SUBMISSION NO. 19
Inquiry into the Role of Science for Fisheries and Aquaculture

RESPONSE TO THE HOUSE OF REPRESENTATIVES INQUIRY INTO FISHERIES AND AQUACULTURE SCIENCE

by the
Fisheries Research and
Development Corporation

The vision to which all FRDC investment is directed:

A vibrant Australian fishing and aquaculture industry,

supporting and adopting world-class research

to achieve prosperity

and to wisely use the natural resources on which it depends.

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EXECUTIVE SUMMARY

Australia's fishing and aquaculture industry is highly dependent on science for its economic, social and environmental assessment and reporting. The industry comprises commercial, recreational and indigenous end-users of research whose activities occur principally in a public aquatic resource (diagram: page 9). Ongoing access to the resource requires continuous research and development to demonstrate compliance with natural resources management regulatory requirements to meet multiple levels of government legislation that embody the community's "social licence to operate". Complex regulatory arrangements and the requirements of supply chain procurement now necessitate reporting against diverse triple-bottom-line criteria in support of ecologically sustainable development. Compliance is a prerequisite for maintaining current access to aquatic resources and securing future development opportunities.

The industry's future access and development is inextricably linked to investment in research, development and extension (RD&E). The industry is still significantly under-developed in comparison with Australia's large, diverse natural resource base. Pursuing the opportunity for development will provide ongoing and renewable benefits to the industry's commercial, recreational and indigenous cultural sectors and the communities they support, especially in remote and regional Australia. Future access and development will also depend on the industry developing significant capacity to promote and market itself and its products in order to boost community perceptions.

The FRDC provides national leadership in ensuring that investment in RD&E for the industry is focused on high-priority science for end-users of research results. A substantial proportion of the Corporation's effort is towards public-good RD&E.

The following summarises areas for future RD&E effort, exemplifying the strategic directions of the FRDC's investments.

TOR 1: RELATIONSHIP BETWEEN SCIENTIFIC KNOWLEDGE OF FISH SPECIES, ECOSYSTEMS, BIODIVERSITY AND FISH STOCK SUSTAINABILITY (PAGE 19)

- Establish a national fishery management standard that harmonises the various government assessment requirements to avoid duplication and ensure equivalence between the various reporting systems.
- Further develop EBFM science, including ecosystem models and practical tools for implementation into cost-effective management.
- Further develop science to determine the acceptable limits of change in systems to develop whole-of-ecosystem target reference points.

TOR 2: FISHERY MANAGEMENT AND BIOSECURITY (PAGE 23)

2.1: CALCULATION AND MONITORING OF STOCK SIZE, SUSTAINABLE YIELD AND BYCATCH, AND RELATED DATA COLLECTION

Increasing sophistication is required in:

- data recording technology
- database and analytical tools

- indicators and performance measures
- harvest strategies and management decisions.

Implementation will involve:

- novel methods for data collection and storage, and further development of analytical tools and assessment techniques
- improved knowledge of stock structure and biology and their inter-relationship, and understanding of bycatch species
- determining acceptable levels of impact on aquatic systems
- development of a national harvest strategy approach
- further development of maximum economic yield approaches
- increasing inclusion of social objectives in harvest strategies and fisheries management.

2.2: EFFECTS OF CLIMATE CHANGE, ESPECIALLY RELATING TO SPECIES DISPERSION, STOCK LEVELS AND IMPACTS ON FISHING COMMUNITIES

- Ensure science provides practical information to inform sectors about adaptation to climate change at the relevant spatial scale at which the sector operates.
- Develop management tools that improve the flexibility of the industry to adapt both spatially and temporally.
- Understand the carbon sequestration opportunities and benefits of Australian wetlands and estuaries with a view to rehabilitation and maintenance of their services.
- Explore further likely changes to species responses to climate variability and assess the threats and opportunities for adaptive management options.
- Scope and trial novel and "borrowed" energy efficiency options to reduce the industry's reliance on fossil fuels and reduce emission levels and carbon footprints.

2.3: PEST AND DISEASE MANAGEMENT AND MITIGATION

- Develop rapid diagnostic tests and provide the capacity and capability to undertake these tests across the nation.
- Develop continuous and immortal cell lines to assess effects of disease to greatly accelerate understanding of diseases and treatments.
- Develop guidelines for disease outbreak management that include complex, multi-factorial fishery health problems.
- Develop detection methods for sub-clinical infections and infectivity models for diseases.
- Determine disease risk factors and disease risk minimisation procedures for imported aquatic animals and products.

2.4: Minimisation of risks to the natural environment and human health

As the community's expectation of maintaining environmental values, the risks to the environment from resource use need to be within acceptable levels. Building from the excellent results that have been achieved to date the following should be undertaken:

- Further training of industry to exceed environmental best practice and obtain formal accreditation through training programs to reduce environmental risk.
- Further development of novel technologies to reduce the footprint of fishing gear.
- Greater cooperation and collaboration between industry and environmental groups, at least through the agreement of common language on terms such as over fishing and depletion.

2.5: Cooperation among governments

- Further develop the national fisheries stock status report and expansion to include social and economic elements and fishery-specific information.

TOR 3: Research, development and applied science of aquaculture (page 31)

3.1: Transitioning from wild fisheries to aquaculture in individual species

- Improve the planning framework for new aquaculture developments.
- Invest in innovative science that supports sophisticated production systems compatible with Australia's development and provides a science-based competitive advantage for competition on domestic in and overseas markets (e.g., complex breeding programs).

3.2: Improving sustainability and life-cycle management practices and outcomes

- Standardise nationally the environmental assessment and reporting requirements for aquaculture.

3.3: Pest and disease management and mitigation

[Covered under 2.3.]

TOR 4: Governance arrangements relating to fisheries and aquaculture (page 34)

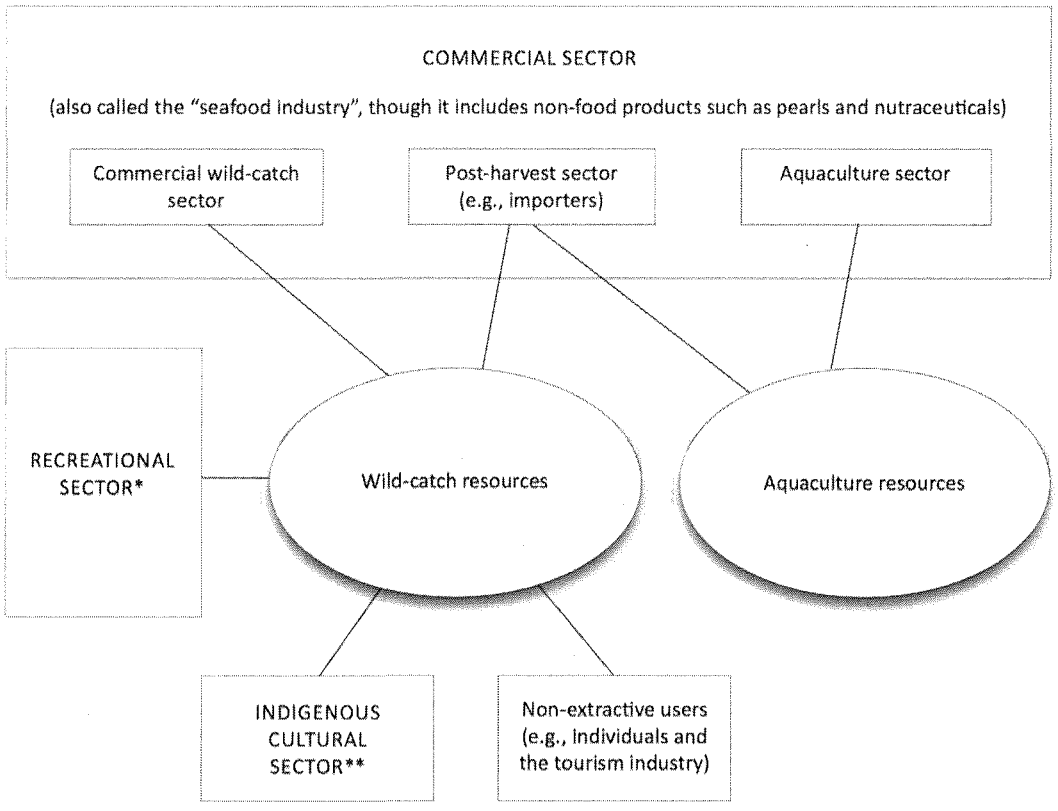
- Continue to develop and implement the national Fishing and Aquaculture RD&E Strategy.
- Support "major–support–link" arrangements to enhance research capacity.
- Finalise the "major–support–link" process as part of the research providers network
- Strengthen investment in extension and adoption by ensuring stronger links to end-users.
- Secure ongoing commitment and engagement by governments to the Research Priorities Forum.

TOR 5: CURRENT INITIATIVES AND RESPONSES TO THE ABOVE MATTERS BY GOVERNMENTS (PAGE 39)

- Execute the elements of the FRDC strategy to promote the science and best practice that underpins the Australian seafood and recreational fishing industry.
- Invest in improved reporting on the performance of Australia's fishing and aquaculture sectors (including publication of the status reports).
- Ensure previous investment in RD&E is more readily available for community use.
- The FRDC and its industry partners and community stakeholders also intend to consider and pursue investments in non-RD&E activities (including marketing and promotion).

Figure 1: Australia's complex fishing and aquaculture industry

The fishing and aquaculture industry includes any industry or activity conducted in or from Australia concerned with taking, culturing, processing, preserving, storing, transporting, marketing or selling fish or fish products.



* The recreational sector includes associated commercial enterprises, such as tackle and charter.

** Aboriginal and Torres Strait Islander people are involved in the commercial and recreational sectors in addition to the indigenous cultural sector.

Sizes of elements in the diagram do not indicate relative economic values, which for the commercial wild-catch sector is ≅ $1.3 billion per annum; aquaculture sector ≅ $0.9 bn (combined total ≅ $2.2 bn); recreational sector ≅ $4–$5 bn. The amount for the indigenous cultural sector is unknown, although it is often significant on local scales. Social values for the sectors are high, especially in rural communities and Aboriginal and Torres Strait Islander communities. In the latter case, consumption of seafood caught for traditional cultural reasons has significant benefits to the health of indigenous communities.

Although not part of the fishing and aquaculture industry, entities strongly involved with the industry are:

- the federal, state and territory governments (especially their fisheries managers and other natural resource managers)
- research partners (including universities, fisheries research organisations, and industry and private sector providers) and research investors (such as the Australian Seafood Cooperative Research Centre)
- the people of Australia (on whose behalf aquatic natural resources are managed, and as consumers).

