

Australasian Institute for Spiny (Rock) Lobster Research

A Concept Study

April 2018

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Executive Summary

This report is a Concept Study designed to articulate a *prima facie* case for the establishment of an **Australasian Institute for Spiny (Rock) Lobster Research** (the 'Proposed Institute'). By identifying and executing a research agenda that is acutely targeted at the knowledge and technology needs of the Australian lobster industry, the Proposed Institute will assist the industry in its goal of at least doubling GVP to A\$1.3 billion within 10 years.¹

The Australian lobster industry is currently the Nation's most valuable seafood industry and one of its most important primary industries. While there are numerous species of spiny lobster native to Australian waters, the current Australian lobster industry is based on the wild-capture, processing and primarily export of four species of spiny lobster – Western Rock Lobster (*Panulirus cygnus*), Southern Rock Lobster (*Jasus edwardsii*), Eastern Rock Lobster (*Sagmariasus verreaux*) and Tropical (or Ornate) Lobster (*Panulirus ornatus*).

The Australian lobster industry produces a total GVP of approximately A\$670 million, accounts for 4 percent of total global lobster supply and 14 percent of global spiny lobster supply. The vast majority of the volume of Australian lobster supply, and approximately 60 percent of the industry's GVP is produced from the Western Rock Lobster sector, with the Southern Rock Lobster sector being the second largest and, currently, fastest growing sector of the industry.

Strategic Case for an Australasian Institute for Spiny Lobster Research

The approximate 300,000 tonnes of lobster product produced globally in 2015 had a value of US\$3.75 billion, representing approximately 2.8 percent of the global seafood industry. Over the past five years, there have been three notable trends in global lobster production:

- Production of American Clawed Lobster has increased and continues to dominate global lobster supply;
- A decline in production of other northern hemisphere, cold water lobster species, primarily from European fisheries; and
- An increase in production of spiny lobster species, driven primarily by increased production of various tropical spiny lobster species.

While it typically attracts premium pricing, Australian wild-caught lobster production represents only a small portion of global supply. Furthermore, its market share is under constant threat from Caribbean Spiny Lobster and particularly production of various species of tropical spiny lobster, increasing volumes in the latter of which are produced from grow-out systems in South East Asia based on harvested puerulus.

Recent trade history in global lobster markets exhibits several key trends:

- North American markets continue to dominate global lobster trade;
- The European Union remains a significant market, but demand has plateaued;
- The People's Republic of China (PRC) is a rapidly expanding market for lobster; and

¹ This target is based on a Western Rock Lobster target to increase GVP from A\$453 million in 2015-16 to A\$1.0 billion by 2028. Should other sectors of the Australian Lobster industry subscribe to the Proposed Institute, growth targets for those sectors will be included.

- Despite increased production, spiny lobster species market share is being displaced by American Clawed Lobster in all key markets, a trend that is particularly evident in Japan and the PRC.

Overall, global demand for lobster is increasing, including in markets traditionally supplied by the Australian lobster industry. However, in all instances, the vast majority of new demand is being met by increased imports of American Clawed Lobster. This overall trend, combined with the threat of increased supply competition from grow-out produced tropical spiny lobster supply from South East Asia is a significant threat to the Australian lobster industry's goal of achieving GVP of at least A\$1.3 billion within 10 years.

Australia is the world's second largest producer of spiny lobster species and its lobster industry can be described according to the following dynamics:

- The Western Australian industry dominates Australian lobster production;
- Prosperity is currently driven by a single product sold to Asian markets;
- The domestic lobster market is very small;
- There is price discrepancy across Australian lobster product; and
- There is limited coordination between the different sectors of the Australian lobster industry.

Strong product similarity, particularly between Southern Rock Lobster and Western Rock Lobster, indicates that more could be done to achieve higher prices for a larger volume of Australian lobster production, and more can likely be done to expand the domestic market for lobster product.

A number of characteristics render the Western Australian lobster industry the leading sector of the national industry and motivates Western Australian lobster industry stakeholders to use this leadership to advance the interests of the Australian lobster industry. Namely the Western Rock Lobster industry:

- Is a key sector of the Australian seafood industry in its own right;
- Is a world-leader in fisheries resource management;
- Is a global leader in Marine Stewardship Council (MSC) certification;
- Is a global leader in the processing of product for premium markets;
- Is an important component of the Western Australian economy;
- Is a major driver of regional Western Australia;
- Shares the resource with an important recreational fishery; and
- Is a basis for an emerging culinary tourism industry in Western Australia.

This leadership position should not serve to discount the significant and expanding contribution made by other sectors of the Australian lobster industry. This Concept Study has focused on preliminary identification of new knowledge and technology needs that are likely to be common to all sectors of the Australian lobster industry. Western Australia hosts significant expertise in lobster research, particularly in the area of fisheries management and stock forecasting. However, considerable other important expertise is more widely distributed, and in some cases fragmented. To be optimally effective, the Proposed Institute will need to incorporate this wider expertise, or at the very least have formal links with it.

A strategic case for the Proposed Institute is founded in the following:

- Lobster is a Nationally important industry with significant opportunity for growth;
- There are significant threats to the competitiveness of Australian lobster;

- Opportunities and threats can only be addressed through the development and commercialisation of new knowledge and technologies designed to address the specific opportunities and threats; and
- To be effective, there must be a concerted, strategically targeted and coordinated investment in developing that knowledge and those technologies

Contemporary Australian Lobster Industry Knowledge and Technology Needs

This Concept Paper has developed a preliminary set of high-level knowledge and technology needs of the Australian lobster industry that will need to be addressed for the Industry to progress toward its goal of achieving a profitable GVP of at least A\$1.3 billion within 10 years. It must be stressed that this preliminary set of needs has been subjected to very limited consultation, and a comprehensive research planning exercise will be one of the first steps in establishing the Proposed Institute.

The following table summarises the preliminary research agenda.

Program	Subprogram
Program 1: Maintaining Optimal Sustainable Harvest	Improving the accuracy of stock assessments
	Impact of climate change on the fishery
	Impact of marine noise on the fishery
	Impact of recreational and tourism use of the marine environment on the fishery
	Impact of increased coastal and urban and industrial development on the fishery
	Risk assessment of invasive species and pathogens
	Cumulative impact modelling
Program 2: Improving Productivity in the Fishing Effort and Maintaining Social License to Operate	Economics of Lobster fishing enterprise
	Efficient vessel design
	Efficient pot handling
	Crew health and welfare
	On-board digital systems
	Improved catch targeting
	Bait alternatives
Program 3: New Australian Lobster Products and Markets	Wildlife protection systems
	Capitalising on the Australia-China Free Trade Agreement and other Trade Agreements
	Australian Lobster product diversification
	Development of new export markets (including development of in-market consumer knowledge and development)

Program	Subprogram
	Domestic market development
Program 4: Downstream Productivity and Supply Chain Optimisation	Digital integration for product traceability and supply chain management
	Processing plant automation
	Improving live product survival rates
	Packaging for optimal product quality
	Australian Lobster supply chain economics
Program 5: Profitable Lobster Aquaculture and Feedlots	Aquaculture production of Australian tropical lobster species
	Feedlot systems design and husbandry practice
	Nutrition for effective feedlot production of Australian Lobster
	Australian Lobster moulting biology
	Managing animal health in Australian Lobster feedlot and aquaculture operations
Program 6: Policy for Growth	Risk and Ecosystems Based Fisheries Management
	Best practice co-management
	Best practice taxation of industry
	Best practice regulation of the recreational sector
	Governance, leadership and people development

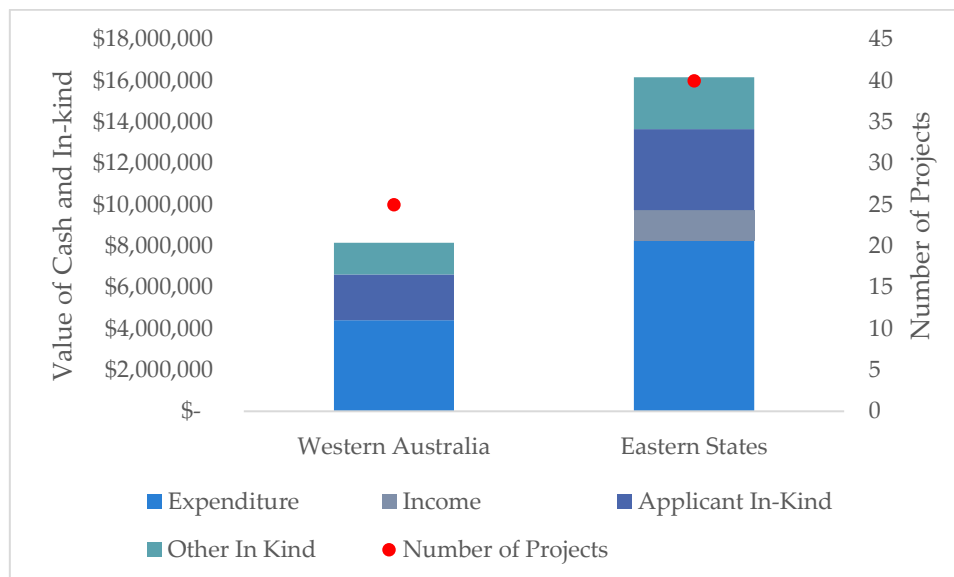
While the Australian Lobster industry competes with production from other countries, there are pre-competitive issues (such as aspects of social license to operate) in which the global industry has a mutual interest. It is envisaged that the Proposed Institute will seek out international linkages for research in such areas.

Current Research Funding for the Australian Lobster Industry and Implications for the Proposed Institute

A key consideration in assessing the case for the Proposed Institute is whether it is able to marshal a greater level of resources to fund and facilitate research and development targeted at developing solutions for the issues identified by the Australian lobster industry than is currently the case. The primary vehicle through which the Australian lobster industry currently invests in industry-oriented research and development is the Fisheries Research and Development Corporation (FRDC).

As a component of payments made to the Western Australian Government via the resource access licence fee, the Western Rock Lobster industry currently makes an indirect contribution to the FRDC of approximately A\$1.0 million per annum. Under current funding arrangements, the Western Rock Lobster industry then receives slightly less than this amount in FRDC expenditure on projects that directly address its needs through its Industry Partnership Agreement with the FRDC. Historically it has received around 50 percent of its indirect investment with the FRDC under this mechanism.

Furthermore, while the Western Rock Lobster sector produces the majority of Australian lobster industry GVP, FRDC investment in projects it deems to be relevant to the Australian lobster industry during the period 201-11 to 201-18 have been substantially less for projects initiated by Western Australian lobster industry interests more generally than those initiated by eastern states lobster interests. This is illustrated in the following diagram.



During the period 2010-11 to 2017-18:

- The FRDC invested, through its various mechanisms, a total of approximately A\$12.7 million across 65 research projects the FRDC deemed to be relevant to the Australian lobster industry.
- The vast majority (77 percent) of FRDC funds that have been committed to research projects deemed by the FRDC to be relevant to the Australian lobster industry, are by virtue of the Australian lobster industry being party to their initiation, indeed relevant to the Australian lobster industry.²
- However, while almost 90 percent of the total FRDC expenditure associated with projects initiated from eastern states lobster interests were initiated by the industry either acting alone or in collaboration with another sector of the Australian seafood industry or a state government, only 54 percent of the funding associated with projects initiated by Western Australian lobster interests had been initiated by the lobster industry, and half of those were in collaboration with the Western Australian government.
- Only the Western Australian industry has had FRDC funded projects deemed relevant to the lobster industry, initiated by other sectors of the industry without express co-initiation from the lobster industry.
- The FRDC funded a total of 34 projects with a total FRDC expenditure of approximately A\$7.0 million through the Southern Rock Lobster, Abalone Council of Australia and Western Rock Lobster Industry Partnership Agreements. Projects initiated by eastern states interests (Southern Rock Lobster and Abalone Council of Australia) accounted for 71 percent of the projects and 82 percent of the FRDC expenditure on those projects. The eastern states industry also achieved superior leverage from FRDC expenditure through their Industry Partnership Agreements.

² This assumes that because the Australian lobster industry has been the sole or co-initiator of a specific project, that project can be deemed to be of relevance to the Australian lobster industry.

- Through the Western Australian, Tasmanian, New South Wales and Victorian Regional Advisory Committee FRDC funding mechanism and a similar mechanisms pertaining to the Torres Strait Regional Authority, the FRDC funded 15 research projects deemed relevant to the Australian lobster industry for a total FRDC expenditure of approximately \$3.2 million. Over half of these projects and almost 70 percent of the associated FRDC expenditure under these mechanisms is attributable to the Western Australian Regional Advisory Committee.

The Western Rock Lobster industry makes a significant indirect contribution to the FRDC, the majority of which is directed to fund research for other Australian fishing sector interests. This is primarily a function of relatively lower hypothecation factors in the Western Rock Lobster Industry Partnership Agreement, a lower level of project proposals presented to the FRDC by the Western Rock Lobster industry and a significant number of the proposals that have been presented being deemed by the FRDC decision-making framework as either not viable for FRDC funding or not competitive.

Preliminary modelling suggests that eastern states lobster interests, and to a lesser extent the Western Australian government will be financially motivated to retain the current mechanism for funding Lobster research unless a substantially compelling case can be presented.

If the Proposed Institute is able to facilitate historical best practice leverage against FRDC expenditure, or even bring all of the industry up to at least average leverage practice, it will generate substantial additional resources. By actively seeking out a much wider range of leverage sources, it should be able to further enhance leverage, bringing significant additional research resources to bear on solving opportunities and challenges identified by the Australian lobster industry.

Finally, given the objective of the Proposed Institute is to grow Australian lobster industry GVP, under the current FRDC funding arrangements, the success of the Proposed Institute in achieving this objective, will result in a concomitant increase in research resources for both the Australian lobster industry, and all other Australian fisheries.

Structural Consideration for the Proposed Institute

Multi-sector, multidisciplinary, mission-oriented formal research collaborations such as that being proposed are common-place in most developed nations (including Australia) and in primary industries generally. The Australian and Western Australian Governments continue to invest in the establishment and operations of such collaboration in industries that are deemed to be of national or state importance.

Mission-oriented research collaborations can adopt a number of structural forms. While a precise structure cannot be determined until a research agenda has been finalised, and resources and participants are committed, it is likely that the Proposed Institute will adopt a hybrid model, combining some proprietary infrastructure and expertise, and formal partnerships with external research providers across Australia and internationally. There are a number of existing options in Western Australia with respect to meeting infrastructure requirements including infrastructure currently operated by the Australian Centre for Applied Aquaculture Research, Batavia Coast Marine Institute, Waterman's Fishery Research Centre and Fisheries WA Hillary's Research Centre.

Key potential participants and stakeholders in the Proposed Institute include Australian lobster fishers, Australian lobster processors, Australian fishery regulators, lobster industry advocates, recreational lobster sector advocates, Australian universities, Australian Institute of Marine

Science, CSIRO, South Australian Research and Development Institute, FRDC, Commonwealth Department of Agriculture and Water Resources, State departments of primary industry, international seafood distributors and retailers, international lobster research programs and the wider community.

While an operating budget for the Proposed Institute cannot be established in the absence of more detailed planning with respect to research agenda, activities and structure, it is expected that the operating budget would at the very least, be in the range of A\$0.5 to A\$1.0 million per annum, excluding investment in research projects.

Resourcing Options for the Proposed Institute

The first immediate potential source of resourcing for the Proposed Institute is the FRDC. By combining the Southern Rock Lobster and Western Rock Lobster FRDC Industry Partnership Agreements in pursuit of the Proposed Institute's research agenda, and optimising leverage under those agreements, substantially greater resources could be bought to bare for the benefit of the entire Australian lobster industry.

Furthermore, other Commonwealth programs could also be used to leverage industry and other stakeholder investment in projects that are aligned with the Proposed Institute's research agenda. This Concept Paper has identified a total of 11 other government sources that could potentially be the source of additional leverage.

While an additional and broader industry levy is also a potential option for resourcing the Proposed Institute, many fishers are likely to resist paying additional fees for research when they are already contributing, and levying a fee on the supply chain downstream from fishers could also prove difficult. The optimisation of in-kind support and use of research students at a project level are also likely to prove important considerations for the economics of the Proposed Institute.

Governance Considerations for the Proposed Institute

Strong and effective governance systems are one of, if not the most important factor in the success of a mission-oriented collaborative research institute. To be optimally effective, a governance framework must be tailored for the specific governance context of the organisation (in this case a multi-sector, multi-disciplinary, mission-oriented collaborative research institute), which is determined by a wide range of factors.

Because the research priorities, activities, structure, resourcing arrangements and participation in the Proposed Institute has not as yet been determined, its governance context cannot be adequately defined. There are however, a number of principles that should be considered in developing the governance framework for the Proposed Institute that, if adhered to, will ensure the high quality decision-making that will be required to underwrite the Proposed Institute's success.

It is likely that irrespective of the specifics of the governance context some key principles such as the following will be required:

- Separation of 'ownership', governance and management responsibilities;
- Strategic research plan that determines areas of research in which the Proposed Institute may invest;
- End-user and independent oriented membership of the peak strategic and operational decision-making body;

- Multi-stage research investment decision-making that ensures technical and end-user credibility in research projects that are funded by the Proposed Institute; and
- Decision-making accountability at all levels of institute and project management.

Moving Forward

This Concept Paper makes a *prima facie* strategic, research needs and funding case for the Proposed Institute. To progress toward design and implementation of the Proposed Institute, the following actions are recommended:

- **Wider Consultation**
Unless the Proposed Institute has in-principle support from the National lobster industry (fishers and processors) and access to a critical mass of the National lobster innovation ecosystem that will be necessary to deliver on the Proposed Institute, its success will be limited to the Western Rock Lobster industry only. This Concept Paper should be used as a tool for attaining input from a wider set of key stakeholders.
- **Research Priorities Plan**
Should adequate in-principle support for the Proposed Institute be identified, the first step in its establishment will be to develop the Research Priorities Plan that will determine the specific nature of specific research investments that will be made by the Proposed Institute in its first five years of operation. It is this end-user driven document that fundamentally underpins the purpose, credibility and success of the Proposed Institute.
- **Capability Assessment and Gap Analysis**
A detailed assessment of research capability that is relevant to the needs identified by the Research Priorities Plan should be undertaken to identify important research partners in Australia and overseas.
- **Business Plan**
A detailed and 'bankable' business planning exercise should be undertaken to determine the optimal organisational and legal structure of the Proposed Institute, any infrastructure or human resource requirements, management structure, operating plan, operating budget and resourcing options.
- **Governance Framework and Charter**
A detailed governance framework that will guide decision-making at the Proposed Institute should be developed and produced as a Governance Charter. Based on a clearly defined governance context, this important document will prescribe issues such as Board function, composition and operations; executive functions and responsibilities; research investment decision-cycle; research project management cycle; and other important aspects of organisational decision-making.
- **Structural Agreements**
Finally, term sheets for any contractual arrangements that are required to give effect to the Proposed Institute will need to be developed.

1. Background and Overview

The Australian lobster industry is the Nation's most valuable seafood industry and one of its most important primary industries. While there are numerous species of spiny lobster native to Australian waters (some commercial species of which are endemic to Australia), the current Australian industry is comprised of wild catch fisheries and downstream processing operations based on the four species of spiny lobster summarised in Table 1 below.





Species	Common Names	Distribution	2014-15 Catch (t)	2014-15 GVP (A\$m)
<i>Panulirus cygnus</i> 	Western Rock Lobster , Western Australian Crayfish, Western Cray	Shark Bay, down the Western Australian coast to Albany.	6,127	385.9
<i>Jasus edwardsii</i> 	Southern Rock Lobster , Cray, Crayfish, Melbourne Crayfish, Red Rock Lobster, Southern Lobster, Southern Spiny Lobster, Tasmanian Crayfish	From Geraldton in Western Australia, around the southern coast of Australia (including Tasmania) and up to Coffs Harbour in New South Wales (Also a significant industry in New Zealand).	2,892	238.0
<i>Sagmariasus verreaux</i> 	Eastern Rock Lobster , Crayfish, Green Rock Lobster, Local Lobster, Packhorse Crayfish, Sydney Crayfish	From the New South Wales and Queensland Border, down the east coast of Australia to Bass Strait (Also a minor industry in New Zealand).	156	11.4
<i>Panulirus ornatus</i> (and other Tropical Lobster species) 	Tropical Rock Lobster , Coral Crayfish, Doublespine Rock Lobster, Green Crayfish, Ornate Rock Lobster, Painted Crayfish, Rock Crayfish, Scalloped Lobster, Tropical Spiny Lobster	Margaret River in Western Australia, around the northern coast of Australia to the Central New South Wales Coast (Also a significant fishery throughout the Indo-Pacific Region)	1,134	32.3
TOTAL			10,309	667.6

TABLE 1 – AUSTRALIAN SPINY LOBSTER INDUSTRY – SNAPSHOT 2014-15³

The purely wild-catch fishery that harvests this resource and the seafood processing sector that produces marketable product accounts for approximately 4 percent of global lobster supply and 14 percent of global spiny lobster supply. It is a very well managed fishery, with the Western Rock Lobster fishery being the first fishery in the world to be granted certification as an ecologically sustainable fishery from the Marine Stewardship Council (MSC).

³ Images courtesy of Western Australian Department of Primary Industries and Regional Development, Primary Industries and Resources South Australia and Australian Museum

The vast majority of Australian lobster product is exported chilled or live to Asia via distribution centres in Vietnam and Hong Kong Special Administrative Region (Hong Kong SAR), albeit this is rapidly changing as a result of the Australia – China Trade Agreement. The industry faces significant opportunity to increase both the volume and value of supply and to develop new products and markets. However, it also faces significant challenges in the form of competition from other producers of lobster product and alternatives to conventional wild-harvest, as well as the generally fickle nature of seafood markets and the high level of product substitution in those markets.

It is entrepreneurship and industry leadership that will ultimately ensure that the industry is able to capitalise on these opportunities and mitigate the risk posed by these threats. However, to be equipped to perform this task, businesses and industry leadership must be adequately equipped with the scientific knowledge and technologies that will enable industry to achieve productivity growth, increase output and maintain and grow market share in existing and new markets. This can only be achieved by an industry driven, end-user focused research program that is acutely targeted at generating the knowledge and technology required to achieve these objectives.

The peak industry body for the Western Rock Lobster Industry (which as illustrated in Table 1 above accounts for approximately 60 percent of the Australian spiny lobster industry's GVP), believes that an institute that is focused on developing this knowledge and technologies will make a significant contribution toward the Australian Lobster industry at least doubling its GVP to A\$1.3 billion within 10 years.⁴

This Concept Study is the first step toward the development of a proposed Australasian Institute for Spiny Lobster Research (the 'Proposed Institute')

1.1. Nature of this Concept Study

The observations and recommendations in this Concept Study are of a preliminary nature only. The strategic analysis that underpins the case for the Proposed Institute, although sound, is not exhaustive, the proposed research agenda is preliminary in nature, resourcing options have not been fully analysed and a business plan and governance framework cannot be fully established until a number of structural issues have been determined.

Most importantly, the stakeholder consultation on which the Concept Study has been based has been limited to the individuals listed in Appendix 1. This has been largely Western Rock Lobster industry centric and even within the Western Rock Lobster Industry, consultation has been limited. A primary purpose of this Concept Study is to communicate the concept to a wider range of Western Australian and Australian industry stakeholders for further input, refinement and validation of the proposal. Should adequate 'buy-in' to the concept be achieved from this wider consultation process, an investment in the comprehensive end-user driven research plan, 'bankable' business case and governance charter for the Proposed Institute will be made. If adequate 'buy-in' is not achieved the Western Rock Lobster Council will give due consideration to progressing the initiative with an initial focus on the Western Australian Lobster industry.

⁴ This target is based on a Western Rock Lobster target to increase GVP from A\$453 million in 2015-16 to A\$1.0 billion by 2028. Should other sectors of the Australian Lobster industry subscribe to the Proposed Institute, growth targets for those sectors will be included.

1.2. Structure of this Concept Study

This Concept Study is structured to articulate the case, as it is currently understood, for the Proposed Institute, the envisaged nature of research that would be undertaken, possible resourcing options, structural considerations, governance issues and a recommended pathway forward. While the Concept Study makes some recommendations, the nature of those recommendations are preliminary and subject to further consultation.

For the purpose of assisting the reader in navigating the content of this Concept Study, Table 2 below summarises the chapters.

Chapter	Summary
<ul style="list-style-type: none"> Background and Overview 	Chapter 1 provides a very high level of overview of the Australian lobster industry, why the Proposed Institute is required and describes the nature and limitations of this Concept Study.
<ul style="list-style-type: none"> The Strategic Case for an Australasian Institute for Spiny Lobster Research 	Chapter 2 provides an evidence-based articulation of the competitive position of the Australian lobster industry in the global lobster industry and international seafood markets. It describes key industry and market dynamics and trends and the opportunities and threats posed to the Australian lobster industry by those dynamics and trends. It also discusses key domestic market and industry issues. This analysis forms the basis for why investment in focused research is required, and the preliminary basis for research investment prioritisation. It makes a case as to why Western Australia should and is motivated to take a leadership role in this endeavour, but for an optimal outcome will endeavour to engage with and incentivise the National industry and the more nationally distributed Lobster research capability.
<ul style="list-style-type: none"> Australian Lobster Knowledge and Technology Needs 	Chapter 3 provides a preliminary, rudimentary assessment of the broad knowledge and technology needs that must be developed to facilitate profitable expansion of the Australian lobster industry. This assessment has been based on very limited consultation and is designed only to serve as a basis for further discussion and the development of a comprehensive research priorities plan based on an assessment of the state-of-the-art and consultation with key stakeholders.
<ul style="list-style-type: none"> The Current Industry Investment in Research and Development 	Chapter 4 explains, to the extent that is possible from information available in the public domain, the main investment that is currently made by the Western Australian and eastern states sectors of the Australian lobster industry in industry-oriented research and development through the Fisheries Research and Development Corporation. This assessment approximates the amount of that investment, explains the mechanisms through which the investment is made and leveraged, and analyses the destinations of that investment. It serves to demonstrate that there is scope to both increase industry research investment leverage and the scope of research across which leveraged funds could be invested.
<ul style="list-style-type: none"> Structural Considerations for the Proposed Institute 	Chapter 5 identifies a number of structural issues that will need to be considered in the formulation of the Proposed Institute. Optimal structural form and operating budget will very much be determined by the extent and nature of its agreed research agenda, the extent to which it will operate any research infrastructure or directly employ research expertise, and the number and nature of formal participants in the Proposed Institute.
<ul style="list-style-type: none"> Resourcing Options for the Proposed Institute 	Chapter 6 describes how current industry contributions to the FRDC could theoretically be redirected to support research undertaken by the Proposed Institute, and identifies other government programs that could prove potential

Chapter	Summary
	sources for further leverage or to support identified research needs that are beyond the scope of the FRDC's research remit.
<ul style="list-style-type: none"> Governance Considerations for the Proposed Institute 	Chapter 7 discusses key governance issues associated with research collaborations and identifies a number of key governance principles that will likely be necessary to underpin the success of the Proposed Institute.
<ul style="list-style-type: none"> Moving Forward 	Chapter 8 makes a recommendation as to the prima facie case for the Proposed Institute as established by the analysis in this Concept Paper, and makes recommendations with respect to actions that should be undertaken to progress to implementation of a functioning Proposed Institute.

TABLE 2 – STRUCTURE OF THIS CONCEPT STUDY

2. The Strategic Case for an Australasian Institute for Spiny Lobster Research

2.1. Australian Lobster Production in the Global Market Place

Like most Australian primary industries, the Australian lobster industry is export market oriented and is almost exclusively a price-taker in those markets. Increasing market share and moving toward a higher degree of 'de-commoditisation' of product are key elements in achieving the objective of growing profitable GVP to A\$1.3 billion within 10 years.

Globally, the lobster fishery is one of the highest value wild-catch fisheries in the world. For example:

- Across all commercial lobster species lobster meat has an average unit value of US\$20 per kilogram (with spiny lobster species typically commanding significantly higher prices than the average), which is double that of shrimp (US\$10 per kilogram) and four times that of the average finfish species (US\$5 per kilogram)⁵; and
- In 2015, the US\$3.75 billion of global lobster production accounted for approximately 2.8 percent of the US\$134 billion global seafood industry⁶.

In 2015, Lobster fisheries across the globe produced approximately 300,000 tonnes of product. Over the past five years, there are three notable trends in global Lobster production:

- Production of American Clawed Lobster has increased and continues to dominate global lobster supply;
- There has been a decline in production of other northern hemisphere, cold water lobster species, primarily from European fisheries; and
- There has been an increase in production of spiny lobster species, driven primarily by increased production of various tropical spiny lobster species.

These trends are important to the future competitiveness of the Australian lobster industry and are discussed in the following subsections.

American Clawed Lobster continues to dominate global supply

Approximately 50 percent of global lobster supply is derived from a single species, American Clawed Lobster (*Homarus americanus*)⁷, which is produced from wild-catch fisheries along the north east coast of the United States and east coast of Canada. In 2015, total landings of American Lobster were approximately 157,000 tonnes, sourced from fisheries off New England in the United States, as well as Brunswick, Nova Scotia, Newfoundland and Labrador



⁵ 2015 prices

⁶ Food and Agricultural Organisation (2017), *FishStatJ – FAO Global Fishery and Aquaculture Statistics*, United Nations

⁷ American Clawed Lobster is also referred to as American Lobster, Atlantic, Canadian and True Lobster; Image courtesy of Greater Atlantic Regional Fisheries Office

in Canada.⁸ As illustrated in Figure 1 below, volumes of American Clawed Lobster production have increased over the past five years at a Compound Annual Growth Rate (CAGR) of 6.0 percent.

Production of European Lobster Species is declining

The other main species of cold water Lobster are the European Lobster (*Homarus gammarus*) and the Norway Lobster (*Nephrops norvegicus*)⁹. The European Lobster is typically considered by seafood markets to be interchangeable with the American Clawed Lobster, and accounts for a very small portion of global production (approximately 2 percent). However, the Norway Lobster, also referred to as the Dublin Bay Prawn and generally categorised by seafood markets as a niche product of its own (despite being a true lobster species), makes up approximately 16 percent of global production.

Production of both the European and Norway Lobster has been in decline for the past five years, with Norway Lobster declining by 5.1 percent and European Lobster by 3.4 percent. This is illustrated in Figure 1 below.



Production of Spiny Lobster, particularly tropical species, is increasing

The remaining approximately 31 percent of global production of lobster is comprised of various spiny lobster species that are produced around the globe. Spiny lobsters (also referred to as rock lobster, langustas, langouste, sea crayfish, crawfish and kreel) can be morphologically distinguished by their very thick and long antennae and the absence of chelae (or claws) on the first four pairs of walking legs. Their lifecycle is also characterised by a unique larval phase known as phyllosoma.

There are 12 extant genera of spiny lobster, containing approximately 60 individual species that are found variably in most warm seas around the world including the Mediterranean Sea, waters off the Caribbean, South East Asia, South Africa and Australasia.

Caribbean Spiny Lobster accounts for approximately 12 percent of the total volume of lobster and around 39 percent of spiny lobster production. Production volumes of Caribbean Spiny Lobster have been relatively stable over the past five years, growing at a CAGR of 0.6 percent. On the other hand, various species of tropical spiny lobster account for approximately 11 percent of total global lobster production and around 37 percent of spiny lobster production, with a production growth rate of 9.4 percent over the past five years.

Production of Australian Western Rock Lobster and Southern Rock Lobster, as well as Ornate Lobster collectively accounts for approximately 4 percent of global lobster production and approximately 14 percent of spiny lobster production. Production of Southern Rock Lobster has grown considerably over the past five years at a CAGR of 15.8 percent, whereas production of Western Rock Lobster and Ornate Lobster from Australia has increased at a more modest 2.4 percent.

⁸ Food and Agricultural Organisation (2017), *GlobeFish*, United Nations

⁹ Images Courtesy of the Institute of Marine Research

Figure 1 below illustrates recent trends in global lobster production.

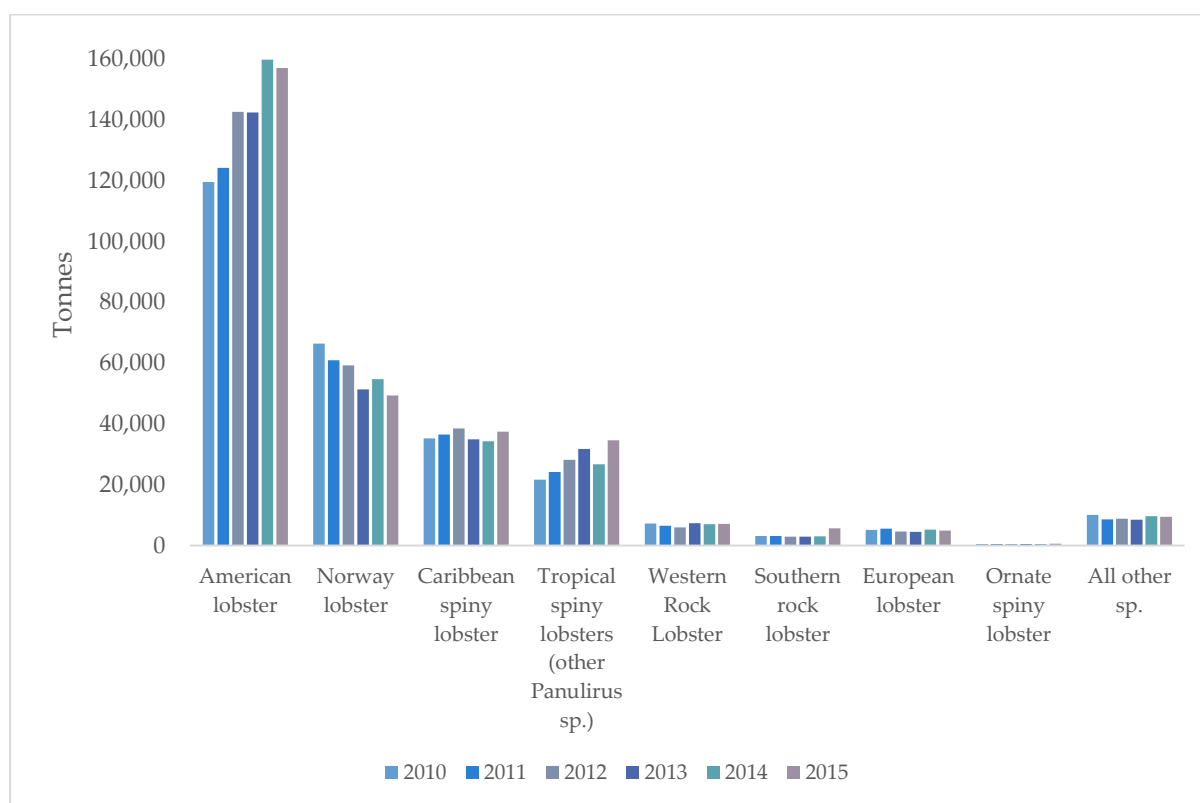


FIGURE 1 – GLOBAL LOBSTER PRODUCTION BY KEY SPECIES

While typically attracting premium pricing, Australian wild-caught lobster supply represents only a small portion of global supply and its market share is under constant threat from Caribbean Spiny Lobster and particularly various species of tropical spiny lobster production, increasing volumes in the latter of which are produced from grow-out systems in South East Asia based on harvested puerulus.

