisms need to be developed to ensure industry-based monitoring, information and R&D feeds into the overall process.

#### **R&D Needs:**

Improved coordination between government agencies, universities, other research providers, and industry and other stakeholders – both within Victoria and, where appropriate, with inter-state counterparts

Development of processes to ensure better linking between funding agencies

Development of a gap analysis identifying needed skill areas to meet expanding R&D needs.

Development of registers or data-bases showing potential R&D service providers, prospective funding/investment sources and key stakeholder bodies to meet expanding R&D needs.

Development of R&D Management Systems linking potential R&D service providers, prospective funding/investment sources and key stakeholder bodies to ensure research outputs and outcomes are maximised.

**Sub-program 8.B: R&D Extension and Technology Transfer**

Considerable fisheries R&D is undertaken in Victoria and to ensure the maximum value from this work it is crucial that outputs and outcomes are jointly determined by and effectively presented to key stakeholders and decision makers. Indeed, one of the key areas of concern expressed by many stakeholders is that the results of R&D are not adequately communicated.

R&D Needs:

Develop a marketing and technology transfer program for fisheries R&D that ensures that outputs and outcomes are taken up by stakeholders

Establishment of a Victorian data-base of completed and current R&D projects

**Sub-program 8.C: Peer Review of R&D**

Peer review is the essential quality control for researchers and managers yet it is difficult to publish important aspects of fisheries R&D such as annual assessments in scientific journals. Consequently other peer review processes are required.

R&D Needs:

Development a peer review process for ongoing assessments and “routine” R&D activities.

Investigate other methods of quality control (eg best practice guidelines, auditing, etc) for ongoing assessments, monitoring and routine R&D.

**Sub-program 8.D: Cost-effective Fishery Data Collection**

The shift in focus from single-species to ESD and EBFM is increasing the needs of fisheries R&D. Thus cost-effective, reliable and statistically rigorous data collection is required to satisfy these new requirements. In addition, the move to cost recovery and greater industry participation in research will also see greater scrutiny of data collection methods. Industry based data collection methods should also be encouraged.

R&D Needs:

Evaluation of the cost effectiveness of current data collection methods

Ongoing assessments of statistical rigour of fisheries data collection and monitoring

Development of methods to obtain comparative data in areas closed to fishing

Evaluation of new technologies to assist ongoing data collection

Development of standards, code of practice and auditing for industry based monitoring and R&D

Development of cost effective fishery-independent data collection methods

Development of training programs to facilitate industry based and fishery independent monitoring and R&D.

## Conclusions

This document sets broad strategic directions for a period of five years and provides a framework on which R&D priorities can be determined on a more frequent basis. This is seen as more effective than trying to set down, in 2005, the specific priority projects for the next five years in what continues to be a dynamic and competitive environment. Like ESD, EBFM is a process, not an endpoint, hence, it is quite likely that the strategy itself will require refinement during the next five years. The mechanism for this process will be the annual R&D Workshop facilitated by FCC in collaboration with FRDC, Fisheries Victoria and other stakeholders.

The FCC sees partnerships as the key to the successful implementation of the R&D Strategy. This means the establishment of close collaboration between government, industry, managers, researchers, key stakeholders and investors to identify the issues, R&D objectives, desired outcomes and strategies. It also means collaboration with program leaders intra-state, inter-state and nationally addressing similar issues. Such programs are becoming increasingly prominent in areas such as industry services, habitat management, market development and communication as well as fisheries science.

One continuing challenge for this broadening of fisheries R&D is the need to expand the funding base. Traditionally the harvesting and aquaculture sectors have borne the major direct cost of contributing to R&D funding. As Victoria's Seafood Industry Strategy shows, much of the need continues to be in post-harvest areas on issues such as market development, industry training, communication and seafood quality. Additionally issues relevant to habitat and environment need addressing by all sectors involved in natural resource management. Water quality and pollution management already incorporate the principles of 'polluter pays' and 'public good'. Finding ways of bringing these sectors together with conventional fisheries R&D funding is important if the full spectrum of strategic needs identified in this document is to be met.