OVERVIEW OF THE FRDC AND FISHERIES AND AQUACULTURE RESEARCH

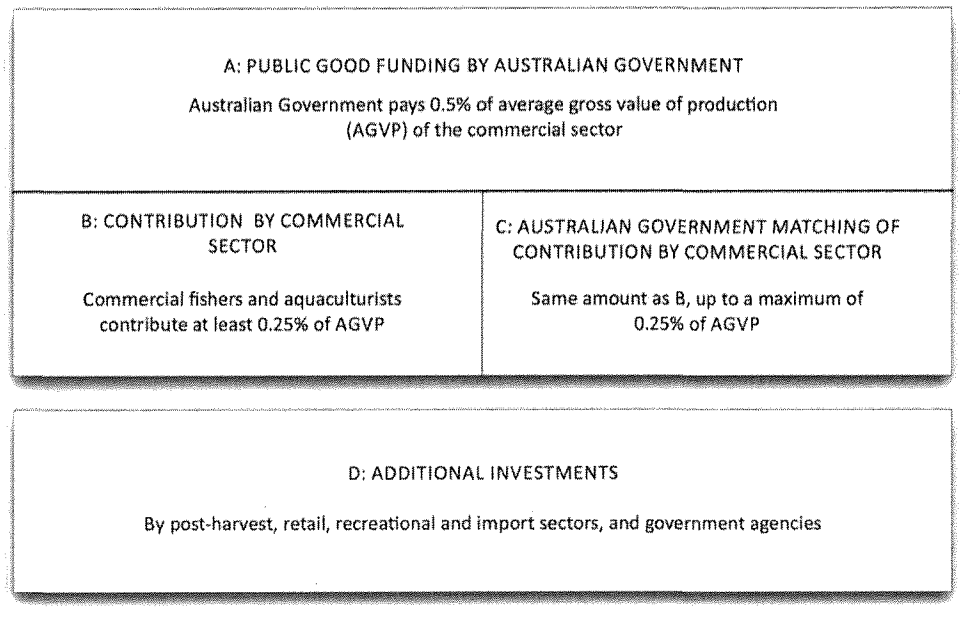
The Fisheries Research and Development Corporation (FRDC) was one of the R&D corporations established by the ground-breaking *Primary Industries and Energy Research and Development Act 1989* (PIERD Act). It is a co-funded partnership between the Australian Government and the fishing and aquaculture industry. Stakeholders in the Corporation are:

- the fishing and aquaculture industry
- the federal, state and territory governments (including their fisheries managers and other natural resource managers)
- research partners (including universities, fisheries research organisations, industry and private sector research providers, and investors)
- the people of Australia (on whose behalf aquatic natural resources are managed, and as consumers).

The FRDC's role is to plan, invest in and manage fisheries and aquaculture research, development and extension (RD&E) activities in Australia. This includes providing leadership and coordination of the monitoring, evaluating and reporting on RD&E activities, facilitating dissemination, extension and commercialisation. The FRDC achieves this through coordinating government and industry investment, including stakeholders to establish and address RD&E priorities. In addition the FRDC monitors and evaluates the adoption of RD&E to inform future decisions.

As shown in figure 2, the primary revenue for the FRDC comes from the Australian Government and the fishing and aquaculture industry. The Corporation also manages significant investments by stakeholders in FRDC-funded projects.

Figure 2: The FRDC's primary revenue sources



A significant responsibility is to ensure, on behalf of the Australian Government, that research is undertaken to assist in the management of fisheries and aquaculture resources for ongoing sustainability. This means that a significant proportion of funding is directed at research that has a public good benefit. Additionally, the FRDC's strategic investments in RD&E activities benefit the three sectors of the fishing and aquaculture industry: commercial (wild catch and aquaculture), recreational and indigenous.

The Corporation aims to maximise the benefits from its investment by ensuring that RD&E is well targeted, meets governments' and industry's RD&E priorities, and builds on previous achievements.

The FRDC is unique among the rural research and development corporations because it takes a leadership role in balancing investment priorities between natural resource management and industry productivity and development. The majority of the FRDC's RD&E investment addresses public good priorities to achieve sustainability in fisheries management, habitats and industry.

The Corporation is strategically placed to broker partnerships between the Australian Government, industry and research partners around Australia. This positioning also allows the FRDC to communicate and network with partners to leverage funds and broker knowledge to get the best results from the investments made by government, industry and the community.

The FRDC plays a leadership role in fisheries RD&E through:

- project planning, management and extension across government agencies and industry nationally
- facilitation and partnership activities with research partners
- collaboration across other R&D Corporation's, independent agencies, states and international organisations
- leverage of investment funds across Australia.

The FRDC also has a strong link with the Australian Seafood Cooperative Research Centre. As a core participant, the FRDC will invest more than $28 million cash and $1.4 million in kind during the CRC's seven-year life. The goal of this investment is to assist end-users of the CRC's research to deliver safe, high-quality, Australian seafood and to increase the profitability and value of the industry.

During the two decades since the rural research and development corporations such as the FRDC were established, they have proved to be a successful model for advancing innovation in rural RD&E — especially in the presence of market failure. They have enabled productive partnerships for government and industry investment in science, producing significant benefits to investors and other stakeholders.

In addition to its reporting to the Minister and Parliament, the FRDC formally reports to the annual meetings of its ministerially appointed representative organisations: the National Seafood Industry Alliance, Commonwealth Fisheries Association, the National Aquaculture Council, and Recfish Australia. Appointment of the representative organisations, and the Corporation's consultation with and reporting to them, are in accordance with its enabling legislation.

GLOBAL FOOD AND ENERGY SUPPLY

Demand drivers

In the past three decades the ***global food market*** has experienced unprecedented expansion and a change in global dietary patterns, with a shift towards more protein. This change results from complex interactions of several factors, including rising living standards, population growth, rapid urbanisation, increased trade and transformations in food distribution.[1]

The OECD-FAO believe the key drivers for ***production risk and price*** during the coming decade will include weather and climate change, stock levels to satisfy volatile short-term demand, energy input prices, exchange rates, rising per-capita demand in developed and developing economies, resource pressures (such as high input costs, slow technology application, irrigation water availability, and expansion into marginal lands), trade restrictions for both exports and imports, and the adverse impacts of speculators in markets.

At a ***global fisheries*** level, seafood is the most important animal protein in the human diet, comprising about one-third of all animal protein intake. Total world fishery supply (including edible and non-edible products) has risen 16 per cent in the decade to 2008 to 142 million tonnes. In developing countries especially, seafood is more prominent, not only because the amount is higher (in Cambodia, about 80 per cent of protein intake) but also because it supplies a source of fresh, healthy food without which people would be malnourished.

World seafood consumption is growing at about 2.5 per cent per year, at which rate the quantity required will be double present tonnage by about 2050. Most global wild-catch fisheries are fully fished. However, since many are now responding to rebuilding measures, some growth in production is expected during the next 20 years. The majority of supply to meet this demand will come from the growth in global aquaculture that will need to grow 70 per cent to 90 million tonnes by 2030.

The FAO estimates global fish per capita consumption in 2008 at 17.1 kg (17.0 kg in 2007). Fish food supply (both total and per capita) has increased at an average of 3.1 per cent each year in the last five decades, nearly twice the rate of growth in world population.

Trade and supply chains

Fish are the most traded global animal food protein. In 2008, the value of global seafood imports was US$107 billion; export trade was US$102 billion. More than 50 per cent of the value of global fisheries production and about 40 per cent of the live weight equivalent of fish and fish products enter international trade. Fish and harvest licenses are widely traded: they are a key source of foreign exchange for many developing countries, especially in coastal Africa. In real terms (adjusted for inflation), fishery exports grew by 11 per cent in the period 2006–08 and by 50 per cent from 1998–2008.

In 2008 the top six importers by value (in decreasing order: Japan, USA, Spain, France, Italy and China) took an aggregate US$52.6 billion in imports or 49 per cent of all globally traded seafood. The top 22 markets collectively imported 85 per cent of imported value. Australia

1 Principal sources for this section are the FRDC's Response to the National Food Plan issues paper (FRDC, 2011); The state of world fisheries and aquaculture 2010 (FAO, 2010); and FAO Yearbook 2008 (FAO, 2009).

ranked 21st in the world as a seafood importer (US$1.1 billion) and 28th as an exporter (US$0.95 billion).

The OECD–FAO forecasts that fishery products will continue to be highly traded during the next decade. The expansion of trade will be affected by:

- availability of new technologies such as breeding
- changes in species farmed, and use of more of the fish
- competition (especially on prices) with other food products such as chicken and meat
- relative prices and profit margins throughout the value chain
- rising commodity prices including aquaculture inputs such as soybeans and fish feeds
- rising energy prices
- perceived and real risks to human health, and mitigating benefits from seafood
- community concerns about sustainability, including over-exploitation of stocks
- use of private standards globally by supermarket and retailer supply chains
- certification and traceability requirements and related compliance
- trade access via WTO, bilateral and plurilateral agreements (e.g. Free trade Agreements) and disputes related to fish species that may affect bilateral trade
- climate change and carbon emissions.

AUSTRALIAN CONTEXT, IMPACTS AND OPPORTUNITIES

Industry context

Australia's exclusive economic zone is the third-largest in the world, covering one-and-a-third times the area of Australia's land mass. However, the quantum of Australia's commercial wild catch ranks 60th in the world, representing only 0.2 per cent of world tonnage but 2 per cent by value. The size of catch of one species in some countries exceeds that of Australia's total production.

The fishing and aquaculture industry is uniquely diverse among Australia's primary industries. In the commercial aquaculture sector, farming is involved; but the commercial wild-catch, recreational and indigenous cultural sectors involve harvesting from a public wild resource along with other, non-extractive, public users of the resource. This brings with it many economic, environmental and social complexities.

Unfortunately, this diversity also makes it extraordinarily difficult to determine the economic value of each of these main sectors because the information available for each sector is so different and evaluation methodologies necessarily differ. However, the economic value for the commercial and recreational sectors is estimated $6 billion to $7 billion per year, broken down as follows:

- As reported by ABARES, commercial wild-catch and aquaculture was Australia's sixth most valuable food-based primary industry in 2009–10, with a combined gross value of production (landed/farmgate value) of $2.18 billion, of which aquaculture provided 40%. Exports were $1.2 billion.

- Collectively, studies have estimated that recreational fishing directly contributes $4 billion to $5 billion to national and regional economies.

Recreational fishing, through factors of lifestyle and diet, also contributes substantially to the well-being of about 3.4 million Australians.

Social value also accrues to health-conscious consumers, who are increasing their seafood consumption in keeping with global trends.

Values germane to customary fishing by Aboriginal and Torres Strait Islander people are even more difficult to determine. Fishing contributes significantly to their cultural life, health, and social cohesion, and their fishing and aquaculture provides a context for economic development and for training. The sector's economic contribution to tourism is believed to be considerable and increasing, even though it has not yet been able to be quantified.