2.2. Australian Lobster and Global Lobster Trade Flows

Recent global trade history in lobster exhibits several key trends:

- North American markets continue to dominate global lobster trade;
- European Union remains a significant market for lobster, but demand has plateaued;
- The People's Republic of China (PRC) is a rapidly expanding market for lobster; and
- Despite increased production, spiny lobster species market share is being displaced by American Clawed Lobster in all key markets, a trend that is particularly evident in Japan and the PRC.

These key trade trends are discussed in the following subsections.

North American markets continue to dominate global Lobster trade

Given the dominance of American Clawed Lobster production, it is not surprising that the United States and Canada are the largest exporters of lobster product, exporting 55,000 and 73,100 tonnes respectively.¹⁰ However, as a result of their large domestic markets, the world's largest exporters of lobster, are also very significant importers of lobster, with the United States

¹⁰ Food and Agricultural Organisation (2017), GlobeFish, United Nations.

being the largest lobster importer (51,200 tonnes) and Canada the third largest importer (31,300 tonnes).¹¹

The majority of North American trade is internal (i.e. between the United States and Canada), but is characterised by significant and growing exports to Japan, European Union and particularly the PRC. The fact that American Clawed Lobster can be purchased from mainstream supermarket chains in Australia at approximately A\$15 per kilogram, an order of magnitude discount to locally produced lobster, is evidence of the global market reach of what is becoming a prolific product.

Trends in lobster imports in the United States and Canada are illustrated in Figure 2 below.

European Union remains a significant but plateauing Lobster market

The European Union is the world's second largest importer of lobster, importing 33,400 tonnes in 2015.¹² Like the North American market, the majority of trade is internal trade in the main local product, being in this case, Norway Lobster. The European Union also imports relatively significant volumes of spiny lobster species. Further, Norway Lobster is not exported outside of the European Union in any significant volume, which is likely the result of seafood markets generally categorising the species as occupying a niche market of its own rather than coming under the broader lobster category.

However, European Union trade in both Norway Lobster and spiny lobster species has declined over the past five years. Volumes of American Clawed Lobster imported to the European Union have grown, primarily at the expense of imports of spiny lobster species.

The People's Republic of China is a rapidly expanding market for Lobster

The PRC is the world's third largest market for lobster, importing 19,700 tonnes in 2015¹³ and the fastest growing market for lobster. The main product imported into the PRC is American Clawed Lobster, as well as various species of spiny lobster. Like other international markets, American Clawed Lobster imports are displacing imports of spiny lobster species to the PRC.

Spiny Lobster is being displaced by American Clawed Lobster in all key markets

As a result of declines in imports of spiny lobster species in all key markets, but particularly in the PRC, the United States, European Union and PRC are markets of equivalent size for spiny lobster species. Furthermore, in each of these cases, the decline in imports of spiny lobster have been offset by increased imports of American Clawed Lobster. This trend has more or less continued over the period 2010 to 2015.

The following Figure 2 illustrates import trends in key international markets for lobster.

¹¹ Food and Agricultural Organisation (2017), GlobeFish, United Nations.

¹² Food and Agricultural Organisation (2017), GlobeFish, United Nations.

¹³ Food and Agricultural Organisation (2017), GlobeFish, United Nations.

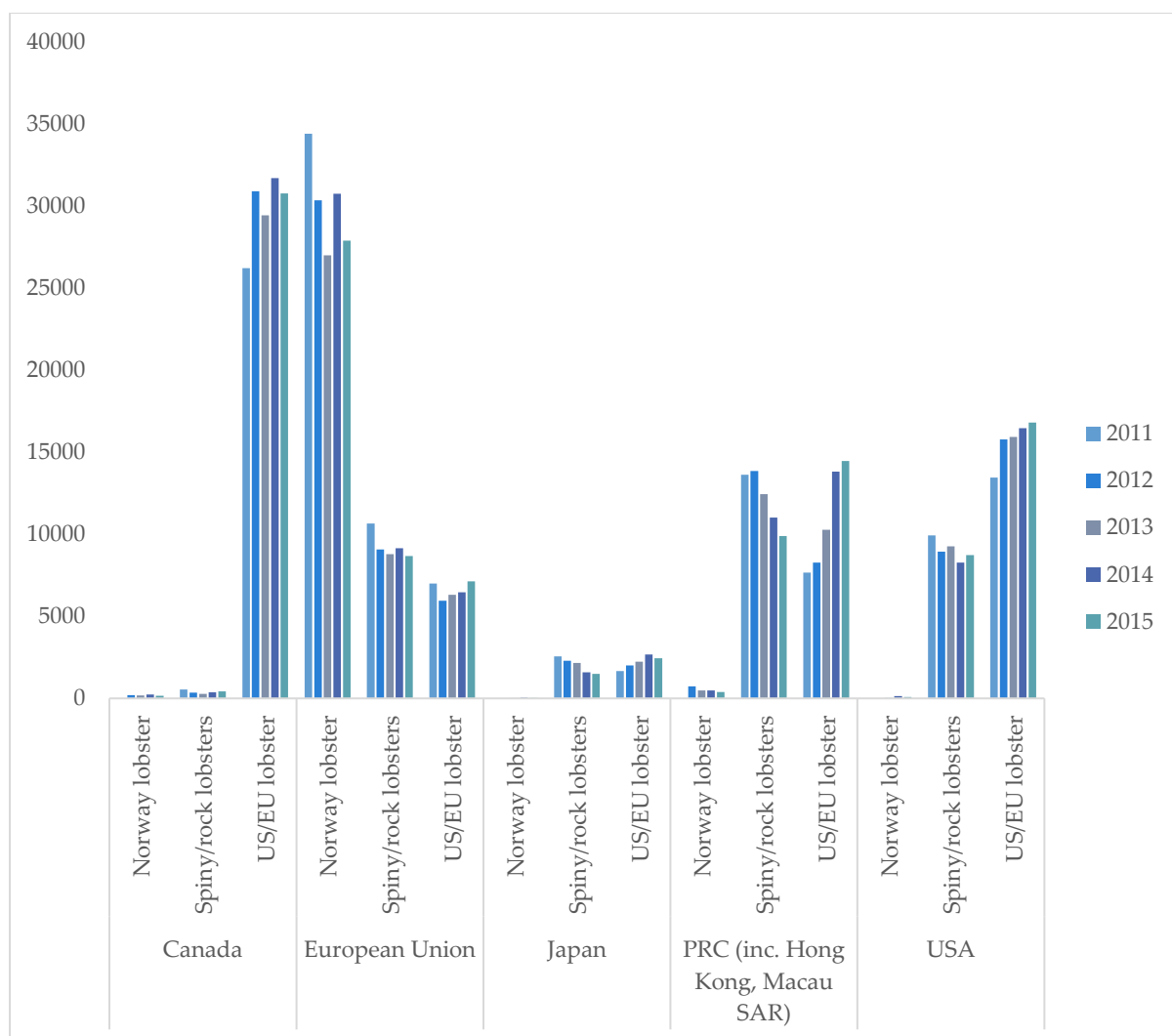


FIGURE 2 – GLOBAL LOBSTER IMPORTS

Overall, global demand for lobster is increasing, including in markets traditionally supplied by the Australian lobster industry. While in its key markets, Australian lobster species command much higher prices than most other species (premiums of up to seven times), in all instances, the vast majority of new demand is being met by increased imports of American Clawed Lobster. This overall trend, combined with the threat of supply competition from grow-out produced tropical spiny lobster species in South East Asia is a significant threat to the Australian Lobster industry's goal of achieving GVP of at least A\$1.3 billion within 10 years.

2.3. The Australian Lobster Industry

As summarised in Table 1 above, the Australian Lobster industry is comprised of wild-catch fisheries that revolve around four key species of spiny lobster. In 2014-15 Australia exported spiny lobster species with a total value of A\$691 million, rendering it the most valuable sector of the Australian seafood industry, as well as its most valuable export.¹⁴ As illustrated in Figure 3 below, Australia is second only to Indonesia in production of spiny lobster species.

¹⁴ Australian Bureau of Agriculture and Resource Economics and Science (2016), *Australian Fisheries and Aquaculture Statistics – 2015*, Australian Government, Canberra

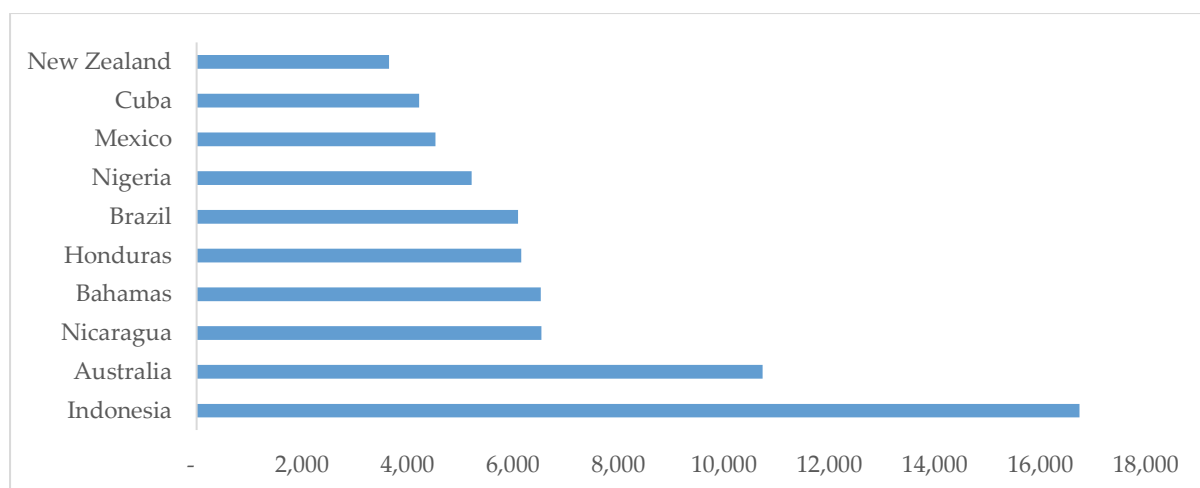


FIGURE 3 – GLOBAL SPINY LOBSTER PRODUCTION

The Australian lobster industry can be described according to the following key dynamics:

- The Western Australian industry dominates Australian lobster production;
- Industry prosperity is currently driven by a single product sold to Asian markets;
- The domestic lobster market is very small;
- There is price discrepancy across Australian lobster product; and
- There is limited coordination between the different sectors of the Australian lobster industry.

These dynamics are discussed in the following subsections.

Production Volume and Value is Dominated by the Western Australian Industry

As illustrated in Figure 4¹⁵ below, the production of Western Rock Lobster, a species endemic to Western Australia, accounts for the majority of the volume of Australian lobster production.

¹⁵ Australian Bureau of Agriculture and Resource Economics and Science (2016), *Australian Fisheries and Aquaculture Statistics – 2015*, Australian Government, Canberra

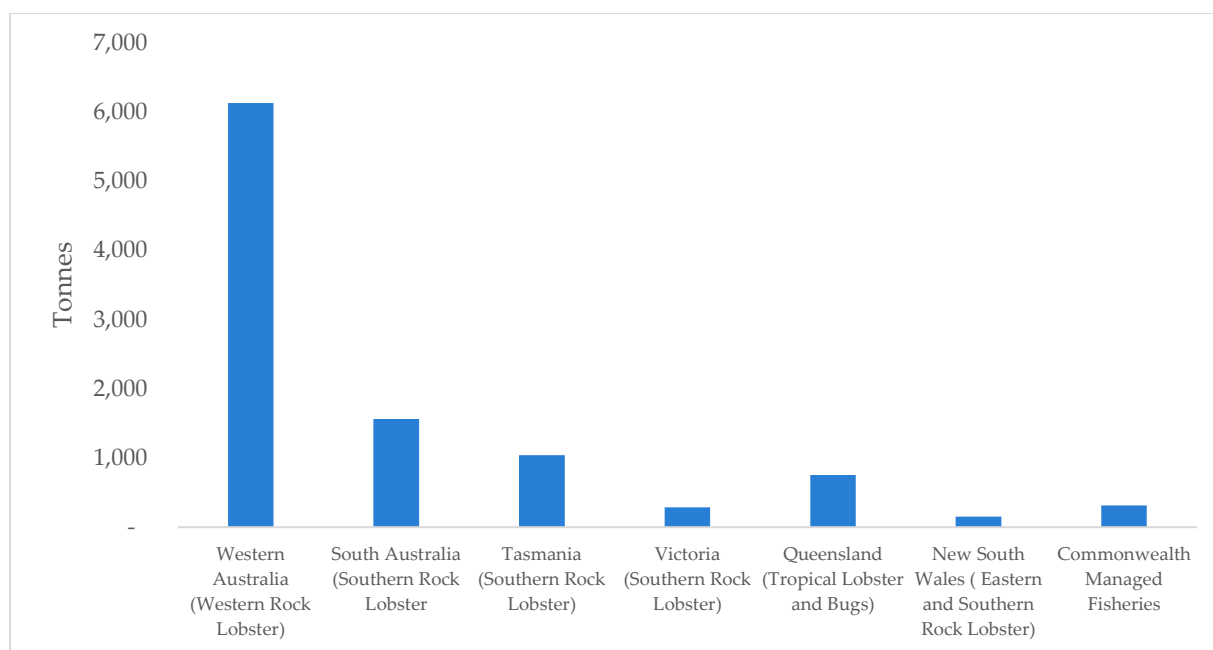


FIGURE 4 – AUSTRALIAN LOBSTER PRODUCTION (VOLUME) BY STATE (2014-15)

As illustrated in Figure 5¹⁶ below, despite typically trading at a discount to most other commercial species of Australian lobster (see Figure 10 below), the dominance of the Western Rock Lobster has translated into Western Australia producing the majority of industry value in almost all years for the past decade.

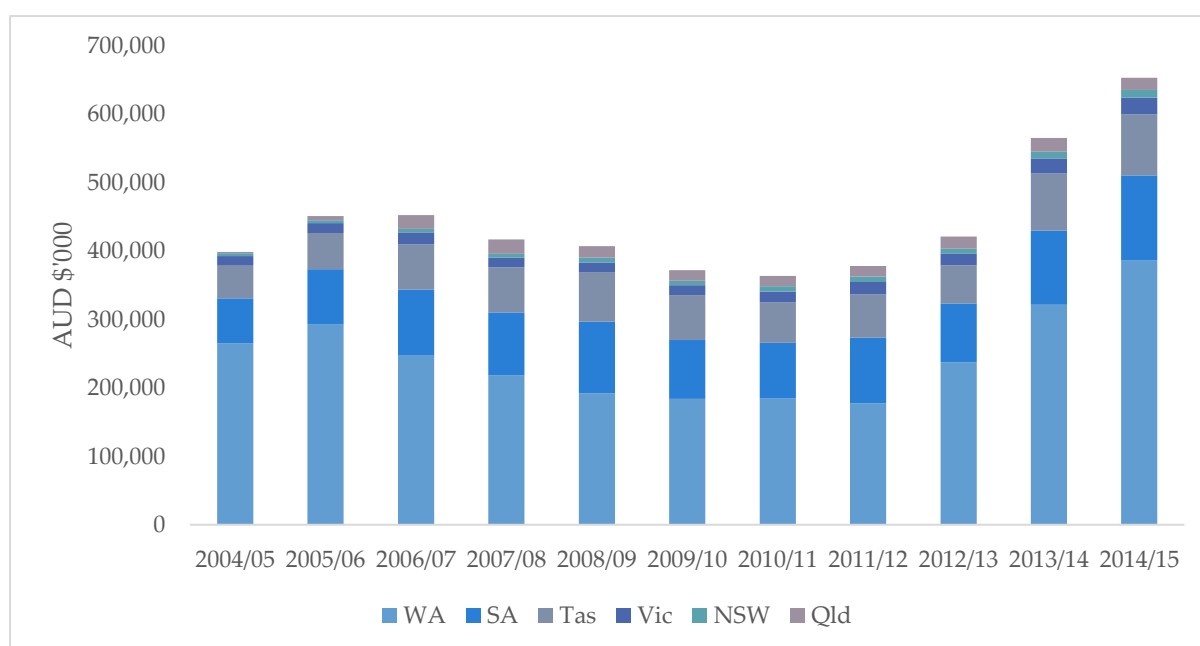


FIGURE 5 – AUSTRALIAN LOBSTER PRODUCTION (VALUE) BY STATE (2004-05 TO 2014-15)

It is important to note at this point that the Western Rock Lobster industry is critically important to the Western Australian fishing industry and a significant contributor to the economy more

¹⁶ Australian Bureau of Agriculture and Resource Economics and Science (2016), *Australian Fisheries and Aquaculture Statistics – 2015*, Australian Government, Canberra

generally. As illustrated in Figure 6¹⁷ below, the Western Rock Lobster industry accounts for almost 70 percent of the value of Western Australia seafood production, whereas the lobster fisheries in other states account for no more than 30 percent of the state's fishing industry GVP.

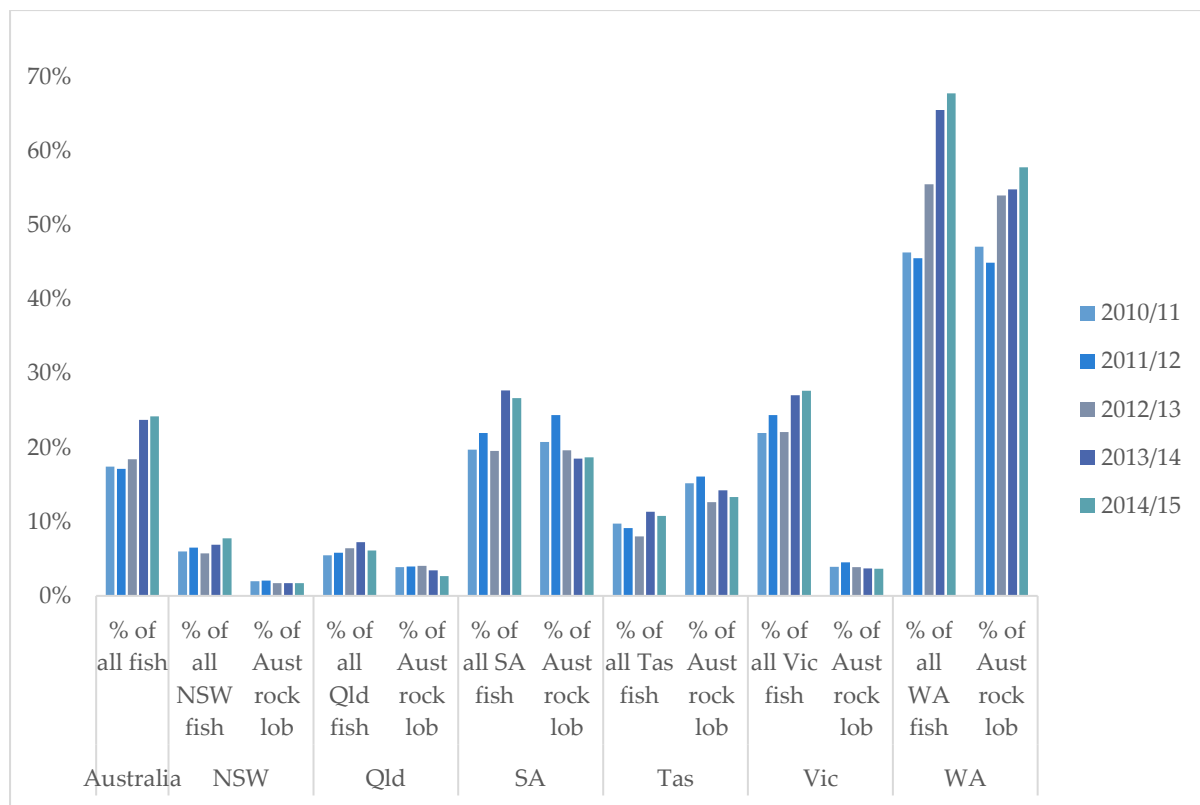


FIGURE 6 – LOBSTER CATCH AS A PORTION OF TOTAL AUSTRALIAN JURISDICTIONAL FISHERIES

Prosperity is driven primarily by a single product sold to Asian markets

Vietnam, PRC, Japan and Singapore collectively account for 92 percent of all Australian seafood exports, the majority of which is lobster.

The vast majority of Australian lobster exports are chilled or live whole lobster shipped to distribution centres in Vietnam and Hong Kong SAR. Historically, Australian Lobster exports to the PRC were mainly distributed through Hong Kong SAR. However, Vietnam has been the main distribution centre in more recent times¹⁸ and with the advent of the Australia-China Free Trade Agreement this dynamic can be expected to continue to evolve. Eastern Rock Lobster is generally not marketed to the PRC because of colour disadvantage in that market, and as a result higher domestic market prices for Eastern Rock Lobster. Figure 7¹⁹ below illustrates the trend in Australian lobster exports to major destinations by product type.

¹⁷ Australian Bureau of Agriculture and Resource Economics and Science (2016), *Australian Fisheries and Aquaculture Statistics – 2015*, Australian Government, Canberra

¹⁸ Economic Research Associates (2015), *An Analysis of the Demand for Western Rock Lobster*, Department of Fisheries, Western Australian Government, Perth

¹⁹ Australian Bureau of Agriculture and Resource Economics and Science (2016), *Australian Fisheries and Aquaculture Statistics – 2015*, Australian Government, Canberra

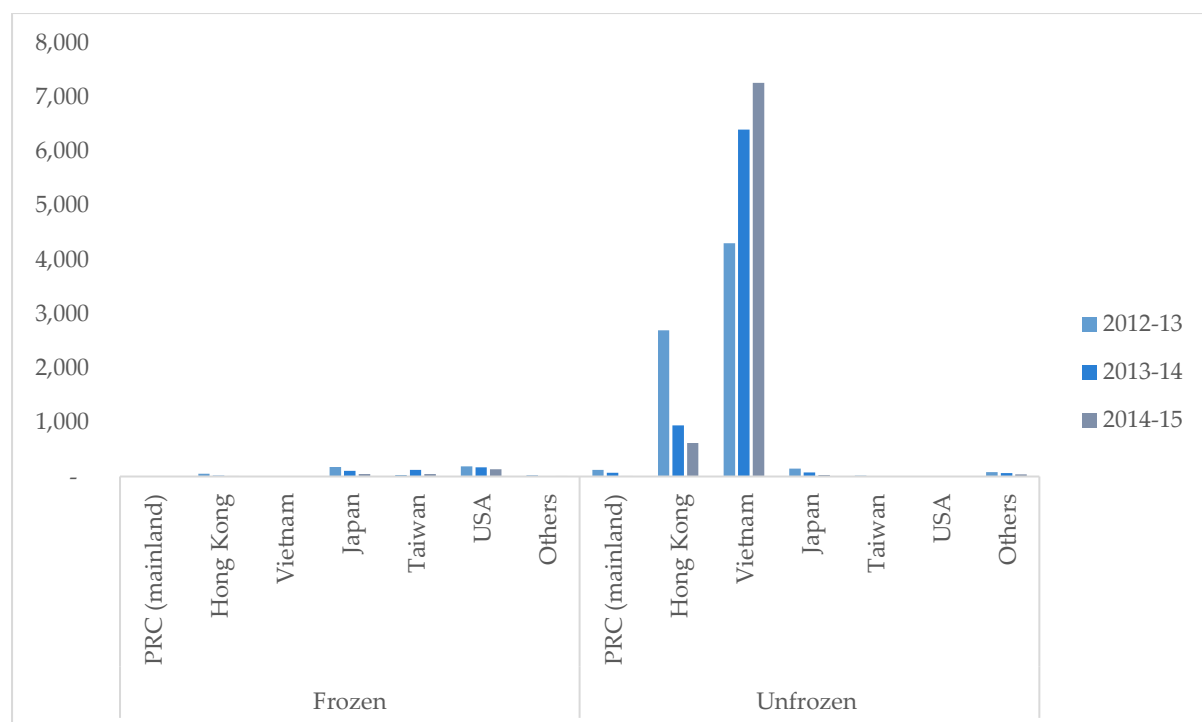


FIGURE 7 – AUSTRALIAN LOBSTER EXPORT DESTINATIONS

Small Domestic Market

Approximately 80 percent of all Australian lobster production is exported, with the domestic market accounting for approximately 2,000 tonnes of consumption per annum. The trend in Australian domestic market lobster supply is illustrated in Figure 8²⁰ below.

²⁰ Australian Bureau of Agriculture and Resource Economics and Science (2016), *Australian Fisheries and Aquaculture Statistics – 2015*, Australian Government, Canberra

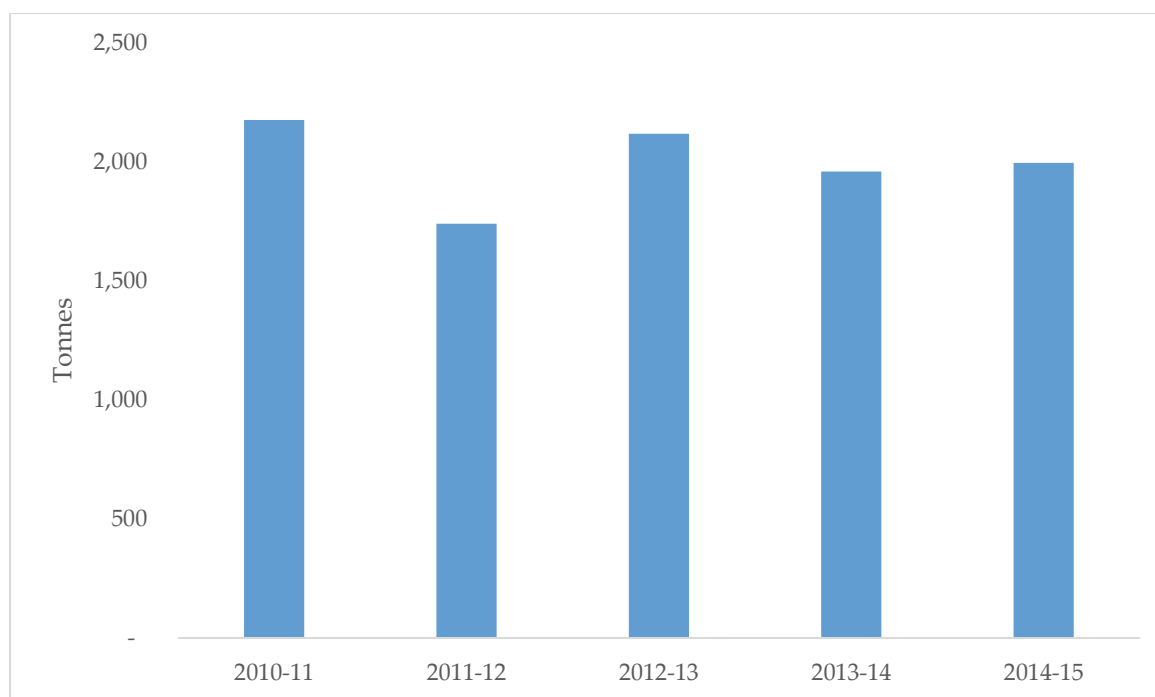


FIGURE 8 – AUSTRALIAN DOMESTIC LOBSTER MARKET SUPPLY (2010-11 TO 2014-15)

While the rest of Australia exported an average of 65 percent of its 2014-15 lobster harvest, Western Australia exported approximately 90 percent of its lobster harvest, delivering approximately 650 tonnes to the domestic market.

Figure 9²¹ below compares lobster harvests in each State with exports from that State. The fact that export volumes are greater than harvest volumes in New South Wales and Victoria is indicative of the concentration of eastern states seafood processing in Sydney and Melbourne.

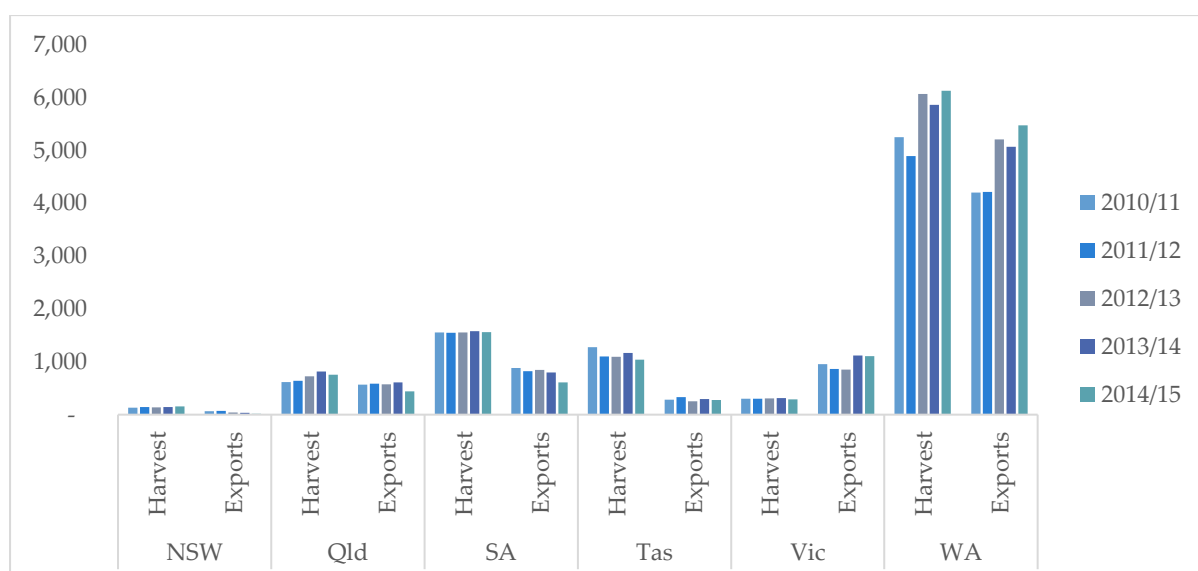


FIGURE 9 – LOBSTER HARVEST AND EXPORTS BY STATE

²¹ Australian Bureau of Agriculture and Resource Economics and Science (2016), *Australian Fisheries and Aquaculture Statistics – 2015*, Australian Government, Canberra

Price Discrepancy across Australian Production

The average landed price for Australian lobster has increased from approximately A\$20 per kilogram in 2004-05 to just over A\$60 per kilogram in 2014-15. The only State to defy the increasing trend in price is Queensland, whose production is comprised almost exclusively of tropical lobster species, a significant portion of which is not suitable for live export, thus reducing its value. Domestic prices for Southern Rock Lobster and Eastern Rock Lobster production in South Australia, Tasmania, Victoria and New South Wales are highly correlated, with price variance between those States rarely being more than a few dollars per kilogram. However, the Western Rock Lobster in Western Australia consistently trades domestically at A\$10 to A\$15 per kilogram discount to other Australian domestic lobster markets. The trend in domestic landed price of Australian lobster is illustrated in Figure 10²² below.

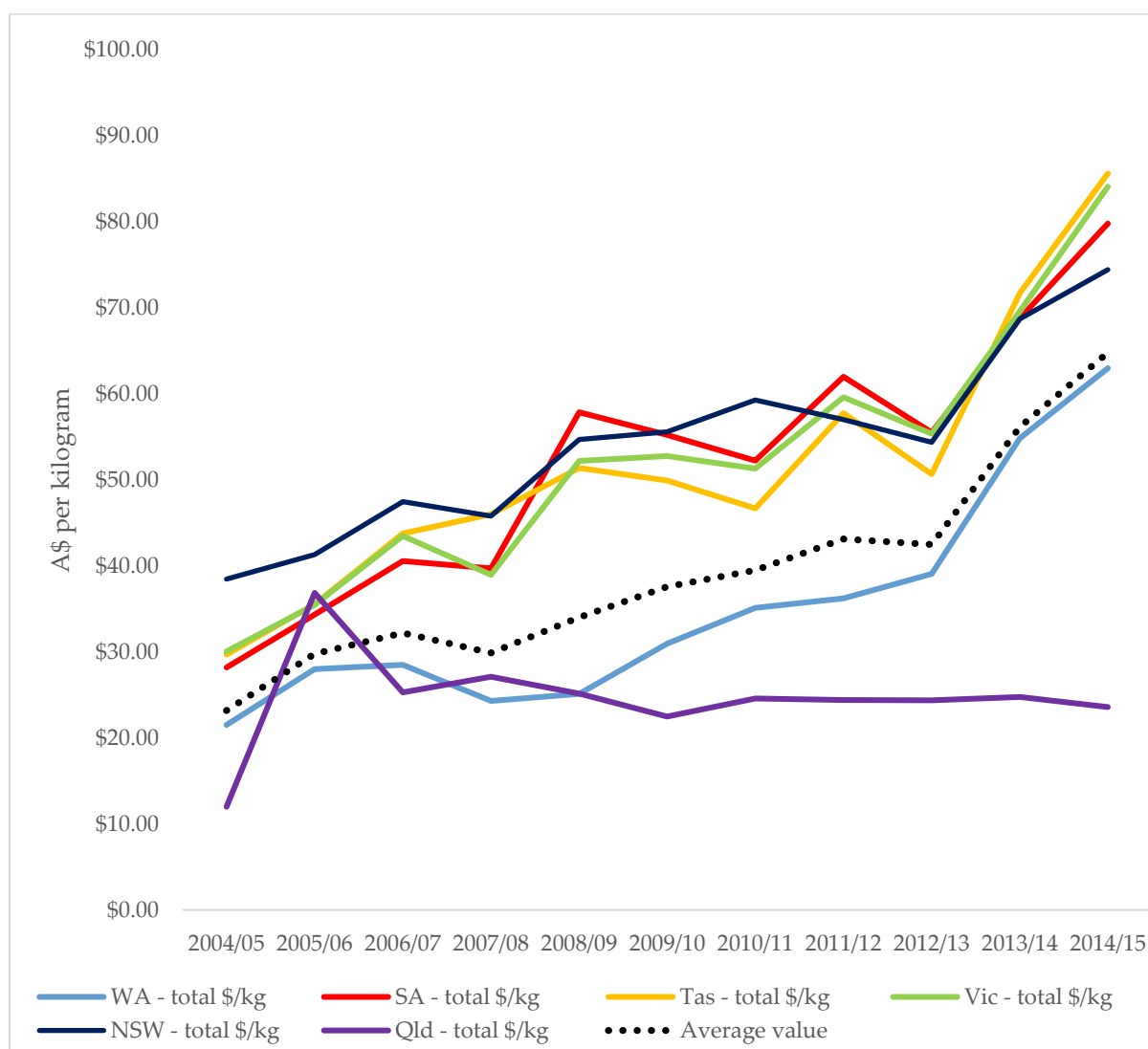


FIGURE 10 – LANDED PRICE OF AUSTRALIAN LOBSTER PRODUCTION

The pricing trends, correlations and discrepancies among Australian lobster product are replicated in export pricing, indicating that domestic prices are determined primarily by export market conditions. The main difference between the domestic and export market dynamics

²² Australian Bureau of Agriculture and Resource Economics and Science (2016), *Australian Fisheries and Aquaculture Statistics – 2015*, Australian Government, Canberra

for Australian lobster is that Queensland production, while trading at discount to other Australian lobster product in export markets, follows the general trend of export market pricing for other Australian lobster. Figure 11²³ below illustrates the trend in export market pricing for Australian lobster.

