



State Aquaculture Research, Training and Service Delivery Capabilities

A review of research, training and service delivery capacity operated by TAFE colleges and the Department of Fisheries

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Project Steering Group

The project was overseen by a Project Steering Group comprised of the following individuals:

- Russell Brown, Executive Director - Service Resource Management, Department of Training and Workforce Development
- Lisa Cinanni, Department of Training and Workforce Development
- Darren Foster, Deputy Director General, Department of Fisheries
- Elise Irwin, Principle Policy Advisor, Minister for Training and Workforce Development
- Steve Nel, Aquaculture Manager, Department of Fisheries
- Helen Smart, Director – Training Infrastructure Management, Department of Training and Workforce Development
- Sharmini Wijay, Manager - Strategic Infrastructure, Training Infrastructure Management, Department of Training and Workforce Development

Project Contributors

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- Desiree Allen, Managing Director, Marine Produce Australia Limited
- Burt Beavers, former Managing Director, former Durack Institute of Technology
- Jonathan Bilton, Hatchery Consultant, Department of Fisheries
- Neil Binning, Portfolio Manager – The Environment and Primary Industries, South Regional TAFE (formerly Great Southern Institute)
- Benjamin Byrne, Lecturer – Aquaculture and Maritime, Batavia Coast Maritime Institute
- David Cohen, Director – Organisational Services, former Durack Institute of Technology
- Cameron Crowe, Aarli Mayi Aquaculture Project
- Serena Cruickshank, Chief Financial Officer, former Durack Institute of Technology
- Glen Dibben, Blue Lagoon Mussels
- Karen Dickinson, former Managing Director, Kimberley Training Institute
- Stephen Douglas, Manager Strategic Projects, Mid West Development Commission
- Nhi Dho, Director Strategic Policy and Executive Support, South Metropolitan TAFE
- Terry Durant, Managing Director, South Metropolitan TAFE
- Lindsay Gassman, Director of Corporate and Regional Services, North Regional TAFE (formerly Kimberley Training Institute)
- Steven Gill, Aarli Mayi Aquaculture Project
- Juan Gutierrez, Operations Manager, Batavia Coast Maritime Institute
- John Harrison, Chief Executive Officer, Western Australian Fishing Industry Council



- Patrick Hone, Chief Executive Officer, Fisheries Research Development Corporation
- John Hutton, Aarli Mayi Aquaculture Project
- Greg Jenkins, Executive Director, Australian Centre for Applied Aquaculture Research
- Craig Jerrard, Manager – Physical Resources, Batavia Coast Maritime Institute
- Suresh Job, Training Director, Batavia Coast Maritime Institute
- Chris Jones, Director Training Services, South Regional TAFE
- Pheroze Jungalwalla, former director, TasSal
- Mike Kendall, Senior Project Manager, Mid West Development Commission
- Craig Kestel, Managing Director, 888 Abalone
- Rowan Kleindienst, Facility Manager, Curtin University Aquatic Research Laboratory
- Neil Lonegran, Leader - Environmental and Conservation Cluster, Murdoch University
- Jennifer McIlwain, Head of Department – School of Science, Curtin University of Technology
- Gavin Partridge, Principal Research Scientist, Australian Centre for Applied Aquaculture Research
- Joanne Payne, Director – Training, former Durack Institute of Technology
- Katherine Reeves, Chief Financial Officer, North Regional TAFE (formerly Kimberley Training Institute)
- Andrew Rowland, Chief Executive Officer, Recfishwest
- Michael Snow, Senior Supervising Scientist – Biodiversity and Biosecurity, Department of Fisheries
- Ian Stagles, Chair, Fish Foundation
- Erica Starling, Director, Indian Ocean Fresh Australia
- Bill Swetman, Managing Director, Central Regional TAFE
- Tina Thorne, Executive Officer, Aquaculture Council of Western Australia
- Gavin Treasure, Chief Executive Officer, Mid West Development Commission
- David Whyte, Group Technical Manager, Huon Aquaculture
- Peter Young, Lecturer – Primary Industries, South Regional TAFE (formerly Great Southern Institute)



Executive Summary

The Western Australian Government's investment in aquaculture training, applied research, advisory and fish stock supply services capacity and infrastructure, primarily through the Department of Training and Workforce Development and the Department of Fisheries, has been substantial over the past two decades. However, the Western Australian aquaculture industry has yet to expand beyond a nascent status of development.

This has resulted in state owned and operated aquaculture training, applied research, advisory and fish stock supply capacity that is well in excess of industry needs, as well as assets that are dilapidated and/or redundant.

Conversely, renewed prospects for the nascent industry that are founded in several contemporary projects that present reasonable prospects as the basis for the establishment of sectors of significant scale, renewed interest from the State reflected in a government policy position that is supportive of the sector, as well as growing multi-stakeholder support for the practice of restocking threatened native species and species targeted by recreational fishers (practices which necessarily require access to aquaculture applied research and fish stock supply capability), means that sustaining a subset of the existing State owned and operated capability and infrastructure is critically important to the development of an aquaculture industry and continuation of restocking practices in Western Australia.

This study has undertaken a comprehensive analysis of the nature and status of the State's investment in aquaculture training, applied research, advisory and fish stock supply capability and infrastructure, the current status and prospects of the Western Australian aquaculture industry and makes recommendations pertaining to both rationalisation of the State operated capabilities and infrastructure, and new infrastructure investment requirements.

The Western Australian aquaculture industry: a troubled history, but a cautiously optimistic outlook...

Western Australia has not followed a national trend in aquaculture development...

In 2013-14, national aquaculture production accounted for approximately 38 percent of the total GVP produced by the A\$2.6 billion Australian wild-catch and aquaculture fisheries industry. Approximately 75 percent of the almost A\$1.0 billion of Australian aquaculture GVP is produced by the states of Tasmania and South Australia, with Tasmania itself accounting for over half of national aquaculture GVP.

The value of aquaculture production in Tasmania and South Australia is dominated by single species with Atlantic salmon accounting for 95 percent of the aquaculture GVP of Tasmania, and Bluefin tuna aquaculture accounting for 70 percent of South Australian aquaculture GVP. Oyster production primarily in New South Wales, Tasmania and South Australia collectively accounts for GVP of approximately A\$90 million, with production in range of other species across Australia including prawns, pearls, barramundi, abalone and mussels each contributing considerably less to the industry's GVP.

In 2013-14, Western Australia's wild-catch and aquaculture fishery industry produced GVP of just under A\$500 million, second only to Tasmania's A\$730 million industry. However, whereas



aquaculture production accounts for 76 percent of the GVP of the Tasmanian industry, it only accounts for 15 percent of the GVP of the Western Australian industry. Furthermore, Western Australia's aquaculture production is concentrated in the *Pinctada maxima* pearl sector which produces annual GVP of approximately A\$60 million. On a seafood only basis, aquaculture accounts for approximately only 3 percent of the value of seafood produced in Western Australia, representing the lowest aquaculture to wild-catch production ratio of any Australian state or territory. Indeed on a national basis, Western Australia accounts for only 1.3 percent of national aquaculture seafood production.

The largest sector of the Western Australian aquaculture industry, *Pinctada maxima* pearl production has declined from approximately A\$120 million 2006-07 to its currently level. Seafood aquaculture production in Western Australia increased from approximately A\$6.5 million in 2006-07 to an historical peak of approximately A\$17 million in 2012-13, subsequently declining to approximately A\$15 million in 2013-14. This recent growth in seafood aquaculture in Western Australia has been driven by a single barramundi operation in the Kimberley Region, which currently accounts for approximately 65 percent of the seafood aquaculture GVP in Western Australia.

While a single operation accounts for the majority of GVP produced by the Western Australian seafood aquaculture sector, there are currently approximately 230 aquaculture licenses on issue in Western Australia reporting production. These licenses pertain to a range of other species including mussels, marron, yabbies, silver perch, rainbow trout and various other species of crustacean. Approximately 80 percent of these licenses apply to marron operations that in 2013-14 produced an average GVP per license of A\$7,600, as opposed to an average GVP per license across the five barramundi licenses of A\$1,562,800.

There are several reasons for this...

The inability of the Western Australian seafood aquaculture industry to develop to the extent that it has in other Australian states such as Queensland, New South Wales, Victoria, Tasmania and South Australia, where aquaculture accounts for between 30 and 50 percent of total wild-capture and aquaculture seafood production has been attributed to a number of factors. Reasons that are commonly cited include a limited availability of suitable sites, high capital and operating costs, investor scepticism, regulatory burden, no demonstrated species advantage, ad hoc policy frameworks and an absence of sustained and suitably focused government support, and the small and fragmented nature of the current industry.

All hope is not lost...

However, despite the challenges that the Western Australian aquaculture industry has historically faced, there is cause for some optimism with respect to the future. This underpinned by:

- A small number of contemporary professionally managed projects in different species that show prospect for evolving into operations of scale that could subsequently underpin a larger Western Australian aquaculture industry;
- An increased incidence of interest in Western Australia from major established aquaculture industry operators in Western Australia that while of a preliminary nature is encouraging; and
- A renewed interest in the sector from the State Government that is underpinned by an aquaculture development policy, as well as identification of aquaculture as an important strategic industry at a regional development policy level.



While the factors discussed above are indicative of arguably the best development environment for aquaculture in the history of the industry in the State, there remains considerable risk. The ventures that have the potential to underpin growth in the industry are at relatively early stages of development and face both technical and agribusiness risk associated with scale-up in a relatively untested production environment.

Western Australian Government support for the aquaculture industry has been long standing, but not optimally targeted...

Since the early to mid-1990s, the Western Australian Government has invested in developing and maintain a range of capabilities and infrastructure across the State designed to support the development of an aquaculture industry. These investments have been made both in initial expectation of an emerging industry, and subsequently to support a nascent industry that has struggled to achieve the critical mass necessary to make a meaningful contribution of Gross State Product. The result of these investments are capabilities and infrastructure operated by the Department of Training and Workforce Development through one metropolitan and three regionally based TAFE colleges, as well the Department of Fisheries primarily through its research division. Other limited infrastructure also exists in the State's university sector.

Department of Training and Workforce Development is the main vector...

Through aquaculture capability and infrastructure that is operated at the Fleet Street Fremantle campus of South Metropolitan TAFE (training facilities and the Australian Centre for Applied Aquaculture Research), Geraldton campus of Central Regional TAFE (Batavia Coast Marine Institute), Broome campus of North Regional TAFE (Broome Aquaculture Centre) and Albany campus of South Regional TAFE, the Department of Training and Workforce Development has and, through ongoing subsidisation of aquaculture programs at these institutions, continues to make a substantial investment in supporting the Western Australian aquaculture industry.

With the exception of the Australian Centre for Applied Aquaculture Research (ACAAR), which was established within the TAFE system with a specific purpose to support the development of the Western Australian aquaculture industry by undertaking applied research, this capability and infrastructure was established primarily to facilitate the delivery of national training package qualifications in aquaculture, namely Certificates I, II, III, IV and Diploma in Aquaculture and predecessor qualifications.

The following table summarises Western Australian TAFE college aquaculture training activity over the period 2011 to 2015. A very significant portion of the lower level (Certificate I, II and III) aquaculture enrolments and qualifications pertain to secondary school students completing the courses under the VET in Schools program.



| | |
|---|-------------|
| Total Enrolments in Aquaculture Training Programs | 1,501 |
| Average Total Enrolments in Aquaculture Training Programs Per Annum | 300 |
| Total Enrolments – Certificate I in Aquaculture | 124 (8.3%) |
| Total Enrolments – Certificate II in Aquaculture | 880 (58.6%) |
| Total Enrolments – Certificate III in Aquaculture | 388 (25.8%) |
| Total Enrolments – Certificate IV in Aquaculture | 7 (0.5%) |
| Total Enrolments – Diploma in Aquaculture | 102 (6.8%) |
| Total Qualifications in Aquaculture Awarded | 570 |
| Average Aquaculture Qualifications Issued Per Annum | 114 |

The following table summarises aquaculture training activity at each of the TAFE colleges delivering aquaculture training over the period 2011 to 2015.

| TAFE College | Enrolments | | | | | | Qualifications Issued |
|--------------------|---------------|----------------|-----------------|----------------|------------|--------------|-----------------------|
| | Certificate I | Certificate II | Certificate III | Certificate IV | Diploma | Total | |
| South Metropolitan | 32 (25.6%) | 138 (15.7%) | 100 (25.8%) | 0 (0.0%) | 44 (43.1%) | 314(20.9%) | 176 (30.9%) |
| Central Regional | 3 (2.4%) | 445 (50.6%) | 40 (10.3%) | 0 (0.0%) | 21 (20.6%) | 509(33.9%) | 240 (42.1%) |
| South Regional | 68 (54.8%) | 82 (9.3%) | 26 (6.7%) | 6 (85.7%) | 11 (10.8%) | 193(12.8%) | 58 (10.2%) |
| North Regional | 21 (16.9%) | 215 (24.4%) | 222 (57.2%) | 1 (14.3%) | 26 (25.5%) | 485(32.3%) | 96 (16.8%) |
| TOTAL | 124 | 880 | 388 | 7 | 102 | 1,501 | 570 |

In addition to the delivery of these training programs, all of the TAFE colleges provide to varying degrees applied aquaculture research, advisory and fish stock supply services to industry and government clients on a fee-for-service basis, with ACAAR providing such services without also delivering training in any substantive way. The scale of this additional activity at Central Regional TAFE, North Regional TAFE and South Regional TAFE is small compared to ACAAR, which since its establishment has been involved in over 100 such projects earning ACAAR approximately A\$4.5 million.

The aquaculture training, applied research, advisory services and fish stock supply services that are provided by the TAFE colleges are supported by an historical capital investment in aquaculture infrastructure by the TAFE system of at least approximately \$21 million. In addition, the wider Western Australian state government has invested A\$4.5 million in the Broome



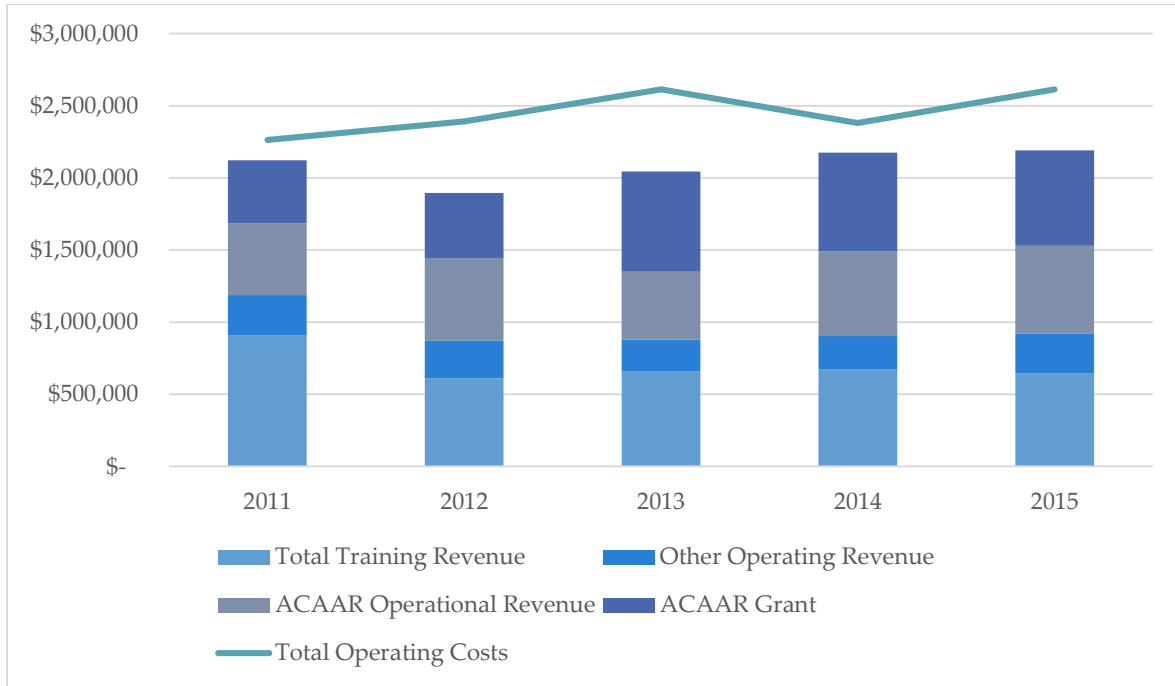
Tropical Aquaculture Park, A\$2.0 million in grants to the Mid West Yellowtail Kingfish Trial, provided financial support to the Aquaculture Council of Western Australia, and made numerous other smaller investments in the sector.

Typical aquaculture facilities operated for the TAFE colleges include classrooms, general purpose laboratories, specialist laboratories, temperature controlled rooms, broodstock holding facilities, hatchery facilities, grow-out tank arrays, in the case of ACAAR, South Metropolitan TAFE training facilities, Central Regional TAFE and North Regional TAFE access to seawater either through seawater bores or open ocean intakes.

The following Table summarises the total direct staffing required to deliver aquaculture training, applied research, advisory and fish stock supply services through the TAFE system.

| TAFE College | | Teaching FTE | Academic and Technical Support FTE | Administrative Support FTE | Total FTEs |
|---------------------|--------------|--------------|------------------------------------|----------------------------|--------------|
| Central TAFE | Regional | 1.0 | 0.48 | 0.32 | 1.8 |
| North Regional TAFE | | 1.5 | 0 | Not Known | 1.5 |
| South TAFE | Metropolitan | 1.8 | 0.6 | 0.12 | 2.52 |
| ACAAR | | 0.0 | 8.0 | Not Known | 8.0 |
| South Regional TAFE | | 1.0 | 0.0 | Not Known | 1.0 |
| TOTAL | | 5.3 | 9.08 | 0.44 | 14.82 |

While training programs are supported by the normal TAFE program financing arrangements and applied research, advisory and fish stock supply services are provided on a fee-for-service basis, the aquaculture capability and infrastructure operated by the TAFE colleges is significantly subsidised by the TAFE system. The following figure summarises the financial performance of Western Australian TAFE aquaculture programs on an aggregated basis.



As summarised below the direct subsidisation of this activity has averaged approximately A\$1.0 million per annum. This does not include other indirect subsidies such as the lease value of the land occupied by aquaculture infrastructure or access to various TAFE corporate services.

| | 2011 | 2012 | 2013 | 2014 | 2015 | Average |
|----------------------------|-----------|-----------|-------------|-----------|-------------|-----------|
| Total Direct Subsidisation | \$579,681 | \$952,105 | \$1,263,054 | \$888,307 | \$1,083,192 | \$953,268 |

The ACAAR grant is a significant component of the direct subsidisation and has grown at a Compound Annual Growth Rate of 11 percent since 2011 and has accounted for 52 percent of ACAAR's total revenue over that period.

The aquaculture training outputs are not used by industry...

Few, if any of the on average 114 student graduating from Western Australian TAFE colleges with aquaculture qualifications go on to work in the Western Australian aquaculture industry. This is partly because the industry is a relatively small employer overall and partly because operators do not value the skill set that is delivered, preferring to employ a mix of marine science oriented higher education qualified persons in management, supervisory and technical roles, and mainstream trade qualified persons in other roles, with many of the skills that are unique to the industry learned on the job.

Despite delivering workforce skills that are not generally required or valued by industry, a number of secondary arguments can be made for operating aquaculture training programs, including:

- North Regional TAFE, Central Regional TAFE and Southern Regional TAFE represent the 'peak' education institutions in their respective regions and are perceived as such by the local community. Regional TAFE colleges are cognisant of the need to reasonably meet the expectations of the communities in which they operate, and aquaculture programs and services have anecdotally proven to be effective tools for engaging with the wider community;



- Anecdotally, lower level aquaculture training programs have proven effective at re-engaging disengaged high school students (particularly via the VET in Schools Program) in the training and education system, as well as engaging student interest more broadly in science and technology; and
- A significant portion of the aquaculture training infrastructure located in the regional TAFEs (that accounts for the majority of the approximate A\$28 million investment that has been made by the TAFE system) is also used by a wide range of other courses. In most cases, this alternative usage is the result of underutilisation of the assets by aquaculture programs, rather than those assets being necessary or specifically suited to these other programs.

However, these are secondary arguments on which it is difficult to justify ongoing significant subsidisation.

But industry is a substantial user of the applied research, advisory and fish stock supply services that are provided by the TAFE system, particularly ACAAR...

Most of the contemporary aquaculture projects that hold promise for a future Western Australian aquaculture industry are dependent to varying degrees on the applied research, advisory and fish stock supply service that are provided by the TAFE system. As is the practice of restocking for conservation or recreational fishing sustainability purposes. ACAAR is by far the main provider of these services across the state, with the regional TAFE colleges playing a relatively minor role.

However, ACAAR is unsustainable under its current funding structure and the loss of ACAAR would substantially undermine the prospects of aquaculture in Western Australia...

ACAAR is an anomaly within the TAFE college aquaculture landscape in that it does not directly deliver VET training programs, but rather focuses on a role in undertaking applied research, advisory services and stock supply services for the purpose of supporting the development of a Western Australian aquaculture industry and is subsidised by the TAFE system for this purpose.

The question as to whether ACAAR should be managed and funded within the structure of an institution that operates under the *Vocational Education and Training Act (WA) 1996* has always been a point of some contention, principally within the VET sector. Changes to the *Vocational Education and Training Act (WA) 1996* that came into effect in July 2015 now present a very clear case that the TAFE system cannot continue funding the ACAAR facility.

Furthermore, issues associated with tenure on the current site and aging facilities means that ACAAR will require significant future capital investment if it is to continue to perform an industry support role. The loss of access to ACAAR's capabilities and infrastructure would critically jeopardise some aquaculture projects, place others at risk and substantially reduce the State's capability with respect to funding.

Western Australian Department of Fisheries also delivers important services to the industry...

Research relevant to aquaculture in Western Australia is undertaken across the Department of Fisheries Research Division, but is mainly the focus of the Biodiversity and Biosecurity Branch, which includes research teams dedicated to aquaculture, fish health and biosecurity. The Department's longer-term investments in fish health and disease diagnostic capability, while not undertaken exclusively for the purpose of the aquaculture industry, are critically important to the industry, as managing fish health is a key aspect of operational risk. More specific



aquaculture focused research undertaken by the Department of Fisheries tends to be undertaken on an opportunistic basis, whereby the Department responds to external funding opportunities however they may be initiated. While there is an internal policy in place to endeavour to align such research with the general direction of the Western Australian aquaculture industry, the degree to which this has been achieved is the subject of some contention.

The main aquaculture research facility operated by the Department of Fisheries is its Hillary's Research Facility, a 400 square meter workspace that includes tank arrays, laboratories and is supported by a seawater intake system. There are currently three full-time scientific and six full time technicians involved in mollusc (abalone and scallop) aquaculture and restocking research at the Department of Fisheries. The operating budget for aquaculture and aquaculture related research activities at the Department of Fisheries is estimated to be approximately A\$1.5 million per annum, excluding externally funded projects.

The Department of Fisheries also operates the Pemberton Freshwater Research Centre. This is a relatively substantive facility whose primary purpose is to produce trout to be introduced to south west waterways in order to support the activities of the recreational fishing sector. However, in more recent times it has also expanded its activities into the area of native fish production and research designed to manage regional biodiversity.

In light of the challenges being face by the Western Australian blue mussel industry, opportunities that are presented in the case of oysters and restocking, industry and the Department of Fisheries have prepared a business case for the establishment of a primarily state funded multi-species mollusc hatchery. This will be based at a Department of Fisheries property, on the southern coast near the town of Albany.

The Department is also the lead agency with respect to the development and implementation of policy pertaining to the aquaculture industry, a major focus of which is the establishment of marine aquaculture zones at various locations along the Western Australian coastline.

The Western Australian University Sector is a small player...

Generally speaking, the Western Australian university sector undertakes limited research and education in aquaculture. Most certainly, the University of Western Australia and Murdoch University undertake some research, and from time-to-time have PhD students researching aquaculture and aquaculture related matters. This relatively ad-hoc and small scale activity is usually supported in collaboration with ACAAR and to a lesser extent, BCMI and/or BAC.

The Western Australian university that is most active in aquaculture education and research is Curtin University of Technology ('Curtin'). There are currently 26 post graduate students undertaking a Master of Science (Aquaculture), Master of Philosophy (Aquaculture) or PhD studies in an aquaculture related field. The vast majority, approximately 85 percent, of these students are international students. Aquaculture is only taught at an undergraduate level through a single unit that is part of a coast science qualification. Aquaculture activities at Curtin are supported by the Curtin Aquatic Research Laboratory Facility.



The new key Western Australian aquaculture projects are species and geographically diverse and are dependent on the non-training services of the TAFE sector, particularly those delivered by ACAAR...

Marine Produce Australia – Cone Bay Ocean Barramundi®

Marine Produce Australia Limited ('MPA') is an unlisted public company that owns and operates a sea cage grow-out operation for barramundi in at a location in the Buccaneer Archipelago, approximately 80 kilometres from the town of Derby in the Kimberley Region of Western Australia. MPA has been operating at this site since 2005, when it was initially granted a permit to trial the grow-out of Barramundi. Current production of approximately 1,200 tonnes per annum is based on a 10-tank seawater flow-through nursery located on Turtle Island, and 23 sea cages (currently expanding to 29) in an anchorage grid system for grow-out. The vast majority of production from the Cone Bay operation is sold to seafood distributors in major Australian capital cities, with those distributors supplying a range of retail and restaurant outlets. MPA is currently applying for an additional 800 hectares within the Kimberley Aquaculture Development Zone and an immediate increase in its production limit by 8,000 tonnes.

MPA has ongoing commercial fingerling supply relationship with ACAAR, uses North Regional TAFE for ad hoc training purposes, and was the catalyst and main advocate for the Kimberley Aquaculture Development Zone.

Indian Ocean Fresh Australia – Mid West Development Commission Yellowtail Kingfish Project

Since 2008, a number of marine finfish sea-cage trials have been conducted in Champion Bay, adjacent to the Port of Geraldton. The purpose of these trials is to demonstrate the technical and commercial viability of species and production systems suitable to the Mid West Region at small scale, with a view to developing a large scale marine finfish industry centred on an existing lease in the Abrolhos Islands (approximately 80 kilometres off the coast of Geraldton), as well as a planned Mid West Aquaculture Development Zone, that will also be located at the Abrolhos Islands.

The principal proponent of these trials has been a private company Indian Ocean Fresh Australia, with financial support provided by the Mid West Development Commission and technical support provided by ACAAR, BCMI, Marine Produce Australia, Marine Finfish Farmers Association, Western Australian Department of Fisheries, Australian Seafood CRC and the Fisheries Research Development Corporation.

The focus on yellowtail kingfish as the main species is driven by the fact that the temperature profile of the Mid West ocean and coastal environment is consistent with achieving optimal growth rates for the species. Results from two consecutive trials have been encouraging in terms of demonstrating competitive commercial production metrics, and have delivered new knowledge pertaining to fish health, nutrition and husbandry practices in a Mid West production environment. It is likely that considerable investment in larger scale commercial trials at the designated production site will be required as the first step toward a clear industry expansion pathway.

888 Abalone

888 Abalone is a private Western Australian company that acquired the adjacent onshore greenlip abalone production facilities of the combined former WA Abalone Farms and Bayside Abalone out of receivership in 2010. 888 Abalone have made a considerable investment in



systems and operational improvements at the facilities and are currently producing approximately 35 tonnes of greenlip abalone per annum, expanding to an estimated 95 tonnes in 2017. The hatchery at 888 Abalone produces approximately 3 million juveniles per annum, 1 million of which are provided to Ocean Grown Abalone under a joint venture agreement between the companies.

Ocean Grown Abalone

Ocean Grown Abalone has developed the world's first commercial abalone ranching business at Flinder's Bay on the south west coast of Western Australia. It is expected that harvest volumes in 2016 will be approximately 12 tonnes, increasing to 60 tonnes in 2017 and then 100 tonnes in 2018, ultimately scalable to approximately 120 tonnes, and if additional sites are developed along the Western Australian coast, substantially higher production levels.

Blue Lagoon Mussels

Native blue mussels have been grown commercially in Cockburn Sound, immediately south of Fremantle, for approximately the last two decades, with several farming operations historically existing in Fremantle Port Authority waters. Blue Lagoon Mussels has been the largest operator in Cockburn Sound for a number of years, and recently acquired the only remaining competition in the Cockburn Sound blue mussel sector. Blue Lagoon Mussels is now examining opportunities to mitigate the risk associate with Cockburn Sound and achieve scale by developing production capacity at suitable locations in and around Albany.

Aquaculture has a symbiotic relationship with restocking with respect to the non-training services provided by the TAFE system, particularly ACAAR ...

Restocking has been a practice that has been undertaken in Western Australia for over a century. While this has focused principally on the stocking of freshwater systems in the south of the State with invasive trout species, the restocking of native species either for conservation purposes or to support recreational fishing is a practice that is receiving increasing support from a range of stakeholders. All contemporary recreational restocking programs and restocking research is funded from the Recreational Fishing Initiatives Fund, which is financed from recreational angler license fees and managed by Recfishwest.

The significant applied research and restocking projects that Recfishwest supports and funds at ACAAR, BAC and BCMI is a significant source of revenue, particularly for ACAAR and the BAC. This revenue contributes substantially to the ability of the TAFE system to continue to operate aquaculture infrastructure.

State Government support for aquaculture infrastructure is commonplace in Australia...

State Government investment in infrastructure, particularly hatchery infrastructure and establishing marine tenure for aquaculture projects, is commonplace in Australian state jurisdictions, albeit it occurs under different industry development circumstances and to varying degrees. This investment by government is generally seen as essential to establishing an aquaculture industry, as arguably the most significant economic obstacles to investment in marine aquaculture is the risk and cost associated with securing suitable and adequate project site tenure, and establishing and operating hatchery facilities.



Recommendations

Subsidised delivery of aquaculture training package courses at Western Australian TAFE colleges should not continue...

The TAFE system has produced 570 graduates with TAFE qualifications specifically in aquaculture since 2011. Few if any of these graduates have found employment in the Western Australian aquaculture industry. Indeed, it would appear that Western Australian aquaculture projects place much higher value on mainstream trade qualifications and task specific operating qualifications such as coxswain and diving qualifications that are delivered by TAFE colleges.

The State likely will need to continue to subsidise applied aquaculture research, advisory and fish stock supply services in order for the Western Australian aquaculture industry to grow and restocking to continue...

For the nascent Western Australian aquaculture industry to have a reasonable possibility of developing into an industry of scale, it is highly probable that the State will need to continue to subsidise this activity at least to the extent of current levels, as well as make additional capital investments over the course of the next decade. Ongoing Western Australian government support should be considered according to the three levels of priority that are summarised in the following table.

| Priority Level | | Recommendation |
|----------------|-------|---|
| Priority 1 | (i) | Revitalisation and maintenance of the capabilities and infrastructure that support the applied research, advisory and fish stock supply services currently delivered by the Australian Centre for Applied Aquaculture Research (ACAAR), as a new centralised facility servicing aquaculture industry and restocking needs across the State; |
| | (ii) | Appropriate resourcing of the Department of Fisheries Fish Health Unit such that it is optimally responsive to the diagnostic and fish health monitoring needs of the aquaculture industry; and |
| | (iii) | For so long as it is supported by industry, establishment of a multi-species mollusc hatchery to support growth in the oyster and mussel sectors of the Western Australian aquaculture industry. |
| Priority 2 | (i) | Maintenance of small-scale nursery and hatchery facilities at the Batavia Coast Maritime Institute and Broome Aquaculture Centre to optimise broodstock management and efficiency of fish stock supply logistics for regional aquaculture operations and restocking programs. These operations would be overseen by the centralised hatchery service discussed in Priority 1. |
| Priority 3 | (i) | Ensure cost effective and predictable access to specialist training through the TAFE system such as coxswain and diving qualifications through the TAFE system. |

State subsidised applied aquaculture research, advisory and fish stock supply services should be delivered under a new funding and governance structure...

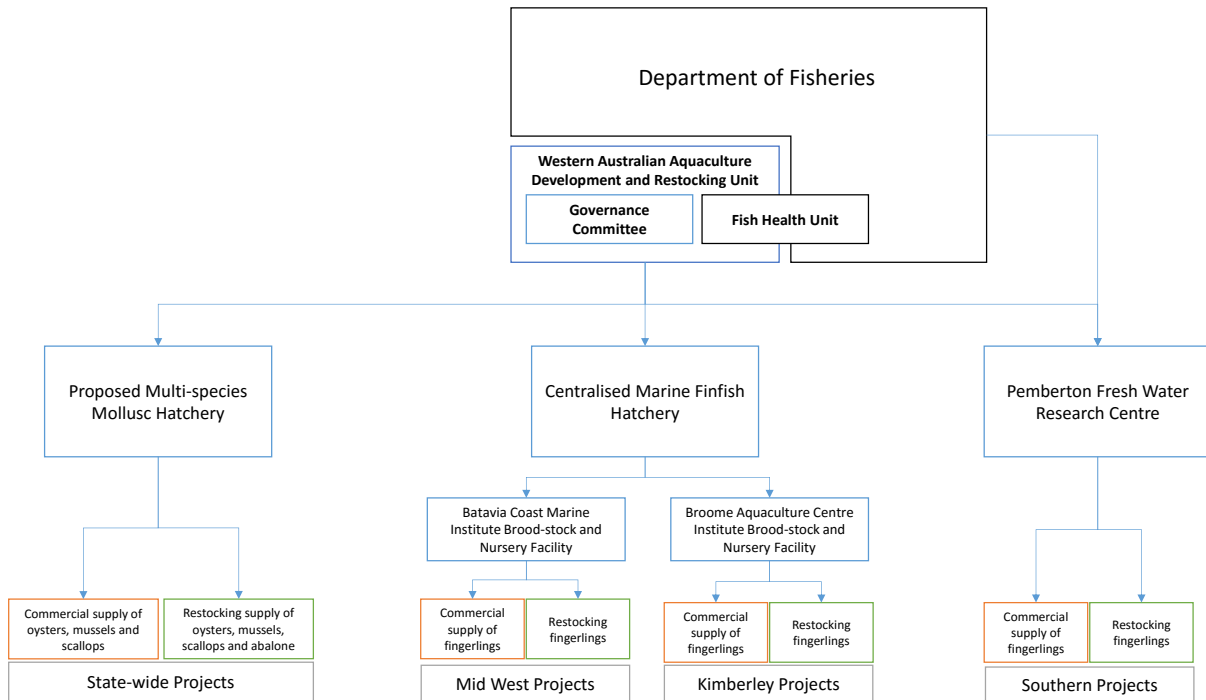
It is recommended the recommendations discussed above be implemented through a new structure to be known as the Western Australian Aquaculture Development and Restocking Unit (WAADRU).

A critical success factor pertaining to the recommendation is that the centralised hatchery capability described in Priority 1 and the infrastructure it manages, is able to maintain the responsiveness to industry that has been characteristic of ACAAR. Because it is highly probable that the State will be the only investor in the required capital, and be required to



provide significant subsidies for a protracted period, the WAADRU will likely require significant accountability to an agency of the government. This should no longer be the Department of Training and Workforce Development, but rather the lead government agency for aquaculture, the Department of Fisheries.

The proposed structure illustrated in the figure below is designed to give the State comfort with respect to accountability and maintained purpose of its investment, while optimising the likelihood that the WAADRU maintains an adequate degree of the industry responsiveness and orientation that is characteristic of ACAAR, and which is highly valued by industry and the restocking sector.



Under the proposed structure, WAADRU would be established as an oversight and activity coordinating body, the operations for which it oversees are resourced from their own revenues and subsidised by a four year recurring grant from consolidated revenue, managed by the Department of Fisheries on the advice of the WAADRU governing council. Capital works associated with the operations it oversees will be funded by one-off grants from Royalties for Regions and/or consolidated revenue.

In order to progress these recommendations, the project principals should ensure that government, the aquaculture industry and the recreational fishing sector have been adequately consulted, undertake further feasibility and costing studies to test the economic viability of the proposal and prepare a fundable business case.



1. Background and Purpose

This section provides background and context to the study by providing an overview of the history, status and prospects of the Western Australian aquaculture industry, the government infrastructure that supports it and the purpose of this study.

1.1. The Western Australian Aquaculture Industry

1.1.1. Aquaculture is a significant contributor the value of seafood production in Australia...

In 2013-14, the Australian aquaculture industry produced approximately 75,000 tonnes of product with a gross value of approximately A\$995 million. This compares to an Australian wild-catch industry that, in the same year, produced approximately 110,000 tonnes of product with a gross value of approximately A\$1.65 billion. Figure 1¹ below illustrates the recent trend in the gross value of the Australian aquaculture and wild-catch sectors.

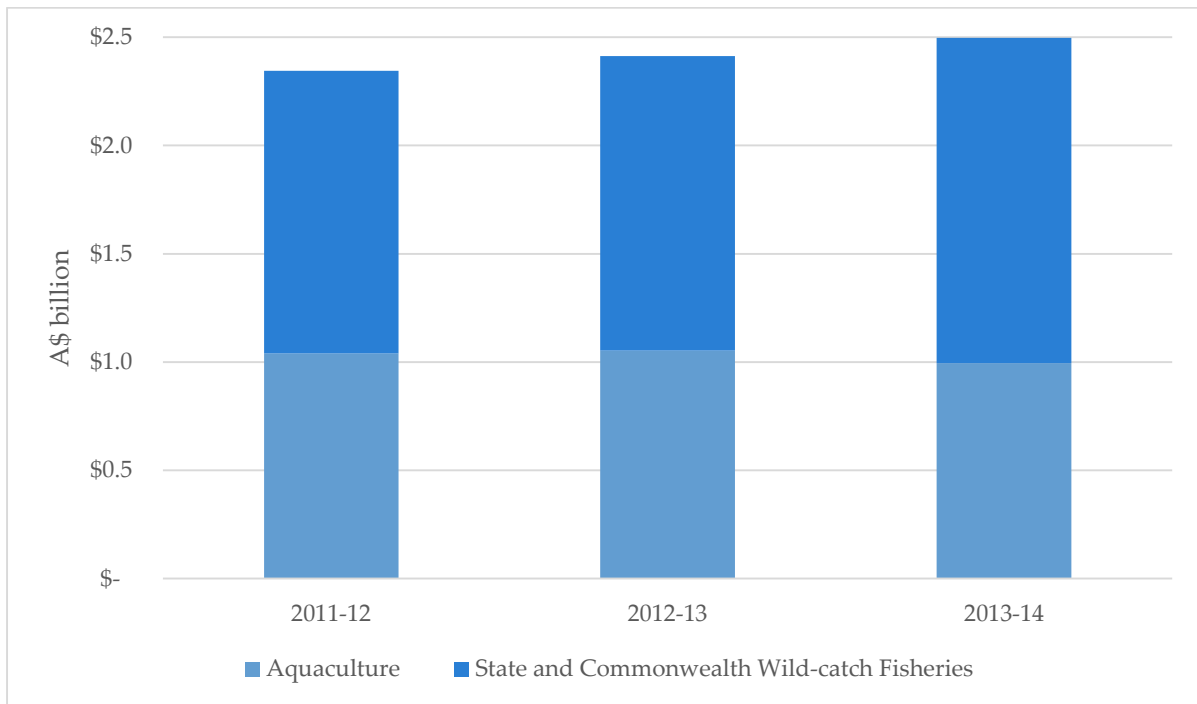


FIGURE 1 – RECENT TREND IN THE VALUE OF AUSTRALIAN AQUACULTURE AND WILD CAPTURE FISHERIES

¹ Australian Bureau of Agricultural and Resource Economics and Sciences (2015), *Australian Fisheries and Aquaculture Statistics 2014*, Department of Agriculture and Water Resources, Australian Government, Canberra



1.1.2. The Value of Australian aquaculture production is dominated by two jurisdictions and a few species...

The vast majority, approximately 75 percent, of the value of aquaculture production in Australia is produced in the states of Tasmania and South Australia. This is illustrated in Figure 2² below.

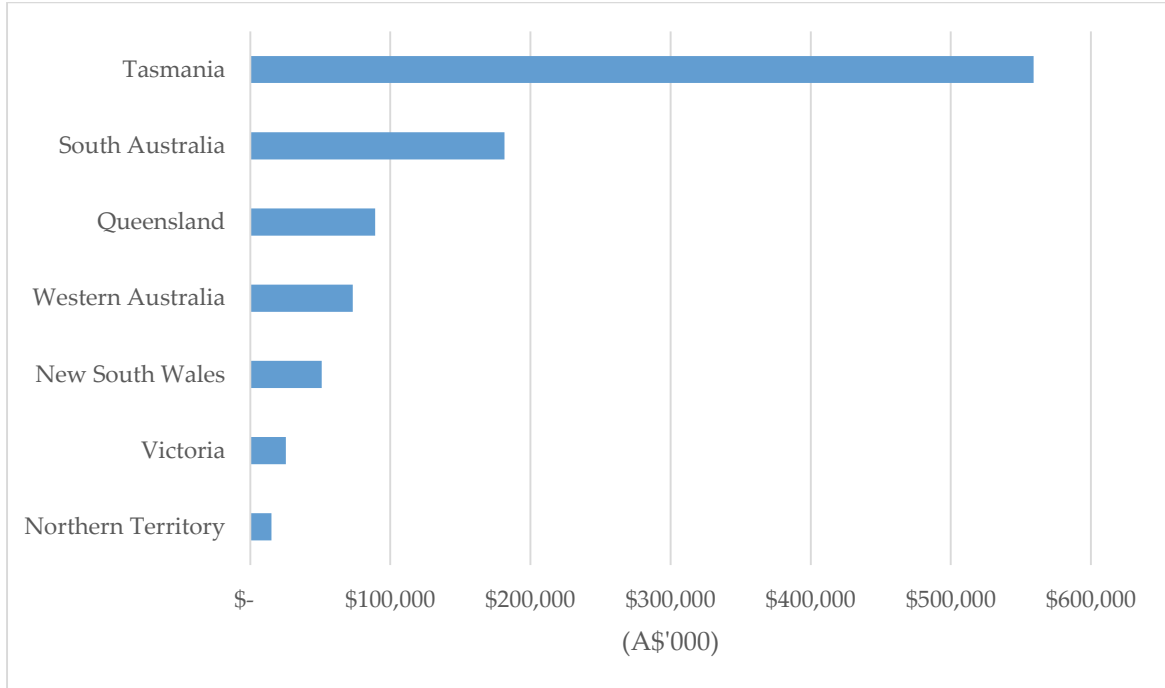


FIGURE 2 – STATE CONTRIBUTIONS TO THE VALUE OF AUSTRALIAN AQUACULTURE PRODUCTION

The largest aquaculture sector in Australia is the Tasmanian salmon industry which accounts for approximately 95 percent of the value of aquaculture production from Tasmania and over half of the total value of Australian aquaculture production. The second largest sector of the Australian aquaculture industry is the South Australian Bluefin tuna sector, which accounts for approximately 70 percent of the value of aquaculture production from South Australia and 12 percent of the value of national aquaculture production. Oysters are the third largest sector with production from New South Wales, Queensland, South Australia and Tasmania accounting for approximately 9 percent of the value of national aquaculture production.

Prawns (which are produced in New South Wales, but primarily Queensland) and pearls (which are produced exclusively in Western Australia) each account for approximately 6 percent of national aquaculture production. Barramundi (which is produced in New South Wales, Victoria, Queensland and Western Australia) accounts for 3.6 percent of national aquaculture production, and Abalone (which is produced in Victoria, South Australia, Tasmania and very recently Western Australia) 2.7 percent. A range of other species collectively account for the remaining 5 percent of the value of aquaculture produced in Australia. The relative

² Australian Bureau of Agricultural and Resource Economics and Sciences (2015), *Australian Fisheries and Aquaculture Statistics 2014*, Department of Agriculture and Water Resources, Australian Government, Canberra



contributions that different sectors make to the value of Australian aquaculture production is illustrated in Figure 3³ below.

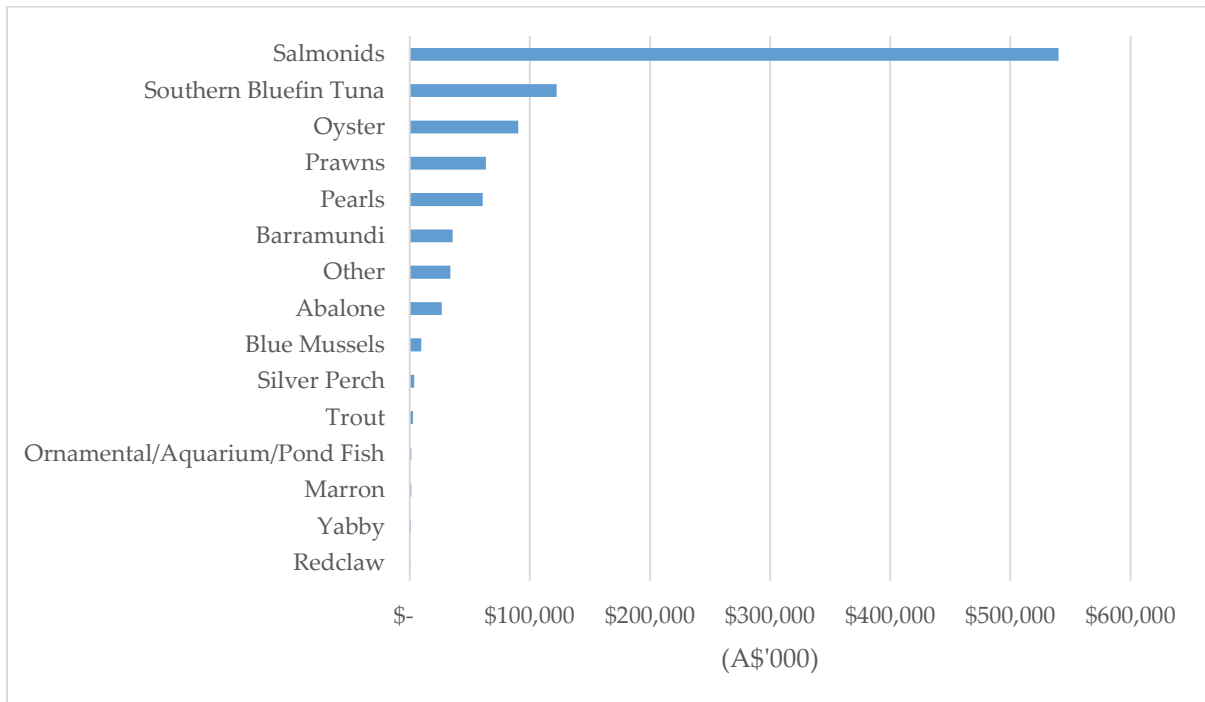


FIGURE 3 – SECTOR CONTRIBUTIONS TO THE AUSTRALIAN AQUACULTURE INDUSTRY

Appendix 1 details the size of the key sectors of the Australian aquaculture industry in each state and territory.

1.1.3. Aquaculture in Western Australia is a national anomaly...

As illustrated in Figure 1 above, approximately 46 percent of the value of national fishery and aquaculture production, is derived from aquaculture. However, as illustrated in Figure 4⁴ below, the ratio of value derived from aquaculture and wild-capture production at a state/territory level is varied.

³ Australian Bureau of Agricultural and Resource Economics and Sciences (2015), *Australian Fisheries and Aquaculture Statistics 2014*, Department of Agriculture and Water Resources, Australian Government, Canberra

⁴ Australian Bureau of Agricultural and Resource Economics and Sciences (2015), *Australian Fisheries and Aquaculture Statistics 2014*, Department of Agriculture and Water Resources, Australian Government, Canberra

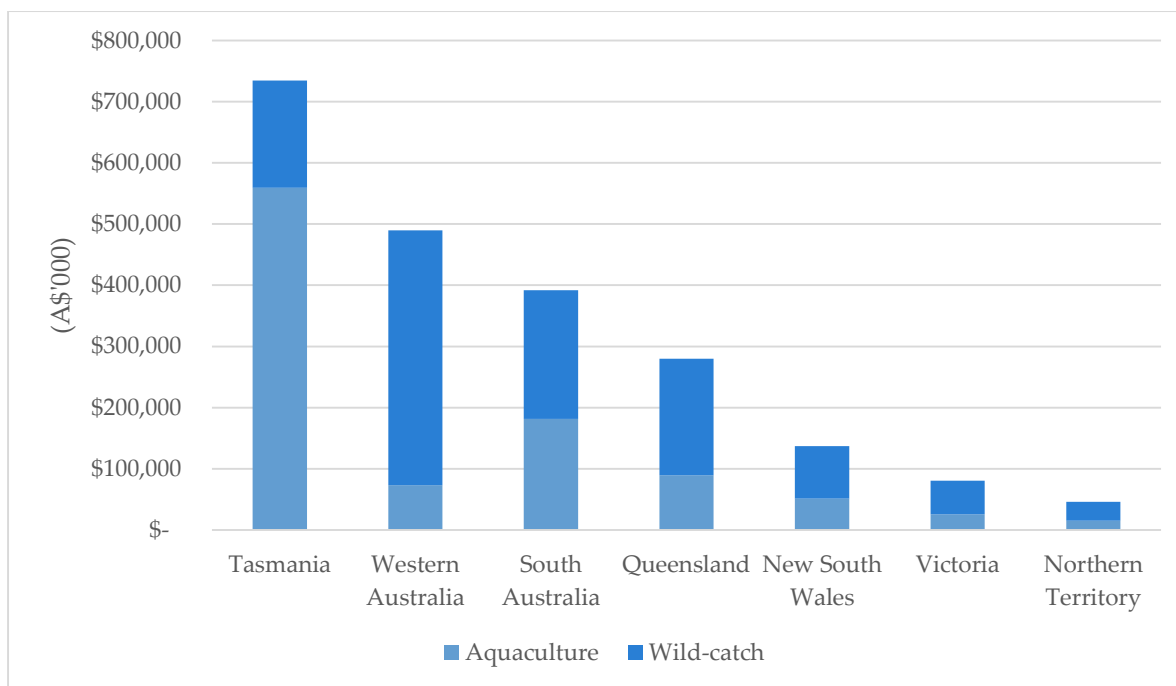


FIGURE 4 – RATIO OF AQUACULTURE TO WILD CAPTURE PRODUCTION BY STATE/TERRITORY – 2013-14

Tasmania and Western Australia host the Nation’s largest wild catch - aquaculture industries. However, whereas aquaculture accounts for 76 percent of the value of the Tasmanian industry, it accounts for only 15 percent of the value of the Western Australian industry. For all other state and territory industries, aquaculture accounts for between approximately 30 and 50 percent of the value of the total industry.

While it can be reasonably argued that a major driver of the ratio of wild-capture to aquaculture production in Western Australia is the significant value of the state’s western rock lobster wild-catch sector, Western Australia is most certainly an anomaly with respect to the small contribution that aquaculture makes to the total value of wild catch and aquaculture production in the State.

If the analysis focuses exclusively on seafood production, and thereby excludes pearling aquaculture, the ratio for Western Australia is considerably more skewed toward the wild-catch sector, with aquaculture contributing approximately 3 percent to the value of seafood produced by the Western Australian fishing and aquaculture industry. It also renders the Western Australian seafood aquaculture industry the smallest in the nation, accounting for only 1.3 percent of total national aquaculture seafood production.

Given that approximately 65 percent of the value of the Western Australian wild-catch sector is attributable to a single species, the western rock lobster, the very low level of aquaculture seafood production in Western Australia contributes to the industry being highly exposed to the potential collapse of single species fishery.

1.1.4. Aquaculture in Western Australia has had a troubled history...

Western Australia has struggled to establish a seafood aquaculture industry. Figure 5 below illustrates the historical value of seafood aquaculture production in Western Australia, which peaked at approximately A\$17.0 million in 2012-13 and has averaged A\$12.5 million over the past eight years.

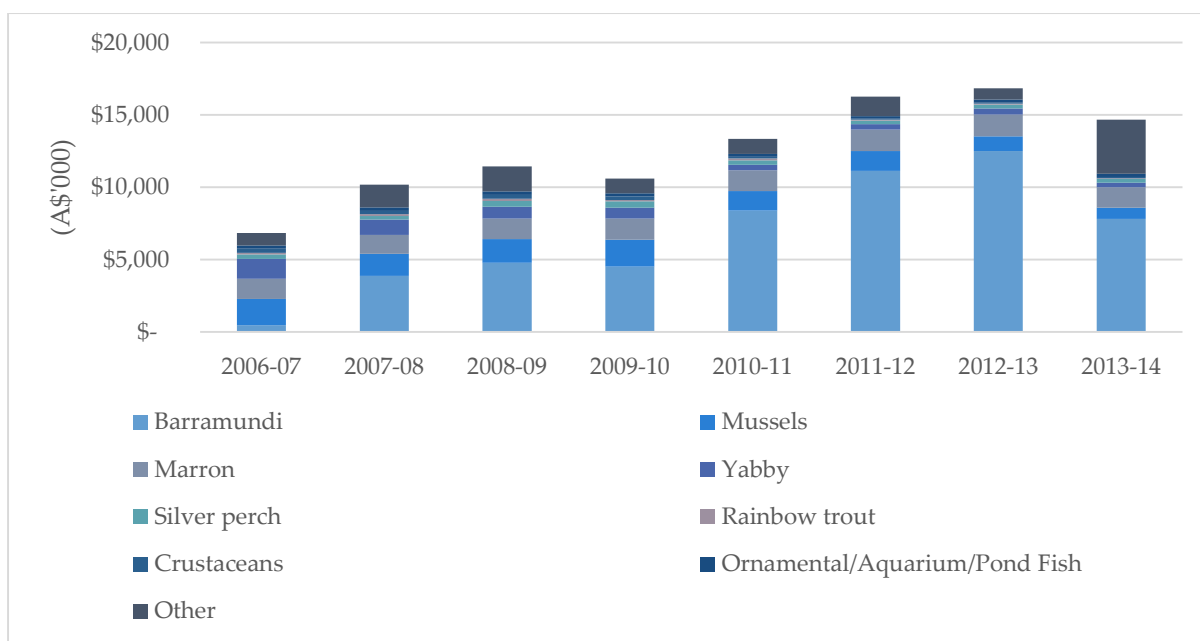


FIGURE 5 – WESTERN AUSTRALIAN SEAFOOD AQUACULTURE PRODUCTION – VALUE (2006-07 TO 2013-14)

As demonstrated by the production data contained in Table 1 below, the growth in the value of production evident in Figure 5 has been driven almost entirely by barramundi production, which has been associated with a single operation (see Section 5.1).

| | Unit | 2006-07 | 2007-08 | 2008-09 | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 |
|----------------------------------|--------|---------|---------|---------|---------|---------|---------|---------|---------|
| Barramundi | Tonnes | 43 | 366 | 455 | 433 | 863 | 1,127 | 1,190 | 699 |
| Mussels | Tonnes | 622 | 481 | 434 | 507 | 365 | 350 | 243 | 188 |
| Marron | Tonnes | 58 | 51 | 53 | 54 | 51 | 51 | 52 | 47 |
| Yabby | Tonnes | 88 | 61 | 44 | 47 | 20 | 19 | 19 | 15 |
| Silver perch | Tonnes | 88 | 17 | 29 | 27 | 18 | 13 | 13 | 14 |
| Rainbow trout | Tonnes | 12 | 13 | 12 | 8 | 11 | 4 | 4 | 3 |
| Other | Tonnes | 95 | 97 | 95 | 94 | 75 | 97 | 44 | 48 |
| Crustaceans | No. | 61,492 | 55,047 | 50,598 | 46,425 | 21,167 | 26,538 | 22,796 | 20,124 |
| Ornamental, Aquarium & Pond Fish | No. | 65,960 | 69,538 | 70,469 | 60,572 | 51,392 | 49,990 | 63,185 | 77,917 |

TABLE 1 – WESTERN AUSTRALIAN SEAFOOD AQUACULTURE PRODUCTION – VOLUME (2006-07 TO 2013-14)

In 2013-14 there were 453 aquaculture licenses on issue in Western Australia, 218 of which (48 percent) declared production in the 2013-14 annual return. As illustrated in Table 2 below, marron account for the vast majority of the number of licenses, but on average produce the second lowest GVP per license. In almost all of the sectors, the volume and value of production is skewed toward one or two relatively large producers, with the remaining production in the sector produced across a relatively large number of very small producers and enthusiasts.



| | Number of Productive Licenses | Average Volume per License | Average Value per License (\$'000) |
|-------------------------------------|-------------------------------|----------------------------|------------------------------------|
| Barramundi (tonnes) | 5 | 139.8 | \$ 1,562.8 |
| Mussels (tonnes) | 5 | 37.6 | \$ 157.1 |
| Marron (tonnes) | 184 | 0.3 | \$ 7.6 |
| Yabby (tonnes) | 7 | 2.1 | \$ 43.4 |
| Silver perch (tonnes) | 10 | 1.4 | \$ 28.0 |
| Rainbow trout (tonnes) | 7 | 0.4 | \$ 4.5 |
| Crustaceans (No.) | 5 | 4,024.8 | \$ 18.9 |
| Ornamental/Aquarium/Pond Fish (No.) | 11 | 7,083.4 | \$ 20.4 |

TABLE 2 – WESTERN AUSTRALIAN AQUACULTURE LICENSES

While pearling remains the largest Western Australian aquaculture sector, the value of production from Western Australian pearling aquaculture has halved since 2006-07. This is illustrated in Figure 6 below.