All these sectors face common, national challenges. Within the sectors there are also many unique challenges that vary around Australia and give rise to specific RD&E needs. A few indicative examples are as follows:

- Some commercial wild-catch fisheries are predicted to face declining stock recruitment as consequence of climate change (e.g., Rocklobster).
- Changes in predation patterns are occurring within ecosystems (Tasmanian Rocklobster and urchins).
- Seafood chain efficiency and viability are crucial in some fisheries (South-east Australian scale fisheries).
- Some aquaculture sectors need to reconfigure their harvest of wild breeding stock (Southern Bluefin Tuna), address predation by seals and other marine mammals (Atlantic Salmon), and build the operational scale to enable efficient reinvestment in RD&E (Blue Mussels).
- Recreational fisheries continue to be hindered by a lack of up-to-date data to guide sector development and define and quantify social and economic benefits.
- Indigenous customary fishing is geographically and culturally diverse, presenting challenges to coordination of planning for RD&E investments.

Drivers for new science

The gap between global seafood demand and supply represents a challenge for the entire world and a particular challenge for the seafood industry, especially Australia's. Science will be at the forefront of progress.

There are five categories of drivers for new fishery and aquaculture science in Australia:

- biosecurity and aquatic animal health
- ecologically sustainable development, improved governance and resource access
- climate change and variability
- consumers and markets
- global demographic factors.

Each category can be seen through the lens of the global seafood gap, but impacts from closing the gap in fisheries and markets elsewhere will differ from local impacts. While research can be adopted from overseas, we still need unique science and innovation to be informed by local capability and context to develop local solutions intrinsically suitable for Australia.

Australia's strength in locally initiated RD&E is recognised in a reputation as a leader in several areas of resource management, assessment and sustainability.

Fisheries are biologically diverse, geographically disparate, and jurisdictionally remote. They change from year to year with climate and weather. To adapt quickly in today's competitive business environment, RD&E must have the depth to initiate quantum changes; small changes are not enough. A less rigorous and focused approach invites a waste of resources and poor use of available funds. This is true globally and for Australia.

Before the FRDC was established in 1991, Australian investment in fisheries and aquaculture RD&E was localised, uncoordinated, and poorly focused, resulting in a plethora of project investments across a menagerie of wild-catch species and potential aquaculture species. The related economic data were often thin and the market limited. Over all, the conversion of outputs to outcomes for wild-catch fisheries in particular was inefficient. The profound change that has taken place since then is that RD&E is highly relevant to businesses and particular sectors of the industry, and is always driven by the needs of end-users of research, not research provider interests. Additionally, since most aquatic resources are a public asset, community expectations for their management and protection as common property necessitate a considerable portion of public good or community benefit RD&E.

Since then, the FRDC has revealed that drivers for science vary considerably across sectors and users. Wild-catch fishery science has been, and largely remains, tied to the role of fisheries management. By contrast, the drivers for science in aquaculture are usually focused on production (genetics, nutrition, disease management, chain management); on efficiency; and on consumers' seafood preferences. (Aquaculture RD&E has a particular urgency because it is the principal means of filling the global gap between seafood demand and supply.)

Seafood marketing

The Australian fishing and aquaculture industry has no current marketing and promotion capability. Historically, seafood has been highly regarded by the food media and nutritionists, which has assisted in promoting demand from consumers. Significant competition within the seafood sector has resulted from Australia's current high currency and the growth in low-cost imported seafood products that provide a quality not seen before. Additionally, high growth in other animal protein sources, particularly chicken, has increased pressure on price and margins.

Aquaculture's advantage is that once efficiencies have been reached with production of a species (Atlantic Salmon being a recent example), further investment can go into generating significantly higher volumes of product while reducing the price to the consumer. By contrast, the commercial wild-catch sector is not able to significantly reduce costs. Wild-catch fishing businesses are therefore increasingly induced to target high-value, low-volume markets. Good marketing has the potential to be very effective in premium markets.

The domestic seafood industry is realising that it must be more proactive in promoting its products to domestic consumers. New country-of-origin labelling laws for seafood

established by the Northern Territory Government in 2008 required retailers to label seafood that had not been harvested in Australia as imported. A review conducted 16 months after the introduction of the laws found that there was strong consumer support for the labelling of imported seafood. The laws clearly influenced consumer choice, since the share of imported product offered by retailers had dropped.

The seafood industry has recognised the need to improve its social "licence to operate" to improve the perception of the industry by the community. This will be critical if the industry wants to maintain or increase its access to aquatic resources. Collective industry marketing and promoting capability will be essential to improve community perceptions of the seafood industry: environmental certification, for example, will only deliver social benefits if it is promoted.

Traded seafood

Trade and overseas market access are essential to the viability of Australian fishers and fisheries. By and large we export high value unprocessed niche species and import commodity seafood. A significant threat for an export intensive seafood producer such as Australia is the emerging trade and market access dominance of key import markets and their related market protocols/standards. Trade and market access barriers to Europe, in particular, now into account social and environmental sustainability including water, human and social capital, energy usage, animal welfare, biodiversity and waste management in the production of food.

Given recent growth in the number and scope of global seafood certification systems it is not surprising that many leading seafood exporters, such as those in Iceland, Alaska and Canada, are now moving to a more cost-effective government certification based on FAO guidelines.

It is vital that Australian Government negotiations on Free Trade Agreements and similar activities be conducted using up-to-date and strategically relevant information to facilitate more beneficial access arrangements for Australian seafood to overseas markets. In 2008 the commercial sector, in conjunction with Seafood Services Australia and the Seafood CRC, established a high-level seafood trade and market access forum. The forum has become a highly effective medium for officials of DFAT, DAFF (AQIS) and other agencies to discuss priorities identified by the seafood industry as barriers to trade and market access, such as tariff, phytosanitary and health factors.

Fewer species to fewer markets may increase supply chain risk. Australian seafood exports and related industry chains are becoming less diverse. The concentration of Australian trade into these markets has increased significantly during the past decade: export volume and value have both become narrowly focused on key species (Abalone, Rocklobster, Southern Bluefin Tuna, Coral Trout, Sea Cucumber and pearls) to two or three key markets. Live, fresh and/or chilled product continues to increase its share of total export value.

Trends are often difficult to capture and document, but it is clear that increased global focus on ethical consumers down the supply chain is inducing seafood and marine science RD&E to follow in search of competitive advantage. This trend must also be part of Australia's strategic science plan.

Expansion of Australia's species and products (e.g., algae-based products and human health supplements) will increase demand or open up new market opportunities. Innovation could also benefit from closer commercial joint ventures with New Zealand seafood chains and operators, which are more globally focused, cost-effective and sophisticated than

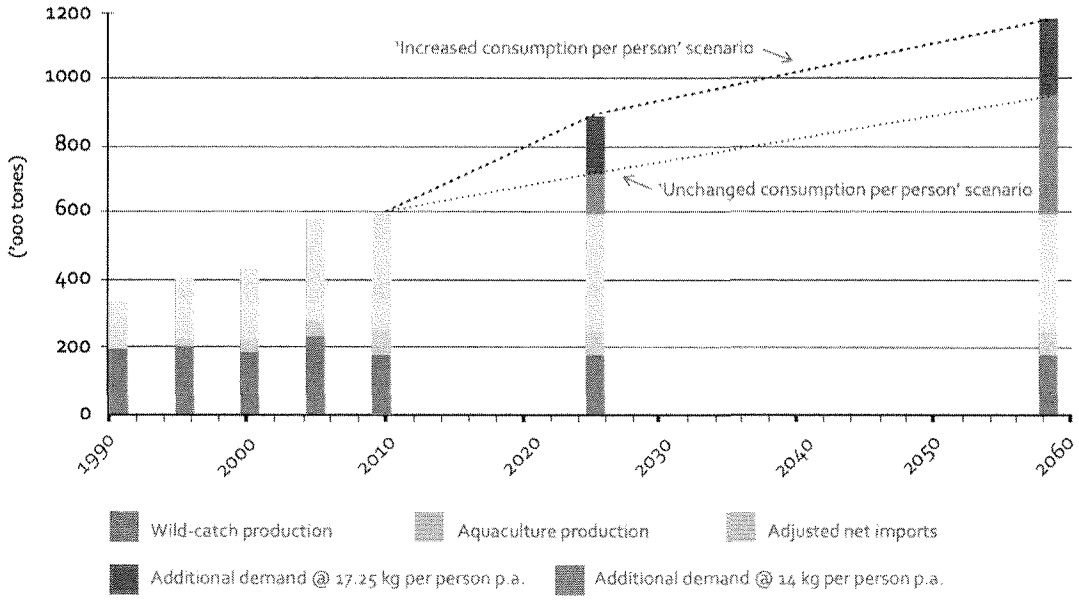
Australia's. Several New Zealand companies already operate Australian fishing licences, and New Zealand is in the top five seafood suppliers to Australia. Such joint commercial operations are good for consumers in both countries and, importantly, they go some way to overcoming the chronic lack of capital available to service the Australian seafood industry.

Other trade-related factors include increased export sales of premium wild-catch seafood at attractive margins; increased trade flows resulting from removal of trade barriers; growth in domestic aquaculture; increased biosecurity risks; increased opportunity to select and adopt global technologies; and uncertainty regarding community perceptions of wild-catch fishing — and therefore access to the resource for use, both passive (i.e., tourism) and active. Higher disposable incomes in the developing economies will drive higher demand for recreation and ecotourism in unique environments such as those in Australia: the fishing tourism sector is likely to expand. These are complex matters. The Australian fishing and aquaculture industry's response, and prosperity, depends on its investment in essential human skills, community endorsement, technologies and financial capacity.

Seafood demand gap

Per capita consumption of seafood is increasing, largely because consumers are increasingly aware of seafood's health benefits. In Australia, demand is forecast to increase substantially owing to population increase, but increased per capita consumption will accentuate the gap between supply and demand. Figure 3 forecasts the magnitude of the gap based on two scenarios of demand, namely 14 kg and 17.25 kg per capita. In the latter scenario, total demand in 2025 will be half as high again as at present, and double the present demand in 2056.

Figure 3: Forecast Australian seafood demand to 2056



NOTES TO THE DIAGRAM

'Unchanged consumption per person' scenario: If consumption remains stable at 14 kg per person, production of 760,000 tonnes will be needed in 2025, and 992,000 tonnes in 2056 — an increase on 2008 production (wild-catch, aquaculture and adjusted imports) of 119,000 and 351,000 tonnes respectively.

'Higher consumption per person' scenario: If consumption increases to 17.25 kg per person, production of 938,000 tonnes will be needed in 2025, and 1.225 million tonnes in 2056 — an increase on 2008 production of 298,000 and 584,000 tonnes respectively.