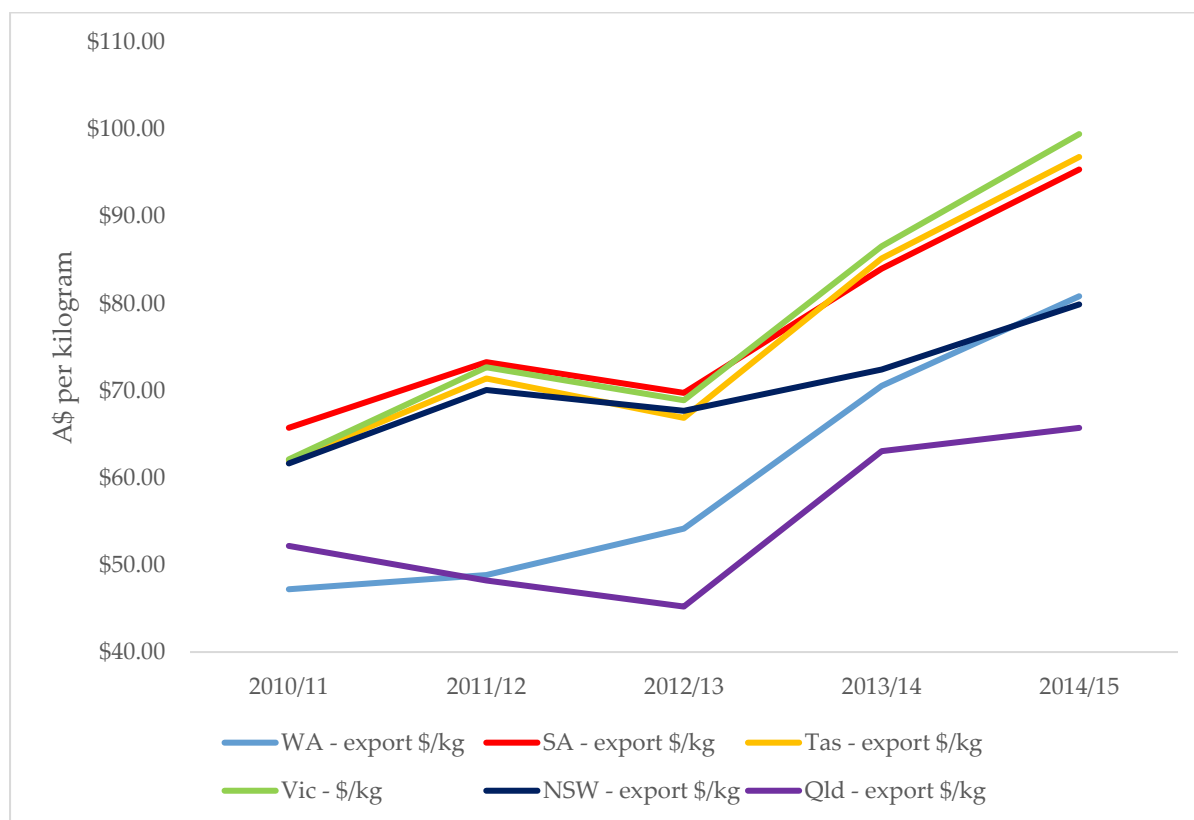


FIGURE 11 – AUSTRALIAN LOBSTER EXPORT PRICES

A number of factors are understood to contribute to this price differentiation, including:

- Different levels of engagement with the market;
- The fact that Southern Rock Lobster (as well as New Zealand Southern Rock Lobster) have entered the PRC market earlier than Western Rock Lobster;
- Southern Rock Lobster demonstrates higher survival rates in the live export markets than Western Rock Lobster and attracts a colour premium in PRC markets; and
- Anecdotally, some provincial seafood markets in the PRC exhibit a strong and persistent preference for a particular species.

The strong product similarity between particularly Southern Rock Lobster and Western Rock Lobster indicates that more could be done to achieve higher prices for a larger volume of Australian lobster production, and more can likely be done to expand the domestic market for Australian lobster product.

²³ Australian Bureau of Agriculture and Resource Economics and Science (2016), *Australian Fisheries and Aquaculture Statistics – 2015*, Australian Government, Canberra

2.4. Leadership from the Western Australian Lobster Industry

A number of characteristics render the Western Australian lobster industry the leading sector of the national industry and motivates Western Australian lobster industry stakeholders to use this leadership to advance the interests of the Australian lobster industry, namely the Western Rock Lobster industry is:

- A key sector of the Australian seafood industry in its own right;
- A world-leader in fisheries resource management;
- A world-leader in Marine Stewardship Council (MSC) accreditation;
- A global leader in Lobster processing for premium markets;
- An important component of the Western Australian economy;
- A major driver of regional Western Australia;
- An important recreational fishery; and
- A basis for an emerging culinary tourism industry in the State, whereby a concentration of local processing and distribution can drive product differentiation.

A key sector of the Australian seafood industry

As discussed in Section 2.3, the Western Australian lobster industry accounts for the vast majority of Australian lobster production and exports and is therefore a critical component of not only the Australian lobster industry, but by virtue of the lobster sectors predominance in the wider commercial fishing industry, the Australian seafood sector. This translates to the Western Australian lobster industry accounting for the majority of employment, exports, local, state and commonwealth government taxation and other payments and contributions to research and development made by the Australian lobster industry.

World Leader in Fishery Resource Management

The Western Rock Lobster fishery was the first fishery in the world to be certified as ecologically sustainable by the Marine Stewardship Council (MSC), a status that it has maintained since it was certified in 2000. It is widely recognised as one of the most effectively managed fisheries in the world, a capability that is underpinned by science that informs a predictive model of puerulus recruitment ensuring that harvest is maintained at sustainable levels.

Recognition of this leadership in fisheries management not only ensures sustainable harvest, but serves to differentiate Australian lobster product in global seafood markets.

An important component of the Western Australian economy

The Western Rock Lobster industry is an important sector of the Western Australian economy. At a macro-level the industry contributes over A\$500 million to Gross State Product (GSP), directly and indirectly employs more than 2,400 people across the fishery (1,700 people), seafood processing (480 people), boat building (190 people) and tourism (60 people) sectors with an estimated employment multiplier of 1.77.²⁴ Furthermore, the total capital value of the industry has been estimated at A\$5.2 billion.²⁵

²⁴ Acil Allen Consulting (2017), *Economic Contribution of the Western Rock Lobster Industry*, Western Rock Lobster Council

²⁵ Reference (Acil Allen/Cooke?)

The industry accounts for approximately 75 percent of the \$29 million of licencing fees that the Western Australian commercial fishing sector pays to the Western Australian Government, the majority of which is allocated to the management of all Western Australian fisheries.

As illustrated in Figure 12²⁶ below, the Western Rock Lobster industry is Western Australia's 7th most valuable primary industry and is equivalent in size to the State's wool and milk production in terms of output. Most importantly, over the past five years the Western Rock Lobster industry has had the second highest growth rate of all major Western Australian primary industries.

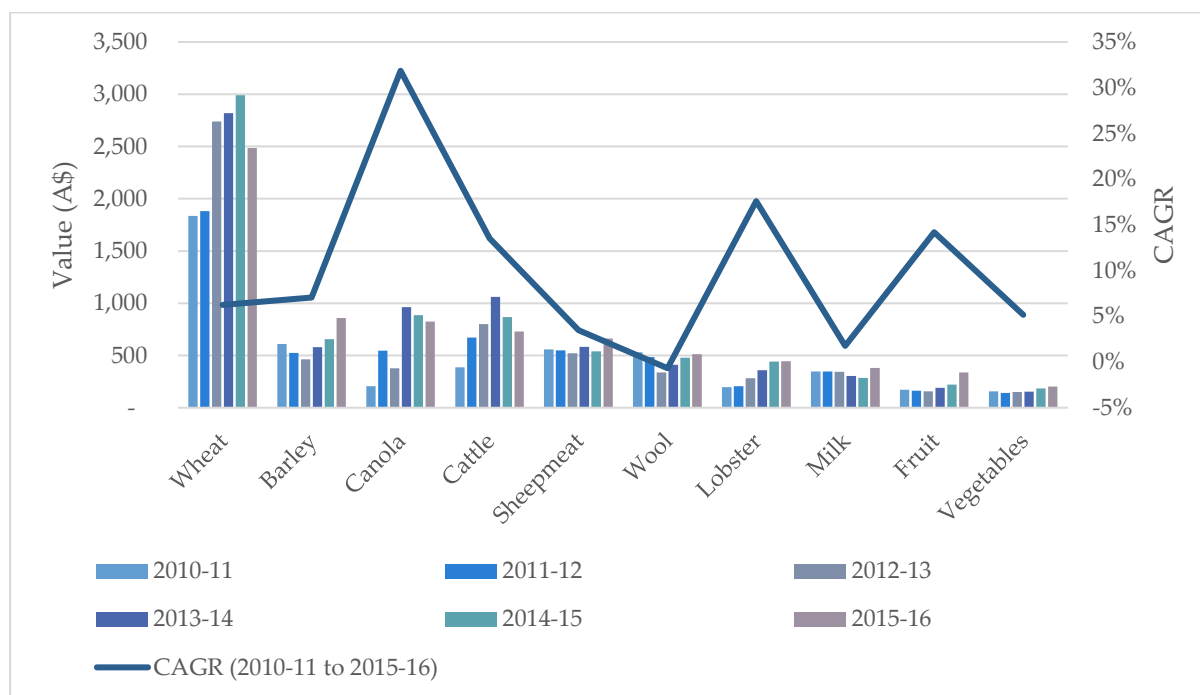


FIGURE 12 – VALUE OF PRODUCTION OF MAJOR WESTERN AUSTRALIAN PRIMARY INDUSTRIES

A major driver of regional Western Australia

As summarised in Table 3²⁷ below, the Western Rock Lobster industry is a major component of the economic and social fabric of many Western Australian communities and coastal towns between Kalbarri and Busselton.

²⁶ Department of Agriculture and Food (2016), *Western Australia's Agrifood, Fibre and Forestry Industries Report*, Western Australian Government, Perth and Australian Bureau of Statistics (2017), *Value of Agricultural Commodities Produced*, Cat. 7503.0

²⁷ Acil Allen Consulting (2017), *Economic Contribution of the Western Rock Lobster Industry*, Western Rock Lobster Council

Location	Activity	Total Gross Value Add (A\$m)	Share of Gross Town Product (%)	Total Local Employment (FTE)
Kalbarri to Horrocks	Fishing fleet	8.7	13	33
Geraldton	Fishing fleet and processing	49.4	24	218
Dongara & Port Denison	Fishing fleet and retail	16.3	14	35
Leeman & Green Head	Fishing fleet	5.7	23	21
Jurien Bay	Fishing fleet	15.4	16	58
Cervantes	Fishing fleet and processing	24.5	75	138
Lancelin, Ledge Point & Two Rocks	Fishing fleet	15.6	32	58
Perth	Fishing fleet and processing	302	n.a.	1,272
Bunbury & Busselton	Fishing fleet	2.3	n.a.	9
TOTAL		439.9		1,842
TOTAL REGIONAL COMMUNITIES		137.9		570

TABLE 3 – CONTRIBUTION OF THE WESTERN ROCK LOBSTER INDUSTRY TO WESTERN AUSTRALIAN COASTAL COMMUNITIES

An important recreational fishery

The Western Rock Lobster, and to a lesser extent the Ornate Lobster, are also the focus of a significant recreational fishery in Western Australia, a pastime that is an important component of particularly coastal Western Australian culture. As illustrated in Figure 13²⁸ below, the number of lobster recreational fishing licenses on issue in Western Australia has increased by more than 50 percent from 2012-13, to approximately 55,500 licenses.

²⁸ Data provided by Recfish West

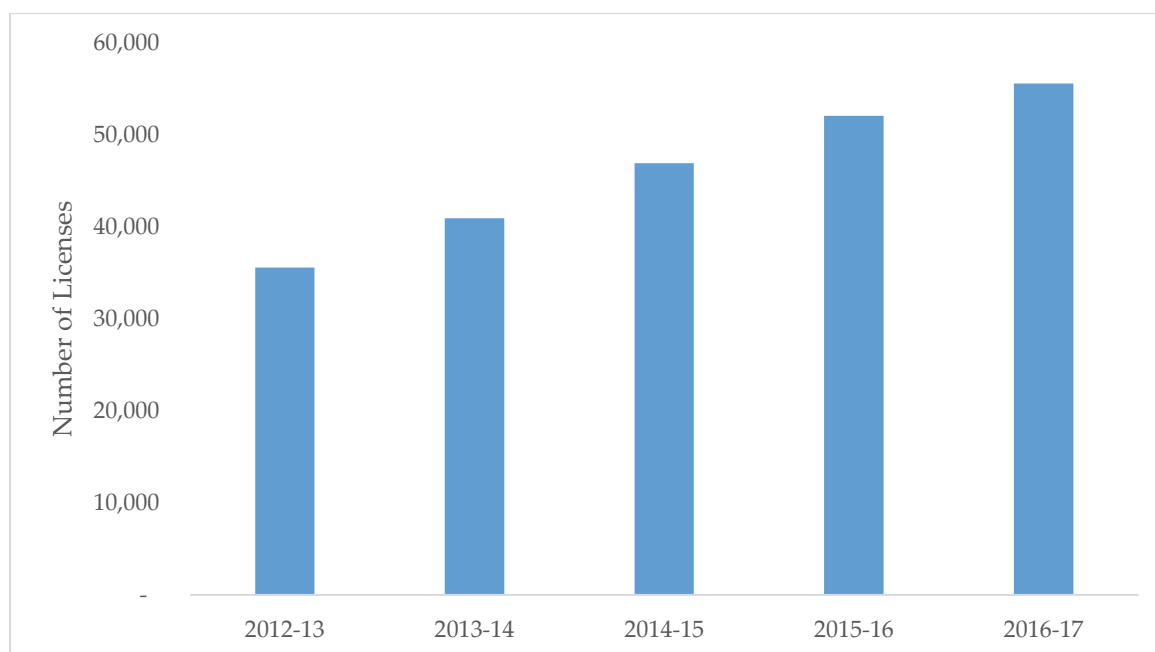


FIGURE 13 - WESTERN AUSTRALIAN ROCK LOBSTER RECREATIONAL FISHING LICENSES ON ISSUE

The increase in issued recreational licenses has responded to an increase in the Total Allowable Recreational Catch (TARC) for lobster in Western Australia. As illustrated in Figure 14²⁹ below, while the estimated³⁰ actual recreational Lobster catch in Western Australia is below the TARC, the gap has narrowed considerably in recent years from as low as 40 percent in 2012-13 to 80 percent currently. It is also worth noting that the TARC for lobster in Western Australia represents a volume that is equivalent to approximately 74 percent of current domestic market supply from the commercial sector.

²⁹ Data provided by Recfish West

³⁰ Recreational catch estimates are based on surveys of recreational license holders.

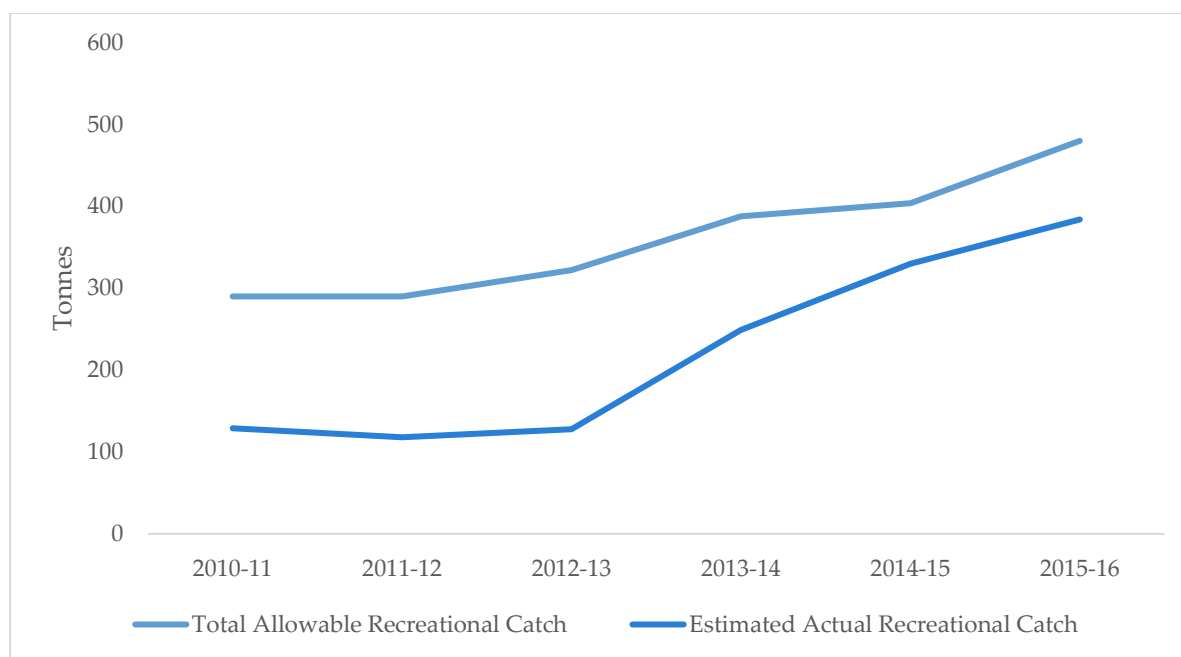


FIGURE 14 – TOTAL ALLOWABLE RECREATIONAL LOBSTER CATCH AND ESTIMATED ACTUAL RECREATIONAL LOBSTER CATCH (VOLUME)

Recreational lobster licensing fees paid to the Western Australian Government currently total approximately A\$1.5 million, representing 20 percent of total recreational fishing licensing fees and 4 percent of total commercial and recreational licensing fees.

Basis for Food Provenance and Culinary Tourism

Even though the domestic market for Western Rock Lobster is relatively small, Western Rock Lobster is becoming a key element of Western Australia's seafood provenance that by virtue of significant participation in the recreational fishery, has some experiential component. Furthermore, as the Western Australian Government continues to pursue its policy designed to promote Western Australia as a tourism destination, Western Rock Lobster will naturally be a key component of any culinary tourism agenda.

2.5. Importance of other Sectors of the Australian Lobster Industry

The discussion in Section 2.4 above articulates the importance of the Western Rock Lobster sector of the Australian lobster industry and while this is justified, it could be argued that by virtue of its origins and the industry's share of national lobster industry output, this Concept Study is currently skewed toward its interests.

The Southern Rock Lobster industry is the second largest contributor to Australian Lobster GVP and exports, and consistently attracts a price premium over Western Rock Lobster in domestic and export markets. Furthermore, it has expanded significantly in recent years, primarily as a result of a coordinated strategic effort by the sector to achieve this growth. There is also opportunity to expand production of tropical lobster species in Australia.

This Concept Study has focused on preliminary identification of new knowledge and technology needs that are likely to be common to all sectors of the Australian Lobster industry. Should it be determined that the Proposed Institute has merit, further effort will be required to optimally integrate the priority issues faced by all sectors of the Australian lobster industry.

2.6. Australian Lobster Research Capability is More Distributed

Western Australia hosts significant expertise in some areas of Lobster related research, particularly in the area of fisheries management and stock forecasting. However, considerable other important expertise is more widely distributed across the Nation, and in some cases this capability is fragmented.

For example, the development of technologies and methods for technically and economically viable aquaculture production of Lobster has been a target of considerable private and public research investment for decades. Research programs and expertise focused on tropical lobster species was initially undertaken at the Australian Institute of Marine Science in the mid-1990s, which was subsequently progressed by research organisations in New Zealand, and more recently pursued at the University of Tasmania. Privately funded projects pursuing the same objective with a range of species were undertaken by a private consortium in Western Australia over a similar timeframe.

The research effort at the University of Tasmania has culminated in an ARC and private industry funded effort to commercialise this research. The ARC Research Hub for Commercial Development of Rock Lobster Culture Systems at the University of Tasmania's Institute for Marine and Antarctic Studies is a formal collaboration formed with a A\$5 million grant from the Australian Research Council's (ARC) Industrial Transformation Research Program, as well as support from the Tasmanian Government. The collaboration brings together aquaculture scientists at the University of Tasmania, University of Auckland and University of Sunshine Coast, with an industry partner, Plastic Fabrications Group. The research program is focusing on mass larval rearing, water treatment systems, lobster physiology, broodstock genetics, animal health and nutrition to underpin closed-cycle aquaculture of Ornatus, Eastern Rock Lobster and Southern Rock Lobster, with the focus primarily on Ornatus.

To be optimally effective the Proposed Institute will need to either incorporate such research effort, or at the very least have formal links to such programs.

2.7. The Strategic Case for an Australasian Institute of Spiny Lobster Research

The analysis in the previous subsections strongly indicates that a *prima facie* case for investment in an industry needs targeted, coordinated research effort that is designed to facilitate growth of the Australian lobster industry is founded in the following:

- **Lobster is a Nationally important industry with significant opportunity for growth**
As the highest value sector of Australia's seafood industry, lobster production is an important export-oriented primary industry for the Australian and Western Australian economy, with a significant regional capital and employment footprint. There is also significant scope to increase the sector's contribution to the Australian economy through expanded production, development of new international and domestic markets, new products and as an increasingly important element of culinary and potentially experiential tourism.
- **There are significant threats to the competitiveness of Australian lobster**
Relatively high prices for Australian lobster exports in recent times have masked the fact that Australian lobster exports have lost market share in important growing international markets to production from other major and emerging producers. For so long as there is significant demand from large growing seafood markets such as the

PRC, this is a trend that is likely to continue. In particular, scale aquaculture production of tropical lobster species in relatively low-cost jurisdictions in South East Asia represents a specific significant threat to the competitiveness of Australian lobster.

- **Opportunities and threats can only be addressed through the development and commercialisation of new knowledge and technologies**

Capitalising on the opportunities and mitigating the risk presented by the threats articulated in this section will require the development of new knowledge and technologies and the commercial application by industry of that new knowledge, technology and products tailored to specific markets.

- **To be effective, there must be a concerted, strategically targeted and coordinated investment in developing that knowledge and those technologies**

Ensuring that research investment is coordinated and acutely targeted at development solutions to commercial opportunity and threats requires strong collaborative leadership from industry, the scientific profession and government.

As discussed in Section 4, the primary mechanism through which Australian lobster industry research is currently coordinated is not optimally addressing this need. The new knowledge and technology needs of the Australian lobster industry has reached a point where a mechanism that optimises this is required.

3. Contemporary Australian Lobster Industry Knowledge and Technology Needs

In order to address the opportunities and challenges discussed in Section 2 above, and thereby progress the Australian lobster industry toward its target of profitable GVP of A\$1.3 billion within 10 years, at the most fundamental level, the following must be achieved:

- The Australian lobster fishery resource must remain viable, and allow for optimal sustainable harvest of the natural resource;
- In order for the industry to remain profitable and for investment to occur, productivity of the fishing effort must continuously improve and the fishing sector's social license to operate must be maintained;
- In order to grow the industry and mitigate against single-market risk, fishers and processors must work together to create new products based on Australian lobster and re-enter or develop new domestic and international markets for those products;
- Systems and technologies that improve the productivity of seafood processing and transport must be developed and implemented
- To be able to supply large volumes of live and fresh product to markets out of harvest season, large-scale wild-harvest value adding mechanisms such feedlots will likely need to be developed and commercialised;
- Even though it is likely that many Australian lobster fisheries are yet to reach maximum sustainable harvest, in order to substantially increase production volumes in the longer term, technically and economically viable aquaculture production systems are likely to be necessary; and
- The policy framework that governs the entire supply chain (including bilateral and multilateral trade agreements) must achieve the objectives of sustainable natural resource management, promoting public confidence that the fishery is managed sustainably and equitably, ensuring that industry is able to operate as effectively and productively as possible and ensuring that its products are competitive in the marketplace.

At a rudimentary level, it is envisaged that the Proposed Institute will focus on a research priorities agenda that is designed to addresses specific issues that underpin the achievement of these broader objectives. However, it must be stressed that should the Proposed Institute be deemed desirable and viable, a comprehensive research priorities plan for the Proposed Institute will be developed through a deeper understanding of the 'state-of-the-art' and an exhaustive consultative process involving end-user experts in industry, scientific sector and government.

The following subsections further illuminate the issues associated with the higher-level objectives developed thus far and an Indicative Research Agenda based on these issues is contained in Appendix 2.

3.1.1. Maintaining Optimal Sustainable Harvest

Scientific research undertaken by the Western Australian Department of Fisheries and other preeminent fisheries scientists at Western Australian universities, has resulted in the ability to predict Western Rock Lobster stocks with a high degree of accuracy using modelling based on knowledge pertaining to the relationship between puerulus recruitment and future harvestable fish stocks. This capability has underpinned the implementation of a natural resource management framework which is widely regarded as contemporary world-best-

practice. However, there remains potential opportunity to increase sustainable harvest and improve resource allocation decisions. Frameworks for achieving this can only be developed if there is adequately robust scientific knowledge to support the development and implementation of those frameworks. This applies to all lobster fisheries across Australia.

As with all of the world's fishery resources, the nature of the Australian lobster fishery will continually change, and as a result of anticipated changes to its ecology, its future viability be questioned by a range of stakeholders. Changes to water temperature and alkalinity that are the manifestation of global climate change, as well as other anthropogenic pressures such as increased recreational and tourism use of the marine ecology that supports the fishery and the fishery resource itself, coastal urban and industrial development, invasive species and pathogens, and increasing marine noise will all impact the fishery to varying degrees. At best this will alter the ecology that supports the fishery, potentially changing the nature of the sustainable resource and at worst, threaten the fishery's viability.

Effective management of both the fishery and investment by industry in the infrastructure and capability that extracts value from the fishery requires the ability to understand the fishery's likely resilience to these pressures and predict the cumulative impact of these pressures on the fishery. In the absence of scientific knowledge that facilitates this understanding, industry faces the prospect of reduced productivity that will result from potential crude application of the precautionary principle by regulators, a higher risk framework for capital investment decisions, sub-optimal environment for strategic and operational decision-making and/or reduced viability of the fishery.

The research undertaken in this theme is of relevance to industry and regulators and there is a clear link between research undertaken in this theme and the policy theme.

3.1.2. Improving Productivity in the Fishing Effort and Maintaining Social License to Operate

Operators of Australian lobster fishing fleets provide the fundamental feedstock for value creation by the industry, and in the absence of competitive aquaculture and/or feedlot alternatives, are the only source of that feedstock. If the fishing sector of the industry is unduly constrained and/or unable to prosper, the Australian lobster industry cannot grow. Furthermore, it is the levies paid by lobster fishers that is the primary source of funding for current industry-oriented research (see Section 4) and therefore, irrespective of the fundamental importance of the fishing effort, it would be unreasonable for any industry-oriented research program to not have its main focus on the needs of the wild-catch fishing sector.

Economic and commercial research is required to understand what trends in innovation and future necessary investments in capital, in-market development and social license to operate will be necessary to improve productivity and profitability of Australian lobster fishing enterprises, as well as to determine the optimal business models and ownership structures for operating Australian lobster fishing enterprises in the future.

Productivity has implications for profitability (and therefore investment) as well as international competitiveness. Like all primary industry, to remain competitive in global markets, the Australian lobster industry must continually improve its productivity. Improving productivity requires achieving greater outputs from fewer inputs in the contemporary operating environment, which is defined by current regulatory frameworks and community expectations with respect to issues such environmental impact and safety. Furthermore, in a marketplace

(particularly premium seafood markets) that is increasingly values oriented, Occupational Health and Safety (OHS) and environmental credentials are key to ensuring market access and premium pricing. As such, factors such as these that are often considered counter-productive to achieving productivity growth, are in fact fundamental aspects of productivity.

Productivity improvements in the fishing effort will come from investments in new knowledge and technology creation, as well as in adaptation of technology from other industries in the areas of vessel design, improved catch targeting, automated pot and other cargo handling and sensor and digital based on-board information systems that inform fishing decisions and are integrated along the supply-chain and with the regulatory system.

Continuous improvement to OHS through higher levels of automation and best practice processes are important to ensuring access to a high quality workforce, as well as meeting societal and market expectations with respect to a safe and healthy workplace. Additionally, ensuring that fishing systems have increasingly minimal impact on the natural environment is essential to ensuring that social license to operate and market share is maintained.

3.1.3. New Australian Lobster Products and Markets

Like most premium Australian seafood product, Australian lobster tends to attract its highest unit value when it is sold in its purest or close-to-purest form. This is why the vast majority of Australian lobster production is sold live, whole-fresh or fresh-tails to premium international seafood markets.

However, as supply of lobster from aquaculture production and other fisheries increases, and new seafood markets emerge, Australian production will come under increasing pressure to develop new lobster based products and markets. New products may involve value-adding to fresh and frozen product through the development of new cuts such as medallions, as well as packaged meals. It may also involve creating value from lobster parts other than the tail which are currently underutilised like lobster broth, ingredients in recipe dishes or bonded meat from legs and antennae to make lobster patties.

As more developing nations transition, demand for lobster in global markets is likely to increase. The Australian lobster industry is currently critically dependent on PRC seafood markets. In 2019, the Australia-China Free Trade Agreement will come into effect. It is important that the Australian industry is ready to capitalise on any opportunities that this might represent.

Currently, the majority of Australian lobster product is exported. The size and expanding nature of the Western Rock Lobster recreational fishery, as well as major Australian retail chain stocking of American Clawed Lobster indicates that there is significant latent demand in the domestic market for lobster product. While it is unlikely that the domestic market will currently present the same value to the industry as export markets, in a future production environment characterised by greater supply competition, a developed domestic market may prove vitally important.

3.1.4. Downstream Productivity and Supply Chain Optimisation

The sector of the Australian lobster industry that purchases catch from fishers, processes product and distributes product to international and domestic markets is critical for value creation. Therefore, it will be imperative that these processors have ownership of and participate in the research agenda that is established to guide the efforts of the Proposed Institute.

In Western Australia, this sector is highly concentrated with four processors competing for supply and distribution of Western Rock Lobster. The largest of these processors is the Geraldton Fisherman's Cooperative (GFC) which processes approximately 60 percent of the total catch, with the balance processed approximately equally between Indian Ocean Rock Lobster (Cervantes), the Kailis Brothers owned National Fisheries and Bluewave Seafood. The Lobster processing sector in the eastern states is characterised by a larger number of smaller processors and a few larger processors.

Research undertaken by the Proposed Institute must provide processors with the knowledge and tools they need to develop new products and access new markets, to meet ever changing customer expectations and to achieve productivity growth that ensures product is competitive and the sector remains profitable. This includes knowledge that can inform market responses to opportunities (and challenges) created by the Australia-China Free Trade Agreement when it comes into effect, as well as other current and future trade agreements to which Australia is a party.

Downstream from the fishing effort, research that supports the seamless integration of information systems along the supply chain, more efficient live export systems, product diversification and new market entry is required. This will be achieved by a research agenda that is deeply integrated with the new products and markets program (see Section 3.1.3) and which includes the development of new knowledge and technology designed to improve the productivity of lobster processing and domestic and international logistics. It will also require a more strategic approach to supply chain management than perhaps currently exists.

3.1.5. Profitable Lobster Aquaculture and Feedlots

The potential escalation of global lobster production through the use of aquaculture and grow-out systems represents both a threat and opportunity for the Australian lobster industry. While, maximum sustainable harvest is yet to be reached in some Australian lobster species and quotas are often managed to optimise price, the capacity to increase supply and have supply flexibility that can respond to future market demand is potentially desirable.

The production of tropical lobster species from the sea-cage grow-out of harvested puerulus in South East Asia has been a driver of increased volumes of smaller tropical spiny lobster species in regional seafood markets in recent years. While this smaller warm-water product does not compete directly with Australia's premium wild-caught Western Rock Lobster, Southern Rock Lobster and Eastern Rock Lobster, it does have some effect on the market for Australian *Panulirus ornatus* production.