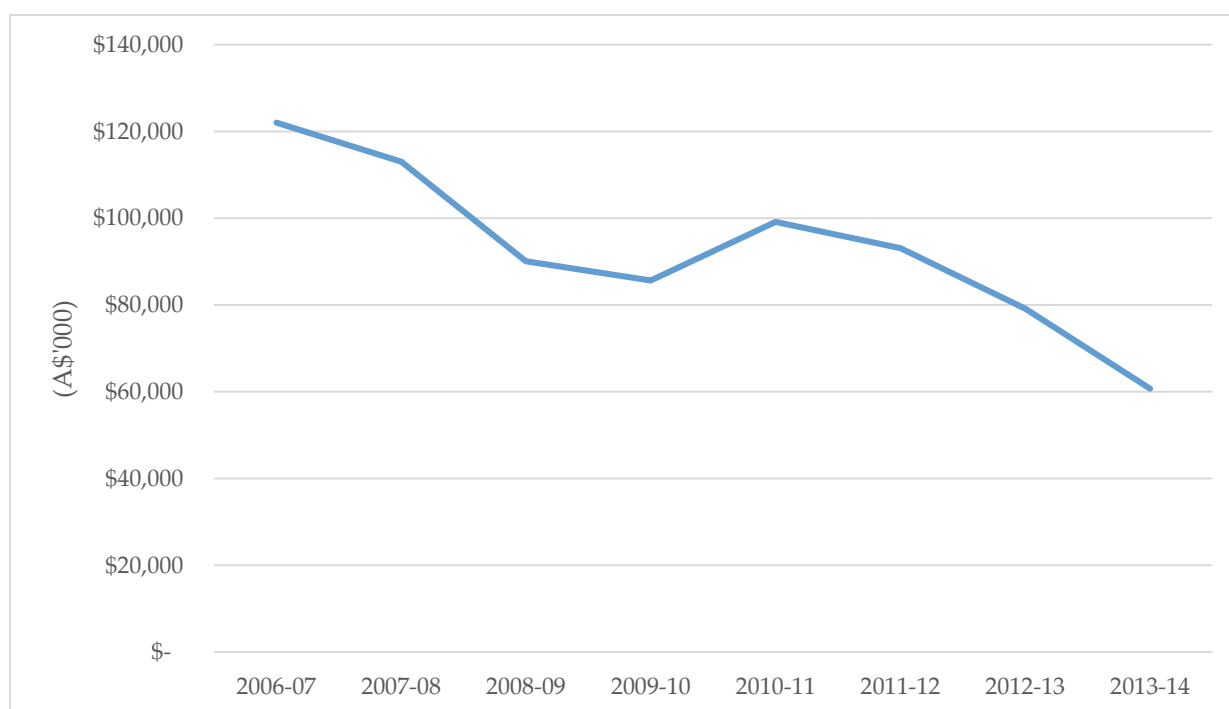


FIGURE 6 – WESTERN AUSTRALIAN PEARL AQUACULTURE – VALUE OF PRODUCTION (2006-07 TO 2013-14)

Historical attempts to establish large scale seafood aquaculture enterprise in Western Australia have resulted in some spectacular, relatively recent failures. For example:

- Two onshore Abalone operations in Bremer Bay, WA Abalone Farms and Bayside Abalone, struggled to achieve economic viability separately, and subsequently as a merged entity, and in 2009 were placed into receivership⁵;
- In 2007, Western Kingfish Limited raised approximately A\$10 million from public equity markets to develop a kingfish sea cage operation on an existing aquaculture lease off Jurien Bay. The operation suffered a catastrophic mortality event approximately six months after stocking its sea cages, and was subsequently placed into voluntary administration; and

⁵ It should be noted that the assets of the merged entity were acquired from the receiver manager by 888 Abalone and are now operational (see Section 5.3)



- There have been numerous earlier attempts to develop operations of scale in other species including prawns, marron, molluscs and various species of freshwater and marine finfish that did not progress beyond planning or very early stage trials.

The inability of the Western Australian seafood aquaculture industry to develop to the extent of those in other Australian states has been the function of a number of possible factors, including:

- **Limited suitable sites**
Despite accounting for approximately one third of the Nation's coastline, there are in fact few sites along the Western Australian coast that demonstrate coastal and oceanographic features that are suited to current large scale aquaculture technology, that have adequate installed infrastructure to render operations economic, and do not demonstrate environmental, social or other industry conflicts that are problematic with respect to establishing large scale aquaculture.
- **High capital and operating costs**
Most sites that are suitable for large scale aquaculture are in regional Western Australia and as a result face relatively high costs associated with both the construction and operation of the project. This is relative disadvantage is exacerbated with respect to projects focusing on species that can be produced in aquaculture systems in Asia, one of the world's lowest cost jurisdictions that services the same markets.
- **Investor Scepticism**
Western Australian aquaculture has a relatively recent history of over-capitalised public company operations that were heavily promoted, pursued high risk scale-up strategies and ultimately failed. This has resulted in investor cynicism toward the sector, restricting access to equity capital for new Western Australian aquaculture projects.
- **Regulatory burden**
Many aquaculture proponents have sought to develop projects on 'greenfield' sites where aquaculture (and in some case any form of development) has not formerly been undertaken, in close proximity to marine conservation reserves, and/or in areas where there is limited or no baseline environmental data. This has created environmental approvals and monitoring challenges for both the project proponents and the regulator. These challenges, combined with a sustained recent period of large-scale resources projects requiring environmental approvals, has meant that approvals processes associated with some proposed aquaculture projects have been protracted, uncertain and expensive. Unlike some states, Western Australia does not have legislation that pertains specifically and exclusively to the development and operation of aquaculture projects.
- **No clear species advantage**
The states of Australia that have the largest aquaculture industries are characterised by a single sector that dominates the value of production. In South Australia this is Southern Bluefin Tuna, in Tasmania, Atlantic salmon and in New South Wales, oysters. These sectors target large and/or high value markets, and the development of scale in these sectors has, to a degree, underwritten soft and hard industry infrastructure and capability from which the development of other sectors has benefited. Western Australia is yet to demonstrate a species in which it has a clear competitive advantage to base a large scale industry. Indeed in the case of Western Australia single projects focused on different species that are geographically distributed are individually endeavouring to achieve scale.
- **Policy framework**
While the Western Australian government has, through various mechanisms, invested in the development of an aquaculture industry, this investment has not demonstrated



the same degree of sustained focus that it has in other states, particularly in Tasmania and South Australia. However, the stated commitment to the sector from the current government is arguably unprecedented in Western Australia.

- **Small, fragmented industry**

The small size of the industry, diversity of operations and scale of operations has resulted in a fragmented industry that has in the past demonstrated episodes of dysfunctionality in prosecuting its interests, particularly through the historical structure of its peak industry body, the Aquaculture Council of Western Australia when its governance structure was dominated by small producers. The inability of the industry to adequately resource its peak industry body has also proven problematic from time-to-time.

1.1.5. The outlook for Western Australian aquaculture is more positive...

Despite the challenges that the Western Australian aquaculture industry has historically faced, there is cause for some optimism with respect to the future. This optimism is underpinned by a:

- Small number of professionally managed projects in different species that show prospect for evolving into operations of scale that could underpin a larger Western Australian aquaculture industry;
- A number of established national and international aquaculture companies have in recent times expressed some preliminary interest in exploring opportunities in Western Australia; and
- Renewed State Government interest that is underpinned by an aquaculture development policy and identification of aquaculture as an important strategic industry in almost all regions of Western Australia with coastline.

New Generation of Projects

Four projects have now been operating for several years across three different species, in locations that broadly represent the different climatic conditions along the Western Australian coast. While none of these projects are yet to demonstrate economic sustainability, they have progressed under professional management and are tracking toward this goal. These projects are discussed in detail in Section 5 and are:

- Marine Produce Australia's Cone Bay Ocean Grown Barramundi project in the Buccaneer Archipelago (West Kimberley) ;
- Indian Ocean Fresh-Mid West Development Yellowtail Kingfish project in Geraldton;
- 888 Abalone onshore greenlip abalone production project in Bremer Bay (southern coast); and
- Ocean Grown Abalone – 888 Abalone greenlip abalone ranching project in Flinder's Bay (southwest coast).

State Aquaculture Strategy

While the Western Australian Government has supported the aquaculture industry for decades through a range of initiatives such as the Aquaculture Development Council (a Ministerial Advisory Council on aquaculture related issues), financial support for the Aquaculture Council of Western Australia (see Section 6.4), the provision of fish health services to aquaculture projects (see Section 3.1), collaboration with industry in aquaculture research and direct project grants, the government's commitment to the industry has been the subject of some scepticism by many in industry.

The Western Australian Government is still to demonstrate the coordinated and sustained policy support for its aquaculture industry that is equivalent to that which has been provided



in Tasmania and South Australia. However in more recent years it has undertaken initiatives to demonstrate a higher degree of support. In 2012, the Western Australian Government issued a Fisheries Policy Statement, recognising aquaculture as a legitimate user of the State's land and aquatic resources and as a strategically important industry. This was followed in 2015 by the *Aquaculture in Western Australia: Statement of Commitment* ('Statement of Commitment').

The Statement of Commitment commits the Western Australian government to supporting the Western Australian aquaculture industry through the initiatives summarised in Table 3 below.

| Area of Commitment | Description |
|---|---|
| Support for existing aquaculture industry | <p>The Western Australian Government will work with industry to maintain access to important aquatic species and marine areas for sustainable pearling and aquaculture development and ensure maintenance and development of pearling and aquaculture industries are considered in marine planning processes, including the creation of marine reserves and developments within the resources sector.</p> |
| Aquaculture zones and infrastructure | <p>The Western Australian Government will establish aquaculture zones in areas that offer suitable competitive advantages for the establishment and operation of aquaculture activities, at both enterprise and industry levels. The establishment of aquaculture development zones significantly reduces investment risk and cost associated with aquaculture in Western Australia, through streamlining environmental approval processes.</p> <p>Having established an aquaculture zone in the Kimberley, the Government will prioritise the completion of a zone in the Mid West region to support and build on existing finfish projects in the area.</p> <p>The Government will explore opportunities and feasibility to develop further zones or aquaculture development in the southern and Gascoyne/Pilbara Regions.</p> <p>The Government will work with industry to identify opportunities for a multi-species mollusc hatchery to support growth in existing and emerging sectors such as mussels, pearl oysters, edible oysters and scallops.</p> |
| Streamlining and reducing regulation | <p>The Government will continue to improve the efficiency and transparency of regulatory processes by:</p> <ul style="list-style-type: none"> ▪ Managing environmental issues through enterprise-level Management and Environmental Monitoring Plans; ▪ Managing aquaculture zones according to an integrated management framework; ▪ Increasing regulatory efficiency by integrating the licensing, environmental management and biosecurity frameworks; and ▪ Increasing opportunities for self-regulation by the industry through recognition of Industry Codes of Practice. <p>The Government will strengthen rights of aquaculture (and pearling) license holders through:</p> <ul style="list-style-type: none"> ▪ Granting of longer-term licenses to build investor confidence and facilitate innovation; and ▪ Aligning the terms of the licence and lease for projects with licenses attached to leases. |
| Industry development and investment | <p>Facilitate in cooperation with industry:</p> <ul style="list-style-type: none"> ▪ Investment attraction through trade promotions, promotion of aquaculture zones and other development opportunities including targeted investment-oriented opportunities, presentations to visiting delegations and participation in relevant Government initiatives; ▪ Support for selected development initiatives with capacity for growth and smaller projects that demonstrate commercial reality; and |



| Area of Commitment | Description |
|-----------------------------|--|
| Fish health and biosecurity | <ul style="list-style-type: none"> ▪ Support for research activities considered a priority for the relevant industry sector or required to support government policy decisions. <p>Work with the Commonwealth to establish regulator and policy frameworks to facilitate aquaculture in Commonwealth waters.</p> <p>Support aquaculture initiatives that enhance recreational fishing opportunities including production of fish for stocking purposes and building the ability of sea cages deployed for aquaculture purposes to attract wild fish.</p> <p>Support national initiatives to facilitate industry growth as a signatory to the National Aquaculture Statement.</p> <p>Support industry implementation of credible certification schemes that assist the sustainable development of the pearling and aquaculture industry, including Marine Stewardship Council or Aquaculture Stewardship Council Certification.</p> <p>Continue to provide a strong fish health capability and the provision of effective diagnostic services to support development and growth of the Western Australian aquaculture industry. Services will include disease investigation and response to known and emerging disease issues. Opportunities to access specialist fish veterinarians and develop/maintain specialist laboratory-based fish health expertise will be pursued.</p> <p>Support investment and research into biosecurity initiatives that safeguard the Western Australian aquaculture industry and aquatic environment.</p> |

TABLE 3 – KEY ELEMENTS OF THE WESTERN AUSTRALIAN GOVERNMENT WESTERN AUSTRALIAN AQUACULTURE STATEMENT OF COMMITMENT

Aquaculture and the Regional Investment Blueprints

From a regional development policy perspective, Western Australia is comprised of nine regions – Kimberley, Pilbara, Gascoyne, Mid West, Wheatbelt, Peel, South West, Great Southern and Goldfields Esperance. Regional development policy initiatives in each of these regions is coordinated at least in part by a region specific Regional Development Commission, established and empowered pursuant to the provisions of the *Regional Development Commission Act (WA) 1993*. Since the proclamation of the *Royalties for Regions Act (WA) 2009*, the resources and influence that these development commission have with respect to developing and implementing regional development policy has increased considerably.

A major tool in directing regional development policy has been the Regional Investment Blueprint process which, among other things, sets out agreed regional development priorities for each of the Regions. Aquaculture is articulated as a development priority in eight of the nine Regional Investment Blueprints (see Section 5.6.4)

There is Still Considerable Risk

While the factors discussed above are indicative of arguably the best development environment for aquaculture in the history of the industry in the State, there remains considerable risk. The ventures discussed above are at relatively early stages of development and face scale-up risk. While they all revolve around species that are the subject of economically sustainable aquaculture sectors in other parts of the Australia and around the world, they have not been demonstrated in Western Australian conditions and in some case have not been demonstrated using the productions systems that have been deployed in



Western Australia. Operational challenges, known and unknown fish health issues, unexpected escalation of input costs, adverse future market conditions and other agribusiness risk could easily result in the demise of any of these early-stage projects.

1.2. Western Australian Government Aquaculture Infrastructure

Since the early to mid-1990s, the Western Australian Government has invested in a range of infrastructure and capabilities in aquaculture. These investments have been made both in initial expectation of an emerging industry, and subsequently to support the nascent industry. These investments are primarily assets and capabilities operated by the Department of Training and Workforce Development (through its TAFE colleges) and the Department of Fisheries. Other limited infrastructure also exists in the State's university sector.

1.2.1. Department of Training and Workforce Development

Over the past two decades predecessor organisations to South Metropolitan TAFE, Central Regional TAFE, South Regional TAFE and North Regional TAFE have invested, to varying degrees, in infrastructure that has enabled them to offer Vocational Education and Training (VET) courses in aquaculture, in some cases undertake applied research, provide advice to industry on aquaculture and provide commercial fish supply services to government, industry and the recreational fishing sector. This capability and capacity is discussed in detail in Section 2.

1.2.2. Department of Fisheries

The Department of Fisheries has maintained some research capacity pertaining to aquaculture and operates hatchery facilities for research and recreational fishing restocking purposes. It also operates a Fish Health Unit, which while not designed to exclusively service the aquaculture industry, is a critically important resource for the industry. This capability and capacity is discussed in Section 3.

1.2.3. University Sector

Each of The University of Western Australia, Curtin University, Edith Cowan University and Murdoch University all, to varying degrees, undertake research in aquaculture or aquaculture related activities. Curtin University has the greatest individual capacity in this regard and also offers post-graduate courses in aquaculture. This capability and capacity is discussed in Section 4.

1.3. Where to Now

The State Government's investment in aquaculture hatchery, training and applied research capacity primarily through the Department of Training and Workforce Development and the Department of Fisheries has been substantial over the past two decades. As a result of the slow historical progress of the industry, this has resulted in capacity and capability that is in excess of the State's needs, training sector's needs and contemporary industry's needs, as well as assets that are dilapidated and/or redundant.

However, in light of the renewed activity and interest in the sector discussed in Section 1.1.5, above there is a desire from industry and government alike, to both rationalise and optimise the State's aquaculture infrastructure so that it meets the State's requirements with respect to



training, applied research and re-stocking programs, as well as industry's needs with respect to applied research and other technical advisory requirements and fingerling supply.

This study seeks to:

- Clearly identify, describe and quantify aquaculture capability, capacity and assets that reside within the Department of Training and Workforce Development and Department of Fisheries;
- Identify the status of development and growth prospects and trajectory of the main sectors of the Western Australian aquaculture industry, as well as its needs with respect to State aquaculture capability, capacity and assets;
- Identify the aquaculture applied research and fish supply services that are required by the State for activities such as fish health and re-stocking
- Determine the subset of State aquaculture capability, capacity and assets that are redundant and/or dilapidated, that which are required by industry and/or government, and that which is required and is in need of investment; and
- Determine a suitable structure for hosting and managing that capability, capacity and assets.



2. Department of Training and Workforce Development

2.1. Introduction

Through the TAFE colleges, the Department of Training and Workforce Development has made considerable investment in aquaculture capability and infrastructure over the past two decades. This was initially made as a strategic investment, primarily to support the training needs of what at the time was expected to be a growth industry in Western Australia that had the potential to reach significant scale and species diversity, as well as being one that would have a significant regional footprint.

As discussed in Section 1.1 this has not eventuated. Today, some of the aquaculture facilities that were invested in are used to provide what is in most cases, limited training in aquaculture, to provide stock supply services to industry, hobbyists and government funded re-stocking programs, to facilitate applied research projects from industry and government clients and to support other training courses operated by the TAFE colleges.

The TAFE colleges that currently operate aquaculture facilities are:

- **Central Regional TAFE**
The former Durack Institute of Technology operated aquaculture training, applied research, advisory and fish stock supply services through its Batavia Coast Maritime Institute located in Geraldton. As of April 2016, the Durack Institute became part of Central Regional TAFE and the Batavia Coast Maritime Institute continues to operate as a business unit of Central Regional TAFE. Aquaculture related activities at Central Regional TAFE are discussed in detail in Section 2.2.
- **North Regional TAFE**
The former Kimberley Training Institute operated aquaculture training, applied research, advisory and fish stock supply services through its Broome Aquaculture Centre. In early April 2016, the entire activities of the Kimberley Training Institute and the Pilbara Institute were merged into a single TAFE college, North Regional TAFE. The Broome Aquaculture Centre continues to operate as a business unit within the new organisation. Aquaculture related activities at North Regional TAFE's Broome Aquaculture Centre are discussed in detail in Section 2.3.
- **South Metropolitan TAFE**
The former Challenger Institute operated aquaculture training courses out of its Fleet Street campus (Fremantle Port). Applied research, advisory and fish stock supply services were also provided through its Australian Centre for Applied Aquaculture Research, located at the same campus. As of April 2016, Challenger Institute became part of the South Metropolitan TAFE. Both the aquaculture training activities and the Australian Centre for Applied Aquaculture Research continue to operate under South Metropolitan TAFE. The aquaculture training activities of South Metropolitan TAFE are discussed in detail in Section 2.4 and the activities of the Australian Centre for Applied Aquaculture Research are discussed in detail in Section 2.5.
- **South Regional TAFE**
The former Great South Institute of Technology operated aquaculture training, advisory and fish stock supply services primarily out of its Albany campus. As of April 2016, the Great Southern Institute became part of the South Regional TAFE, which continues to deliver aquaculture training, advisory and fish stock supply services. The aquaculture



training, advisory and fish stock supply services provided South Regional TAFE are discussed in detail in 2.6.

The aquaculture courses delivered by these TAFE colleges comprise the following, or a subset of the following individual qualifications:

▪ **Certificate I in Aquaculture**

This qualification represents the minimum requirements for an individual commencing a career as an aquaculturist. It provides individuals with an introduction to the aquaculture environment and some basic skills needed in this area of the seafood industry. It is an appropriate level for an individual undertaking work experience, or in a probationary period in employment. It is particularly applicable to school-based studies. The qualification will have application for people working:

- On aquaculture farms or fish-out/put-and-take operations;
- In hatcheries and nurseries;
- In live post-harvest holding facilities, such as processing plants, wholesalers or transporters;
- In pet shops, public aquaria, zoos or other facilities with aquatic animals; or
- For companies providing contract specialist services for aquaculture operations.

▪ **Certificate II in Aquaculture**

This qualification represents the base entry point into this sector of the seafood industry and provides people with a range of core and underpinning skills and knowledge relevant to work as a field hand in the aquaculture sector. It is particularly applicable to school-based studies. The qualification will have application for people working:

- On aquaculture farms or fish-out/put-and-take operations;
- In hatcheries and nurseries;
- In live post-harvest holding facilities, such as processing plants, wholesalers or transporters;
- In pet shops, public aquaria, zoos or other facilities with aquatic animals; or
- For companies providing contract specialist services for aquaculture operations.

▪ **Certificate III in Aquaculture**

This qualification specifies the competencies relevant to an individual working in the aquaculture sector of the seafood industry in the capacity of a skilled worker or leading hand. The qualification will have application for people working:

- For companies providing contract specialist services for aquaculture operations;
- In hatcheries and nurseries;
- In live post-harvest holding facilities, such as processing plants, wholesalers or transporters;
- In pet shops, public aquaria, zoos or other facilities with aquatic animals; or
- On aquaculture farms or fishout/put-and-take operations.

▪ **Certificate IV in Aquaculture**

This qualification specifies the competencies relevant to people working as aquaculturists in a supervisory or leadership capacity. A person operating at this level may be expected to comply with legislative requirements, as well as implement a range of enterprise policies and procedures. They will also use their knowledge and skills to solve problems, plan for future work activities and take responsibility for others. The qualification will have application for people working:

- On aquaculture farms or fishout/put-and-take operations;
- In hatcheries and nurseries;



- In live post-harvest holding facilities, such as processing plants, wholesalers or transporters;
 - In pet shops, public aquaria, zoos or other facilities with aquatic animals;
 - For companies providing contract specialist services for aquaculture operations; or
 - For companies providing consultancy, advisory, equipment sale or other services.
- **Diploma of Aquaculture**
- This qualification represents the competencies relevant to people working in the aquaculture sector of the seafood industry at a management level. The qualification will have application for people working:
- On aquaculture farms or fish-out/put-and-take operations;
 - In hatcheries and nurseries;
 - In live post-harvest holding facilities, such as processing plants, wholesalers or transporters;
 - In pet shops, public aquaria, zoos or other facilities with aquatic animals;
 - For companies providing contract specialist services for aquaculture operations; or
 - For companies providing consultancy, advisory, equipment sales or other services.

The detailed training packages for these courses is contained in Appendix 3.

2.1.1. Aquaculture Training Activity in Western Australia

This sub-section provides a brief summary of the aquaculture training activity undertaken across South Metropolitan TAFE, Central Regional TAFE, North Regional TAFE and South Regional TAFE and their predecessor organisations since 2011.

Enrolments

Since 2011, there has been a total of 1,501 students enrolled in Certificate I, II, III, IV and Diploma in aquaculture courses or their historical equivalents (average of 300 enrolments per annum) delivered by North Regional TAFE, Central Regional TAFE, South Metropolitan TAFE or South Regional TAFE. Approximately 60 percent of those enrolments have been in Certificate II in Aquaculture courses, 50 percent of which were enrolled at Central Regional TAFE, 25 percent at North Regional TAFE, 16 percent at South Metropolitan TAFE and 9 percent of South Regional TAFE. A significant portion of Certificate II enrolments were through the VETiS Program.

The next highest portion of enrolments were in Certificate III in Aquaculture (26 percent), following by Certificate I (8 percent) and Diploma in Aquaculture (7 percent). Only 0.5 percent of enrolments were in the Certificate IV qualification. All but one of the seven students who enrolled in a Certificate IV in Aquaculture qualification enrolled in the course at South Regional TAFE. Total enrolments across the four TAFE colleges by qualification delivering aquaculture programs is detailed in Table 4 below.



| | 2011 | 2012 | 2013 | 2014 | 2015 | Total | Average | Portion |
|-----------------|------|------|------|------|------|-------|---------|---------|
| Certificate I | 67 | 3 | 9 | 45 | 0 | 124 | 25 | 8.3% |
| Certificate II | 169 | 138 | 182 | 184 | 207 | 880 | 176 | 58.6% |
| Certificate III | 63 | 47 | 59 | 92 | 127 | 388 | 78 | 25.8% |
| Certificate IV | 1 | 0 | 1 | 5 | 0 | 7 | 1 | 0.5% |
| Diploma | 29 | 24 | 20 | 10 | 19 | 102 | 20 | 6.8% |
| TOTAL | 329 | 212 | 271 | 336 | 353 | 1501 | 300.2 | |

TABLE 4 – TOTAL ENROLMENTS IN AQUACULTURE TRAINING PROGRAMS BY QUALIFICATION

Table 5 below details total enrolments in aquaculture programs by TAFE college.

| | 2011 | 2012 | 2013 | 2014 | 2015 | Total | Average | Portion |
|-------------------------|------|------|------|------|------|-------|---------|---------|
| South Metropolitan TAFE | 100 | 58 | 53 | 57 | 46 | 314 | 62.8 | 20.9% |
| Central Regional TAFE | 121 | 92 | 100 | 106 | 90 | 509 | 101.8 | 33.9% |
| South Regional TAFE | 38 | 32 | 8 | 74 | 41 | 193 | 38.6 | 12.9% |
| North Regional TAFE | 70 | 30 | 110 | 99 | 176 | 485 | 97 | 32.3% |
| TOTAL | 329 | 212 | 271 | 336 | 353 | 1501 | 300 | |

TABLE 5 –TOTAL ENROLMENTS IN AQUACULTURE PROGRAMS BY TAFE COLLEGE

Completions

Since 2011, a total of 570 Certificate I, II, III, IV or Diploma in Aquaculture qualifications or their historical equivalents (average of 114 per annum) have been issued by North Regional TAFE, Central Regional TAFE, South Metropolitan TAFE and South Regional TAFE. Approximately 42 percent of the qualifications were issued by Central Regional TAFE, 31 percent by South Metropolitan TAFE, 17 percent by North Regional TAFE and 10 percent by South Regional TAFE. Table 6 below details total qualifications awarded by the TAFE colleges delivering aquaculture training since 2011.

| | 2011 | 2012 | 2013 | 2014 | 2015 | Total | Average | Portion |
|-------------------------|------|------|------|------|------|-------|---------|---------|
| South Metropolitan TAFE | 27 | 38 | 49 | 39 | 23 | 176 | 35.2 | 30.9% |
| Central Regional TAFE | 44 | 28 | 56 | 68 | 44 | 240 | 48 | 42.1% |
| South Regional TAFE | 14 | 2 | 2 | 13 | 27 | 58 | 11.6 | 10.2% |
| North Regional TAFE | 16 | 15 | 18 | 27 | 20 | 96 | 19.2 | 16.8% |
| TOTAL | 101 | 83 | 125 | 147 | 114 | 570 | 114 | |

TABLE 6 – AQUACULTURE QUALIFICATIONS ISSUED BY TAFE COLLEGE

Table 7 below summarises the total enrolments at each TAFE college by training program and total aquaculture qualifications issued for the period 2011 to 2015.



| TAFE College | Enrolments | | | | | Total | Qualifications Issued |
|--------------------|---------------|----------------|-----------------|----------------|------------|------------|-----------------------|
| | Certificate I | Certificate II | Certificate III | Certificate IV | Diploma | | |
| South Metropolitan | 32(25.6%) | 138 (15.7%) | 100 (25.8%) | 0 (0.0%) | 44 (43.1%) | 314(20.9%) | 176 (30.9%) |
| Central Regional | 3 (2.4%) | 445 (50.6%) | 40 (10.3%) | 0 (0.0%) | 21 (20.6%) | 509(33.9%) | 240 (42.1%) |
| South Regional | 68 (54.8%) | 82 (9.3%) | 26 (6.7%) | 6 (85.7%) | 11 (10.8%) | 193(12.8%) | 58 (10.2%) |
| North Regional | 21 (16.9%) | 215 (24.4%) | 222 (57.2%) | 1 (14.3%) | 26 (25.5%) | 485(32.3%) | 96 (16.8%) |
| TOTAL | 124 | 880 | 388 | 7 | 102 | 1,501 | 570 |

TABLE 7 – SUMMARY OF TOTAL ENROLMENTS AND QUALIFICATIONS ISSUED – 2011 TO 2015

Student Curriculum Hours

Since 2011, total Student Curriculum Hours associated with the delivery of aquaculture courses at North Regional TAFE, Central Regional TAFE, South Metropolitan TAFE and South Regional TAFE has averaged approximately 62,300 hours per annum. Approximately 36 percent of these Student Curriculum Hours were associated with programs at Central Regional TAFE, 26 percent at South Metropolitan TAFE, 23 percent at North Regional TAFE and 15 percent at South Regional TAFE. Table 8 below summarises the Student Curriculum Hours associated with the delivery of aquaculture training across the four TAFE colleges.

| | 2011 | 2012 | 2013 | 2014 | 2015 | Total | Average | Portion |
|-------------------------|--------|--------|--------|--------|--------|---------|---------|---------|
| South Metropolitan TAFE | 27,854 | 14,930 | 10,816 | 12,094 | 15,615 | 81,309 | 16,262 | 26.1% |
| Central Regional TAFE | 35,815 | 21,607 | 27,810 | 16,836 | 11,514 | 113,582 | 22,716 | 36.5% |
| South Regional TAFE | 12,735 | 6,645 | 3,185 | 13,275 | 10,000 | 45,840 | 9,168 | 14.7% |
| North Regional TAFE | 17,140 | 8,600 | 11,052 | 15,974 | 17,935 | 70,701 | 14,140 | 22.7% |
| TOTAL | 93,544 | 51,782 | 52,863 | 58,179 | 55,064 | 311,432 | 62,286 | |

TABLE 8 – TOTAL STUDENT CURRICULUM HOURS ASSOCIATED WITH THE DELIVERY OF AQUACULTURE TRAINING PROGRAMS

Staffing

The aquaculture programs across North Regional TAFE, Central Regional TAFE, South Metropolitan TAFE, South Regional TAFE and the Australian Centre for Applied Aquaculture Research are delivered by a teaching staff estimated to total approximately 5.3 FTEs, academic and technical support staff estimated to total 9.08 FTEs and administrative support staff totalling 0.44 FTEs, representing a total of 14.82 FTEs.

Revenue

Total revenue related to training at North Regional TAFE, Central Regional TAFE, South Metropolitan TAFE and South Regional TAFE has averaged approximately A\$700,000 per annum across the four institutions since 2011, and has declined at a CAGR of 8.2 percent. Total other revenue from these institutions averaged A\$253,000 for the period and was relatively consistent over the period. Revenue associated with applied research, advisory and fish stock



supply activities at the Australian Centre for Applied Research averaged A\$1.1 million over the period and grew at a CAGR of 8.0 percent, albeit a State Government grant has accounted for an average of 52 percent of this income over the period.

Table 9 below details revenue associated with the delivery of aquaculture training, applied research, advisory services and fish stock supply services across the four TAFE Colleges.

| | 2011 | 2012 | 2013 | 2014 | 2015 | Total | Average |
|--|---------------------|--------------------|--------------------|--------------------|--------------------|----------------------|--------------------|
| Direct Training Revenue | \$ 909,917 | \$ 610,259 | \$ 656,715 | \$ 675,264 | \$ 647,508 | \$ 3,499,663 | \$ 699,933 |
| Other Revenue Sourced by Training Programs | \$ 277,737 | \$ 263,732 | \$ 222,442 | \$ 229,050 | \$ 272,358 | \$ 1,265,319 | \$ 253,064 |
| ACAAR Revenue ⁶ | \$ 934,886 | \$1,022,265 | \$1,164,328 | \$1,271,774 | \$1,270,159 | \$ 5,663,412 | \$1,132,682 |
| TOTAL REVENUE | \$ 2,122,540 | \$1,896,256 | \$2,043,485 | \$2,176,088 | \$2,190,025 | \$ 10,428,394 | \$2,085,679 |

TABLE 9 – TAFE COLLEGE AQUACULTURE FACILITIES TOTAL REVENUE

Costs

Table 10 below summarises the direct costs associated with delivering the aquaculture training, applied research, advisory services and fish stock supply services across the four TAFE's. This table does not include any indirect costs such as access to TAFE college corporate services or lease value of premises used by the activities.

| | 2011 | 2012 | 2013 | 2014 | 2015 | Total | Average |
|-------------------------|---------------------|--------------------|--------------------|--------------------|--------------------|----------------------|--------------------|
| South Metropolitan TAFE | \$ 170,694 | \$ 168,787 | \$ 171,461 | \$ 179,204 | \$ 186,854 | \$ 877,000 | \$ 175,400 |
| Central Regional TAFE | \$ 333,935 | \$ 329,727 | \$ 402,584 | \$ 114,925 | \$ 150,871 | \$ 1,332,041 | \$ 266,408 |
| South Regional TAFE | \$ 67,800 | \$ 67,800 | \$ 67,800 | \$ 67,800 | \$ 67,800 | \$ 339,000 | \$ 67,800 |
| North Regional TAFE | \$ 733,850 | \$ 806,776 | \$ 889,277 | \$ 975,224 | \$ 887,363 | \$ 4,292,490 | \$ 858,498 |
| ACAAR | \$ 957,269 | \$1,018,838 | \$1,081,807 | \$1,043,910 | \$1,319,517 | \$ 5,421,341 | \$1,084,268 |
| TOTAL | \$ 2,263,548 | \$2,391,928 | \$2,612,929 | \$2,381,063 | \$2,612,405 | \$ 12,261,872 | \$2,452,374 |

TABLE 10 – TAFE COLLEGE AQUACULTURE FACILITIES TOTAL DIRECT COSTS

Operational Subsidisation

Based on the operating deficits of the programs at North Regional TAFE, Central Regional TAFE, South Metropolitan TAFE and South Regional TAFE, as well as the annual grant provided to the Australian Centre for Applied Aquaculture Research, the State Government has provided a direct subsidy averaging approximately \$990,000 per annum to TAFE operated aquaculture programs in Western Australia since 2011. Operational subsidisation is summarised in Table 11 below.

⁶ Includes annual ACAAR Western Australian Government Grants, which on average accounts for approximately 50 percent of ACAAR's total revenue (see Table 11).



| | 2011 | 2012 | 2013 | 2014 | 2015 | Total | Average |
|---|-------------|-------------|--------------|--------------|--------------|---------------|-------------|
| Surplus/Deficit South Metropolitan TAFE | \$ 96,046 | -\$ 1,807 | -\$ 55,186 | -\$ 59,896 | -\$ 11,625 | -\$ 32,468 | -\$ 6,494 |
| Surplus/Deficit Central Regional TAFE | \$ 51,507 | \$ 39,037 | -\$ 26,022 | \$ 125,494 | -\$ 35,366 | \$ 154,650 | \$ 30,930 |
| Surplus/Deficit South Regional TAFE | -\$ 57,200 | -\$ 52,223 | -\$ 60,252 | -\$ 48,205 | -\$ 46,150 | -\$ 264,030 | -\$ 52,806 |
| Surplus/Deficit North Regional TAFE | -\$ 185,313 | -\$ 462,984 | -\$ 504,641 | -\$ 443,238 | -\$ 259,393 | -\$ 1,855,569 | -\$ 371,114 |
| ACAAR State Subsidy | -\$ 438,673 | -\$ 456,433 | -\$ 693,610 | -\$ 683,332 | -\$ 660,812 | -\$ 2,932,860 | -\$ 586,572 |
| TOTAL | -\$ 533,633 | -\$ 934,411 | -\$1,339,711 | -\$1,109,177 | -\$1,013,346 | -\$ 4,930,277 | -\$ 986,055 |

TABLE 11 – DIRECT OPERATIONAL SUBSIDIES PROVIDED TO AQUACULTURE PROGRAMS

This is in addition to the normal subsidisation provided to the program by the TAFE system, in the form of access to TAFE corporate services, facilities, leases on land used by the programs and so on.

Given that the TAFE programs have been operating since the mid-1990s, the total direct subsidy is likely to be substantially more for the life of the programs.

Capital Investment

Since the establishment of aquaculture programs at Western Australian TAFE colleges during the early to mid-1990's the Western Australian TAFE system has invested at least approximately A\$21 million in infrastructure to support the aquaculture training, applied research, advisory services and fish stock supply services of the TAFE colleges. This investment is summarised in Table 12 below.

| Facility | Estimated Capital Investment (A\$m) |
|--|-------------------------------------|
| Australian Centre for Applied Aquaculture Research | \$2.5 |
| Batavia Coast Maritime Institute | \$13.4 |
| Broome Aquaculture Centre | \$5.4 |
| Total Minimum TAFE Sector Capital Investment | \$21.3 |

TABLE 12 – MINIMUM TAFE SECTOR CAPITAL INVESTMENT IN AQUACULTURE INFRASTRUCTURE

In addition, the wider Western Australian state government has invested A\$4.5 million in the Broome Tropical Aquaculture Park, A\$2.0 million in grants to the Mid West Yellowtail Kingfish Trial, provided financial support to the Aquaculture Council of Western Australia) and made numerous other smaller investments in the sector.

2.1.2. Some General Nuances

The discussion in this section of the report should be considered in the context of the more general issues discussed in the following subsections.

Peak Regional Education Institutes

While Perth based universities have a regional presence in the Great Southern, Mid West and Kimberley Regions, it is typically limited to a research presence and is generally not widely accessible to the local community. As such, North Regional TAFE, Central Regional TAFE and



Southern Regional TAFE represent the 'peak' education institutions in their respective regions and are perceived as such by their respective local communities.

The local communities very much see the TAFE colleges as community assets and have an expectation they will integrate with the community and address the community's needs. The regional TAFE colleges are cognisant of this perception and the need for a licence to operate within the community. In this context, reasonably meeting the expectation of the community is a paramount concern for the executive of regional TAFE colleges.

Even though aquaculture remains a very small component of the profile of each of the TAFE colleges that operate aquaculture programs, the aquaculture programs have anecdotally demonstrated to be important mechanisms for community engagement. This is mostly likely because, generally speaking:

- Aquaculture is an industry of emerging global significance and regional communities perceive having an education focus on emerging industries as being important for the region;
- Each of the regions of focus have some form of heritage that creates a community familiarity with aquaculture (e.g. pearling industry in the Kimberley, wild-catch fishing industry in the Mid West and recreational trout fishing in the Great Southern);
- Aquaculture training is such that is suitable for delivering beyond the main urban centres in each region, including into Aboriginal communities and smaller towns; and
- Aquaculture courses are of interest to aquaculture hobbyists and enthusiasts, as well as individuals undertaking the training for vocational purposes and therefore have broad community appeal.

Maintaining Capability in the Regions is a Challenging

Three of the four TAFE colleges that operate aquaculture programs are located in regional centres. As a result of relatively smaller and narrow local employment pools, specialised employment positions typically require recruitment from outside of the region. This issue is acute in specialised areas of teaching and research, particularly when there isn't a large state-wide capability in the field. For this reason, it is very difficult to attract and maintain aquaculture teaching and research staff at the regional TAFE colleges.

Furthermore, the cost of servicing and maintaining technical aspects of aquaculture facilities such as water supply systems and monitoring and control systems can prove expensive in regional locations, particular if service providers need to be sourced from outside of the Region.

Vocational Education and Training in Aquaculture as a Pathway

As discussed in Section 5.7, the number of enrolments in aquaculture training programs across the State, and qualifications being issued by the TAFE colleges operating those programs is well in excess of the employment needs of the Western Australian aquaculture industry. However, there is some evidence that indicates that aquaculture has been successful in activating disengaged students and others in a training and education pathway. For example:

- Under the VET in Schools (VETiS) program, Certificate I, II and III aquaculture courses have proven popular among disengaged high school students who are presumably attracted to working with vessels and fish over sitting in a classroom and there are examples of these students subsequently continuing training through other TAFE course offerings; and
- Lecturers in aquaculture report that the courses have proven useful in engaging student interest in science and technology.



While these claims are anecdotally reasonable, there is limited empirical evidence to determine the extent to which this phenomenon exists, or the benefits of aquaculture over other similar courses in achieving this outcome.

Cross – Utilisation of Aquaculture Teaching Facilities

In each of the three regional TAFE colleges, the aquaculture teaching facilities are used by a range of other courses offered by the Institution, including courses as diverse as conservation and land management, environmental monitoring technology, tourism and security. It is certainly true that in some instance the aquaculture teaching facilities used by these courses could be substituted with other institute assets and are only being used because the assets are underutilised by aquaculture activities. However, the fact that the facilities are used by non-aquaculture courses means that the impact of any restructuring of these facilities will have on those other courses will need to be considered.

Advisory, Applied Research and Fish Stock Supply

Other training portfolio areas within TAFE colleges deliver services other than profile training. These services are typically offered as a by-product to training activities or in the form of tailored training programs. However, arguably, the degree to which aquaculture programs operated by North Regional TAFE, Central Regional TAFE, South Regional TAFE and the Australian Centre for Applied Aquaculture Research provide advisory, applied research and/or sell product (fish stock supply) to industry and the community is unusual in the TAFE college operating environment, particularly in light of the extent to which these programs are subsidised by the TAFE system (see Section **Error! Reference source not found.**).

The Australian Centre for Applied Aquaculture Research in an Anomaly

Furthermore, the fact that the Australian Centre for Applied Aquaculture Research almost exclusively performs applied research, advisory and fish stock supply services (see Section 2.5), does not participate in any significant way in profile training and is subsidised by the TAFE system on this basis, is an anomaly in the TAFE system.

Relevance of Aquaculture Course Curriculum to the Western Australian Aquaculture Industry

The analysis in this section has identified two key perceived deficiencies in the aquaculture training packages with respect to relevance to the needs of the Western Australian aquaculture industry:

- Aquaculture lecturers discourage students from enrolling in the Certificate IV qualification on the basis it can be reasonably replaced by the Diploma qualification that has greater coverage and is a more marketable qualification. This has rendered the Certificate IV qualification almost redundant in the Western Australian aquaculture training landscape; and
- Presumably because the curriculum is a national curriculum based largely on the needs of the more established Eastern States aquaculture industries, content (particularly associated with elective units) is largely irrelevant to the stage of the aquaculture industry in Western Australia. For example, the strong focus on seafood processing would be better replaced by training relating to vessel handling, diving and even tourism to meet the needs of the Western Australian aquaculture industry.



This implies the need for a more flexible aquaculture curriculum in Western Australia and for regional TAFE colleges to focus their limited resources on delivering elective units that are relevant to the needs of the local industry.

2.2. Central Regional TAFE

Central Regional TAFE was formed in early April 2016 as the result of consolidation of the following former TAFE college campuses under a single administrative structure:

- CY O'Connor Institute Merredin Campus
- CY O'Connor Institute Moora Campus
- CY O'Connor Northam Campus
- Durack Institute of Technology, Carnarvon Campus
- Durack Institute of Technology, Exmouth Campus
- Durack Institute of Technology, Geraldton Campus
- Durack Institute of Technology, Wiluna Campus
- Goldfields Institute of Technology, Kalgoorlie Campus

Included in the portfolio of the newly formed Central Regional TAFE are the aquaculture training, applied research, advisory and fish stock supply services undertaken by the former Durack Institute of Technology (and previously, Geraldton Regional College and then Central West TAFE), delivered through its Geraldton based Batavia Coast Marine Institute (BCMI).

2.2.1. History of Aquaculture Training

Genesis of Aquaculture Training at Central Regional TAFE

Aquaculture training was first delivered by a predecessor organisation to the former Durack Institute, Geraldton Regional College, in the early 1990s from a small facility located at what is now the Central Regional TAFE Campus on Fitzgerald Street in Geraldton. The establishment of this initial training program coincided with a feasibility study into the establishment of a regional maritime studies and research centre in Geraldton that was commissioned by the Midwest Labour Market Advisory Council in 1994.

The emphasis for a greater focus on aquaculture and marine activities generally, emerged in 1996, partly as a result of the Mid West Development Commissions 'Smart Mid West' strategy, a strategy designed to increase the VET, higher education and research sector presence in the Mid West, and which was ultimately underpinned by the establishment of the BCMI, the Abrolhos Island Research Institute (AIRI) and the Geraldton University Centre.

In 1997, the Geraldton Regional College presented a proposal to the then Western Australian Department of Training for investment in a new aquaculture training and research facility, to be known as the Geraldton Aquaculture Training Centre. This proposal identified potential partners in the facility as being the Department of Commerce and Trade, Department of Fisheries and the Midwest Development Commission. In 1998, senior staff from Geraldton Regional College and the Midwest Development Commission undertook a study tour of aquaculture facilities in Tasmania, New Zealand, Canada and the United States to identify best practice design for facilities similar to the one proposed in Geraldton. The report from this study tour concluded that *'...an integrated centre that offers marine and fishing industry related training, undertakes fishing industry driven research and promotes public awareness of the local marine environment is a unique concept and one that could be implemented in Geraldton successfully.'*



Other studies that supported the development of the proposed centre include:

- Jones Coulter Young Architects (1996), *Aquaculture/Maritime Training and Research Facility Feasibility Study*
- Miles Morgan Fish Unlimited (1997), *Training Priorities for Aquaculture in Western Australia*
- Makaira & Ecologia (1997), *Technical Evaluation of Sites for Land Based Marine Aquaculture in the Midwest Region*

In addition to the findings of these studies, other contextual factors underpinned the confidence of the proponents for the proposed centre, including

- Aquaculture and mariculture operations, pearl farms and beta carotene production was either established or in the process of being planned by various project proponents at the time;
- There was a widely held view at the time that the aquaculture industry was on the cusp of a major expansion across Western Australia;
- At the time, the Mid West was home to over 50 percent of Western Australia's commercial fishing fleet and there were growing concerns with respect to the sustainability of the wild catch sector and growing pressure to reduce the activity of the wild catch sector; and
- Geraldton Regional College, as it was known then, was the main provider of vocational training in the Mid West Region and was already operating training programs in aquaculture.

In 1998, PriceWaterhouseCoopers was engaged by the Department of Training and Geraldton Regional College to undertake concept planning, evaluation and definition work for the proposed Marine Centre of Excellence.

During the late 1990s the project gained considerable support from the City of Geraldton-Greenough, as well as the local business community. In 2001, support for the initiative broadened across the Western Australian Government, with Department of Fisheries, then Department of Training, then Department of Conservation and Land Management and the Environmental Protection Authority lending support for the project.

In 2003-04 funding for the development of the Aquaculture Training Facility of A\$10.2 million was approved and the facility was commissioned as the BCMI in July 2006. The land on which the facility is based was leased to Central Regional TAFE by the City of Geraldton-Greenough at a 'peppercorn' rent for the first four years and then transferred to the institution.

Initially the BCMI offered courses in Aquaculture, Fishing Operations and Maritime Operations. As the result of growing demand for other courses for which the BCMI facilities are relevant, as well as a local aquaculture industry that has not lived up to the expectations on which the planning for the BCMI was in part based, the BCMI facilities have increasingly been utilised by other marine and non-marine related courses. For example, in 2009 the focus of BCMI was extended to include Conservation and Land Management (CALM) and Laboratory Operations courses and over the course of the past five years the activities of the BCMI have expanded further to incorporate horticulture, environmental monitoring and technology, sustainability and tourism courses. In addition to optimising the use of assets and staff, this has led to an increased number of integrated training programs for students. Issues associated with the discipline focus of BCMI are discussed in more detail in Section 2.2.7.



Aquaculture Course Delivery History at Central Regional TAFE

As discussed above, aquaculture courses in various forms have been delivered by Central Regional TAFE and its predecessor organisations for approximately 25 years. Table 13 below summarises aquaculture courses that have been delivered historically and which are currently delivered.

| Course | First Delivery | Last Delivery |
|---|----------------|---------------------|
| Certificate II in Aquaculture | Not known | Still delivered |
| Certificate III in Aquaculture | Not known | Still delivered |
| Diploma of Aquaculture | Not known | Still Delivered |
| Certificate II in Seafood Industry (Aquaculture) | Not known | No longer delivered |
| Certificate III in Seafood Industry (Aquaculture) | Not known | No longer delivered |
| Diploma of Seafood Industry (Aquaculture) | Not known | No longer delivered |

TABLE 13 – HISTORICAL AND CURRENT AQUACULTURE COURSES OFFERED BY CENTRAL REGIONAL TAFE

In addition, the following courses delivered by Central Regional TAFE include aquaculture related units:

- Diploma of Marine Studies
- Certificate II in Fishing Operations
- Certificate III in Fishing Operations
- Certificate II in Tourism
- Certificate III in Guiding

Marine oriented VET courses are very popular in the Mid West, primarily as a result of the fact that many families are associated with the commercial fishing industry, as well as a general community affinity with the marine environment.

Since 2011, the total number of enrolments in aquaculture courses at Central Regional TAFE has declined from 121 to 90 in 2015, and has averaged 102 students per annum. Almost 90 percent of the 509 students enrolled in aquaculture courses at Central Regional TAFE between 2011 and 2015 were enrolled in the Certificate II course, which is indicative of the popularity of aquaculture among Mid West high school students under the VETiS program. In 2014 and 2015 approximately, 40 percent of Certificate II in Aquaculture enrolments were non-profile enrolments. Certificate III in aquaculture comprised approximately 8 percent of total enrolments for the period and Diploma in Aquaculture 4 percent. There were only 3 enrolments in Certificate I for the period and Central Regional TAFE does not offer Certificate IV in Aquaculture.

The trend in enrolments in aquaculture courses at Central Regional TAFE is illustrated in Figure 7 below.

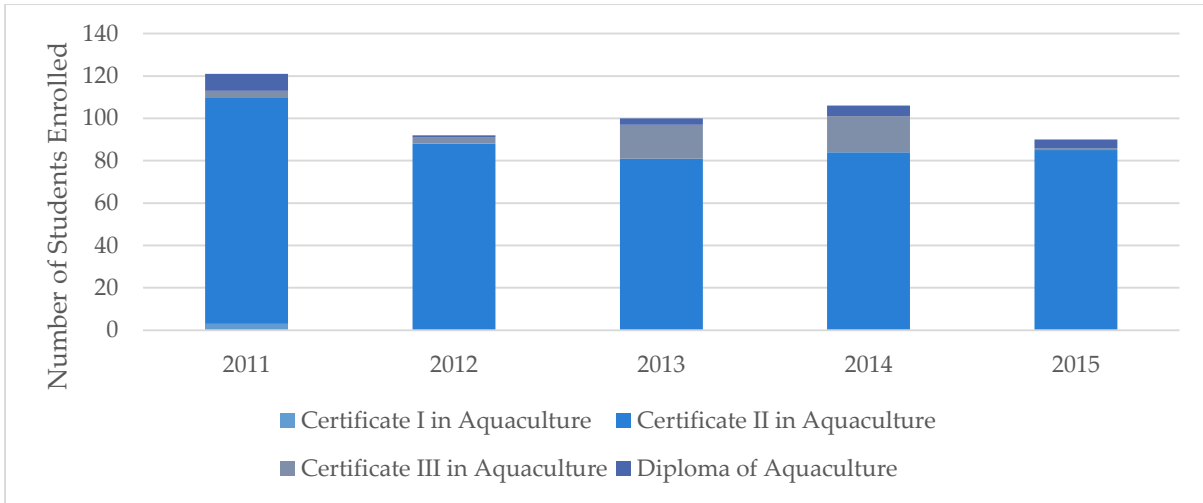


FIGURE 7 – TREND IN ENROLMENTS IN AQUACULTURE COURSES - CENTRAL REGIONAL TAFE (2011 TO 2015)

During the period 2011 to 2015, Central Regional TAFE issued a total of 240 aquaculture qualifications, averaging 48 per annum. Following a period of dramatic increase between 2012 and 2014, the number of qualifications issued declined to 2011 levels in 2015. This is illustrated in Figure 8 below.