Since most imports are fillets, canned fish or otherwise value-added, the figure for imports (net of excluded exports) has been adjusted to reach a whole-fish equivalent, by doubling it.

'Additional demand' assumes production of aquaculture and imports as of 2008. It is based on consumption of 14 kg/person, which equates to 28 kg/person of whole fish; and in the higher scenario 17.25 kg/person = 34.5 kg/person of whole fish. Mid-point estimates of population are 27.2 million in 2025 and 35.5 million in 2056.

Australia currently produces only about 28 per cent of its seafood needs. This could fall to as little as 20 per cent by 2050 since current projections indicate little future growth in wild-catch production and a trend to reduced access to resources through marine planning processes. Although Australia will remain a net seafood importer, if the nation is to increase its food security national policy must encourage aquaculture as the vector for most growth in seafood production.

Traded seafood requires processing and value-adding capacity to transform the product to meet the needs of specific market segments. The Australian seafood industry currently has minimal value-adding capacity or infrastructure. Only if the volume processed is high and technology considerably reduces the input cost of labour can value-adding begin to be competitive against Asian cost levels. Consequently, Australian value-adding mainly involves short product runs that are unique and can be branded to differentiate from mass products.

Encouragingly, significant opportunities exist for the Australian seafood industry to meet this challenge by adopting advanced technologies, processes and competencies. They have significant potential to improve production and efficient delivery of products that meet consumer needs, aided by more advanced marketing and product branding strategies.

Australian food supply security is aimed at protecting national food-producing resources and assets so they are ecologically and economically sustainable and are competitive with imports wherever possible. This approach enables capacity for continuance of wild-catch fisheries and development of existing and new aquaculture fisheries.

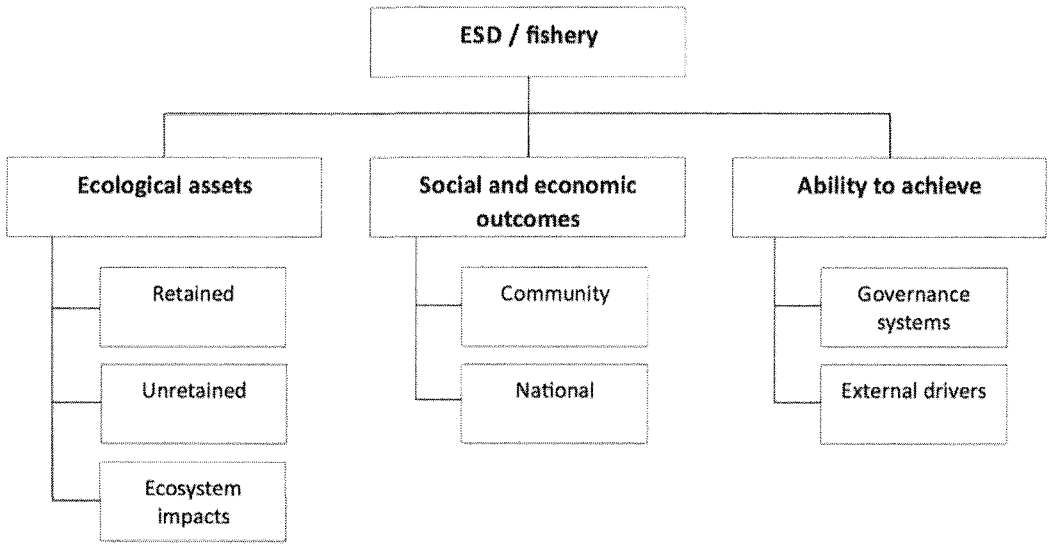
RESPONSE TO THE INQUIRY'S TERMS OF REFERENCE

TOR 1 RELATIONSHIP BETWEEN SCIENTIFIC KNOWLEDGE OF FISH SPECIES, ECOSYSTEMS, BIODIVERSITY AND FISH STOCK SUSTAINABILITY

Historically, Australian fisheries science has focused on single-species assessments, usually within a particular jurisdiction without considering cross-jurisdictional overlaps and individual fisheries that access them. This is not surprising, given that there are more than 600 marketing names for retained commercial catch. As the 2010 worldwide Census of Marine Life confirmed, Australian marine waters are some of the most biologically diverse in the world. Australia's freshwater fish have a high degree of endemism, reflecting the geological isolation of Australia. Research to support fisheries management has focused in the past on key biological, structure and fishery interactions in assessing stock status. The agreement by all Australian governments to an ecologically sustainable development (ESD) policy in the early 1990s had a significant impact on how fisheries were managed. The policy requires a balanced consideration of ecological, social and economic information in the management of fisheries.

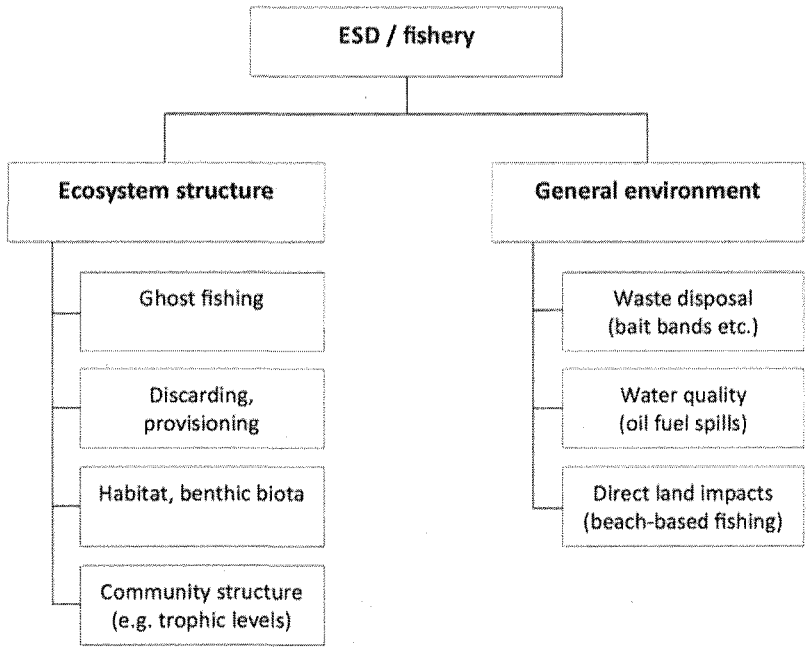
To provide for a nationally agreed approach to assessment and reporting that could be adapted to local industries, the FRDC, in partnership with governments and industry, established an ESD Subprogram in the late 1990s. At the time the subprogram was being developed, the Australian Government introduced the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and strategic assessments for wild fisheries. The subprogram assisted the assessment process and developed a national approach to assessments and reporting, which had at its core the development of assessment component trees (figure 4).

Figure 4: The main assessment component tree



In addition to the core component tree, other component trees were developed for each box. Figure 5 provides an example for Ecosystem impacts.

Figure 5: An example of an assessment component tree (ecosystem impacts)



The federal environment department developed its own principles when assessing fisheries:

- *Principle 1*: A fishery must be conducted in a manner that does not lead to over-fishing, or for those stocks that are over-fished, the fishery must be conducted such that there is a high degree of probability the stock(s) will recover.
- *Principle 2*: Fishing operations should be managed to minimise their impact on the structure, productivity, function and biological diversity of the ecosystem.

At the same time, third party environmental labels were also developing. The best known, and the most comprehensive, was the Marine Stewardship Council environmental standard for sustainable fishing, which identified three principles:

- *Principle 1, Sustainable fish stocks*: The fishing activity must be at a level which is sustainable for the fish population. Any certified fishery must operate so that fishing can continue indefinitely and is not overexploiting the resources.
- *Principle 2, Minimising environmental impact*: Fishing operations should be managed to maintain the structure, productivity, function and diversity of the ecosystem on which the fishery depends.
- *Principle 3, Effective management*: The fishery must meet all local, national and international laws and must have a management system in place to respond to changing circumstances and maintain sustainability.

The FRDC's ESD subprogram, EPBC fisheries assessments and the third-party environmental labels all required fisheries to consider in their assessment an ecosystem approach that went

beyond single-species stock assessments. The problem at present is the complexity that has arisen from the various governance and reporting requirements for fisheries. Requirements by retailers as part of their procurement policies are also significant.

The EBFM approach

The Australian Fisheries Management Forum (comprising directors of fisheries and aquaculture for each management jurisdiction in Australia) developed an approach to embody ESD in fisheries. Titled the Ecosystem Based Fisheries Management (EBFM) Approach, it included the following guidelines for adoption:

> EBFM is a holistic approach for the management of fishing activities, be they commercial, recreational, charter or customary fishing, at the regional or ecosystem level. EBFM considers the cumulative impacts on the environment from all fisheries-related activities operating in a region while taking into account the social, economic and other fisheries management objectives. Taking an integrated approach should assist reach more balanced and well-considered decisions on the appropriate use of resources, consistent with the principles for ecologically sustainable development
>
> The environmental impacts considered by EBFM include those generated from the capture of target and non-target species, plus any direct or indirect impacts on fish habitats and ecosystems. Importantly, EBFM also explicitly considers the social and economic benefits (and costs) derived from the mix of these activities. Finally, were relevant, it takes account of any material impacts on fish and aquatic resources (including fish stocks, habitats, ecosystems) and economic outcomes (including costs, markets) generated by 'external' sources including climate shifts and, importantly, non-fishing activities and processes (such as land use and run-off) that are managed by other (non-fishery) agencies.
>
> By taking a regional level approach, EBFM builds upon the extensive fishery-level, ESD based work that has been undertaken during the past decade. While there are now comprehensive "ESD" assessments for most individual fisheries, EBFM integrates these into a regional level assessment of all fisheries activities within a specified region. Consequently, EBFM provides the essential linkage between the fishery-level management arrangements used by fisheries agencies and the regional-level planning generally undertaken by other government agencies that deal with coastal development, ports and shipping, MPAs, mining/petroleum etc. The integrated consideration of all these interests and activities is generally termed Ecosystem Based Management (EBM).

Key elements and scope of EBFM

- The focus is on regional level, multi-fishery and, where relevant, aquaculture and freshwater fisheries.
- Decision-making is integrated, using a holistic risk-management approach.
- Management of the effects of all fishing activities on the ecosystem, including any cumulative impacts, is incorporated.
- Social and economic outcomes in decision-making are integrated to generate the best outcomes for the community.
- A critical link to broader EBM processes is assisting influence, or recognition, of the management of impacts on fisheries caused by external factors.

Areas for future RD&E effort

- Establish a national fishery management standard that harmonises the various government assessment requirements to avoid duplication and ensure equivalence between the various reporting systems.
- Further develop EBFM science, including ecosystem models and practical tools for implementation into cost-effective management.
- Further develop science to determine the acceptable limits of change in systems to develop whole-of-ecosystem target reference points.