There are currently efforts underway to commercialise research at the University of Tasmania that has developed systems for closed lifecycle aquaculture production of *Panulirus ornatus*, and other tropical Lobster species native to Australian waters may also prove suitable for aquaculture production. However, as with most tropical aquaculture, it will likely prove difficult for Australian aquaculture production of tropical lobster species to be price competitive with the much lower cost structure of Asian aquaculture. However, Australia's reputation for high standards of food safety, for example, are potentially a basis for competitive advantage.

Aquaculture production of Southern Rock Lobster and particularly Western Rock Lobster is not likely to be feasible for some time. The protracted larval and grow-out cycles associated with these species render closed lifecycle aquaculture technically challenging and even if

technically achievable, the long production cycle inhibits economic returns and amplifies agricultural risk.

However, the development of effective feedlot systems for these species could potentially add significant value to the wild-harvest. The ability to retain a portion of the normal harvest in grow-out systems would allow:

- Meat yield from smaller lobsters to be optimised (for example, a single moult can increase meat yield by 20 percent);
- Fishers to retain 'whites' (recently moulted lobsters) and hold them until they become a marketable red in colour;
- The industry to guarantee specific customer product specifications with confidence; and
- Quality product to be marketed all-year-round.

The development and commercialisation of lobster feedlots requires new knowledge pertaining to the ability to identify animals optimally suited to grow-out, as well as nutrition and husbandry requirements, systems design, biology of moulting inhibiting hormones and animal health in order to optimise feedlot operations.

The focus of this subprogram is to develop the capability so that industry can use it as a tool to respond to future market conditions if necessary.

The ability to hold Australian commercial lobster species for extended periods in artificial environments will also assist in undertaking other research such investigating the fishery's resistance to the various pressures identified in Section 3.1.1 above.

3.1.6. Policy for Growth

As discussed previously in this Concept Paper, Australian lobster fisheries are widely regarded as exhibiting world-best-practice sustainable natural resource management. This reputation bears well for the sustainability of the industry, marketability of its product and maintenance of its social license to operate. However, community expectations and what is considered world-best-practice are continually evolving and the policy framework must be one that achieves both natural resource sustainability and optimal industry competitiveness. Regulation should not impose unnecessary productivity penalties on industry and its implementation should be cost effective. To this end, new knowledge is required that will allow regulation of the commercial sector to move toward eco-systems and risk based management and co-management of the resource.

Furthermore, as the recreational fishery continues to grow, more robust data on the extent of the recreational catch, extent of any potential non-compliance and intra-fishery issues such as pot theft and black-market for product will need to be established to ensure that recreational fishing remains viable, and allocation of the fishery resource among its users remains acceptable to all stakeholders. The recreational fishery itself is coming under increasing scrutiny from animal welfare groups and as such, it must have access to scientific knowledge to support its social license to operate.

3.1.7. International Issues

While the focus of the Proposed Institute is to grow the Australian lobster industry, spiny lobster and lobster production generally is a global industry. Australian lobster competes with lobster

production from other nations, but also shares areas of mutual interest such as maintaining social license to operate. To ensure that the Australian industry benefits from research undertaken in other jurisdictions that is mutually beneficial to the industry, and that Australian lobster research is able to contribute to the global effort, it is envisaged that the Proposed Institute will seek out international linkages for research that is of mutual interest. A preliminary scope for international reach is yet to be established, but may include projects such as the review of global stocks that has recently been commissioned by the Western Rock Lobster Council

3.1.8. Preliminary Research Agenda

Appendix 2 sets out a preliminary research agenda for the proposed institute. This preliminary research agenda is for indicative purposes only, and a detailed research plan will be developed based on a 'state-of-the-art' assessment, consultative end-user prioritisation process and expert input, should a decision to proceed to full planning for the Proposed Institute be made.

4. The Current Industry Investment in Research and Development and Implications for the Proposed Institute

A key consideration in assessing the case for the Proposed Institute is whether it is able to marshal a greater level of resources to fund and facilitate research and development targeted at developing solutions for the issues identified by the Australian lobster Industry than is currently the case.

The primary vehicle through which the Australian lobster industry currently invests in industry-oriented research and development is the Fisheries Research and Development Corporation (FRDC). The mechanism through which industry funds research via the FRDC is mainly indirect, whereby fishers pay a levy or fee to a State (or Territory) Government (typically administered by a Department of Primary Industry), an agreed portion of which is provided to the FRDC. Depending on specific and unique arrangements between a State and the FRDC, the agenda of a State's specific FRDC Research Advisory Committee (RAC)³¹ and specific terms of any Industry Partnership Agreement (IPA)³² that might exist between the FRDC and a particular sector of the industry, a portion of the industry levy or fee paid to the FRDC by the State is spent on research projects agreed between the FRDC and the industry sector. Through the FRDC, this amount is then matched with Commonwealth funds, providing an approximate 1:1 leverage at a project level.

4.1. Fisheries Research and Development Corporation

The Fisheries Research and Development Corporation (FRDC) is one of 15 Rural Research and Development Corporations, the principle mechanism through which the Australian Government and different sectors of primary production in Australia co-invest in research and development for industry and community benefits. Pursuant to Commonwealth legislation, Rural Research and Development Corporations collect levies from primary producers in the industry they represent, which are then matched by the Australian Government (from consolidated revenue) for investment in research and development (and in some cases market promotion) for that industry as determined by the Rural Research and Development Corporation, and within limits set by its legislation and an associated funding agreement with the Australian Government.

The fishing industry differs from the other primary industries that have Rural Research and Development Corporations in that the resource the fishing industry utilises is in a public space (as opposed to a farm environment where there are stronger tenure rights) and the resource

³¹ A Research Advisory Committee (RAC) is a representative and expert-based committee that makes recommendations to the Board of the FRDC as to research project applications that should be supported. Each State and the Northern Territory has a RAC.

³² Each major sector of the Australian seafood industry has an Industry Partnership Agreement (IPA) which are unique and specific to that sector. The purpose of the IPAs are to ensure a certain amount of FRDC funds are available to support research in key sectors. Committees of FRDC, industry and experts are formed under each IPA and those committees make recommendations to the Board of the FRDC as to research project applications that should be supported under an IPA.

is shared with other users. Reflecting this, the FRDC levy model is also, arguably necessarily, unique. In the case of other Rural Research and Development Corporations the Australian Government collects a compulsory levy from primary producers on behalf of the Rural Research and Development Corporation that it then matches and provides to the Rural Research and Development Corporation in accordance with specific provisions of the relevant legislation and funding agreement. Whereas, the FRDC is funded through agreements between it and the State or Territory Governments (which are variable between the States and Territories) that regulate a specific fishing industry based on compulsory or voluntary levies that are paid by the fishing industry in those States and Territories.

The Federal Government uniquely funds the FRDC via a two-stage process. Firstly, the FRDC receives the equivalent of 0.5 percent of Australian Fisheries GVP from the Federal Government. It then matches industry contributions up to 0.25 percent of industry GVP. Therefore the FRDC receives 1.0 percent of the GVP of any industry that contributes the maximum 0.25 percent of its GVP that the Federal Government is prepared to match. This is an important aspect of the FRDC model with respect to the Proposed Institute. Given the objective of the Proposed Institute is to grow GVP, under the current arrangements the success of the Proposed Institute in this regard, will result in a concomitant increase in resources for both lobster industry specific and fisheries research more generally.

The FRDC also uses Industry Partnership Agreements (IPA) to ensure that the research needs of the major sectors of the Australian fishing and aquaculture industry are met. An IPA is an agreement between the FRDC and a commercial fishing sector peak body, or in some cases individual companies, to manage a suite of sectoral research projects over a specified timeframe. IPAs exist for the main commercial fisheries in Australia, including the Western Rock Lobster and Southern Rock Lobster fisheries.

Under the IPA, funds allocated to IPA governed research may only fund projects that conform with the FRDC legislation and R&D priorities, and those priorities set out in the R&D plans for the relevant sector body. The FRDC's National Fishing and Aquaculture Research, Development and Extension Strategy³³ identifies the following objectives to be achieved by 2020:

- Fishing and aquaculture will continue to have improved performance in environmental sustainability;
- Fishing and aquaculture will be more resilient to social, environmental and economic change;
- Fishing and aquaculture businesses will be more productive and profitable;
- Recreational fishers will have improved opportunities for better fishing experience and will play a greater role in the stewardship of fisheries resources;
- More Indigenous people will derive benefit from fishing and aquaculture activities and will play a greater role in the stewardship of fisheries resources; and
- Information about the science and management of sustainability of fishing and aquaculture will be more accessible to the consumer and meet consumer's needs.

The amount of FRDC funds allocated under an IPA are firstly determined by the sector's share of national fishing and aquaculture GVP, and then discounted according to a prescribed percentage, with the unallocated amount being retained for general fisheries research and research specific to smaller fisheries that do not have IPAs, as determined by State Research Advisory Committees.

³³ Fisheries Research and Development Corporation (2015), *Research Development and Extension Plan*, Australian Government, Canberra

Irrespective of an IPA, a number of principles determine what the FRDC can invest in:

- The FRDC can only invest in research, development and extension (unlike some other Rural Research and Development Corporations it cannot invest in promotion);
- All RD&E investments must be in partnership, with good governance exhibited by all parties to that partnership;
- All RD&E must address an agreed strategic plan;
- FRDC aims to invest nationally where possible and makes sense to do so;
- RD&E investments should compromise a balance of high and low risk projects as well as a 'balanced portfolio' across the areas of environment, industry, communities, people and extension; and
- The FRDC cannot fund an organisation's core business, or advocacy activity.

4.2. Western Rock Lobster Industry Investment in Research and Development

Western Rock Lobster fishers pay the Western Australian Government a Resource Access License fee equivalent to 5.75 percent of the sector's GVP on a three year rolling average basis. This fee is charged by the State under powers afforded to it under the *Fish Resources Management Act 1994* (WA).

Last year, the amount paid by the Western Rock Lobster industry under this arrangement was \$22.1 million based on a three year rolling average GVP for the industry of approximately \$384.3 million. This is equivalent to 76.5 percent of the \$28.9 million total Resource Access License fee paid by the Western Australian commercial fishing industry and 60 percent of the total Resource Access License Fee paid by the commercial and recreational fishing sectors. It is worth noting that of the \$7.7 million of licensing fees paid by the recreational sector, Western Rock Lobster recreational licence fees account for 22.7 percent.

Under the current arrangement, the 5.75 percent levy paid to the Western Australian Government is allocated as summarised in Table 4 below.

Recipient/Payee	Percentage of GVP	2016-17 Amount (based on 3-year GVP rolling average of A\$384.3m)	Application of Funds
Western Australian Resource Access License Fee Revenue			
Total receipts from commercial lobster fishers	5.750	\$22.1m	
Application of Western Australian Resource Access License Fee Funds			
Western Australian Government	5.000	\$19.2m	Allocated at the Western Australian Government's discretion across consolidated revenue and DPRID for fisheries management and research.
Western Australian Fishing Industry Council	0.375	\$1.4m	WAFIC is allocated 0.5 percent of the total levy and it subsequently provides the Western Rock Lobster Council with 25 percent of that amount, with the balance used to part fund the operations of WAFIC
Western Rock Lobster Council	0.125	\$0.5m	Used to part fund the operations of the Western Rock Lobster Council
Fisheries Research and Development Corporation	0.250	\$1.0m	Voluntary contribution to the FRDC for research, development and extension.
Total Allocation of Resource Access License Fee	5.750	\$21.1m	

TABLE 4 – DISTRIBUTION OF ROCK LOBSTER INDUSTRY LEVY

The contribution made to the FRDC from the Resource Access Licence Fee is paid as one lump-sum, aggregating the collections from all fisheries operating under Western Australian Government's jurisdiction. As such, the approximate A\$1.0 million paid by the Western Rock Lobster industry is not provided to the FRDC specifically for Western Rock Lobster Research, but rather according to an agreement between the State and the FRDC. At its discretion, the FRDC then allocates a gross portion of its total Australian fishing industry contributions to the Western Rock Lobster industry based on Western Rock Lobsters contribution to total fishing industry GVP, but discounts this amount according to discount factors that are prescribed in the IPA between the Western Rock Lobster Council and the FRDC. In the three most recent years this discount has been 50 percent, increasing to 60 percent in 2017-18 and 70 percent in 2018-19, less an 8 percent administration fee that is deducted by the FRDC.

Table 5 below sets out an estimate as how the Western Rock Lobster sector's 0.25 percent of GVP research levy has contributed to funds available for Western Rock Lobster related research over the life of the existing Western Rock Lobster IPA.

	2014-15 (a) \$m	2015-16 (a) (\$m)	2016-17 (a) (\$m)	2017-18 (e) (\$m)	2018-19 (e) (\$m)	TOTAL (\$m)
Estimated Western Australian Fishing Industry GVP (3 year rolling average)	317.43	384.83	383.90	391.55	410.09	1,887.79
Voluntary R&D Levy (0.25 percent of GVP)	0.79	0.96	0.96	0.98	1.03	4.72
WA Fisheries Western Rock Lobster Contribution	0.50	0.61	0.78	0.85	0.90	3.63
IPA Percentage	50%	50%	50%	60%	70%	
Hypothecated IPA contribution	0.25	0.30	0.39	0.51	0.63	2.08
FRDC Matching Funds	0.25	0.30	0.39	0.51	0.63	2.08
Less: FRDC Service Fee (8% of total research funds)	0.04	0.05	0.06	0.08	0.10	0.33
Additional Special Funds (Rock Lobster Post Harvest Subprogram)	0.16	-	-	-	-	-
Total FRDC Western Rock Lobster Research Funds Available	0.62	0.56	0.71	0.94	1.16	3.99

TABLE 5 – ESTIMATED INDIRECT CONTRIBUTION OF THE WESTERN ROCK LOBSTER R&D LEVY TO FRDC FUNDS THAT ARE AVAILABLE FOR INVESTMENT UNDER THE WESTERN ROCK LOBSTER IPA

Since 2014-15, the Western Rock Lobster industry has made a voluntary R&D contribution totalling \$3.6 million. Since 2010-11, projects funded under the Western Rock Lobster industry's IPA have had total FRDC expenditure of approximately \$1.2 million (see Section 4.4) and projects that have been initiated by the Western Rock Lobster Industry either by itself or in collaboration with the Western Australian Government (see Section 4.4) have had total FRDC expenditure of \$2.3 million. This would suggest that the Western Rock Lobster industry is not receiving an equitable return on the voluntary contribution made indirectly to the FRDC, and that a significant portion of the Western Rock Lobster industry's contribution is directed to other Australian fishing sector interests.

It is also worth noting that recent funding applications for the projects listed in Table 6 below, which are generally aligned with the high-level research themes discussed in Section 3 were not supported by the FRDC, despite being recommended by the Western Rock Lobster IPA management committee and approved by the Western Rock Lobster Council Board.

Program Application	Amount (A\$)
Communications	\$500,000
Understanding the Market for Western Rock Lobster	\$400,000
Digitising the Western Rock Lobster Industry	\$550,000
TOTAL	\$1,450,000

TABLE 6 – RECENT WESTERN ROCK LOBSTER PROJECT FUNDING APPLICATIONS REJECTED BY THE FRDC

4.3. Southern Rock Lobster Industry Investment in Research and Development

The Southern Rock Lobster industry operates in the fisheries management jurisdictions of South Australia, Tasmania and Victoria. Established in 2006, Southern Rock Lobster Ltd (a company limited by guarantee) is the national body responsible for industry research, development and extension for the Southern Rock Lobster fishing industry. In November 2010, Southern Rock Lobster Limited, Primary Industries and Resources South Australian (PIRSA), Department of Primary Industries Victoria (DPI-Vic) and Department of Primary Industries, Parks, Water and Environment Tasmania (DPIPWE) reached in-principle agreement to establish an IPA with the FRDC covering the national Southern Rock Lobster industry.

Even though specific detail of the Southern Rock Lobster FRDC IPA is not publicly available, it is clear from this analysis summarised in Section 4.4 that, despite the Southern Rock Lobster industry producing less GVP than the Western Rock Lobster industry, it has marshalled a much larger research budget and focused that on a more comprehensive research program that is more acutely aligned with its industry identified needs.

It is understood that Southern Rock Lobster has achieved this additional leverage through a number of mechanisms including a significant separate contribution by the Tasmanian Government to the FRDC (some of which was allocated to the Southern Rock Lobster IPA), the use of the former Seafood CRC to leverage investment and a more favourable IPA that sees 100 percent of the FRDC funds attributable to Southern Rock Lobster according to its share of national fishing and aquaculture industry GVP hypothecated to research governed under the Southern Rock Lobster IPA.

4.4. FRDC Investment in Australian Lobster Industry Research and Development

The key purpose of this section of the Concept Study is to provide a basis for assessing how effective the Proposed Institute model might be in marshalling resources for investment in research and development targeted at developing solutions for issues identified by the Australian lobster industry as opposed to the current primary mechanism. To achieve this an analysis of research projects deemed to be relevant³⁴ to the Australian Lobster industry that have been commenced with funding from the FRDC during the Period 2010-11 to 2017-18³⁵ has been undertaken.

This analysis is based on data provided to this study by the FRDC. In order to focus on the total amount committed and for ease of analysis, the modelling identifies new projects at their designated start date and assigns the full project value to that start date (in reality most projects are undertaken over multiple years with total expenditure apportioned over the project's life).

The analysis is contained in Appendix 3 and has been undertaken at two levels. In the first instance, Appendix 3 discusses FRDC investment in research that the FRDC has deemed relevant to the Australian lobster industry according to the various FRDC funding mechanisms, namely IPAs, RACs, Seafood CRC Program, and specific FRDC programs such as Tactical

³⁴ FRDC projects have been deemed to be relevant to the Australian Lobster Industry if a keyword search of the FRDC project database identifies the project.

³⁵ The data pertaining to the 2017-18 financial years is up to 31 January 2018

Research Fund, FRDC National Program, Incentive Fund, Response Research Fund, National Priorities Program and Climate Change Program. In the second instance, Appendix 3 discusses FRDC investment in research the FRDC has deemed relevant to the Australian lobster industry according to the Australian lobster industry stakeholder that initiated the research project. Stakeholder categories that have been used for this purpose are:

- The Australian lobster industry or recreational sector acting alone or in collaboration with another sector(s) of the Australian seafood industry;
- Other Australian seafood industry acting in the absence of explicit co-initiation with the Australian lobster industry or recreational sector;
- State Governments co-initiating with the Australian lobster industry or recreational sector;
- State Governments initiating without the explicit co-initiation of the Australian lobster industry or recreational sector; and
- Research organisations initiating without the explicit co-initiation of the Australian lobster industry or recreational sector.

It can be reasonably assumed that where the Australian lobster industry has been party to the initiation of a project, that project is in fact immediately relevant to the Australian lobster industry. Whereas in cases where the industry has not been party to the initiation of a project, that project's direct relevance is perhaps more questionable.

The analysis in Appendix 3 highlights that during the period 2010-11 to 2017-18:

- The FRDC invested, through its various mechanisms, a total of approximately A\$12.7 million across 65 research projects it deemed to be relevant to the Australian Lobster industry.
- While the in-kind leverage achieved from FRDC expenditure has been broadly equivalent across Western Australian and eastern states initiated Lobster research, eastern states initiated research has achieved total cash leverage of 17 percent, whereas Western Australian initiated research has not achieved any cash leverage from the FRDC expenditure.

The allocation of FRDC expenditure and the leverage achieved from that expenditure for Western Australian and eastern states initiated projects deemed by the FRDC to be relevant to the Australian lobster industry for the period 2010-11 to 2017-18 is summarised in Figure 15 below.

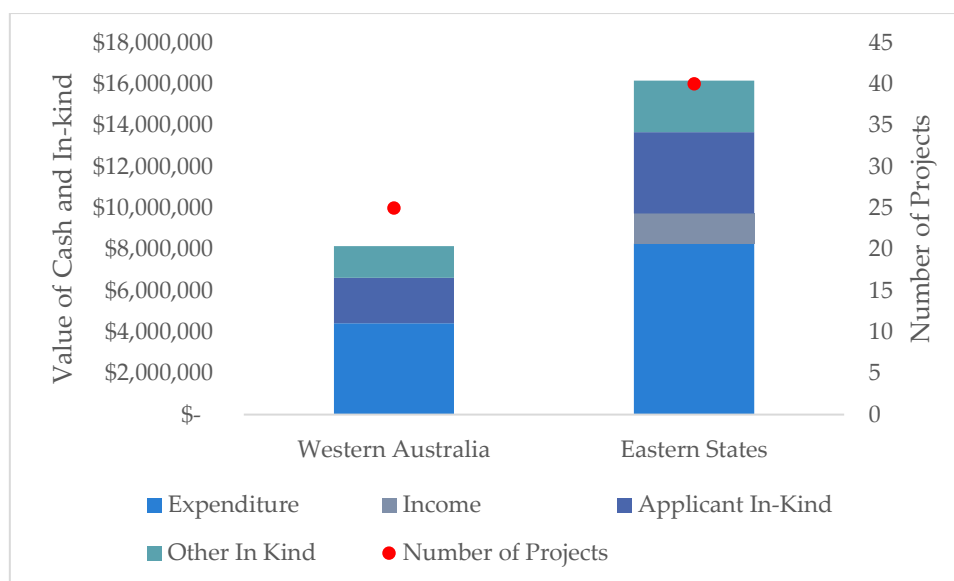


FIGURE 15 – FRDC INVESTMENT AND LEVERAGE ATTAINED FOR PROJECTS DEEMED RELEVANT TO THE AUSTRALIAN LOBSTER INDUSTRY BY THE FRDC FOR THE PERIOD 2010-11 TO 2017-18

4.4.1. Key Observations – Funding According to FRDC Funding Mechanism

The analysis in Appendix 3 highlights that during the period 2010-11 to 2017-18:

- The FRDC funded a total of 34 projects with a total FRDC expenditure of approximately A\$7.0 million through the Southern Rock Lobster, Abalone Council of Australia and Western Rock Lobster IPAs. Projects initiated by eastern states interests (SRL and ACA) accounted for 71 percent of the projects and 82 percent of the FRDC expenditure on those projects. The eastern states industry achieved superior leverage from FRDC expenditure through their RAC.
- Through the Western Australian, Tasmanian, New South Wales and Victorian RACs and a RAC-like arrangement with the Torres Strait Regional Authority, the FRDC funded 15 research projects deemed relevant to the Australian lobster industry for a total FRDC expenditure of approximately \$3.2 million. Over half of these projects and almost 70 percent of the associated FRDC expenditure under these RACs is attributable to the Western Australian RAC.
- FRDC funded a total of 5 projects for a total expenditure of \$791,000 through the Seafood CRC mechanism. Three of these projects accounting for 80 percent of the total FRDC expenditure through this mechanism were initiated by the Southern Rock Lobster industry
- 11 projects with a total FRDC expenditure of approximately \$1.7 million were supported through other FRDC programs. Of these, 55 percent of the projects accounting for 59 percent of the FRDC expenditure were initiated from Western Australian lobster sector interests, with the balance from eastern states lobster sector interests.

4.4.2. Key Observations – Funding According to Project Initiator

The analysis in Appendix 3 highlights that during the period 2010-11 to 2017-18:

- The vast majority (77 percent) of FRDC funds that have been committed to research projects deemed by the FRDC to be relevant to the Australian lobster industry, are by

virtue of the Australian Lobster industry being party to their initiation, indeed relevant to the Australian lobster industry.

- Where, almost 90 percent of the total FRDC expenditure associated with projects initiated from eastern states lobster interests were initiated by the industry either acting alone or in collaboration with another sector of the Australian seafood industry or a state government, only 54 percent of the funding associated with projects initiated by Western Australian lobster interest had been initiated by the lobster industry, and half of those were in collaboration with the Western Australian government.
- Only the Western Australian industry has had FRDC funded projects deemed relevant to the lobster industry initiated by other sectors of the industry without express collaboration from the lobster industry.
- Of the projects that were deemed relevant to the Australian lobster industry and initiated by government without express collaboration from the Australian lobster industry, approximately 56 percent of the projects associated with 61 percent of the total FRDC funding in this category were initiated by the Western Australian Government.

Section 4.2 highlights that the Western Rock Lobster industry makes a significant indirect contribution to the FRDC, the vast majority of which is directed to fund research for other Australian fishing sector interests. This is primarily a function of relatively lower hypothecation factors in the Western Rock Lobster IPA, a lower level of project proposals presented to the FRDC by the Western Rock Lobster industry and a significant number of the proposals that have been presented being deemed by the FRDC decision-making framework as either not viable for FRDC funding or not competitive.

4.4.3. Implications for the Proposed Institute

As discussed in the following subsections, the circumstances summarised in Sections 4.4.1 and 4.4.2 above present both a challenge and opportunity to the Proposed Institute.

To be optimally effective, the Proposed Institute will likely need to be financially compelling to other stakeholders

The eastern states lobster industry has been very effective in accessing FRDC resources for its identified research projects and substantially leveraging the FRDC expenditure from other cash and in-kind sources under the current arrangements. As such, it is probable that it would resist any alternative that reduced its access to these resources, unless a compelling alternative can be demonstrated.

To address this, the Proposed Institute would need to add value by firstly increasing the total amount of research resources available to the entire Australian lobster industry and secondly, by investing those resources more efficiently across industry identified research projects that are shared priorities across the sectors of the Australian lobster industry, as well as projects that are specific to each sector.

Further, the Western Australian Government has used its RAC and other FRDC programs to support substantial Lobster industry related research for its purposes. It is likely that unless the Western Australian Government's lobster and other fisheries research activities can be maintained or enhanced through the Proposed Institute, it will also likely resist any change that reduces its access to these resources.

There is an opportunity to marshal greater resources

The Proposed Institute presents three opportunities to marshal greater research resources for the Australian lobster industry.

Firstly, full hypothecation under the Western Rock Lobster IPA would result in a greater base resource that could be shared across identified priority projects in which the wider Australian lobster industry has a common interest under the Proposed Institute model. For example, a 100 percent hypothecation factor in 2016-17 under the Western Rock Lobster IPA would have resulted in an additional \$0.4 million.

Secondly, if the Proposed Institute facilitates the ability of all sectors of Australian lobster interests to achieve industry best practice (or even average practice) with respect to leveraging FRDC funds additional resources could be realised. For example, Table 7 below summarises the additional resources that would have been marshalled over the period 2010-11 to 2017-18 under IPAs and RACs if those sectors that did not achieve best practice leverage had, and if those sectors that did not achieve at least average leverage had. According to this analysis an additional resource of between \$1.1 million (at minimum average leverage) and \$3.7 million at best practice leverage would have been realised. This analysis does not include other FRDC funding mechanisms.

FRDC Mechanism	FRDC Expenditure	Total Resources at Actual Leverage	Total Resources at Best Practice Leverage	Total Resources at a Minimum of Average Leverage
Industry Partnership Agreements				
Western Rock Lobster	\$1.2	\$2.1	\$2.5	\$2.3
Southern Rock Lobster	\$5.2	\$10.5	\$10.5	\$10.5
Australian Abalone Council	\$0.6	\$0.6	\$1.2	\$1.1
Subtotal	\$7.0	\$13.2	\$14.2	\$13.9
Regional Advisory Committees				
Western Australia	\$2.2	\$4.1	\$6.3	\$4.5
New South Wales	\$0.1	\$0.3	\$0.4	\$0.3
Victoria	\$0.3	\$0.6	\$0.8	\$0.6
Tasmania	\$0.4	\$1.3	\$1.3	\$1.3
Torres Strait Regional Authority	\$0.2	\$0.3	\$0.6	\$0.4
Subtotal	\$3.2	\$6.6	\$9.3	\$7.0
TOTAL	\$10.8	\$19.8	\$23.5	\$20.9

TABLE 7 – ADDITIONAL RESOURCES AVAILABLE AT BEST PRACTICE AND AVERAGE LEVERAGE FROM FRDC INVESTMENT (2010-11 TO 2017-18)

Finally, the Proposed Institute is intended to seek out much wider sources of potential leverage than that which is typical under the current FRDC mechanism (see Section 6.3).

While additional modelling that is beyond the scope of this Concept Study is required to validate the notion, it is likely that the Proposed Institute will garner greater research resources for the Australian Lobster industry than is currently the case.

5. Structural Considerations for the Proposed Institute

5.1. Case Precedence

Multi-sector, multidisciplinary, mission-oriented formal research collaborations such as that being proposed are common-place in most developed nations (including Australia) and in primary industries generally. Appendix 4 summarises a number of such institutions that operate in various commercial seafood industries globally.

Nationally, the Cooperative Research Centres program was developed specifically to give effect to such programs and some ARC Centres of Excellence operate as multi-sector collaborations. In Western Australia, collaborations have been established outside of these Commonwealth frameworks with financial support from the State in key sectors including:

- Western Australian Energy Research Alliance;
- Minerals Research Institute of Western Australia;
- Western Australian Biodiversity Science Institute; and
- Western Australian Marine Science Institution.

5.2. Type of Institution

Multi-sector, multidisciplinary, mission-oriented formal research can adopt a number of structural forms. At one end of the spectrum there are institutions that are entirely virtual, comprised typically of a governance structure that allocates resources to research providers on a competitive basis pursuant to specific project research agreements that tightly align research projects, their management and outputs to a very specific institute research plan. At the other end of the spectrum, there are research institutes that are entirely self-contained, owning their own research infrastructure and directly employing the scientific expertise that is managed to deliver against the research institutes research plan.

Most multi-sector, multi-disciplinary, mission-oriented formal research collaborations adopt a form that is a hybrid of these extremes. The Proposed Institute will also likely be a hybrid structure. Because Lobster research capability in Australia is distributed across a number of institutions, it is likely that a primary function of the Proposed Institute will be to coordinate the Lobster research activity of those institutions to achieve common goals articulated by an agreed strategic research plan. However, there is also a desire to have dedicated physical research infrastructure to support programs such as feedlot and aquaculture research, as well as to integrate the activities of the Proposed Institute into local tourism and cuisine, helping to enhance Lobster's role in establishing Australian seafood provenance.

The precise nature of the Proposed Institution cannot be established until a research agenda has been finalised and the necessary Lobster research capability identified and engaged.

5.3. Potential Participants and Stakeholders in the Proposed Institute

The structure that the Proposed Institute adopts will in part be determined by the number and nature of entities that participate in the Proposed Institute, as well as how they participate. As

identified in Table 8 below participants and key stakeholders in the Proposed Institute can be broadly classified as:

- End users of the research outputs of the proposed institute
- Scientific research providers
- Fisheries and other research funders
- Other stakeholders

Stakeholder	Description
End Users of Research Outputs	
Australian Lobster Fishers	Owners and operators of wild-catch fishing vessels in the Western Rock Lobster, Southern Rock Lobster, Eastern Rock Lobster and Tropical Rock Lobster sectors of the Australian Lobster industry.
Australian Lobster Processors	Seafood processing businesses located in Western Australia, South Australia, Victoria, Tasmania, New South Wales and Queensland that acquire raw product from Lobster fishers, value-add to that product and/or distribute to domestic and international markets.
Australian Fishery Regulators	Departments of Primary Industry with jurisdiction over state fisheries in Western Australia, South Australia, Victoria, Tasmania, New South Wales and Queensland, as well as the Australian Fisheries Management Authority.
Lobster Industry Advocates	Western Rock Lobster Council and Southern Rock Lobster Limited
Recreational Lobster Sector Advocates	Recfish West, Recfish SA, VRFish and Tasmanian Association for Recreational Fishing
Scientific Research Providers	
Universities	Australian universities with Lobster related research interests such as Curtin University, Murdoch University, University of Western Australia, University of Tasmania and James Cook University
Australian Institute of Marine Science	Tropical marine aquaculture and fisheries research capability.
CSIRO	Marine aquaculture and fisheries research capability.
SARDI	Marine aquaculture and fisheries research capability.
Research Funders	
Fisheries Research and Development Corporation	Rural Research Development Corporation with principal responsibility for managing Commonwealth investment in industry-oriented fisheries and aquaculture research (see Section 4.1)
Commonwealth Department of Agriculture and Water Resources	Commonwealth agency responsible for regulation and development of primary industries and administrator of several agribusiness research and development grants programs (see Section 6.3)
State Departments of Primary Industry	State agencies responsible for regulation and development of fisheries and aquaculture within state jurisdiction, with some states offering grant programs.

Stakeholder	Description
Other Stakeholders	
International Seafood Distributors and Retailers	International seafood distributors and retailers form key components of the Australian Lobster supply chain and as such will have interests in any aspects of research undertaken by the Proposed Institute that potentially impacts that supply chain.
International Lobster Research Programs	The Proposed Institute will seek to collaborate with the global Lobster industry and international Lobster research providers on global issues of mutual interest.
Community	The community has a stake in the Proposed Institute to ensure that it provides a scientific basis that underpins the protection of the community's interest in the industry and the fishery.

TABLE 8 – POTENTIAL PARTICIPANTS AND STAKEHOLDERS IN THE PROPOSED INSTITUTE

It should also be noted that the Western Australian Marine Science Institute (WAMSI) currently has a proposal with the Western Australian Government, that if funded would see it become an overarching coordination mechanism for research that is undertaken in the State's interest pursuant to the priorities identified in the Western Australian Blueprint for Marine Science 2050³⁶. Subject to the outcomes of WAMSI's proposal and finalisation of the research agenda, funding arrangements and structure of the Proposed Institute, potential benefits and drawbacks associated with different potential relationships between the Proposed Institute and WAMSI should be explored.

5.4. Western Australian Infrastructure Options

Should the Proposed Institute be 'headquartered' in Western Australia, it is likely that it will incorporate office infrastructure and some aquaculture oriented research infrastructure. While much of it is dated, there is currently significant excess capacity of aquaculture oriented research infrastructure in Western Australia.³⁷ This capacity is summarised in the following subsections, and is distributed across the Perth metropolitan area, and some regional locations. The Proposed Institute could potentially operate a 'node-style' program across multiple facilities including in Geraldton.

5.4.1. Australian Centre for Applied Aquaculture Research

Formerly known as the Aquaculture Development Unit, the Australian Centre for Applied Aquaculture Research (ACAAR) was established in 1993 with a charter to assist in the development of the marine aquaculture industry in Western Australia. ACAAR is viewed as a critically important piece of industry infrastructure by the Western Australian aquaculture industry and proponents of restocking of recreational species, is highly regarded and used (to a limited extent) by national aquaculture operators, and is held in high esteem by the national and international aquaculture research sector. Since 1994, ACAAR has undertaken exclusively,

³⁶ Australian Venture Consultants (2016), *Blueprint for Marine Science 2050*, Western Australian Marine Science Institution.