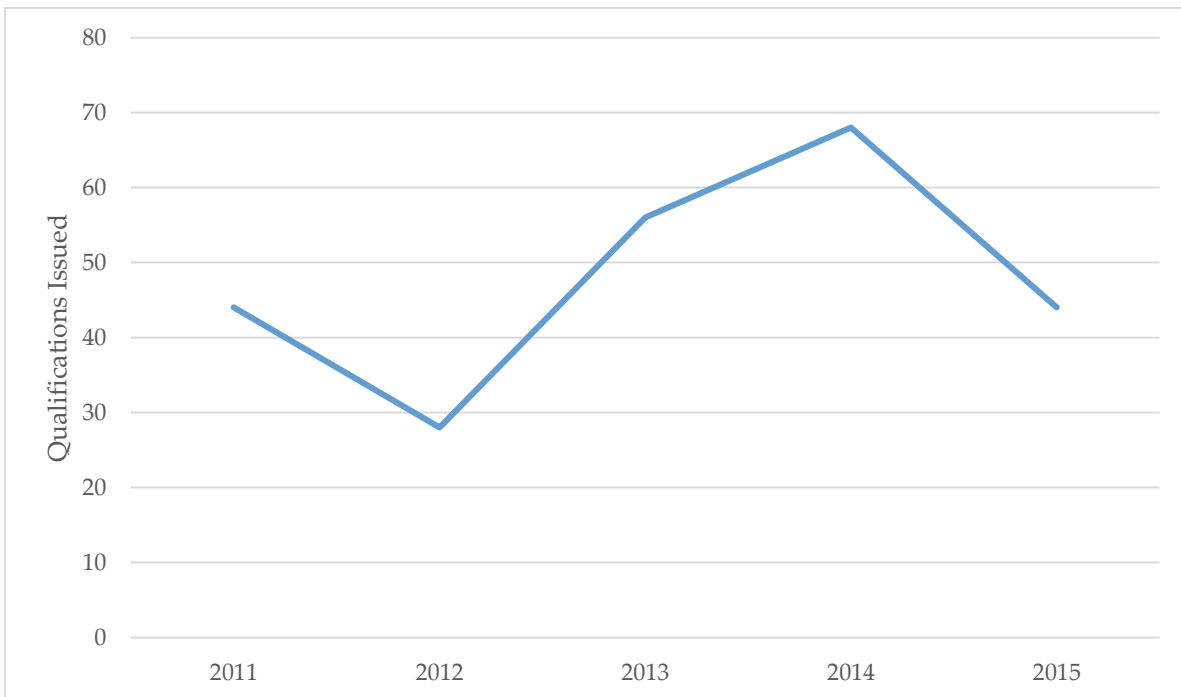


FIGURE 8 – AQUACULTURE QUALIFICATIONS ISSUED – CENTRAL REGIONAL TAFE

Student Curriculum Hours associated with the delivery of aquaculture courses at Central Regional TAFE have decreased by approximately 25 percent per annum since 2011, which represents a substantially greater decrease than the decrease in enrolments and is counter to the general trend in qualifications issued. Figure 9 below illustrates the trend in Student Curriculum Hours associated with aquaculture course delivery at Central Regional TAFE.

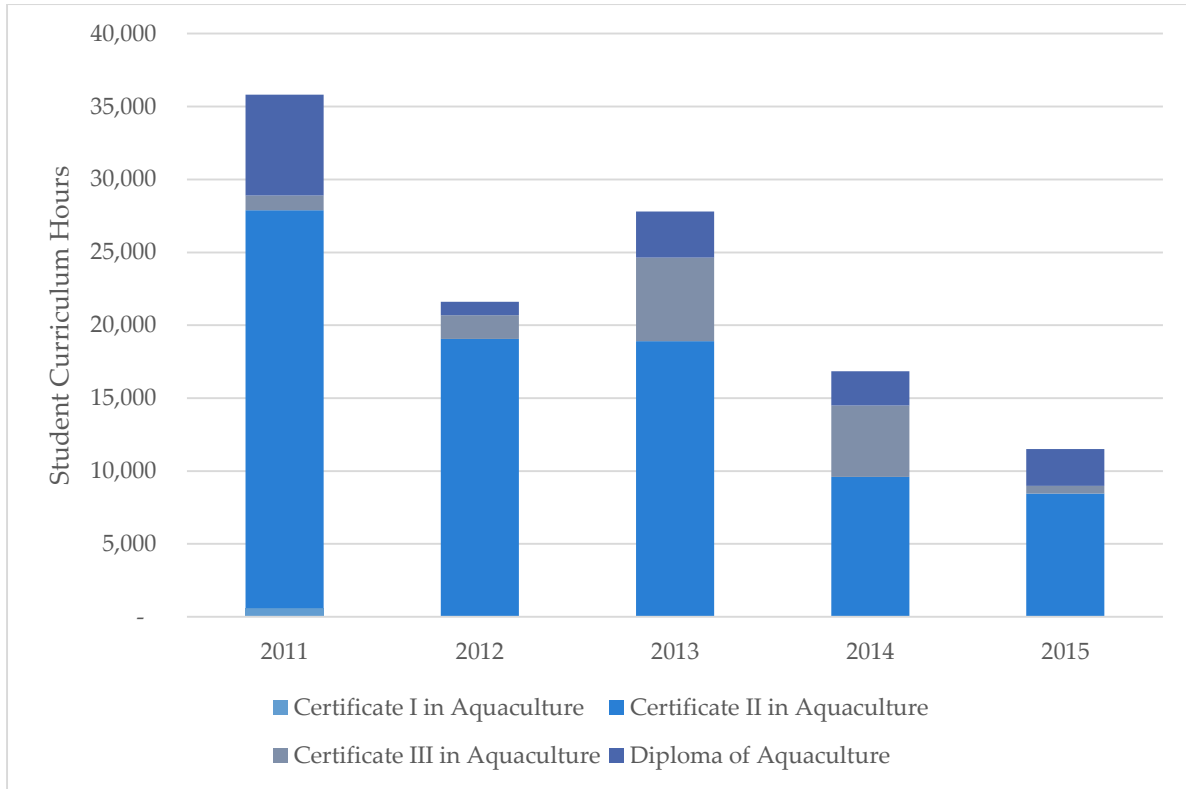


FIGURE 9 – STUDENT CURRICULUM HOURS FOR AQUACULTURE COURSES DELIVERED BY CENTRAL REGIONAL TAFE

Figure 10 below, illustrates the trend in Student Curriculum Hours per enrolment in aquaculture courses.

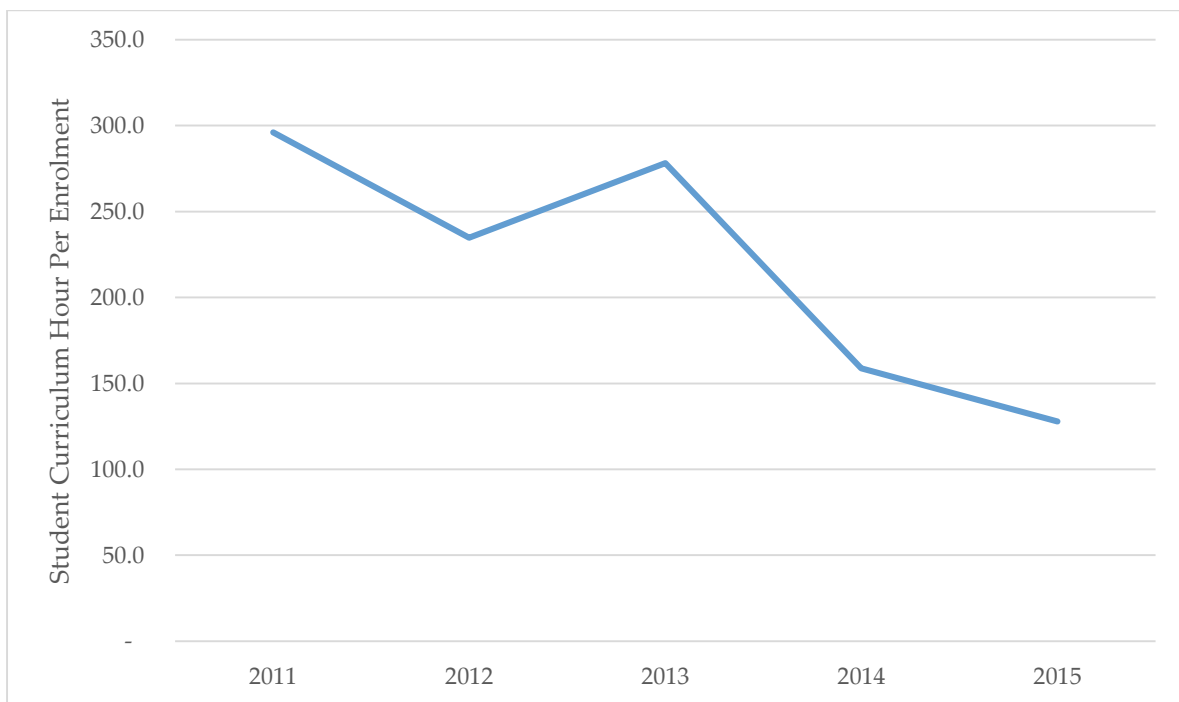


FIGURE 10 – STUDENT CURRICULUM HOURS PER ENROLMENT IN AQUACULTURE COURSES – CENTRAL REGIONAL TAFE



Up until 2014, the vast majority of students undertaking aquaculture courses at Central Regional TAFE were profile students. In 2014 and 2015, non-profile students accounted for approximately 40 percent of total enrolments. This is illustrated in Figure 11 below. Of the total 509 students that have been enrolled in aquaculture courses at Central Regional TAFE since 2011, only two students have been enrolled under a trainee program.

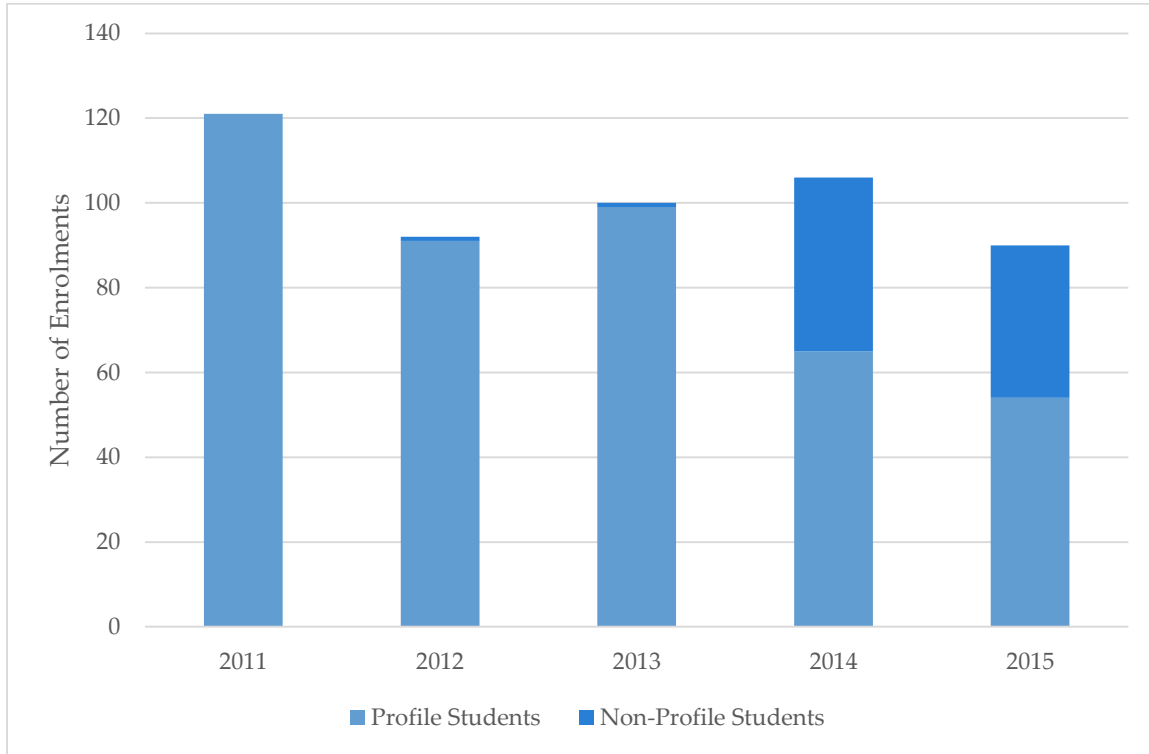


FIGURE 11 – SOURCE OF STUDENTS ENROLLING IN AQUACULTURE COURSES AT CENTRAL REGIONAL TAFE

Financial Performance of the Aquaculture Program and Central Regional TAFE

Approximately 88 percent of revenue associated with the delivery of aquaculture courses at Central Regional TAFE is in the form of a budget salary allocation. Since 2011 this has declined at a rate of approximately 29 percent per annum, which is consistent with the decline in the number of Student Curriculum Hours associated with delivering the courses. The trend in revenue associated with the delivery of aquaculture training courses is illustrated in Figure 12 below.

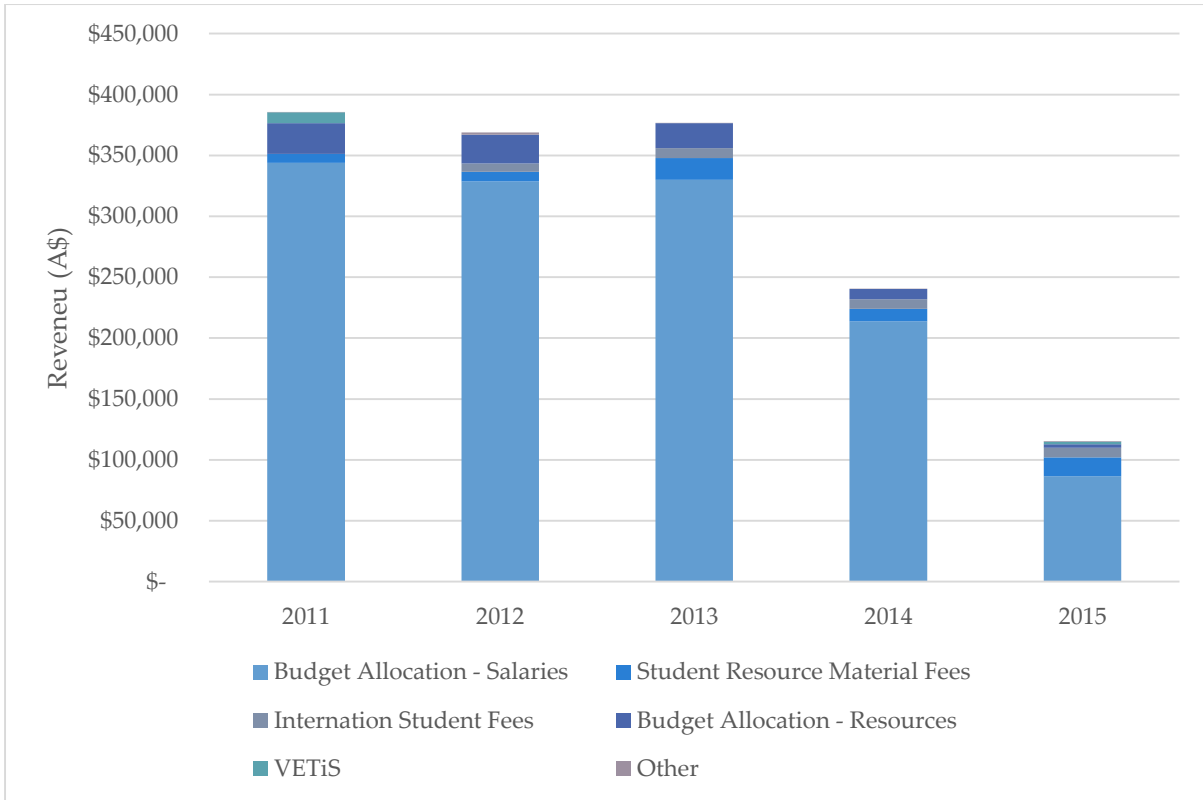


FIGURE 12 – SOURCES OF REVENUE FOR AQUACULTURE TRAINING AT CENTRAL REGIONAL TAFE

Employment costs associated with lecturer and academic appointments accounted for 84 percent of total costs over the five year period. While SCH associated with delivering aquaculture courses at Central Regional TAFE declined by 25 percent over the period, expenses only declined by 18 percent, largely reflecting the limited ability of semi-variable staffing costs to respond to reduction in student numbers. The trend in expenses is illustrated in Figure 13 below.

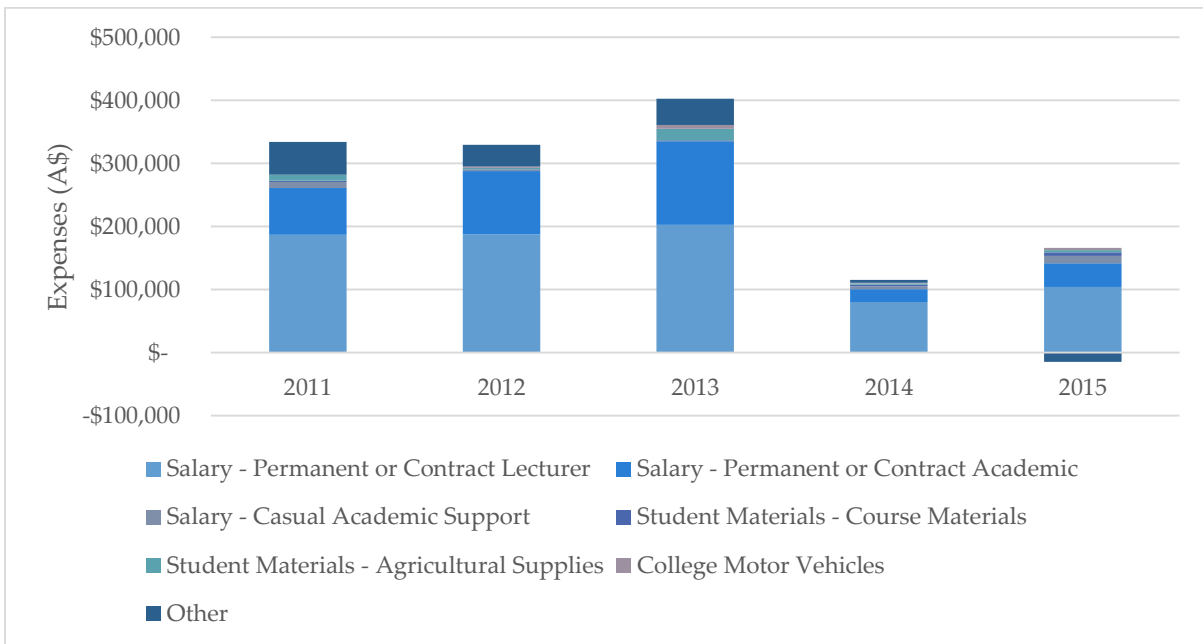


FIGURE 13 – COST OF AQUACULTURE TRAINING – CENTRAL REGIONAL TAFE



Since 2011, the aquaculture program at the Central Regional TAFE has delivered an average surplus of approximately A\$31,000. The trend in surplus is illustrated in Figure 14 below.

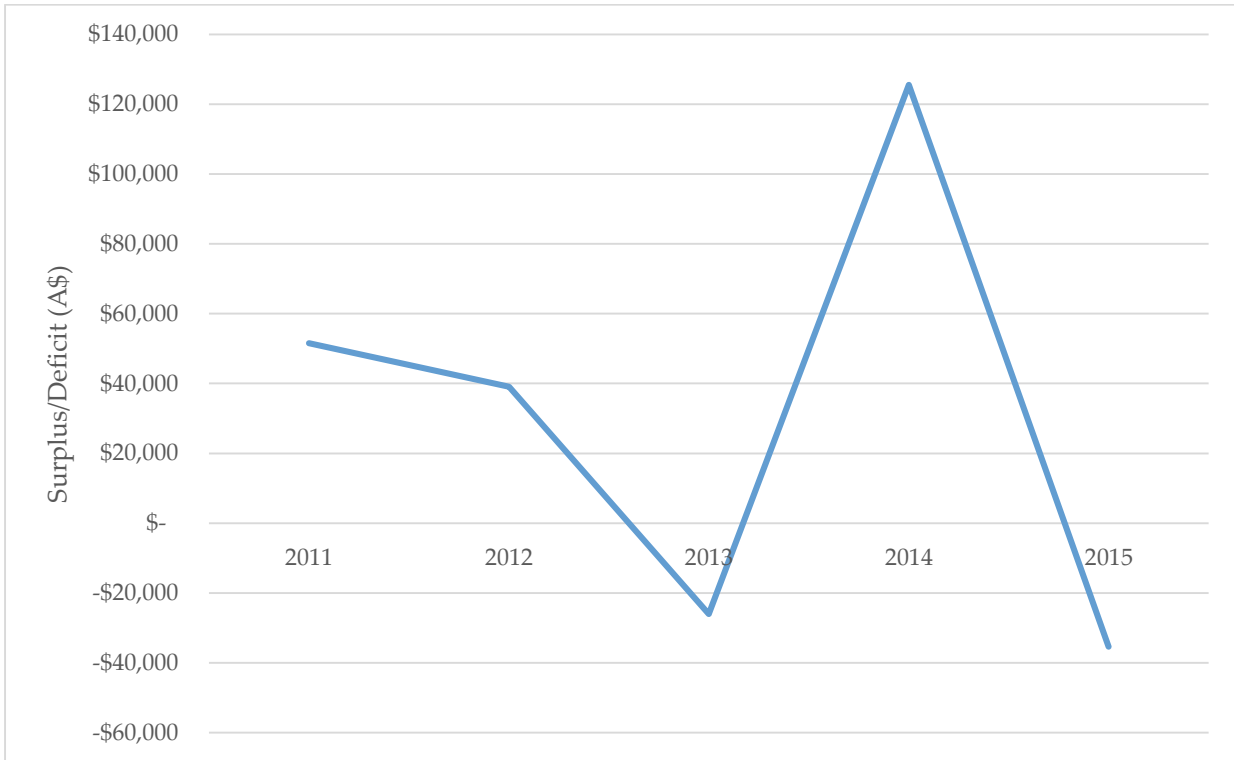


FIGURE 14 – SURPLUS/DEFICIT – AQUACULTURE COURSES – CENTRAL REGIONAL TAFE (2011 TO 2015)

Table 14 below summarises the financial performance of the aquaculture program at Central Regional TAFE on a per Student Curriculum Hour basis.

| | 2011 | 2012 | 2013 | 2014 | 2015 | Average |
|---|----------|----------|----------|----------|----------|----------|
| Total Revenue Per Student Curriculum Hour | \$ 10.76 | \$ 17.07 | \$ 13.54 | \$ 14.28 | \$ 10.03 | \$ 13.14 |
| Total Cost Per Student Curriculum Hour | \$ 9.32 | \$ 15.26 | \$ 14.48 | \$ 6.83 | \$ 13.10 | \$ 11.80 |
| Total Deficit/Surplus Per Student Curriculum Hour | \$ 1.44 | \$ 1.81 | -\$ 0.94 | \$ 7.45 | -\$ 3.07 | \$ 1.34 |

TABLE 14 – CENTRAL REGIONAL TAFE FINANCIAL PERFORMANCE BY STUDENT CURRICULUM HOUR

2.2.2. Current Staffing

Aquaculture training is delivered at BCMI by a total of 1.8 FTEs. This is summarised in Table 15 below.



| Roles | FTE |
|--------------------------------|-------------|
| Teaching | 1.0 |
| Academic Support | 0.48 |
| Subtotal Teaching | 1.48 |
| Program Management | 0.16 |
| Program Administration Support | 0.16 |
| Subtotal Administration | 0.32 |
| TOTAL | 1.8 |

TABLE 15 – CURRENT AQUACULTURE TRAINING STAFF PROFILE – CENTRAL REGIONAL TAFE

2.2.3. Current Facilities

The facilities operated by the BCMI for the purposes of aquaculture training are listed in Table 16 below.

| Item | Quantity | Utilisation | | |
|--|----------|-------------|----------|---------|
| | | Cert II | Cert III | Diploma |
| Class room | 1 | √ | √ | √ |
| Computer room | 1 | √ | √ | √ |
| Teaching laboratory | 1 | √ | √ | √ |
| Wet laboratory | 1 | √ | √ | √ |
| Water quality laboratory | 1 | √ | √ | √ |
| Fridge and freezer room | 1 | √ | √ | √ |
| Algae and preparation room | 1 | √ | √ | √ |
| Larvae room | 1 | √ | √ | √ |
| Broodstock room | 1 | √ | √ | √ |
| Hatchery and mollusc room | 1 | √ | √ | √ |
| Growout area | 1 | √ | √ | √ |
| Seawater pumping and filtration system | 1 | √ | √ | √ |
| Seawater intake line | 1 | √ | √ | √ |

TABLE 16 – BCMI AQUACULTURE TRAINING FACILITIES AND UTILISATION

The facilities listed in Table 16 above, together with the equipment contained in those facilities, are the result of a total capital investment of approximately A\$14 million. A significant portion



of this investment, some 41 percent, has been associated with the seawater intake system and remediation of problems associated with the original design of that system. This is discussed further in Section 2.2.7

The facilities listed in Table 16 are also utilised as teaching facilities for the courses listed in Table 17 below.

| Discipline | Courses |
|---|---|
| Conservation and Land Management | Certificate II in Conservation and Land Management Certificate III in Conservation and Land Management Certificate IV in Conservation and Land Management Diploma of Conservation and Land Management |
| Horticulture | Certificate II in Horticulture Certificate III in Horticulture |
| Agriculture | Certificate III in Agriculture Diploma of Agriculture |
| Fishing Operations | Certificate II in Fishing Operations Certificate III in Fishing Operations Diploma of Marine Studies |
| Maritime Operations | Certificate I in Maritime Operations (Coxswains Grade 2 Near Coastal) Certificate II in Maritime Operations (Coxswains Grade 1 Near Coastal) Certificate III in Maritime Operations (Marine Engine Driver Grade 2 Near Coastal) Certificate IV in Maritime Operations (Marine Engine Driver Grade 1 Near Coastal) Certificate III in Maritime Operations (Master up to 24 metres Near Coastal) Certificate IV in Maritime Operations (Master up to 35 metres Near Coastal) |
| Boating Services | Certificate I in Boating Services (Recreational Skippers Ticket skill set) |
| Laboratory Operation | Certificate III in Laboratory Skills Certificate IV in Laboratory Techniques Diploma of Laboratory Technology |
| Environmental Monitoring and Technology | Certificate IV in Environmental Monitoring and Technology Diploma of Environmental Monitoring and Technology |
| Tourism | Certificate II in Tourism Certificate III in Guiding |
| Sustainability | Diploma of Sustainability |

TABLE 17 – NON-AQUACULTURE COURSE USING AQUACULTURE TEACHING FACILITIES AT BCMI

The use of the BCMI in the delivery of the additional courses listed in Table 17 above has resulted in the total Student Curriculum Hours delivered through the BCMI increasing from



approximately 75,000 in 2009 to 140,000 in 2015. It has also resulted in interaction with the BCMI from a wider range of industry sectors.

The facilities listed in Table 16 are also used to support a number of research projects that are not directly related to aquaculture. These projects are focused exclusively on environmental research and remediation and are summarised in Table 18 below.

| Research Project | Description |
|--|--|
| Protecting and restoring flora and habitat at the Houtman Abrolhos Islands | Total funding is approximately \$1.6 million over 4 years. The project's primary objective is to restore habitat and flora at the Abrolhos Islands through the removal of weed species and revegetation with local provenance native plant species. The project is funded by the Commonwealth Government, and carried out in partnership with the Northern Agricultural Catchments Council, WA Department of Fisheries, WA Department of Parks and Wildlife, the WA Museum and Geraldton Senior College. Four year project from 2014 – 2017. |
| Control of the noxious invasive species <i>oreochromis mossambicus</i> in the southwest of Western Australia | Total funding is approximately \$950,000 over 3.5 years. The primary objective of the project is to develop control strategies for the noxious invasive fish species, <i>Tilapia mossambicus</i> in Mid West WA river systems. Funded by the Commonwealth Government, and carried out in partnership with the Northern Agricultural Catchments Council, WA Department of Fisheries, WA Department of Water, the City of Greater Geraldton and Geraldton Senior College. Four year project from 2014 – 2017. |
| Back Beach coastal dune rehabilitation project | Funded by the WA Planning Commission and carried out in partnership with the City of Greater Geraldton and Geraldton Senior College. One year project implemented in 2013. The primary objective was to remove introduced weed species from Back Beach, and to re-vegetate the area with suitable native plant species. Grant value: \$17,540 plus GST. |
| <i>Opuntia stricta</i> and <i>Agave Americana</i> eradication on crown reserve, Willcock Drive | Funded by the Northern Agricultural Catchments Council and carried out in partnership with the City of Greater Geraldton. One year project currently being implemented in 2016. The primary objective is to remove introduced weed species from part of Willcock Drive, and to re-vegetate the area with suitable native plant species. Grant value: \$6,725 plus GST. |
| NACC NRM capacity building for Indigenous prison inmates project | Funded by the Commonwealth Government, and carried out in partnership with the Northern Agricultural Catchments Council and the Greenough Regional Prison. Four year project from 2014 – 2017. The primary objective is to provide on-ground training in conservation and land management for minimum security Indigenous prison inmates, and to help facilitate their gaining employment after release from Prison. |
| Designing, planning and obtaining approvals for a house mouse eradication program in the Rat Islands cluster, Houtman Abrolhos | Funded by the Northern Agricultural Catchments Council and carried out in collaboration with the Conservation Council of WA. One year project to be implemented in 2016. The primary objective is to eradicate house mice in the Easter Group of the Abrolhos Islands. Grant value: \$9,768 plus GST. |

TABLE 18 – NON-AQUACULTURE RESEARCH PROJECTS USING AQUACULTURE RESEARCH FACILITIES AT BCMI

2.2.4. Aquaculture Research Projects at the Batavia Coast Marine Centre

Table 19 below summarises current and historical aquaculture related research projects being undertaken at the BCMI.



| Project | Description |
|--|---|
| Current Research Projects | |
| Live rock and coral aquaculture in the Mid West | The project proponent is Baba Marda Abrolhos Live Rock (a local Aboriginal business). The objective of the project is to develop methodologies for the aquaculture of live rock and coral at the Abrolhos Islands. The company has also branched into the development of artificial reef systems, and is currently conducting a pilot scale trial in Mauritius. The early outcomes from the project suggest that the Abrolhos Islands are a viable location for the culture of live rock and corals, with rapid growth achieved to date in the trials. |
| Pearl oyster spat production | BCMI is currently undertaking a pilot pearl oyster run for Blue Lagoon Pearls using Bat-wing oysters. The project's objectives are to produce spat for Blue Lagoon Pearls. This initial run is aimed primarily at testing the suitability of the BCMI's water quality for pearl oyster aquaculture following the recent filtration system upgrades. Directly after this run, another run will be conducted on Black-lip oysters, with the spat to be sold to Blue Lagoon Pearls as well as other pearling companies based at the Abrolhos Islands. Institute facilities used in the project include seawater and aquaculture tanks. Institute staff involved in the project include Juan Gutierrez and Ben Byrne. The pearl oyster runs are done as part of our training programs and students are involved in all aspects of the run. The project budget for the pilot trial is \$3,000. |
| Stock enhancement in the Mid West Region | BCMI has recently submitted EOIs to Recfishwest to undertake stock enhancement of key recreational fishing species in the Mid West. The proposed stock enhancement projects would focus on Pink Snapper, Blue Swimmer Crabs and Roe's Abalone. |
| Historical Research Projects | |
| Development of the non-maxima pearl industry at the Abrolhos Islands (2007-2010) | The BCMI was a key collaborator on this FRDC-funded project that was undertaken by the Abrolhos Islands pearling industry. The BCMI seawater system, hatchery and laboratory were used extensively in the project. |
| Holding yellowtail kingfish brood stock for Western Kingfish | The BCMI was engaged by Western Kingfish Ltd to hold Yellow-tail Kingfish in flow-through seawater tanks located at the BCMI. Key objectives included monitoring YTK health, condition and growth in tanks. The BCMI seawater system, hatchery and laboratory were used in the project. |
| Mulloway sea cage aquaculture project | The BCMI was a collaborator on this project, which involved trialing the aquaculture of Mulloway by Indian Ocean Fresh Australia (IOFA) at the BCMI's sea cage site in Champion Bay. The project proponent was IOFA, with funding from the Mid West Development Commission (MWDC). Institute staff involved included Steve Webster and Craig Koltasz (neither of who are still with Durack Institute). The project demonstrated the viability of Mulloway aquaculture in the region, albeit on a pilot scale. Furthermore, it demonstrated that sea cage aquaculture of marine finfish in general was potentially viable in the waters off Geraldton. |
| Development of a marine finfish research and development centre | The project was funded by the Mid West Development Commission (MWDC), and spanned 2 years. The proponent was Durack Institute in collaboration with IOFA, Grange Court Holdings and Kalbarri Seahorse Sanctuary. Institute facilities used in the project included the BCMI seawater systems, broodstock and hatchery systems, laboratory, and growout tanks. Institute staff involved in the project included Suresh Job, Robert Power, and Colin Johnson. |
| Yellowtail kingfish Stage 1 Trial | The BCMI was a collaborator on this project which was funded by the MWDC. The project involved trialing the aquaculture of YTK by Indian Ocean Fresh Australia (IOFA) at the BCMI's sea cage site in Champion Bay as well as at their own site off Geraldton. |



| Project | Description |
|-----------------------|---|
| Pink Snapper Grow out | The project proponent was Grange Court Holdings Pty Ltd, and the objective was to determine the feasibility of growing Pink Snapper to market size in flow through tank systems in the Mid West. Institute facilities used in the project included the seawater system, broodstock and hatchery systems, growout tanks and the laboratory. Institute staff involved in the project included Robert Power and Colin Johnson. |

TABLE 19 – CURRENT AND HISTORICAL AQUACULTURE RESEARCH PROJECT – BATAVIA COAST MARINE INSTITUTE

2.2.5. Fish Stock Supply Contracts

Table 20 below summarises the fish stock supply services that have been provided historically by the BCMI.

| Contract | Description |
|-------------------------------------|---|
| Marine ornamentals | Marine ornamental fish are used as a training tool for the Aquaculture, Marine Science and Tourism training programs at Central Regional TAFE. Animals that are produced as part of training are sold to the aquarium trade. Approximately 9,500 fish are sold annually to approximately 33 shops and wholesalers throughout Australia. Revenue averages approximately \$80,000 per annum. Costs for delivering this service is \$50,000 per annum. |
| Yellowtail kingfish eggs and larvae | BCMI supplied 180,000 Yellowtail Kingfish eggs to Indian Ocean Fresh Australia and Challenger Institute in August 2015 for the current YTK Stage 2 trial. These eggs were the source of all the WA-produced YTK that are currently involved in the trial. There were no non-training related costs involved in the supply of the eggs as they were produced as part of our training programs. As such, we did not charge IOFA for the eggs/larvae. |
| Other finfish | BCMI regularly produces small numbers of Pink Snapper and Black Bream as part of its training programs. These fish are generally either sold to industry as juveniles or on-grown and then processed and sold to the general public at the end of the training program. We are also in discussion with Recfishwest as to the possibility of using these fish in stock enhancement programs in the future. |

TABLE 20 – CENTRAL REGIONAL TAFE FISH SUPPLY CONTRACTS

2.2.6. Other Collaborations

In addition to aquaculture and other research and fish stock supply relationships, Central Regional TAFE and its BCMI are party to a number of other collaborations. Current and historical collaborations are summarised in Table 21 below.

| Collaboration | Description |
|-------------------------------|---|
| Current Collaborations | |
| Curtin University | Central Regional TAFE has a MOU with Curtin University to facilitate PhD students from Curtin undertaking their aquaculture research at the BCMI. Currently hosting a single PhD student. |
| Curtin University | BCMI regularly supplies marine finfish eggs to Curtin University for undergraduate and honours student projects. |



| Collaboration | Description |
|----------------------------------|--|
| Central Queensland University | Central Regional TAFE is developing a dual-badged Bachelor of Environmental Science degree program in Geraldton that will be delivered jointly that is scheduled to commence in 2017. It is proposed that this will eventually include an aquaculture unit available to all Central Queensland University Students and run out of the BCMI. |
| Ningaloo Centre | BCMI was requested by the Shire of Exmouth to assist them with the design of the research and training sections in the Ningaloo Centre. The research area included fully equipped laboratories, seawater filtration systems and tanks. We have worked closely with the Shire of Exmouth and their consultants on the design of the research area, and are a part of the Ningaloo Alliance. The Department of Training and Workforce Development no longer has an association with this Centre. |
| Historical Collaborations | |
| Challenger Institute (2014) | Supply of 150 aquacultured pink snapper to Challenger for their aquaculture courses |
| Challenger Institute (2014) | Purchased rotifers from Challenger |
| Challenger Institute (2014-2015) | Supplied Challenger with Yellowtail kingfish eggs and/or larvae |
| Challenger Institute (2009-2011) | Collaborated on the Marine Finfish Research and Development Centre project |
| University of Western Australia | Hosted a PhD student from the University of Western Australia. |
| Recfishwest | BCMI collaborated with Recfishwest on a pilot study into the management of the noxious invasive species, <i>Tilapia mossambicus</i> , in local river systems. This project involved the use of the BCMI's staff expertise and facilities. This initial work has since led to a much larger project that involves mapping biodiversity in the waterways of the Mid West, as well as, developing management strategies for invasive species. We are currently undertaking this project in partnership with a range of stakeholders including the City of Greater Geraldton, WA Department of Fisheries, WA Department of Water, Northern Agricultural Catchments Council and Recfishwest. |
| Aurora Algae | Aurora Algae Pty Ltd is an American microalgae production company that previously had research and development sites in Western Australia. They worked with us on developing a previously unused area of land at the BCMI, including extending utilities and services to the area. This area was then leased by them for their Geraldton Research & Development site. In addition, they paid commercial rates for access to our facilities and equipment including laboratories, filtered seawater and algae production equipment. On the conclusion of the first stage of their trials, they made the decision to concentrate on their American-based site for the second stage, and withdrew from Western Australia. |
| Kalbarri Seahorse Sanctuary | Kalbarri Seahorse Sanctuary was a marine ornamentals aquaculture and tourism business operating from Kalbarri. They collaborated with us on the development of aquaculture techniques for marine ornamental species including the production and use of copepods as a live feed. |
| BMT Oceanica | BMT Oceanica is an environmental consulting company that leased facilities, equipment and technical staff from the BCMI for their environmental assessment work around the proposed Oakajee Port site. Facilities used included laboratories, freezers and cool rooms. |



| Collaboration | Description |
|------------------|---|
| Western Kingfish | Western Kingfish was an aquaculture company that was seeking to culture Yellow-Tail Kingfish (YTK) in sea cages off Jurien Bay. They leased facilities and equipment from the BCMI including access to filtered seawater, holding tanks and laboratories. In addition, they housed YTK stock at the BCMI as a risk management measure and collaborated with us on the maintenance and care of the fish. When they made the decision to close down, they donated this stock to the BCMI for use in training. |

TABLE 21 – CENTRAL REGIONAL TAFE – OTHER COLLABORATIONS

2.2.7. Issues

Tension between significant operators in the Mid West aquaculture industry and the management of BCMI is evident. This seems to stem primarily from the following:

- **Industry Perception of ‘Ownership’ of BCMI**

There exists a perception among most in industry that because the initial, and to some extent, ongoing investment in BCMI was undertaken with the intent of establishing a facility to support the development of the aquaculture industry in the Region, this should remain its primary focus, with BCMI placing priority on activities designed to support aquaculture over its other endeavours. While it is most certainly the case that one of the main reasons that the BCMI was established was to support the development of the local aquaculture industry (see Section 2.2.1), the fact is that the BCMI is a wholly-owned business unit of Central Regional TAFE and Central Regional TAFE has an obligation to the government to optimise the utility of that investment. This issue was exacerbated over the course of 2008 and 2009 when climate change became an increasing focus of particularly the commonwealth government and BCMI was encouraged the increase its activities in the environmental space in order to secure additional commonwealth funding, an endeavour in which it has had some success (see Table 18). This was also a natural extension of existing conservation and land management training at the former Durack Institute and integrate well with other training courses such as tourism and horticulture. Similarly, during the expansion phase of the Mid West iron ore industry, BCMI was able to offer water quality testing services to operators of iron ore projects in the region, and during the pre-development of Oakajee various facilities to technical consultants to the Oakajee Project (see Table 21). Given that over the course of the past decade, an aquaculture industry of scale has not emerged in the Mid West, it is not unreasonable that Central Regional TAFE has used the facility for purposes other than aquaculture in order to maximise revenue associated with the facility and its utilisation.

- **Operational Integrity**

Related to the abovementioned issue is a concern held by many in industry that because the importance of aquaculture support has been diluted by other activities undertaken by BCMI, the quality of aquaculture related infrastructure has deteriorated. For example, BCMI no longer maintains National Association of Testing Authorities (NATA) accreditation on a water quality laboratory that was established, in part, to support the development of an aquaculture industry. However, a similar economic rationale can be applied to this decision in that it is reasonable for Central Regional TAFE to forgo the cost of NATA accreditation for a laboratory for which there is limited demand when it has other spending priorities across the institution. This laboratory still undertakes commercial water testing from time-to-time, is used in training programs and is operated according to NATA requirements regardless of not having NATA accreditation.



- **Seawater In-take**

It is understood that as a result of poor initial design and construction, the sea-water ocean intake system at BCMI has presented considerable challenges that have required ongoing remediation. The specifications in terms of water quality and volumes associated with the intake system were initially designed around the need of the pearling industry. However, post initial construction, both quality and volumes from the intake system never met specification. It is understood that the problem was a function of both substandard specifications and construction, an issue that was the subject of a legal settlement between Central Regional TAFE and contractors involved in the design and construction of the system. During the period 2004 to 2008, Central Regional TAFE worked to secure funding necessary to remedy the problem and then it took another four years to undertake the remediation work. To date, this issue has taken the best part of a decade and cost approximately A\$3.2 million in additional capital to resolve. This significant investment and time delay was primarily the result of technical complexities associated with retrofitting an existing system that was based on both a flawed design and implementation. BCMI's reputation amongst industry has suffered as a result, and the issue has also caused considerable angst within the institution and the Department of Training and Workforce Development.

- **Perceptions of an Underutilised Facility**

There is a perception held by some in industry that as a result of the abovementioned factors, the BCMI facility as far as it pertains to aquaculture has been and remains underutilised. There is a desire to see aspects of the aquaculture facilities to be managed separately for the purposes of supporting industry development. BCMI contest this claim on the basis of the number of aquaculture students enrolled in its aquaculture training programs each year and services they provide to a few small aquaculture projects in the region (see Table 19, Table 20 and Table 21). BCMI further argue that the revenue associated with the use of the facilities for non-aquaculture related training and research has helped maintain the facilities that are used for aquaculture purposes.

2.3. North Regional TAFE

North Regional TAFE was formed in early April 2016 as a result of the merger of the following former TAFE college campuses:

- Kimberley Training Institute Broome Campus
- Kimberley Training Institute Derby Campus
- Kimberley Training Institute Fitzroy Crossing Campus
- Kimberley Training Institute Halls Creek Campus
- Kimberley Training Institute Kununurra Campus
- Kimberley Training Institute Wyndham Campus
- Pilbara Institute Karratha Campus
- Pilbara Institute Newman Campus
- Pilbara Institute Punulmurra Campus
- Pilbara Institute Minurmarghali Mia Campus
- Pilbara Institute South Hedland Campus
- Pilbara Institute Tom Price Campus

Included in the North Regional TAFE portfolio is the aquaculture training, applied research, advisory and fish stock supply activities of the former Kimberley Training Institute's Broome Aquaculture Centre.



2.3.1. History of Aquaculture Training

Genesis of Aquaculture Training at North Regional TAFE

North Regional TAFE has been involved in aquaculture training since 1997 and similar to the circumstances at Central Regional TAFE, in 2000, it established a centre devoted to aquaculture, known as the Broome Aquaculture Centre (BAC).

Initially, the BAC had a specific focus on delivering aquaculture training to Aboriginal communities and in 2002, developed a Certificate I in Aquaculture course targeted specifically at Aboriginal students. In 2005, North Regional TAFE was the first Registered Training Organisation in Australia to implement traineeships in aquaculture.

With respect to aquaculture, the Kimberley Region differs substantially from the other regions of Western Australia in that it has a long heritage in aquaculture and an established aquaculture industry of scale. The Western Australian *Pinctada maxima* (south sea pearl) aquaculture industry is based primarily in the Kimberley Region and with an annual GVP of approximately A\$60 million is approximately four times the size of the rest of the Western Australian aquaculture industry. The Kimberley Region also hosts the Cone Bay barramundi operations, which accounts for approximately 50 percent of the GVP of the Western Australian non-*Pinctada maxima* aquaculture industry and resides in the only gazetted large-scale aquaculture development zone in Western Australia (see Section 3.4). In other words, the Kimberley Region accounts for approximately 90 percent of the GVP of the Western Australian aquaculture industry. In addition, projects revolving around prawns, crocodiles, the freshwater culture of barramundi and other species have been proposed from time to time in the Kimberley Region. Aquaculture is widely considered to be an important future growth industry in the Kimberley Region.

Historically, there has also been private investment in aquaculture hatchery and training facilities in the Kimberley. For example, the Broome Tropical Aquaculture facility resides on land that is the subject of a sublease from the Department of Fisheries adjacent to the BAC. This facility was initially established by the Western Australian Government in the late 1990s with an investment of approximately A\$4.5 million. In 1999, the Western Australian Government provided the Kimberley Aquaculture Aboriginal Corporation with a A\$600,000 grant to establish a hatchery operation at the facility. In 2009, a Receiver Manager was appointed and Broome Hatcheries Pty Ltd acquired the facility from the Receiver Manager. The facility is currently dormant and somewhat dilapidated. However, Broome Hatcheries Pty Ltd has explored using the facility to offer aquaculture training and North Regional TAFE has historically expressed interest in acquiring the facility.

Aquaculture Course Delivery History

Table 22 below summarises historical and contemporary aquaculture courses delivered by North Regional TAFE.



| Course | First Delivery | Last Delivery |
|---|----------------|---------------|
| Certificate I in Seafood Industry (Aquaculture) | 2005 | 2012 |
| Certificate II in Seafood Industry (Aquaculture) | 2005 | 2012 |
| Certificate III in Seafood Industry (Aquaculture) | 2005 | 2012 |
| Certificate IV in Seafood Industry (Aquaculture) | 2005 | 2011 |
| Diploma of Seafood Industry (Aquaculture) | 2006 | 2011 |
| Certificate I in Aquaculture | 2012 | 2012 |
| Certificate II in Aquaculture | 2012 | Present |
| Certificate III in Aquaculture | 2012 | Present |
| Certificate IV in Aquaculture | 2012 | Present |
| Diploma in Aquaculture | 2012 | Present |

TABLE 22 – HISTORICAL AND CURRENT AQUACULTURE COURSES OFFERED BY NORTH REGIONAL TAFE

Starting in 2002, North Regional TAFE delivered Certificate I level aquaculture training directly into various Aboriginal communities. This activity received strong support from communities on the Dampier Peninsula and around Derby and Kununurra. However, due to both logistical and economic challenges, this activity ceased in 2005. During the period 2008 to 2012, aquaculture courses were also offered by North Regional TAFE at various high schools across the Kimberley under the VETiS program. However, this arrangement was terminated as a result of changes to funding arrangements associated with VETiS, which rendered its operation sub-economic.

During the period 2011 to 2015 there was a total of 485 students enrolled in aquaculture training courses at North Regional TAFE. The vast majority of these students (90 percent) were enrolled in Certificate II and III training courses and 97 percent of all students were profile students. During this period, annual enrolments have increased from 70 to 176 per annum and averaged 97 students per annum. The trend in enrolments in aquaculture courses at North Regional TAFE is illustrated in Figure 15 below.

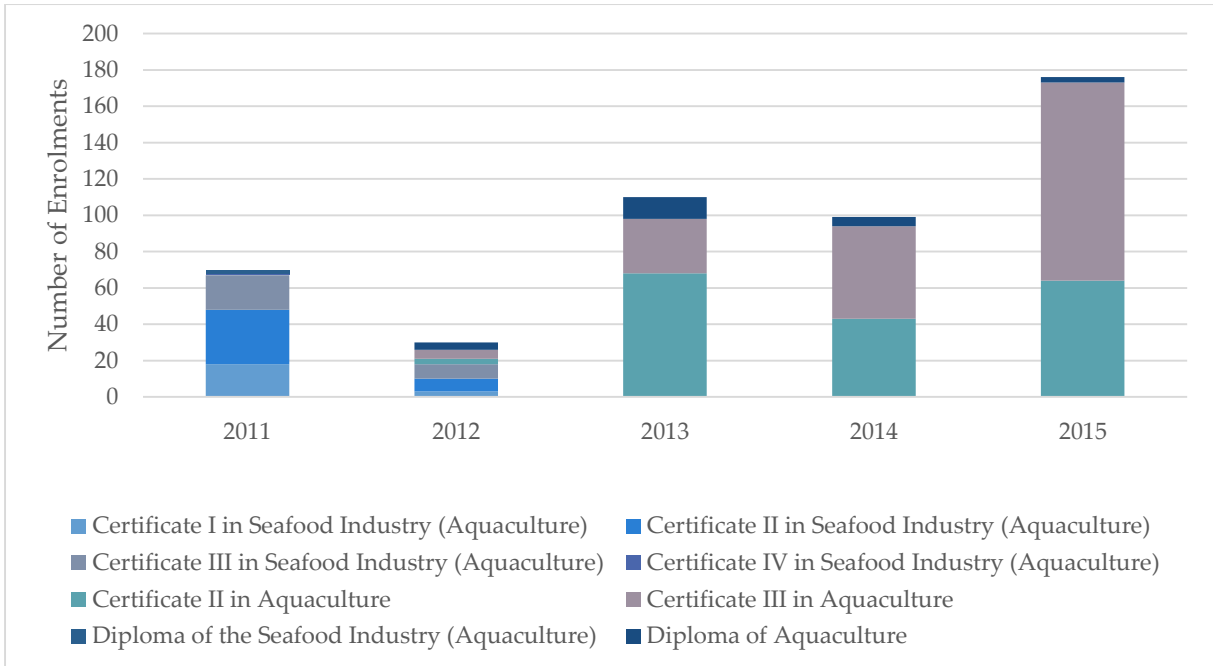


FIGURE 15 – TREND IN ENROLMENTS IN AQUACULTURE COURSES –NORTH REGIONAL TAFE (2011 TO 2015)

Over the same period, North Regional TAFE has issued a total of 96 qualifications in aquaculture, averaging 19 per annum. The average module load completion rate percent across all aquaculture courses at North Regional TAFE since 2011 has been 69 percent.

The trend in aquaculture qualifications issued by North Regional TAFE since 2011 is illustrated in Figure 16 below.

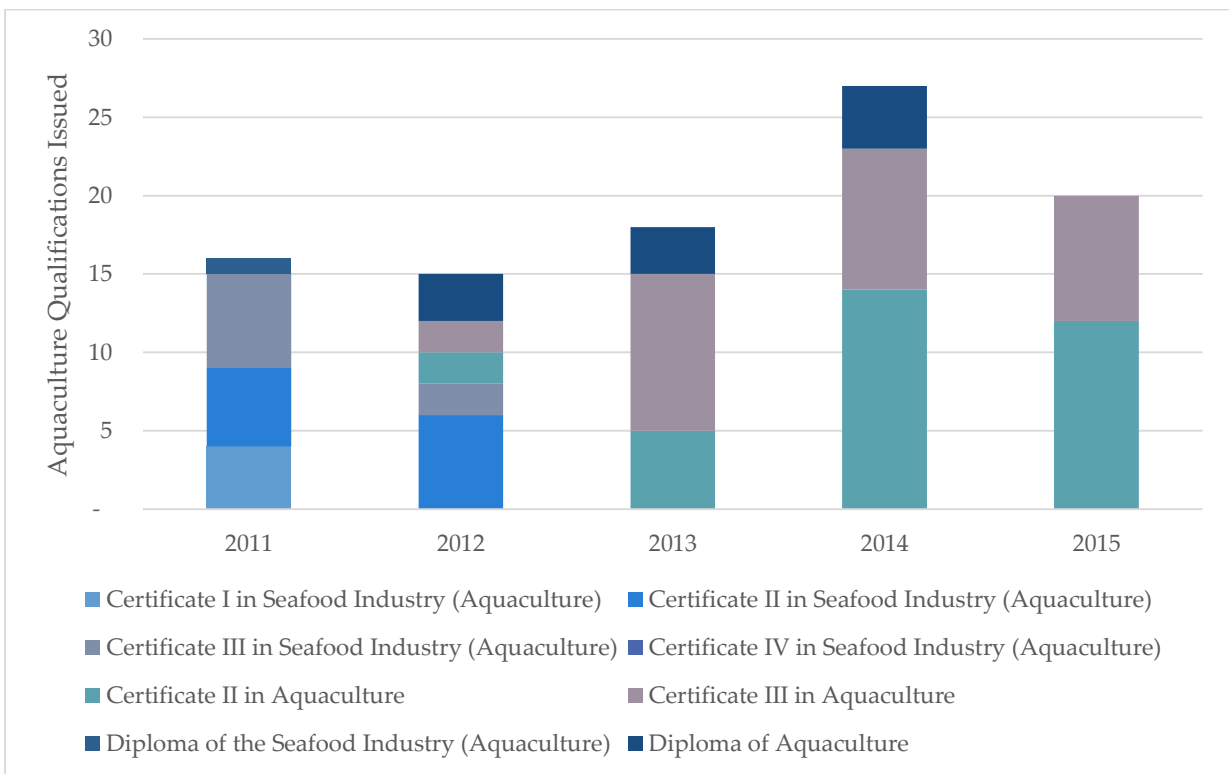


FIGURE 16 – AQUACULTURE QUALIFICATIONS ISSUED BY NORTH REGIONAL TAFE



In 2011, Student Curriculum Hours associated with aquaculture courses at North Regional TAFE were relatively high given the relatively low level of enrolments in that year. In 2012, Student Curriculum Hours reduced dramatically in response to the dramatic decline in enrolments and then gradually increased over the course of 2013, 2014 and 2015. In 2015, Student Curriculum Hours were at levels comparable to 2011, servicing almost twice as many enrolments. Indeed, Student Curriculum Hours per enrolment were 434 in 2015, compared to 1,496 in 2011. Figure 17 below illustrates the trend in Student Curriculum Hours associated with the delivery of aquaculture training courses at North Regional TAFE.