TOR 2 FISHERY MANAGEMENT AND BIOSECURITY

TOR 2.1 CALCULATION AND MONITORING OF STOCK SIZE, SUSTAINABLE YIELD AND BYCATCH, AND RELATED DATA COLLECTION

A fundamental requirement for fisheries management and the sustainable use of fisheries resources is to estimate stock size, sustainable and economic yields of harvest, and incidental capture of bycatch (i.e., species that are not a retained or saleable component of the catch). Reliable data needs to be collected to inform these estimations. In some situations this information is abundant and provides robust estimations of sustainable harvests. In others the data is deficient, difficult to obtain, or too costly to collect. In these circumstances precautionary approaches are often taken. However, increasingly sophisticated methods of risk assessment based on life-history parameters or the use of surrogate information (from data-rich species to data poor species) is being used to inform sustainable harvest levels.

Calculation and management of these components individually ensures sustainable management of target or individual species, or understanding or mitigation of levels of bycatch. Consideration of these components in a multiple-species context begins the process of ecosystem-based fisheries management discussed on page 21.

A "four box" framework that includes performance indicators and harvest strategies, under headings as below, has been developed for wild-catch abalone monitoring and analysis. This framework can be applied more broadly to fisheries data, analysis and management response.

BOX 1. DATA RECORDING TECHNOLOGY

Use of past, current and evolving methods to collect data. Can be from dependent and independent sources, with varying spatial and biophysical detail. It is the foundation for informing analytical and assessment tools.

BOX 2. BYCATCH INTERACTION

An understanding of the incidental capture of species assists in fuller understanding and improved management of specific fisheries. This could be to understand interactions, utilisation of bycatch species, mitigation of bycatch species and interaction with threatened endangered and protected (TEP) species. Of increasing importance when moving to Ecosystem Based Fisheries Management. Relates also to box 1.

BOX 3. ANALYTICAL TOOLS AND ASSESSMENT TECHNIQUES

The development of assessment and analytical tools to collate and analyse the data collected in 1 and 2. Sophisticated tools are being developed that relate environmental variables to biological data and behavioural responses of fishers. Can often be data-hungry, with accuracy becoming higher with increasing availability of data. As bycatch species are considered increasingly in assessments, surrogate information is being used.

BOX 4. MANAGEMENT DECISIONS/HARVEST STRATEGIES

Outputs from box 3 inform management decisions and harvest strategies. These often take risk-based approaches depending on individual species assessments, the level of bycatch and TEP interaction as well as the information that is available to inform the assessment. Less information from 1 and 2 provides less surety in the outputs of 3, which can lead to a

precautionary approach to management and harvest strategies. To ensure appropriate levels of harvest, novel methods of decision-making frameworks are being developed.

Areas for future RD&E effort

Increasing sophistication is required in:

- data recording technology
- database and analytical tools
- indicators and performance measures
- harvest strategies and management decisions.

Implementation will involve:

- novel methods for data collection and storage including spatial tagging data
- collection and collation of relevant environmental information
- improved knowledge of stock structure and biology and their inter-relationship in an ecosystem context
- improved understanding of bycatch species in an ecosystem context
- defining and determining acceptable levels of impact on aquatic systems
- identification of surrogate knowledge bases for data-poor species to inform assessment and harvest strategies and reduce the increasing cost of data-hungry assessment methods
- further development of analytical tools and assessment techniques that assess cumulative impacts and take a more system-based approach
- development and collation of jurisdictionally based harvest strategies to a national harvest strategy approach
- further development of maximum economic yield approaches
- increasing inclusion of social objectives in harvest strategies and fisheries management.

TOR 2.2 Effects of climate change, especially relating to species dispersion, stock levels and impacts on fishing communities

Climate change is predicted to have a series of impacts on fisheries and their management, further emphasising the need for evidence-based decision-making in all matters relating to fisheries and overall aquatic management. Key impacts and FRDC roles in providing science evidence are discussed under the five following headings.

Increasing climate variability

Many Australian fish stocks, and their abundance, are strongly linked to seasons. For example, a wet season or consecutive wet seasons assist spawning and recruitment of prawn species, whereas a run of drier years will affect recruitment of juveniles and the availability of that species to harvest. Fish species can have similar fluctuations correlated to environ-

mental variation. The impact on a species from variability in climate will depend on their life history characteristics and potential ability, or inability, to adapt to it. Science is needed to predict the population's resilience and vulnerability to harvest, and then to develop adaptive management that could increase or decrease the level of harvest to ensure sustainable biological and economic yield.

Increasing frequency of extreme events

A recent example of extreme events was the impact of cyclones on the live Coral Trout fishery. Populations of Coral Trout were reduced in entire sections of the Great Barrier Reef after the run of cyclones from 2009 to 2011. This led to displacement of both commercial and recreational effort. Under such fluctuations, spatial entitlements and management are below optimum and not adaptive to change. This refers to both closures for marine conservation objectives through marine reserve networks and any partitioning of fishery effort based on fixed boundaries. Again, impacts would be reduced through predictive stock assessment and more spatial and rotational harvest management arrangements.

Changing ocean temperature and currents

Alterations to Australia's prevailing current systems are likely to affect the residency rates and viability of some species and the recruitment success and range expansion of others: for example, the relationship between the strength of the Leeuwin Current and lobster puerulus settlement along the Western Australian coast. Research funded through both the FRDC and WA Fisheries has demonstrated correlations between current strength and lobster abundance, which is now being used to assist in setting management controls. Likewise, with the recent onset of abnormally high ocean temperatures mass kills of sessile species such as Roe's Abalone have occurred, necessitating temporary closure of the northern sector of the fishery. Further, patterns of warm eddies extending further south than normal along Australia's east coast can lead to aggregation of pelagic fish stocks within the eddies. This increases the geographic range for profitable fishing and recreational fishing opportunities.

To take advantage of opportunities and to minimise the impacts of threats, science investment is essential to monitor biophysical conditions of our oceans and their currents, to predict this influence on populations, and to modify and make more flexible the management of all fisheries.

Increasing sea level and impacts on estuaries and wetlands

Estuaries and wetlands are at the forefront of impacts of rising sea level. Without a major initiative to repair and retain habitat, severe impediments will arise in Australia's potential to produce fish and prawns, to retain coastal biodiversity and to buffer marine systems from land-sourced water quality problems. Fortunately with climate change and Australia's efforts to sequester greenhouse gases, potential solutions are at hand. Our estuaries and wetlands are the most productive of the world's ecosystems, so it is no surprise that per hectare, these estuaries and wetlands sequester the most carbon — and do so with unparalleled long-term certainty. For example the certainty of carbon sequestered into coastal sediments is high compared with carbon sequestered in forests, with the ongoing threat of wildfire. Repair can be as simple as increasing the size of causeways and road culverts so that tidal flows are restored, or removing unnecessary barrages to fish passage such as bunds and ponded pasture levees. Unfortunately, Australia's National Carbon Accounting System does not yet account for sequestration within estuaries and wetlands. Internationally this is a major policy

area (termed "blue carbon") is seen as a large part of global mitigation opportunities to reduce the impact of greenhouse gases.

Climate change therefore provides Australia with a substantial opportunity to maintain and potentially increase its fish stocks through habitat repair while simultaneously increasing coastal biodiversity, water quality and carbon sequestration. Again science is needed to underpin such initiatives so that the carbon sequestered is accounted for, the repair works are done with minimal impact on surrounding high- value land uses, and the value of fish habitat is maximised. The FRDC is seeking to foster such an initiative with Australian Government agencies. The first step required is for Australian Government policy to be changed so that carbon sequestered from such estuary and wetland repair works is included within the National Carbon Accounts.

Climate change: Clean Energy Future policy implications

Research sponsored by the FRDC is under way to analyse how Clean Energy Future policies affect commercial and recreational fishing. In brief, diesel is a large part of the input costs of most fishing enterprises: up to about 40 per cent for ocean-going trawlers. Likewise, energy costs for aquaculture such as prawn and abalone farms are high, and energy plays a large part of any downstream processing and transport of product. Fishers are keen to play their part in reducing energy use. Again science has a key role: for example in ensuring reduced drag systems for fishing vessels; improved energy efficiency; use of alternative fuels and energy sources; reduced reliance on electricity from the grid for aquaculture; and smarter storage, processing and refrigeration systems.

Areas for future RD&E effort

- Ensure science provides practical information to inform sectors about adaptation to climate change at the relevant spatial scale at which the sector operates.
- Develop management tools that improve the flexibility of the industry to adapt, both spatially and temporally.
- Understand the carbon sequestration opportunities and benefits of Australian wetlands and estuaries with a view to rehabilitation and maintenance of their services.
- Explore further likely changes to species responses to climate variability and assess the threats and opportunities for adaptive management options.
- Scope and trial novel and "borrowed" energy efficiency options to reduce the industry's reliance on fossil fuels and reduce emission levels and carbon footprints.

TOR 2.3 Pest and disease management and mitigation

Australian state and territory governments have all agreed to participate in a national approach to animal health.

The FRDC, through its Aquatic Animal Health Subprogram (AAHS), is concentrating on diseases as they relate to biosecurity and invasive pests. The FRDC has made it explicit in its RD&E Plan that biosecurity will be addressed as it relates to diseases caused by infectious organisms. Biosecurity as it relates to aquatic invasive pests, such as Zebra Mussels, is beyond the FRDC's scope and is being dealt with by state and federal government agencies.

Aquatic diseases present unique challenges to fishery managers and industry. Water is a more transmissible vector than air for harbouring, promoting and supporting the ready transmission of pathogens between species. Terrestrial animal health risks can be readily ring-fenced and quarantined with animal health strategies allocating resources across prevention, containment and subsequent eradication. However, for wild-catch seafood and aquaculture (especially marine cage technologies and open-ocean ranching), resources must be almost totally allocated to ensuring prevention of the pathogen's incursion into the water vector. Control and eradication is only possible if the incursion occurs in a contained water body. If it occurs in most open aquatic environments, control is impossible and the only option available for managers is to limit the spread through biosecurity protocols.

Current animal health challenges

Australia's aquatic animal sector is free from many diseases that occur overseas, providing us with a comparative advantage in both production and trade. The number of aquatic animal species and the absolute number of aquatic animals being farmed in Australia is increasing, and new diseases caused by emerging infectious agents (e.g., oyster oedema disease, abalone viral ganglio neuritis and ostreid herpesvirus) continue to threaten the sustainability of significant enterprises. The call on health services to support the industry is growing.

In addition to aquaculture, aquatic animal health RD&E is required for the other aquatic animal sectors, including wild-catch (abalone herpesvirus, cf *Streptococcus agalactiae* in Grouper), recreational and ornamental (cf gourami iridovirus), that share the aquatic environment. Thus health services need to be coordinated across these sectors to ensure synergy while avoiding duplication. The FRDC, through its AAHS, plays a major role in addressing research needs and training in aquatic animal health. With its incumbent expertise and experience, AAHS is able to direct these activities to the most pressing areas.