³⁷ Australian Venture Consultants (2016), *State Aquaculture Research, Training and Service Delivery Capabilities: A Review of Research, Training and Service Delivery Capacity Operated by TAFE Colleges and Department of Fisheries*, Department of Training and Workforce Development and Department of Fisheries, Western Australian Government, Perth

or participated in, over 100 aquaculture and aquaculture related advisory, applied research and fish stock supply projects for industry and government clients. The total value of these projects is approximately A\$7.25 million.³⁸

Table 9 below summarise aquaculture systems at ACAAR.

Item	Quantity
2,000 square metres of enclosed area reticulated with air and water	
Saltwater bores supplying seawater at 25L/sec	2
Hatchery laboratories, aquaria and live food culture rooms	?
Controlled environment (photo-therm) rooms	3
8 X 5 tonne larviculture arrays with heating capacity	2
10 tonne tank research array	14
200 litre tank research array	20
1 tonne live fish transport system with computer monitoring and life support	6
High density rotifer RAS within a dedicated controlled environment room	1
42 tonne broodstock tank facilities	2
30 tonne broodstock tank facilities	3
Dedicated broodstock transport trailer	1

TABLE 9 - ESTIMATED CAPITAL INVESTMENT IN ACAAR

The facilities listed in Table 9 above are housed in 80 year old buildings constructed from timber and corrugated iron that are listed on the Western Australian State Heritage Register. While this does not impact on the operations of ACAAR, it presents a significant ongoing maintenance challenge and presents challenges to any substantial modification.

Generally speaking, the life expectancy of most aquaculture systems is approximately 30 years. Many of the aquaculture systems at ACAAR have been operating for approximately 20 years and as such, maintenance and biosecurity issues are becoming more frequent and problematic.

In light of ACAAR's importance to the aquaculture industry and its degrading systems, the State Government is preparing to relocate ACAAR to a new, purpose built facility. This would leave the existing facility as an option for the Proposed Institute. However, the investment needed to bring systems up to an acceptable standard, and potential water quality issues associated with the absence of an ocean-intake would need to be the subject of a detailed

³⁸ Australian Venture Consultants (2016), *State Aquaculture Research, Training and Service Delivery Capabilities: A Review of Research, Training and Service Delivery Capacity Operated by TAFE Colleges and Department of Fisheries*, Department of Training and Workforce Development and Department of Fisheries, Western Australian Government, Perth

economic and technical feasibility study once an investable case for the Proposed Institute has been established.

5.4.2. Batavia Coast Marine Institute

The Batavia Coast Marine Institute (BCMI) is a marine research and training facility that was constructed in the mid-2000s on coastal land in Geraldton and is operated by Centre Regional TAFE. The BCMI facility hosts a number of research assets that may prove useful to the Proposed Institute, including laboratories, larvae culturing systems, broodstock holding systems, hatchery and grow-out systems all of which are supported by a seawater intake and seawater pumping facility.³⁹ Much of this infrastructure had been relatively underutilised in recent years, but is now being used by the Mid West Yellowtail Kingfish aquaculture project.

The BCMI is potentially attractive from the perspective of being in close proximity to a major concentration of the Lobster fishing and processing sectors. However, locating capacity in regional centres, always faces the challenge of higher cost structure and attracting critical mass of talented staff.

5.4.3. Waterman's Fishery Research Centre

The Indian Ocean Marine Research Centre (IOMRC) involves the co-location of four of the largest providers of marine science in Western Australia (Australian Institute of Marine Science, CSIRO, Fisheries WA and University of Western Australia) in purpose built facilities at the University of Western Australia Crawley Campus and the Western Australian Government marine laboratories at Waterman's Bay.

The aquaculture oriented facilities at Waterman's Bay (including the ocean intake) have been recently refurbished and there is currently excess capacity.

5.4.4. Fisheries WA Hillary's Research Centre

The Western Australian Department of Primary Industries and Regional Development's Hillary's Fisheries Research facility is a 400 square metre workspace with seawater provided directly by an ocean intake system. The facility is currently configured as a mollusc hatchery facility supporting investigations into a saucer scallop restocking research project. Table 10⁴⁰ below summarises the aquaculture related research facilities operated by the Department of Fisheries at its main research centre located in Hillary's, Western Australia.

³⁹ Australian Venture Consultants (2016), *State Aquaculture Research, Training and Service Delivery Capabilities: A Review of Research, Training and Service Delivery Capacity Operated by TAFE Colleges and Department of Fisheries*, Department of Training and Workforce Development and Department of Fisheries, Western Australian Government, Perth

⁴⁰ Australian Venture Consultants (2016), *State Aquaculture Research, Training and Service Delivery Capabilities: A Review of Research, Training and Service Delivery Capacity Operated by TAFE Colleges and Department of Fisheries*, Department of Training and Workforce Development and Department of Fisheries, Western Australian Government, Perth

Equipment	Description
Seawater intake system	Ocean intake system with capacity of 70,000L/hr
Mollusc broodstock tanks	10 X 400lt, 2 X 5,000lt, 24 X 200lt, 3 X 2,000lt and 1 X 20,000lt
Larval rearing tanks	24 X 270lt, 12 X 1,000lt, 8 X 200lt
Micro-algal production	Two algae laboratories, stock culture and upscale room
Supporting laboratories	Cold storage, feed preparation laboratory, AQIS approved quarantine facility

TABLE 10 – DEPARTMENT OF FISHERIES RESEARCH DIVISION – AQUACULTURE RESEARCH FACILITIES

Subject to current and planned usage, this facility could also potentially be leased to provide aquaculture oriented infrastructure for the Proposed Institute.

5.5. Operating Budget and Legal Structure

5.5.1. Operating Budget

Until the precise scope of research activity that will be undertaken by the Proposed Institute, the structure that it will adopt and the nature of its participants has been established, it is not possible to determine an operating budget with any degree of precision. This activity will be the subject of a business case, should the Proposed Institute be progressed further.

However, case precedence suggests that any formalised research collaboration that is based on an institute model tends to incur an annual administrative expense of between \$500,000 and A\$1.0 million, at a minimum. Administrative costs would be expected to escalate considerably under a structure whereby the Proposed Institute is operating infrastructure and directly employing research expertise.

5.5.2. Legal Structure

There are various legal structure options that the Proposed Institute could adopt including incorporated or unincorporated joint venture. If incorporated, the benefits and drawbacks of a private or public company or company limited by guarantee structure will need to be considered. Again, the preferred legal structure will not be evident until other structural aspects of the Proposed Institute have been determined.

6. Resourcing Options for the Proposed Institute

There are a number of options that can be considered with respect to resourcing the Proposed Institute, including:

- Making a compelling case to the FRDC to optimise leverage of FRDC matching funds from industry contributions;
- Implementation of an additional levy on industry;
- Accessing other Commonwealth programs for additional leverage;
- Reallocating or redirecting existing Western Australian Government lobster research funding;
- Potential allocation of a portion of the 5.0 percent levy that is paid to the Western Australian Government by the industry; and
- Ensuring projects supported by the Proposed Institute optimise in-kind contributions from industry and research provider partners.

The likely accessibility and effectiveness of these different resourcing options will depend on the nature of the research agenda and structure of the Proposed Institute that is ultimately adopted.

6.1. Improved Leverage from Existing Contributions

As discussed in Sections 4.4.1 and 4.4.2, while the Southern Rock Lobster industry manages to considerably leverage its FRDC investment, the FRDC investment from the Western Rock Lobster industry is considerably under-leveraged. As discussed in Section 4.4.3 the Proposed Institute will seek to substantially increase overall industry leverage from FRDC resources.

It should also be noted that if the Proposed Institute is successful, any levy based on industry GVP will see the contribution to research increase. A future decision will need to be made as to whether increases should accrue to research, or contributions should be capped.

6.2. Additional Levy

Another option for resourcing the Proposed Institute is to charge a separate levy on the industry. This might be additional to the industries existing contribution to research, or in State's where the research contribution is voluntary it might replace the existing levy. Given the cross-supply chain focus of the Proposed Institute, consideration should be given to if and how any such levy might apply to businesses downstream to the fishing effort.

Commercial Western Rock Lobster fishers currently pay a fee of \$300 per licence that is additional to the Resource Access Licence fee discussed in Section 4.2. This additional fee raises an amount of approximately A\$180,000 that is allocated to the Western Rock Lobster Council to support its operations. While this sets a precedent for such additional charges, resistance to an additional charge for research may be encountered on the basis that a contribution is already being made through the Resource Access Licence fee.

6.3. Other Sources of Leverage

There are a number of other Commonwealth Government grant and funding programs that could potentially be accessed by the Proposed Institute at an institute, program or project level in order to leverage the industry investment and other external funding sources. These programs are summarised in Table 11 below.

Program	Description
Rural Research and Development for Profit	Rural Research and Development for Profit is A\$180.5 million program operating over eight years until 2022. Its objective is to generate knowledge, technology, products and processes that benefit primary producers, strengthen pathways to extend the results of research and establishing and fostering industry and research collaborations. Applications must be led by a Rural Research and Development Corporation such as the FRDC in collaboration with researchers, funding agencies, universities, producer groups and private sector. This program is administered by the Commonwealth Department of Agriculture and Water Resources.
Innovation Grants	Innovation Grants are grants ranging from A\$250,000 to A\$1.5 million that are available to farmers, fishers, groups and businesses to develop and implement tools that lead to sustainable practices, reduce costs and build productivity. This program is administered by the Commonwealth Department of Agriculture and Water Resources.
Regional Food Producers Innovation and Productivity Program	Regional Food Producers Innovation and Productivity Program is a four year, A\$35 million program, with A\$10 million quarantined specifically for the seafood industry. Under the program, matched-funding grants are available for food and seafood businesses to under projects based on the design and implementation of new technologies, production or processing techniques, adoption of food production or processing technologies developed overseas or innovative redesign of existing production and processing lines to improve efficiencies and productivity. This program is administered by the Commonwealth Department of Agriculture and Water Resources.
Food Innovation Australia Ltd	Food Innovation Australia Ltd (FIAL) was established by the Federal Government to help the food and agribusiness industry grow. FIAL acts as a knowledge hub for the industry and agribusiness and food markets, assists organisations in the sector to build capabilities and facilitates inter-industry and market networks.
AUSTRADE	A successful application by the Proposed Institute to AUSTRADE resulting in the Proposed Institute becoming a AUSTRADE Approve Body would allow the Proposed Institute access to AUSTRADE Export Market Development Grants that could potentially be used to fund market related research.
Departments of Primary Industry	<p>In the event that the Proposed Institute performs some of the fisheries research that is currently undertaken by Departments of Primary Industry, a portion of levies and fees paid to the Departments of Primary Industry by the commercial and recreational Lobster sectors could be invested in the Proposed Institute.</p> <p>Additionally, if part of the Proposed Institute's activities are undertaken in regional Western Australia, Royalties for Regions and its related programs may also be viable sources of funding.</p>
Australian Research Council Centre of Excellence	ARC Centres of Excellence are prestigious foci of expertise through which high-quality researchers maintain and develop Australia's international standing in research areas of national priority. These are significant multi-sector collaborations between research organisations, government and industry.
Australian Research Council Linkage Projects	The Linkage Projects scheme promotes national, and international, collaboration and research partnerships between key stakeholders in research and innovation including higher education institutions, government, business, industry and end-users. Projects must be

Program	Description
	undertaken to acquire new knowledge and involve risk or innovation. The Linkage Projects scheme provides project funding of \$50,000 to \$300,000 per year for two to five years on a matched-funding basis. This program is administered by the Australian Research Council.
Australian Research Council Industrial Transformation Research Program	The Industrial Transformation Research Program seeks to engage Australia's best researchers in issues facing the new industrial economies and training the future workforce. Food and agribusiness is one of the current industrial transformation priorities and the program provides funding of A\$500,000 to A\$1.0 million per annum for three to five years to support the activities of collaborations designed to achieve this objective. This program is administered by the Australian Research Council.
Cooperative Research Centre Program	The Cooperative Research Centres (CRC) Program supports industry-led collaborations between industry, researchers and the community. The program aims to improve the competitiveness, productivity and sustainability of Australian industries, foster high quality research to solve industry identified problems and encourage and facilitate SME participation in collaborative research. Funding is provided on a matching basis for programs of up to 10 years in duration. This program is administered by the Commonwealth Department of Industry, Innovation and Science.
Cooperative Research Centres Projects Grants	This program (sometimes referred to as CRC-lite) provides grant funds on a matching basis for smaller, project oriented collaborations between industry, research and community sectors to develop new technologies, products and services. Successful collaboration applicants must have at least two Australian industry organisations (including at least one SME) and one Australian research organisation. This program is administered by the Commonwealth Department of Industry, Innovation and Science.

TABLE 11 – OTHER POTENTIAL SOURCES OF LOBSTER RESEARCH INVESTMENT LEVERAGE

6.4. Optimisation of In-kind Support

Any cash investment that has been marshalled to support the Proposed Institute or its research agenda can also be substantially leveraged by accessing in-kind resources from participants and partners in the form of infrastructure and human resources.

6.5. Optimising Utilisation of Research Students

At a research project level optimising the use of PhD and other research students in research activities can prove a very cost effective way of producing research outcomes.

7. Governance Considerations for the Proposed Institute

As with structural considerations, a governance charter for the Proposed Institute cannot be established until research priorities planning, operating model, participation and resourcing is adequately identified and articulated. However, there is increasing evidence that strong and effective governance systems are one of, if not the most important factor in the success of a mission-oriented collaborative research institute. This notion is further reinforced by the fact that demonstrable good governance of research programs is typically a condition precedent for attracting external research funding from government programs and industry sources alike.

This section 7 discusses key governance concepts and principles that should be considered in the development of a governance charter for the Proposed Institute.

7.1. Governance and Research Organisations

Governance refers to the rules, practices, structures and processes through which an organisation is directed and controlled, or in other words, the systems and processes that guide the collective decision-making of the organisation.⁴¹ The design of any governance framework should seek to:

- Optimise the performance of the organisation;
- Provide members of and stakeholders in the organisation with an assurance as to the integrity and effectiveness of the organisation;
- Enhance the organisation's reputation through the accountability of its governing committee(s) and the transparency of its decision-making processes;
- Understand and manage the organisation's risks; and
- Evaluate the effectiveness of the organisation's performance against its objectives.

In an incorporated entity all company directors have a duty under the *Corporations Act 2001* (Cth) and common law to ensure good governance is maintained. In any unincorporated organisation, those who have been entrusted with the responsibility to make decisions have a similar obligation by virtue of the fiduciary duty they owe various stakeholders in that organisation under common law.

To be optimally affective in achieving these objectives, a governance framework must be tailored for the specific governance context facing the organisation for which that framework is designed. The following Figure 16 below summarises key factors that determine an organisation's governance context.

⁴¹ Stoker, G. (2004), 'Designing Institutions for Governance in Complex Environments: Normative Rational Choice and Cultural Institutional Theories Explored and Contrasted', *Economic and Social Research Council Fellowship*, Paper No 1



FIGURE 16 – KEY FACTORS DEFINING THE GOVERNANCE CONTEXT OF AN ORGANISATION

Good governance structures encourage organisations to create value and provide accountability and control systems commensurate with the risks involved.⁴² Essentially, good governance should ensure that decisions that are made by decision-making bodies in the organisation are decisions of high quality and would be judged by an informed reasonable person to be a high quality decision, both now and upon reflection in the future. Figure 17 below summarises the key characteristics of a high-quality decision in the context of a multi-sector, multi-disciplinary, mission-oriented collaborative research institute.

⁴² ASX Corporate Governance Council (2003), Principles of Good Corporate Governance and Best Practice Recommendations, Australian Stock Exchange, Sydney

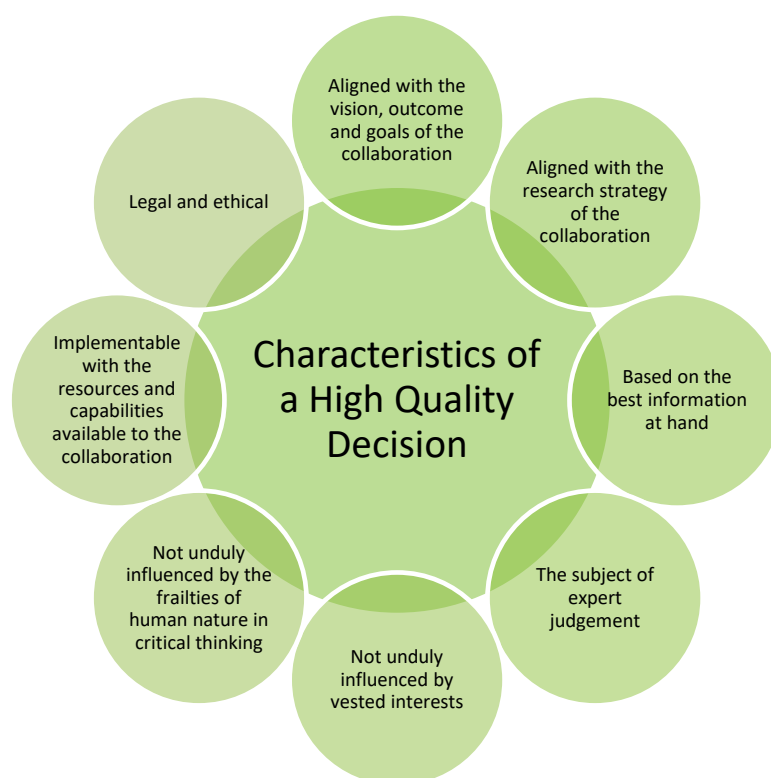


FIGURE 17 – CHARACTERISTICS OF A HIGH QUALITY DECISION

7.2. The Cooperative Research Centre Experience

'Good governance adds significant strategic value to the CRC and enables it to maximise its opportunities and accomplish its objectives, delivering benefits to its participants and to Australia. Making good governance a priority from the outset helps ensure that, through entrepreneurialism, innovation, development and exploration, CRCs create value in their organisation and provide accountability and control systems commensurate with the risks involved.'

CRC Governance Guide

Largely as a result of the Australian Government's Cooperative Research Centre (CRC) Program, the Australian research sector has now had considerable experience with establishing governance frameworks for mission-oriented research organisations. Particularly in the case of institutions that involve collaborations, the system of governance pertaining to the collaboration is often attributed to

playing a major part in the success or otherwise of a collaboration. The reality is that all such structures have governance challenges, and it is the detail of the governance relationships where the problems typically arise and the ability of those charged with governance to navigate these problems that determines success.

The CRC Association recommends an approach to establishing governance frameworks for CRCs that is founded in the Australian Stock Exchange (ASX) principles for best practice governance, and adapted for the purposes of providing a basis of design for a governance framework for a CRC.⁴³ These principles are as follows:

⁴³ Anderson, K. and Sciascia, R. (2008), *Cooperative Research Centre Governance Guide*, Hynes Legal

- Lay solid foundations for management and oversight;
- Structure the board to add-value;
- Promote ethical and responsible decision-making;
- Safeguard integrity in financial reporting;
- Make timely and balanced disclosure;
- Respect the rights of shareholders or participants;
- Recognise and manage risk; and
- Remunerate fairly and responsibly.

The framework works by proposing a series of subordinate considerations under each of the principles. Consistent with the notion that a governance system must be tailored to its governance context, the approach to using the framework is that if the answer to a subordinate consideration is not 'Yes', then there should be a credible explanation as to why, in the organisations specific governance context, it is not. The key principles and the subordinate considerations are detailed in Appendix 3.

7.3. Preliminary Governance Context of the Proposed Institute

While key aspects of the Proposed Institute that will determine the governance context are as yet to be established, it is possible to identify some basic elements of the likely context. Table 12 below, summarises some basic strategic settings that are likely to frame the governance context of the Proposed Institute.

Strategic Parameter	Preliminary Setting
Vision	To facilitate investment in and execution of high quality end-user scientific research that is designed to provide the Australian Lobster industry with the tools and knowledge it needs to achieve a profitable GVP of A\$1.0 billion by 2028.
Purpose	<p>Determine the knowledge and technology priorities of Australian Lobster fishers, processors, regulators and recreational sector that must be addressed to increase the value of profitable production from the industry.</p> <p>Deliver optimal research project value and outcomes by coordinating multi-disciplinary, cross institutional research projects that optimise capability and whose intended outcomes are acutely aligned with the end-users of those outcomes.</p> <p>Optimise the quantum of research funds that can be invested in this projects by leveraging industry investment against a range of other relevant funding sources.</p> <p>Ensure that the outcomes of managed research are in a form that are easily accessible and usable by those end users.</p>
Principles	<ol style="list-style-type: none"> 1. Strategically directed research 2. End-user outcome focused 3. First class science 4. Light administration
Success Measures	<p>It is likely that the proposed institute will be deemed successful when:</p> <ul style="list-style-type: none"> ▪ The industry is making tangible and measurable progress toward the target of increasing profitable GVP to \$1.3 billion by 2028 and by 2028 has achieved this objective; ▪ Industry is able to measure and articulate the impact of research coordinated by the institute on its operations; and ▪ Industry, regulators and community are satisfied that the resulting increase in productivity is not reducing the sustainability of the fishery, infringing on lifestyle and cultural expectations and as a result the industry's social license to operate is maintained.

TABLE 12 – PRELIMINARY STRATEGIC SETTINGS FOR THE PROPOSED INSTITUTE

Table 8 in Section 5 summarises potential participants in the Proposed Institute. While these participants share a common interest in participating in Lobster related research, the fiduciary obligations under which they participate, their strategic motivations for participation and their specific desired research outcomes will often be different and sometimes in conflict. Ensuring that these discrepancies and conflicts do not undermine the success of the Proposed Institute a robust governance framework will be requires, some of the likely elements of which are summarised in Table 13 below.

Key Element of the Governance Framework	Summary
Separation of 'ownership', governance and management	The Proposed Institute should be structured such that there is decision-making separation between participants with 'equity' in the Proposed Institute, the peak strategic and operational decision-making body and the executive responsible for day-to-day management of the Proposed Institute. While decision-making responsibility should be clearly demarcated between these functions, transparency and good communications should be facilitated through formal reporting structures.
Strategic research plan that determines areas of research in which the Proposed Institute may invest	A detailed research priorities plan will be established that identifies through a consultative process, specific knowledge and technology needs of end users in the Australian Lobster industry and regulators of that industry, as well as an assessment of the current state-of-the-art in identified areas. To ensure contemporary relevance, the research priorities plan will be periodically reviewed and to ensure that the Proposed Institute is responsive to unexpected issues, the peak strategic and operational decision body will have the capacity to instigate a review at any time outside of the routine review cycle. The peak strategic and operational decision-making body will only be permitted to support project proposal that are aligned with the research priorities plan.
End-user and independent oriented membership of the peak strategic and operational decision-making body	In order to ensure the strategic direction of the Proposed Institute and the research projects that it supports remain focused on developing solutions that address the specific needs of industry and government end users and produce solutions that are readily adoptable by those end users, different end-users should be represented on the peak strategic and operational decision-making body (typically a board of directors). There should also be adequate independent expertise represented on the peak strategic and operational decision-making body to ensure quality decisions are made.
Multi-stage research investment decision-making process that ensures technical and end-user credibility	Any research project proposals supported by the Proposed Institute should be assessed for technical merit by a committee comprised primarily of independent technical experts. This committee should make investment recommendations to the peak strategic and operational decision-making body which makes the final investment decision based on the recommendation of the technical committee, and its assessment of end-user relevance and alignment with the Strategic Research Plan. These project investment decision-making bodies should also ensure that investment has been optimally and sensibly leveraged.
Decision-making accountability	The peak decision-making body should regularly provide formal reports to the entities with 'equity' in the proposed Institute on research project support decisions that have been made and the progress of the Proposed Institute toward achieving its objectives. The management should prepare an annual business plan for the operations of the Proposed Institute that is approved by the peak strategic and operational decision-making body, and the peak strategic and operational decision-making body should monitor management's progress toward the implementation of that business plan. Research project managers should provide regular prescribed reports to the Proposed Institute executive that allow the executive to monitor project performance, understanding the industry risk and developing both a strategic and operating risk framework.

TABLE 13 – KEY LIKELY ELEMENTS OF A GOVERNANCE FRAMEWORK FOR THE PROPOSED INSTITUTE

8. Moving Forward

8.1. Preliminary Recommendations

This Concept Paper makes a *prima facie* strategic, research needs and funding case for the Proposed Institute. However, there is considerable work that is required to be undertaken to:

- Ensure that there is adequate national industry support for the concept;
- Ensure that the ultimate design of the Proposed Institute meets the research output, governance framework and funding requirements of key stakeholders; and
- Establish a definitive research priorities plan, resourcing plan, governance framework and business plan such that the Proposed Institute can be established with adequate confidence that it will be successful.

8.2. Next steps

8.2.1. Wider Consultation

The immediate priority in any process going forward is to use this Concept Paper as a basis for wider consultation. Unless the Proposed Institute has in-principle support from the national Lobster industry (fishers and processors) and a critical mass of the innovation ecosystem that will be necessary to deliver on the Proposed Institute, its success will be limited to its impact on the Western Rock Lobster sector only.

The purpose of this consultation should be to reject, validate and refine the analysis and observations made in this Concept Paper and to identify support or otherwise for the defined model from key stakeholders. It is proposed that this Concept Paper be provided to key stakeholders in this group in order to seek that input.

8.2.2. Research Priorities Plan

Should adequate in-principle support for the Proposed Institute be identified, the first step in establishing the Proposed Institute is to develop the Research Priorities Plan that will determine the nature of research investments that will be made by the Proposed Institute in its first five years of operation. It is this document that fundamentally underpins the purpose and credibility of the Proposed Institute.

The Research Priorities Plan will identify, in detail, specific knowledge and technology needs of industry and government end-users through a consultative process. Based on a review of technical literature and interviews with experts, it will then establish the current state-of-the-art in the priority areas identified through the consultative process. From this analysis a list of research priorities that will be the focus the Proposed Institute will be established.

It is likely that the consultative process that determine end user needs will be facilitated via a series of workshops with fishers, processors, seafood distributors, cold-chain logistics service providers, recreational sector representative and regulators across the main sectors of the Australian Lobster industry.

8.2.3. Capability Assessment and Gaps Analysis

A detailed assessment of research capability that is relevant to the needs identified by the Research Priorities Plan will be undertaken to identify important research partners in Australia

and overseas. Strategies will be developed to address any immediately identifiable gaps in required research capability.

8.2.4. Business Plan

A detailed and 'bankable' business planning exercise will be undertaken to determine the optimal organisational and legal structure of the Proposed Institute, any infrastructure or human resource requirements, management structure, operating plan, operating budget and resourcing options.

8.2.5. Governance Framework and Charter

A detailed governance framework that will guide decision-making at the Proposed Institute will be developed and produced as a Governance Charter. Based on a clearly defined governance context, this will articulate issues such as Board function, composition and operations; executive functions and responsibilities; research investment decision-cycle; research project management cycle and other important aspects of organisational decision-making.

8.2.6. Structural Agreements

Finally, term sheets for any contractual arrangements that are required to give effect to the Proposed Institute will be developed.

Appendix 1: Interviewees

Person	Position	Organisation
Kim Colero	President	Western Rock Lobster Council
Matt Taylor	Chief Executive Officer	Western Rock Lobster Council
Clare Robinson	Communications & Research Officer	Western Rock Lobster Council
Peter Cooke	Director	Western Rock Lobster Council
Alex Kailis	Managing Director	MG Kailis
Nick Caputi	Supervising Scientist – Invertebrates	Department of Primary Industries and Regional Development, Fisheries
Simon de Lestang	Principal Research Scientist	Department of Primary Industries and Regional Development, Fisheries
Mathew Kenway	Seawater Processing and Life Support	Australian Institute of Marine Science
Erika Techera	Director	University of Western Australia Oceans Institute
Greg Jenkins	Director	Australian Centre for Applied Aquaculture Research
Peter Davies	Pro Vice Chancellor - Research	University of Western Australia
Janet Howieson	Post-doctoral Scientist	Curtin University Centre for Excellence for Science, Seafood and Health
Bruce Philips	Adjunct Professor	Curtin University, School of Environmental Biology and Aquatic Science Research Unit
Roy Melville-Smith	Adjunct Professor	Curtin University, Faculty of Science and Engineering
Peter Klinken	Chief Scientist	Western Australian Government, Office of Science
Fiona Roche	Director	Western Australian Government, Office of Science

Person	Position	Organisation
Peter Rogers	Former Director General	Western Australian Government Department of Fisheries
Andrew Rolland	Chief Executive Officer	Recfish West
Richard Stevens	Principal	Private fisheries industry consultant and former director of the Fisheries Research and Development Corporation
Crispian Ashby	Programs Manager	Fisheries Research and Development Corporation
Patrick Hone	Chief Executive Officer	Fisheries Research and Development Corporation
Gary Morgan	Former Chair	Southern Rock Lobster Limited

Appendix 2: Preliminary Research Agenda

This Appendix contains a preliminary research agenda for the Proposed Institute. It has been based on very limited consultation and is indicative only. Its purpose is to inform further analysis and consultation with a view to developing a comprehensive, stakeholder owned research priorities plan for the Proposed Institute, should a decision be made to proceed with the proposal.

PROGRAM 1	Maintaining Optimal Sustainable Harvest
DESCRIPTION Program 1 focuses on the development of new knowledge and technologies that are used by industry and regulators to accurately assess stock and stock structure of Australian Lobster fisheries and usage of the resource, therefore providing an increasingly robust scientific basis for a framework of optimal sustainable harvest. Program 1 is also focused on generating the scientific knowledge that underpins industry and regulator understanding of pressures on the fishery, the cumulative impact of those pressures with respect to the nature of the fishery and its viability. The resulting knowledge and technologies are intended to inform both regulatory and industry responses to the changing fishery.	
SUBPROGRAMS	DESCRIPTION
Improving the accuracy of stock assessment	This subprogram will focus on continuously improving the statistical robustness and inputs to current stock prediction models that are based on puerulus recruitment. It will also seek to develop new, more efficient and accurate stock assessment methods such as those based on mainstream and emerging genetic science technologies. The intended application of the outcomes of this program are tools for regulators that ensure Total Allowable Catch are set at optimal sustainable harvest and that resource allocation decisions are sound, as well as to inform strategic, investment and operational decision-making by industry.
Impact of Climate Change on the fishery	This subprogram will focus on understanding the impact of increasing water temperature, ocean alkalinity and reduced coastal freshwater ingress that is the result of Global Climate Change on the Australian Lobster fishery. It will endeavour to understand the current and future impact of these changes on the larval cycle of Australian Lobster species, important habitats and food sources within the geographical boundaries of the fisheries (e.g. replacement of kelp with tropical seagrasses in northern parts of fisheries) and the biological viability of various potential pathogens within the fishery, as well as the resilience of the fishery to these changes.
Impact of marine noise on the fishery	The impact of marine noise, particularly that generated from offshore petroleum exploration programs using seismic survey tools, has been recently controversial and for so long as the Australian Lobster industry shares the marine resource with the petroleum industry and the impact of this and other sources of marine noise (i.e. increased commercial and recreational vessel traffic) on the lifecycle of various commercial Lobster species is not well understood, it will likely remain controversial. This research subprogram will focus on understanding the impact of the various sources of marine noise on the lifecycle of commercial Australian Lobster species, as well as the

	fisheries resilience to these impacts. It will focus on generating scientific knowledge that can be used to effectively manage sharing of the marine resource with the offshore petroleum industry (such as identifying low-impact windows for seismic operations) and if necessary and appropriate, accurately inform any justified compensation decisions.
Impact of recreational and tourism use of the marine environment on the fishery	In addition to recreational Lobster fishing, generally increased use of the marine environment for recreational and tourism purposes will naturally lead to a larger anthropogenic footprint on the ecosystems that support the Australian Lobster fishery and the ecosystems connected to those ecosystems. This subprogram will focus on developing scientific knowledge that enhances understanding of these trends, their likely impact on the Australian Lobster fishery and the resilience of the fishery to these pressures as a basis for developing resource sharing frameworks.
Impact of increased coastal urban and industrial development on the fishery	The vast majority of the Australian population and industry is coastally oriented. This is a paradigm that is unlikely to change and as a result, as Australia and its economy continues to expand so will the pressures on the coastal marine environment that result such as hinterland and coastal waterway diversion, urban and industrial run-off, increased risk of vessel-borne pathogens and other anthropogenic pressures that are associated with population and industrial concentration. The life-cycle of all Australian Lobster fisheries has a coastal intersection in areas where urban and industrial development is progressing. This subprogram will focus on predicting Australian urban and coastal development, its likely externalities with respect to impact on the lifecycle of commercial Australian Lobster species and the resilience of those species to these pressures.
Risk assessment of invasive species and pathogens	Increased marine tourism and international shipping in waters that comprise or are in proximity to those that define the Australian Lobster fishery increases the risk of invasive species and pathogens being introduced that may affect the productivity or viability of the fishery. Furthermore, a marine environment that is altered by global climate change means that the biological viability of various pathogens and invasive species in the Australian Lobster fishery will also change. This subprogram will focus on developing a scientific framework for understanding current and future pathogen and invasive species risk to the Australian Lobster industry, and developing monitoring and response technologies and frameworks for mitigating that risk.
Cumulative Impact Modelling	Each of the pressures on the Australian Lobster industry that have been identified above will occur, to varying degrees, at the same time. As such, an understanding of the cumulative impact of these pressures on the productivity and viability of the fishery in different geographical areas and on different species, as well as the

	resilience of different species in different geographical areas to the cumulative impact of these pressures is critical to ensuring an optimal regulatory and strategic, investment and operational investment decision-making environment. This subprogram will focus on aggregating the scientific knowledge from the other subprograms and generating additional knowledge that better informs predictive modelling of the cumulative impact of these pressures on the productivity and viability of different sectors of the Australian Lobster fishery.
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PROGRAM 2	Improving Productivity of the Fishing Effort and Maintaining Social License to Operate
DESCRIPTION Program 2 focuses on the development of new knowledge and technologies, as well as the adaption of technology from other industries, and its implementation to ensure that the Australian Lobster industry achieves rates of productivity growth that are necessary for the industry to remain competitive in international markets and levels of profitability that are necessary to attract necessary investment, as well as to ensure that its Occupational Health and Safety (OHS) and environmental credentials continue to meet societal and market expectations.	
SUBPROGRAMS	DESCRIPTION
Economics of Australian Lobster Fishing Enterprises	This subprogram will focus on commercial and economic research designed to better understand key innovation, economic and social trends will impact on future productivity and profitability for Australian Lobster fishing operations. This will be used to help operators in the industry to undertake strategic and investment decisions.
Efficient vessel design	This subprogram will likely focus primarily on adapting vessel designs, construction materials, powertrain technologies and operational systems layouts from other marine industries to produce more efficient Lobster fishing vessels. The objective will be to develop and deploy vessels that use less fuel (including hybrid and electric technologies), are faster, more manoeuvrable and optimally suited to the Lobster fishing task.
Efficient pot handling systems	The main operational task on a Lobster fishing vessel is the retrieval of pots, removal of pot catch and sorting of pot catch whereby by-catch and prohibited catch is released and harvestable catch stored on the vessel. While winches are used to retrieve pots, the remainder of the process is largely a manual operation. This subprogram will focus on the adaption of existing technology in other industries that optimally automates this process, minimising damage to by-catch or prohibited catch and reducing OHS risk.
Crew health and welfare	This subprogram will focus on all aspects of OHS associated with the fishing vessel, including on board operating systems that safeguard against injury and crew mental health.