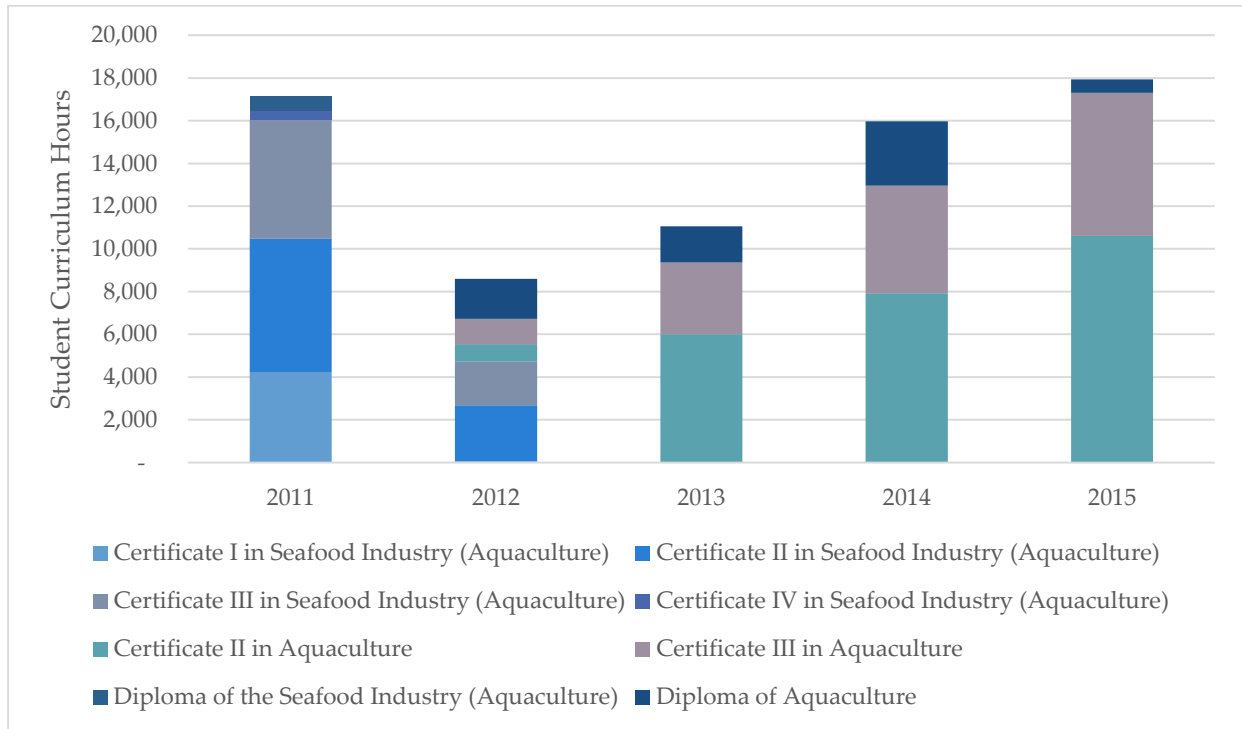


FIGURE 17 – STUDENT CURRICULUM HOURS FOR AQUACULTURE COURSES DELIVERED BY NORTH REGIONAL TAFE

As illustrated in Figure 18 below, the vast majority of students enrolled in aquaculture courses at North Regional TAFE since 2011 have been profile students.

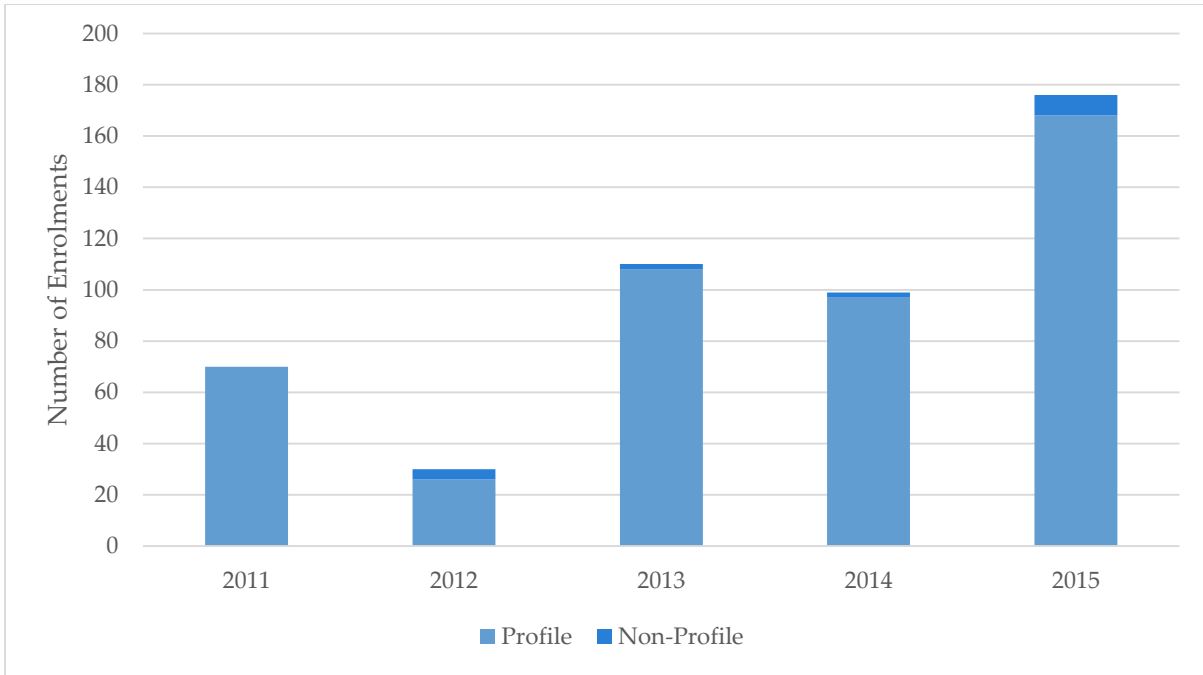


FIGURE 18 – SOURCE OF STUDENTS ENROLLING IN AQUACULTURE COURSES AT NORTH REGIONAL TAFE

Financial Performance of Aquaculture Programs at North Regional TAFE

Profile allocation accounted for 53 percent of total revenue over the period 2011 to 2013 and has varied over that period in accordance with Student Curriculum Hours. The second most significant source of revenue over the period was funding associated with the Lake Kununurra barramundi restocking program (see Section 2.3.5) which accounted for 24 percent of revenue. The Lake Kununurra contract expires this year and unless it is replaced by a new source of external revenue, its expiration will result in a significant decline in revenue. The trend in revenue is illustrated in Figure 18 below.

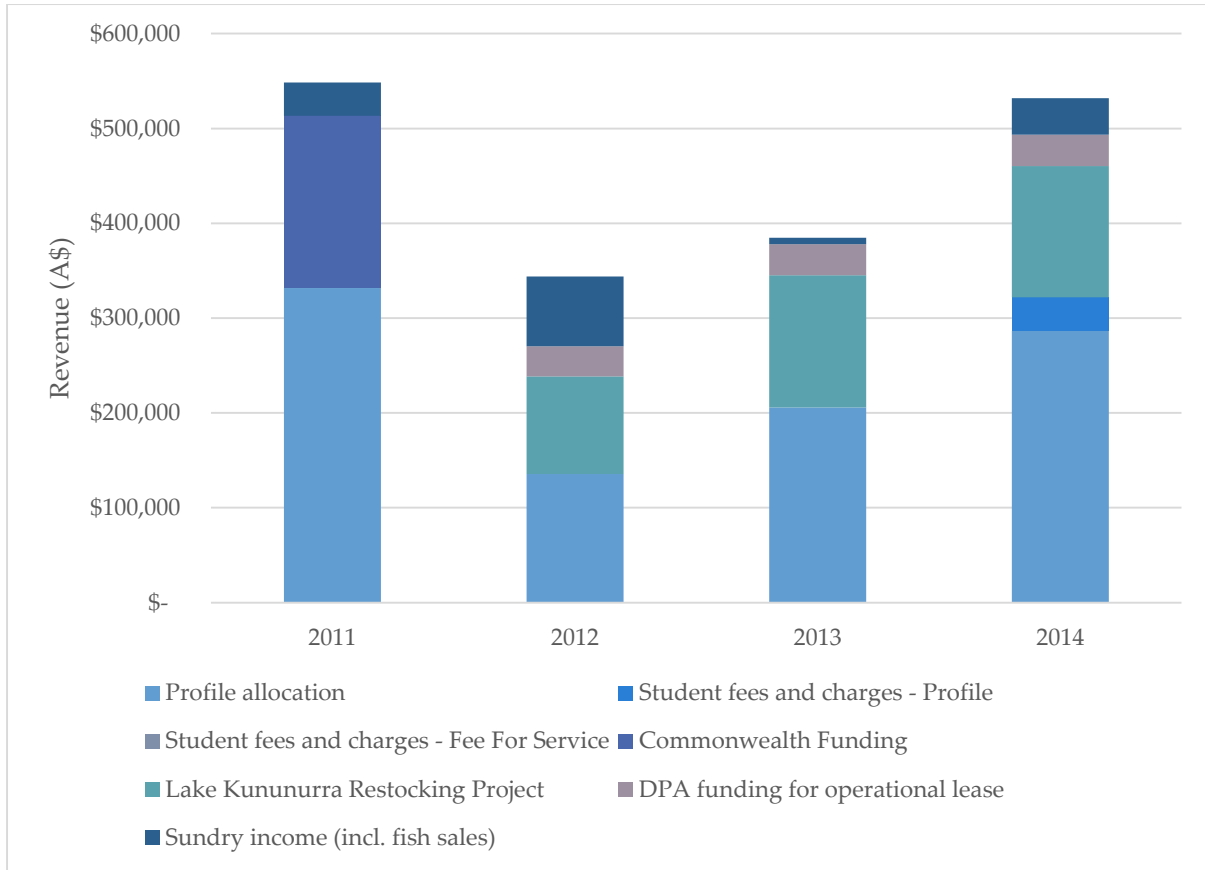


FIGURE 19 – SOURCES OF REVENUE FOR THE AQUACULTURE PROGRAM AT NORTH REGIONAL TAFE

During the period 2011 to 2014 cost increased at a CAGR of 10 percent, despite sporadic enrolments and in the context of declining revenue. However, in 2015 there was a strong focus on cost control, resulting in a CAGR increase in costs for the period 2011 to 2015 of 5 percent. Lecturer and non-lecturer salaries are the largest cost component, collectively accounting for 58 percent of total costs for the period. However, growth in lecturer salaries has been relatively modest at 6.0 percent and non-lecturer salary costs have declined by 2.0 percent over the period. The main drivers of the escalation of costs over the period were separation of the water supply charge from the lease combined with a dramatic increase in the water supply charge, as well as a dramatic increase in electricity charges associated with the BAC.

The trend in costs associated with the aquaculture program at North Regional TAFE is illustrated in Figure 20 below.

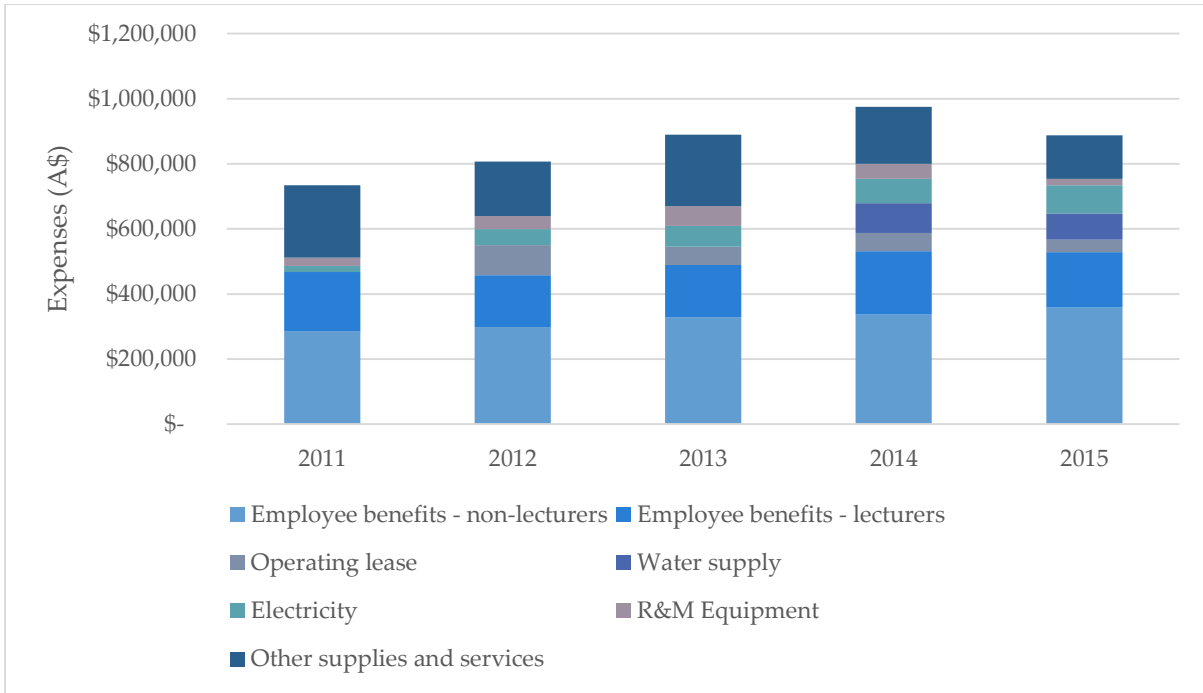


FIGURE 20 – NORTH REGIONAL TAFE AQUACULTURE PROGRAM COSTS

The aquaculture program at North Regional TAFE has operated a deficit in each of the years examined by this review, with that deficit peaking at A\$500,000 in 2013. Increased revenue and tighter cost control in 2014 and 2015 have reduced that deficit to A\$250,000. The trend in operating deficit is illustrated in Figure 21 below.

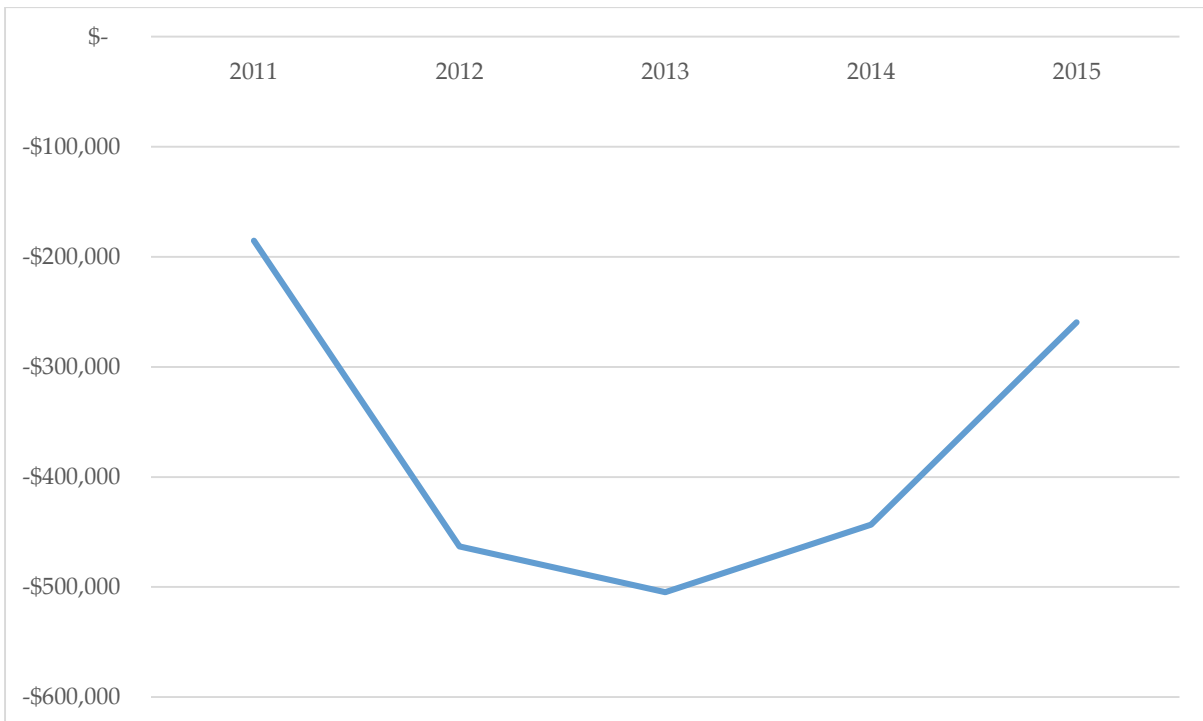


FIGURE 21 – NORTH REGIONAL TAFE AQUACULTURE PROGRAM DEFICIT (2011 TO 2015)

Table 23 below summarises the financial performance of North Regional TAFE on a per Student Curriculum Hour basis.



| | 2011 | 2012 | 2013 | 2014 | 2015 | Average |
|---|-----------|-----------|-----------|-----------|-----------|-----------|
| Total Revenue Per Student Curriculum Hour | \$ 32.00 | \$ 39.98 | \$ 34.80 | \$ 33.30 | \$ 35.01 | \$ 35.02 |
| Total Cost Per Student Curriculum Hour | \$ 42.82 | \$ 93.81 | \$ 80.46 | \$ 61.05 | \$ 49.48 | \$ 65.52 |
| Total Deficit/Surplus Per Student Curriculum Hour | -\$ 10.81 | -\$ 53.84 | -\$ 45.66 | -\$ 27.75 | -\$ 14.46 | -\$ 30.50 |

TABLE 23 – FINANCIAL PERFORMANCE OF THE NORTH REGIONAL TAFE AQUACULTURE PROGRAM BY STUDENT CURRICULUM HOUR

2.3.2. Current Staffing

The aquaculture program at North Regional TAFE is delivered by a total of 1.5 FTEs, including a lecturer that is on secondment from South Metropolitan TAFE. This is summarised in Table 24 below.

| Roles | FTE |
|-----------------------------|-----|
| Lecturers ⁷ | 1.5 |
| Administrative ⁸ | 0.0 |

TABLE 24 – CURRENT AQUACULTURE TRAINING STAFF PROFILE – NORTH REGIONAL TAFE

2.3.3. Current Facilities

North Regional TAFE's aquaculture facilities are located at the BAC on a 7,166 square metre site near the Port of Broome. The site is owned by the Kimberley Port Authority and leased by the Department of Fisheries, with North Regional TAFE holding a sublease from the Department of Fisheries.

The facilities at BAC have an insurance value of approximately A\$5.4 million. The Kimberley environment is harsh on infrastructure, resulting in relatively high maintenance costs. The hatchery facilities have the capacity to produce 200,000 barramundi fingerlings to 25 millimetres.

The facilities operated by the BCMI for the purposes of aquaculture training are listed in Table 25 below.

Utilisation

⁷ Peak course delivery has seen up to 3 teaching FTEs in the past

⁸ KTI does not assign administrative FTEs to the aquaculture program



| Item | Quantity | Cert II | Cert III | Diploma |
|--|----------|---------|----------|---------|
| Hatchery sheds | 3 | √ | √ | √ |
| Algal laboratory | | √ | √ | √ |
| Aquaria | | √ | √ | √ |
| Salt water holding tanks under a tropical roof structure | | √ | √ | √ |
| Classroom | | √ | √ | √ |
| Laboratory | | √ | √ | √ |
| Vessels | | √ | √ | √ |
| Seawater provided by Department of Fisheries | | √ | √ | √ |
| Saline water bore | | √ | √ | √ |

TABLE 25 –NORTH REGIONAL TAFE TRAINING FACILITIES AND UTILISATION

The facilities listed in Table 25 are also used as teaching facilities for courses in logistics and warehousing, maritime, aviation and security, as well as for the purposes of community engagement.

2.3.4. Research and Advisory Projects

Students are integrated into all research and advisory projects undertaken at North Regional TAFE. Historical and current aquaculture related research projects undertaken by North Regional TAFE are summarised in Table 26 below.



| Project | Description |
|-------------------------------------|---|
| Current Research Projects | |
| Aarli Mayi | Provided expertise and advice on MEMP, technical advice on production systems, capability, production cycles and strategies for Aarli Mayi's application under the KADZ |
| Historical Research Projects | |
| Willie Creek | Provided advice to Willie Creek pearl farms on design and construction for a new tour offering as well as training for Willie Creek staff. |
| Emama Nguda | Provided advice on the feasibility of a commercial mud crab fishing opportunity based on their current exemption. |
| Live Rock Project | Contract with the Commonwealth Government (A\$180,000) in 2011 to deliver live rock capacity in the Ardyaloon (One Arm Point) community. |
| CAT Funding Project | CAT funding project in Kalumburu in 2012 to develop aquaponics system and provide training in the community for food production. |
| Agrifoods | Development of a training model in 2009 to work in Aboriginal communities. |

TABLE 26 – NORTH REGIONAL TAFE CURRENT AND HISTORICAL RESEARCH AND ADVISORY PROJECTS

2.3.5. Fish Stock Supply Services

Historically fish stock supply services undertaken by BAC focus primarily on barramundi for both aquaculture and restocking purposes. BAC has had some hatchery experience with prawns and is advocating to be a provider of juvenile prawns to the proposed Seadragon project in the Northern Territory should it materialise, and is also exploring a threadfin salmon restocking project with Recfishwest.

Table 27 below summarises fish supply services that have been provided by BAC.



| Contract | Description |
|--------------------------------------|--|
| Prawn production | Limited supply to small scale trials during the period 2004 to 2006 |
| Marine Produce Australia | Worked with ACAAR in 2010 to produce barramundi fingerlings |
| Lake Kununurra Barramundi Restocking | Restocking of 550,000 barramundi in Lake Kununurra under a \$700,000 contract with Recfishwest. The project also included training outcomes for MG rangers and local students. |
| Willie Creek Barramundi Restocking | Recfishwest restocking projects in 2013 and 2015 |
| Dampier Creek Barramundi Restocking | Recfishwest restocking project in 2012 |
| Dampier Creek Barramundi Restocking | Woodside funded restocking project in 2011. |

TABLE 27 – NORTH REGIONAL TAFE FISH SUPPLY CONTRACTS

BAC also periodically sells smaller volumes of barramundi and ornamental fish across Australia.

2.3.6. Other Collaborations

In addition to the research and advisory projects and fish stock supply projects discussed in Sections 2.3.4 and 2.3.5 above, North Regional TAFE has a number of other aquaculture related current and historical external collaborations.

| Collaboration | Description |
|----------------------------------|---|
| Current Collaborations | |
| Aarli Mayi | MOU with aspiration KADZ barramundi producer pertaining to training, advice and fingerling supply should the Aarli Mayi project proceed. |
| Recfishwest | Development of a training program in 2013 known as Young Future Leaders designed to enhance the development of young leaders in fisheries and aquaculture. |
| Historical Collaborations | |
| Department of Fisheries | During the period 2000 to 2004, the Department of Fisheries utilised the Broome Aquaculture Centre for a co-funded barramundi program. This involved providing technical support and operational funds. The Department of Fisheries also sub-leased a laboratory a deployed a development and research officer to the facility. |

TABLE 28 – NORTH REGIONAL TAFE OTHER AQUACULTURE RELATED COLLABORATIONS

2.3.7. Issues

Lease

The sublease on which the BAC is located, as well as the electricity and seawater supply components of that sublease are becoming increasingly expensive, threatening the viability of the BAC and its aquaculture programs. Furthermore, as a result of the age of the facility and



the harsh environment, parts of the facility are in need of significant maintenance. Identifying a suitable alternative site that doesn't require significant capital investment is challenging.

Excess Capacity

There is significant excess capacity at the BAC and the dormant adjacent Broome Tropical Aquaculture Centre. The scale of this excess capacity and the term for which it has not been productively used, renders it difficult for the BAC to argue for significant additional investment in existing facilities.

Speculative Projects

The Lake Kununurra Restocking Project has been an important source of revenue for the aquaculture program at North Regional TAFE and is due to expire this year. Future revenue growth for the BAC is very much dependent on:

- The materialisation of a number of regional aquaculture projects that are currently aspirational, conceptual or at a very early stage of development, as well as the ability of the BAC to integrate its service offerings into those projects. It is notable that while Marine Produce Australia uses the BAC for training purposes, it sources its fingerlings, for reasons of preferred genetics, from a commercial hatchery in Victoria and uses the Australian Centre for Applied Aquaculture as a staging point in the transfer of those fingerlings directly to its grow-out operations in Cone Bay;
- Growth in the practice of restocking particularly barramundi in Kimberley waterways and the ability of the BAC to continue to control the market the supply of stock for this purpose.

There is uncertainty pertaining to both aspects of potential future revenue growth.

2.4. South Metropolitan TAFE: Aquaculture Training

South Metropolitan TAFE was formed in early April 2016 as the result of the merger of the following former TAFE college campuses:

- Polytechnic West Aerospace Training Centre
- Polytechnic West Armadale
- Polytechnic West Balga
- Polytechnic West Bentley
- Polytechnic West Carlisle
- Polytechnic West Brigadoon Equine Centre
- Polytechnic West Midland
- Polytechnic West Thornlie
- Challenger Institute of Technology Australian Centre for Energy Processing Technology (Munster and Henderson)
- Challenger Institute of Technology Maritime (Fremantle Port)
- Challenger Institute of Technology Fremantle (Beaconsfield and E-Tech)
- Challenger Institute of Technology Kwinana
- Challenger Institute of Technology Murdoch
- Challenger Institute of Technology Peel
- Challenger Institute of Technology Rockingham

Within the portfolio of the new South Metropolitan TAFE are the aquaculture training activities of the former Challenger Institute of Technology Maritime campus, as well as the applied research, advisory and fish stock supply activities of the former Challenger Institute of Technology's Australian Centre for Applied Aquaculture Research, located at the same



campus. Given the distinctive focus of the Australian Centre for Applied Aquaculture Research, the two operations are discussed in separate sections.

This section 2.4 discusses the aquaculture training activities of South Metropolitan TAFE and the activities of the Australian Centre for Applied Aquaculture Research are discussed in Section 2.5.

2.4.1. History of Aquaculture Training

Genesis of Aquaculture Training at South Metropolitan TAFE

South Metropolitan TAFE, through its predecessor organisations, Challenger Institute and South Metropolitan College of TAFE, have been delivering aquaculture training programs for almost 30 years. Driven primarily by aspiring student inquiries around marron and ornamental fish production, the first VET course in aquaculture was delivered at the Institution’s Beaconsfield campus in 1987. In 1989, the aquaculture training program was transferred to the Western Australian Maritime Institute facilities located on Fleet Street at the southern side of the western end of Victoria Quay at Fremantle Port, where, together with the Australian Centre for Applied Aquaculture facilities, it operates to day.

The entire Australian Maritime Institute is located on Fremantle Port Authority land and is the subject of a lease that is due to expire in mid-2018.

Aquaculture Course Delivery History

Table 29 below summarises historical and contemporary aquaculture courses delivered by South Metropolitan TAFE.

| Course | Brief Description | First Delivery | Last Delivery |
|---|-------------------|----------------|-----------------|
| Certificate II in Aquaculture | | 1987 | Still delivered |
| Certificate III in Aquaculture | | 1987 | Still delivered |
| Diploma of Aquaculture | | 2006 | Still Delivered |
| Graduate Diploma in Aquaculture Hatchery Management | | 2012 | 2013 |
| Graduate Diploma in Marine Finfish Hatchery Management/Graduate Diploma of Marine Hatchery Operations | | 2002 | 2012 |
| Marine Finfish Hatchery Short Course | | 2005 | 2010 |
| Aquaponics Short Courses | | 2009 | 2012 |

TABLE 29 – HISTORICAL AND CURRENT AQUACULTURE COURSES OFFERED BY SOUTH METROPOLITAN TAFE



During the period 2011 to 2015 there have been a total of 314 students enrolled in aquaculture courses at South Metropolitan TAFE averaging 63 students per annum. While the majority (75 percent) of these students have been enrolled in Certificate II and III courses, 13 percent of enrolments were in diploma courses. Total enrolments have decreased from 100 in 2011 to 46 in 2015. The trend in enrolments in aquaculture course at South Metropolitan TAFE is illustrated in Figure 22 below.

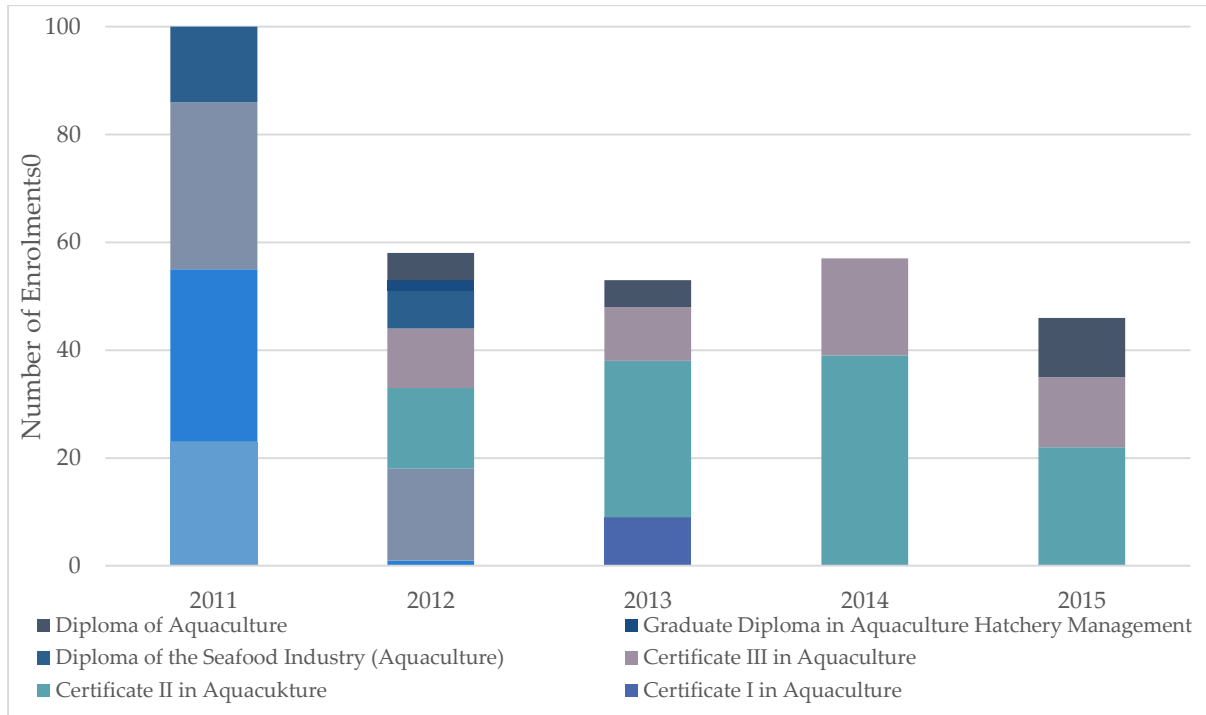


FIGURE 22 – TREND IN ENROLMENTS IN AQUACULTURE COURSES SOUTH METROPOLITAN TAFE

Over the same period a total of 176 students have received aquaculture qualifications from South Metropolitan TAFE, or an average of 35 students per annum. Aquaculture qualifications issued by South Metropolitan TAFE peaked at 49 in 2013 and have since declined to their lowest levels since 2011. The trend in aquaculture qualifications issued by South Metropolitan TAFE is illustrated in Figure 23 below.

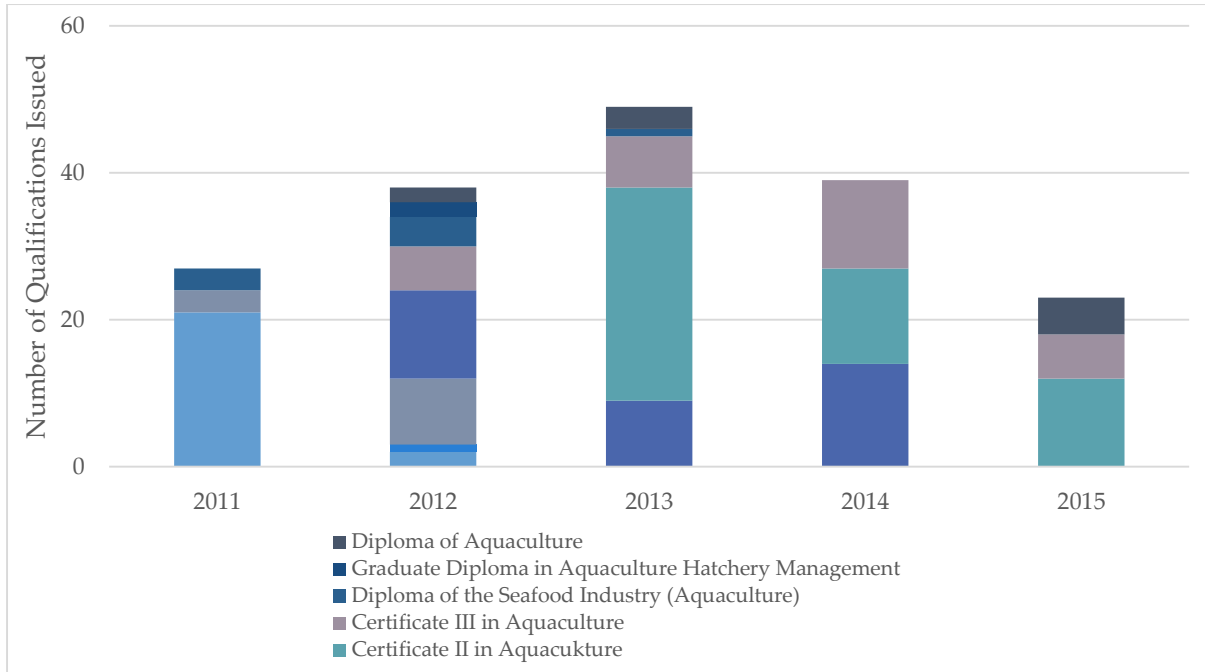


FIGURE 23 – TREND IN COMPLETION OF AQUACULTURE COURSES AT SOUTH METROPOLITAN TAFE

In addition to the aquaculture courses, seven students have enrolled in Certificate courses in seafood processing and one student has completed a Certificate III in Seafood Processing over the same time period at South Metropolitan TAFE.

The total Student Curriculum Hours associated with the delivery of aquaculture courses at South Metropolitan TAFE have, over the period 2011 to 2014, reflected trends in enrolments. However, in 2015, there was an increase in Student Curriculum Hours associated with the delivery of aquaculture courses at South Metropolitan TAFE despite a decline in enrolments. Indeed, Student Curriculum Hours per enrolment is currently at its highest level since 2011. The trend in Total Student Curriculum Hours associated with the delivery of aquaculture courses at South Metropolitan TAFE is illustrated in Figure 24 below.

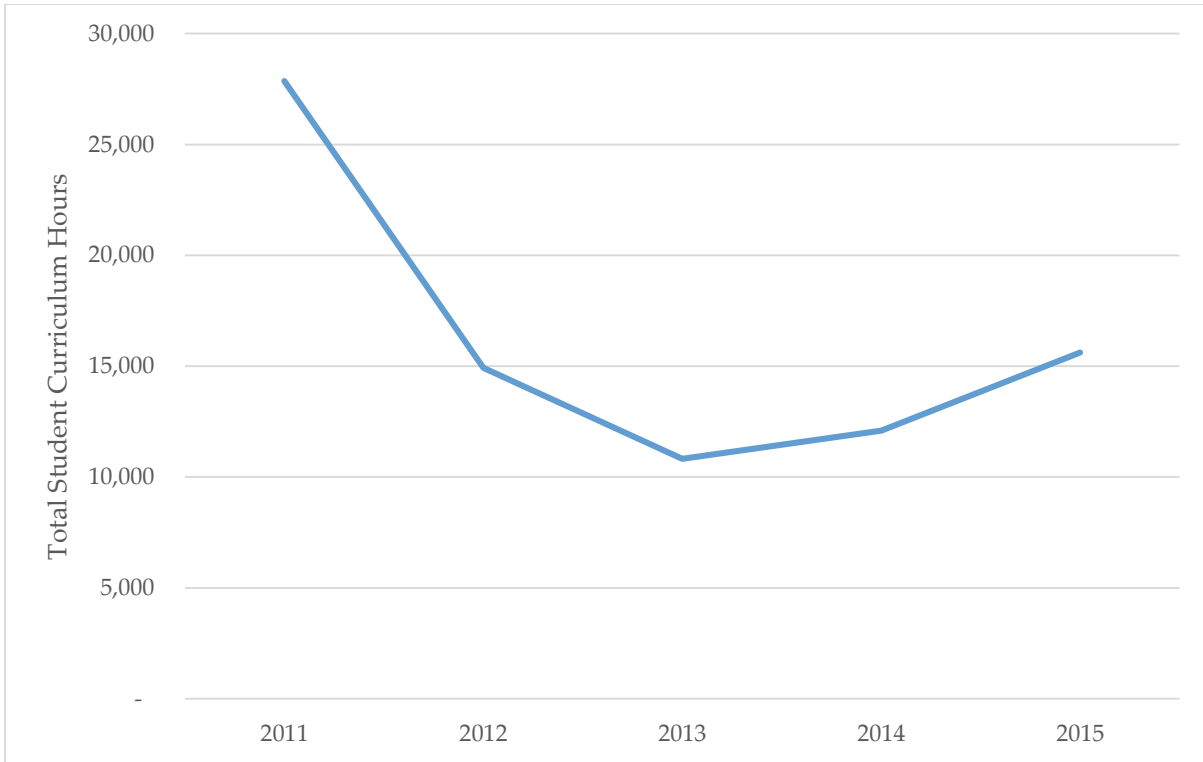


FIGURE 24 – TOTAL STUDENT CURRICULUM HOURS FOR AQUACULTURE COURSE DELIVERY AT SOUTH METROPOLITAN TAFE

Over the course of the past five years, an average of 60 percent of students doing aquaculture courses at South Metropolitan TAFE have been profile students, 10 percent international students and 30 percent from other sources such as fee-for-service or commercial delivery. The trend in the source of student enrolments is illustrated in Figure 25 below.

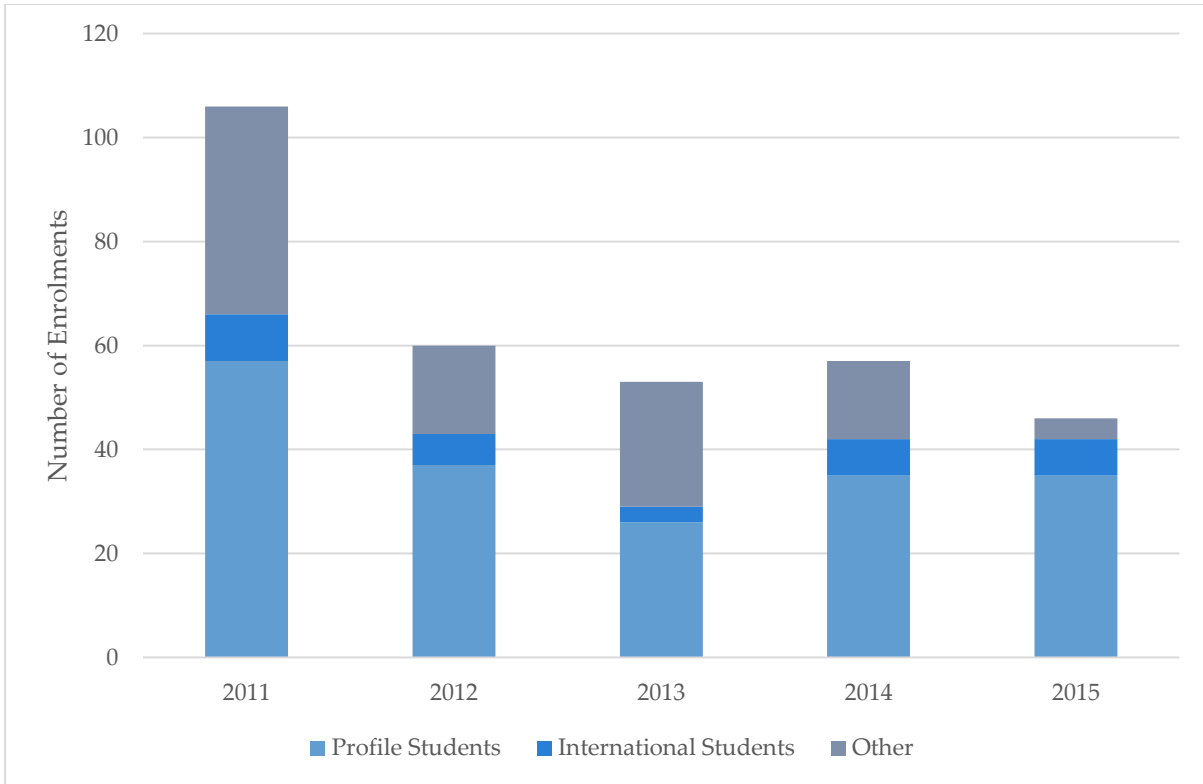


FIGURE 25 – SOURCE OF STUDENTS ENROLLING IN AQUACULTURE COURSES AT SOUTH METROPOLITAN TAFE

Financial Performance of Aquaculture Courses at South Metropolitan TAFE

Delivery and performance funding for lecturers and academic support accounted for 84.4 percent of total revenue for the period 2011 to 2015. Over this period, delivery and performance funding for lecturer positions declined by a CAGR of 9.9 percent and delivery and performance funding for academic support declined by 12.7 percent, consistent with the trend in Student Curriculum Hours associated with the delivery of aquaculture courses. Indirect delivery and performance funding, while accounting for only 15 percent of total revenue over the period 2011 to 2015, declined by 13 percent. The trend in revenue associated with the delivery of aquaculture courses at South Metropolitan TAFE is illustrated in Figure 26 below.

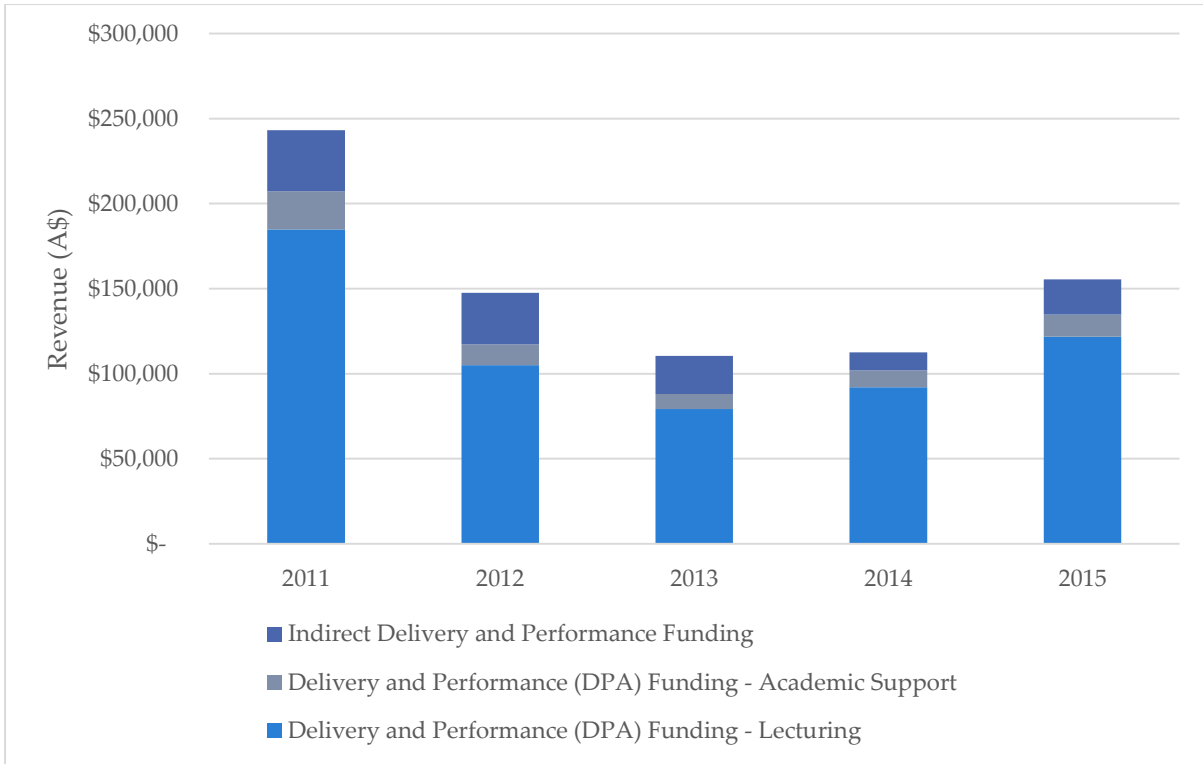


FIGURE 26 – SOURCES OF REVENUE FOR AQUACULTURE TRAINING AT SOUTH METROPOLITAN TAFE

Over the same period, direct lecturing costs accounted for 92 percent of total costs and grew at a CAGR of 4.1 percent over the period. Administration support costs associated with aquaculture programs represented the balance of total costs and declined at a CAGR of 12.2 percent over the period. Costs associated with the delivery of aquaculture programs at South Metropolitan TAFE are illustrated in Figure 27 below.

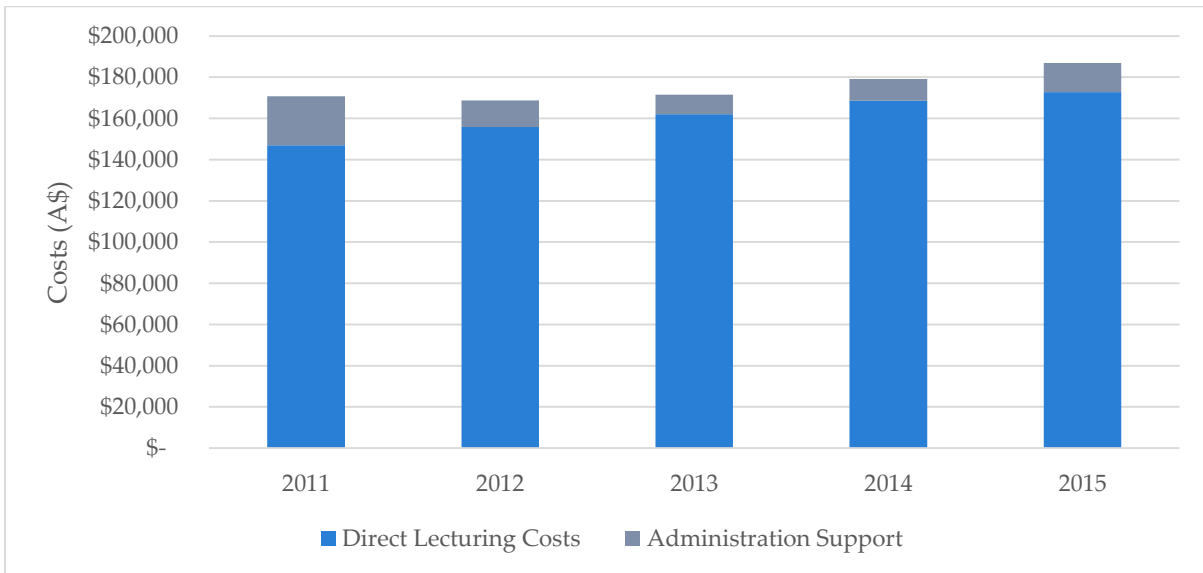


FIGURE 27 – COSTS OF AQUACULTURE TRAINING AT SOUTH METROPOLITAN TAFE

The total deficit associated with delivering aquaculture training courses at South Metropolitan TAFE over the period 2011 to 2015 is approximately A\$108,052, with an average annual deficit of A\$21,610. This excludes an allocation of additional revenue for international students. In



2011, aquaculture training delivered a relatively significant surplus. As the result of the dramatic reduction in revenue in subsequent years, the program achieved break-even in 2012 and has operated at a deficit since, albeit operating deficit was substantially reduced in 2015.

Figure 28 below illustrates the trend in the surplus and deficit associated with delivering aquaculture training courses at South Metropolitan TAFE over the period 2011 to 2015.

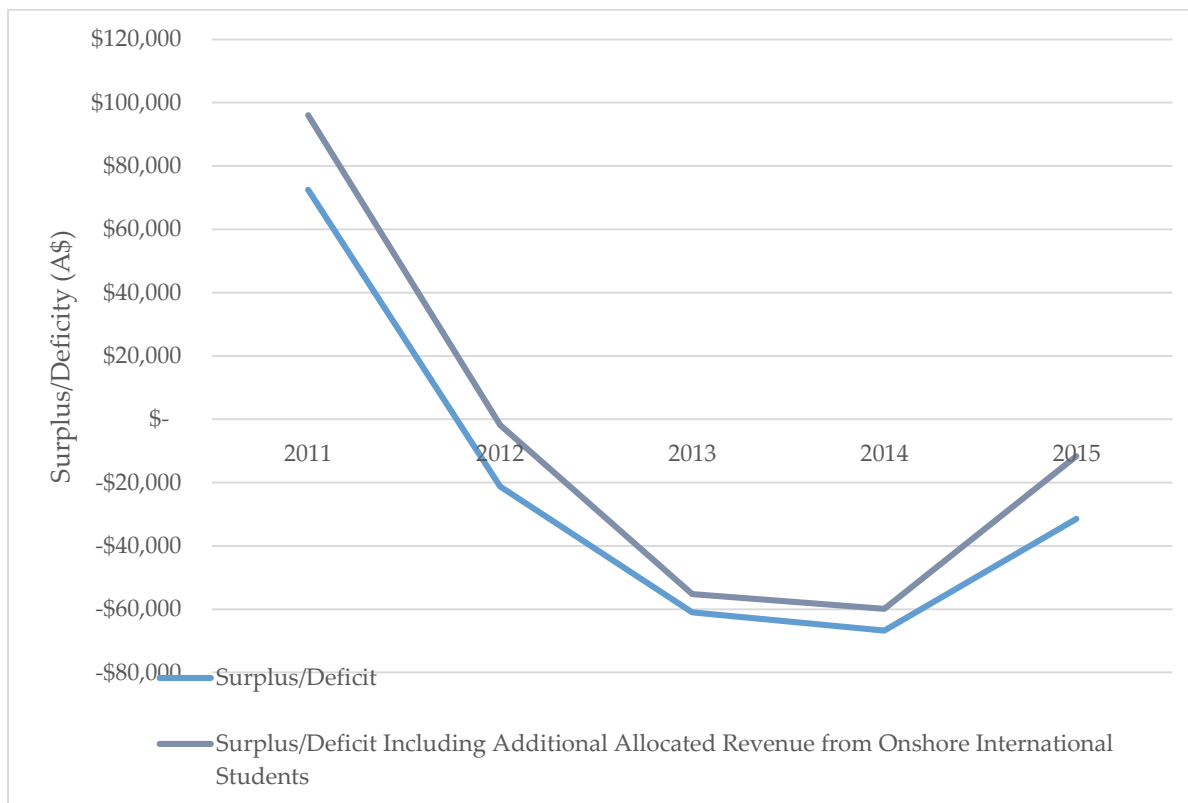


FIGURE 28 – SURPLUS/DEFICIT ASSOCIATED WITH DELIVERING AQUACULTURE TRAINING AT SOUTH METROPOLITAN TAFE

Table 30 below summarises the financial performance of the delivery of aquaculture courses at South Metropolitan TAFE on a per Student Curriculum Hour basis.

| | 2011 | 2012 | 2013 | 2014 | 2015 | Average |
|---|---------|----------|----------|----------|----------|----------|
| Total Revenue Per Student Curriculum Hour | \$ 8.73 | \$ 9.88 | \$ 10.21 | \$ 9.30 | \$ 9.95 | \$ 9.61 |
| Total Cost Per Student Curriculum Hour | \$ 6.13 | \$ 11.31 | \$ 15.85 | \$ 14.82 | \$ 11.97 | \$ 12.01 |
| Total Deficit/Surplus Per Student Curriculum Hour | \$ 2.60 | -\$ 1.43 | -\$ 5.64 | -\$ 5.52 | -\$ 2.02 | -\$ 2.40 |

TABLE 30 – FINANCIAL PERFORMANCE OF AQUACULTURE COURSE DELIVERY AT SOUTH METROPOLITAN TAFE ON A PER STUDENT CURRICULUM HOUR BASIS

2.4.2. Current Staffing

Aquaculture training at South Metropolitan TAFE is currently delivered and supported by a total 3 FTEs. This staffing profile is summarised in Table 31 below.



| Position | FTE |
|---|-------------|
| Aquaculture Lecturer 1 | 0.6 |
| Aquaculture Lecturer 2 | 0.4 |
| Aquaculture Lecturer 3 | 0.8 |
| Aquaculture Technician | 0.6 |
| School of Maritime Studies Administration Staff 1 (Level 2) | 0.06 |
| School of Maritime Studies Administration Staff 2 (Level 3) | 0.06 |
| Subtotal Teaching | 1.8 |
| Subtotal Administration | 0.72 |
| Total | 2.52 |

TABLE 31 – CURRENT AQUACULTURE TRAINING STAFF PROFILE AT SOUTH METROPOLITAN TAFE⁹

2.4.3. Current Facilities

The facilities operated by South Metropolitan TAFE for the purposes of training are summarised in Table 32 below.

⁹ An additional Challenger aquaculture lecturer is currently on secondment to the Broome Aquaculture Facility at North Regional TAFE



| Item | Quantity | Utilisation | | |
|-------------------------------|----------|-------------|----------|---------|
| | | Cert II | Cert III | Diploma |
| 5,000 L tank | 2 | | √ | √ |
| 1,000 L tank | 10 | √ | √ | |
| 40 L aquaria | 40 | √ | √ | |
| Microscopes | 15 | √ | | √ |
| Autoclave | 1 | √ | √ | √ |
| Electric pump | 4 | √ | √ | √ |
| Aquaculture laboratory | 1 | √ | √ | √ |
| Recirculation system room | 1 | √ | √ | √ |
| Tank room | 1 | √ | √ | |
| Aquaria room | 1 | √ | √ | √ |
| Kitchen/fish preparation room | 1 | √ | | √ |
| Oxygen bottles and regulators | 4 | √ | √ | √ |
| Workshop access | 1 | | √ | |

TABLE 32 – SOUTH METROPOLITAN TAFE AQUACULTURE TRAINING FACILITIES AND UTILISATION

2.4.4. Collaborations

The aquaculture training team at South Metropolitan TAFE have been involved in a number of collaborations. These are summarised in Table 33 below.



| Collaboration | Description |
|---|--|
| Current Collaborations | |
| Bunbury Regional Prison | Development of an aquaponics system and delivery of some associated aquaculture training. |
| Perth and South West Secondary Schools | Delivery of Certificate II in Aquaculture through the VETiS program to various secondary schools in the Perth metropolitan area and the South West Region. Lecturers at Challenger are also supervising aquaculture traineeships with various private companies in the Perth region. |
| Historical Collaborations | |
| Challenger Institute School of Science and Environment (2010) | Development of an aquaponics system that was awarded the Sustainability Award from the Western Australian Fishing Industry Council (WAFIC). |
| Armadale Noongar Corporation (2009) | Development of an aquaponics system to deliver Certificate II in Aquaculture training in cooperation with the Armadale Noongar Corporation (\$85,000) |
| Aquaculture Council of Western Australia and Department of Fisheries (2006) | Together with the Aquaculture Council of Western Australia (ACWA) and Department of Fisheries, A\$140,000 was sourced to fund research projects for abalone, marron and prawns. |
| Kimberley College of TAFE (2000 and 2002) | Development of national course material with Kimberley College of TAFE for prawn course and sea cage course through several science and technology grants. |

TABLE 33 – CURRENT AND HISTORICAL COLLABORATIONS

2.5. South Metropolitan TAFE: Australian Centre for Applied Aquaculture Research

As a result of the merger discussed in Section 2.4, within the portfolio of South Metropolitan TAFE is the Australian Centre for Applied Aquaculture Research (ACAAR). Formerly known as the Aquaculture Development Unit, ACAAR was established in 1993 with a charter to assist in the development of the marine aquaculture industry in Western Australia.