Pacific Oyster Mortality Syndrome (POMS) is a large threat to Australia's $100 million oyster farming sector.

Pacific Oyster mortalities are associated with the virus Ostreid herpesvirus-1 microvariant (OsHV-1 µVar) in Australia.

The virus has been associated with high mortality events (often brought on by environmental or handling stress) involving the Pacific oyster (*Crassostrea gigas*) in Europe, New Zealand and NSW.

All ages of Pacific Oysters may be affected, but spat and juvenile oysters often suffer higher mortalities. To date there is no evidence of POMS affecting any other oyster species

A major strength of AAHS has been the access to industry and scientific expertise via a steering committee, incorporating a scientific advisory committee and a core of technical experts. All research proposals are evaluated for their relative priority to industry and government and to their scientific soundness and feasibility. Where appropriate, collaboration between research providers has been encouraged and has resulted not only in enhanced project output but also in further development of the professional relationships within the research community. This has improved Australia's research capacity in aquatic animal health across all sectors.

Areas for future RD&E effort

- Develop rapid diagnostic tests and provide the capacity and capability to undertake these tests across the nation.
- Develop continuous and immortal cell lines to assess effects of disease to greatly accelerate understanding of diseases and treatments.

- Develop guidelines for disease outbreak management that include complex, multi-factorial fishery health problems.
- Develop detection methods for sub-clinical infections and infectivity models for diseases.
- Determine disease risk factors and disease risk minimisation procedures for imported aquatic animals and products.

TOR 2.4 MINIMISATION OF RISKS TO THE NATURAL ENVIRONMENT AND HUMAN HEALTH

There is increasing pressure to minimise impacts to the natural environment from the use of natural resources. Considerable research has been conducted and its outputs adopted to understanding the ecological footprint of fishing and aquaculture activities; mitigation strategies such as methods to reduce bycatch; reduction of benthic disturbance of fishing gear and aquaculture practices; and the control and spread of exotic diseases. This has included reducing the impacts on TEP species, reducing the footprint of aquaculture activities, ensuring populations of harvested species are within population recovery bounds and where not, implementing management strategies and recovery plans to rebuild the populations of those species at risk, such as Southern Bluefin Tuna and Orange Roughy. Several jurisdictions have implemented ecological risk assessment frameworks and harvest strategies that contain triggers for implementing adaptive management to reduce risks to the natural environment.

Education is playing an increasing role to minimise risks to the environment. Members of all sectors of the industry, as users of the resource, are increasingly working as custodians of the environment on which their livelihoods depend. Training programs are being developed on environmental stewardship, best-practice approaches, and schemes for responsible fishing. Relationships are improving with environmental interest groups and processes for "common language" are being developed.

Risk to human health is currently mitigated in several ways. Firstly, occupational health and safety practices, on farm and on vessel, are improving workplace safety and awareness to minimise the risks to workplace injuries. Food safety is also being addressed through monitoring of aquatic bio-toxins and residues on edible aquatic species; maximum residue limits of potentially harmful substances such as mercury and cadmium; and outbreaks of potentially harmful bacteria such as coliforms. This is to ensure that if there is detection or outbreak, a suitable response can be actioned.

Areas for future RD&E effort

As the community's regard for environmental values increases, risks to the environment from resource use need to be within acceptable levels. Building from the excellent results achieved to date, the following should be undertaken:

- Further training of industry to exceed environmental best practice and obtain formal accreditation through training programs to reduce environmental risk.
- Further development of novel technologies to reduce the footprint of fishing gear.
- Greater cooperation and collaboration between industry and environmental groups, at least through the agreement of common language on terms such as over fishing and depletion.

TOR 2.5 COOPERATION AMONG GOVERNMENTS

Under-performing by $1 million per day

An external report to the FRDC in 2009 found that existing fishery management structural barriers to change are and will increasingly undercut progression to better fishery performance. The report stated:

> ... it is clear that most structures in the current arrangement are struggling to evolve. The progression towards best use is being held back ... fishery bodies (users and managers) are not evolving fast enough to make much-needed information transparent to users and communities; and data from national and regional jurisdictions is incomplete, hard to find, not harmonised, and often inaccurate.

The study was based on independent analyses of selected wild fisheries and iterative input from the expert panel comprising 70 fishery managers, active fishers, and technical experts (across science, technology, viability, sustainability of marine resource use and management, human interactions and fishery inputs). The report concluded that Australia's commercial wild-catch fisheries across all jurisdictions were under-performing compared to their potential. The value of this under-performance gap across all fishery users was in the order of $416 million per year, or more than $1 million forgone per day.

Industry needs to review structural impediments to fishery performance, including consideration of a single national marine fishery management agency. The creation of a single national fishery agency endorsed by all users is seen as an attractive, if politically challenging, goal.

Leadership on fishery status and sustainability

Monitoring and reporting of fishery status (including sustainability) is a critical activity for all jurisdictions. Criteria for assessing fishery status are well accepted and uniformly agreed across the scientific community and by most of the broader public. However, individual jurisdictions continue to independently assess, monitor and report the status of their respective fisheries using a range of criteria and methodologies. This leads to confusion and further opportunity for distortion of reality.

Despite Australians' strong connection with their aquatic environments, especially for the enjoyment they provide for leisure activities and the location of most people near the coast, the community's understanding of the status of national public fishery assets is poor. In a 2011 survey, 37 per cent of respondents believed they are sustainable; 26 per cent believed they are not sustainable; and the remaining 37 per cent were undecided. Unfortunately, selective reference to the over-exploitation existing in overseas fisheries, and misrepresentation into the Australian fisheries context, has significantly influenced public perception, as have some poor management decisions in the past. Through political processes, such widespread public perceptions can limit access to fishery resources even though in many cases fishing activities are sustainable.

The reality is somewhat different from these community perceptions. Australia has an enviable global record of marine fishery management — Australian marine fisheries are now ranked among the world's top four sustainable fisheries. Recent improvements in Australia's ranking have been particularly strong, as evidenced in the ABARES annual fishery status reports and international journals. Much of this improvement comes from the strong governance that has been developed in Australia, and increasing political and legal

commitment to long-term sustainability. Fishery legislation is becoming more effective in governing fishing and aquaculture activities (through licensing etc.) and environment legislation in ensuring this activity is compatible with broader ecosystem and environmental management objectives.

To address this perception–reality gap, last year the FRDC has developed a new strategy in conjunction with its stakeholders. It aims "to promote the science and best practice that underpins the Australian seafood and recreational fishing industry". This approach will proactively promote the results of research to the Australian community, media outlets and seafood consumers, and formally respond to factually incorrect media stories or information in the public arena.

A single national approach to assessing and reporting the status of all Australian fisheries, based on uniform criteria, is required. The FRDC is currently working with ABARES to initiate a national fisheries stock status report to provide a simple, scientifically robust tool to compare the status and sustainability of key wild-catch fish stocks around Australia. The first of the new reports is expected to be launched in the third quarter of 2012 from a dedicated website, www.fish.gov.au. A similar report is planned for the aquaculture sector.

Further collaboration and alignment of jurisdictional approaches and cooperation of Australian governments is discussed in the response to TOR 4, on page 34.

Areas for future RD&E effort

- Further develop the national fisheries stock status report and expansion to include social and economic elements and fishery-specific information.

TOR 3 RESEARCH, DEVELOPMENT AND APPLIED SCIENCE OF AQUACULTURE

TOR 3.1 TRANSITIONING FROM WILD FISHERIES TO AQUACULTURE IN INDIVIDUAL SPECIES

Oceans cover 66 per cent of the surface of the globe. Any balanced analysis of the potential to feed the projected world population of 9 billion by 2050 will recognise the key role to be played by marine production systems. Significantly, Australia's submission to *Rio+20* has recognised the "blue economy" as being both an opportunity and challenge during the next 20 years.

The evolution of the world aquaculture colossus continually demonstrates that food production must move from wild-harvest to marine culture, hand-in-hand with sustainable management practices. Through iterations in science, technology and investment risk we are moving from near-shore pondages to sea ranching, to marine cage systems, and to comprehensive marine farming that can survive the significant marine engineering challenges entailed. Even though emergent technologies are typically available off the shelf, progression through these stages is sometimes in parallel and sometimes in series, depending on the species, market and risk environment. As the Aurora Inc. algae project in Karratha WA demonstrates, global finance and technology quickly seek out and collocate with competitive advantage where returns look attractive.

It is the FRDC's view that this process is more an evolution and consolidation than a "transition" as described in these Terms of Reference. Innovation builds capacity on to the industry base; it does not replace it. Wild fisheries will always exist, although their use may change over time. The FRDC recognises that there is an ever-increasing "blur at the edges" of definitions, technologies and sciences. No longer is aquaculture solely about food; it also provides services to support ranching and translocation that draws skills from both wild-catch and aquaculture. At the core of this blurred evolution is science and innovation. In Australia we are still exploring the science and after three decades of increasingly focused RD&E can now point to some world-leading innovations such as closing the lifecycle for Southern Bluefin Tuna and Black Tiger Prawn. But our propensity and opportunity to continue creating innovations at the margins suited to our environment is constrained by the complexity and inflexibility of structures and planning frameworks in Australia.

Global trends confirm the move by key wild-catch fisheries species towards comprehensive aquaculture systems. While this concept has been relevant for millennia, it is the development of global consumer and media markets that has underpinned, financed and driven the transition to aquaculture for key species. The intersection of unique species attributes and eating qualities and consumer preferences has prioritised species and financed their domestication and selective breeding (e.g. Vannamei prawns, Atlantic Salmon and Barramundi) for world markets. More recently, global consumer and community concerns regarding the sustainability of species (e.g. tuna) has motivated new investment in closing the lifecycle and creating new aquaculture species. As has occurred in terrestrial species in the past, a limited number of species has emerged to dominate global aquaculture food markets. The same is likely to happen for industrial aquaculture markets.

In Australia, six species dominate the edible commercial catch in Australia, as presented in the following table. Year to year, these species comprise about 70 per cent of the value of the total Australian commercial harvest, 60 per cent of wild-catch value, and 75 per cent of aquaculture harvest value.

As can be seen in the table, three of these species are produced from wild-catch and aquaculture; two are aquaculture only; and one is wild-catch only. Australia's biggest fishery by value is now an aquaculture fishery. Other lesser species such as barramundi are also caught in the wild and produced in aquaculture systems.