The process by which these partnerships will work will differ from those that have characterised much of fisheries R&D funded in Victoria in the past. For a start, the commercial and recreational fishers who now invest substantial sums in research funds are having a strong and direct influence on R&D priorities. The FCC strongly encourages them to use every opportunity to further influence the agenda through participation in and with, Fishery Victoria's stock and habitat assessment workshops, recognised Peak Bodies and the FCC Fishery Committees. This process can be strengthened further if each sectoral group determines its own R&D priorities based on the key opportunities and challenges it sees in the immediate future. Successful priority setting and project development will also depend on partners working over timeframes of at least 18 months ahead of funding application deadlines. The industry or management agencies expected to implement R&D outcomes must be involved from the start of this process – the days of researchers developing proposals more or less in isolation and then seeking letters of endorsement from stakeholders at the last minute, are over.

## Appendix 1

### Stakeholder Groups Consulted during the formulation of this Strategy

Arthur Rylah Institute	Murray-Darling Freshwater Research Centre
Australian Agribusiness Group	North Central Catchment Management Authority
Australian Conservation Foundation	North East Catchment Management Authority
Central Coastal Board	Parks Victoria
Corangamite Catchment Management Authority	Port Campbell Professional Fisherman's Association
CSIRO	Port Phillip and Westernport Catchment Management Authority
Department of Agriculture Fisheries and Forestry*	Primary Industries Research Victoria*
Department of Primary Industries Victoria*	PrimeSafe
Department of Sustainability and Environment Victoria*	Restaurant and Catering Victoria
East Gippsland Catchment Management Authority	Ruello & Associates Pty Ltd
Eastern Zone Abalone Industry Association Inc	Seafood Industry Victoria
Environment Protection Authority Victoria	Seafood Processors
Environment Victoria	Seafood Services Australia
Fishery Committees of the Fisheries Co-Management Council Victoria	SeaNet
Fisheries Research and Development Corporation*	Tasmanian Aquaculture & Fisheries Institute
Fishwell Consulting	TQA Research Pty Ltd
Food Science Australia*	Victorian Abalone Divers Association
Gippsland Aquaculture Industry Network	Victorian Aquaculture Council
Gippsland Coastal Board	Victorian Aquaculture Council*
Glenelg-Hopkins Catchment Management Authority	Victorian Catchment Management Council
Goulburn Broken Catchment Management Authority*	Victorian Coastal Council*
Gould League	Victorian National Parks Association
GHD Pty Ltd	Victorian Rock Lobster Association*
Infofish Services	Victorian Universities*
Koori Business Network	VRFish*
Mallee Catchment Management Authority	West Gippsland Catchment Management Authority*
Marine Stewardship Council	Western Abalone Divers Association*
Melbourne Museum	Western Coastal Board
	Wimmera Catchment Management Authority
	Workplace Learning Initiatives

\* Denotes groups that made submissions to the draft Fisheries & Aquaculture R&D Strategy