ACAAR is an anomaly within the TAFE college aquaculture landscape in that it does not directly deliver VET training programs, but rather focuses on a role in undertaking applied research, advisory services and stock supply services for the purpose of supporting the development of a Western Australian aquaculture industry and is subsidised by the TAFE system for this purpose. Aquaculture VET courses at South Metropolitan TAFE are delivered through a separate, but related set of aquaculture training infrastructure (see Section 2.4).

While 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, the question as to whether it should be managed and funded within the structure of an institution that operates under the *Vocational Education and Training Act (WA) 1996* has always been a point of some contention, principally within the VET sector.



Changes to the *Vocational Education and Training Act (WA) 1996* that came into effect in July 2015 now present a very clear case that the VET system cannot continue funding the ACAAR facility. This issue is discussed further in Section 2.5.5.

2.5.1. Advisory, Applied Research and Stock Supply Services

Since 1994, ACAAR has undertaken exclusively, 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, from which ACAAR has received direct income of approximately A\$4.5 million, or 60 percent of the total contract value. Of the over 100 projects that ACAAR has undertaken, approximately 20 have been undertaken in collaboration with other research organisations. Customers have included a number of operators in the local Western Australian aquaculture industry, operators in the national and international aquaculture industry, key Western Australian government agencies (particularly the Department of Fisheries), national aquaculture research funding organisations and collaborations and foreign governments.

Figure 29 below illustrates historical project initiation at ACAAR by demonstrating total project value at the year the project was initiated, indicative of the relatively unpredictable nature of ACAAR's external revenue and the fact that in most large collaborative projects, ACAAR does not typically account for the majority of project revenue.

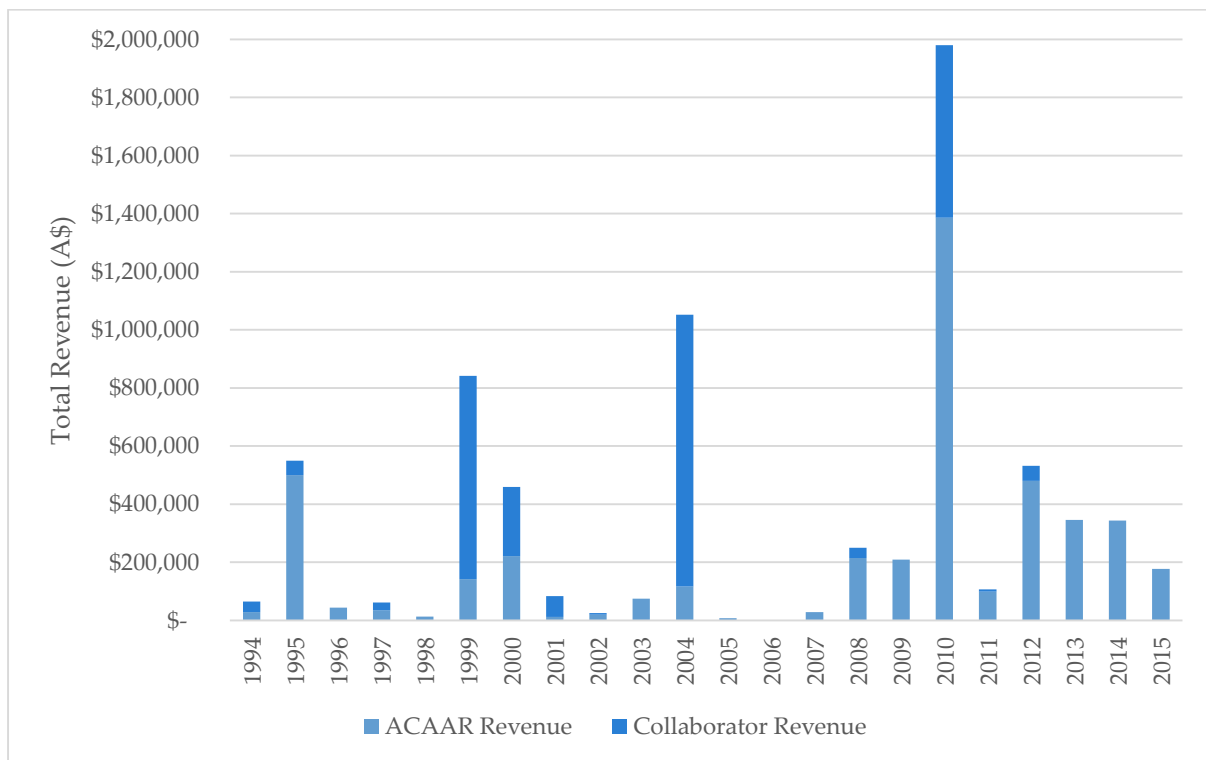


FIGURE 29 – ACCAR CONTRACTS BY TOTAL CONTRACT VALUE AT COMMENCEMENT DATE

Species Experience

In terms of ACAAR revenue from projects, projects focusing on barramundi accounted for approximately 32 percent of ACAAR's total project revenue since 1994, the majority of which has been sourced in more recent years. The next largest category of income, were projects



that were not specific to a single species, which accounted for approximately 24 percent of total project revenue for the period. Projects focused on Western Australian dhufish accounted for 11 percent of revenue and projects focused on yellowtail kingfish, 9 percent of revenue. Figure 30 below illustrates the species focus of ACAAR projects since its establishment by total revenue attributable to ACAAR.

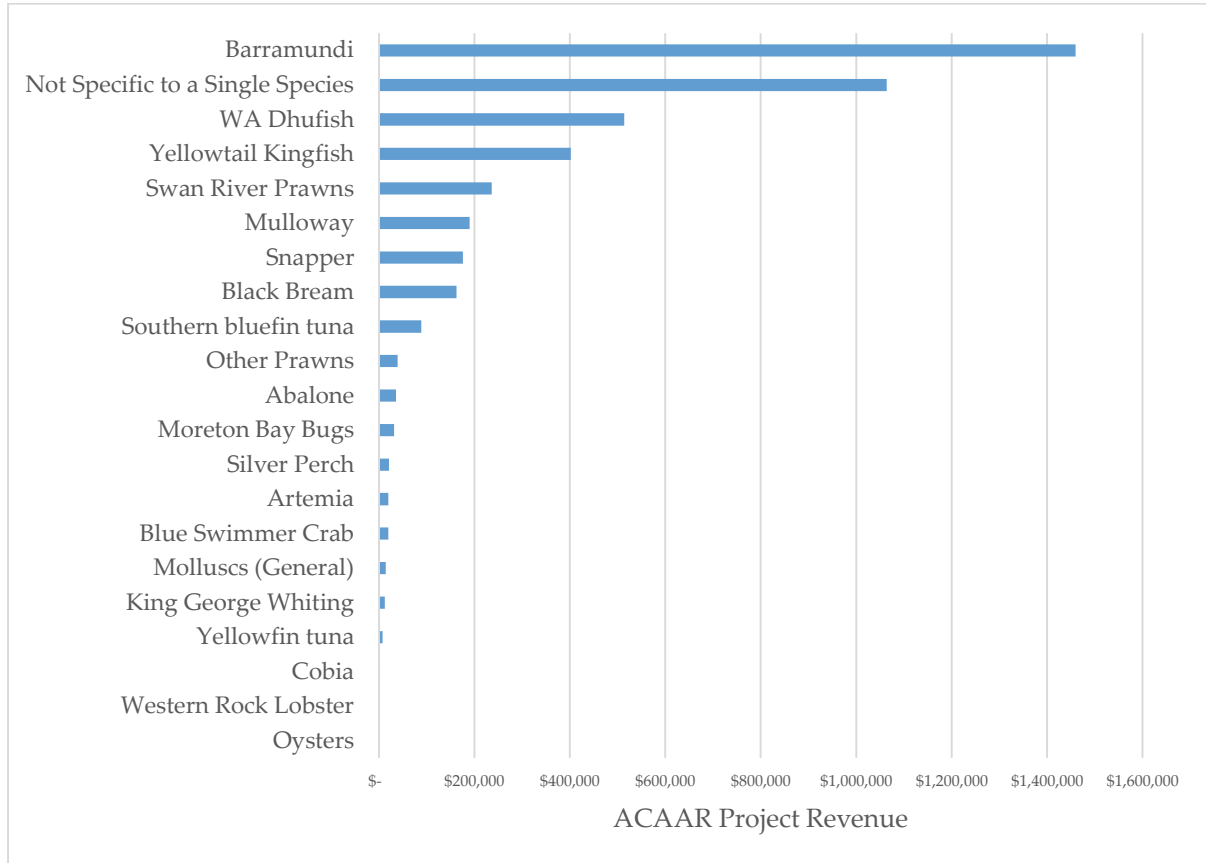


FIGURE 30 – ACAAR ADVISORY, APPLIED RESEARCH AND FISH SUPPLY SERVICES INCOME BY SPECIES (1995 TO 2015)

A key fact to note is that approximately 42 percent of ACAAR's external revenue has been associated with projects that are focused specifically on species in which Western Australia has established aquaculture projects (molluscs generally), or projects at various stages of development (barramundi, yellowtail kingfish and abalone). Approximately 70 percent of ACAAR's external revenue is focused on species for which there existing aquaculture projects, aquaculture projects under development or active or planned restocking projects for recreational species. Additionally, a reasonable portion of the projects that are not specific to a single species have application in these areas.

Activity Focus

In addition to species focus, the activities of ACAAR can be broadly classified according to the activity focus summarised in Table 34 below.



| Activity | Description |
|---------------------------------|---|
| Fish stock supply | The production of fish eggs or fingerlings for commercial, research or trial purposes, excluding those supplied for the purposes of restocking programs |
| Aquaculture techniques | Advisory and applied research services pertaining to developing or optimising overall aquaculture systems techniques and methods for specific species or locations. |
| Restocking R&D and Stock Supply | Applied research, advisory services, trials and fish production pertaining to restocking programs. |
| Technology development | Applied research, advisory services or trials pertaining to the development of aquaculture and aquaculture related technology. |
| Industry development | Applied research and advisory services pertaining to overcoming obstacles to the development of the aquaculture industry. |
| Hatchery R&D | Applied research, advisory services and trials pertaining to hatchery operations. |
| Fish health R&D | Applied research and trial pertaining to addressing fish health issues in aquaculture production systems. |
| Environmental | Applied research and trials that involve the use of aquaculture systems to undertake projects pertaining to the marine environment. |
| Nutrition R&D | Applied research and trials pertaining to developing nutrition programs, products or addressing problems associated with those programs or products. |
| Training | Development of custom aquaculture training programs or input into the design and development of mainstream aquaculture training programs. |
| R&D Coordination | Role in the coordination of multi-partner aquaculture related research projects. |
| Site Selection | Applied research and advisory services pertaining to the selection of suitable sites for aquaculture operations. |
| Genetics | Applied research and trials pertaining to issues associated with fish genetics for the purposes of aquaculture. |

TABLE 34 – ACAAR PROJECT ACTIVITY CLASSIFICATIONS

As illustrated in Figure 31 below, the provision of juvenile fish and eggs is by far the most significant source of external revenue for ACAAR, accounting for approximately 37 percent of total external revenue. Applied research, advisory and trial services pertaining to aquaculture techniques is the second main source of external income accounting for approximately 17 percent, and restocking the third largest source, accounting for 13 percent. Individually, other activities account for a relatively small portion of external revenue.

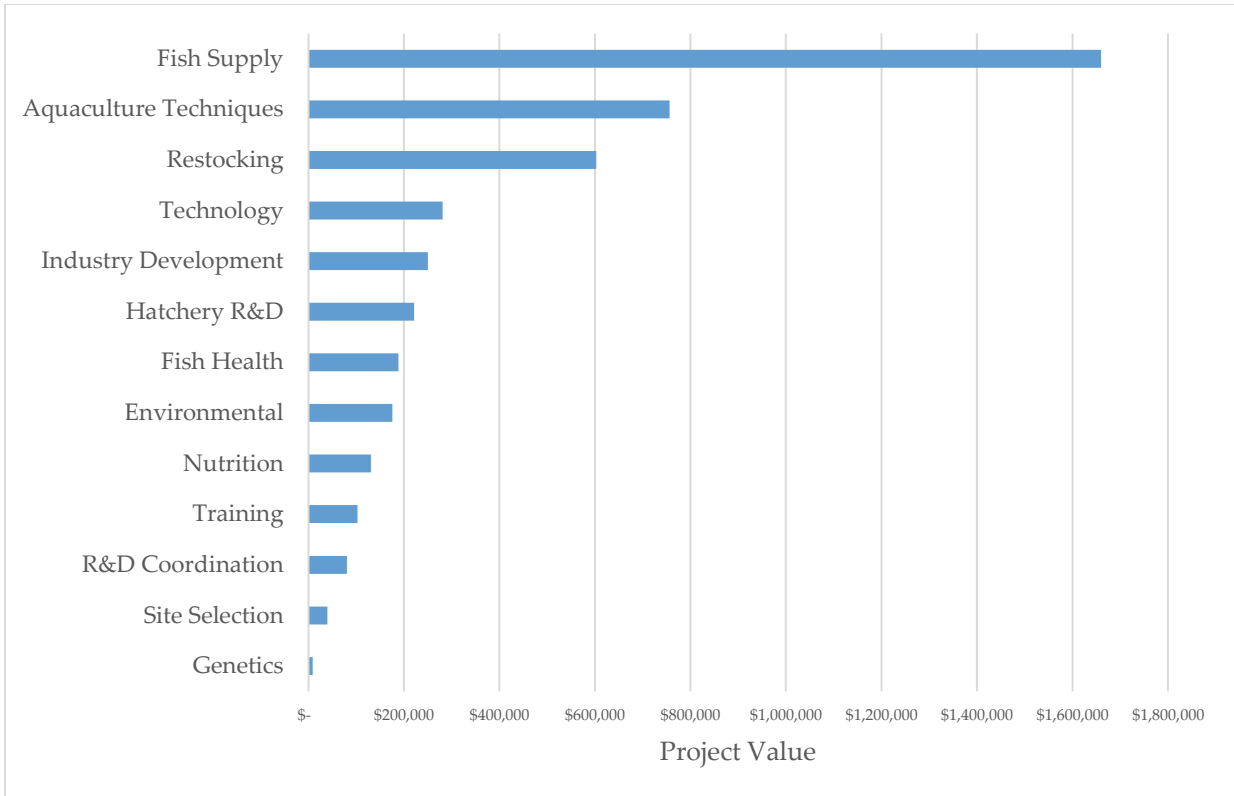


FIGURE 31 – ACCAR ADVISORY, APPLIED RESEARCH AND FISH SUPPLY SERVICES INCOME BY ACTIVITY (1994 TO 2015)

It is important to note that approximately 55 percent of ACAAR's external revenue since its establishment has been derived from activities directly related to hatchery (genetics, hatchery R&D, restocking and fish supply activities) and a number of projects in other activity categories have a hatchery element.

Fish Supply Stock Supply Activities

ACCAR has been supplying juvenile fish and eggs to a range of private sector clients since 2008 including the supply of:

- Barramundi to Marine Produce Australia and Marine Farms, both operations in Western Australia;
- Barramundi to ASMAK, a project in the United Arab Emirates and to Phillips Seafood, a project in Indonesia;
- Mulloway and yellowtail kingfish to Indian Ocean Fresh Australia, the operator of sea cage trials of both species in the Mid West;
- Silver perch to Aldrich Holdings for an operation in Western Australia; and
- Numerous other small fish and egg supply contracts.

Approximately 73 percent of ACAAR's total fish stock supply revenue is attributable to its service contract with Marine Produce Australia's Cone Bay barramundi operation (see Section 5.1. ACAAR has delivered barramundi fingerlings under this contract since 2010. Initially ACAAR produced the fingerlings from broodstock held at its facilities. However in recent years, Marine Produce Australia began sourcing fingerlings from a private hatchery located in Geelong Victoria (Mainstream Aquaculture), which according to Marine Produce Australia has a superior genetic line derived from faster growing Queensland barramundi broodstock. Under this arrangement, ACAAR receives juvenile from Mainstream Aquaculture and performs a mid-



transit nursery function before the larger juveniles are transported to the grow-out facility at Cone Bay.

Over the period 2011 to 2012, the provision of barramundi eggs and juveniles accounted for approximately 80 percent of ACAAR's total fish stock supply revenue. While smaller contracts pertaining to various species accounted for a relatively smaller portion of total revenue from fish stock supply contracts (14.3 percent), it has been a consistent and reliable source of revenue. The supply of yellowtail kingfish juveniles accounted for approximately 3 percent of external income from fish stock supply contracts.

Figure 32 below illustrates the total value of fish stock supply contracts that ACAAR is party to by year of contract commencement.

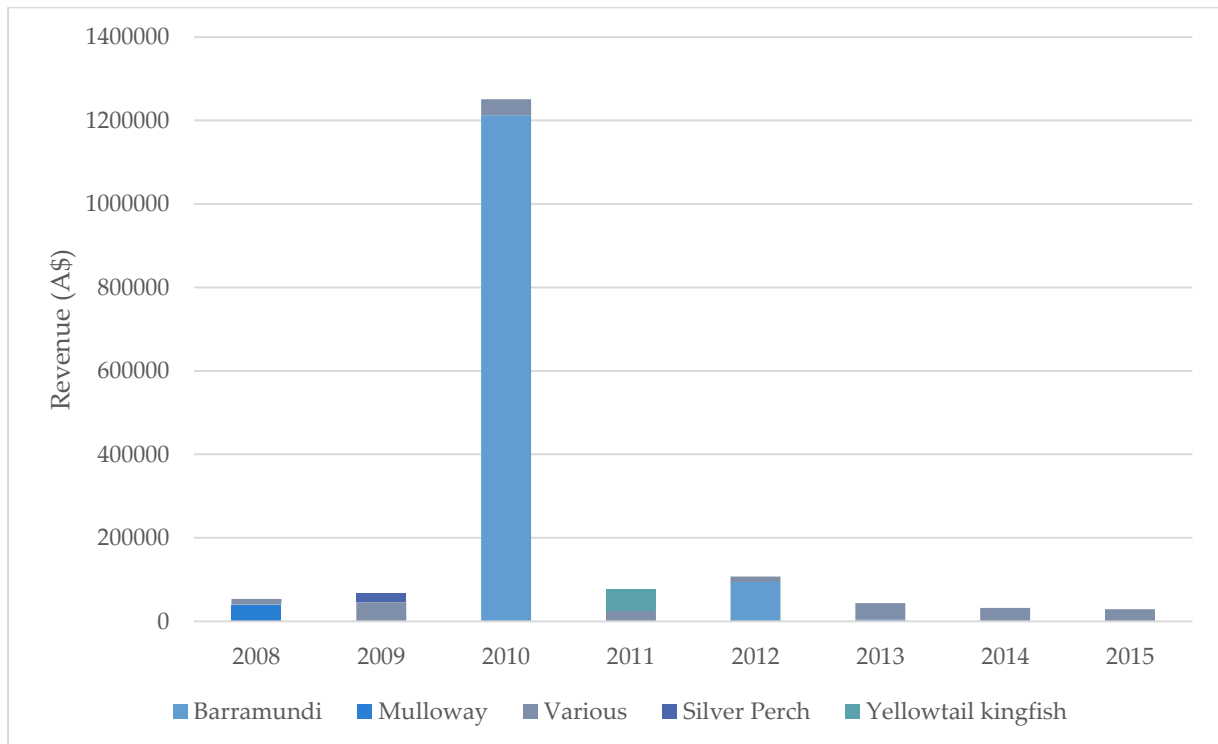


FIGURE 32 – ACAAR FISH SUPPLY CONTRACTS

Aquaculture Techniques

Pursuant to the purpose for which it was established, ACAAR has been undertaking applied research and providing advice on the development or optimisation of aquaculture systems since its establishment. However, new contracts have only been initiated in approximately half of the years in which ACAAR has been operational.

The relative scale of revenue delivered by this area of activity is derived from a single project that was funded by the Western Australian Department of Fisheries and the Fisheries Research and Development Corporation, revolving around developing aquaculture production techniques for the Western Australian dhufish. This project commenced in 1995 and was completed in 2000. While the project delivered technical success, it concluded that, primarily as a result of slow growth rates, the aquaculture production of Western Australian dhufish is sub-economic.



Importantly, the next largest source of revenue from applied research and advice pertaining to aquaculture techniques (13 percent of the total since 2011) relates to yellowtail kingfish operations. ACAAR commenced providing such services to yellowtail kingfish research projects, trials and operations in 2009. Clients have included Wageningen UR, a research collaboration in the Netherlands focusing on food production, Acuino, a commercial producer of marine finfish in Chile, the Australian Seafood Cooperative Research Centre and the Indian Ocean Fresh – Mid West Development Commission Yellowtail Kingfish Project off the coast of Geraldton (see Section 5.2).

Services provided in this area with respect to other species has been relatively minor in terms of revenue generation and have been provided exclusively to private sector clients. Figure 33 below illustrates revenue associated with applied research, advisory and trial aquaculture technique services by year of contract commencement.

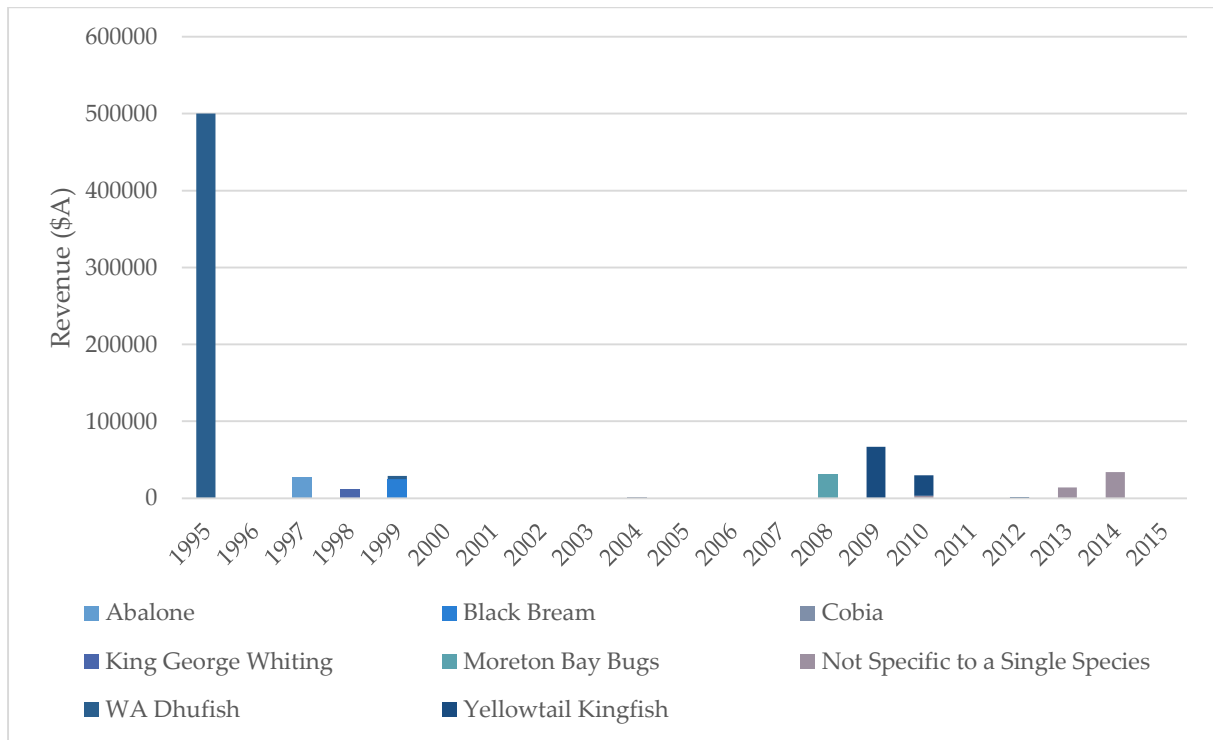


FIGURE 33 – ACAAR ADVISORY AND APPLIED RESEARCH AQUACULTURE TECHNIQUE CONTRACTS

Restocking R&D and Stock Supply

ACAAR's first restocking project commenced in 1996 and between 1996 and 2008 undertook or was party to R&D, trials and production of juveniles for the purposes of restocking a popular recreation fishing species, black bream, in the Swan and Blackwood Rivers. These projects were funded by the Fisheries Research and Development Corporation, Water Corporation and Western Australian Department of Fisheries and in one instance undertaken in collaboration with Murdoch University. In 2010, ACAAR participated in a study designed to examine the potential for restocking of species targeted by recreational fishers and since then has undertaken restocking R&D and trial programs for a number of such species including mulloway, snapper, swan river prawns and blue swimmer crab. The restocking projects in these additional species have been funded exclusively by Recfishwest (see Section 6.1).

Figure 34 below, illustrates ACAAR revenue associated with restocking projects by year of project commencement.

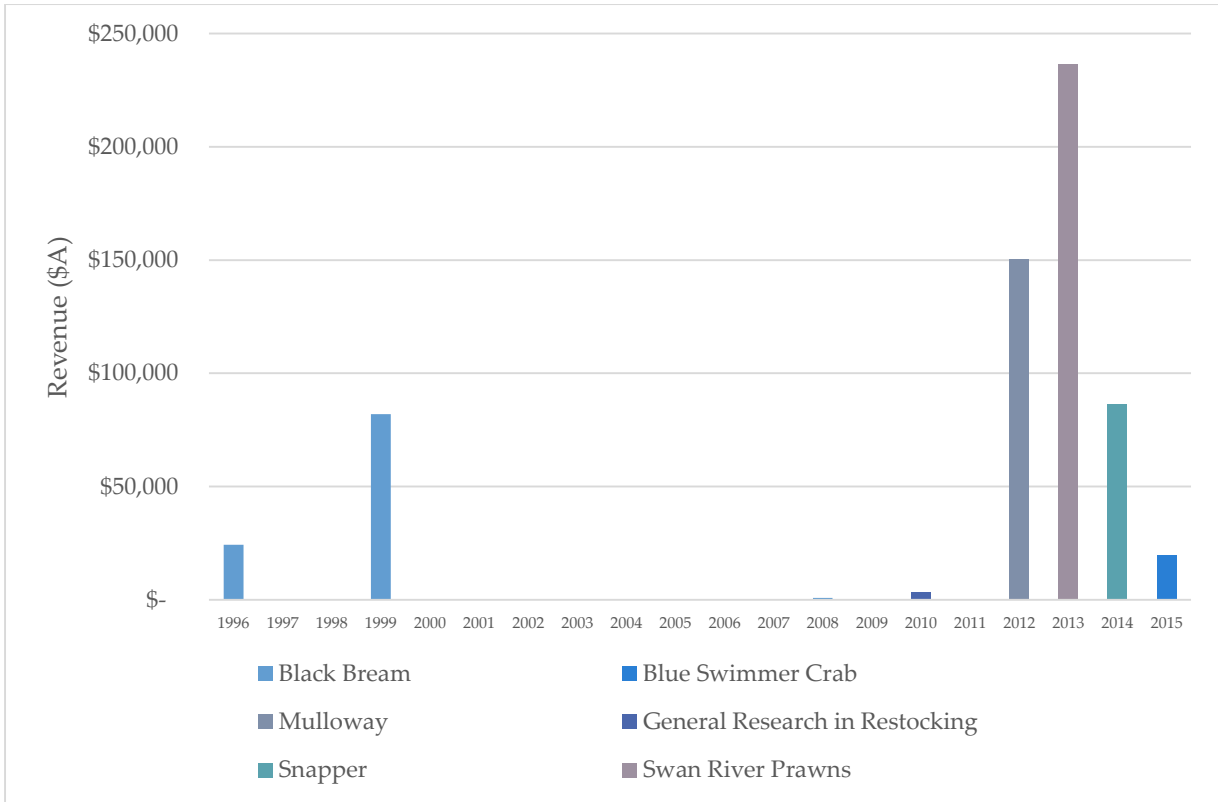


FIGURE 34 – ACAAR RESTOCKING APPLIED RESEARCH AND SUPPLY CONTRACTS

Aquaculture Technology Development

ACAAR has undertaken R&D and trials and advised on the development of technology for aquaculture systems since 2006. With the exception of a project pertaining to artemia in 2009 and two pro-bono projects pertaining to snapper and western rock lobster undertaken in 2001 and 2015 respectively, ACAAR’s involvement in technology development has been for systems that are not specific to a single species.

Approximately 50 percent of the value of projects undertaken in this area have revolved around general recirculating aquaculture systems technology and 33 percent on systems specifically for inland saline aquaculture. Approximately 12 percent has been associated with the design and trial of systems for transporting live juvenile fish by aviation or road freight.

Projects in this area have been undertaken for international clients in Israel and Greece, for a range of private sector clients including Morowa Farm Improvement Group, McRoberts Contracting, Q-Leach, Cell Aquaculture and Cleanseas Tuna, as well as a number of government instrumentalities including Department of Fisheries, Western Power, Fisheries Research and Development Corporation, Western Power and the Gascoyne Development Commission.

Figure 35 below, illustrates ACAAR revenue associated with technology development projects by year of project commencement.

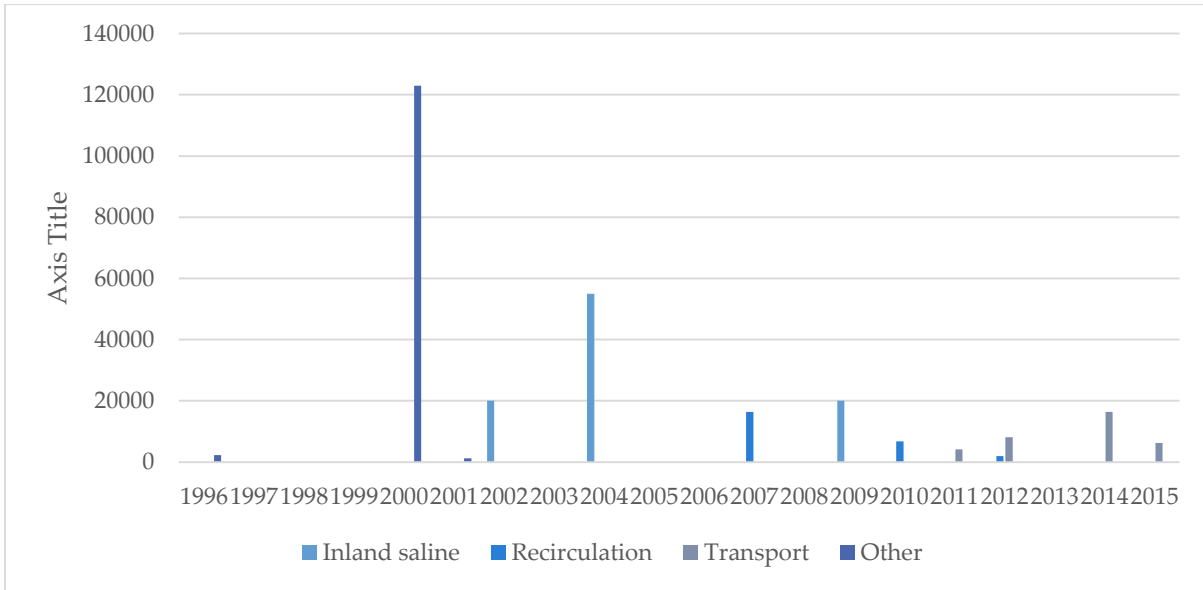


FIGURE 35 – ACAAR TECHNOLOGY DEVELOPMENT CONTRACTS

Industry Development

Between the period 2003 and 2015, ACAAR has also been involved in several industry development projects. Four projects undertaken by ACAAR in this category have focused on developing a marine finfish industry in Western Australia and collectively accounted for 98 percent of revenue in this category, with an additional project undertaken for the Chilean Government accounting for the balance.

Since 2003, ACAAR has sourced revenue of approximately A\$250,000 from this category of activity. The vast majority (82 percent) was associated with a Seafood CRC project examining removal of barriers to profitability for a marine finfish industry in Western Australia. A project designed to develop guidelines for sustainable development of a Western Australian marine finfish industry funded by Challenger, Fisheries WA and the WA Conservation Council undertaken in 2003, and an opportunity study of open ocean aquaculture in Western Australia funded by the Western Australian Department of Fisheries was undertaken in 2008, collectively accounted for an additional

Figure 36 illustrates ACAAR revenue associated with technology development projects by year of project commencement.

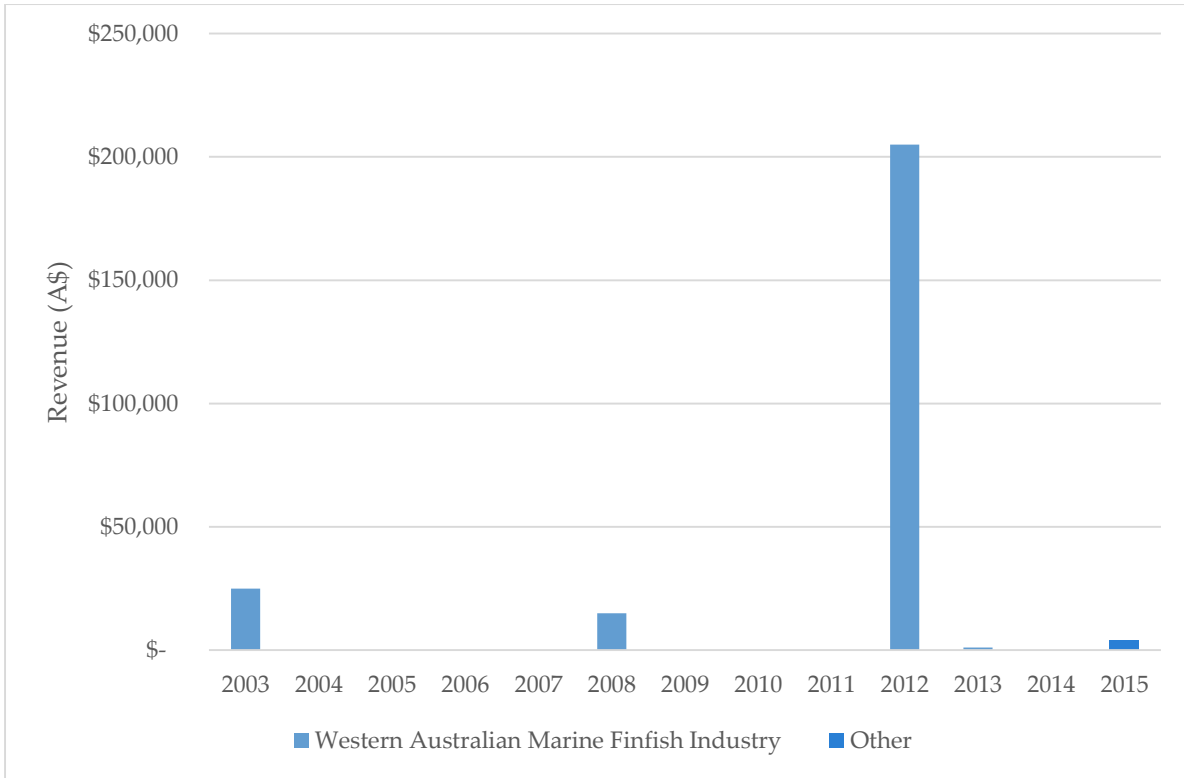


FIGURE 36 - ACAAR TECHNOLOGY DEVELOPMENT CONTRACTS

Hatchery R&D

While ACAAR has undertaken hatchery related R&D projects since 1996, the majority of this work has been undertaken since 2010 and has revolved around a southern Bluefin tuna hatchery R&D project undertaken for the Seafood CRC and two separate yellowtail kingfish hatchery projects undertaken for Cleanseas Tuna and the Mid West yellowtail kingfish project.

Figure 37 illustrates ACAAR revenue associated with hatchery R&D projects by year of project commencement.

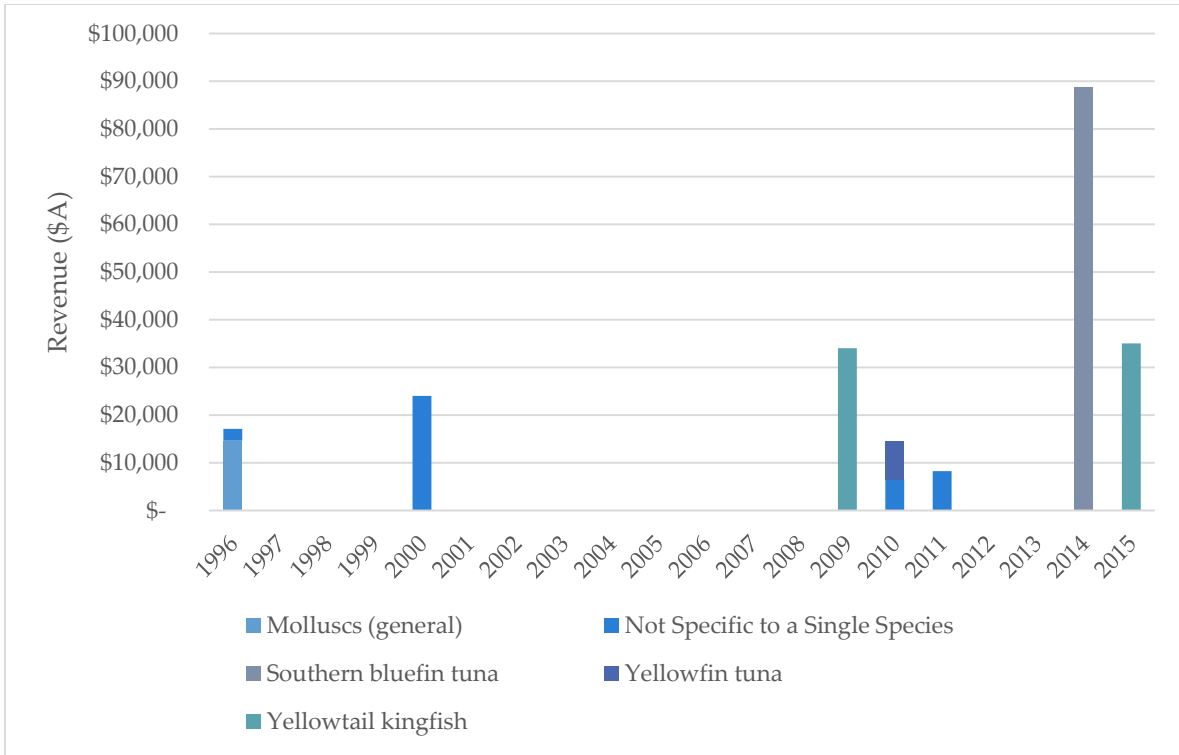


FIGURE 37 – ACAAR HATCHERY R&D CONTRACTS

Fish Health R&D and Trials

The vast majority (95 percent) of fish health R&D and trials that have been supported by ACAAR have occurred since 2008 and have focused on barramundi and yellowtail kingfish. All of the barramundi fish health work has been undertaken for private clients including Stirling Products and Zamira Life Sciences. The yellowtail kingfish work has been undertaken for Zamira Life Sciences, Midwest Development Commission and the FRDC.

Figure 38 illustrates ACAAR revenue associated with fish health R&D and trial projects by year of project commencement.

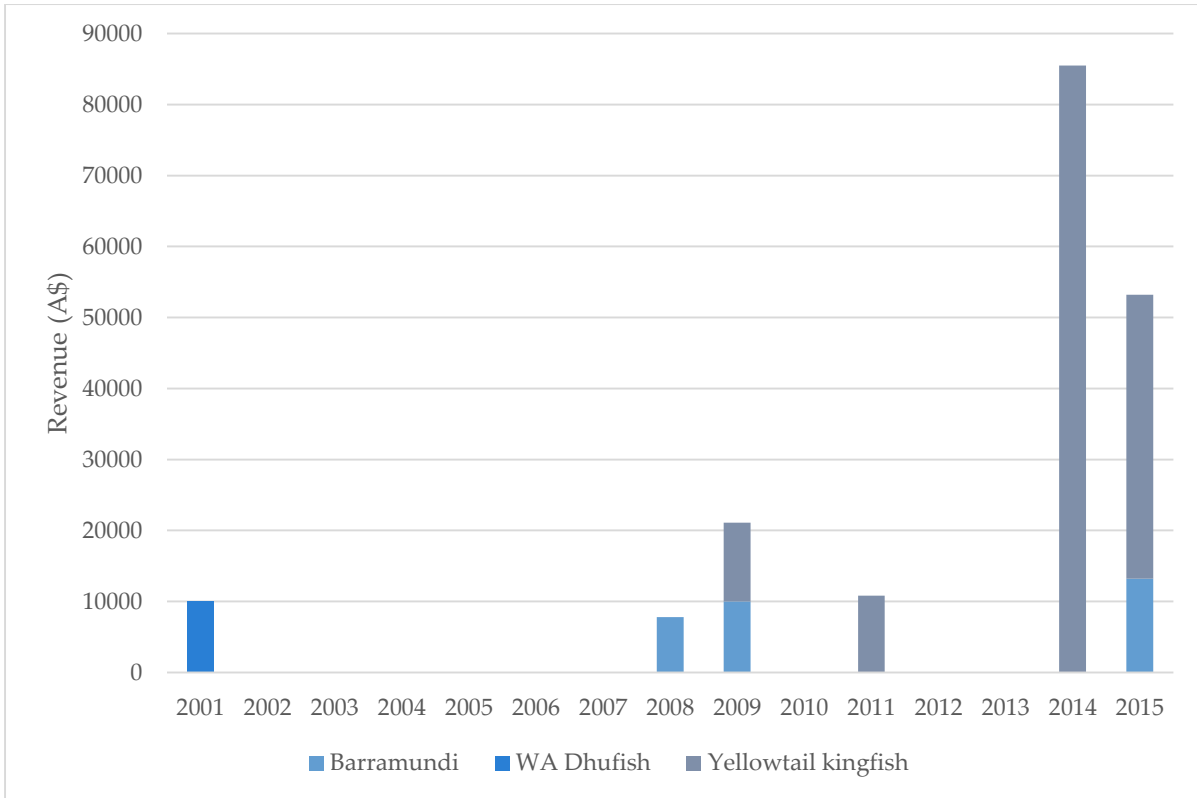


FIGURE 38 – ACAAR FISH HEALTH R&D AND TRIAL PROJECTS

Environmental Simulation and Analysis

Between 2003 and 2010, ACAAR supported three projects undertaken for the private sector in the environmental impact study area. This included a study investigating the effects of phylite dredge spoil on barramundi for INPEX, desktop study exploring the effect of dredge plume on fish eggs and larvae for Oceanica Consulting and a study exploring the effect of dredge plume on Cockburn Sound snapper eggs and larvae. This work had a total value of approximately A\$175, 500.

Nutrition R&D and Trials

ACAAR's first involvement in nutrition R&D and trials occurred during the 1990s, when it provided some support to work being undertaken primarily by the Grains Research and Development Corporation pertaining to the use of lupin meal as a replacement for fishmeal in aquaculture diets. In 2013, ACCAR undertook some research supported by the World Wildlife Foundation exploring sustainable feeds for barramundi, and in 2015 supported yellowtail kingfish nutrition trials for the FRDC. Total revenue from this category of activity up to 2015 is approximately A\$130,000.

Design and Delivery of Training Programs

Since 2000, ACAAR has periodically developed training programs for overseas clients and the private sector, including in collaboration with other TAFE colleges. This has included a:

- VET course for aquaculture production of marine prawns developed in collaboration with North Regional TAFE, Cape Seafarms, MG Kailis, Southern Cross Aquaculture and Glen Forrest Stockfeeds in 2000;
- VET course for environmental management of marine finfish growout for Department of Training and Workforce Development, MG Kailis and Conservation Council in 2003;



- Marine fish culture course for the Government of Chile; and
- Tailored training course for SILT BV pertaining to yellowtail kingfish aquaculture.

ACAAR has sourced total revenue up to 2015 from this area of activity of A\$171,000.

Other Activities

ACAAR has also played a role in coordinating R&D for FRDC, Fisheries WA and Seafood CRC funded projects, has provided input to aquaculture site selection projects from government and private sector clients and has undertaken a small project pertaining to genetics in barramundi.

2.5.2. Financial Performance of ACAAR

While all categories of ACAAR revenue have grown over the period 2011 to 2015, the strongest growth has been in the State Government contribution (a direct subsidy) which has grown at a CAGR of 11 percent over the period and accounts for 52 percent of ACAAR's total revenue. Fee for service associated primarily with the post 2010 projects discussed above accounted for 35 percent of total revenue and grew at a CAGR of 5.3 percent over the period and revenue from ancillary training accounted for 8.2 percent of total revenue for the period and grew at a CAGR of 9.0 percent.

The trend in ACAAR revenue is illustrated in Figure 39 below.

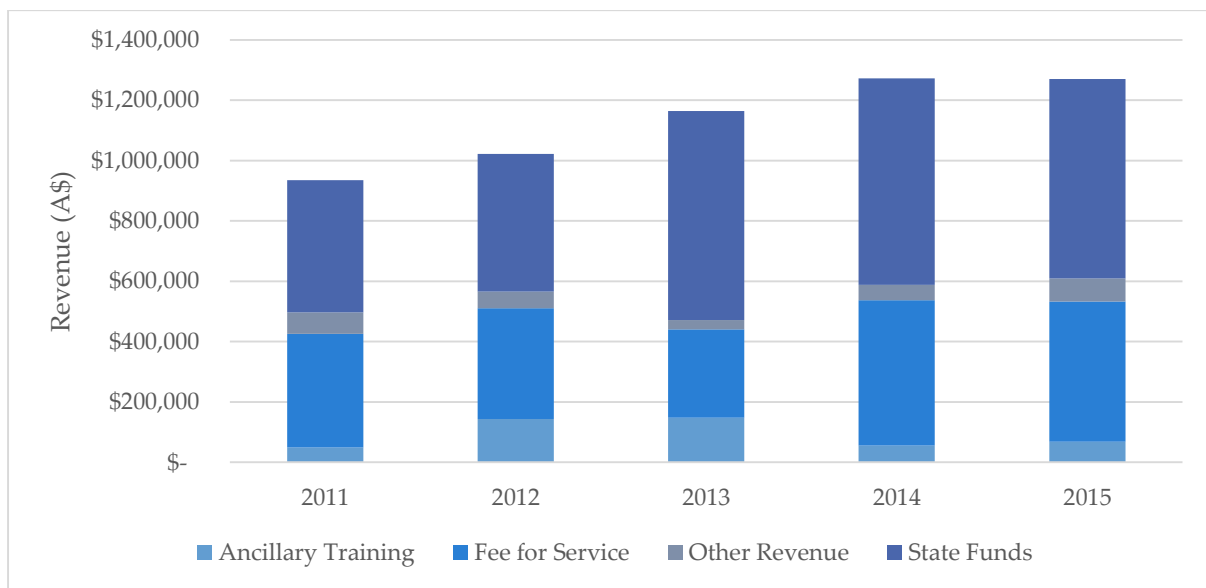


FIGURE 39 – ACAAR REVENUE (2011 TO 2015)

ACAAR's total costs grew at a CAGR of 8.5 percent for the period 2011 to 2015. Salaries which accounted for 70 percent of the total cost base grew at a CAGR of 7.7 percent over the same period. Figure 40 below illustrates the trend in costs at ACAAR.



FIGURE 40 – ACAAR EXPENDITURE (2011 TO 2015)

Over the period 2011 to 2015, ACAAR has either operated on a near break-even basis or at a surplus. The average surplus over the period was \$48,414. However, this has been entirely the result of subsidisation by the State that averaged in excess of 50 percent of ACAAR's total revenue for the period. As illustrated in Figure 41 below, in the absence of this subsidy, ACAAR would have incurred substantial deficits for the period and importantly, that deficit demonstrates an increasing trend.

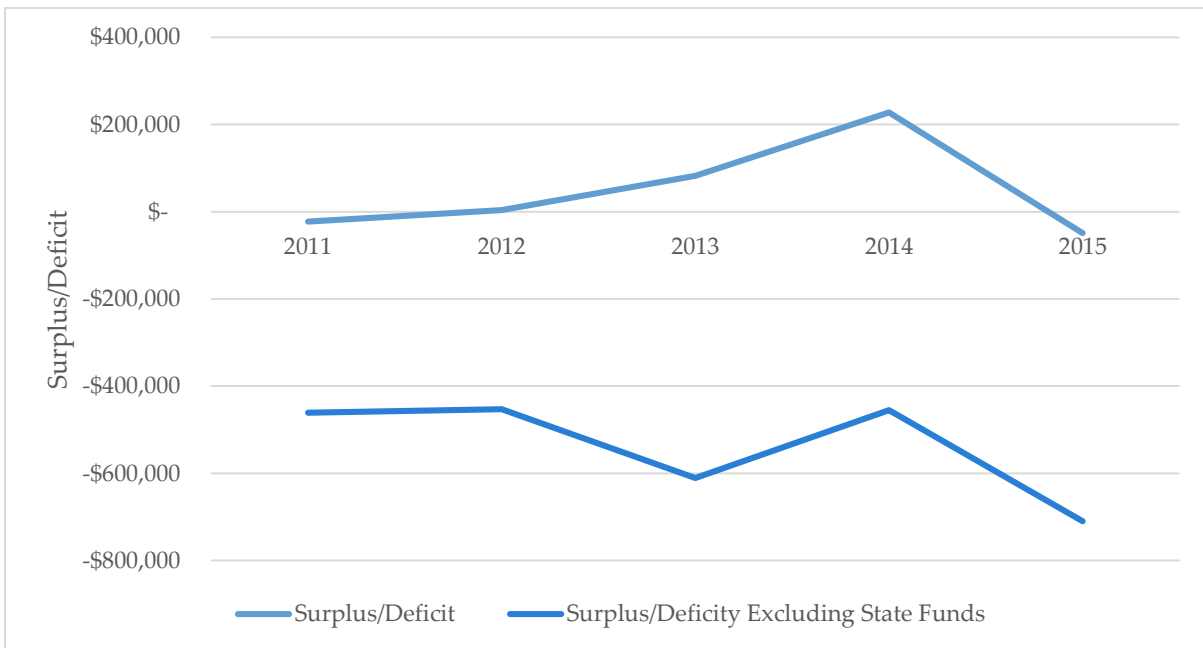


FIGURE 41 – ACAAR OPERATING SURPLUS/DEFICIT (2011 TO 2015)



2.5.3. Current Staffing

The capability at ACAAR is currently underpinned by the 8 FTE resources summarised in Table 35 below.

| Position | FTE |
|-----------------------------------|------------|
| ACAAR Director | 1.0 |
| Aquaculture Systems Specialist | 1.0 |
| Aquaculture Production Supervisor | 1.0 |
| Senior Research Scientist | 1.0 |
| Senior Technician | 1.0 |
| Prawn Technician | 1.0 |
| Research Coordinator | 1.0 |
| Casual Technician 1 | 0.5 |
| Casual Technician 2 | 0.5 |
| TOTAL | 8.0 |

TABLE 35 – ACAAR STAFFING PROFILE

2.5.4. Current Facilities

Table 36 below summarises the aquaculture facilities operated by ACAAR. These facilities are utilised almost exclusively for the purposes of ACAAR and are not used in the conduct of the VET aquaculture courses offered by South Metropolitan TAFE discussed in Section 2.4 above.



| 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 36 – ACAAR AQUACULTURE FACILITIES

The estimated capital investment associated with the ACAAR facilities is summarised in Table 37 below.

| Item | Installation Date | Cost |
|--|--------------------------|-----------------|
| Initial Fit Out | 1994 | A\$2.0 million |
| Seawater bores | 1996 | A\$50,000 |
| Pumps (including replacement) | Replaced every 2.5 years | A\$270,000 |
| Rotifer and Controlled Environment Rooms | | A\$40,000 |
| Tropical Larval Deck | | A\$20,000 |
| Nutrition Tank Array | | A\$70,000 |
| Autoclave | | A\$20,000 |
| ICT | | A\$20,000 |
| TOTAL | | A\$2.49 million |

TABLE 37 – ESTIMATED CAPITAL INVESTMENT IN ACAAR



2.5.5. Issues for South Metropolitan TAFE and ACAAR

Critical Component of Industry Infrastructure

The services provided by ACAAR, particularly with respect to the provision of juvenile fish and the hatchery nursery facilities and expertise that underpin that service, as well as general aquaculture advice pertaining particularly to barramundi and yellowtail kingfish is of critical importance to the two key marine finfish projects currently under development in Western Australia.

Noting that this activity is subsidised by South Metropolitan TAFE and the Western Australian Government, the loss of access to the ACAAR capacity and capability would likely be problematic for the Marine Produce Australia Cone Bay barramundi operations and catastrophic for the Mid West yellowtail kingfish project, Such an eventuality has the potential to be terminal for the development of a Western Australian marine finfish aquaculture sector for the foreseeable future. The Western Australian Government has an interest in the Kimberley Aquaculture Development Zone in which the Cone bay project is the only current operator, the development of the proposed Mid West Aquaculture Development Zone and a direct financial interest in the Mid West Yellowtail Kingfish Project (see Sections 3.4 and 5.2).

Critical Component of the Recreational Fishing Restocking

The restocking of species of inland and marine fish that are popular with recreational fishers is controversial. The controversy revolves around perspectives as to whether resources are better directed to addressing the management of underlying ecosystem issues that are driving the reduction of stocks, which can include over-fishing from a commercial or recreational perspective. In some cases, there is also some conjecture as to how effective restocking is with respect to survival of introduced stock.

Nevertheless, there is a growing acceptance among industry, the scientific sector and regulators that the restocking of species that are popular with recreational fishers and can be beneficial, at least from a community perspective. Furthermore, the recreational fishing sector demonstrates enthusiastic support for restocking and the practice has significant political support. It is highly probable that restocking will play an increasingly important role in managing stocks of certain species in Western Australia.

ACAAR's facilities and capabilities fundamentally underpin restocking capability and capacity in Western Australia.

Site Lease

Both the aquaculture training facilities of South Metropolitan TAFE and ACAAR operate on a site that is the subject of a lease with the Fremantle Port Authority. The cost of lease attributable to the area of the lease site on which aquaculture training and ACAAR are located was A\$150,250 in 2015.

This lease is scheduled to expire in mid-2018.