TABLE 1: KEY WILD-CATCH AND AQUACULTURE SPECIES 2010 (ABARES)

Species in 2010	Wild catch Value $'000	Aquaculture Value $'000
1. Salmonids	—	369,126
2. Rocklobster	368,839	—
3. Prawn	246,604	77,488
4. Tuna	58,499	66,800
5. Abalone	158,188	15,440
6. Oyster edible	—	99,811

The key point from the table for this discussion is that the FRDC has continually invested and supported the prawn, tuna and abalone industries to the point where they are now established and globally competitive contributors in both the wild-catch and aquaculture supply chains.

Growth will enable the operational margins and reinvestment needed for innovation and market development. However, as competition increases from imported aquaculture, Australian producers must achieve the operating scale, global technologies and human capacity to be internationally competitive, and these venture must be based on new differentiated products. It is unlikely Australia will be able to compete on price alone. The aquaculture sector must:

- engage with local communities to increase awareness of aquaculture practices and demonstrate the sustainability, positive economic contribution and excellent products created by aquaculture, and in so doing secure endorsement to gain access to waters and natural resources
- align legislation across jurisdictions to motivate and promote efficient, sustainable investments by industry based on competitive advantages of regions and ecosystems
- continue to invest in innovation and closely monitor and adopt/adapt technologies available in advanced aquaculture operations worldwide
- jointly plan development strategies for each species and identify the key research areas that drive the strategic competitive advantages of that species.

Areas for future RD&E effort

- Improve the planning framework for new aquaculture developments.

- Invest in innovative science that supports sophisticated production systems compatible with Australia's development and provides a science-based competitive advantage for competition on domestic in and overseas markets, such as complex breeding programs.

TOR 3.2 Improving sustainability and life-cycle management practices and outcomes

A relatively recent phenomenon for the seafood industry has been that both wild-catch and aquaculture fisheries must address and meet performance standards for sustainability and lifecycle management.

In this regard, the dominant operator in Australia's highest value sector (aquacultured Atlantic Salmon in Tasmania) released its first sustainability report in 2012 — the first significant lifecycle review for a large Australian seafood company. Further reports are expected each year.

The report details the company's sustainability achievements to date and provides a snapshot of future sustainability initiatives across all operations of the business.

The Tassal Sustainability Report is at:

http://www.republicast.com/publications/a0a440a31fa04e2bb73922f8051e8b6a/default.htm#p=1&c=0&v=1

The inaugural sustainability report reflects a view that the company is a global leader in sustainable aquaculture from an environmental, operational and financial perspective.

The report was overseen by a committee that advises Tassal on social, environmental and cultural issues. It comprises representatives from environmental non-government organisations; the Tasmanian Department of Primary Industries, Parks, Water and Environment; the Environment Protection Authority; Forestry Tasmania; a social inclusion advocate; and recreational users of Tasmanian waterways.

Looking at the broad stakeholder expectations behind this report, there is a widely held expectation that aquaculture in all its forms (onshore ponds, food and industrial, marine ranching cages, recirculation systems, grow-out, hatchery, etc.) will make no demands on, or have any impact on, the natural environment. In an operating sense, this means that aquaculture should use less water, should use feeds produced from outside the seafood industry (reducing reliance on fish meal), should employ people on terms that are acceptable to the labour market, should not release any wastes to the external environment, and should use less inputs than comparable food production systems.

Since the report clearly seeks to demonstrate Tassal's commitment to and compliance with these broader community expectations, it is a welcome new benchmark for the Australian fishing and aquaculture industry.

Areas for future RD&E effort

- Standardise nationally the environmental assessment and reporting requirements for aquaculture.

TOR 3.3 Pest and disease management and mitigation

This topic is discussed on page 26.

TOR 4 GOVERNANCE ARRANGEMENTS RELATING TO FISHERIES AND AQUACULTURE

CURRENT GOVERNANCE ARRANGEMENTS

RD&E planning environment

In 2010, the Primary Industries Ministerial Council approved *Working Together: the National Fishing and Aquaculture RD&E Strategy 2010*. This landmark document sets out future directions to improve the focus, efficiency and effectiveness of RD&E in support of Australia's fishing and aquaculture industry.

A key concept of the strategy is one of *major*, *supporting*, and *linking* (major–support–link) roles in RD&E. The three elements are as follows:

- *Major*: National-level RD&E is developed by leading institutions having major capabilities.
- *Support*: In support of major RD&E, a component of national-level RD&E may be provided by an institution with high levels of expertise in a particular field, under the leadership of another jurisdiction.
- *Link*: Links are established to extend the results of R&D effectively to end-users at the regional or local level.

"Major–support–link" arrangements aim to reduce duplication in effort and infrastructure, improve efficiencies and maintain key national capabilities. Changes in research capacity need to be undertaken sensitively, especially to ensure experienced scientists are retained to support the new arrangements and infrastructure is utilised to maximum effect. To ensure a smooth transition, the FRDC has participated with key stakeholders to develop three facilitating bodies: the National Priorities Forum, Research Providers Network, and Extension and Adoption Working Group. The bodies will work together to progress the allocation of activities and responsibilities against the "major–support–link" framework. Implementation of any component will depend on coordinated implementation by individual state and territory ministers.

Running in parallel to the development of the national strategy has been the FRDC's most recent five-year RD&E plan, Investing for tomorrow's catch: the FRDC's Research, Development and Extension Plan 2010–2015, which is the Corporation's core strategic document for its investment in the fishing and aquaculture industry.

The RD&E plan sets out five programs and fourteen theme areas that replicate the programs and themes in the National Fishing and Aquaculture RD&E Strategy, ensuring that the FRDC gives effect to the national strategy. The Corporation has rigorously aligned its programs, structures, documents, RD&E activities and governance regime to the legislative and other requirements of the national planning environment, as illustrated in figure 6 on page 36.

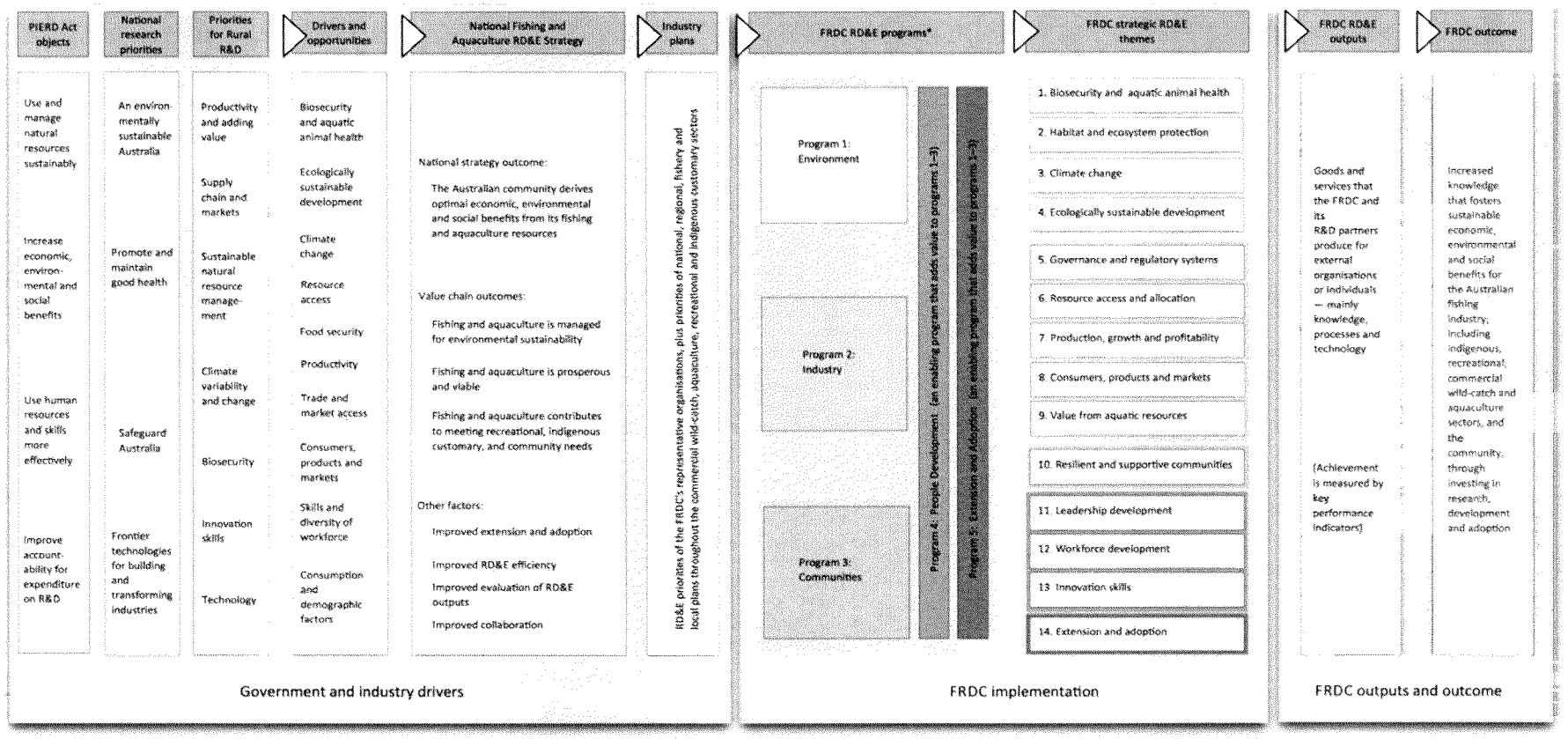
Legislated objects and national priorities

The FRDC liaises closely with its two ministers and the Department of Agriculture, Fisheries and Forestry to ensure that it delivers results in accordance with both the Australian Government's national research priorities and its priorities for rural R&D. The FRDC has

developed explicit programs (e.g., Climate Change) to ensure the translation of those priorities into its planning and reporting systems. At a higher level, the national priorities and the FRDC's four legislated objects are addressed in its RD&E programs and its reporting. The priorities themselves are outlined in figure 7 (page 37). Other significant national plans and policies, including those of the fishing and aquaculture industry, are also addressed appropriately.