On-board digital systems	Digital systems that integrate real-time information that is normally produced from the vessels operation (such as fuel consumption, GPS location, metocean conditions etc.), as well as that from new sensor technology that can produce catch and biological data can inform information and decision support systems resulting in improved strategic and operational decision-making in the fishing operation and if integrated with downstream information systems, along the supply chain. This information can also be used to support product traceability that is an increasingly common requirement of premium food markets and to ensure that compliance with regulatory requirements is efficient. This subprogram will focus on adapting existing technologies in other industries for this purpose.
Improved catch targeting	The ability to rapidly locate and target optimal volumes of catch with a high degree of accuracy reduces vessel usage and time at sea, thus improving the productivity of the fishing operation. This subprogram program will be highly integrated with stock assessment research undertaken in Program 1 and seek to generate new knowledge that can be used to develop predictive models for effective and reliable catch targeting.
Bait alternatives	The standard practice of baiting pots with fish is coming under increasing scrutiny. Whilst effective, baits attract other untargeted species that are either not trapped or released back into the natural environment, potentially altering the natural food-chain and are also a potential vector for invasive pathogens. This subprogram will focus on the development of Lobster attraction technologies as an alternative to baits.
Wildlife protection systems	Considerable development designed to reduce the impact of pots on wildlife has already been undertaken, resulting in pot design that has minimal impact on wildlife. However, as societal expectations change, continuous improvement in this area will be required. This subprogram will seek to progress pot systems design toward a goal of zero wildlife impact.

PROGRAM 3	New Australian Lobster Products and Markets
DESCRIPTION Program 4 focuses on identifying, describing and quantifying new markets for Australian Lobster production and opportunities to develop new products based on Australian Lobster production.	
SUBPROGRAMS	DESCRIPTION
Capitalising on the Australia-China Free Trade Agreement and other Trade Agreements	The New Zealand Lobster industry provides a very good precedence for how a Trade Agreement with the PRC can be utilised to significantly enhance the penetration of premium seafood product in PRC markets. This subprogram will seek to understand opportunities presented to the Australian Lobster industry that stem from the Australia-China Free Trade Agreement so that the industry is ready to capitalise on those opportunities when the agreement comes into effect in 2019.
Australian Lobster product diversification	As a premium seafood product the majority of Australian Lobster production is currently marketed in its purest or close-to-purest form. As global supply increases and markets expand diversification of Australian Lobster product may be required. This subprogram will explore opportunities for different Lobster cuts, new products that can be developed from processing waste and value-adding through avenues such as pre-packaged meals.
Development of new export markets	The transition of developing economies will create new export markets for Australian Lobster product. This subprogram will focus on understanding when and how these markets will emerge, as well as how to effectively engage with these markets. This knowledge will be critical to the Australian Lobster industry penetrating these emerging markets early and developing a competitive position on which market share can be established and maintained.
Domestic market development	The size and growing nature of the recreational fishery, indicates that there is significant latent domestic demand for Australian Lobster product. Furthermore, the ability to deliver adequate supplies of affordable product to the

	domestic market may increasingly impact on the industry's social license to operate. This subprogram will focus on understanding the dynamics and trends in the domestic market for Australian Lobster product and developing strategies for the industry to optimally capitalise on any identified latent demand.
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PROGRAM 4	Downstream Productivity and Supply Chain Optimisation
DESCRIPTION Program 5 focuses on generating the new knowledge and technology, as well as adapting technology from other industries, that is required to ensure that the Australian Lobster supply chain between fishers and end customers in the domestic and international markets is competitive and effective with respect to meeting the expectations of those customers.	
SUBPROGRAMS	DESCRIPTION
Digital integration for product traceability and supply chain management	The application of sensor technology, digitisation of processing and logistics operations and the integration of that downstream capability with fishing vessel systems will become increasingly important with respect to providing an increasingly discerning premium seafood market with verifiable product traceability information and to effectively manage the supply chain (for example, understanding issues such as live product mortality). This subprogram will focus on generating new knowledge and technology, as well as the adaptation of technology from other industries that facilitates an optimal supply chain information system for the Australian Lobster industry.
Processing plant automation	The reduction of OHS risk and improved productivity in the Australian Lobster processing sector will require optimal automation of processing tasks. This subprogram will focus on generating new knowledge and technology, as well as the adaptation of technology from other industries that facilitates high levels of automation of the Australian Lobster processing function.
Improving live product survival rates	The survival rate of Australian Lobster product through live export channels is variable across species and markets, potentially resulting in the Australian Lobster industry being less competitive in international markets and not extracting optimal value from those markets. This subprogram will focus on understanding causes of mortality in different commercial Australian species of Lobster (e.g. stressors such as temperature, density etc.), developing technologies and methods for mitigating mortality risk and the cost-benefit associated with using those methods.
Packaging for optimal product quality	Outside of the live product market, ensuring that fresh and frozen product is delivered to the customer at the highest possible quality is important for maintaining premium pricing. Post the processing plant, quality of non-live product is determined largely by the conditions under which it is transported. This Subprogram will focus on

	understanding optimal transport conditions for fresh and frozen Australian Lobster product such as atmosphere and packaging (styrene, woodchips, chiller packs, etc.) and the cost benefit of various options.
Australian Lobster supply chain economics	The structure of the Australian Lobster processing industry is relatively complex. It is comprised of a range of organisation structures (cooperatives, family companies, private equity back companies and public companies); at a local level competition is concentrated in oligopolistic industry structures; and there seems to be limited relationship between the sectors on the west and eastern side of the Nation. This subprogram will seek to better understand the structure of the downstream sector of the Australian Lobster industry, its relationships should with Lobster sources and the distribution channels and networks it uses to distribute product, with an objective of assisting the industry to optimise its overall competitiveness in domestic and international markets.
Governance, leadership and people development	This subprogram will focus on ensuring that Australian Lobster industry governance and advocacy is based on world-best-practice at that there are effective sector-wide professional development programs that are designed to ensure strong industry leadership succession.

PROGRAM 5	Profitable Lobster Aquaculture and Feedlots
DESCRIPTION Program 3 focuses on identifying species that are suitable for aquaculture in Australia and developing aquaculture systems for those species. It also focuses on developing and commercialising the knowledge and technology that is required to develop commercial scale feedlot operations for key wild-harvest species of Western, Southern and Eastern Rock Lobster.	
SUBPROGRAMS	DESCRIPTION
Aquaculture production of Australian tropical Lobster species	The development of the ability to economically produce <i>P. ornatus</i> and potentially other Australian tropical lobster species may be necessary to defend market share by being able to produce marketable volumes of 'clean-and-green' aquaculture product to complement Australian wild-caught <i>P. ornatus</i> . A domestic market for <i>P. ornatus</i> could also be established. This subprogram will support established Australian Lobster aquaculture programs, as well as identify other Australian species of tropical Lobster that could be the subject of commercial aquaculture production.
Feedlot systems design and husbandry practice	The development of specifications for and design of ocean-based, semi-closed or closed holding systems that can minimise agricultural risk and maximise grow-out economics in terms of meat yield per unit of cost and meat yield per unit of time, while producing commercial volumes of value-added product will be key to the success of this program. This subprogram will focus on the systems development required to achieve this.
Nutrition for effective feedlot production of Australian Lobster	The economics of any feedlot operation is also a function of achieving the correct balance of feed cost and feeds that optimise Food Conversion Ratio (FCR). This subprogram will explore a range of feed options including wild-caught or aquaculture produced natural feeds such as mussels, as well as formulated manufactured feeds with a view to identifying optimal feed options.
Australian Lobster moulting biology	Effective feedlot operations require the fishers to be able to identify animals within their catch that are optimally suited to feedlot production. These animals will achieve maximum increase in meat yield in the shortest period of time and at the lowest feed (and potentially preventative treatment) costs. This will need to be informed by a greater

	understanding of the animal biology that drives FCR and moulting in each of the key species. This subprogram will focus on understanding aspects of the biology of Western Rock Lobster, Southern Rock Lobster and Eastern Rock Lobster that determine moulting such as molting inhibiting hormones.
Managing animal health in Australian Lobster feedlot and aquaculture operations	The largest agricultural risk to most commercial aquaculture and grow-out systems is maintaining animal health. Intensive production of Australian Lobster species either through aquaculture or feedlots is likely to have the same challenges and as a result of very limited experience with intensive production of Lobster, knowledge pertaining to fish health in such an environment is very limited. This subprogram will focus on understanding pathogens and disease that can occur in an intensive production environment for Lobster and the preventative and curative actions that can be undertaken to minimise disease risk.

PROGRAM 6	Policy for Growth
DESCRIPTION Program 6 focuses on generating new knowledge that is the basis for ensuring that the policy and regulatory framework for the Australian Lobster industry remains world-best-practice and ensuring sustainable fisheries management and optimal competitiveness of Australian Lobster product.	
SUBPROGRAMS	DESCRIPTION
Risk and Ecosystems Based Fisheries Management	Ecosystems Based Fisheries Management (EBFM) involves the assessment and management of all impacts and outcomes related to any commercial, recreational, charter, customary or 'no-take' sector operating within a bioregion. It deals with the cumulative impacts on the environment (including fish stocks, habits and ecosystems) from all the fisheries –related activities operating in a region and includes the consideration of the overall social and economic outcomes generated by these activities. EBFM is increasingly being recognised as the 'gold-standard' in fisheries management. Ensuring that EBFM optimises sustainable production from Spiny Lobster fisheries is in the interests of both industry and regulators and this subprogram has a natural link to Program 1. This subprogram will integrate new knowledge generated under Program 1 into a EBFM based fisheries management framework so that its potential impact on industry competitiveness can be accurately assessed. It will also work toward developing social science knowledge as the basis to progress toward a full risk-based fisheries management model.
Best practice co-management	There is a significant trend globally toward the co-management of natural resources. Such a practice provides industry with greater influence on the regulatory framework and reduces external regulatory costs. This subprogram will focus on understanding how best practice co-management can be applied to the Australian Lobster industry to satisfy both regulator and industry needs.
Best practice taxation of industry	Many Spiny Lobster industries, like many other primary industries, pay a range of levies that are designed to fund not only regulation of the industry, but also other activities such as research and market development. Ensuring that these systems are efficient and produce optimal outcomes for the industry is of significant importance. This subprogram will seek to develop a best-practice system of taxation and levies for the industry that satisfies

	government revenue requirements and longer term industry needs such as ongoing research and development and market development.
Best practice regulation of the recreational sector	The recreational sector of particularly the Western Australian Lobster fishery is significant and growing. While it is regulated, like most recreational fishing sectors data pertaining to the extent of compliance is limited and compliance itself is largely dependent on an 'honour system'. Furthermore, increasing concern over the extent of 'pot-theft' and a 'black market' that is supplied by recreational licences is not in the interests of the commercial or recreational sector and undermines the efficacy of fishery resource allocation policy. It is in the interest of the overall fishery management, the commercial and recreational sector that systems designed to manage the recreational fishery are efficacious. This subprogram will focus on developing new knowledge and technologies that deliver a more evidence-based approach to managing the Australian recreational Lobster fishery.

Appendix 3: FRDC Investment in Australian Lobster Fishery Research and Development

Recent FRDC Investment in Australian Lobster Research by FRDC Investment Mechanism

During the period 2010-11 to 2017-18, the FRDC has invested, through its various mechanisms, a total of approximately A\$12.7 million across 65 research projects deemed to be relevant to the Australian lobster industry. As illustrated in Figure 18 below, the majority of the identified projects (65 percent) and total FRDC expenditure associated with those projects (62 percent) have been initiated by Eastern States lobster sector interests.

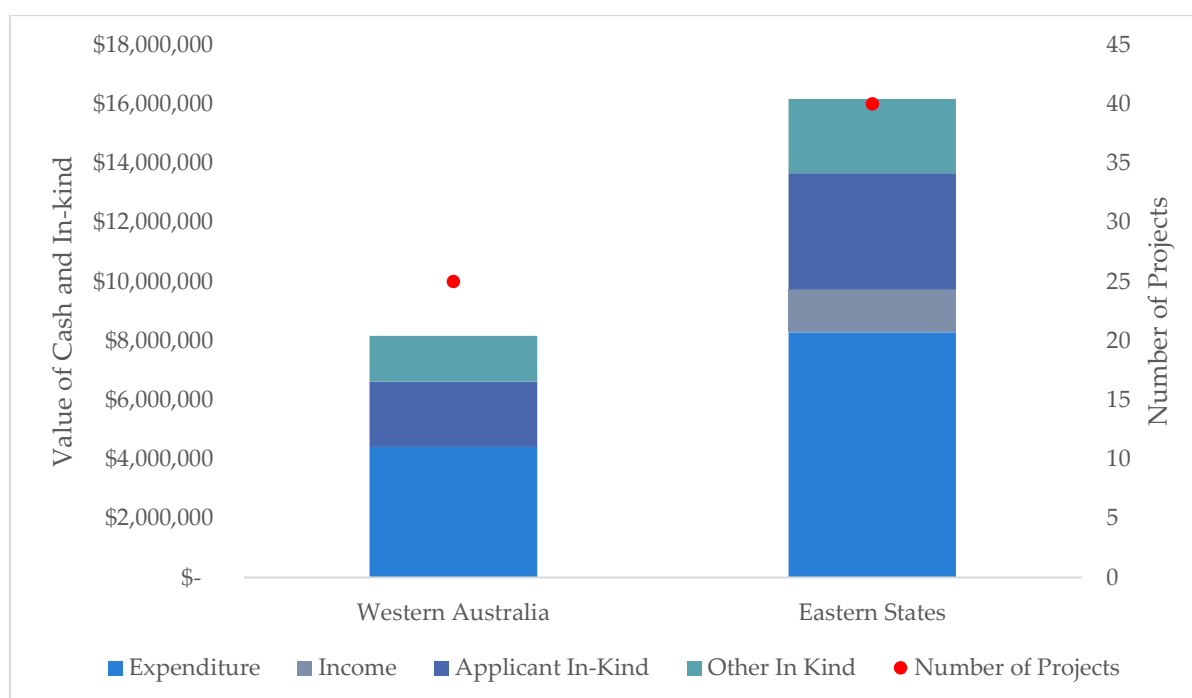


FIGURE 18 – TOTAL FRDC FUNDED LOBSTER RELATED RESEARCH (2010-11 TO 2017-18)

While the in-kind leverage achieved from FRDC expenditure has been broadly equivalent across Western Australian and Eastern States initiated lobster research, Eastern States initiated research has achieved total cash leverage of 17 percent, whereas Western Australian initiated research has not achieved any cash leverage from the FRDC expenditure. This is illustrated in Figure 19 below.

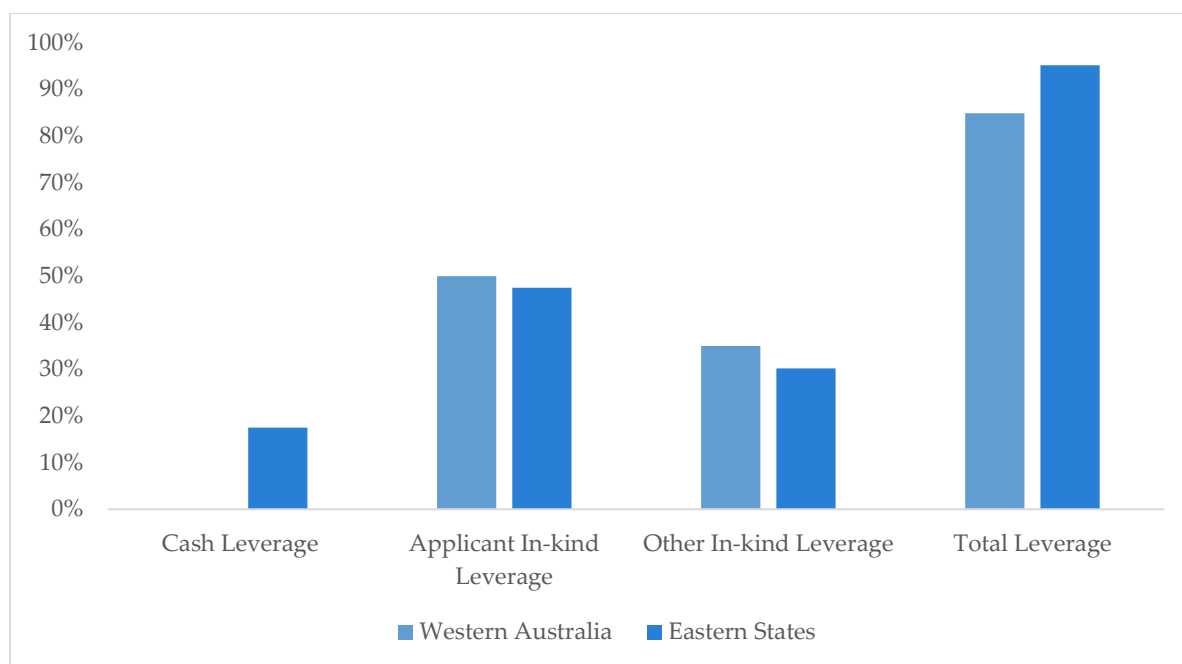


FIGURE 19 – LEVERAGE ACHIEVED AGAINST FRDC FUNDED LOBSTER RESEARCH PROJECTS (2010-11 TO 2017-18)

Industry Partnership Agreement Projects

During the period 2010-11 to 2017-18, research projects deemed relevant to the Australian lobster industry were supported by the FRDC through the Western Rock Lobster Industry IPA (WRL), Southern Rock Lobster Industry IPA (SRL) and in collaboration with the Australian Abalone industry, through the Abalone Council of Australia IPA (ACA). The FRDC funded a total of 34 projects with a total FRDC expenditure of approximately A\$7.0 million through these mechanisms over the period. Projects initiated by Eastern States interests (SRL and ACA) accounted for 71 percent of the projects and 82 percent of the FRDC expenditure on those projects, with WRL accounting for the balance. This is illustrated in Figure 20 below.

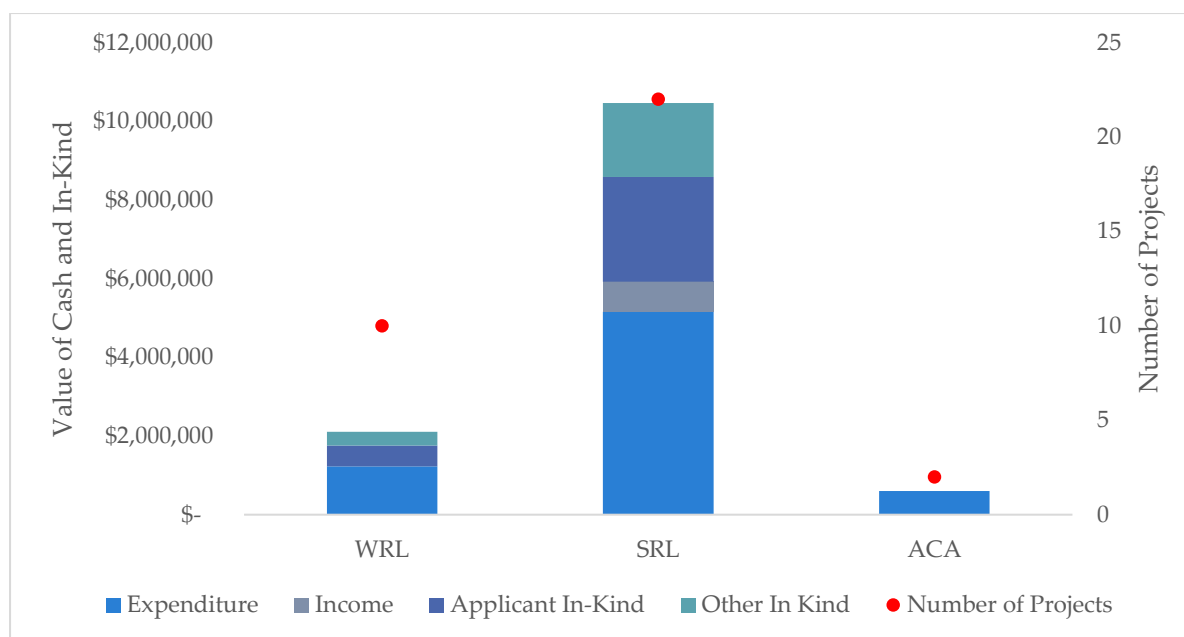


FIGURE 20 – FRDC LOBSTER RELEVANT PROJECTS FUNDED UNDER THE WESTERN ROCK LOBSTER (WRL), SOUTHERN ROCK LOBSTER (SRL) AND AUSTRALIAN ABALONE COUNCIL (ACA) FRDC INDUSTRY PARTNERSHIP AGREEMENTS (2010-11 TO 2017-18)

While projects funded through the ACA IPA did not attain any additional leverage against the FRDC expenditure, projects executed through the SRL IPA attained considerably greater cash and in-kind resource leverage from the FRDC expenditure than was the case for projects executed through the WRL IPA. This is illustrated in Figure 21 below.

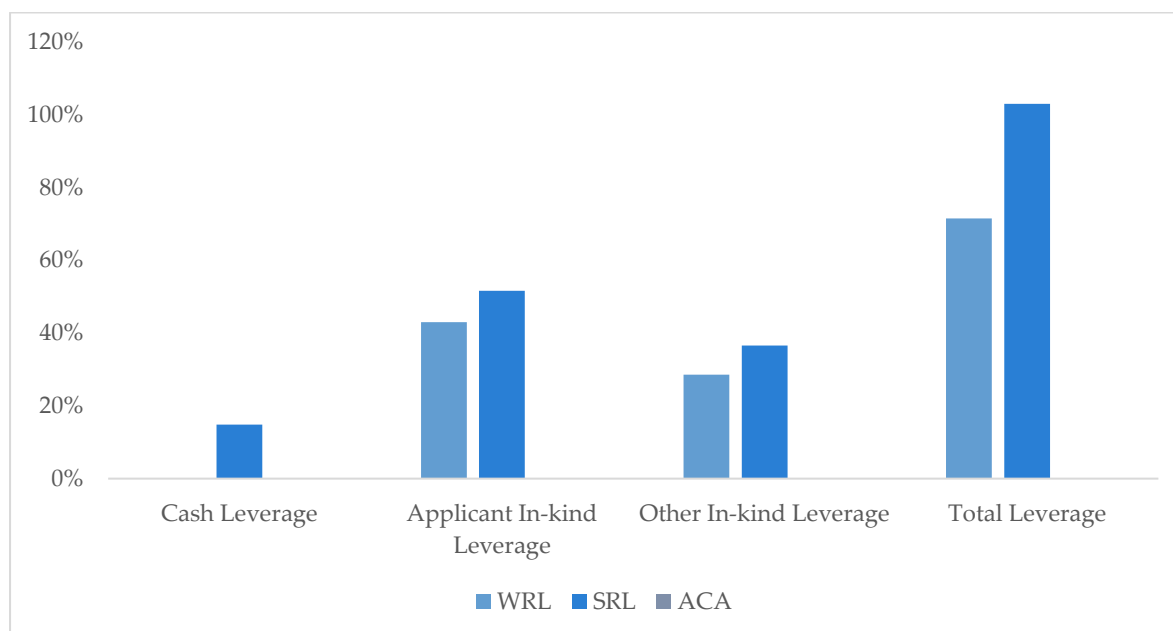


FIGURE 21 – LEVERAGE ACHIEVED AGAINST FRDC EXPENDITURE FOR LOBSTER RELEVANT PROJECTS FUNDED UNDER THE WESTERN ROCK LOBSTER (WRL), SOUTHERN ROCK LOBSTER (SRL) AND AUSTRALIAN ABALONE COUNCIL (ACA) FRDC INDUSTRY PARTNERSHIP AGREEMENTS (2010-11 TO 2017-18)

Regional Advisory Councils

During the period 2010-11 to 2017-18, the FRDC funded research projects deemed relevant to the Australian lobster industry through the Western Australian, New South Wales, Victorian and

Tasmanian RACs, as well as a through a similar mechanism pertaining to the Torres Strait Regional Authority (TSRA). Through these RAC and RAC-like frameworks, the FRDC funded 15 research projects deemed relevant to the Australian lobster industry for a total FRDC expenditure of approximately \$3.2 million. Over half of these projects and almost 70 percent of the associated FRDC expenditure under these RACs is attributable to the Western Australian RAC, with the Tasmanian RAC accounting for 20 percent of the projects and 14 percent of the FRDC expenditure, the New South Wales RAC 13 percent of projects and 4 percent of the FRDC expenditure, Victoria 7 percent of the projects and 8 percent of FRDC expenditure and TSRA, 7 percent of the projects and 6 percent of the FRDC expenditure. This is illustrated in Figure 22 below.

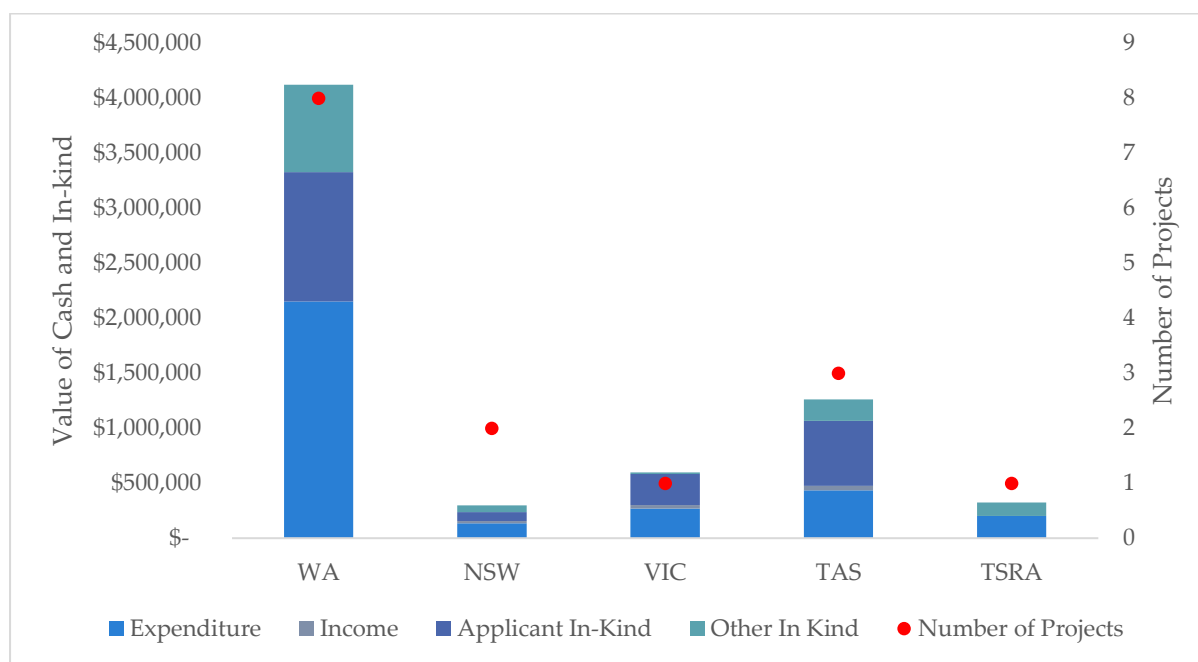


FIGURE 22 – LOBSTER RELATED PROJECTS FUNDED BY THE FRDC THROUGH THE WESTERN AUSTRALIAN, NEW SOUTH WALES, VICTORIAN AND TASMANIAN RACs AND THE RAC-LIKE ARRANGEMENT WITH THE TORRES STRAIT REGIONAL AUTHORITY (2010-11 TO 2017-18)

While projects executed through the Western Australian RAC have achieved higher levels of absolute leverage, this leverage has only been in the form of in-kind resources and is proportionately lower than that achieved through all other RACs. This is illustrated in Figure 23 below.

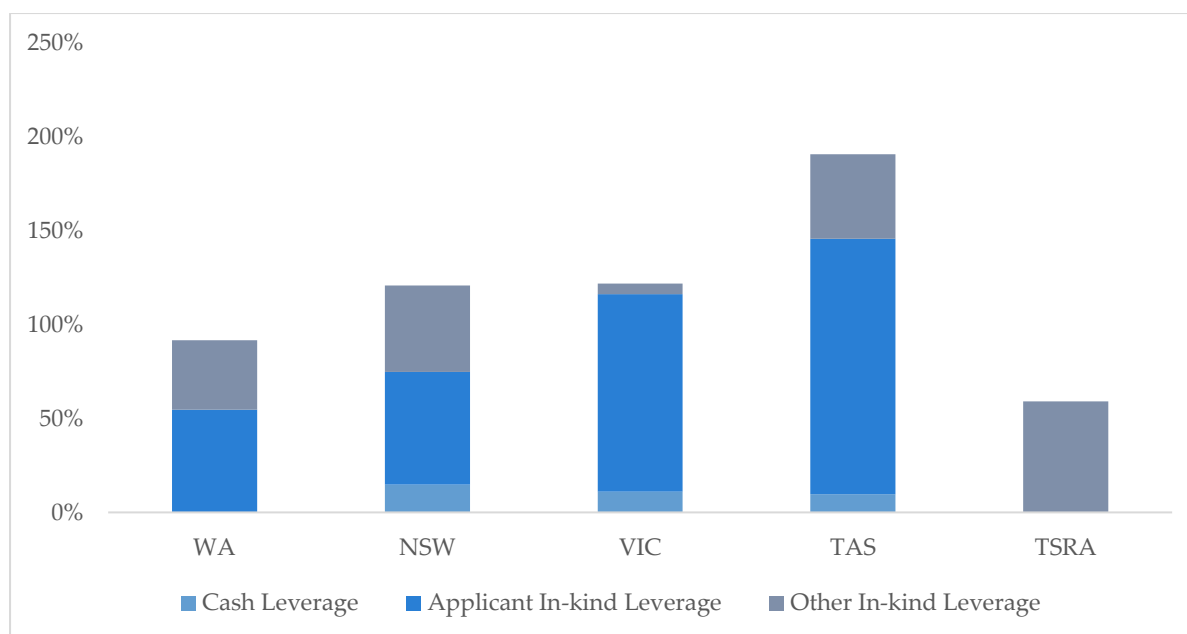


FIGURE 23 – LEVERAGE ACHIEVED AGAINST FRDC EXPENDITURE FOR LOBSTER RELEVANT PROJECTS FUNDED UNDER THE WESTERN AUSTRALIAN, NEW SOUTH WALES, VICTORIAN, TASMANIAN RACs AND THE FRDC RAC- LIKE ARRANGEMENT WITH THE TORRES STRAIT REGIONAL AUTHORITY

Seafood CRC

Through participation in the Australian Seafood Cooperative Research Centre (Seafood CRC), the Western Australian Fishing Industry Council (WAFIC), Southern Rock Lobster (SRL) and Abalone Council of Australia (ACA) (among others) were able to access additional research funds through the FRDC. During the period 2010-11, the FRDC funded a total of 5 projects for a total expenditure of \$791,000. Three of these projects accounting for 80 percent of the total FRDC expenditure through this mechanism were initiated by SRL. A single project initiated by the ACA accounted for an additional 20 percent of the FRDC expenditure through this mechanism, with a WAFIC initiated project accounting for the balance. This is illustrated in Figure 24 below.

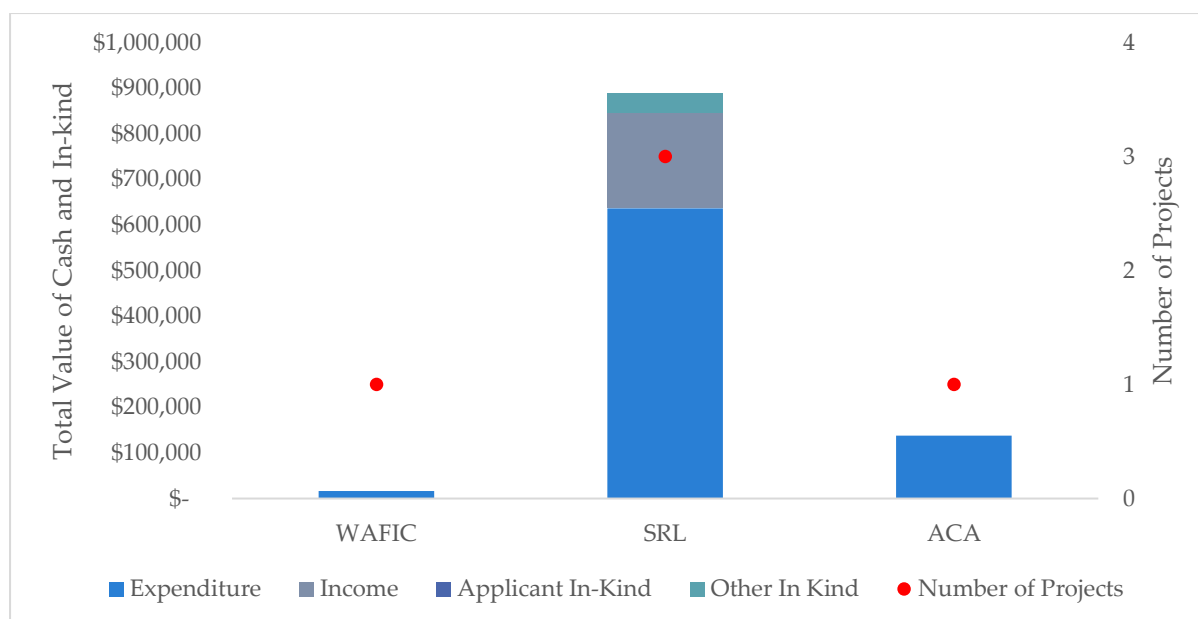


FIGURE 24 - LOBSTER RELATED PROJECTS FUNDED BY THE FRDC THROUGH THE SEAFOOD CRC MECHANISM

As illustrated in Figure 25 below, SRL was the only entity able to further leverage the FRDC investment through the Seafood CRC mechanism.