There has been some speculation that the proposed sale of Fremantle Port may compromise the ability of the South Metropolitan TAFE aquaculture training facilities and ACAAR to remain on its existing site, as an acquirer of Fremantle port will likely desire full optionality with respect to the quay and other port lands. However, it is understood that while it is as yet to be determined by the Western Australian Government, the area that includes the aquaculture



facilities has been recommended to be excluded from the Fremantle Port divestment package and retained by the residual Port Authority.¹⁰

Regardless of the tenure of the lease, it is understood that it is unlikely that South Metropolitan TAFE will renew the lease in 2018. This is because with the exception of aquaculture training and ACAAR which require access the seawater bore infrastructure, other activities at the Fleet Street campus do not require immediate access to the ocean and could be more efficiently delivered from a lower cost location.

This circumstance presents a significant challenge to ACAAR and aquaculture training, as relocation from the immediate site area would be limited to locations that have access to existing seawater intakes or bores of adequate scale and quality, or the establishment of expensive new infrastructure.

Buildings

The facilities listed in Table 36 above are housed in 80 year old buildings constructed from timber and corrugated iron. They are also 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 the 'make-good' requirements should South Metropolitan TAFE not renew its Fleet Street Campus lease are understood to be considerable (A\$0.5 million to A\$3.0 million).

Aquaculture Systems Integrity

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.

It is estimated that rebuilding the ACAAR facility on or immediately adjacent to the existing Challenger Institute site whereby it is able to utilise the existing marine bore infrastructure would cost in the vicinity of A\$6 to 8 million. If ACAAR was to move to a new site, where new water intake systems would need to be established, the cost would likely be around A\$20 million. Options for re-establishing the ACAAR capability are discussed in detail in Section 8.

Operating Outside the Mandate of the TAFE System

While ACAAR was established with a specific purpose, that purpose and the extent to which that purpose is pursued by ACAAR is now outside the mandate of the TAFE system. ACAAR does not conduct or support VET training in any substantial way and is subsidised by the TAFE system for the purpose it was established. This has always been controversial. However, as the result of changes to the governance of the TAFE system, the current operational and funding framework for ACAAR can no longer persist.

2.6. South Regional TAFE

South Regional TAFE was formed in early April 2016 as a result of the merger of the following former TAFE college campuses:

- CY O'Connor Institute, Narrogin
- Goldfields Institute of Technology, Esperance

¹⁰ Department of Treasury, Western Australian Government.



- Great Southern Institute Albany
- Great Southern Institute Denmark
- Great Southern Institute Katanning
- Great Southern Institute Mt Barker
- South West Institute of Technology Bunbury
- South West Institute of Technology Busselton
- South West Institute of Technology Collie
- South West Institute of Technology Harvey
- South West Institute of Technology Manjimup
- South West Institute of Technology Margaret River

Included in the portfolio of the South Regional TAFE is the aquaculture training, advisory and fish stock supply service activities undertaken by the former Great Southern Institute, primarily at its Albany campus. Compared to the aquaculture activities of North Regional TAFE, Central Regional TAFE, South Metropolitan TAFE (including ACAAR), the aquaculture activities of South Regional TAFE are relatively small in scale and breadth from a training, advisory and fish stock supply perspective.

2.6.1. History of Aquaculture Training

Genesis of Aquaculture Training at South Regional TAFE

Primarily as a result of encouragement from local industry operators and associations such as Ocean Foods International, the Great Southern Trout Alliance and West Inland Fisheries Association, South Regional TAFE began developing and aquaculture program in 1993 and delivered its first aquaculture course in 1994.

Aquaculture Course Delivery History

Table 38 below summarises historical and contemporary aquaculture courses delivered by South Regional TAFE.

| Course | First Delivery | Last Delivery |
|---|----------------|---------------|
| Certificate I in Seafood Industry (Aquaculture) | | 2005 |
| Certificate II in Seafood Industry (Aquaculture) | | 2005 |
| Certificate III in Seafood Industry (Aquaculture) | | 2005 |
| Certificate IV in Seafood Industry (Aquaculture) | | |
| Certificate III In Seafood Operations (Aquaculture) | | 2005 |
| Certificate I in Aquaculture | | 2011 |
| Certificate II in Aquaculture | | Present |
| Certificate III in Aquaculture | | Present |
| Certificate IV in Aquaculture | | Present |
| Diploma of Aquaculture | | Present |

TABLE 38 – HISTORICAL AND CURRENT AQUACULTURE COURSES OFFERED BY SOUTH REGIONAL TAFE



Since 2011, a total of 193 students have enrolled in aquaculture courses at South Regional TAFE, or an average of approximately 39 students per year. The majority of these students, approximately 78 percent, were enrolled in Certificate I or Certificate II courses. Enrolments in aquaculture programs at South Regional TAFE grew from 38 in 2011 to a peak of 74 in 2014 and in 2015, reduced to 41.

Students enrolling in aquaculture courses at South Regional TAFE typically do so for one of the following three reasons:

- To set the foundations for a career in the aquaculture industry;
- As a basis for further education, such as a pathway into marine science; or
- As a basis for establishing an aquaculture enterprise, which typically represents an income diversification strategy for a broad-acre livestock and/or cropping enterprise in the region, using saline dam infrastructure, or a as a hobby.

Stocking of saline farm dams with trout is a reasonably common practice in the Region. However, because the water temperature becomes unsuitable by the early summer months, the local market tends to become flooded with product around October each year.

The trend in enrolments in aquaculture courses at South Regional TAFE is illustrated in Figure 42 below.

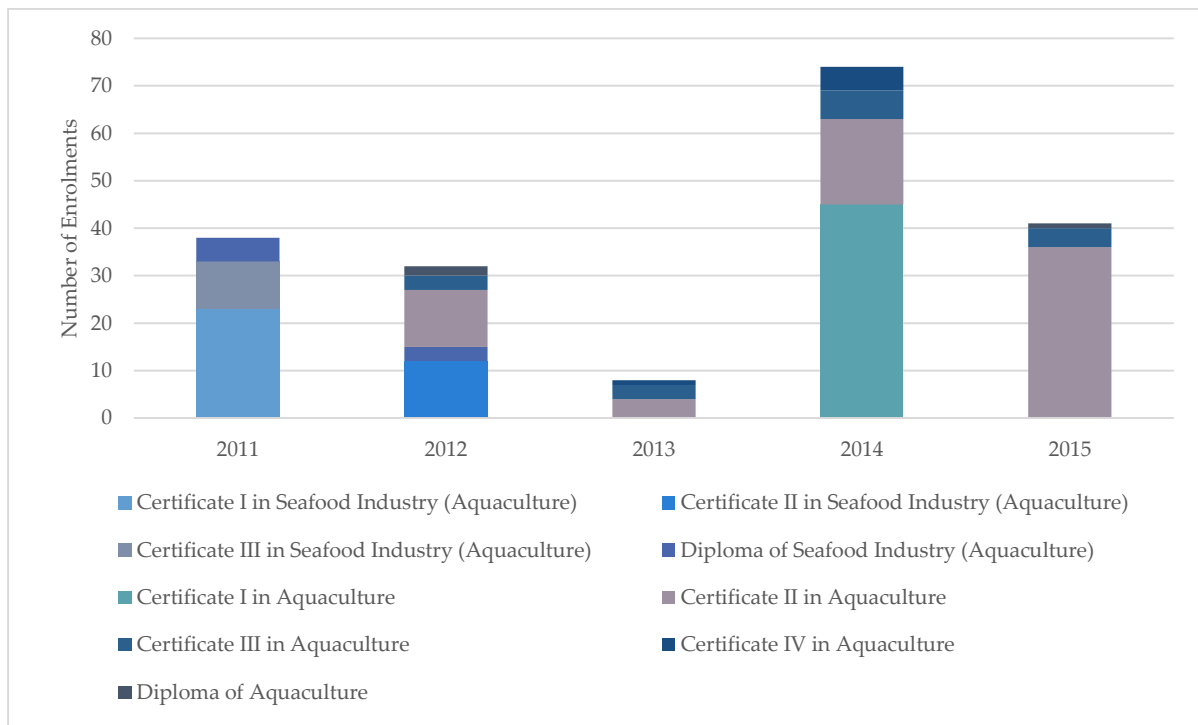


FIGURE 42 – TREND IN ENROLMENTS IN AQUACULTURE COURSES AT SOUTH REGIONAL TAFE (2011 TO 2015)

As illustrated in Figure 43 below, the total Student Curriculum Hours associated with the enrolment history illustrated in Figure 42 has been relatively consistent with the trend in enrolments.

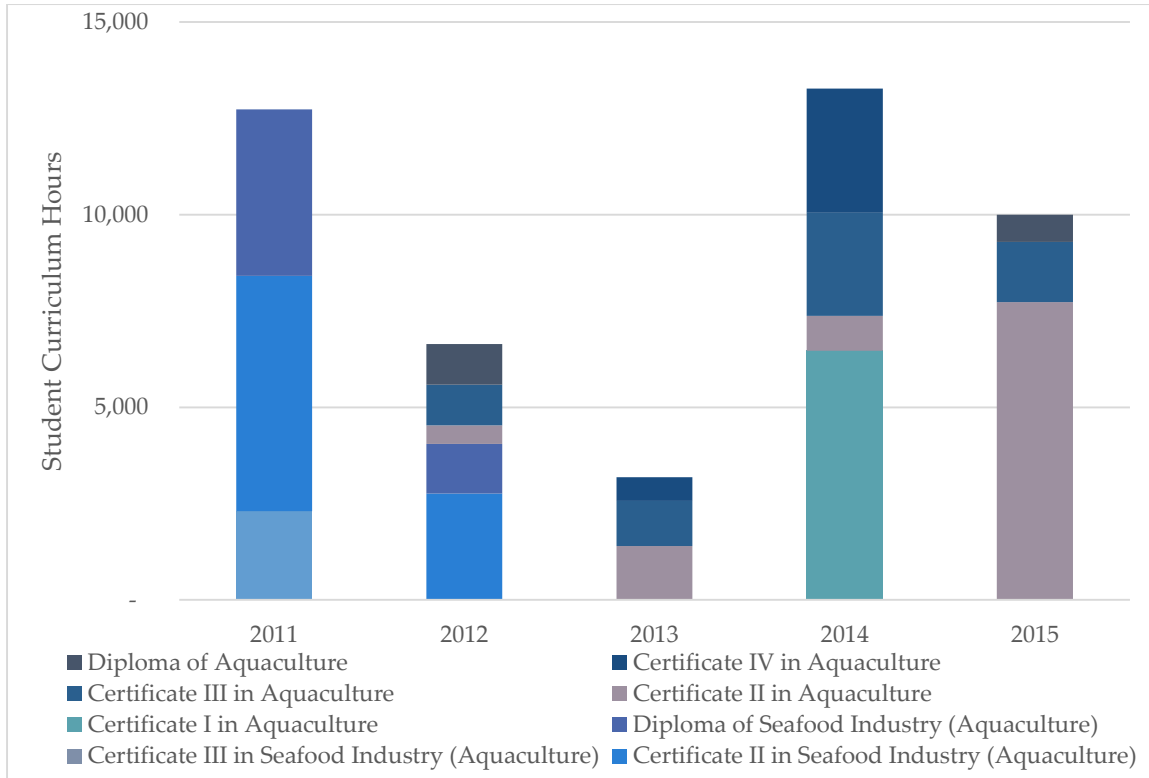


FIGURE 43 – STUDENT CURRICULUM HOURS FOR AQUACULTURE COURSES DELIVERED BY SOUTH REGIONAL TAFE

Over the same period South Regional TAFE has issued a total of 58 qualifications in aquaculture, representing an average of approximately 12 qualifications per annum. The trend in aquaculture qualifications issued by South Regional TAFE is illustrated in Figure 44 below.

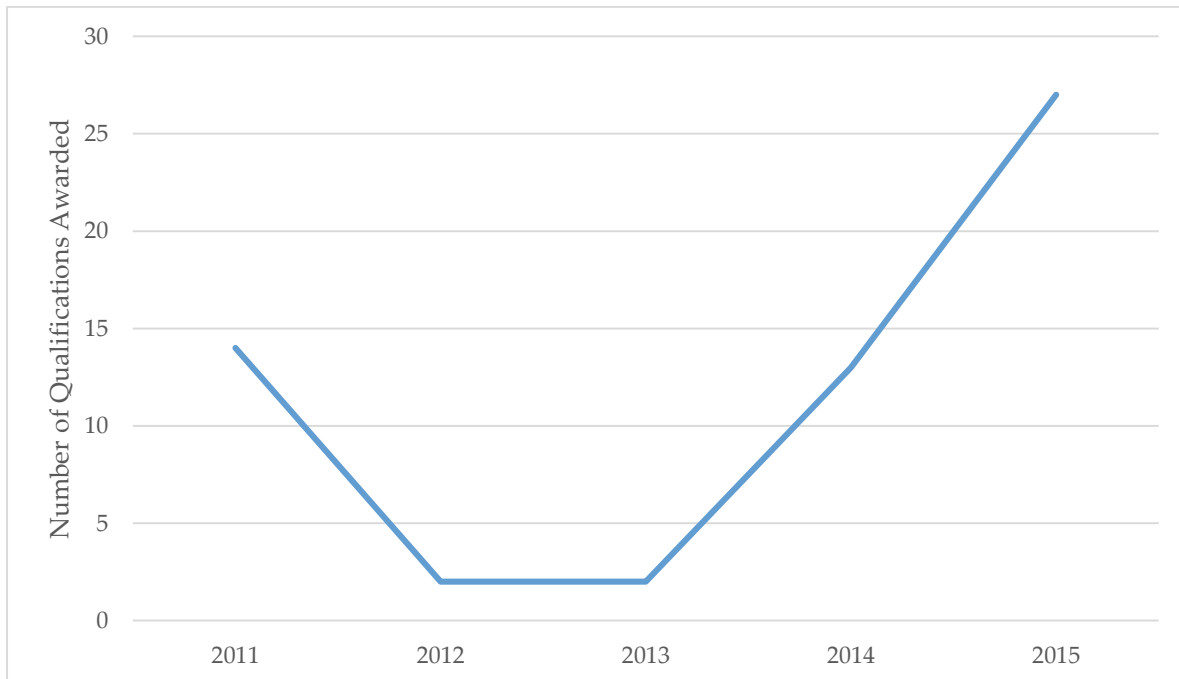


FIGURE 44 – TREND IN AQUACULTURE QUALIFICATIONS ISSUED BY SOUTH REGIONAL TAFE



Financial Performance of the Aquaculture Program at South Regional TAFE

The main source of revenue for the program is the budget salary allocation for lecturers. As illustrated in Figure 45 below, this varies in accordance with Student Curriculum Hours associated with course delivery.

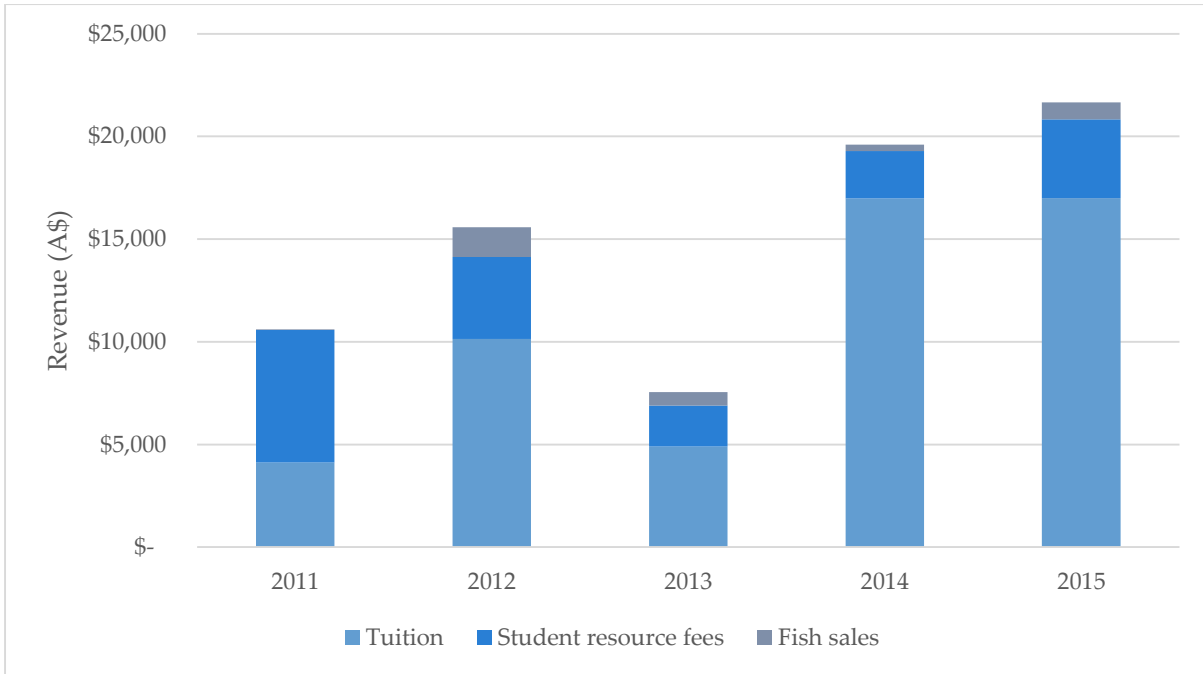


FIGURE 45 – SOURCES OF REVENUE FOR AQUACULTURE TRAINING AT SOUTH REGIONAL TAFE

Because the aquaculture program at South Regional TAFE is a relatively small area of activity within the TAFE, its costs are not directly accounted for, but absorbed into the larger Agriculture Portfolio. Based on an allocation methodology, direct lecturing costs accounted for 84 percent of the total cost of running aquaculture courses at South Regional TAFE, with total costs being approximately A\$70,000 per annum.

The aquaculture program at South Regional TAFE operated at an average deficit of approximately A\$53,000 between 2011 and 2015. The trend in the operational deficit of the aquaculture program is illustrated in Figure 46 below.

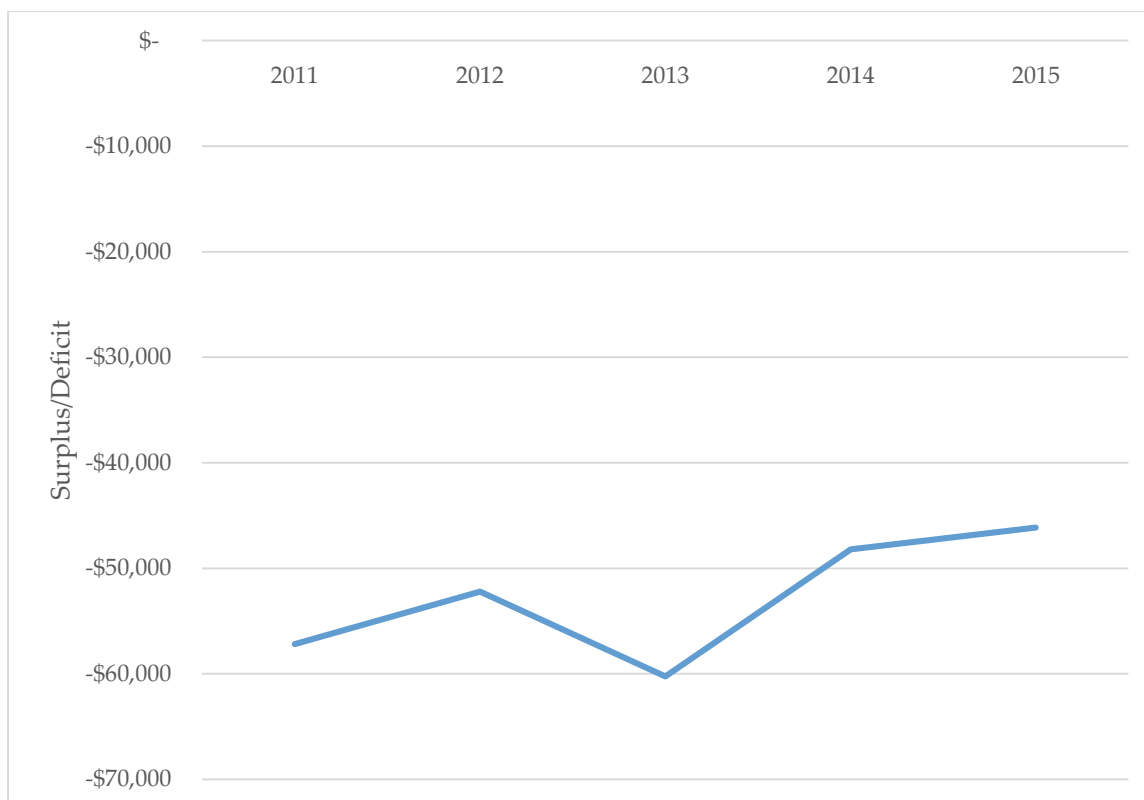


FIGURE 46 – OPERATING SURPLUS/DEFICIT OF AQUACULTURE PROGRAM AT SOUTH REGIONAL TAFE

Table 39 below summarises the financial performance of the aquaculture program at South Regional TAFE on a per Student Curriculum Hour basis.

| | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|----------|----------|-----------|----------|----------|
| Total Revenue Per Student Curriculum Hour | \$ 1.02 | \$ 2.34 | \$ 2.37 | \$ 1.69 | \$ 2.17 |
| Total Cost Per Student Curriculum Hour | \$ 6.50 | \$ 10.20 | \$ 21.29 | \$ 5.86 | \$ 6.78 |
| Total Deficit/Surplus Per Student Curriculum Hour | -\$ 5.48 | -\$ 7.86 | -\$ 18.92 | -\$ 4.16 | -\$ 4.62 |

TABLE 39 – FINANCIAL PERFORMANCE OF SOUTH REGIONAL TAFE ON A PER STUDENT CURRICULUM HOUR BASIS

2.6.2. Current Staffing

Aquaculture training is delivered at South Regional TAFE by a total of 1 FTE. This is summarised in Table 40 below.

| Roles | FTE |
|-----------------|-------|
| Lecturing staff | 1 FTE |

TABLE 40 – CURRENT AQUACULTURE TRAINING STAFF PROFILE AT SOUTH REGIONAL TAFE

2.6.3. Current Facilities

The facilities operated by South Regional TAFE revolve primarily around a demonstration scale recirculation system for full aquaculture cycle of rainbow trout production. Rainbow trout are used as a species for teaching at South Regional TAFE because they are relatively robust and are a suitable species for small scale hobbyists in the region, the TAFE's principal market for



aquaculture courses. The students dismantle and rebuild the system each year as part of their training. The broodstock are sourced from the Pemberton Trout Hatchery operated by the Department of Fisheries (see Section 3.2), and stock produced by the system is sold to local hobbyists or farmers for dam stocking, to the local TAFE community so that students can experience the process of selling product and assessing customer feedback, or provided to other courses operated by South Regional TAFE, such as catering as a teaching resource.

The facilities also include a cascading recirculation system that simulates a freshwater ecosystem typical of the region including native plant and fish species that is used by environmental management programs, a small recirculation system used for marron and a small mariculture facility.

The facilities operated by South Regional TAFE for the purposes of aquaculture training are listed in Table 41 below.

| Item | Quantity | Utilisation | | |
|--|----------|-------------|----------|---------|
| | | Cert II | Cert III | Diploma |
| Temperature controlled hatchery | 1 | √ | √ | √ |
| Back-up generator | 1 | √ | √ | √ |
| Fresh water RAS for rainbow trout broodstock | 1 | √ | √ | √ |
| Small scale 6 tanks freshwater RAS for grow-out | 1 | √ | √ | √ |
| Rainwater harvesting system | 1 | √ | √ | √ |
| Five stage cascading fresh water RAS to replicate regional freshwaterway environment | 1 | √ | √ | √ |
| Four stage cascading fresh water RAS for marron | 1 | √ | √ | √ |
| Small aquaponics system | 1 | √ | √ | √ |
| General laboratory | 1 | √ | √ | √ |

TABLE 41 –SOUTH REGIONAL TAFE TRAINING FACILITIES AND UTILISATION

The facilities listed in Table 41 are also used as teaching facilities for the courses associated with the Conservation and Land Management and Horticulture Programs at South Regional TAFE.

2.6.4. Research Projects

Approximately a decade ago, the aquaculture team at South Regional TAFE's Albany campus collaborated with Murdoch University to recruit black bream from the region for a project being undertaken by Murdoch University and also undertook a project that revolved around supply chain analysis for the Great Southern trout sector. However, South Regional TAFE has not been involved in any significant applied research projects in recent history.



2.6.5. Fish Stock Supply Contracts

South Regional TAFE regularly supplies small volumes of rainbow trout to local small trout businesses and enthusiasts.

2.6.6. Other Collaborations

South Regional TAFE has had discussions with the manager of the proposed multi-species bivalve hatchery (see Section 3.3) with respect to playing a supporting role for this facility and meeting the training needs of the regional supply chain that would be necessary to support a bivalve aquaculture industry in the Region should one emerge.

2.6.7. Issues

The main challenge facing the aquaculture program at South Regional TAFE is its relatively small scale. The program is seen as important by local small-scale trout producers and enthusiasts and by the institution as a mechanism to achieve community outreach. However, the program, like aquaculture programs at other institutions, requires subsidisation and doesn't make a significant impact on other performance metrics. These circumstances will always present questions about its sustainability. Additionally, the support it provides to small scale trout producers and enthusiasts could, on-the-face-of-it, reasonably be alternatively provided by the Pemberton Freshwater Research Centre (see Section 3.2) if that facility was required to do so.

Furthermore, small scale and inland freshwater and saline focus of the South Regional TAFE's aquaculture capability, limits its immediate applicability to supporting a future bivalve aquaculture sector in the Region without a significant change of focus from its current activities.



3. Department of Fisheries

3.1. Department of Fisheries Research Division

Research relevant to aquaculture in Western Australia is undertaken across the Department of Fisheries Research Division, but is mainly the focus of the Biodiversity and Biosecurity Branch, which includes research teams dedicated to aquaculture, fish health and biosecurity. The structure of the Biodiversity and Biosecurity Branch is illustrated in Figure 47 below.

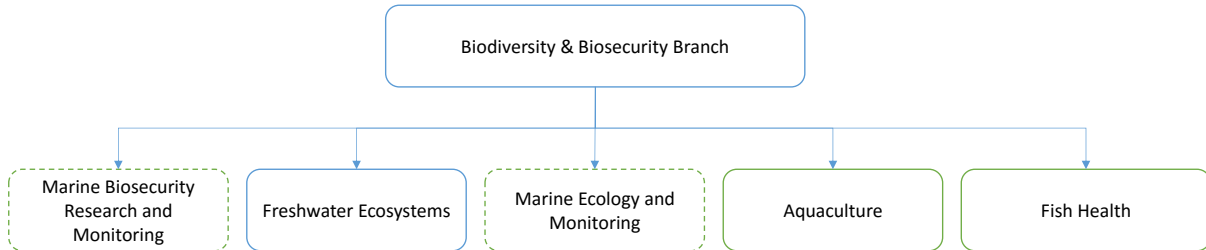


FIGURE 47 – STRUCTURE OF THE DEPARTMENT OF FISHERIES RESEARCH DIVISION

Research activities that revolve around building internal expertise in fish health and disease diagnostic capability is a long-term investment that benefits the aquaculture, wild catch and recreational sectors. However, more specific aquaculture focused research undertaken by the Department of Fisheries tends to be more opportunistic, responding to external funding opportunities however they may be initiated. There is an internal policy whereby the Department of Fisheries should endeavour to ensure that opportunistic research pertaining to aquaculture is aligned with the specific and current ambitions of the Western Australian aquaculture industry and the fact that some projects are partnered with proponents in that industry suggests the policy is being pursued. However, the Department of Fisheries has been the subject of some criticism from industry that it is not adequately aligned with the priorities that are agreed upon among the majority in industry.

Table 42 below summarises the main aquaculture related research currently being undertaken by the Department of Fisheries according to the issues it is intended to support.



| Issue | Activity |
|-----------------------------|---|
| Production techniques | <p>Identification of opportunities and technologies to facilitate the development of a multi-species mollusc hatchery to support growth in existing and emerging sectors (mussels, pearl oyster, oysters and scallops)</p> <p>Development of specific hatchery capacity in scallop culture for restocking</p> <p>Supply of trout for commercial grow-out (see Section 3.2)</p> <p>Development of hatchery production techniques for juvenile abalone for the purposes of restocking (see Section 3.3)</p> |
| Fish health and biosecurity | <p>Development and provision of effective and efficient diagnostic services to the aquaculture industry</p> <p>Development of strategies for health testing and certification to support the safe and cost effective movement of and trade of aquaculture product</p> <p>Maintenance of various laboratory testing standards required to support the aquaculture industry</p> <p>Advice to the aquaculture industry and support the development of industry-based veterinary expertise</p> <p>Work with industry to ensure access to essential veterinary chemicals currently implemented through the Minor Use Permit process</p> <p>Continue to undertake genetic studies as required to evaluate the impact of the translocation requirements of the aquaculture industry</p> <p>Contribute to internal governance and risk assessment processes for new aquaculture activity under consideration in Western Australia</p> <p>Maintain the state-wide Fish-Kill reporting program in the interests of State and National fish health biosecurity</p> <p>Maintain emergency response capacity to respond to major fish health incidents (aquaculture and wild catch)</p> <p>Collaborate with industry on pilot projects to establish new species aquaculture in Western Australia with a specific focus on improving health</p> <p>Explore opportunities to develop an aquaculture-sector information system to facilitate improvements to fish disease passive surveillance and mortality monitoring, noting industry's in-principle support for such a project</p> <p>Contribute to biosecurity monitoring regimes to safeguard key Western Australian aquaculture infrastructure and the aquatic environment</p> |
| Aquaculture zones | <p>Baseline environmental assessment work required for the strategic environmental approval process that underpins the declaration of the zones discussed in Section 3.4.</p> |
| Industry development | <p>Support implementation of credible certification schemes that assist the sustainable development of aquaculture industry, including Marine Stewardship Council or Aquaculture Stewardship Council certification.</p> |
| Stakeholder engagement | <p>Actively consult with the aquaculture policy group and the industry to ensure that the Department of Fisheries research and support activities reflect the developing requirements of the industry and its regulatory bodies.</p> |

TABLE 42 – KEY AQUACULTURE RELATED RESEARCH ACTIVITIES CURRENTLY UNDERTAKEN BY THE DEPARTMENT OF FISHERIES



Historically, the research division at the Department of Fisheries has been involved in a number of other aquaculture related research projects, including:

- Commercial artemia aquaculture;
- Scallop re-seeding;
- Octopus aquaculture;
- Abalone (multi-species) aquaculture;
- Yellowtail kingfish aquaculture;
- Fish larvae rearing system;
- Marine finfish feed development; and
- Automatic hatchery feeding system development.

The Department of Hillary's 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 43 below summarises the aquaculture related research facilities operated by the Department of Fisheries at its main research centre located in Hillary's, Western Australia.

| 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 43 – DEPARTMENT OF FISHERIES RESEARCH DIVISION – AQUACULTURE RESEARCH FACILITIES

There are currently three full-time scientific and six full time technicians involved in mollusc (abalone and scallop) aquaculture and restocking research at the Department of Fisheries. The operating budget for aquaculture and aquaculture related research activities at the Department of Fisheries is estimated to be approximately A\$1.5 million per annum, excluding externally funded projects.

3.2. Pemberton Freshwater Research Centre

The Department of Fisheries took over responsibility for the Pemberton Freshwater Research Centre from the Western Australian Trout Acclimatisation Council in 1971. The primary role of this facility is to produce trout to be introduced to south west waterways in order to support the activities of the recreational fishing sector. However, in more recent times it has also expanded its activities into the area of native fish production and research designed to manage regional biodiversity.

The restocking of trout, as an invasive species, into Western Australian waterways can be a controversial topic. While a conservation purist will accurately argue that trout a not a native species and therefore their introduction and maintenance has altered the natural ecosystem, it can be equally argued that because the practice of stocking trout has been undertaken in Western Australia for approximately 100 years there is limited knowledge as to the impact that



the introduction has had, or what the impact of removal of the species from the ecosystem would be. It is also an expensive process, with an estimated cost of approximately A\$40 per introduced trout. However, anecdotally, the practice is supported by a significant portion of the approximate 10,000 to 12,000 holders of freshwater recreational angling licenses.

While production and stocking of trout for recreational purposes remains the primary function of the facility, in more recent times it has also expanded its activities into the area of native fish production and research designed to manage regional biodiversity.

The facility is the largest freshwater hatchery and research facility in Western Australia. It is located on the Lefroy Brook in Pemberton and is comprised of two neighbouring sites, the original Pemberton Freshwater Hatchery and the Dr Noel Morrissy Research Ponds. The original hatchery is comprised of 10 earthen ponds, 22 concrete ponds, 36 research tanks, fish hatching and larval rearing troughs. The nearby Dr Morrissy Research Pond facility is comprised of 25 earthen ponds (including commercial grow-out scale ponds), 28 tanks and a post-harvest handling facility. The site also includes an area that is leased to Forest Fresh Marron for processing and marketing the product from over 60 local marron growers.

The Pemberton Freshwater Research Centre maintains what is understood to be a highly valued genetic line of rainbow trout that has been selectively bred to best adapt it to the changing climatic conditions in Western Australia. The line is of significant interest to other countries that are impacted by climate change to the extent that conventional trout no longer thrive.

The facility also houses a variety of endangered native species for the purposes of mitigating against species extinction and to support biodiversity restoration through active restocking initiatives.

There is an intention for the facility to play an increasing role in community engagement.

3.3. Proposed Multi-species Bivalve Hatchery

The production of blue mussels from Cockburn sound has until recently been a consistent, albeit small component of the Western Australian aquaculture sector. However, issues associated with spat recruitment and survival of juvenile mussels on farm systems that are derived from changes to the marine ecosystem in Cockburn sound have placed that sector under stress and threatened its viability (see Section 5.5).

Furthermore, oyster production on the southern coast, concentrated around Albany has struggled to achieve scale and to compete with established industries in New South Wales, Tasmania and South Australia. With a potential proliferation of Pacific Oyster Mortality Syndrome in the Eastern States wild and farmed stock, an opportunity for a Western Australian oyster industry may emerge (see Section 5.6.1).

Additionally, restocking of molluscs (including abalone) is likely to become increasingly popular for conservation and recreational fishing purposes.

In light of the challenges being face by the Western Australian blue mussel industry, opportunities that are presented in the case of oysters and restocking, industry and the Department of Fisheries have prepared a business case for the establishment of a primarily state funded multi-species mollusc hatchery based partly on a similar initiative undertaken by the Victorian Government. It is proposed that this will be established by means of refurbishing the currently dilapidated Department of Fisheries Albany Aquaculture Park.



While this facility is the subject of industry support from the mussel and oyster sector, as well as the aquaculture industry more broadly, if it materialises it must be careful not to compete with the established abalone hatchery facility located in Bremer Bay (see Section 5.3)

3.4. Aquaculture Zoning Projects

A component of the Western Australian Government's aquaculture development strategy (see Section 1.1.5) is the establishment of marine aquaculture zones. These are areas of State water designated for the purposes of marine aquaculture. Currently, an aquaculture development zone has been established across a body of water in the Buccaneer Archipelago, in the Kimberley known as the Kimberley Aquaculture Development Zone ('KADZ') and an additional zone in the Mid West, known as the Mid West Aquaculture Development Zone ('MWADZ') is currently under development. Other zones are also being considered for the future.

The location of the KADZ is illustrated in Figure 48 below.

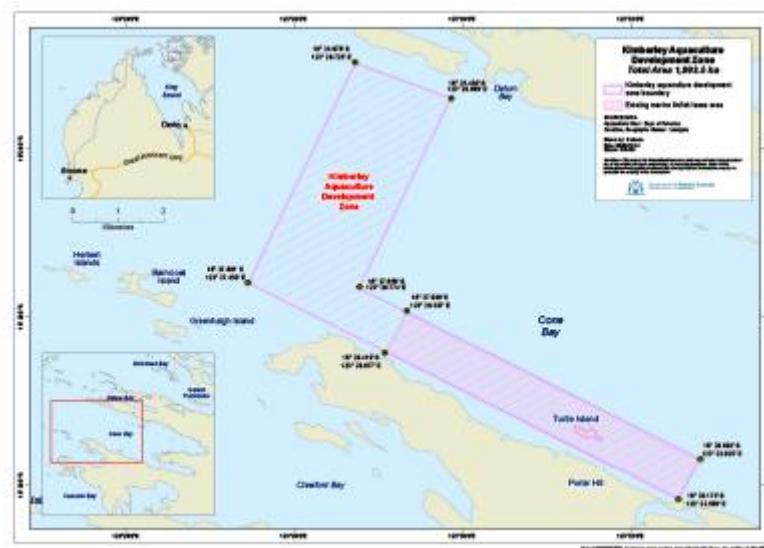


FIGURE 48 – LOCATION OF THE KIMBERLEY AQUACULTURE DEVELOPMENT ZONE



4. University Sector

Generally speaking, the Western Australian university sector undertakes limited research and education in aquaculture. Most certainly, the University of Western Australia and Murdoch University undertake some research, and from time-to-time have PhD students researching aquaculture and aquaculture related matters. This relatively ad-hoc and small scale activity is usually supported in collaboration with ACAAR and to a lesser extent, BCMI and/or BAC.

The Western Australian university most active in aquaculture education and research is Curtin University of Technology ('Curtin').

4.1. Curtin University of Technology

4.1.1. Aquaculture Education

Curtin commenced delivering an undergraduate qualification in aquaculture in the late 1990s. This qualification was offered until 2009 and now only offers post graduate qualifications in aquaculture and an aquaculture unit as part of an undergraduate qualification in coastal science.

There are currently 26 post graduate students undertaking a Master of Science (Aquaculture), Master of Philosophy (Aquaculture) or PhD studies in an aquaculture related field. The vast majority, approximately 85 percent, of these students are international students. These students are supported by a single aquaculture academic.

4.1.2. Aquaculture Education and Research Facilities

The aquaculture research and education activities at Curtin are underpinned by the Curtin Aquatic Research Laboratories (CARL), located in Technology Park, Bentley, adjacent to its main campus. This facility has evolved from a small recirculating aquaculture system established in the late 1990s to support the aforementioned undergraduate qualification.

Currently, there are three 50 tonne recirculating aquaculture systems (RAS) originally designed for holding animals in either seawater, freshwater and inland saline water and a 70-tonne recirculating mesocosm tank for ecosystem and behavioural studies.

The nature of the research conducted at CARL is varied and includes larviculture, live feeds, nutritional trials, ecological studies, acoustic studies, and climate change experiments. These activities encompass a wide variety of aquatic species including marine and freshwater finfish, invertebrates, seaweeds, microalgae and corals.

Quarantine, live feed and algae culture rooms are available at CARL, as are numerous aquaria, tanks and equipment for housing the aforementioned animals in a variety of rearing systems.

Laboratories of moderate scale are also present, which support research in aquaculture nutrition, seafood science, post-harvest seafood quality studies, seafood waste utilisation and phytoplankton taxonomy and ecology.

The Ecotoxicology Laboratory specialises in evaluation of the health status of aquatic organisms in contaminated environments. The facilities include multiple aquariums for



toxicological testing, cryogenic storage, refrigerated high speed centrifuges, electrophoresis equipment, spectrofluorescence and spectrophotometry readers and scanners and microplate readers.

Much of the capacity of CARL, including a 70 tonne mesocosm tank, is currently unutilised, albeit Curtin is confident that the facility will be used more extensively in the future.

5. The Western Australian Aquaculture Industry

5.1. Marine Produce Australia - Cone Bay Ocean Barramundi®

Marine Produce Australia Limited ('MPA') is an unlisted public company that owns and operates a sea cage grow-out operation for barramundi in at a location in the Buccaneer Archipelago, approximately 80 kilometres from the town of Derby in the Kimberley Region of Western Australia.

Figure 49¹¹ below, illustrates the location of the Cone Bay barramundi operation.



FIGURE 49 – LOCATION OF MARINE PRODUCE AUSTRALIA CONE BAY BARRAMUNDI OPERATION

MPA has been operating at this site since 2005, when it was initially granted a permit to trial the grow-out of Barramundi. In 2009, the Company obtained a permit to produce 1,000 tonnes per annum, expanding this to 2,000 tonnes per annum in 2012. In 2014, the license was extended to allow for the current maximum production of 6,990 tonnes of barramundi within its existing 699 hectare aquaculture lease. This lease was granted for 21 years in 2011, with a 21 year renewal option.

As a remote location the project suffers high logistics costs. However, the relatively sheltered environment and strong tidal movements provide a suitable location for large scale sea cage production, and the pristine environment provides the basis for competitive branding in a premium seafood market that values sustainable production from pollution free environments.

MPA has been a pioneer in the fledgling marine finfish aquaculture sector in Western Australia. To date it has invested approximately A\$60 million of capital and \$40 million of revenue into the venture to achieve current production of approximately 1,200 tonnes per annum. The

¹¹ www.marineproduce.com/our-farm



project is as yet to achieve an operating profit¹², and requires increased scale to deliver the economies of scale necessary to drive operating profitability.

Production is currently based on a 10-tank seawater flow-through nursery located on Turtle Island and 23 sea cages (currently expanding to 29) in an anchorage grid system for grow-out. Fish are transferred from the nursery to the tanks via a moveable pipeline facility. Juvenile fish are sourced from a commercial hatchery located in Victoria (Mainstream Aquaculture) and delivered via a logistics chain that involves ACAAR.

5.1.1. Market

The vast majority of production from the Cone Bay operation is sold to seafood distributors in major Australian capital cities, with those distributors supplying a range of retail and restaurant outlets. The 'Cone Bay' brand is established in the Australian domestic seafood market. Table 44 below summarises the key seafood distributors in Australia that market Cone Bay Ocean Barramundi®.

| Queensland | New South Wales | Victoria | South Australia | Western Australia |
|-----------------------------|-------------------------|----------------|----------------------|--------------------|
| Cardinal Seafoods | JOTO Seafoods | Clamms Seafood | International Oyster | Sealanes |
| River City Seafood | De Costi Seafoods | | Atlanta Oyster | Kailis Bros |
| AUSSEA Resources | Martins | | Angelakis Bros. | Catalano's Seafood |
| PFD Food Service | Penrith Seafoods | | | Aristos |
| Ahoy Seafood | Musumecis | | | Coastal Fisheries |
| Morgans Seafood | Trans Tasman Seafood | | | Partridges Seafood |
| Custom Seafood Distributors | Northern Rivers Seafood | | | WestnFresh Seafood |
| Noosa Fish Providores | Claudios Seafood | | | New West Seafoods |
| Noosa Ice and Seafood | | | | Central Seafoods |

TABLE 44 – AUSTRALIA DISTRIBUTORS OF CONE BAY BARRAMUNDI

As illustrated in Figure 50¹³ below, Cone Bay's largest retail footprint is in New South Wales, Queensland and Western Australia.

¹² The company achieved a net profit in 2015 as the result of a R&D Tax credit, but still carried an operating loss.

¹³ <http://www.marineproduce.com/restaurants-and-retailers>

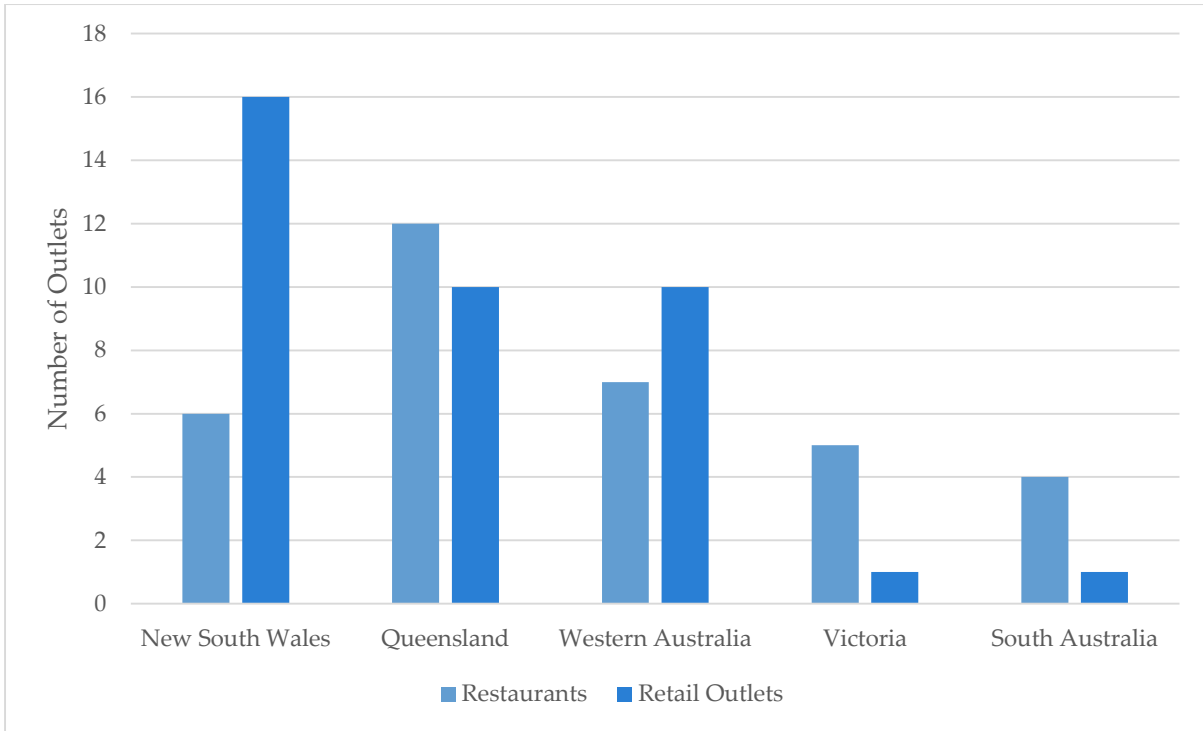


FIGURE 50 – CONE BAY BARRAMUNDI RETAIL FOOTPRINT

Current levels of production prohibit MPA from significantly penetrating export markets. However, as production scales-up (see Section 5.1.2), Marine Produce Australia intends to leverage the Cone Bay brand into premium Asian, European and North American seafood markets.

5.1.2. Scale-up Plans

The current MPA lease is fully contained within the 2,000 hectare Kimberley Aquaculture Development Zone (see Section 3.4). MPA is currently applying for an additional 800 hectares within the Kimberley Aquaculture Development Zone and an immediate increase in its production limit by 8,000 tonnes. MPA is of the view that unit costs at this volume of production will be adequately low to deliver investment attractive returns, with MPA ultimately planning to expand to 15,000 tonnes per annum of production within the extended lease.

5.1.3. Operating Relationship with the Western Australian Government

Australian Centre for Applied Aquaculture Research

The Cone Bay operation has had a long operating relationship with ACAAR, which has revolved primarily around the supply of fingerlings (see Section 2.5). While MPA have held broodstock with ACAAR it has always bought eggs in. Cone Bay sources its fingerlings from Mainstream Aquaculture, a private hatchery operation located in Geelong, Victoria. MPA started acquiring fingerlings from Mainstream Aquaculture because the genetic line maintained by Mainstream Aquaculture is based on Queensland barramundi which demonstrate faster growth rates than Western Australian barramundi. ACAAR continues to play a role in the MPA supply chain by receiving fingerlings from Mainstream and growing them at the ACAAR facility until they reach a certain size, and then transporting them to the Turtle Island nursery. ACAAR also provides occasional advice to the Cone Bay operation and



have developed key transport infrastructure in conjunction with MPA that enables the safe and economic transport of fingerlings across long distances.

Broome Aquaculture Centre

MPA uses North Regional TAFE's Broome Aquaculture Centre for limited, ad-hoc, training purposes only. It does not have a fish stock supply or aquaculture advisory relationship with the Broome Aquaculture Centre.

Department of Fisheries

While MPA has, from time-to-time used the services of the Department of Fisheries Fish Health Unit, its main interaction with the State has been in the establishment of Kimberley Aquaculture Development Zone. The Cone Bay project was established prior to the Kimberley Aquaculture Development Zone having been contemplated, and as any development project in a marine estate that has been void of historical development, was the subject of a stringent environmental approvals process that as a result of the absence of any significant baseline data and apparent initial concerns over the suitability of the site for aquaculture, was a protracted process.

The existence of the Cone Bay project in its current location was a major catalyst for the development of the Kimberley Aquaculture Development Zone and the process of creating that zone has been informed by MPA's operating experience at the site. MPA is an applicant for an expanded lease and license within the zone, the success of which is critical to MPA achieving economic sustainability.

5.2. Indian Ocean Fresh Australia – Midwest Development Commission Yellowtail Kingfish Project

Since 2008, a number of marine finfish seacage trials have been conducted in Champion Bay, adjacent to the Port of Geraldton. The purpose of these trials is to demonstrate the technical and commercial viability of species and production systems suitable to the Mid West Region at small scale, with a view to developing a large scale marine finfish industry centred on an existing lease¹⁴ in the Abrolhos Islands (approximately 80 kilometres off the coast of Geraldton, as well as a planned Mid West Aquaculture Development Zone (see Section 3.4), that will also be located at the Abrolhos Islands.

The principal proponent of these trials has been a private company Indian Ocean Fresh Australia, a member of the Marine Finfish Farmers Association, with financial support provided by the Mid West Development Commission and technical support provided by ACAAR, BCMI and Department of Fisheries. These trials have also been supported by the Australian Seafood CRC and the Fisheries Research Development Corporation. The first trial species was mulloway. However, for commercial reasons, subsequent trials have focused on yellowtail kingfish, a species for which the Mid West is understood to possess considerable competitive advantage with respect to natural aquaculture conditions.

¹⁴ A site designated for yellowfin tuna located in the Zeewijk Channel in the Abrolhos Islands was approved in 2004 and since amended to yellowtail kingfish and other finfish in 2007.



5.2.1. First Yellowtail Kingfish Trial

The focus on yellowtail kingfish as the main species is driven by the fact that the temperature profile of the Mid West ocean and coastal environment is consistent with achieving optimal growth rates for the species. The yellowtail kingfish trials have been a collaboration between government agencies and instrumentalities and an industry partner, whereby:

- **Marine Finfish Farmers Association**, provided in-kind contributions in the form of coordinating the establishment of the project;
- **Indian Ocean Fresh Australia**, a member of the Marine Finfish Farmers Association and principal proponent of the project, has provided in-kind contributions of equipment, a licensed site in Champion Bay, expertise and labour;
- **Marine Produce Australia**, the operator of a sea cage based barramundi project in the Kimberley Region (see Section 5.1) have provided in-kind technical advice based on their experience in operating in Western Australian waters;
- **Department of Fisheries**, (see Section 3.1), provided lead agency support for the project, a cash grant of A\$35,000 toward the production of juveniles at ACAAR, as well the critical services of the Fish Health Unit over the course of the trial with in-kind basis;
- **ACAAR**, (see Section 2.5) provided critical juvenile supply and advisory services over the life of the project, partly on a discounted fee-for-service basis and partly in-kind contribution of diagnostic services;
- **BCMI** (see Section 2.2) provided a range of in-kind services including fish health monitoring and reporting, onshore facilities to support the trials and laboratories and access to their inshore research site at Champion Bay under a Memorandum of Understanding with Indian Ocean Fresh Australia; and
- **Mid West Development Commission**, provided a grant of A\$605,595 under the Royalties for Regions Program, as well as in-kind support primarily in the form of project governance and promotion.

The total value of cash and in-kind services that have been provided to the first yellowtail kingfish trial is estimated to be A\$1,906,140 (including A\$640,595 of cash from the Western Australian Government). The fish produced from the trial were sold in domestic fish markets for a total consideration of A\$280,112, A\$150,000 of which was subsequently invested in relevant research projects with the Seafood CRC generating additional research projects with a total value of A\$450,000. The balance remains vested with the Mid West Development Commission to support further project activities, including industry development modelling based on the trial.

The first yellowtail king fish trial was conducted over the period 2010 to 2012 and its objectives were to:

- Demonstrate yellowtail kingfish sea cage aquaculture is commercially viable in Western Australia;
- Promote Western Australia as an attractive investment destination for large aquaculture projects;
- Demonstrate the Western Australian coastline has a competitive advantage due to warm water and well located sea cage sites for the production of temperate finfish;
- Develop practical marine aquaculture experience and knowledge in both the local labour market and the local marine services sector;
- Develop local expertise in fish health and husbandry at the adviser and research level;
- Provide alternative career paths for local fishing industry members during uncertain times; and
- Develop a collaborative working model as a template to stimulate the marine aquaculture industry in Western Australia and to explore new collaborative research targeted at national level funding bodies.



The trial achieved the following key industry development outcomes:

- **Mortality Rates**
Despite an extreme weather event and two serious mortality events late in the production cycle, commercially acceptable mortality rates were demonstrated. Furthermore, new knowledge that can be used to mitigate the risk of mortality events was developed.
- **Growth Rates**
The growth rates achieved by the trial were high compared to other yellowtail kingfish operations in Australia, and possibly the world. This is attributable to the optimal water temperature for yellowtail kingfish that is characteristic of the Region. A parallel control study was conducted at BCMI, suggesting that even higher growth rates should be achievable with optimised sea cage aquaculture conditions.
- **Competitive Product**
Product from the trials was successfully marketed to domestic seafood markets, attracting premium pricing.
- **Optimised Diet**
In collaboration with a commercial aquaculture feed supplier, a diet formulation was optimised for yellowtail kingfish in a fast growing environment that also improved fish health.
- **Fish Health**
The trial resulted in a better understanding of fish health risks, more effective monitoring of fish health and development of fish health monitoring systems that are optimised for yellowtail kingfish aquaculture in the Mid West. It also provided local fish health science professionals the opportunity to broaden their experience with the species, underpinning future fish health capacity should an industry develop.
- **Aquaculture Systems**
Overall the trial provided greater confidence in understanding the impact of various environmental and systems variables on aquaculture production of yellowtail kingfish in the Mid West.
- **Industry Development Requirements**
The trial illuminated the necessary inputs and supporting services critical to the development of a Mid West marine finfish aquaculture industry based initially on yellowtail kingfish.

The precise details of the trials are the subject of a confidentiality agreement whereby the partners to the trials initially had a two year period to commercialise the outcomes before the detailed results are published. This period of exclusivity was due to expire in 2015, but was extended for another two year period by agreement of the partners.

5.2.2. Second Yellowtail Kingfish Trial

A second trial of yellowtail kingfish has been underway since 2015. This project is being undertaken by the same partners as the trial referred to in Section 5.2, with a cash contribution of A\$1.3 million from the Mid West Development Commission from the Royalties for Regions Program. While the funds were awarded in 2014, the project was delayed due to challenges



in getting broodstock to perform at ACAAR a challenge that was partly addressed in the short-term by sourcing eggs from Cleanseas in South Australia. This trial is being undertaken in an offshore lease, outside of Champion Bay owned by Indian Ocean Fresh Australia.

The purpose of this second trial is to refine the research outcomes of the first trial such as growth rate, food conversion efficiency and stocking densities, and to generate additional knowledge pertaining to the scale-up of a marine finfish industry based on yellowtail kingfish in the Mid West. The first harvests from this trial occurred in April 2016. At the time of writing this trial is still in progress. However, it is understood that preliminary results have been encouraging.