Figure 6: The FRDC'S framework for integrating legislative, government and industry priorities

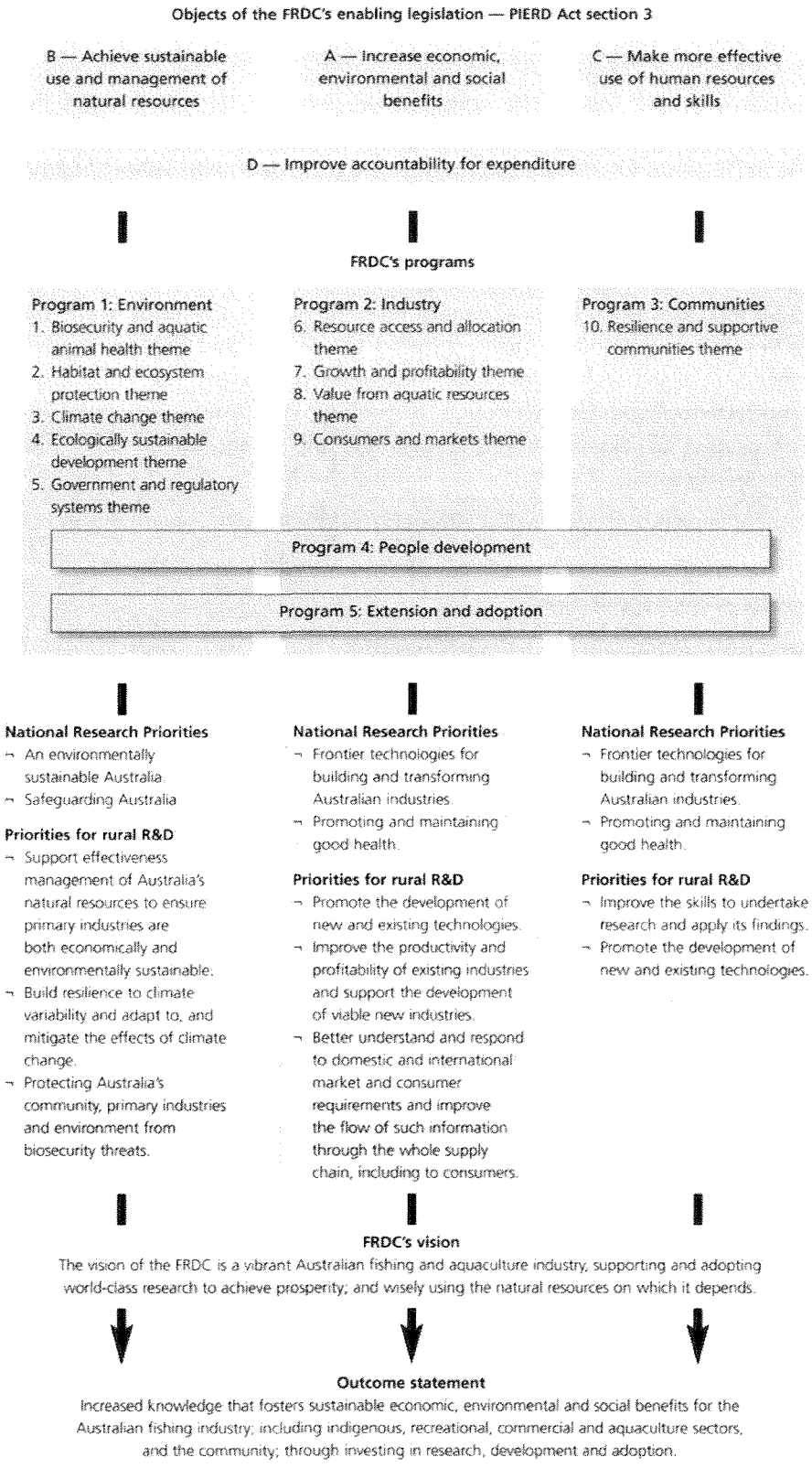
When viewing this diagram on screen, you can zoom in by clicking the "+" button on your PDF viewer



* An additional program (the Management, Communications and Accountability Program) derives from the fourth object of s.3 of the PIERD Act. It does not undertake RD&E activities.

The wording of the PIERD Act objects, national research priorities and priorities for rural R&D has been heavily condensed in this diagram. The full text is available via www.frdc.com.au/plans

Figure 7: The FRDC's legislative, government and industry priorities



The FRDC's objects, derived from section 3 of the PIERD Act, are the cornerstone of its vision and planned outcome. Further, the FRDC's RD&E programs mirror directly the core themes of sub-sections 3(a) to 3(c) of the PIERD Act. This alignment has brought simplicity and robustness to the FRDC's RD&E planning, implementation and reporting, and to many of its kindred organisations. It has also facilitated a triple-bottom-line approach to funded activities.

The FRDC invests in RD&E across the whole value-chain of the commercial fishing and aquaculture industry, and for the benefit of both recreational and indigenous fishers. Through its investment, the FRDC seeks to achieve maximum leverage by providing research administration and services using a value-adding model. Research projects are tailored to deliver a specific outcome, and are actively managed and monitored.

The value proposition to running the value-adding model at minimal cost, compared to a simple "granting" model for research and development funding, is that the returns are significantly better. This is because more time is spent ensuring the design and implementation of each project is correct and aligns with stakeholders' specified outcomes. The FRDC manages the value-adding model's implementation through its ongoing investment in systems that deliver best practice in project development and assessment and integrated project, financial and human resource management.

A variety of flexible investment approaches characterise the FRDC's investment in RD&E. They include:

- an open call for project applications
- formal partnership agreements with industry sectors
- subprograms and coordination programs tailored to specific industry sectors or activity
- short-term tactical research investment
- specifically targeted commissioned RD&E, especially where there is market failure by private investment.

The framework for FRDC RD&E planning

Within the governance framework outlined above, the FRDC sets its strategic directions by facilitating and consolidating the views and priorities of all its key stakeholders. Chief among them are government investors and the Corporation's industry representative organisations: the Commonwealth Fisheries Association, the National Aquaculture Council, and Recfish Australia. Since fishing and aquaculture RD&E has to be well tuned to the many diverse, and often competing, uses and users of aquatic resources, the Corporation has strong, wide-ranging links with its stakeholders. Government entities (especially fisheries management and other natural resources management agencies) are equal with industry entities in their significance.

To undertake its RD&E planning activities, the FRDC maintains formal structures and processes, including:

- Commonwealth, state and territory Fisheries Research Advisory Bodies (FRABs), which undertake RD&E planning relating to their respective jurisdictions
- subprograms, such as the aquatic animal health subprogram
- coordination programs that undertake RD&E planning on a national scale, such as the social sciences research coordination program.

Benefits from the National Fishing and Aquaculture RD&E Strategy

The National Fishing and Aquaculture RD&E Strategy 2010 is providing:

- an agreed national RD&E plan linked to an agreed assessment of the state of the industry and the drivers for change, which the FRDC has used as the basis for its own RD&E Plan
- a forum of all stakeholders for determining and reviewing national priorities and discussing national RD&E policy development
- networks for R&D and extension and adoption (E&A) that include representation across the industry
- future development of a more efficient R&D delivery structure based on a national–regional hub model that describes "major–support–link" arrangements for each theme.

The FRDC's commitment to the Strategy has resulted in:

- improved efficiencies in planning through less fragmented advice and having one plan
- improved efficiencies in research collaboration from the new Research Providers' Network
- a single E&A Network that has reduced the cost of FRDC consulting on development and implementation of its new E&A Program.

It is anticipated that end-users of RD&E, and the FRDC, will derive further benefits from a more consolidated national approach to planning, consultation and investment.

Areas for future RD&E effort

- Continue to develop and implement the national Fishing and Aquaculture RD&E Strategy.
- Support "major–support–link" arrangements to enhance research capacity.
- Finalise the "major–support–link" process as part of the research providers network
- Strengthen investment in extension and adoption by ensuring stronger links to end-users.
- Secure ongoing commitment and engagement by governments to the Research Priorities Forum.

TOR 5 CURRENT INITIATIVES AND RESPONSES TO THE ABOVE MATTERS BY GOVERNMENTS

The FRDC, at the behest of its stakeholders, established an initiative to better communicate and extend research and development outputs and outcomes to the community and the consumer. The initiative was developed in consultation with Dr Mike Kelly, MP, when he was the Parliamentary Secretary. The Corporation has historically focused the majority of its communication and extension activities on end-users of the information: industry, fisheries managers and scientists.

Internationally, Australia is highly regarded for its fisheries and aquaculture management. However, during the last decade the Australian community's perception of the Australian

seafood industry's sustainability has declined significantly. At present, only a quarter of Australians believe the industry is sustainable. This perception has been reflected by retailers and the food service sector seeking assurances that seafood supplies are derived from sustainable natural resources. Similar trends are evident towards recreational and indigenous cultural fishing.

A key driver of unfavourable perceptions is negative and factually incorrect media reporting. This arises from journalists incorrectly assuming that what happens overseas also happens in Australia, or simply misinterpreting or misrepresenting the science.

The FRDC initiative for promoting science plans to address this through developing:

- briefings on key issues and topics for all stakeholders (including the community, consumers, environmental NGOs, the finance sector, and the food service sector)
- a national stock status report for Australia's wild-catch fisheries
- sustainability indicators for Australia's aquaculture sector.

The strategy contains four key areas:

- industry unity
- media relations
- community relations
- stakeholder advocacy "influencers".

Under each of these key areas, activities and projects (new and existing) will be undertaken by members of the commercial, recreational and indigenous cultural sectors of the industry, and by government employees and researchers.

In some activities, a few stakeholders will work together; for example in developing briefing notes on specific fishery issues and responding to factually incorrect media stories or information in the public arena.

Targeted projects, on the other hand, are discrete bodies of work such as those outlined below. These projects may produce outputs such as web resources, fact sheets or briefing notes. They will include a national fisheries stock status report; *Let's Talk Fish*, to influence conversations about the sustainability of wild-catch fishing; and strategic media training for the seafood industry

Central to the strategy is coordination and collaboration, focused on driving towards improving community understanding of sustainable fishing practices and the positive contribution of seafood and angling activities to economic, environmental and social wellbeing.

THE FRDC'S ROLE IN THE STRATEGY

The primary role the FRDC will undertake is media relations; with a focus on the development of factual information and its dissemination for ease of digestion. The rationale is this approach:

- complements the FRDC's intent to expand its extension and adoption activities
- leverages the FRDC's past $800 million investment in research, development and extension
- is consistent with the priorities of the FRDC's representative organisations and government
- provide a set of tools that will ensure best return from related investments in the strategy's other three key areas.

Key areas in which the FRDC will operate include:

- the Internet and associated enabling technologies as the central point from which the FRDC will disseminate information
- coordination of responses by appropriate industry stakeholders who are best equipped to respond
- proactively engage with the media about the industry and current research
- development of new stories for media consumption, meeting the demand by staff-constrained media agencies for ready-made stories with images
- development of a stakeholder database for tracking stories and build partnerships with journalists
- easily digestible information in a simple format — beyond fact sheets, extending to baseline data, new articles, accurate images and presentations.

Areas for future RD&E effort

- Execute the elements of the FRDC strategy to promote the science and best practice that underpins the Australian seafood and recreational fishing industry.
- Invest in improved reporting on the performance of Australia's fishing and aquaculture sectors (including publication of the status reports)
- Ensure previous investment in RD&E is more readily available for community use
- The FRDC and its industry partners and community stakeholders also intend to consider and pursue investments in non-RD&E activities (including marketing and promotion).

TOR 6 OTHER RELATED MATTERS

The five terms of reference have allowed the FRDC to present a comprehensive coverage relevant to the Inquiry. Therefore, discussion of further matters is not necessary.

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