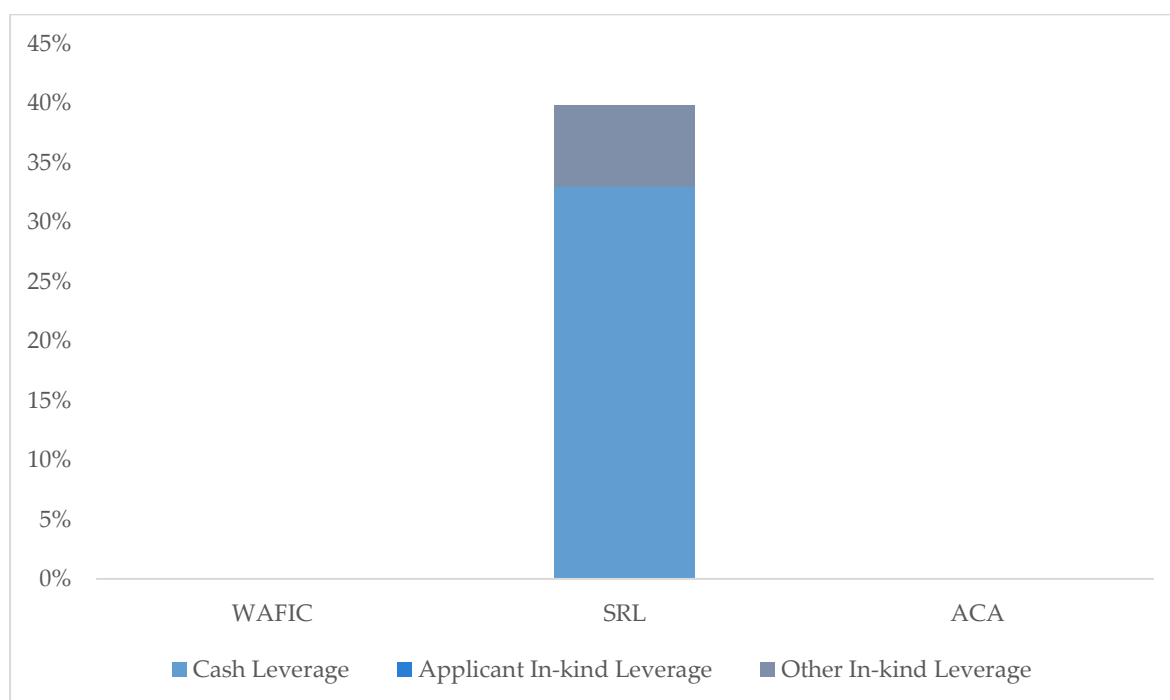


FIGURE 25 - LEVERAGE ACHIEVED AGAINST FRDC EXPENDITURE FOR LOBSTER RELEVANT PROJECTS FUNDED UNDER THE SEAFOOD CRC MECHANISM

Other FRDC Programs

During the period 2010-11 to 2017-18, research projects deemed relevant to the Australian lobster industry have been supported by the FRDC through a number of other FRDC programs namely, Tactical Research Fund, Incentive Fund, Response Research Fund, National Priority Program, Human Dimensions Sub Program and Climate Change DCCEE. During the period, 11 projects with a total FRDC expenditure of approximately A\$1.7 million were supported through

these other FRDC programs. Of these, 55 percent of the projects accounting for 59 percent of the FRDC expenditure were initiated from Western Australian lobster sector interests, with the balance from Eastern States Lobster sector interests. This is illustrated in Figure 26 below.

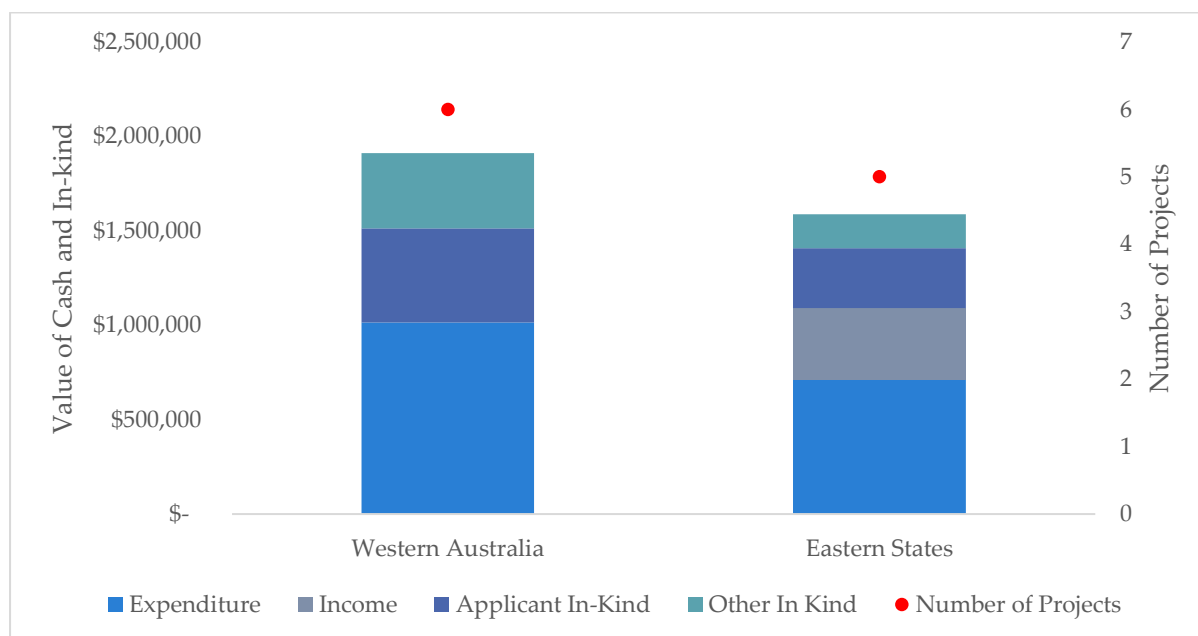


FIGURE 26 - LOBSTER RELATED PROJECTS FUNDED BY THE FRDC THROUGH OTHER FRDC PROGRAMS

Despite accounting for the majority of FRDC expenditure across these other FRDC programs, projects initiated by Western Australian lobster sector interests have again not attained the same level of leverage against the FRDC expenditure as that of projects initiated by Eastern States lobster sector interests. This is illustrated in Figure 27 below.

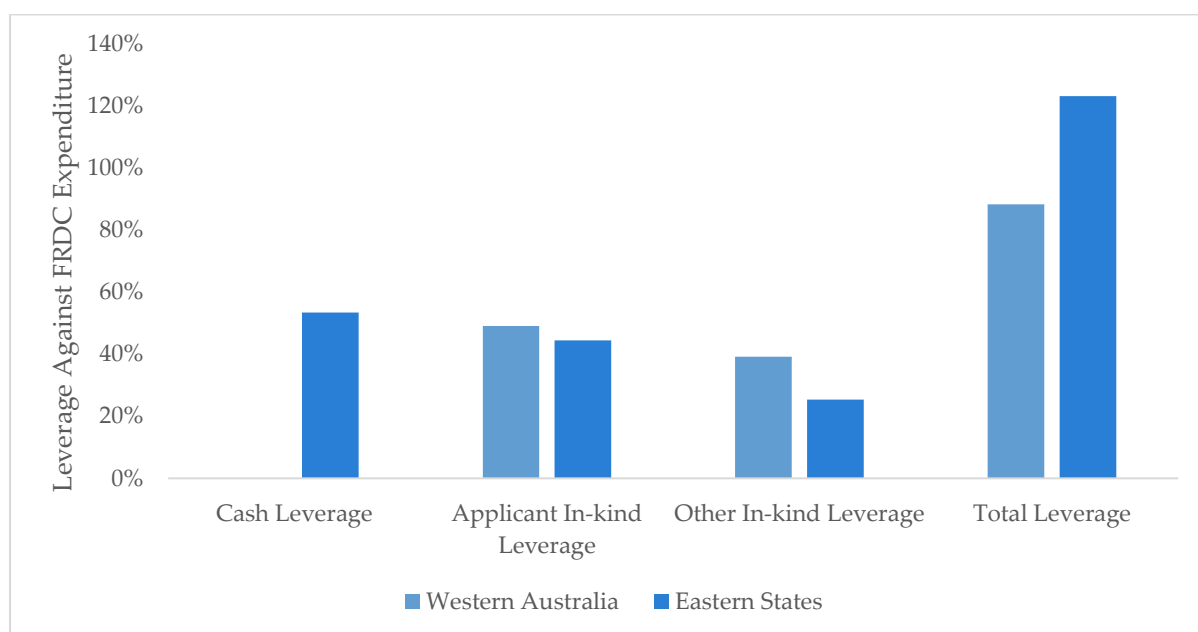


FIGURE 27 - LEVERAGE ACHIEVED AGAINST FRDC EXPENDITURE FOR LOBSTER RELEVANT PROJECTS FUNDED UNDER OTHER FRDC PROGRAMS

FRDC Funding by Project Initiator

The discussion in the previous section provides an indication as to the extent to which the various funding mechanisms used by the FRDC have funded research projects deemed relevant to the Australian lobster industry and through a geographical dissection, the Western and Eastern sectors of the industry. However, other than by comparing funding through IPAs with other mechanisms (which is a relatively blunt analysis), this does not provide an indication as to the extent that funding is addressing knowledge needs espoused specifically by the Australian lobster industry.

In order to provide higher resolution on these issues, this Section 0 analyses the database of FRDC projects deemed to be relevant to the Australian lobster industry according to the nature of the entity that initiated the specific project. For this purpose, the following categories of project initiator have been used:

- The Australian lobster industry or recreational sector⁴⁴ initiating alone or in co-initiating with another sector of the Australian seafood industry;
- Other Australian seafood industry initiating in the absence of explicit co-initiation with the Australian lobster industry or recreational sector;
- State Governments initiating with co-initiation from the Australian Lobster industry or recreational sector;
- State Governments initiating without the explicit co-initiation of the Australian lobster industry or recreational sector; and
- Research organisations initiating without the explicit co-initiation of the Australian Lobster industry or recreational sector.

As illustrated in Figure 28 below, 58 percent of the FRDC expenditure on research projects deemed relevant to the Australian lobster industry during the period 2010-11 to 2017-18 has been on projects that the Australian lobster industry or recreational sector have either exclusively initiated or have initiated in collaboration with another sectors of the Australian seafood industry. Furthermore, projects that have been initiated by a state government in collaboration with the Australian lobster industry account for an additional 19 percent of total FRDC expenditure in research projects deemed to be relevant to the Australian lobster industry. In other words, the vast majority (77 percent) of FRDC funds that have been committed to research projects deemed to be relevant to the Australian lobster industry, are by virtue of the Australian lobster industry being party to their initiation, indeed directly relevant to the Australian lobster industry.

⁴⁴ During the period the Western Rock Lobster recreational sector was the only recreational interest to initiate a project.

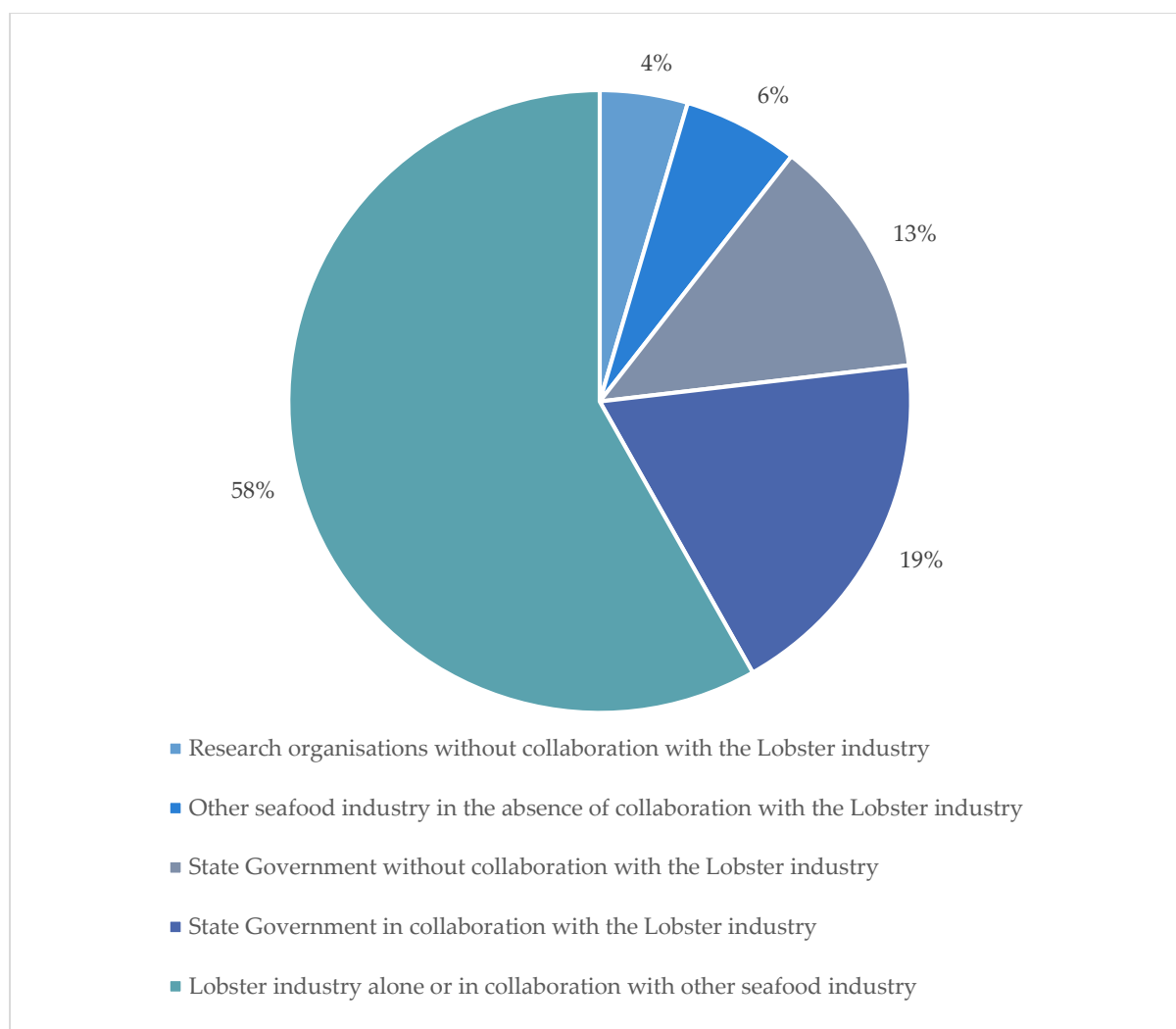


FIGURE 28 – PORTION OF FRDC LOBSTER RELATED RESEARCH EXPENDITURE BY INITIATOR TYPE (2010-11 TO 2017-18).

However, when initiating entities are compared on a sectoral basis, the distribution is much different. As illustrated in Figure 29 below, in the case of eastern states lobster interests, projects representing almost 90 percent of the total FRDC expenditure associated with projects initiated from eastern states lobster interests were initiated by the industry either acting alone or in collaboration with another sector of the Australian seafood industry or a state government.

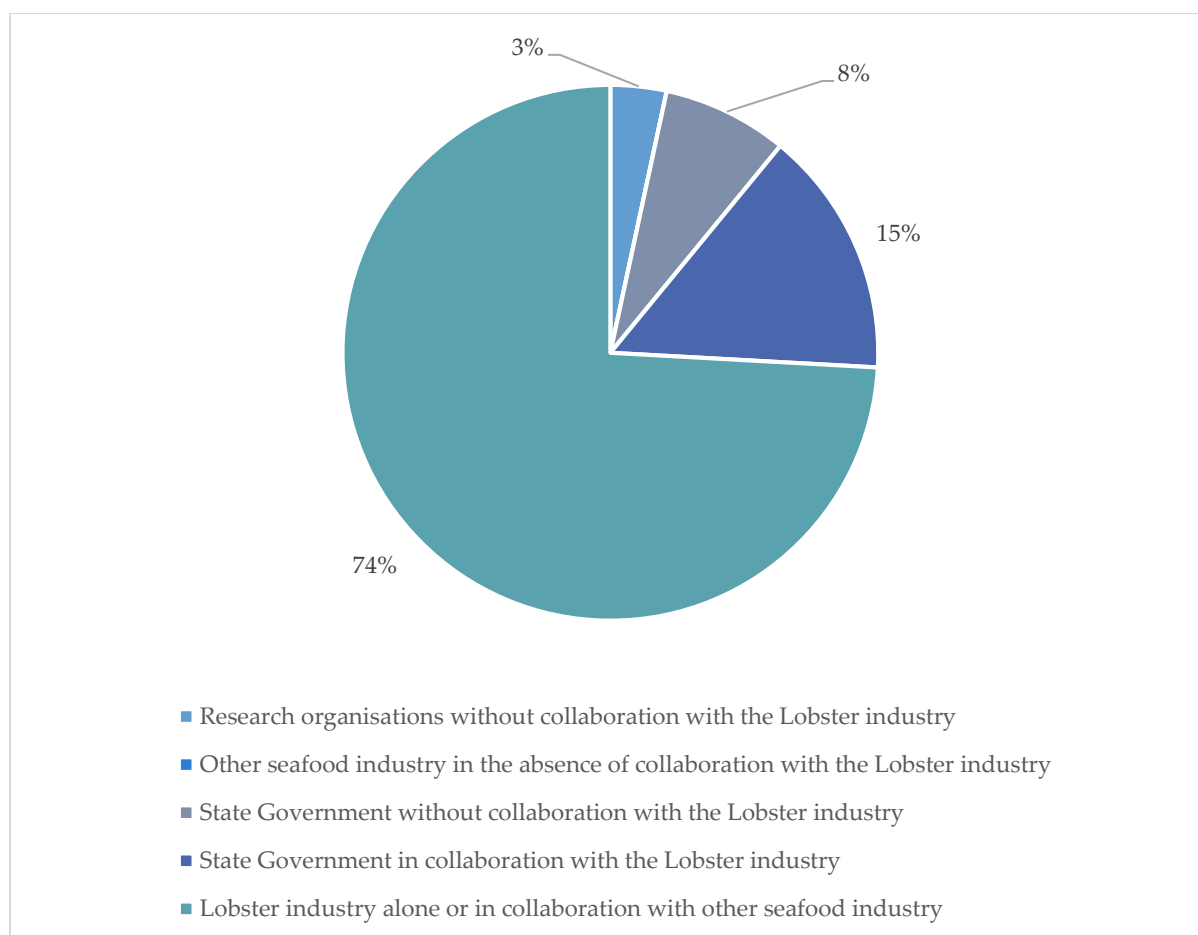


FIGURE 29 - PORTION OF FRDC LOBSTER RELATED RESEARCH EXPENDITURE BY INITIATOR TYPE – EASTERN STATES LOBSTER INTERESTS (2010-11 TO 2017-18).

In the case of Western Australian lobster interests, only 54 percent of the funding associated with projects initiated by Western Australian lobster interest had been initiated by the lobster industry, and half of those were in collaboration with the Western Australian government. This suggests that only around a quarter of FRDC funding in Western Australia has been focused on research issues of a commercial nature. This is illustrated in Figure 30 below.

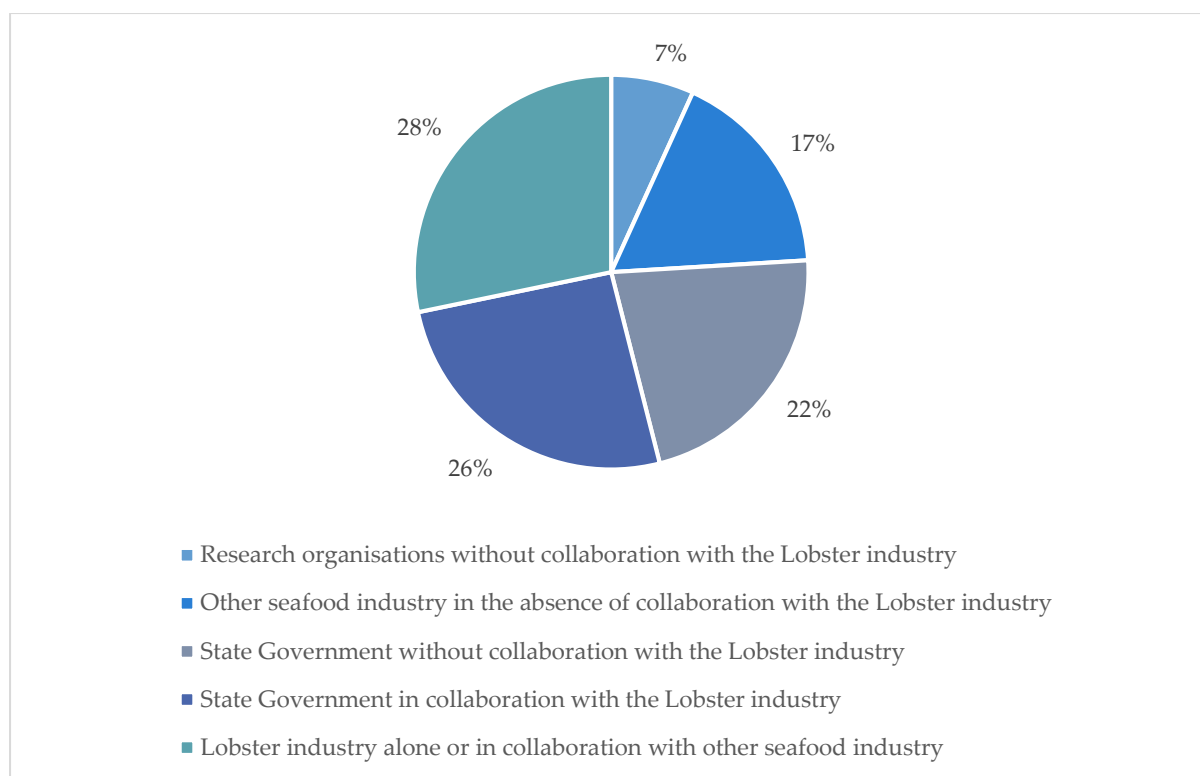


FIGURE 30 - PORTION OF FRDC LOBSTER RELATED RESEARCH EXPENDITURE BY INITIATOR TYPE – WESTERN AUSTRALIAN LOBSTER INTERESTS (2010-11 TO 2017-18).

Projects Initiated by the Australian Lobster Industry or Recreational Sector Alone or in Collaboration with other Sectors of the Australian Seafood Industry

During the period 2010-11 to 2017-18 a total of 39 projects with an associated FRDC expenditure of approximately \$7.4 million were initiated by the lobster industry or recreational sector acting alone or in collaboration with another sector of the Australian seafood industry. Approximately 28 percent of these projects accounting for 17 percent of the associated FRDC expenditure were initiated by the Western Australian industry, whereas 72 percent of the projects accounting for 83 percent of the expenditure were initiated by the eastern states industry. This is illustrated in Figure 31 below.

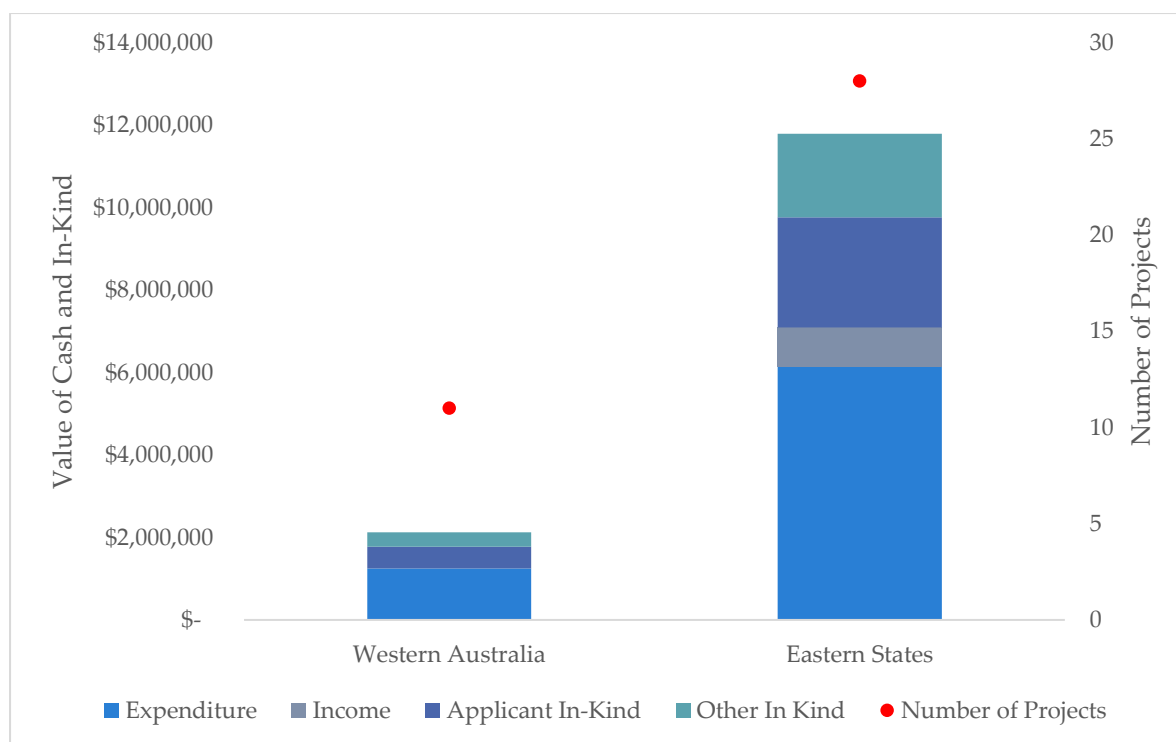


FIGURE 31 – PROJECTS INITIATED BY THE AUSTRALIAN LOBSTER INDUSTRY OR RECREATIONAL SECTOR ACTING ALONE OR IN COLLABORATION WITH ANOTHER SECTOR OF THE AUSTRALIAN SEAFOOD INDUSTRY

Not surprisingly the vast majority (75 percent of projects and 82 percent of FRDC expenditure) of projects in this category were undertaken through the IPAs. The distribution of projects and project resources across the IPA projects that were initiated by the lobster industry or the recreational sector acting alone or in collaboration with another sector of the Australian seafood industry is illustrated in Figure 32 below.

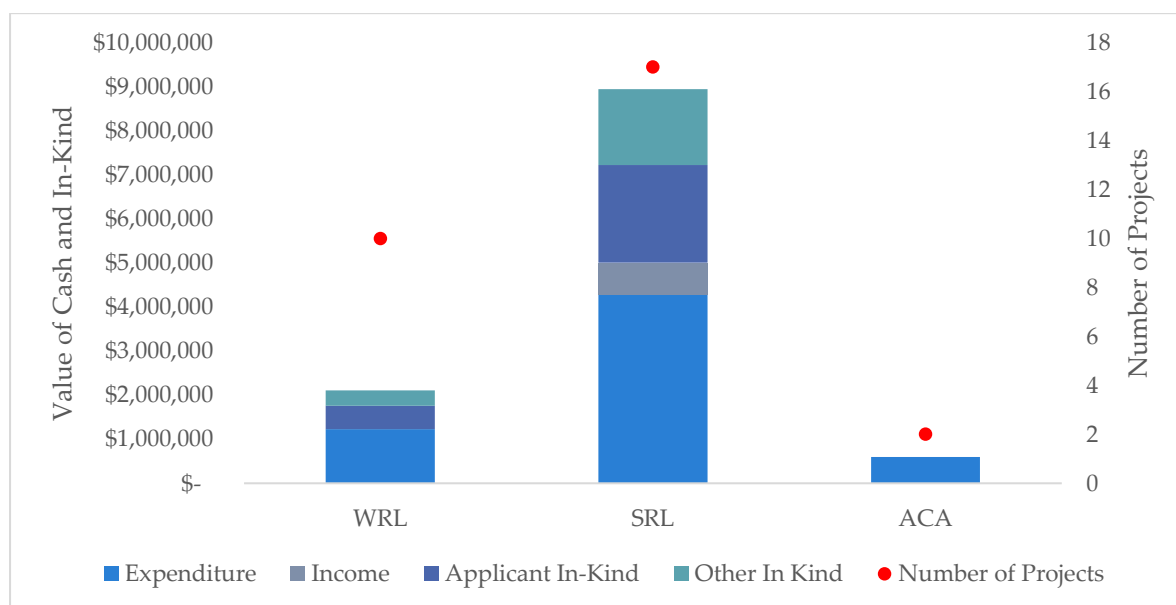


FIGURE 32 – PROJECTS INITIATED BY THE AUSTRALIAN LOBSTER INDUSTRY OR RECREATIONAL SECTOR ACTING ALONE OR IN COLLABORATION WITH ANOTHER SECTOR OF THE AUSTRALIAN SEAFOOD INDUSTRY FUNDED THROUGH IPAS

As illustrated in Figure 33 below, the Southern Rock Lobster industry achieved almost twice the leverage from projects funded through its IPA than the Western Rock Lobster industry.

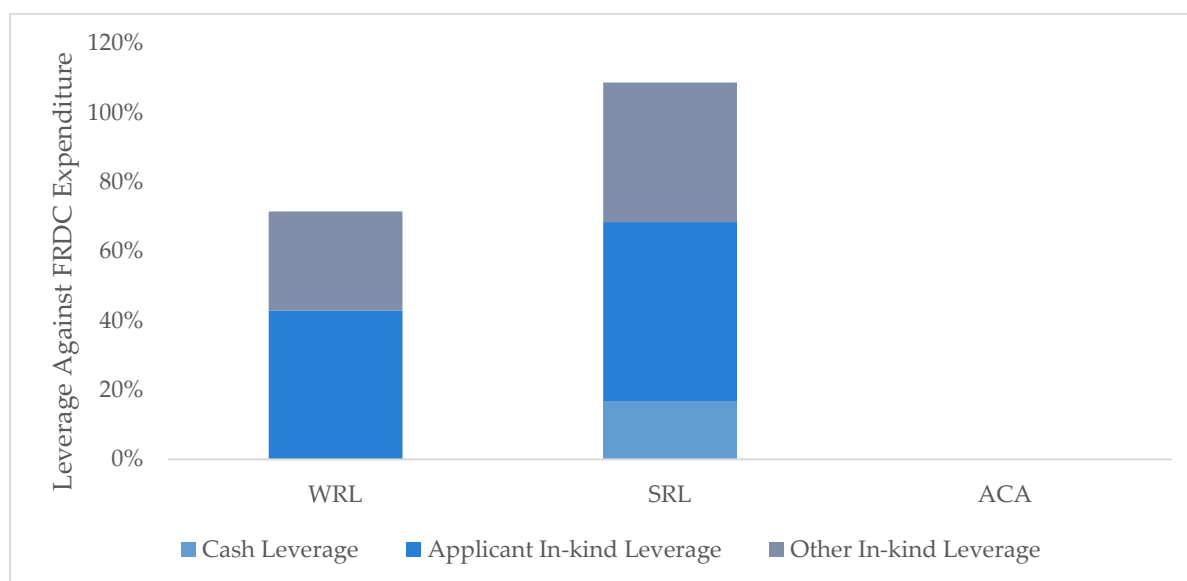


FIGURE 33 -LEVERAGE ACHIEVED AGAINST LOBSTER RELATED RESEARCH INITIATED BY INDUSTRY OR THE RECREATIONAL SECTOR ALONE OR ACTING IN COLLABORATION WITH ANOTHER SECTOR OF THE AUSTRALIAN SEAFOOD INDUSTRY AND FUNDED THROUGH AN IPA

Research funding leveraged against the Seafood CRC was the next highest contributor (11 percent of total expenditure). This was dominated by the eastern state's industry, which accounted for 98 percent of expenditure associated with the Seafood CRC and in the case of the Southern Rock Lobster industry it leveraged additional cash and in-kind resources equivalent to 40 percent of the FRDC expenditure.

Funding through the RAC mechanism accounted for approximately 7 percent of FRDC expenditure that was initiated by the industry or recreational sector acting alone or in collaboration with another sector of the Australian seafood industry, with approximately one third of that initiated under the New South Wales RAC and two-thirds under the Tasmanian RAC. The Tasmanian RAC investment was characterised by significant in-kind leverage representing 180 percent of the FRDC expenditure, and the NSW RAC by cash and in-kind leverage representing 121 percent of the expenditure.

Projects funded under the FRDC Tactical Research Fund and Incentive Fund represented 0.5 percent of the funding of projects initiated by the lobster industry or recreational sector acting alone or in collaboration with another sector of the Australian seafood industry.

Projects Initiated by other Sectors of the Australian Seafood Industry not in Collaboration with the Australian Lobster Industry

During the period 2010-11 to 2017-18, two projects with a total FRDC expenditure of \$761,000 and in-kind leverage of 102 percent were initiated by other seafood industry interests out of Western Australia. The larger project representing 90 percent of the FRDC expenditure in this category was funded under the Western Australian RAC, achieving in-kind leverage of 108 percent. The other project was funded out of the FRDC Tactical Research Fund and achieved total in-kind leverage of 48 percent.

No eastern states projects were initiated by other sectors of the Australian seafood industry unless in collaboration with the Australian lobster industry.