5.2.3. The Future

The trials discussed in 5.2.1 and 5.2.2 above have made significant inroads to assessing the viability of a large-scale marine finfish sector in the Mid West Region that is based on yellowtail kingfish. In addition to the clear commitment from the industry and service provider partners to the project, the relatively small investment made by the Mid West Development Commissioned (approximately A\$2.0 million cash¹⁵ in total across the two projects) has served to lower the investment hurdle rate of industry, in what has been a relatively high risk venture, designed to de-risk future investment in marine aquaculture in the Mid West.

A confidential study commissioned by the project partners contains industry growth modelling based on agribusiness data that is validated within the limitations of the trial discussed in Section 5.2.1. This modelling suggests that a marine finfish industry based on yellowtail kingfish, similar to scale and economic impact of the Tasmanian salmon industry, could develop in the Mid West in the medium-term. The study also notes that the industries that developed in both Tasmania and the Eyre Peninsula in South Australia did so over a decadal scale, with ongoing support from their respective State Governments and suggests a similar level of State government support will be required to establish an industry in Western Australia.

The trials that have been undertaken are a necessary risk-managed step in the process toward validating the viability of commercial scale yellowtail kingfish aquaculture in the Mid West Region. It is likely that considerable investment in larger scale commercial trials at the designated production site will be required as the first step toward a clear industry expansion pathway. This is likely to be the next step for marine finfish aquaculture in the Mid West.

5.3. 888 Abalone

888 Abalone is a private Western Australian company that acquired the adjacent onshore greenlip abalone production facilities of the combined former WA Abalone Farms and Bayside Abalone out of receivership in 2010. Prior to being placed in receivership, approximately A\$12 million had been invested in the infrastructure operated by WA Abalone Farms and Bayside Abalone, initially as competing ventures and subsequently as a merged enterprise.

Following the acquisition of these assets from the receiver manager, 888 Abalone invested a further approximately A\$7.0 million in a range of systems improvements including:

- Improving the reliability of back-up power systems;
- Increasing the capacity of the seawater intake system;
- Improving the maintenance regime on all plumbing systems;

¹⁵ The Mid West Development Commission has also allocated significant in-kind resources in the form of project governance and promotion.



- Introduction of a weaning stage in the production cycle, which reduces mortality risk and decreasing the grow-out cycle time to three years; and
- Implementing a greater focus on genetic improvement.

The facility's hatchery currently has capacity to produce approximately 3 million juvenile abalone per annum. Two million of each year's juvenile production is introduced as feedstock to the onshore grow-out facility, and 1 million are supplied to Ocean Grown Abalone under the ranching joint venture between 888 Abalone and Ocean Grown Abalone (see Section 5.4).

Production from the 888 Abalone onshore facility has been increasing as the upgrades have been completed and was approximately 35 tonnes of 70 to 80 gram animals in 2015 and approximately 75 to 80 tonne in 2016 and approximately 95 tonne in 2017 in addition to the juveniles supplied to OGA

5.4. Ocean Grown Abalone

Ocean Grown Abalone has developed the world's first commercial abalone ranching business at Flinder's Bay on the south west coast of Western Australia. From 2014-2016, the company deployed 12 kilometres of concrete block artificial reef infrastructure on three offshore leases that it seeds with 10 gram juveniles supplied by its joint venture partner, 888 Abalone (see Section 5.3). The animals are stocked at a low density to allow harvesting size optionality. The animals can be harvested at any size, but it is likely that initial harvests will remain at around 200 grams, potentially increasing to 300 grams. Production is targeted primarily at the Hong Kong export market, as well as Perth and Sydney premium seafood markets.

It is expected that harvest volumes in 2016 will be approximately 12 tonnes, increasing to 60 tonnes in 2017 and then 100 tonnes in 2018, ultimately scalable to approximately 120 tonnes. This would see the joint venture partners collectively producing 200 tonnes of greenlip abalone per annum. Investigations into additional sites in Bremer Bay and Esperance suggest the industry is scalable up to 500 tonnes of product within a decade.

Ocean Grown Abalone is also investigating further expansion sites in Port Lincoln, South Australia.

5.5. Blue Lagoon Mussels

Native blue mussels have been grown commercially in Cockburn Sound, immediately south of Fremantle for approximately the last two decades, with several farming operations historically existing in Fremantle Port Authority waters. Production from these operations has been sold almost exclusively to local distributors that service the local restaurant market. Historically, growth in this sector has been limited by scale restrictions in Cockburn Sound and limited export potential of the product. In more recent years the sector has also experienced production challenges that were initially thought to be associated with larger than normal crab recruitment in Cockburn Sound which presented a significant predation issue for the farms, but is now thought to be ultimately the result of significant changes in the marine ecosystem at Cockburn Sound.

Blue Lagoon Mussels has been the largest operator in Cockburn Sound for a number of years, and recently acquired the only remaining competition in the Cockburn Sound blue mussel sector. Blue Lagoon Mussels is now examining opportunities to mitigate the risk associate with



Cockburn Sound by developing production capacity at suitable locations in and around Albany.

5.6. Aspirational Projects

5.6.1. Edible Oysters

Western Australia has, from time-to-time hosted a small edible oyster industry, focused on small-scale production on the coast in Albany. The coastline is generally considered prospective for developing an oyster aquaculture industry, but has struggled to compete with established industry in New South Wales, Tasmania and South Australia.

The detection of Pacific Oyster Mortality Syndrome (POMS) on oyster farms in 2010 and wild oysters in 2011 in New South Wales, and subsequent significant mortality events in farmed oysters in New South Wales in 2013 has raised questions about the sustainability of the New South Wales industry, and if it spreads, Tasmania and potentially south Australia.

Such an eventuality may create opportunity for growth in the Western Australian oyster aquaculture industry, particularly given a species of oyster that is native to Western Australia is genetically very similar to the valued Sydney Rock Oyster.

5.6.2. Aarli Mayi Aquaculture Project

The Aarli Mayi Aquaculture Joint Venture is an aspirational operator of a proposed significant sea cage barramundi farm to be located adjacent to the existing Marine Produce Australia Cone Bay operation (see Section 5.1) in the Kimberley Aquaculture Development Zone (see Section 3.4). This project is targeting an ultimate scale of 15,000 tonnes and is currently in the process of applying for an aquaculture license and lease in the Kimberley Aquaculture Development Zone.

The project is the subject of a proposed joint venture between the Dambimangari, Mayala and Bardi Jawi Traditional owners and Maxima, a company with equity interests in other Western Australian pearling and aquaculture projects.

Aarli Mayi has a MOU with North Regional TAFE, whereby the Broome Aquaculture Centre would be the major supplier of training, applied research, advisory services and fish stock supply, should the project proceed.

5.6.3. Project Sea Dragon

Seafarms is an established Australian agrifoods company and the largest existing producer of prawns in Australia, with operations in three locations across Queensland and an established brand, Crystal Bay Prawns. Project Sea Dragon is a large scale (up to 10,000 hectares), integrated, land based prawn aquaculture project being proposed by Seafarms. The project is proposed to be developed on Legune Station, in the Northern Territory immediately adjacent to the Western Australian border.

5.6.4. Regional Investment Blueprints

Western Australia is comprised of nine regional areas – Kimberley, Pilbara, Gascoyne, Mid West, Wheatbelt, Peel, South West, Great Southern and Goldfields-Esperance. Each of these regions is represented by a Regional Development Commission, which are Western Australian



Government statutory authorities charged with the responsibility of facilitating and promoting economic development in the region for which it has responsibility. Over the past several years, each Regional Development Commission has been tasked with developing a Regional Development Blueprint, which are plans for investment, outlining strategies that are intended to be transformative for the region, priority actions and investment opportunities.

Eight of the nine Regional Development Blueprints – Kimberley, Pilbara, Gascoyne, Mid West, South West, Wheatbelt, Great Southern and Goldfields-Esperance have identify aquaculture as an important driver of future growth.

5.7. Employment Profile

5.7.1. The Western Australian Aquaculture Industry is a Small Employer

The Western Australian aquaculture industry is a small overall employer. For example:

- The largest Western Australian seafood aquaculture operation, Marine Produce Australia (see Section 5.1), employs a total of 30 people on its farming operation on a FIFO employment basis and nine people in its corporate headquarters in Perth; and
- 888 Abalone (see Section 5.3) employs a total of 15 people at its operations in Bremer Bay and 2 people at its corporate headquarters in Perth.

Other Western Australian aquaculture projects are typically operated by 10 or fewer people. Even if the industry expands the commercially compelling case for high levels of automation will naturally place a limit on employment associated with the industry.

5.7.2. VET Aquaculture Qualifications are not Common

Other than the occasional short-term placement of a small number of aquaculture trainees, employees with TAFE aquaculture qualifications are a rarity among the Western Australian aquaculture industry workforce. For example of the 30 people employed by Marine Produce Australia and 17 people employed at 888 Abalone, none have aquaculture specific TAFE qualifications. 888 Abalone historically employed one person with an aquaculture specific TAFE qualification.

The staffing profile that is typical of an aquaculture operation in Western Australia is comprised of:

- Senior technical and supervisory staff who typically have tertiary qualifications in marine science or aquaculture, and extensive experience in aquaculture operational management;
- Technicians and other staff, most of which are trade qualified, but in more mainstream trades that have adapted the application of those skills to the needs of farm management; and
- Various staff within these categories that attain supplementary licenses and qualifications to perform their role, such as coxswain and diving qualifications.

This study has not ascertained the degree to which the workforce profile associated with the pearling industry is comprised of people with aquaculture specific TAFE qualifications. However, this is understood to be similarly limited.



5.7.3. Career Path for TAFE Aquaculture Course Graduates

The vast majority of the, on average, 100 graduates of aquaculture specific TAFE courses in Western Australia each year do not find employment in the Western Australian aquaculture industry. Typically, the graduates embark on one of the following paths:

- Enrolment in a subsequent TAFE program which eventually leads to employment in another industry;
- Articulation into an undergraduate, usually marine science based, course at a university;
- Employment in an aquaculture industry in the Eastern States or overseas aquaculture industry; or
- Employment in the aquaria or pet shop industry.



6. Other Non-Government Organisations

6.1. Recfishwest

Recfishwest is the peak body for the recreational fishing sector, representing 740,000 recreational fishers in Western Australia (equivalent to approximately one third of the State's population). Recfishwest is a not-for-profit organisation resourced primarily through a service level agreement with the Department of Fisheries for the representation of recreational fishing interests. This funding represents a portion of the licensing fees paid by recreational fishers in Western Australia.

The significant applied research and restocking projects that Recfishwest supports and funds at ACAAR, BAC and BCMI is a significant source of revenue, particularly for ACAAR and the BAC (see Section 2). Recfishwest is a significant proponent for restocking key recreational species, a program that has widespread support from its constituents. Revitalised recreational prawning in the Swan River and increased recreational black bream catches in the south of the State and barramundi catches in the north of the State have been attributed to Recfishwest supported restocking programs. In addition, projects such as the restocking of oyster reefs around Albany to improve habitat, a project undertaken in conjunction with the Nature Conservancy, have led to community engagement in restocking beyond the recreational fishing sector.

Restocking has been a practice that has been undertaken in Western Australia for over a century. While this has focused principally on the stocking of freshwater systems in the south of the State with invasive trout species, the restocking of native recreational species is growing in popularity as a method for ensuring that recreational fishing remains a viable sector in Western Australia.

The majority of recreational restocking programs¹⁶ and restocking research is funded from the Recreational Fishing Initiatives Fund ('RFIF'). The RFIF is a State Government grants program resourced from recreational fishing license revenue and used to fund projects and research aligned with recreational fishing community's priorities. The 25 percent of total annual recreational fishing license revenue that is allocated to this program has to date funded over 30 projects for a total of A\$7.0 million across the following priority areas:

- Stocking and stock enhancement of recreationally important species;
- Habitat protection and/or enhancement;
- Improving recreational fishing safety;
- People development/capacity building/succession planning;
- Management, access, data collection and governance of recreational fishing;
- Biology and ecology of important recreational species; and
- Extension, communications and promotion of recreational fishing.

Recfishwest sees the State's investment in aquaculture infrastructure as being symbiotic with its restocking priorities, as demand for key components of this infrastructure from the restocking sector has the potential to maintain its viability until such time as there is adequate demand from the aquaculture industry to underwrite its sustainability.

¹⁶ The Lake Kununurra barramundi restocking project was funded by the Kimberley Science and Conservation Strategy



Recfishwest has an agenda to see sensible restocking continue in Western Australia. Key priority restocking projects include:

- Restocking of barramundi in Lake Argyle;
- Continuation of restocking of prawns in the Swan River;
- Exploration of restocking of Snapper and blue swimmer crabs in Cockburn Sound;
- Restocking of Abalone along the temperate coastline;
- Stocking of impoundments that are popular marron fishing locations; and
- Exploration of restocking of shellfish (oyster and mussel) reefs in temperate estuaries.

6.2. Western Australian Fish Foundation

The Western Australian Fish Foundation was established in 2004 as a not-for-profit organisation to prosecute the need to address a range of fish population problems as they arise, and by utilising best practice restocking techniques in order to maintain wild stocks using aquaculture reared fingerlings, while at the same time undertaking scientific monitoring of restocking programs. The organisation has been funded through voluntary membership and sponsorship, grants from the Recreational Fishing Initiatives Fund (see Section 6.1), as well as Ministerial Grants.

By coordinating the current expertise available, from both around Australia and overseas, the Western Australian Fish Foundation is able to advocate for and support conservation restocking with a range of fresh and saltwater species, supporting a valuable service to maintain and enhance fish stocks throughout the State. As illustrated in Table 45 below, the Western Australian Fish Foundation has played a role in the majority of the restocking projects discussed in Section 2.

| Barramundi | Black Bream | Mulloway Pilot | Swan River |
|---------------------------|-----------------|----------------|--|
| Lake Kununurra Restocking | Blackwood River | Mid West Coast | Swan River Prawns 1 Swan River Prawns 2 |

TABLE 45 – WESTERN AUSTRALIAN FISH FOUNDATION RESTOCKING PROJECTS

These projects have been supported by ACAAR (the Executive Director of ACAAR is a member of the Western Australian Fish Foundation Board. The Western Australian Fish Foundation also works with Recfishwest, Murdoch University, Australian Centre for Fish and Fisheries Research, Swan River Trust and Queensland University of Technology.

6.3. Western Australian Fishing Industry Council

The Western Australian Fishing Industry Council (WAFIC) is the peak industry body representing the interests of the commercial fishing, pearling and aquaculture sectors, and is the lead advocate on significant matters affecting the industry as a whole. WAFIC supports the development of a sustainable aquaculture industry not only on the basis that it has a mandate to advocate for the sector, but also on the basis that aquaculture will play an increasingly important role supplementing production from the wild-catch sector.

WAFIC has a cautious view on restocking. This is likely based on the view that the current and foreseeable scale of restocking and the target species for restocking programs is unlikely to impact on the sustainability of commercial fisheries in Western Australia and as such, WAFIC would prefer that resources allocated to restocking were directed at addressing fundamental



ecosystem function problems that are contributing to reduction of stock in key commercial fisheries.

6.4. Aquaculture Council of Western Australia

Supported by WAFIC and a state government levy that is administered through WAFIC, the Aquaculture Council of Western Australia (ACWA) is the peak representative of the exclusive interests of the Western Australian aquaculture industry. The members of ACWA also make a direct financial contribution and comprise 80 percent of the current gross value of production of Western Australia's non-Maxima Pearl aquaculture, as well as organisations that support the industry.

The current membership of ACWA is summarised in Table 46 below.



| Aquaculture Producers | Service Providers | Other Associations |
|------------------------------|-----------------------|------------------------------------|
| Blue Lagoon Holding | Central Regional TAFE | Marine Finfish Farmers Association |
| Ocean Grown Abalone | North Regional TAFE | Marron Growers Association |
| Great Southern Mussels | MScience | AMWING Pearl Producers Association |
| Ocean Foods International | Dr R Loh | |
| Ms A Beale | Curtin University | |
| Latitude Pearls | ACAAR | |
| 888 Abalone | Rowan Kleindienst | |
| A&T Basile | | |
| Graeme Watt | | |
| Southseas Abalone | | |
| Blue Ridge Marron | | |
| Marine Produce Australia | | |
| Indian Ocean Fresh Australia | | |
| Cambinata Yabbies | | |
| Global Barramundi | | |
| Batavia Coral Farm | | |
| Kimberley Prawn Farm | | |
| Latitude Fisheries | | |
| Seafarms Group | | |
| Maxima Pearling Company | | |
| Radar Holdings | | |
| Beta Nutrition | | |
| Abrolhos Pearls | | |
| John McGarry | | |
| David Edwards | | |

TABLE 46 – MEMBERSHIP OF THE AQUACULTURE COUNCIL OF WESTERN AUSTRALIA

Up to around 2009, ACWA was controlled primarily by small aquaculture business and enthusiast interests and was widely considered ineffective at prosecuting the interests of the projects with scale potential (see Section 5). Changes to the Committee of Management and executive management of ACWA have addressed this, with ACWA now substantially more focused on supporting industry in developing cornerstone projects that can be the basis of a scalable industry.



6.5. Pearl Producers Association

The Pearl Producers Association represents the interests of the Western Australian *Pinctada maxima* pearling sector.



7. Aquaculture Industry Development in other Jurisdictions

State Government investment in infrastructure, particularly hatchery infrastructure and establishing marine tenure for aquaculture projects, is commonplace in Australian state jurisdictions, albeit it occurs under different industry development circumstances and to varying degrees. This investment by government is generally seen as essential to establishing an aquaculture industry, as arguably the most significant economic obstacles to investment in marine aquaculture is the risk and cost associated with securing suitable and adequate project site tenure, and establishing and operating hatchery facilities.

The notion of a subsidised hatchery can be controversial, as they have the potential to crowd-out private hatcheries. As such, from a free-markets purist perspective they should only be subsidised, where there is true market failure. For such circumstances to exist the government must form a view that it is in the wider public interest to establish an aquaculture industry and the main reason an industry does not is because there is inadequate motivation for the private sector to invest in necessary hatchery infrastructure and operations. Under such circumstances, the hatchery investment should only apply to species or operations that cannot be competitively or legally serviced from a private hatchery. Furthermore, services should only be provided from a subsidised hatchery operation in compliance with national competition law. Any subsidised hatchery facility should be transferred to the private sector once an industry is established and can reasonably absorb the cost of the hatchery facility.

The following subsections provide examples of government involvement in aquaculture zoning and hatchery operations in other States.

7.1. Tasmania

7.1.1. Salmon Enterprises of Tasmania (Saltas)

The Tasmanian Government played a significant role in facilitating the establishment of the Tasmanian salmon aquaculture industry, now the largest aquaculture sector in Australia. This involved engaging expertise from the established global salmon aquaculture industry (principally located in Norway and Scotland), investing in a demonstration farm and hatchery infrastructure.

Atlantic salmon were first introduced to Tasmanian waterways from eggs imported from the United Kingdom in the early 1800s for the purpose of supporting recreational fishing. However, a population was never established from these early imports. In the early 1960s Atlantic salmon fingerlings and eggs were imported from Nova Scotia in Canada to a hatchery and nursery facility in New South Wales for release into the waterways in and around the Snowy Mountains.

In 1984, fish from the New South Wales hatchery were translocated to a secure hatchery operated by the Department of Sea Fisheries in Tasmania, from which 36,000 fish were transferred to the demonstration farm as founding stock for Tasmania's salmon industry.

In 1986, the Tasmanian Government invested approximately A\$1.25 million against an equal contribution from nine actual and aspiring private operators of Atlantic salmon farms in Tasmania to establish a hatchery facility under a government-industry joint venture known as



Salmon Enterprises of Tasmania Pty Ltd ('Saltas'). This joint venture hatchery operated under the following principles:

- The level of equity of each private investor in the hatchery determined their respective volume entitlement of fingerlings, but not fingerling quality;
- 25 percent of revenue from the hatchery was re-invested in research and development to support the industry, including development of vaccines and importation and modification of production technology from the established global industry; and
- Price and cost structure was regulated to ensure the hatchery was not profitable.

A second hatchery was subsequently developed on the same basis. The Tasmanian Government's total investment to support the development of its salmon industry was approximately A\$13 million. Over the course of the past 30 years, the Tasmanian Government has sold down its interest in Saltas, which is now owned by three remaining main industry operators.

Several contextual factors need to be considered in determining the suitability of this model for the Western Australian aquaculture industry:

- At the time of the establishment of Saltas, Salmon farming was a well-established industry in Norway, Scotland and to a lesser extent Chile. As a result, the Tasmanian Government and the aspiring industry were able to draw significant expertise and technology from this industry;
- Salmon production from Tasmania was not seen as a competitive threat by these established industries and as such there was a willingness to assist in its development. Even today Tasmanian salmon accounts for only a few percent of global production; and
- There were nine actual or aspiring salmon producers in Tasmania willing to cooperate around the same species.

In contrast, the emerging Western Australian aquaculture industry is focused on a relatively diverse range of species, for which there is limited global experience when compared to Atlantic salmon and there are one or only a few operators in each species sector.

7.1.2. Inland Fisheries Service Hatchery

This hatchery is purely publically funded to produce rainbow trout for restocking and research purposes.

7.1.3. Australian Seafood Industries

This oyster hatchery facility is owned by a co-op comprised of the South Australian Oyster Growers Association, South Australian Oyster Research Council and Tasmanian Oyster Research Council. It focuses on breeding pacific oysters with resistance to Pacific Oyster Mortality Syndrome and supplies broodstock to other hatcheries. It is funded from operational revenue as well as industry levies and commonwealth government grants.

7.2. South Australia

Technical expertise pertaining to hatchery operations for the various species that comprise the relatively substantial South Australian aquaculture industry have been provided to industry, primarily from the South Australian Research and Development Institute (SARDI) and facilities



owned and operated by SARDI have been used to support industry operations from time-to-time. Historically, the state had an investment in the South Australian Oyster Hatchery. However, this was privatised in 1993.

The main investment that the South Australian Government has made in the development of its aquaculture industry is a whole-of-government coordinated process that prioritises the awarding of aquaculture leases and licenses. Within designated aquaculture areas, the time taken to secure an aquaculture lease and licence is between three and six months.

7.3. New South Wales

Hatcheries operated by the New South Wales Department of Primary industries have supported most sectors of the New South Wales aquaculture industry.

7.3.1. Gaden Trout Hatchery

This hatchery is operated by the New South Wales Department of Primary Industry and funded by operating revenues and a contribution derived from angler license fees. It produces brook, rainbow and brown trout, as well as Atlantic salmon for restocking and for supply to aquaculture operations.

7.3.2. Narredera Fisheries Centre

This hatchery is operated and funded by the New South Wales Department of Primary Industry and supports restocking and research and development pertaining to Murray cod, trout cod, golden perch and silver perch.

7.3.3. Port Stephens Fisheries Institute

This research facility is operated by the New South Wales Department of Primary Industries and includes hatchery services that support Sydney rock oyster, prawn and some finfish operations.

7.3.4. Selected Oyster Company

This oyster hatchery is a collaboration between various oyster producers, supported by the New South Wales Department of Primary Industry to perform selective breeding targeting high growth rates and disease resistance. It has a strong operational relationship with the Port Stephens Fisheries Institute.

7.4. Victoria

7.4.1. Queenscliffe Shellfish Hatchery

Victoria hosts a significant mussel aquaculture sector. Traditionally, mussel farmers have been dependent on the spawning of wild mussels to produce spat that settles on the rope based farming systems. In more recent years, the quantity of spat produced from wild mussels has decreased dramatically, placing the viability of the industry at risk. To address this problem the Victorian Government invested in a shellfish hatchery to produce mussel spat so that producers are guaranteed recruitment and can extend their growing season.



This facility is owned and operated by Victorian Department of Primary Industries at its Queenscliffe Research Centre, located on the shore of Port Phillip Bay.

7.5. Queensland

7.5.1. Gladstone Area Water Board

The Gladstone Area Water Board initially developed a hatchery to restock Lake Awoonga. This project has developed into a commercial scale hatchery that supplies barramundi, sea mullet, mangrove jack and other species to local aquaculture projects.

7.5.2. Queensland Tropical Finfish

The Tropical Marine Finfish project was a Queensland Government supported hatchery project to develop new broodstock techniques for Giant Grouper and other high value tropical species that was established in 1999. The objective of this project was to diversify aquaculture in Queensland and protect coral reefs. In 2015, the operation began a process of privatisation focusing on producing Giant, Gold Spot and Tiger Grouper, as well as Coral Trout juveniles.

7.6. Northern Territory

7.6.1. Northern Territory Darwin Aquaculture Centre

The Darwin Aquaculture Centre was established by the Department of Primary Industry and Fisheries on Channel Island in Darwin Harbour in 1998. The centre has specific areas dedicated to finfish, molluscs, echinoderms, crustaceans, algae, live feeds and environmental control work, as well as laboratories. In 2000, the Centre was expanded with the addition of a commercial barramundi fingerling production facility capable of producing approximately 1 million advanced fingerlings per annum.



8. Conclusion and Recommendations

This section sets out the conclusions and recommendations of the study.

8.1. State Investment in Aquaculture Training

8.1.1. The Subsidised Provision of Aquaculture VET Courses in their Current Form Should Not Continue

Aquaculture VET course delivery across the State operates at a deficit. This deficit is not fully recoverable from the development of supplementary revenue streams associated with the assets and capabilities that underpin the delivery of those courses. This occurs to the extent that aquaculture VET course delivery has been directly subsidised by the TAFE system at an average rate of approximately A\$400,000 per annum. This does not include the direct subsidies provided to ACAAR or indirect subsidies received by the aquaculture training programs in the form of access to other TAFE infrastructure and lease values of the land that the facilities occupy. The direct subsidy provided to ACAAR averaged approximately A\$600,000 per annum since 2011 and the indirect subsidisation of aquaculture training program is likely to be an amount approximately equivalent to the direct subsidy.

VET courses in aquaculture have been delivered by North Regional TAFE, Central Regional TAFE, South Metropolitan TAFE and South Regional TAFE and their respective predecessor organisations since the mid-1990s. Since 2011, approximately 1,500 students have enrolled in these courses across these four TAFE colleges and 570 VET aquaculture qualifications have been issued. Only a very small portion of holders of TAFE qualifications in aquaculture find employment in the Western Australian aquaculture industry, with most operations not employing a single person with a TAFE aquaculture qualification. Indeed, it would appear that aquaculture projects place a much higher value on mainstream trade qualifications and specific operating qualifications such as coxswain and diving qualifications that are delivered by TAFE colleges.

Arguments supporting the continuation of aquaculture courses such as aquaculture is a useful course for re-engaging disengaged students and others in the training and education system; engaging students in science and technology; in the case of regional TAFE colleges, are important for achieving community engagement; or the facilities used for teaching aquaculture are used by other course are undoubtedly valid.

However, the fact is that the Western Australian TAFE system is subsidising the production of people with qualifications for which in the first instance do not seem highly sought after by the industry they are targeting, and even if they were, there is inadequate employment market associated with target industry to employ even a small portion of the annual graduates, suggests that the subsidy is misdirected.

In light of this analysis, there is limited justification for the TAFE system to continue to subsidise aquaculture VET courses. This resource would be better applied to other TAFE priorities, or developing tailored training that meets the specific needs of the aquaculture industry.



8.2. State Investment in Supporting the Development of the Aquaculture Industry

8.2.1. Context of this Conclusion and Recommendation

Key elements of the aquaculture capability and infrastructure that is currently operated by the TAFE system and Department of Fisheries is critically important to the development of a marine seafood aquaculture industry in Western Australia. This capability has historically been substantially subsidised by the State, primarily through these agencies, but also through others. For the nascent Western Australian aquaculture industry to have a reasonable possibility of developing into an industry of scale, it is highly probable that the State will need to continue to subsidise this activity at least to the extent of current levels, as well as make additional capital investments over the course of the next decade.

This represents a moderately significant commitment from the State and should be considered in the context of the following issues illuminated by this study:

- **History of Aquaculture Development in Western Australia has not been encouraging:**
 - The State's largest aquaculture sector, *Pinctada maxima* pearl production has demonstrated a trend of declining GVP over the past eight years from A\$80 million in 2006-07 to A\$60 million in 2013-14;
 - Western Australia has the lowest ratio of aquaculture produced seafood to wild-catch seafood of any state or territory in Australia;
 - The seafood aquaculture sector has historically failed to thrive, with a single enterprise having driven GVP from approximately A\$6.5 million in 2006-07 to a peak of A\$17.0 million in 2012-13, and GVP having declined over the past year.
- **There Remains some Fundamental Challenges:**
 - Western Australia has a range of attributes that render aquaculture challenging, namely limited suitable sites; high capital and operating costs; history of over promotion and over capitalisation of projects; regulatory overburden; no clear demonstrated species advantage; inconsistent and ad hoc policy framework pertaining to aquaculture; and a small and fragmented local aquaculture industry.
- **There has been a Substantial State Investment to Date**
 - While some may argue the investment hasn't been optimally directed, the fact is that the State has to date, invested substantial resources in the State's aquaculture industry. For example, the analysis in this report identifies a specific direct annual subsidy since 2011 of approximately A\$1.0 million and a capital investment of approximately A\$30 million associated with the TAFE infrastructure. This does not take into account the indirect subsidy provided through the TAFE system, direct grants provided to projects, or the Department of Fisheries investment in supporting aquaculture.

In the context of these challenges, this report makes its recommendation with respect to State involvement in supporting the development of the Western Australian aquaculture industry on the basis of the following:

- There is a new generation of Western Australian aquaculture projects that still carry considerable development risk, but are focused on species for which a prima facie plausible strategic and business case can be made, which are scaling sensibly under professional management and which to varying degrees are reliant on key



components of the TAFE and Department of Fisheries aquaculture capabilities and infrastructure;

- An assumption that restocking of species for recreational fishing and conservation purposes will be an ongoing and growing practice supported by the Government; and
- An assumption that the State's commitment to the development of an aquaculture industry in Western Australia as espoused in the 2012 Western Australian Aquaculture Policy and 2015 Statement of Commitment and demonstrated through direct grants to projects and investment in the creation of aquaculture development zones will be sustained, focused, appropriately resourced and effectively prosecuted into the future

8.3. Western Australian Aquaculture Development Unit

The key recommendation of this study is the implementation of a Western Australian Aquaculture Development and Restocking Unit ('WAADRU') that is focused exclusively on supporting the development of a sustainable aquaculture industry of scale in Western Australia and restocking of wild stocks for the purposes of conservation and supporting the recreational fishing sector. This unit will require additional capital investment and ongoing operational subsidisation from the State Government for a period of approximately one decade, and oversee a subset of key capabilities and infrastructure currently operated by the TAFE system and the Department of Fisheries. While it is possible that the resulting infrastructure and capability may ultimately be able to be transferred to industry ownership and operation, this is unlikely to be a viable option for the foreseeable future.

8.3.1. Capability and Infrastructure Priorities

The key capabilities and assets that will be managed by the WAADRU can be considered in three levels of priority, depending on the State's funding appetite.

Priority 1: Centralised Hatchery and Fish Health

ACAAR Capability and Infrastructure

The hatchery and hatchery related expertise and infrastructure operated by ACAAR is essential to the development of a Western Australian aquaculture industry and the continuation of restocking. This capability should be retained as centralised hatchery and hatchery services facility supporting the aquaculture industry and restocking sector.

As a result of the expiring lease and age of the facilities a capital investment is required to revitalise and relocate the facilities. Ideally, the new facility would be located at a site adjacent to the existing ACAAR facility on Fremantle Port Authority land that is likely to be excised from the Fremantle Port Sale Package. Building a facility on this site has the advantage of being able to access the existing seawater bore infrastructure and would likely have an associated capital expenditure in the range of A\$8.0 million to A\$10.0 million. A schematic of the proposed new site and facility is contained in Appendix 4. Relocation to a site where new seawater intake infrastructure is required, would likely see the capital expenditure associated with the development escalate to approximately A\$20.0 million.

If this site is not viable, other potential metropolitan sites should be considered as the next best option. For the purposes of access the broadest possible talent pool for employment and service provision, operational cost efficiency and logistical efficiency in servicing the regional distributed industry, the core hatchery capability and infrastructure should remain in or close to the Perth metropolitan area. Existing seawater bore infrastructure associated with the former Atlantis Seaworld facility in Two Rocks is an option that could be considered, albeit the site



would need to be acquired or leased from a private landholder. The seawater intake at the Department of Fisheries Hillary's facility is also an option that could be considered, albeit there is inadequate space at the site to host a commercial scale hatchery.

Department of Fisheries Fish Health Unit

The Department of Fisheries Fish Health Unit has and remains a critical resource for the aquaculture industry in identifying, addressing and rectifying fish health issues as they arise, and in ensuring product is marketable. It is important that the industry has continued access to a responsive and well-resourced Department of Fisheries Fish Health Unit.

Multi-species Mollusc Hatchery

Given that a prima facie business case has been established by industry in collaboration with government, and the project has industry support, the proposed multi-species mollusc hatchery should be established. Caution should be taken to ensure it does not compete with the private abalone hatchery operated by 888 Abalone in Bremer Bay. This aspect of WAADRU could potentially be funded through the Royalties for Regions program.

Priority 2: Regionally Distributed Broodstock and Nursery Facilities

There is a strong development argument to maintain in the first instance some limited broodstock holding and nursery facilities at the BCMI facility in the Mid West and BAC facility in the Kimberley. Broodstock holding facilities will provide a layer of biosecurity by geographically distributing the location of valuable broodstock resources, as well as improve the logistics of sourcing broodstock. Distributed nursery capability will assist the logistics of transitioning juveniles from the centralised hatchery to project sites and improve the efficiency and effectiveness of restocking operations.

To ensure consistent operations and quality assurance, the operation of the assets and capabilities associated with this distributed infrastructure should be overseen by the centralised hatchery capability and quarantined from other operations and activities that might be undertaken at BCMI and BAC.

This aspect of the WAADRU could potentially be funded through the Royalties for Regions program.

If industries expand in the Mid West and/or Kimberley, these regionally distributed facilities may eventually evolve into stand-alone, industry owned and operated hatchery and nursery facilities supporting those industries.

Priority 3: Limited Tailored Training Available from a Single Point of Access

The TAFE sector should work with the aquaculture industry to determine its specific training needs, and ensure that there is single point of access to accredited and non-accredited courses that deliver on these needs that can be accessed with a reasonable degree of predictability, and cost effectively. This is likely to be in the form of various licenses and permits such as coxswain and diving tickets.



8.3.2. Governance

A critical success factor pertaining to the recommendation is that the centralised hatchery capability described in Priority 1 and the infrastructure it manages, is able to maintain the responsiveness to industry that has been characteristic of ACAAR. However, because it is highly probable that the State will be the only investor in the required capital, and be required to provide significant subsidies for a protracted period, the WAADRU will likely require significant accountability to the lead government agency, the Department of Fisheries.

Over the course of the consultation associated with this study a number of alternative hosting government agencies and instrumentalities were proposed. These are listed in Table 47 below, together with an explanation of challenges associated with the proposed alternative hosts.

| Proposed Hosting Organisation | Challenges |
|---|--|
| Office of Science | The Office of Science was suggested on the basis that it and its Minister have been supportive of the aquaculture industry. However, the Office of Science is a policy unit and is not structured to manage infrastructure. |
| Department of Regional Development | Because the aquaculture industry and some of the State infrastructure is regionally distributed, the Department of Regional Development was suggested as the hosting agency. Potentially increased access to Royalties for Regions funding was also presumably a rationale to promote this structure. However, the Department of Regional Development is similarly a policy oriented Department and the predominate portion of the State infrastructure and capability that needs to be supported is metropolitan based. |
| Department of Fisheries Research Division | There is considerable concern among industry that if housed within the Department of Fisheries Research Division the WAADRU would lose the industry orientation and responsiveness that has been characteristic of ACAAR and seen as essential to its success. There is a widely held view that if WAADRU was to be housed within the Department of Fisheries Research Division the culture and operating mandate of that Division with respect to its aquaculture activities would need to undergo a significant transition for WAADRU to be effective. |
| University Sector | In light of Curtin University's interests in aquaculture, transferring the operation of the WAADRU to Curtin was contemplated. However, housing such an operation in a university environment risks the assets being deployed increasingly for research purposes that undermine the intention of the WAADRU. |
| Western Australian Marine Science Institution | The Western Australian Marine Science Institute (WAMSI) was also suggested. WAMSI is a multi-partner research project coordinating mechanism that is not structured to manage industry oriented infrastructure. Furthermore, its partners are primarily government agencies and universities, potentially introducing the challenges discussed above. |

TABLE 47 – ALTERNATIVE HOST STRUCTURES FOR THE PROPOSED WESTERN AUSTRALIAN AQUACULTURE DEVELOPMENT UNIT

The proposed structure illustrated in Figure 51 below is designed to give the State comfort with respect to accountability and maintained purpose of its investment, while optimising the likelihood that the WAADRU maintains an adequate degree of the industry responsiveness and



orientation that is characteristic of ACAAR, and which is highly valued by industry and the restocking sector.

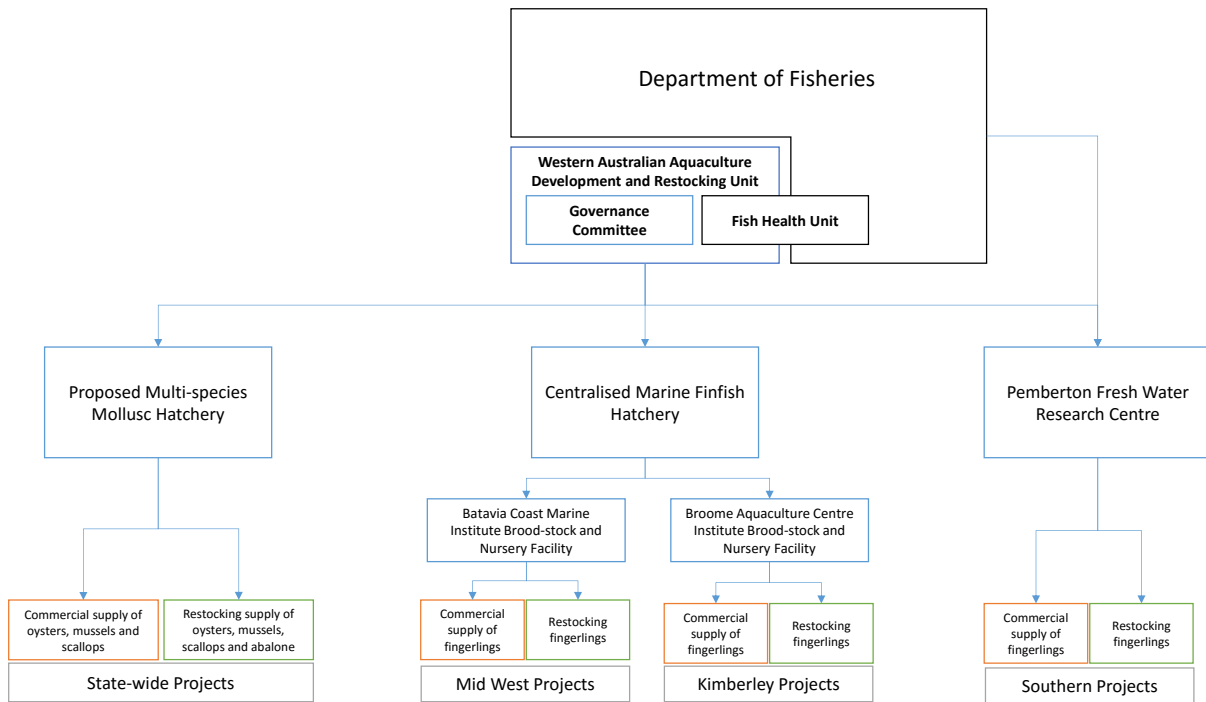


FIGURE 51 – PROPOSED STRUCTURE OF THE WESTERN AUSTRALIAN AQUACULTURE DEVELOPMENT AND RESTOCKING UNIT

Under the proposed structure, WAADRU would be established as an oversight and activity coordinating body, the operations for which it oversees are resourced from their own revenues and subsidised by a four year recurring grant from consolidated revenue, managed by the Department of Fisheries on the advice of the WAADRU governing council. Capital works associated with the operations it oversees will be funded by one-off grants from Royalties for Regions and/or consolidated revenue.

WAADRU will be governed by a governing council that has and independent Chair and representation from:

- Department of Fisheries (Corporate)
- Department of Fisheries (Research)
- Aquaculture Industry
- Recfishwest
- Independent hatchery management expertise
- Executive Directors of the proposed Mollusc Hatchery, Centralised Marine Finfish Hatchery and Pemberton Fresh Water Research Centre

The WAADRU will allocate an agreed portion of its annual operating grant to supporting the Fish Health Unit to ensure it is adequately resourced to respond to the aquaculture industry's needs. The remainder of its operating grant will be used to subsidise the operations that it oversees.

WAADRU will oversee and coordinate the activities of the proposed new Multi-species Mollusc Hatchery, the Centralised Marine Finfish Hatchery Facility (i.e. the revitalised ACAAR) and the Pemberton Freshwater Research Centre. The Centralised Marine Finfish Hatchery will



oversee and coordinate the activities and operations of the broodstock holding and nursery facilities at the Batavia Coast Marine Institute and the Broome Aquaculture Centre. Because the new structure renders the aquaculture capability at South Regional TAFE redundant, the Pemberton Fresh Water Research Centre, which has superior and larger scale capabilities to the regional TAFE with respect to freshwater species (including trout and marron) will ensure it is able to service local industry and enthusiasts. To ensure this occurs, it is recommended that the WAADRU oversees the activities of the Pemberton Fresh Water Research Centre in collaboration with the Department of Fisheries Research Division, albeit this is a less critical component of the structure.

8.3.3. Preliminary Cost Estimate

A detailed costing of the proposal is beyond the scope of this study. However Table 48 below provides a preliminary indicative cost. A detailed study into the implementation and operational costs associated with WAADRU is a necessary next step.

| Expense | Cost |
|---|---------------|
| Restructure and Investment Feasibility and Implementation Studies | A\$400,000 |
| Investment in new ACAAR Facility ¹⁷ | A\$10,000,000 |
| Investment in Multi-species Mollusc Hatchery | A\$1,000,000 |
| Upgrades at BCMI and BAC | A\$500,000 |
| Total Capital Cost | A\$11,900,000 |
| Annual Operating Subsidy ¹⁸ | A\$2,000,000 |

TABLE 48 – ESTIMATE COST ASSOCIATED WITH ESTABLISHING AND OPERATING THE PROPOSED WESTERN AUSTRALIAN AQUACULTURE DEVELOPMENT AND RESTOCKING UNIT

Additional costs will be required to decommission or redeploy excess aquaculture related infrastructure at each of the TAFEs

8.3.4. Next Tasks

In order to progress the recommendations of this study the following actions should be taken:

1. Official Consultation

Once the content of this study has been validated by its contributors, its observations and recommendations should be socialised with key stakeholder to ensure that they are implementable and will achieve the desired outcomes. Any feedback from this process can be used to refine the recommendations.

2. Feasibility and Costing Studies

A detailed options assessment, feasibility study and costing on the preferred option for relocating and revitalising the existing ACAAR facility as the Centralised Finfish Hatchery should be commissioned. This study should also examine capital and

¹⁷ Assumes the new facility uses an already accessible seawater intake system

¹⁸ This initial estimate is considered a minimum and further work needs to be undertaken to determine projected revenues and costs associated with each element of WAADRU



operating costs associated with maintaining the proposed nursery and hatchery capability at BCMI and BAC.

3. Business Case

A detailed governance framework and business case should be developed for the implementation and operation of the WAADRU. It is intended that the governing council of WAADRU will oversee its implementation.

4. Funding Proposal

Based on the above analysis a formal proposal for 4 year recurrent funding should be presented to the State Government, as well as for the one-off capital grants. This should include a proposal to Royalties for Regions for the regional components of WAADRU.



Appendix 1: Western Australian Aquaculture Production Statistics

Volume of Aquaculture Production by State by Sector (tonnes) 2013-14

| | Abalone | Prawns | Salmonids | Southern Bluefin Tuna | Yabby | Redclaw | Marron | Oyster | Silver Perch | Trout | Blue Mussel | Barramundi | Ornamental Fish | Pearls | Other | Total |
|--------------------|------------|--------------|---------------|-----------------------|-----------|-----------|-----------|---------------|--------------|------------|--------------|--------------|-----------------|----------|--------------|---------------|
| New South Wales | - | 287 | - | - | 18 | - | - | 3,266 | 195 | 253 | 38 | 59 | - | - | 215 | 4,331 |
| Victoria | 431 | - | 1,186 | - | 3 | - | - | - | - | - | 644 | 157 | - | - | - | 2,421 |
| Queensland | - | 3,487 | - | - | - | 36 | - | - | 97 | - | - | 2,682 | - | - | 145 | 6,447 |
| South Australia | 330 | - | - | 7,544 | 12 | - | - | 4,900 | - | - | 1,619 | - | - | - | 1,042 | 15,447 |
| Western Australia | - | - | - | - | 15 | - | 47 | - | - | - | 188 | 716 | - | - | - | 966 |
| Tasmania | 98 | - | 40,405 | - | - | - | - | 3,236 | - | - | 749 | - | - | - | - | 44,488 |
| Northern Territory | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 815 | 815 |
| TOTAL | 859 | 3,774 | 41,591 | 7,544 | 48 | 36 | 47 | 11,402 | 292 | 253 | 3,238 | 3,614 | - | - | 2,217 | 74,915 |

Value of Aquaculture Production by State by Sector (A\$'000) 2013-14

| | Abalone | Prawns | Salmonids | Southern Bluefin Tuna | Yabby | Redclaw | Marron | Oyster | Silver Perch | Trout | Blue Mussel | Barramundi | Ornamental/Aquarium /Pond Fish | Pearls | Other | Total |
|--------------------|-----------|-----------|------------|-----------------------|--------|---------|----------|-----------|--------------|----------|-------------|------------|--------------------------------|--------|-----------|------------|
| New South Wales | \$ - | \$ 4,495 | \$ - | \$ - | \$ 285 | \$ - | \$ - | \$ 36,007 | \$ 2,718 | \$ 2,739 | \$ 233 | \$ 938 | \$ 411 | \$ - | \$ 3,169 | \$ 50,995 |
| Victoria | \$ 12,778 | \$ - | \$ 8,863 | \$ - | \$ 27 | \$ - | \$ - | \$ - | \$ - | \$ - | \$ 2,150 | \$ 1,594 | \$ - | \$ - | \$ - | \$ 25,412 |
| Queensland | \$ - | \$ 59,027 | \$ - | \$ - | \$ - | \$ 682 | \$ - | \$ 522 | \$ 1,107 | \$ - | \$ - | \$ 25,105 | \$ 737 | \$ - | \$ 1,956 | \$ 89,136 |
| South Australia | \$ 10,890 | \$ - | \$ - | \$ 122,400 | \$ 430 | \$ - | \$ - | \$ 32,080 | \$ - | \$ - | \$ 3,450 | \$ - | \$ - | \$ - | \$ 12,120 | \$ 181,370 |
| Western Australia | \$ - | \$ - | \$ - | \$ - | \$ 304 | \$ - | \$ 1,406 | \$ - | \$ - | \$ - | \$ 785 | \$ 8,126 | \$ 318 | \$ - | \$ 60,719 | \$ 73,103 |
| Tasmania | \$ 3,135 | \$ - | \$ 531,322 | \$ - | \$ - | \$ - | \$ - | \$ 21,684 | \$ - | \$ - | \$ 2,996 | \$ - | \$ - | \$ - | \$ - | \$ 559,137 |
| Northern Territory | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ - | \$ 15,200 | \$ 15,200 |



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|-------------|--------|--------|---------|----|---------|-----|-------|--------|-------|-------|-------|--------|----|-------|--------|--------|---------|
| Total | \$ | \$ | \$ | \$ | 122,400 | \$ | \$ | \$ | \$ | \$ | \$ | \$ | \$ | 1,466 | \$ | \$ | \$ |
| Aquaculture | 26,803 | 63,522 | 540,185 | | 1,046 | 682 | 1,406 | 90,293 | 3,825 | 2,739 | 9,614 | 35,763 | | | 60,719 | 33,890 | 994,353 |



Appendix 2: ACAAR Applied Research and Industry Development Activities

Current Applied Research Projects

| Project | Facilities Used | Staff Involvement | Expected Outcome | Budget |
|---|---|--|--|------------|
| Midwest Yellowtail Kingfish Grow Out Trial II | Marine bore system, Kingfish brood stock facilities, temperate larval array, live feed infrastructure, laboratories etc | Greg Jenkins, Gavin Partridge, Robert Michael, Lindsey Woolley, Brendan Spillman, Bruce Ginbey | Supply of fingerlings and ongoing support for Project Steering Group and Project Research Reference Group | A\$35,000 |
| Coordination of Fish Health and Nutrition Research for Midwest Yellowtail Kingfish Grow Out Trial II | Office space and IT | Lindsey Woolley, Gavin Partridge, Greg Jenkins | Coordination of the nutrition and fish health research services for the project | A\$80,000 |
| Growing a profitable, innovative and collaborative Australian Yellowtail Kingfish aquaculture industry – WA component | Marine bore system, 12 large tanks, nutrition laboratory, dry laboratory, cool-room etc | Gavin Partridge, Lindsey Woolley, Greg Jenkins, Robert Michael, Brendan Spillman, Bruce Gibney | 12 month nutrition trial for the Midwest Yellow Tail Kingfish Grow Out Trial II | A\$170,000 |
| Improving the taste, bioavailability and efficacy of orally administered praziquantel for Kingfish | Marine bore system, 2 large tanks, bioassay room, nutrition laboratory, dry laboratory, office space etc | Gavin Partridge, Lindsey Woolley, Greg Jenkins, Robert Michael, Brendan Spillman, Bruce Ginbey | Develop and test the use of nanoparticles for encapsulating the anthelmintic compound praziquantel into a pellet diet to protect Kingfish against infestation with flukes. | A\$120,000 |
| Restocking Mulloway into West Coast waters for Recfishwest (via the WA Fish Foundation) | Marine bore system, mulloway broodstock, temperate larval array, live feed infrastructure, laboratories, office space etc | Greg Jenkins, Gavin Partridge, Robert Michael, Lindsey Woolley, Brendan Spillman, Bruce Gibney | Collection of additional mulloway broodstock, culturing of up 30,000 juveniles, marked and released into metropolitan waters | A\$131,000 |



| Project | Facilities Used | Staff Involvement | Expected Outcome | Budget |
|---|---|--|--|------------|
| Re-establishing recreational prawning in the Swan River for Recfishwest | Marine bore system, prawn culture facilities, live feed infrastructure, autoclave and dedicated microalgae infrastructure, laboratories, office space | Robert Michael, Bruno Pais, Greg Jenkins | Build on a previous three year prawn re-stocking project to stock 2 million prawns in the Swan River. Partners include Swan River Trust and Murdoch University | A\$151,272 |