## Appendix 2

### Glossary, Acronyms & Abbreviations

#### GLOSSARY

Agri-aquaculture	Combination and integration of agriculture and aquaculture e.g. using irrigation drainage water for grow-out and waste water being used on agri-forestry plots.
anthropogenic	Human induced
benthic communities	Organisms which live on the bottom of oceans, seas, bays and freshwaters
biodiversity	Biological species and genetic diversity
byproduct	Caught, retained, low value species
bycatch	Caught and discarded species
cross-jurisdictional species	Species which are fished in two or more adjacent jurisdictions
ecological processes	The natural processes that occur within an ecosystem (as diverse as: breeding, species interactions or, nutrient fluxes)
ecosystem	Community of organisms, interacting with one another, plus the environment in which they live and with which they interact.
environmental impact mitigation	Actions which are taken to reduce the likely or known impact of a development or human activity
grow-out	Stocking fingerlings and growing until ready for harvest
heterogeneity	Composed of different parts
husbandry	Farming, careful management
isotope	One of two or more atoms having the same atomic number but different mass numbers
isotope analysis	Laboratory testing of stable isotopes of, say carbon, nitrogen, sulphur and hydrogen, which occur naturally in animal tissues, and are available for use as intrinsic markers in tracking nutrient origin and migration
otolith microchemistry	Testing the chemical make-up of fish earbones (otoliths). Some waters have distinctive chemical make-ups which allow identification of the spawning location of fish as otoliths incorporate these chemical into their layers.
predictive Bayesian approaches	Statistical analysis which uses probability models to quantify uncertainty in statistical conclusions. Can be used to build information for policy and science because they force the users to think about the nature of the data and the questions.
riparian	Pertaining to, or situated or dwelling on the bank of a river or other body of water, usually refers to

	bankside or riparian, vegetation
Socio-economic	Analysis which considers both social and economic factors to classify communities or impacts from policy decisions
spatial interpretations	Interpretation of catch or other results on a small scale basis rather than regional or State scales (scale determined by the fishery characteristics)
spatial management	Management of fisheries on a small scale relevant to the fishery, e.g. reef scale for abalone
spatially nesting	Statistical analysis which takes accounts of spatial variation
spatial scales	The area which is relevant to a species biology or their response to impacts from pollution or harvesting
spatial zoning	Zoning using scales relevant to the fishery characteristics
stochastic models	A statistical technique for estimating the occurrence of an event using probabilities based on past occurrence
straddling stocks	A fish stock which is across one or more jurisdictions; a shared stock
surrogates	Substitute
totemic values	Values that relate to an object assumed to be an emblem of a family or related group
whole-of-chain	From harvest to consumer often referred in the seafood industry as 'water to waiter'

**ACRONYMS & ABBREVIATIONS**

AAHL	Australian Animal Health Laboratory
AFMA	Australian Fisheries Management Authority, Australian Government
AFMF	Australian Fisheries Managers Forum
AFNL	Australian Fish Names List
ARC	Australian Research Council
ASIC	Australian Seafood Industry Council
ASS	Australian Seafood Standard
CMA	Catchment Management Authority
CSIRO	Commonwealth Scientific & Industrial Research Organisation
DEH	Department of Environment and Heritage, Australian Government
DPI	Department of Primary Industries, Victorian Government
EPBC	Environment Protection & Biodiversity Conservation
ESD	Ecologically Sustainable Development
EBFM	Ecosystem Based Fisheries Management
EMS	Environmental Management Systems
FCC	Fisheries Co-Management Council Victoria
FRAC	Fisheries Revenue Allocation Committee, Victoria
FRDC	Fisheries Research & Development Corporation
FRAB	Fisheries Research Advisory Body
JASANZ	Joint Accreditation System for Australia & New Zealand
GIS	Geographic Information System
MDBC	Murray-Darling Basin Commission
MPA	Marine Protected Areas
NHT	Natural Heritage Trust
NRM	Natural Resource Management
OH&S	Occupational Health & Safety
PET	Protected, Endangered & Threatened
PIRVic	Primary Industries Research Victoria
RC	Research Committee of Fisheries Co-Management Council Victoria
R&D	Research & Development
RFL	Recreational Fishing Licence
RHS	River Health Strategies
SIV	Seafood Industry Victoria
SSA	Seafood Services Australia Ltd
TAC	Total Allowable Catch
TAFE	Technical and Further Education
VCC	Victorian Coastal Council
VFFMA	Victorian Fish & Food Marketing Association
VMSC	Victorian Marine Science Consortium
VNPA	Victorian National Parks Association
VRFish	Victorian Recreational Fishing Peak Body