State Government and Lobster Industry

A total of 13 projects with a total FRDC expenditure of approximately A\$2.4 million were initiated by State Government's in collaboration with the Australian lobster industry. As illustrated in Figure 34 below, these were spread relatively equally across Western Australian and eastern states initiated projects.

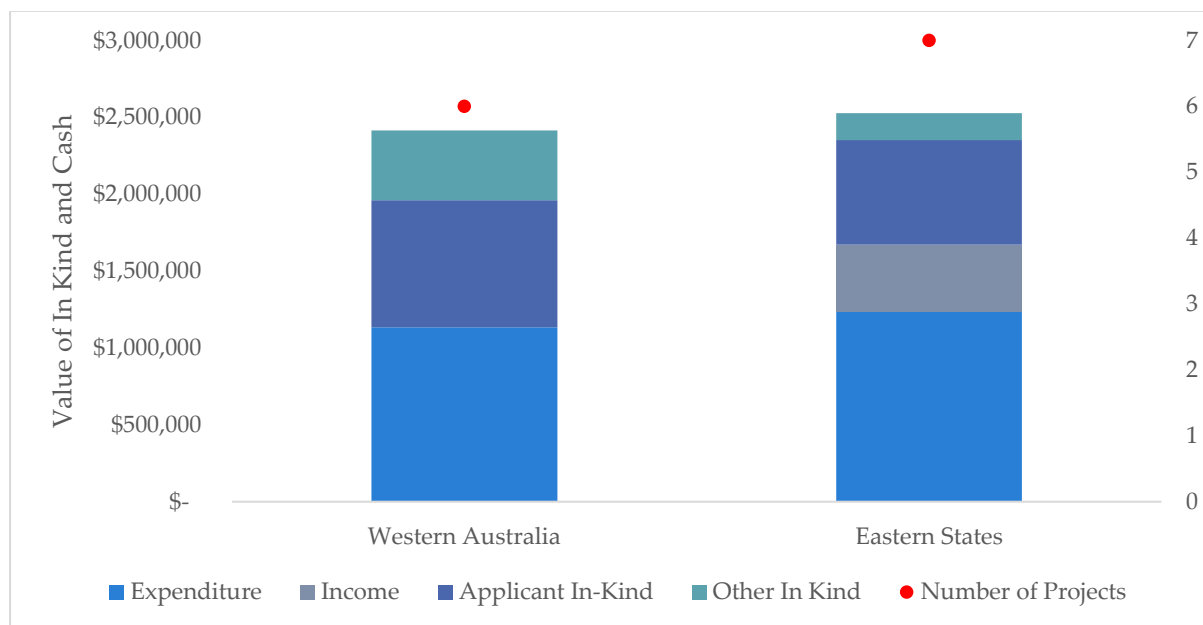


FIGURE 34 - PROJECTS INITIATED BY THE AUSTRALIAN LOBSTER INDUSTRY IN COLLABORATION WITH GOVERNMENT

While Western Australian initiated projects in this category did not attain any cash leverage against the FRDC expenditure, overall leverage was relatively equivalent between Western Australian and eastern states initiated projects. This is illustrated in Figure 35 below.

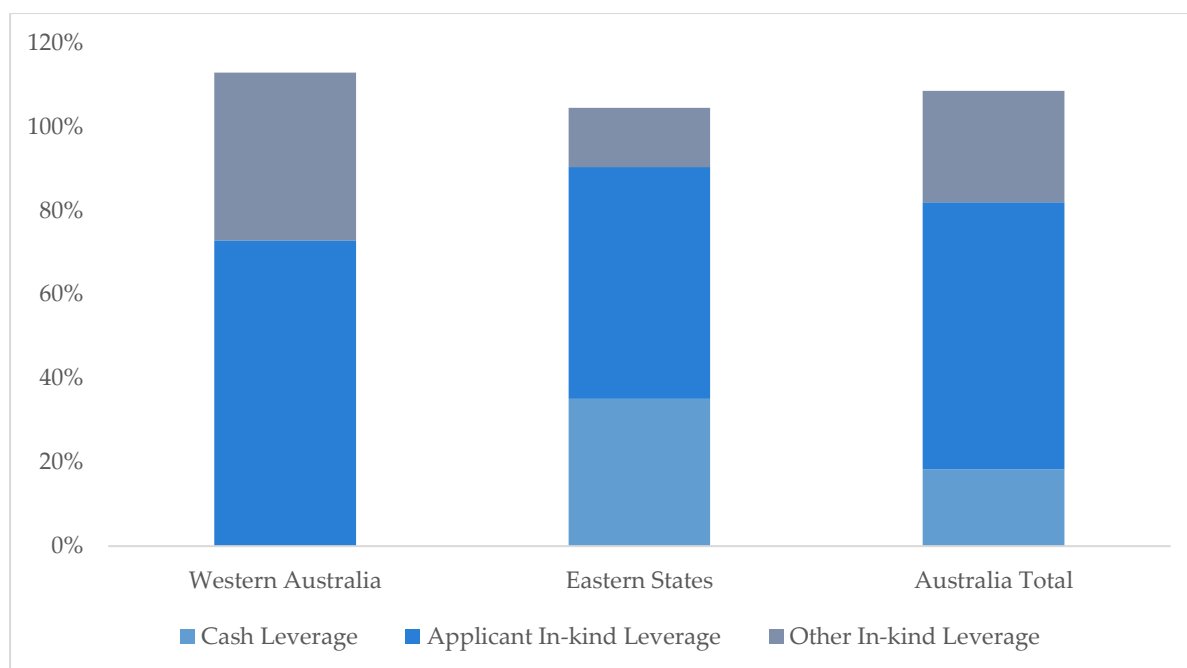


FIGURE 35 - LEVERAGE ACHIEVED AGAINST LOBSTER RELATED RESEARCH INITIATED BY AUSTRALIAN LOBSTER INDUSTRY AND STATE GOVERNMENT

Six projects in this category accounting for just over half of the total FRDC expenditure associated with projects in this category were funded under the Western Australian and Tasmanian RACs, with the Western Australian RAC accounting for five of the projects and over 90 percent of the FRDC expenditure in the category. These projects achieved just over 100 percent in-kind leverage.

Five projects under this category representing approximately 37 percent of the total FRDC expenditure in this category were funded under the Southern Rock Lobster IPA. These projects achieved total cash and in-kind leverage equivalent to approximately 75 percent of the total FRDC expenditure associated with projects in this category.

An eastern states initiated project funded under the National Priorities Program accounted for the balance of FRDC expenditure in this category and achieved cash and in-kind leverage of almost 200 percent.

State Government Acting without Collaboration from the Australian Lobster Industry

During the period 2010-11 to 2017-18, a total of 9 projects representing total FRDC expenditure of approximately \$1.6 million were initiated in this category. Approximately 56 percent of the projects associated with 61 percent of the total FRDC funding were initiated by the Western Australian Government. This is illustrated in Figure 36 below.

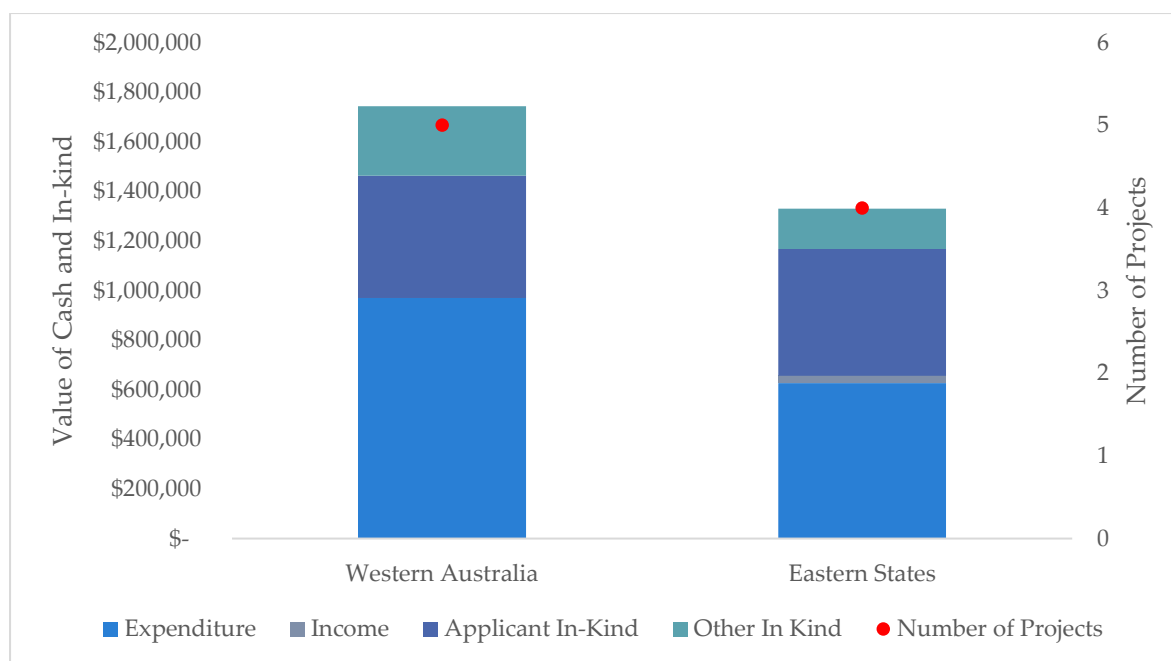


FIGURE 36 - PROJECTS INITIATED BY A STATE GOVERNMENT NOT IN COLLABORATION WITH THE AUSTRALIAN LOBSTER INDUSTRY

As illustrated in Figure 37 below, eastern states governments were more effective at leveraging the FRDC expenditure associated with projects in this category.

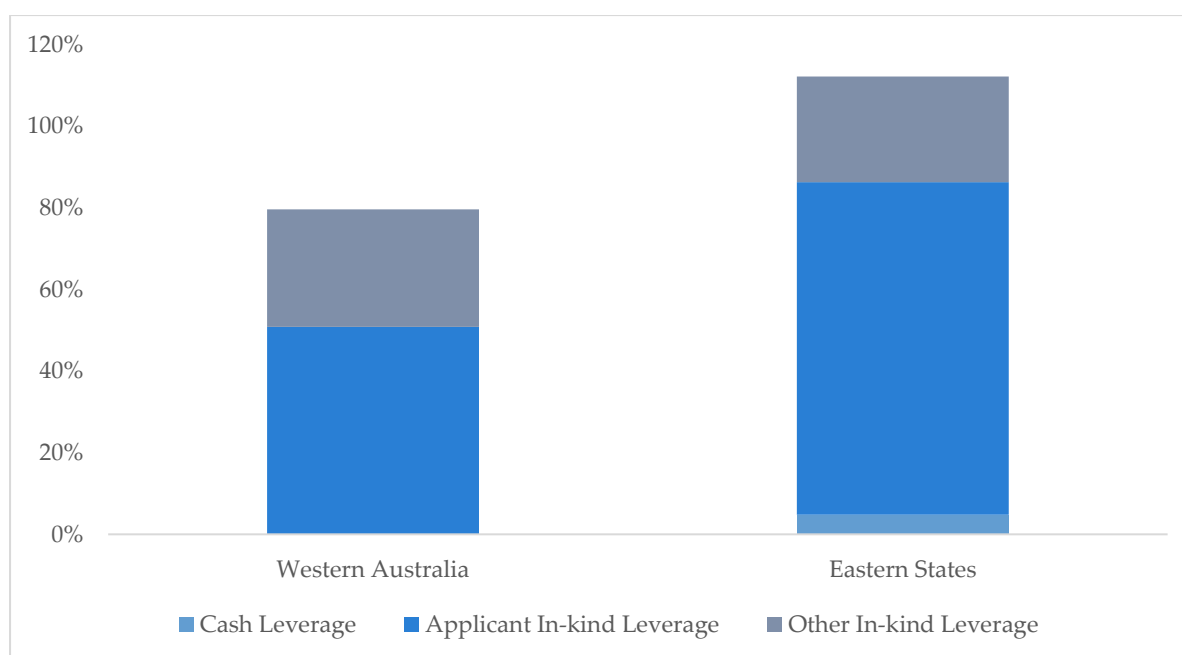


FIGURE 37 - LEVERAGE ACHIEVED AGAINST LOBSTER RELATED RESEARCH INITIATED BY A STATE GOVERNMENT NOT IN COLLABORATION WITH THE AUSTRALIAN LOBSTER INDUSTRY

Approximately 55 percent of the FRDC funding associated with projects in this category were executed under a RAC. This is illustrated in Figure 38 below.

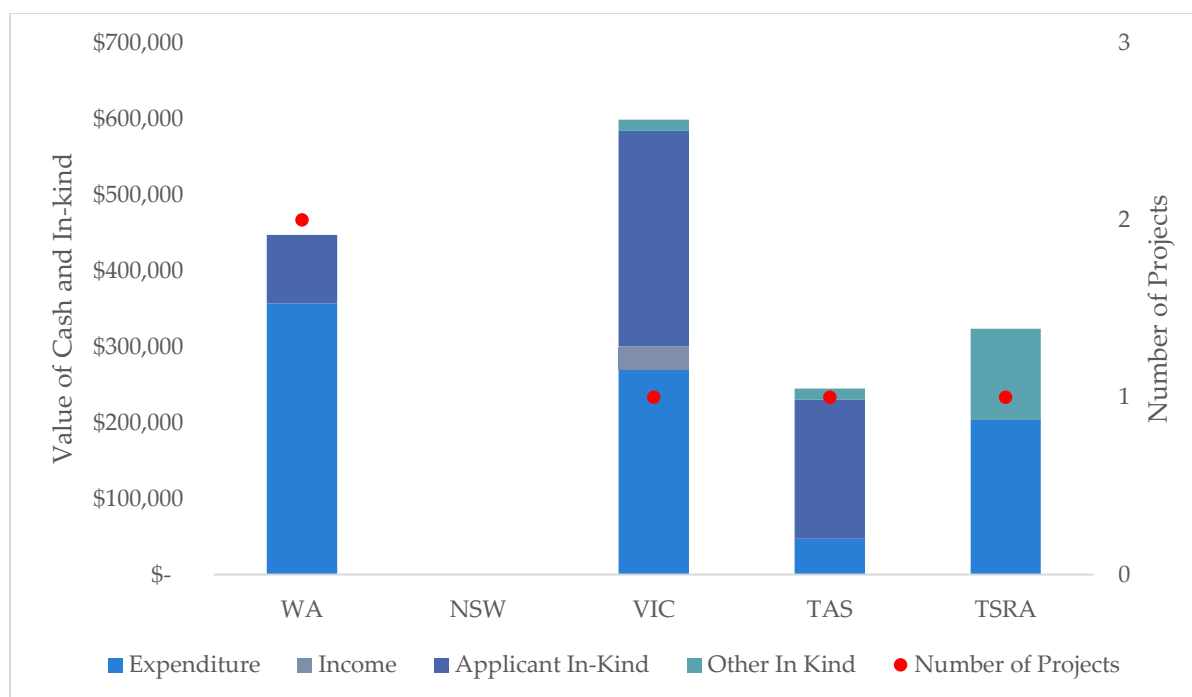


FIGURE 38 - PROJECTS INITIATED BY A STATE GOVERNMENT NOT IN COLLABORATION WITH THE AUSTRALIAN LOBSTER INDUSTRY AND FUNDED THROUGH A RAC

Again, as illustrated in Figure 39 below, the eastern state's government projects were more effective at leveraging the FRDC expenditure.

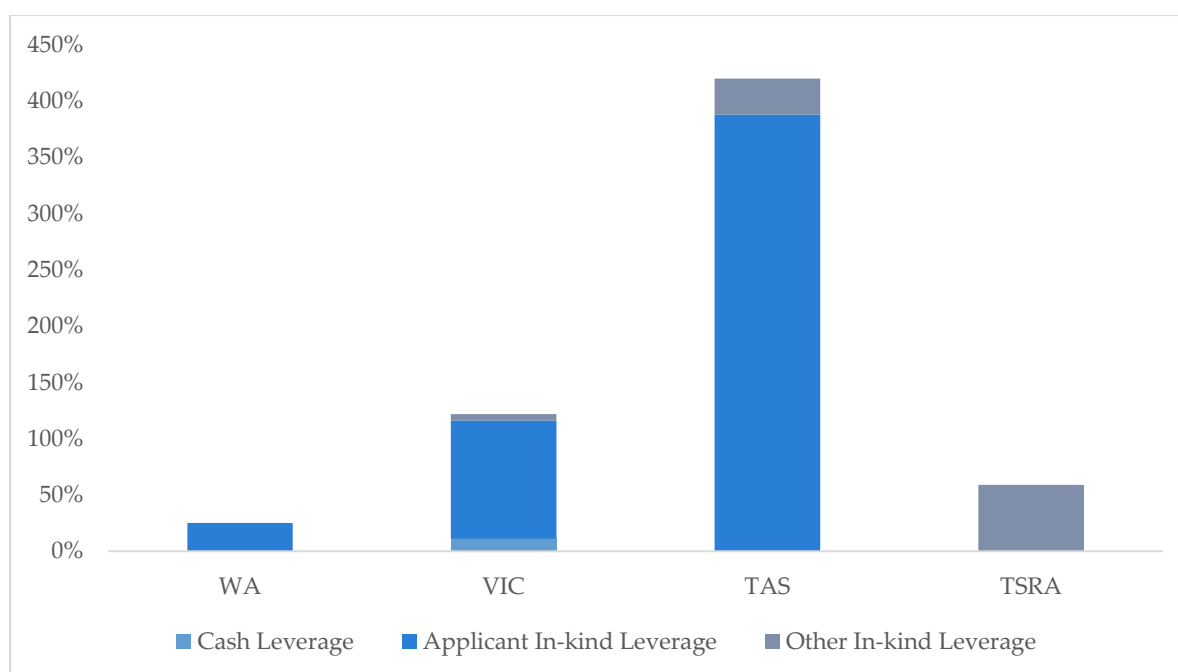


FIGURE 39 - LEVERAGE ACHIEVED AGAINST LOBSTER RELATED RESEARCH INITIATED BY A STATE GOVERNMENT NOT IN COLLABORATION WITH THE AUSTRALIAN LOBSTER INDUSTRY AND FUNDED THROUGH A RAC

The remaining projects accounting for approximately 45 percent of the FRDC expenditure in this category were funded through other FRDC programs namely the Climate Change DCCEE Program, Incentive Fund and Human Dimensions Sub Program. Projects initiated by the Western Australian Government accounted for three out of the four projects and 85 percent

of the FRDC expenditure associated with projects in this category funded under other FRDC projects. The Western Australian Government attained in-kind leverage equivalent to approximately 110 percent of the FRDC expenditure.

Research Organisations Acting without Collaboration from the Australian Lobster Industry

During the period 2010-11 to 2017-18 a total of two projects representing FRDC expenditure of approximately \$300,000 each were funded directly with research institutions without the explicit support of the Australian lobster industry. The Western Australian initiated project achieved in-kind leverage of approximately 12 percent of the FRDC expenditure and the eastern states project, cash and in-kind leverage of approximately 85 percent of the FRDC expenditure. The Western Australian initiated project was funded under the Climate Change DCCEE program and the eastern states initiated project under the FRDC Response Research Fund.

Appendix 4: Other Seafood Industry Research Collaborations and Institutes

PFG/ARC Research Hub for Rock Lobster Culture spinoff entity

Aspect	Details
Type	Public/private – new entity to be formed as partnership between University of Tasmania Institute for Marine and Antarctic Studies ARC Research Hub for Rock Lobster Culture and PFG Group P/L
Mission (summary)	Establish world-first closed cycle rock lobster aquaculture production system, see Tasmania become global leader in rock lobster research.
Focus	Commercial scale aquaculture production of rock lobsters, particularly tropical rock lobster, but ongoing work on southern and western rock lobster.
Funding	Mixed – private capital from PFG Group to form basis of spinoff entity to market and licence new production system, earlier research funded by public grants and CRC funding.
Nexus	Tasmanian focus, Southern Rock Lobster species-specific – but little public information about new production technique.

While still nascent, in late 2017 the University of Tasmania and PFG Group announced that they would be forming a spinoff entity to market and licence a new closed-cycle aquaculture technique at commercial scale for farming tropical rock lobsters. This would be the first fully closed-loop system at scale globally. PFG has committed to build the first hatchery, while ongoing production optimisation research continues and is estimated to conclude by 2019 with full production by 2021. While the entity has a strong aquaculture focus, the parallels to the proposed WRLC Centre for Excellence are obvious, and the University is seeking commercial partners to trial expanding the process to western rock lobster species⁴⁵ and aims to position Tasmania as an Australian leader in rock lobster husbandry and lifecycle research⁴⁶.

⁴⁵ *World-Leading Aquaculture Breakthrough to Transform Lobster Production* (2016), media release, published University of Tasmania 8 October 2016

⁴⁶ *Tasmanian manufacturer orders serve of world-leading lobster research* (2017), media release, published University of Tasmania 13 September 2017

Maine Lobster Institute

Aspect	Details
Type	Public/private – research partnership between University of Maine and several industry bodies (fishers, exporters/processors, community reps).
Mission (summary)	Sustaining American lobster (<i>Homarus americanus</i>) resource and fishery through research, outreach, education and communication.
Focus	Specific and targeted research programmes towards conservation and sustainability of lobster resource. Coordination and united front advocacy to government, communities re industry operation. Facilitation of communication and dissemination of info to and between wider industry, business and research community.
Funding	Mixed – little public domain information, but majority of funds appear to be provided by industry members, some specific funding grants to University of Maine.
Nexus	USA and Canada – species focus on American lobster means little interest to producers and consumers in other regions targeting other species.

The Maine Lobster Institute is perhaps the closest parallel to the proposed Centre as described to AVC. Initially developed as a partnership between specific industry bodies – Maine Lobstermen's Association, Massachusetts Lobstermen's Association, Maine Pound (quota) Owners Association, Maine Import/Export Dealer's Association – and the University of Maine, the Institute has operated since 1987 and has made significant contributions to the viability of the lobster fishery in North America. Specific areas of research and focus include not only pure research, but also science communication, advocacy and supply-chain innovation. The impetus for its formation appears to have been a desire on the part of peak industry bodies to ensure the continued sustainability of their resource and to increase industry profitability, which has strong parallels to the WRLC's current aims.

International Atlantic Salmon Research Board (SALSEA) – North Atlantic Salmon Conservation Organisation

Aspect	Details
Type	Public international – established by international treaty (Convention for the Conservation of Salmon in the North Atlantic Ocean ⁴⁷)
Mission (summary)	Conserve, restore and rationally manage international Atlantic salmon stocks.
Focus	Stock management and genetic diversity research to assist regulatory reform, management frameworks and habitat protection.
Funding	Entirely public – contributions from States Parties to Convention.
Nexus	North Atlantic ocean – signatory States Parties include Canada, Denmark, European Union, Norway, Russian Federation, USA.

⁴⁷ 1338 UNTS 33

As the 'pure research' arm of NASCO, the Research Board has implemented the 'Salmon at Sea' (SALSEA) programme to identify genetic diversity, growth history and profiles, mortality causes and other population metrics, as well as pursuing innovation in large-scale sampling and tagging. This species-specific management-centric approach has parallels to some of the aims of the proposed Centre. In addition, the expertise and focus on cross-jurisdictional linkages and international cooperation seem to be aligned with broader Centre goals.

Greenfins Aquaculture Tuna Center of Excellence⁴⁸

Aspect	Details
Type	Public/private – research partnership between University of Rhode Island and private capital to create joint Greenfins entity
Mission (summary)	Create viable closed-loop aquaculture of tuna in mainland USA.
Focus	Research and development of aquaculture systems in tuna, predominantly yellowfin, life cycle science and mortality causes of tuna species.
Funding	Little public data – appears to be funded by private capital partner.
Nexus	Species-centric – significant cooperation and data-sharing with other international institutions in advancing aquaculture techniques and life-cycle science.

A public-private partnership in which private capital has enabled a specific research programme at the University of Rhode Island, the GATCE aims to commercialise tuna aquaculture in the USA to meet growing consumer demand. While there is an element of public science to the programme, with data-sharing between other international entities and institutions and a number of graduate and undergraduate students hosted at the GATCE, the main objective appears to be commercialisation of as-yet proven techniques. Parallels for a proposed WRLC Centre of Excellence include a single-species focus, industry-led marine science for high-value species and a focus on collaboration with other institutions.

⁴⁸ [sic]

Tuna Research and Conservation Center⁴⁹

Aspect	Details
Type	Public/private – research partnership between private research entity and public funded aquarium.
Mission (summary)	Promote basic biological research on tuna species and captive husbandry.
Focus	Research and development of husbandry of fast-moving migratory fish, primarily tuna, with view towards conservation, basic biological research on captive population, and data collection techniques.
Funding	Little public data – appears to be funded by combination of donations, grants, private funds and research collaborations.
Nexus	Species-centric – significant cooperation and data-sharing with other international institutions in advancing husbandry and biological science.

An unusual public-private partnership in which the private entity is a research organisation (Stanford University), the TRCC has operated since 1994 to perform basic biological research on captive tuna and other migratory fish species. While not explicitly commercially focused, the ongoing work on tuna husbandry has been of interest to industry and other institutions, and a range of collaborations have been undertaken. Similarly to the proposed Centre, the TRCC is primarily focused on basic biological and biomechanical research aimed at better understanding a species of high commercial value.

The National Lobster Hatchery

Aspect	Details
Type	Not-for-profit – charitable foundation for conservation and research
Mission (summary)	Stock enhancement programme to stabilise UK populations of US/EU lobster.
Focus	Captive husbandry, breeding and wild release of hatchery-bred lobster juveniles, research into lobster husbandry and breeding.
Funding	Publicly funded through grants and donations.
Nexus	UK

A charitable foundation based in Cornwall, UK, the National Lobster Hatchery aims to rebuild local populations of the US/EU lobster along the UK coast, thus supporting fisheries sustainability and the livelihoods of coastal communities. The majority of their efforts focus on a breeding programme, followed by wild release of juvenile lobsters into targeted locations. Operating as a charity, the Hatchery has no particular commercial nexus, but is broadly supported by the UK lobster fishing industry to ensure the continued viability of the UK fishery.

⁴⁹ [sic]

The AVC Lobster Science Centre

Aspect	Details
Type	Public/private – research undertaken at Atlantic Veterinary College of University of Prince Edward Island at behest of Canadian lobster industry and part funded by industry contributions
Mission (summary)	Apply principles of veterinary medicine to lobster health research and industry needs.
Focus	Lobster husbandry, pathogen research, growth cycles and health research
Funding	Little public data on exact split, but some public funding and grants paired with industry contributions through grants and levies
Nexus	Strong focus on Canada-specific issues and therefore US/EU lobster

Established in 2000 at the request of Canadian lobster industry, the LSC is entirely focused on fundamental research into animal health and husbandry specific to the Canadian lobster industry, and is somewhat unique in that it appears to be the only lobster research body attached to a veterinary school. Like the Maine Lobster Institute, research areas include not only pure science, but also downstream processing, supply-chain, product flow and market dynamics. With a specific mandate to respond to the needs of the local industry, parallels to the proposed WRLC Centre of Excellence are easily drawn.

Experimental Aquaculture Facility

Aspect	Details
Type	Public/private – research partnership between University of Tasmania, Huon Aquaculture, Skretting, and State and Federal government
Mission (summary)	Advance Tasmanian aquaculture through directed, commercially relevant research.
Focus	Specialist research facilities and new science into salmonid species, attract regional and national seafood research expertise, address husbandry and environmental concerns.
Funding	Joint funding from industry partners Huon and Skretting, grants and other contributions from State and Federal government.
Nexus	Primarily focused on Tasmanian industry needs, particularly surrounding salmon aquaculture, but also Pacific oysters.

Opened in late 2015, the EAF is one of the largest aquaculture research facilities in the southern hemisphere. Designed specifically to allow research at scale and on larger individuals, while allowing for a full range of temperature and climate controls, the EAF is a significant investment by both industry partners and government which it is hoped will underpin further productivity gains in the Tasmanian aquaculture industry. The governance and funding model may be relevant to the proposed Centre of Excellence, as well as being an example of Australian (predominantly) single-species research.

Fish Health Centre of Excellence

Aspect	Details
Type	Public/private – Tasmanian State Department of Primary Industries research institute part funded by industry funds, FRDC funding and Commonwealth grants
Mission (summary)	Hatch to harvest diagnostic, research and preventative medicine programmes for aquaculture.
Focus	Diagnostic expertise, development of vaccines suitable for usage in aquaculture systems, particularly salmon production.
Funding	Funded through State and Federal government grants, FRDC CRC funding, and levies raised through the Tasmanian Salmon Growers Association
Nexus	Primarily focused on Tasmanian industry needs, particularly surrounding salmon aquaculture, but aims to build global reputation in vaccine development and fish health diagnostics.

Opened in late 2015, the Fish Health Centre operates from the Tasmanian Department of Primary Industries' Animal Health Laboratories biosecure facilities in Mount Pleasant to undertake broad-based research into predominantly finfish health, particularly salmonids. The early focus of the centre has been on vaccines suitable for use in Australian aquaculture production systems. Part-funded by industry levies and focused on industry needs, the FHC may help inform the priorities and design of the proposed WRLC Centre.

Norwegian Institute of Food, Fisheries and Aquaculture (NOFIMA)

Aspect	Details
Type	Public research institute
Mission (summary)	Increase competitive advantage along the complete production chain.
Focus	Broad-based research agenda for primary production, including in aquaculture, wild-catch seafood and land-based production.
Funding	Publicly funded through government expenditure. Some income from matched contributions, EU funding and industry sponsors.
Nexus	Broad research agenda. Aquaculture and seafood divisions focused mainly on fish health, genetics, production and farming systems, nutrition and marine biotech.

As one of the largest primary-production and food research institutes globally, NOFIMA undertakes a range of research programmes. Based in Norway, NOFIMA is strongly focused on applied research to benefit broad industry, although with no specific mandate it is not focused on single-species or -industry research. Highly regarded internationally, NOFIMA is also involved with a number of collaborative research programmes and data-sharing arrangements that may be relevant to the proposed Centre for Excellence.

Skretting Aquaculture Research Centre

Aspect	Details
Type	Private – commercial laboratory.
Mission (summary)	Ensure continual profitability of Skretting company.
Focus	Research and development of aquaculture feed, ancillary research into captive husbandry of various commercial marine species.
Funding	Privately funded. Some co-research with partner institutions and entities or work on fee-for-service basis.
Nexus	Broad base for operations across most commercially farmed species.

A fully private research entity, the Skretting ARC is predominantly focused on developing specialise aquaculture feed for commercial supply. With a strong commercial focus, and a history of public/private partnerships, the ARC has amassed considerable expertise in its specialist areas of research.

Appendix 5: Principles of Good Governance Framework

Principle	Subordinate Considerations
Lay solid foundations for management and oversight	<p>Are the Chair and CEO two different people?</p> <p>Are the respective roles of the Chair and CEO clearly defined?</p> <p>Is the time commitment of the Chair sufficient to enable him/her to fulfil their responsibilities?</p> <p>Are the roles of the board and the management team clearly defined?</p> <p>Is the process for board appointments and dismissals clear, transparent and agreed by all participants?</p> <p>Does the director receive formal letters of appointment outlining expectations, rights, responsibilities, terms and conditions?</p> <p>Are induction procedures in place to assist directors to quickly integrate and participate fully in board decision-making?</p> <p>Does the board meet regularly enough to be effective?</p> <p>Do directors have access to continuing professional development to maintain and update skills?</p> <p>Are individual performance evaluations of directors undertaken regularly?</p> <p>Is the process for evaluating the performance of senior executives known to participants?</p>
Structure of the Collaboration Board to Add Value	<p>Is the Chair independent?</p> <p>Are the majority of directors independent?</p> <p>Is the board skills based?</p> <p>How large is the board?</p> <p>Is there diversity on the board?</p> <p>Are performance evaluations of the board as a whole undertaken regularly?</p>
Promote ethical and responsible decision-making	<p>Has a code of conduct and standards of behaviour required of the board and senior executives been established?</p> <p>What procedures are in place to manage actual or potential conflicts of interest for board members from participant organisations?</p> <p>How are other conflicts of interest handled at the board level?</p> <p>Can participants have confidence in the board's integrity in respect of their legal obligations?</p> <p>Are policies in place for the reporting and investigation of reports of unethical practices?</p>

Principle	Subordinate Considerations
	<p>Are processes in place for reporting and investigating of reports of unethical practices?</p> <p>Are processes in place for reporting decisions of the board to participants and taking into account their issues and concerns?</p>
Safeguard integrity and financial reporting	Has a finance and audit committee been established?
Make timely and balanced disclosure	<p>Are policies in place to ensure collaboration communications about financial and non-financial issues are timely, factual, clear and objective?</p> <p>Are policies in place to ensure accountability at a senior level for compliance?</p> <p>Are those policies disclosed to participants?</p> <p>Is commentary on financial results issued to enhance the clarity and balance of reporting?</p> <p>Are senior management core entitlements disclosed to participants?</p> <p>Are board evaluations disclosed to participants?</p>
Respect the rights of participants	<p>Is there communications policy in place which details how, and how often, information will be communicated to participants?</p> <p>Are there general meetings that encourage the attendance of all participants?</p> <p>Is there clear consideration of those matters that participants need to vote upon and those that need to be addressed by the board?</p> <p>Is the latest technology used to communicate with participants?</p> <p>Does the collaboration have a website and are all communications accessible from the website?</p>
Recognise and manage risk	<p>Are there practices in place which identify, assess, monitor and manage both strategic and operational risk?</p> <p>Does the board regularly review and approve the risk management and oversight policies?</p> <p>Has the board established a risk management committee?</p> <p>Are the policies disclosed to participants, for example, by being placed on the CRC's website?</p> <p>Does the CEO or a relevant member of the CRC's management team advise the board in writing that the integrity of financial statements is founded on a sound system of risk management and internal compliance and control?</p>
Remunerate fairly and responsibly	<p>Is the level of board remuneration sufficient and reasonable?</p> <p>Is the relationship between remuneration and performance clear?</p> <p>Does the board have a remuneration committee to review and recommend levels of remuneration of senior executives?</p> <p>Is there a remuneration policy which motivates senior executives to pursue the long-term growth and success of the organisation?</p> <p>Is there a balance between fixed and incentive pay?</p>