Historical Research Projects

| Title | Conducted by: Principal Investigator (PI) Co-investigator (C) Funder (F) | Challenger component of the total funds allocated | Dates | Outcomes |
|---|--|---|-------------|--|
| Incorporation of lupins into the diets of farmed marine finfish. | PI - AGWA C – Challenger F – GRC | ACAAR \$20,000 AGWA \$36,000 TOTAL \$56,000 | 1994 - 1997 | This successful project funded by the WA Grains Research Council was the precursor for all subsequent investigations into the use of lupins in fish diets. |
| Three concurrent projects for the 'Development of aquaculture techniques for WA Dhufish (<i>Glaucosoma hebriacum</i>).' | PI – Challenger C - Fisheries WA F – Fisheries Research & Development Corporation (FRDC) | ACAAR \$500,000 TOTAL \$550,030 | 1995 - 2000 | Following two private attempts to culture this species, this project was successful in developing culture techniques but identified that the WA Dhufish was not going to be a viable species for commercial culture. Dhufish do however, have potential for restocking if ever required. A 'Hatchery Manual' for the species has been published. |
| Temperature control of nutritional research facilities. | PI – Challenger C - AgricultureWA F – WA Fisheries | ACAAR \$8,700 | 1996 | This grant assisted to provide heating control for the project 'Incorporation of Lupins into the diets of farmed marine finfish'. |
| Study of technology for land-based mariculture in Israel. | PI – Challenger C – Fisheries WA F – WA Fisheries | ACAAR \$2,290 | 1996 | This was the first WA aquaculture study tour of Israel. It resulted in a collaborative project with the National Centre for Mariculture (Elat) for the <i>Ulva</i> project (2000). |
| Preliminary assessment of Carrarang Station and Shark Bay Salt Works for potential for aquaculture. | PI– Challenger C – WA Fisheries F – Clough Engineering | Expenses only | 1996 | Recommended further investigation of opportunities. However, the remoteness of the location remains an issue for commercial aquaculture. |



| Title | Conducted by: Principal Investigator (PI) Co-investigator (C) Funder (F) | Challenger component of the total funds allocated | Dates | Outcomes |
|---|---|--|--------------|---|
| Visiting scientist collaboration and seminar Prof N & Dr T Pankhurst. | PI – Uni of Tasmania C – Challenger F – WA Fisheries | ACAAR \$2,500 | 1996 | Established a collaborative relationship with the University of Tasmania in early larval rearing indicators, in eye development and maturation. |
| Establishment of a mollusc training and development hatchery. | PI – Challenger F – WA Fisheries | ACAAR \$14,600 | 1996 | This hatchery was used for specific industry training of staff for the scallop and pearl oyster hatcheries between 1997 and 2002. |
| Trial restocking of black bream stocks in the Swan River. | PI – Challenger C – WA Fisheries F - NHT | ACAAR \$24,220 | 1996 - 1997 | This was the first successful restocking trial with this species. Dr Lenanton presented and subsequently published a collaborative paper at the First International Symposium of Sea Ranching and Stock Enhancement in Norway in 1997. |
| Investigation into the culture of Roe's abalone. | PI – Challenger C – Mr Shane McLinden F – McLinden & WA Fisheries | ACAAR \$27,500 McLinden \$27,500 TOTAL \$55,000 | 1997 - 1998 | This project provided Mr McLinden his first experience with abalone hatcheries and in his own words it provided a "fast learning curve on the culture of abalone and gave me the confidence to move forward in the industry. The project had a significant impact on my decision to get into business." |
| Preliminary investigations into the viability of <i>Haliotis scalaris</i> for aquaculture. | PI – Challenger F – WA Fisheries | ACAAR \$7,000 | 1997- 1999 | This project was successful in developing and documenting aquaculture techniques for this species. |
| 'Further development of techniques for the culture of King George whiting for commercial aquaculture or for enhancement of fish stocks in Western Australia'. | PI - Challenger | ACAAR \$12,490 | 1998 - 2000 | This project developed culture techniques for King George Whiting for the potential future use for restocking in WA. Many thousand KGW were cultured and the techniques were documented in the report to the Minister. KGW were subsequently trialled in inland saline waters where they grew well. |
| 'Visual development in the WA dhufish'. | PI – University of WA C - Challenger F - FRDC | ACAAR \$4,000 TOTAL \$10,026 | 1999 | This project identified the environmental cues for visual development in dhufish and has increased the academic understanding of fish eye development generally. Several papers were published as a result. |
| 'Elucidation of the characteristics of inland fresh and saline water bodies that influence growth and survival of black bream'. | PI – Fisheries WA C - Murdoch University C - Challenger F - FRDC | ACAAR \$30,684 TOTAL \$200,000 | 1999 - 2000 | This project followed on from farmers stocking black bream into farm dams throughout the Wheatbelt during 1994 – 1997. The project identified those water body characteristics conducive to good survival and growth of black bream. |



| Title | Conducted by: Principal Investigator (PI) Co-investigator (C) Funder (F) | Challenger component of the total funds allocated | Dates | Outcomes |
|---|---|--|--------------|--|
| 'Factors required for the successful aquaculture of black bream in inland waters.' | PI – Murdoch University C - Challenger F - FRDC | ACAAR \$25,000 TOTAL \$299,636 | 1999 -2000 | This project was successful in identifying factors for successful bream survival in farm dams. The potential for a new industry was stifled by subsequent DoF regulations that limited black bream stocking in the Wheatbelt. |
| Restocking the Blackwood River Estuary with Black Bream. | PI – Challenger C – Murdoch University F - FRDC | ACAAR \$42,000 TOTAL \$322,000 | 1999 - 2005 | This project successfully rehabilitated the black bream stocks in this system and resulted in the commercial fisherman recommencing fishing operations in the river. |
| 'Evaluation of lupin and oilseed products in diets for marine finfish'. | PI – Agriculture WA C - WA Fisheries C - Challenger F – GRDC | ACAAR \$35,000 TOTAL \$165,000 | 2000 | This project was the stimulus for a larger effort into identifying opportunities for lupin inclusion into aquaculture diets. A very successful project. |
| 'Demonstration of seaweed nutrient stripping for aquaculture wastewater'. | PI - Challenger C - National Centre for Mariculture (Israel) F – Natural Heritage Trust | ACAAR \$122,950 | 2000 | This project was successful in demonstrating the effectiveness of the seaweed <i>Ulva</i> to strip nutrients and of the subsequent value of the seaweed. The results were picked up and applied by industry in WA and SA. |
| Development of a VET training course and research and development into aquaculture production of Marine Prawns. | PI – Challenger C - Kimberley Training Institute, Cape Seafarms, MG Kailis Group, Southern Cross Aquaculture, Glen Forrest Stockfeeds F – WA Dept of Training | ACAAR \$39,423 TOTAL \$147,029 | 2000 - 2001 | This project developed the first prawn culture training course in Australia, built a prawn training hatchery at Broome TAFE, oversaw the professional development of TAFE staff with international expert assistance, cultured 280,000 prawns and investigated local feed ingredients for prawn diets. Despite the resounding success of the project, and the involvement of all of the interested commercial partners, there is yet to be a prawn industry established in WA. |
| Compilation of existing ACAAR IP into the 'Hatchery Manual for Snapper and Black Bream'. | PI – Challenger C - NSW Fisheries/CRC F - FRDC | ACAAR \$24,032 | 2000 - 2001 | This project funded ACAAR to compile its existing information into the first Hatchery Manual for marine fish published in Australia and has been the model for such publications since. It is still available and in print. |
| Commercial Contract 'Aquaculture and Biology of the Tropical Abalone <i>Haliotis asinina</i> '. | PI – Challenger F – Commercial Client working in Indonesia | ACAAR \$2,000 | 2001 | This literature review and guideline for development recommended a feasibility study for the location chosen in Indonesia. |
| Commercial Consultancy | PI - Challenger F – Western Power | ACAAR \$1,200 | 2001 | Contract to review the operations of a private aquaculture company operating at Western Power's Kwinana premises. The operation was terminated as a result of the review. |



| Title | Conducted by: Principal Investigator (PI) Co-investigator (C) Funder (F) | Challenger component of the total funds allocated | Dates | Outcomes |
|---|--|--|-------|---|
| 'Technology Review of WA Fish Farm for Western Power's Kwinana Power Station'. | PI – Challenger C – DoF F - Gascoyne Development Corporation (GDC) | Expenses only | 2001 | Successful technology transfer of snapper culture techniques to a private enterprise in Shark Bay – for a small-scale restocking project under the supervision of the WA Fisheries. |
| 'Health problems of the WA dhufish'. | PI–Murdoch University Vet C – Challenger C – Fisheries WA F - FRDC | ACAAR \$9,985 TOTAL \$81,405 | 2001 | This project developed skills in fish health for WA (Dr Fran Stephens) and identified the causes of several of the health issues related to dhufish which have been useful in managing wild fish stocks. |
| Study Tour of Inland Saline Groundwater Projects for Aquaculture in the US. | PI – Challenger C- MFA, CYOC TAFE, DAFWA, industry F – AusIndustry | ACAAR \$20,000 TOTAL \$25,000 | 2002 | This study tour identified technologies that may be suitable for adaption in the WA Wheatbelt and established relationships between WA and US research and educational agencies in the field. |
| The Development of a World Best Practice VET Course for the Environmental Management of Marine Finfish Growout Operations in Western Australia. | PI – Challenger C - MG Kailis Group, Conservation Council of WA, Esperance Marine Institute. F – WA Dept of Training | ACAAR \$49,920 | 2003 | The main enduring outcome from this project was the establishment of environmental guidelines to allow the development of this sector in Western Australia. Other outcomes were the development of a marine fish environmental management VET training course and the opportunity for VET sector staff to assess current, developing and new innovative technologies for the environmental management of marine fish farming. |
| Sustainable Development of Marine Fish Farming in WA – a Workshop and the creation of Guidelines for Sustainable Development for the WA marine fish industry. | PI – MFA/ Challenger C - WA Conservation Council F – Fisheries WA (20K) F – WA Dept of Training (5K) | MFA \$25,000 | 2003 | This Workshop brought together aquaculture industry members and representatives of the conservation and government sectors to discuss sustainability in the marine environment in the context of the development of the aquaculture industry in WA. It developed agreed guidelines for the sustainable development of the marine aquaculture industry in WA. |
| Commercial Contract 'Cobia Biology and Requirements for Pilot Aquaculture Operations in Indonesia'. | PI – Challenger F – Commercial Client in Indonesia | ACAAR \$2,000 | 2004 | The commercial client diversified their milkfish growout operation to other species including cobia. |



| Title | Conducted by: Principal Investigator (PI) Co-investigator (C) Funder (F) | Challenger component of the total funds allocated | Dates | Outcomes |
|--|---|--|--------------|--|
| Inland Saline Aquaculture 'National Coordination of State Projects'. | PI – NSW Fisheries C - Challenger, SARDI, QDPI F – FRDC | ACAAR \$60,000 TOTAL \$617,047 | 2004 - 2006 | This project coordinated ISA R&D across 4 states and developed the national R&D Strategy for ISA in Australia. |
| New Technology for Inland Saline Aquaculture. | PI – Challenger C - Murdoch University C - CY O'Connor TAFE F - FRDC | ACAAR \$55,000 TOTAL \$433,532 | 2004 - 2007 | This project was linked to the National Coordination project and identified the limiting factors of successful ISA in WA and the way forward for commercial practice. |
| The suitability of saline groundwater from Wagin for aquaculture. | PI– Challenger C – DAFWA F - AFFA | ACAAR \$8,000 | 2005 | This AFFA grant established that saline groundwater pumped from below the Wagin town-site by the DAFWA Liquid Assets Scheme is suitable for the growout of mullocky, trout and barramundi. |
| Ongoing Monitoring of Blackwood Bream Stocks. | PI – Murdoch University C – Challenger F – WAFF/Min or Fisheries | ACAAR Nil TOTAL \$40,000 | 2005 - 2012 | This project is internationally recognised as one of the longest monitored and most successful marine enhancements undertaken to date. |
| Commercial contract. 'Desktop Study for the effect of dredge plume of fish eggs and larvae'. | PI – Challenger F – Oceanica Consulting | ACAAR \$12,000 | 2007 | ACAAR undertook a desk top study into the effect of dredge plume on fish eggs and techniques to study it. ACAAR were subsequently funded to undertake those studies by Oceanica. |
| SIFTS technical support to McRobert Contracting Services. | PI – Challenger F - MAG | ACAAR \$8,600 | 2007 | ACAAR provided technical support to MAG for SIFTS development during 2007. |
| General fish sales for 2008. | PI – ACAAR F - Various | ACAAR \$8,818 | 2008 | ACAAR provided non-commercial quantities of juvenile fish to a range of customers during 2008 including universities and companies. |
| Fish egg and live feed sales for 2008. | PI – ACAAR F - Various | ACAAR \$4,808 | 2008 | ACAAR provided live fertilised fish eggs and live feeds to a range of customers during 2008 including universities and companies. |
| Black bream juveniles for restocking. | PI – ACAAR F – WA Water Corp | ACAAR \$770 | 2008 | ACAAR provided live juvenile black bream to the WA Water Corporation to restock a body of water that experienced a fish kill. |



| Title | Conducted by: Principal Investigator (PI) Co-investigator (C) Funder (F) | Challenger component of the total funds allocated | Dates | Outcomes |
|--|---|--|--------------|---|
| SIFTS technical support to McRobert Contracting Services. | PI – Challenger F - MAG | ACAAR \$5,478 | 2008 | ACAAR provided technical support to MAG for SIFTS development during 2008. |
| Commercial contract for medicated feed development trials. | PI – Challenger F – Stirling Products | ACAAR \$7,800 | 2008 | This commercial efficacy trial added knowledge to the development of an in-feed immune-stimulant for barramundi. |
| Commercial contract. Salinity and temperature trials for Moreton Bay bugs. | PI – Challenger F – Lobster Harvest | ACAAR \$32,000 | 2008 | ACAAR successfully conducted salinity and temperature trials for Lobster Harvest to determine the optimal parameters for growout. |
| Commercial Consultancy 'The effect of dredge plume on Cockburn Sound snapper eggs and larvae'. | PI – Challenger F – Oceanica Consulting | ACAAR \$89,846 | 2008 | This consultancy provided information relevant to the marine environmental implications of the proposed development of a new port facility in Cockburn Sound. |
| Commercial Consultancy 'An Opportunity Study Of An Open Ocean Aquaculture Project In Western Australia'. | PI – Ord Group Pty Ltd C - Challenger F – WA Fisheries | ACAAR \$15,000 TOTAL \$50,000 | 2008 | This study detailed the opportunities and steps required for the development of a significant industry sector in WA. |
| Commercial contract Supply of 50,000 mullet juveniles to IOFA and WKL. | PI– Challenger F - IOFA | ACAAR \$40,000 | 2008 | ACAAR contracted to grow mullet juveniles for Indian Ocean Fresh and Western Kingfish Ltd for grow-out trials. |
| Travel Grant Dr Partridge to Panama and Miami for tuna/cobia culture. | PI - Challenger F – WA Fisheries | ACAAR \$16,000 | 2008 | This international visit established the working relationship between ACAAR and University of Miami (UM) which has resulted in highly productive collaborative projects with cobia, yellowtail kingfish and yellowfin tuna in Miami, Fremantle, Panama and Indonesia. |
| General fish sales for 2009. | PI – ACAAR F - Various | ACAAR \$7,530 | 2009 | ACAAR provided non-commercial quantities of juvenile fish to a range of customers during 2009 including universities and companies. |
| Fish egg and live feed sales for 2009. | PI – ACAAR F - Various | ACAAR \$38,077 | 2009 | ACAAR provided live fertilised fish eggs and live feeds to a range of customers during 2009 including universities and companies. |



| Title | Conducted by: Principal Investigator (PI) Co-investigator (C) Funder (F) | Challenger component of the total funds allocated | Dates | Outcomes |
|--|---|--|--------------|--|
| Commercial contract to supply 200,000 Silver Perch juveniles to Aldwich Holdings. | PI – Challenger F – Aldrich Holdings | ACAAR \$21,403 TOTAL \$21,403 | 2009 | ACAAR was contracted to grow Silver Perch juveniles to a supplier due to a market need. |
| Commercial Contract 'Development of an Inland Saline <i>Artemia</i> Biomass Production System and Training Manual'. | PI – Challenger F – Morowa Farm Improvement Group | ACAAR \$20,000 | 2009 | This project developed an <i>Artemia</i> production system and training manual for the MFIG for use with their saline water source. |
| Consultancy to Clean Seas Tuna to provide advice on yellowtail kingfish hatchery issues. | PI – Challenger F – Clean Seas tuna | ACAAR \$34,050 Plus expenses | 2009 | This consultancy provided assistance and advice to correct inappropriate protocols being utilised within the CST kingfish hatchery that were preventing good survival and growth. It also reviewed their Standard Operating Procedures and provided recommendations. |
| Free Consultancy 'Iron and pH degassing in bore water from Marine Farms – Exmouth'. | PI – Challenger F – N/A | Expenses only | 2009 | ACAAR purpose designed, built and tested a degassing column for the Exmouth Marine Farms facility to overcome specific water quality issues for the company and then installed it with the help of a WA Fisheries technician. The column effectively treated all incoming water to the company's satisfaction. |
| Commercial trials for a feed additive. | PI – Challenger F – Zamira Life Sciences | ACAAR \$10,010 | 2009 | Study titled: Efficacy of <i>Bacillus polyfermenticus</i> KJS-2 in protecting against infections with <i>Streptococcus iniae</i> in barramundi <i>Lates calcarifer</i> . |
| Commercial trials for a formulated medicated feed. | PI – Challenger F – Zamira Life Sciences | ACAAR \$2,100 | 2009 | Commercial trials for kingfish feed formulated to contain the flukicide Praziquantal. |
| Commercial trials for kingfish feed formulated to contain the flukicide Praziquantal. | PI – Challenger F – Zamira Life Sciences | ACAAR \$9,000 | 2010 | Second round of commercial trials for a formulated medicated feed. |
| Collaborative program with Wageningen IMARES in Holland for growout of kingfish in RAS. | PI – Challenger F – W. IMARES | ACAAR \$19,753 | 2009 - 2012 | ACAAR grew and supplied yellowtail kingfish for a joint trial to investigate the suitability to grow out the yellowtail kingfish in |



| Title | Conducted by: Principal Investigator (PI) Co-investigator (C) Funder (F) | Challenger component of the total funds allocated | Dates | Outcomes |
|--|---|--|--------------|--|
| | | | | a RAS in Holland. A joint scientific paper has been published that details the success of this project. |
| Commercial Consultancy 'Marine fish broodstock advice to Irvin & Johnson in South Africa'. | PI – Challenger F – Irvin & Johnson | ACAAR \$6,500 Plus expenses | 2010 | This project developed a broodstock strategy for a marine finfish aquaculture project in South Africa. |
| Consultancy to investigate the effects of phyllite dredge spoil on barramundi. | PI - Challenger F - INPEX | ACAAR \$73,800 | 2010 | ACAAR undertook specific research into the effect of Darwin Harbour dredge spoil on barramundi eggs and larvae in this study. |
| ADC Consultancy to prepare a Paper titled 'Opportunities for finfish stock enhancement and restocking in Western Australia'. | PI – Murdoch University C - Challenger and UNSW F – WA Fisheries | ACAAR \$3,188 TOTAL \$10,000 | 2010 | ACAAR, Murdoch University and UNSW identified and documented opportunities for marine fish enhancement for WA. The barramundi recommendation has since been implemented. |
| Marine fish culture Short Course for government scientists from Chile. | PI – Challenger F – Fundacion Chile | ACAAR \$6,500 | 2010 | The Chilean government is a world player in the salmon industry and wishes to diversify into marine fish. ACAAR conducted a short training course for two of their scientists. |
| Consultancy and trials for 'clean oxide' for a private WA company. | PI – Challenger F – Q Leach | ACAAR \$6,748 | 2010 | Commercial trials to test the efficacy of a new product for maintaining cleanliness in a RAS. |
| Provision of ongoing services for Indian Ocean Fresh Australia. | PI – Challenger F - IOFA | ACAAR \$3,000 | 2010 | Growth monitoring support, spawning planning, setup and ongoing advice for IOFA 2009/2010. |
| Fish egg and live feed sales for 2010. | PI – Challenger F - Various | ACAAR \$15,628 | 2010 | ACAAR provided live fertilised fish eggs and live feeds to a range of customers during 2010 including universities and companies. |
| General fish sales for 2010. | PI – Challenger F - Various | ACAAR \$22,399 | 2010 | ACAAR provided non-commercial quantities of juvenile fish to a range of customers during 2010 including universities and companies. |
| SIFTS technical support to McRobert Contracting Services. | PI – Challenger F - MAG | ACAAR \$2,305 | 2010 | ACAAR provided technical support to MAG for SIFTS (in Fremantle) development during 2010. |



| Title | Conducted by: Principal Investigator (PI) Co-investigator (C) Funder (F) | Challenger component of the total funds allocated | Dates | Outcomes |
|---|---|--|--------------|--|
| Support Services for CRC PhD student Lindsay Woolley for kingfish trials at ACAAR. | PI – Challenger F - CRC | ACAAR \$2,000 TOTAL \$2,000 | 2010 | Provision of space, equipment, fish and services to support a CRC PhD student to undertake trials at ACAAR. |
| ACIAR GRANT: 'Achieving consistent spawning of captive yellowfin tuna (<i>Thunnus albacares</i>) broodstock at Gondol Research Institute for Mariculture, Bali, Indonesia.' | PI – SARDI C - Challenger, Uni of Miami F – ACIAR | ACAAR \$8,000 TOTAL \$14,803 | 2010 - 2011 | This project has further developed the facilities and programs for yellowfin tuna broodstock at the Gondol Research Station. ACAAR has also brought Prof Dan Benetti of Uni of Miami into this project and subsequently have signed an MOU between SARDI, UM, Gondol and ACAAR for further development of the program. |
| Growout of yellowtail kingfish in Western Australia. | PI– MFA C – IOFA, Challenger, DoF, BCMI F – Royalties for Regions | ACAAR \$25,000 TOTAL \$605, 595 | 2010 - 2012 | This project saw the first kingfish grown to market in WA and demonstrated that a kingfish industry is possible in WA. The fish sale proceeds are currently funding the MFA and ACAAR Seafood CRC research. |
| Supply of one million barramundi juveniles per annum to Marine Produce Australia. | PI – Challenger F - MPA | ACAAR \$792,000 \$264,000 per annum | 2010 - 2013 | ACAAR is contracted to culture and deliver juvenile barramundi for this company and provides substantial additional research services at cost. ACAAR has fulfilled every aspect of this contract to date to the company's complete satisfaction. |
| Transport trials for live fish to Greece. | PI – Challenger C – Southern Aquaculture | ACAAR \$4,100 | 2011 | This project successfully shipped live marine fish to Greece for grow-out trials. |
| International consultancy to support a marine hatchery development in Holland. | PI – Challenger F – SILT BV | ACAAR \$8,250 Plus expenses | 2011 | This consultancy advised on the hatchery requirements for a commercial marine fish project in Holland. |
| Supply and delivery of yellowtail kingfish juveniles to Indian Ocean Fresh Australia | PI – Challenger F - IOFA | ACAAR \$51,000 | 2011 | ACAAR contracted to supply 27,700 yellowtail kingfish juveniles to Indian Ocean Fresh Australia in Geraldton.. |
| Fish egg and live feed sales for 2011. | PI – ACAAR F - Various | ACAAR \$4,653 | 2011 | ACAAR provided live fertilised fish eggs and live feeds to a range of customers during 2011 including universities and companies. |



| Title | Conducted by: Principal Investigator (PI) Co-investigator (C) Funder (F) | Challenger component of the total funds allocated | Dates | Outcomes |
|---|---|--|--------------|---|
| General fish sales for 2011. | PI – ACAAR F – Various | ACAAR \$20,688 | 2011 | ACAAR provided non-commercial quantities of juvenile fish to a range of customers during 2011 including universities and companies. |
| Scientific support services for IOFA feed and flesh analysis relating to yellowtail kingfish feed trials. | PI – Challenger F – IOFA | ACAAR \$2,000 | 2012 | ACAAR contracted to supply support services for Indian Ocean Fresh Australia. |
| Yellowtail kingfish sale for R&D Farm in the Netherlands. | PI – Challenger F – SILT-BV | ACAAR \$22,500 | 2012 | ACAAR supply of kingfish to an experimental marine fish farm in Holland. |
| RDS - YTK Taste masking Agent project. | PI – Challenger F – Mid West Development Commission | ACAAR \$10,800 TOTAL \$18,250 | 2011 - 2012 | This project was successful in developing a coating to mask the bitterness of the medication Praziquantel on pellets to treat flukes in yellowtail kingfish. |
| Seafood CRC Program – Development of finfish culture in WA – removing barriers to profitable production. | PI - Challenger C - DoF, Flinders Uni, Curtin Uni F – Seafood CRC | ACAAR \$168,000 TOTAL \$256,350 | 2012-2014 | ACAAR is the CRC Research Provider and PI for the MFA project to improve the larviculture practices for Yellowtail kingfish in Australia. |
| Barramundi sale for R&D farm in the United Arab Emirates | PI – Challenger F – ASMAK | ACAAR \$4,580 TOTAL \$4,580 | 2012 | ACAAR supply of barramundi juveniles to an experimental fish farm in UAE. |
| Free Consultancy to Ocean Foods in Albany | PI – Challenger F – N/A | ACAAR - NIL | 2012 | ACAAR assistance to Ocean Foods to determine appropriate opportunities and mechanisms to increase company profitability in relation to their oyster aquaculture business. |
| Fish egg and live feed sales for 2012 | PI – ACAAR F - Various | ACAAR \$3,935 | 2012 | ACAAR provided live fertilised fish eggs and live feeds to a range of customers during 2012 including universities and companies. |
| General fish sales for 2012 | PI – ACAAR F - Various | ACAAR \$9,398 | 2012 | ACAAR provided non-commercial quantities of juvenile fish to a range of customers during 2012 including universities and companies |
| Barramundi to Marine Farms in Exmouth | PI – ACAAR F – Marine Farms | ACAAR \$16,255 | 2012 | ACAAR supply of barramundi juveniles to a company in Exmouth. |
| Barramundi to Indonesia | PI – ACAAR F – Phillips Seafoods | ACAAR \$73,060 | 2012 | ACAAR supply of barramundi juveniles to a company in Indonesia. |
| Yellowtail kingfish to Holland | PI – ACAAR F – SILT BV | ACAAR \$24,758 | 2012 | ACAAR supply of kingfish juveniles to a company in Holland. |



| Title | Conducted by: Principal Investigator (PI) Co-investigator (C) Funder (F) | Challenger component of the total funds allocated | Dates | Outcomes |
|--|---|--|--------------|--|
| Consultancy to Australian company | PI – ACAAR F – Cell Technologies | ACAAR \$2,000 | 2012 | ACAAR undertook small scale trials for a WA company |
| Small contract with CRC | PI – ACAAR F – CRC Bursary | ACAAR \$4,500 | 2012 | Travel Bursary |
| Consultancy in Chile | PI – ACAAR F - Acuinoir | ACAAR \$1,500 | 2012 | ACAAR provided advice on kingfish culture to a private company in Chile. |
| Consultancy to Clean Seas | PI – ACAAR F – CleanSeas | ACAAR \$8,081 | 2012 | ACAAR provided advice on live fish air transport to Clean Seas in South Australia |
| Mulloway restocking project | PI – ACAAR F – Recfishwest | ACAAR \$22,727 | 2012 | 2012 instalment of a restocking project. |
| Barramundi to Indonesia | PI – ACAAR F – Phillips Seafood | ACAAR \$25,648 | 2012 | ACAAR supply of barramundi juveniles to a company in Indonesia. |
| Mulloway restocking project | PI – ACAAR F - Recfishwest | ACAAR \$25,000 | 2013 | 2013 instalment of a restocking project |
| Barramundi to Marine Farms in Exmouth | PI – ACAAR F – Marine Farms | ACAAR \$3878 | 2013 | ACAAR provided juvenile barramundi to an Exmouth company. |
| Consultancy to a French company | PI – ACAAR F – Cabinet Gressard | ACAAR \$1850 | 2013 | Marine fish aquaculture advice to an international consulting company. |
| General fish sales for 2013 | PI – ACAAR F – Various | ACAAR \$39,666 | 2013 | ACAAR provided non-commercial quantities of juvenile fish to a range of customers during 2013 including universities and companies |
| First instalment of the prawn restocking project | PI – ACAAR F - Recfishwest | ACAAR \$50,000 | 2013 | 2013 instalment of a prawn restocking project |
| Consultancy for the World Wild Life Fund | PI – ACAAR F – WWF | ACAAR \$35,000 | 2013 | Feed experiments for sustainable barramundi diets |
| CRC barramundi project | PI – ACAAR F – Seafood CRC | ACAAR \$9,000 | 2013 | Small National barramundi genetics project for the Seafood CRC |
| Consultancy for the Mid West Development Commission | PI – ACAAR F – MWDC | ACAAR \$1,000 | 2013 | Advice and input to an industry development plan |
| Consultancy and training for an aquaculture company in Holland | PI – ACAAR F – SILT BV | ACAAR \$6,900 | 2013 | Consultancy and training of a staff member of a Dutch aquaculture company in kingfish culture. |



| Title | Conducted by: Principal Investigator (PI) Co-investigator (C) Funder (F) | Challenger component of the total funds allocated | Dates | Outcomes |
|--|---|--|-------|---|
| Mulloway restocking project | PI – ACAAR F - Recfishwest | ACAAR \$102,500 | 2013 | 2013 instalment of a restocking project. |
| Consultancy to a Singapore company | PI – ACAAR F – Private company | ACAAR \$12,000 | 2013 | Marine fish aquaculture advice to an international company. |
| General fish sales for 2014 | PI – ACAAR F – Various | ACAAR \$32,410 | 2014 | ACAAR provided non-commercial quantities of juvenile fish to a range of customers during 2014 including universities and companies |
| Prawn restocking project | PI – ACAAR F - Recfishwest | ACAAR \$104,546 | 2014 | 2014 instalment of the prawn restocking project |
| Seafood CRC project 2013/737 | PI – ACAAR F – Seafood CRC | ACAAR \$88,770 | 2014 | Final payments for 'Propagation of Southern Bluefin Tuna – Addressing constraints to larval rearing' |
| Seafood CRC project 2011/754 | PI – ACAAR F – Seafood CRC | ACAAR \$37,000 | 2014 | Final payments for 'Development of Yellowtail Kingfish Aquaculture in Western Australia: Removal of barriers to profitable production.' |
| Inland Saline Aquaculture consultancy to a private company in 2014 | PI – ACAAR F – Private company | ACAAR \$27,000 | 2014 | Advice and services for an ISA project |
| Marine fish consultancy to a French Company | PI – ACAAR F – Cabinet Gressard | ACAAR \$2,293 | 2014 | Consultancy advice |
| Snapper restocking trials | PI – ACAAR F - Recfishwest | ACAAR \$40,909 | 2014 | First instalment of a novel restocking trials for snapper |
| Broodstock trailer development | PI – ACAAR F - Recfishwest | ACAAR \$16,364 | 2014 | First instalment of a project to develop a specialised broodstock trailer |
| FRDC project 2014 – 729 | PI – ACAAR F – Various | ACAAR \$50,300 | 2014 | ACAAR provided the cost of quantities of juvenile fish to a range of customers during 2014 including universities and companies |
| General fish sales for 2015 to September 14 | PI – ACAAR F – various | ACAAR \$28,881 | 2015 | ACAAR provided non-commercial quantities of juvenile fish to a range of customers during 2015 including universities and companies |



| Title | Conducted by: Principal Investigator (PI) Co-investigator (C) Funder (F) | Challenger component of the total funds allocated | Dates | Outcomes |
|---|---|--|--------------|--|
| Supply of one million barramundi juveniles per annum to Marine Produce Australia. | PI – ACAAR F – MPA | ACAAR \$420,804 \$260,400 in 2014 \$160,404 in 2015 | 2013 - 2015 | ACAAR is contracted to culture and deliver juvenile barramundi for this company and provides substantial additional research services at cost. ACAAR has fulfilled every aspect of this contract to date to the company's complete satisfaction. |
| Live fish transport trials for a WA commercial finfish fishing company | PI – ACAAR F – Private company | ACAAR \$6,200 | 2015 | Live fish transport trials to enhance product value |
| Inland Saline Aquaculture consultancy to a private company in 2015 | PI – ACAAR F – Private company | ACAAR \$4,500 | 2015 | Advice and services for an ISA project |
| RfR YTK Grow out Trial#2 | PI – ACAAR F – MWDC | ACAAR \$35,000 | 2015 | For culture of YTK juveniles for the trial to commence in Geraldton during October 2015. |
| Prawn restocking trials | PI – ACAAR F - Recfishwest | ACAAR \$45,455 | 2015 | Partial payment for the 2015 prawn season. |
| Snapper restocking trials | PI – ACAAR F - Recfishwest | ACAAR \$45,455 | 2015 | Second of three payments for this project. |
| Probiotic trial for an international commercial company | PI – ACAAR F – Private company | ACAAR \$13,200 | 2015 | Two of three instalments for the project 'The effect of top-coating commercial diets with Epicin-D on the growth and health of juvenile barramundi.' |
| Technical advice for a large scale RAS | PI – ACAAR F - GFC | ACAAR \$0 | 2015 | Technical advice to Geraldton Fisherman's Cooperative for design for their live rock lobster holding facility currently being built at Perth Airport – no invoice for services as yet. |
| Blue swimmer crab culture trials | PI – ACAAR F - Recfishwest | ACAAR \$19,773 | 2015 | First instalment for a crab culture trial for restocking purposes. |
| FRDC Project 2014/706 | PI – MFA F - FRDC | ACAAR \$40,000 | 2015 | First instalment of Project 'Co-ordination of Fish Health and Nutrition Research for the WA Yellowtail Kingfish Trial 2' |
| Prawn restocking trials | PI – ACAAR F - Recfishwest | ACAAR \$36,364 | 2015 | Final payment for the 2015 prawn season. |
| FRDC project 2014 – 729 | PI – ACAAR F – FRDC | ACAAR \$35,500 | 2015 | Second instalment 'For improving the taste, bioavailability and efficacy of orally administered praziquantel for kingfish' |
| FRDC Project 2016 – 200.40 | PI – ACAAR F – FRDC | ACAAR \$30,000 | 2015 | First instalment for the commencement of yellowtail kingfish nutrition trials (Value of \$170,000) |



| Title | Conducted by: Principal Investigator (PI) Co-investigator (C) Funder (F) | Challenger component of the total funds allocated | Dates | Outcomes |
|---------------------------|---|--|--------------|--|
| International Consultancy | PI – ACAAR F – CORFU | ACAAR \$4,100 | 2015 | Assessment of Chilean government aquaculture funding proposals |

Fish Stock Supply Contracts

| Description | Challenger Facilities Used | Challenger Staff | Budget and Expected Outcome |
|--|---|---|--|
| A commercial contract to supply 1 million juvenile barramundi to Marine Produce Australia per annum since 2010. ACAAR also provides fish transport and nursery technology and advice | Marine bore systems, tropical larval array, live feed infrastructure, laboratories, cool-room, office space etc | Robert Michael, Brendan Spillman, Gavin Partridge, Greg Jenkins, Bruce Ginbey | Fee of A\$160,404 per annum. Contract expires in November 2017. |
| Live fish transport trials to enhance product value for Abacus Fisheries | Marine bore systems, dedicated metabolic chamber and associated equipment, FishPac transport tubes, monitoring equipment, nutrition laboratory, dry laboratory, cool-room, office space etc | Gavin Partridge, Greg Jenkins, Robert Michael, Brendan Spillman | Investigation and development of techniques for the cost effective transport of live blue swimmer crabs to interstate and international markets. Total estimated value of A\$5,000 |
| Technical advice to Geraldton Fisherman's Cooperative for design of their live rock lobster holding facility currently being constructed a Perth Airport | Office space and IT | Gavin Partridge, Bruce Ginbey | Development of an efficient and effective facility in Perth and the PRC for improvements in live transport of the WA Rock Lobster. No revenue is associated with this project |
| Inland saline aquaculture support for Leigh Grange Pty Ltd in Morawa | Marine bore systems, 1 10 cubic metre tank, bioassay room, nutrition laboratory, dry laboratory, cool-room, office space etc | Gavin Partridge, Bruce Ginbey, Greg Jenkins | Development of a system and protocol to develop a profitable business selling live barramundi and Queensland Grouper to the domestic market. |





Appendix 3: Aquaculture Training Packages

Units that can be offered and undertaken to achieve the various VET aquaculture qualifications are prescribed by the Australian Government Industry Skills Council. While all TAFE colleges must offer the core competency units in order to be able to deliver the qualification, their ability to make available various elective units is a function of internal teaching resources, as well as student demand for individual units. Typically, the range of elective units that are available to students undertaking aquaculture at each of the TAFE colleges examined in this analysis is limited.

Certificate I in Aquaculture

Description

This qualification represents the minimum requirements for an individual commencing a career as an aquaculturist. It provides individuals with an introduction to the aquaculture environment and some basic skills needed in this area of the seafood industry. It is an appropriate level for an individual undertaking work experience, or in a probationary period in employment. It is particularly applicable to school-based studies.

The qualification will have application for people working:

- on aquaculture farms or fishout/put-and-take operations
- in hatcheries and nurseries
- in live post-harvest holding facilities, such as processing plants, wholesalers or transporters
- in pet shops, public aquaria, zoos or other facilities with aquatic animals
- for companies providing contract specialist services for aquaculture operations.

Job Roles

An individual operating at this level undertakes a range of basic work activities, such as feeding, handling and harvesting stock, minor construction work, general cleaning and maintenance of stock culture structures. Work is carried out under close direction and supervision and duties may vary between aquaculture enterprises.

Job role titles may include:

- Farm hand
- Farm labourer
- Farm worker.

Pathway into the Qualification

Entry into this qualification may be:

- By direct entry and without prior aquaculture skills or knowledge
- Through a school vocational studies program combined with work experience.

Pathways from the Qualification

After achieving this qualification, candidates may undertake:

- SFI20111 Certificate II in Aquaculture
- SFI30111 Certificate III in Aquaculture.



Employability Skills Qualification Summary

EMPLOYABILITY SKILLS QUALIFICATION SUMMARY

SFI10111 Certificate I in Aquaculture

The following table contains a summary of the employability skills as identified by the aquaculture sector for this qualification. This table should be interpreted in conjunction with the detailed requirements of each unit of competency packaged in this qualification. The outcomes described here are broad industry requirements and may vary from one agency to another.

| Employability Skill | Industry/enterprise requirements for this qualification include: |
|---------------------------|---|
| Communication | <ul style="list-style-type: none"> ▪ confirming instructions ▪ estimating the duration of tasks ▪ oral reporting on work activities, problems and abnormal stock behaviour to a supervisor ▪ reading and interpreting instructions and work procedures ▪ reading schedules relating to feeding, grading or harvesting ▪ recording and reporting data. |
| Teamwork | <ul style="list-style-type: none"> ▪ contributing to participative OHS arrangements ▪ respecting people from diverse backgrounds ▪ sharing information relevant to work with co-workers ▪ undertaking duties in a positive manner to promote cooperation. |
| Problem solving | <ul style="list-style-type: none"> ▪ assisting in solving problems ▪ recognising and resolving problems and conflicts that may arise in workplace ▪ reporting problems to supervisor. |
| Initiative and enterprise | <ul style="list-style-type: none"> ▪ adapting to new situations ▪ identifying environmental, OHS, quality and food safety hazards. |
| Planning and organising | <ul style="list-style-type: none"> ▪ collecting and checking equipment before beginning work activities ▪ following safe work practices ▪ planning to complete work within an allocated timeframe. |
| Self-management | <ul style="list-style-type: none"> ▪ prioritising work ▪ seeking support to improve own performance. |
| Learning | <ul style="list-style-type: none"> ▪ identifying own learning needs for future work requirements and career aspirations ▪ taking part in learning opportunities. |
| Technology | <ul style="list-style-type: none"> ▪ using automated equipment, such as feeders and data loggers. |

Core Units of Competency

| Unit code | Unit title |
|--------------|--|
| SFICORE101C* | Apply basic food handling and safety practices |
| SFICORE103C | Communicate in the seafood industry |
| SFICORE105B | Work effectively in the seafood industry |
| SFICORE106B | Meet workplace OHS requirements |



** Note: SFICORE101C is not a required unit for operations that are growing or holding species not destined for human consumption. This includes ornamental or display species, stock for pearls, and stockers for conservation purposes. The unit FDFOP2063A Apply quality systems and procedures, is to be used in its place.*

Elective Units of Competency

Group A: Aquaculture Specialist Units

| Unit code | Unit title |
|------------------|---|
| SFIAQUA102B | Carry out basic aquaculture activities |
| SFIAQUA220A | Use waders |
| SFIEMS201B | Participate in environmentally sustainable work practices |

Group B: Other Elective Units

Maintenance and Operations Support

| Unit code | Unit title |
|------------------|--|
| FDFOP1009A | Follow work procedures to maintain quality |
| RIICCM208D | Carry out basic levelling |
| RIISAM201D | Handle resources and infrastructure materials and safely dispose of nontoxic materials |
| RIISAM203D | Use hand and power tools |
| RIISAM204D | Operate small plant and equipment |

Occupational Health and Safety

| Unit code | Unit title |
|------------------|-------------------|
| HLTAID003 | Provide first aid |

Seafood Processing

| Unit code | Unit title |
|------------------|--|
| SFIPROC101C | Clean fish* <i>SFIPROC106B Work with knives</i> |
| SFIPROC102C | Clean work area |



| | |
|-------------|--|
| SFIPROC105B | Fillet fish and prepare portions* <i>SFIPROC106B Work with knives</i> |
|-------------|--|

| | |
|-------------|------------------|
| SFIPROC106B | Work with knives |
|-------------|------------------|

| | |
|-----------|-------------------------------|
| MTMP2002C | Prepare animals for slaughter |
|-----------|-------------------------------|

Seafood Transport and Storage

| Unit code | Unit title |
|-----------|--|
| TLID1001A | Shift materials safely using manual handling methods |

Certificate II in Aquaculture

Description

This qualification represents the base entry point into this sector of the seafood industry and provides people with a range of core and underpinning skills and knowledge relevant to work as a field hand in the aquaculture sector. It is particularly applicable to school-based studies.

- The qualification will have application for people working:
- On aquaculture farms or fishout/put-and-take operations
- In hatcheries and nurseries
- In live post-harvest holding facilities, such as processing plants, wholesalers or transporters
- In pet shops, public aquaria, zoos or other facilities with aquatic animals
- For companies providing contract specialist services for aquaculture operations.

Job Roles

Individuals operating at this level undertake a sequence of routine tasks under direction caring for stock which may be at varying stages of development. Duties may include:

- Harvesting stock, carrying out post-harvest operations and preparing stock for transport
- Maintaining the quality of stock culture environment or holding facility, including Water quality, temperature and flow
- Maintaining and constructing stock culture structures and other farm structures.

Work may vary between enterprises.

Job role titles may include:

- Farm hand
- General hand
- Shop hand
- Feeder
- Pond worker
- Farm labourer



- Hatchery or nursery assistant.

Pathways into the Qualification

Entry into this qualification may be:

- By direct entry and without prior aquaculture skills or knowledge
- Through a school vocational studies program combined with work experience.

This qualification is suited to Australian Apprenticeship pathways.

Pathways from the Qualification

After achieving this qualification, candidates may undertake a:

- SFI30111 Certificate III in Aquaculture
- SFI30311 Certificate III in Seafood Industry (Environmental Management Support).

Maritime competencies gained through SFI20111 Certificate II In Aquaculture may be counted towards a Coxswain maritime certification.

Licensing, Legislative, Regulatory or Certification Considerations

Licenses for operating motor vehicles, tractors, forklifts, vessels and other plant apply for some competencies. Occupational health and safety (OHS), food safety, and environmental protection regulations apply to aquaculture enterprises.

This qualification contains SFISHIP units for basic vessel operation skills. If a Coxswain certification is required then consider undertaking some or all of the units found in the electives, in the functional grouping, Maritime operations. The remaining competencies required to achieve the Coxswain certification can be gained in the SFI30111 Certificate III in Aquaculture.

Employability Skills Summary

EMPLOYABILITY SKILLS QUALIFICATION SUMMARY

SFI20111 Certificate II in Aquaculture

The following table contains a summary of the employability skills as identified by the aquaculture sector for this qualification. This table should be interpreted in conjunction with the detailed requirements of each unit of competency packaged in this qualification. The outcomes described here are broad industry requirements and may vary from one agency to another.

| Employability Skill | Industry/enterprise requirements for this qualification include: |
|---------------------|---|
| Communication | <ul style="list-style-type: none"> ▪ counting stock numbers ▪ estimating percentage of feed consumed ▪ estimating the duration of tasks ▪ oral reporting on work activities, problems and abnormal stock behaviour to a supervisor ▪ reading and interpreting standard operating procedures (SOPs) and equipment manufacturer guidelines ▪ reading meters or test kits when making adjustments to culture environment or calibrating equipment ▪ reading schedules relating to feeding, grading or harvesting ▪ recording and reporting data. |



| | |
|---------------------------|---|
| Teamwork | <ul style="list-style-type: none"> ▪ contributing to participative OHS arrangements ▪ respecting people from diverse backgrounds ▪ sharing information relevant to work with co-workers ▪ undertaking duties in a positive manner to promote cooperation. |
| Problem solving | <ul style="list-style-type: none"> ▪ assisting in solving problems ▪ recognising and resolving problems and conflicts that may arise in the workplace ▪ reporting problems to supervisor ▪ recording and reviewing water quality data or environmental condition. |
| Initiative and enterprise | <ul style="list-style-type: none"> ▪ adapting to new situations ▪ identifying environmental, OHS and food safety hazards ▪ monitoring and responding to changing weather conditions ▪ monitoring stock and responding to abnormal activity. |
| Planning and organising | <ul style="list-style-type: none"> ▪ collecting and checking equipment before beginning work activities ▪ identifying hazards prior to commencing a job ▪ moving equipment into position in readiness for work activities ▪ planning to complete work within an allocated time frame. |
| Self-management | <ul style="list-style-type: none"> ▪ prioritising work ▪ seeking support to improve own performance. |
| Learning | <ul style="list-style-type: none"> ▪ identifying own learning needs for future work requirements and career aspirations. |
| Technology | <ul style="list-style-type: none"> ▪ using automated equipment, such as feeders and data loggers. |

Core Units of Competency

| Unit code | Unit title |
|--------------|--|
| SFICORE101C* | Apply basic food handling and safety practices |
| SFICORE103C | Communicate in the seafood industry |
| SFICORE105B | Work effectively in the seafood industry |
| SFICORE106B | Meet workplace OHS requirements |

* *Note: SFICORE101C is not a required unit for operations that are growing or holding species not destined for human consumption. This includes ornamental or display species, stock for pearls, and stockers for conservation purposes. The unit FDFOP2063A Apply quality systems and procedures, is to be used in its place.*

Elective Units of Competency

Group A: Aquaculture Specialist Units

| Unit code | Unit title |
|-------------|----------------------------------|
| SFIAQUA201C | Collect broodstock and seedstock |



| | |
|-------------|---|
| SFIAQUA205C | Feed stock |
| SFIAQUA206C | Handle stock |
| SFIAQUA209C | Manipulate stock culture environment |
| SFIAQUA211C | Undertake routine maintenance of water supply and disposal systems and structures |
| SFIAQUA212C | Work with crocodiles |
| SFIAQUA213C | Monitor stock and environmental conditions |
| SFIAQUA214B | Produce algal or live-feed cultures |
| SFIAQUA215B | Carry out on-farm post-harvest operations |
| SFIAQUA216B | Harvest cultured or held stock |
| SFIAQUA217B | Maintain stock culture, holding and other farm structures |
| SFIAQUA219B | Operate and maintain high technology water treatment components |
| SFIAQUA221A | Control predators and pests |
| SFIAQUA222A | Control diseases |
| AHCMOM304A | Operate machinery and equipment |
| MTMP2002C | Prepare animals for slaughter |

Group B: Other Elective Units

Aquaculture Operations

| Unit code | Unit title |
|------------------|---|
| SFIAQUA220A | Use waders |
| SFIEMS201B | Participate in environmentally sustainable work practices |
| SFIFISH209C | Maintain the temperature of seafood |
| SFIFISH210C | Assemble and repair damaged netting |
| SFISTOR202C | Receive and distribute product |
| SFISTOR204A | Prepare, pack and dispatch stock for live transport |
| SFISTOR205A | Prepare, pack and dispatch non-live product |

Diving Operations



| Unit code | Unit title |
|------------------|--|
| SFIFISH211A | Provide support for diving operations* <i>HLTFA311A Apply first aid</i> |
| SFIFISH312A | Perform breath-hold diving operations* <i>HLTFA311A Apply first aid</i> |
| SISOODR302A | Plan outdoor recreation activities |
| SISOOPS304A | Plan for minimal environmental impact |
| SISOSCB301A | SCUBA dive in open water to a maximum depth of 18 metres |

Farm Operations

| Unit code | Unit title |
|------------------|---------------------------------------|
| AHCBIO202A | Follow site quarantine procedures |
| AHCCHM201A | Apply chemicals under supervision |
| AHCCHM304A | Transport, handle and store chemicals |
| AHCMOM202A | Operate tractors |
| AHCMOM205A | Operate vehicles |
| AHCPMG201A | Treat weeds |

Fishing Operations

| Unit code | Unit title |
|------------------|---|
| SFIFISH208C | Maintain, prepare, deploy and retrieve purse seines to land catch |

Maintenance and Operations Support

| Unit code | Unit title |
|------------------|--|
| AHCARB205A | Operate and maintain chainsaws |
| AHCINF204A | Fabricate and repair metal or plastic structures |
| AHCMOM204A | Undertake operational maintenance of machinery |
| RIICCM205D | Carry out manual excavation |
| RIICCM208D | Carry out basic levelling |



| | |
|------------|--|
| RIICCM211D | Erect and dismantle temporary fencing and gates |
| RIICRC208A | Lay pipes |
| RIISAM201D | Handle resources and infrastructure materials and safely dispose of nontoxic materials |
| RIISAM203D | Use hand and power tools |
| RIISAM204D | Operate small plant and equipment |
| SITHACS101 | Clean premises and equipment |

Maritime Operations

The units in this group can contribute towards a MAR20313 Certificate II in Maritime Operations (Coxswain Grade 1 Near Coastal). Additional MAR units from this qualification are listed in Certificate III in Aquaculture.

The units below are equivalent to the former Elements of Shipboard Safety.

| Unit code | Unit title |
|------------------|---|
| MARC020 | Transmit and receive information by marine radio |
| MARF001 | Apply basic survival skills in the event of vessel abandonment |
| MARF002 | Follow procedures to minimise and fight fires on board a vessel |
| MARF004 | Meet work health and safety requirements |
| MARF005 | Survive at sea using survival craft |

Occupational Health and Safety

| Unit code | Unit title |
|------------------|-------------------|
| HLTAID003 | Provide first aid |

Ornamental Operations

| Unit code | Unit title |
|------------------|---|
| SIRXCCS201 | Apply point-of-sale handling procedures |
| SIRXINV001A | Perform stock control procedures |

Quality Assurance and Food Safety

| Unit code | Unit title |
|------------------|-------------------|
|------------------|-------------------|



| | |
|------------|--|
| FDFOP2063A | Apply quality systems and procedures |
| FDFFS2001A | Implement the food safety program and procedures |

Seafood Processing

| Unit code | Unit title |
|------------------|--|
| SFIPROC101C | Clean fish* <i>SFIPROC106B Work with knives</i> |
| SFIPROC102C | Clean work area |
| SFIPROC105B | Fillet fish and prepare portions* <i>SFIPROC106B Work with knives</i> |
| SFIPROC106B | Work with knives |
| SFIPROC201C | Head and peel crustaceans |
| SFIPROC203C | Shuck molluscs |
| FDFOP2056A | Operate a freezing process |

Seafood Sales, Distribution and Marketing

| Unit code | Unit title |
|------------------|---|
| SFIDIST202C | Retail fresh, frozen and live seafood |
| SIRXICT001A | Operate retail technology |
| SIRXCCS202 | Interact with customers |
| SIRXFIN201 | Balance and secure point-of-sale terminal |

Seafood Transport and Storage

| Unit code | Unit title |
|------------------|--|
| SFISTOR203C | Assemble and load refrigerated product |
| TLID1001A | Shift materials safely using manual handling methods |
| TLID2004A | Load and unload goods/cargo |
| TLILIC2001A | Licence to operate a forklift truck |

Vessel Operations



| Unit code | Unit title |
|-------------|---|
| SFIFISH215B | Apply deckhand skills aboard a fishing vessel |
| SFISHIP201C | Comply with organisational and legislative requirements |
| SFISHIP205C | Maintain marine plant |
| SFISHIP206C | Operate a small vessel |
| SFISHIP207C | Operate and maintain outboard motors |
| SFISHIP208C | Operate low powered diesel engines |

Business Services

| Unit code | Unit title |
|------------|--|
| BSBCUS201B | Deliver a service to customers |
| BSBINM201A | Process and maintain workplace information |
| BSBWOR204A | Use business technology |
| FNSACC301A | Process financial transactions and extract interim reports |

Certificate III in Aquaculture

Description

This qualification specifies the competencies relevant to an individual working in the aquaculture sector of the seafood industry in the capacity of a skilled worker or leading hand.

The qualification will have application for people working:

- for companies providing contract specialist services for aquaculture operations
- in hatcheries and nurseries
- in live post-harvest holding facilities, such as processing plants, wholesalers or transporters
- in pet shops, public aquaria, zoos or other facilities with aquatic animals
- on aquaculture farms or fishout/put-and-take operations.

Job Roles

An individual operating at this level will have a broad range of well-developed skills and the ability to adapt and transfer skills to new activities. That person will have some responsibility for decision making and may coordinate some team activities. Their duties may include:

- installing or constructing stock culture or holding structures and other allied structures
- maintaining the culture or holding environment by:



- treating and disposing of effluent and wastes
- monitoring environmental conditions
- maintaining water quality
- overseeing stock-related activities, such as:
 - feeding, handling, harvesting and controlling predators, pests and diseases
- responsibility for:
 - operating high technology water treatment components
 - implementing emergency procedures
 - implementing occupational health and safety policies and guidelines.

Duties may vary between aquaculture and aquatic holding enterprises.

Job role titles may include:

- autonomous farm attendant
- junior technician
- leading hand
- senior shop hand
- shift or team leader
- supervisor
- work foreman.

Pathways into the Qualification

Entry into this qualification may be:

- by direct entry
- after completion of the SFI20111 Certificate II in Aquaculture.

This qualification is suited to Australian Apprenticeship pathways.

Pathways from the Qualification

After achieving this qualification, candidates may undertake:

- SFI40111 Certificate IV in Aquaculture
- SFI40311 Certificate IV in Seafood Industry (Environmental Management).

Licensing, Legislative, Regulatory or Certification Considerations

Licences for operating motor vehicles, tractors, forklifts, vessels and other plant apply to some competencies. Occupational health and safety (OHS), food safety and environmental protection regulations apply to aquaculture enterprises.

Employability Skills Summary

EMPLOYABILITY SKILLS QUALIFICATION SUMMARY

SFI30111 Certificate III in Aquaculture

The following table contains a summary of the employability skills as identified by the aquaculture sector for this qualification. This table should be interpreted in conjunction with the detailed requirements of each unit of competency



packaged in this qualification. The outcomes described here are broad industry requirements and may vary from one agency to another.

| Employability Skill | Industry/enterprise requirements for this qualification include: |
|---------------------------|---|
| Communication | <ul style="list-style-type: none"> ▪ counting stock numbers ▪ estimating percentage of feed consumed ▪ estimating the duration of tasks ▪ reading and interpreting standard operating procedures (SOPs) and equipment manufacturer guidelines or instructions ▪ reading meters or test kits when making adjustments to culture or holding environment or calibrating equipment ▪ reading schedules relating to feeding, grading or harvesting ▪ recording and reporting data ▪ summarising oral reports of team members on work activities, problems and abnormal stock behaviour for a supervisor. |
| Teamwork | <ul style="list-style-type: none"> ▪ contributing to participative OHS arrangements ▪ overseeing or coordinating work of other team members ▪ respecting people from diverse backgrounds ▪ sharing information relevant to work with co-workers ▪ undertaking duties in a positive manner to promote cooperation. |
| Problem solving | <ul style="list-style-type: none"> ▪ developing practical and creative solutions to workplace problems either individually or in teams ▪ recognising and resolving problems and conflicts that may arise in the workplace ▪ recording and reviewing water quality data or environmental conditions ▪ reporting problems to supervisor. |
| Initiative and enterprise | <ul style="list-style-type: none"> ▪ adapting to new situations ▪ being creative in response to workplace challenges ▪ identifying opportunities that might not be obvious to others ▪ identifying, assessing and managing environmental, OHS and food safety hazards ▪ monitoring and responding to changing weather conditions ▪ monitoring stock and responding to abnormal activity ▪ recognising and reporting faulty equipment and following OHS procedures. |
| Planning and organising | <ul style="list-style-type: none"> ▪ applying continuous improvement processes ▪ coordinating labour, equipment and other resources to ensure that work is carried out according to timelines and priorities ▪ establishing and communicating clear goals and deliverables for self and team members ▪ identifying hazards prior to commencing a job ▪ planning for self and work team to complete work within an allocated timeframe. |
| Self-management | <ul style="list-style-type: none"> ▪ maintaining own knowledge of the job role, reviewing own performance and actively seeking and acting upon advice and guidance ▪ prioritising work and completing delegated tasks ▪ taking responsibility at the appropriate level. |
| Learning | <ul style="list-style-type: none"> ▪ being open to learning, new ideas and techniques ▪ identifying own learning needs for future work requirements and career aspirations ▪ learning in a range of settings, including informal learning ▪ sharing knowledge and skills with other team members. |
| Technology | <ul style="list-style-type: none"> ▪ examining options for automation, mechanisation or other technology to reduce risks and improve efficiencies ▪ using automated equipment, such as feeders and data loggers. |

Core Units of Competency



| Unit code | Unit title |
|--------------|--|
| SFICORE101C* | Apply basic food handling and safety practices |
| SFICORE103C | Communicate in the seafood industry |
| SFICORE105B | Work effectively in the seafood industry |
| SFICORE106B | Meet workplace OHS requirements |

** Note: SFICORE101C is not a required unit for aquaculture operations that are growing or holding ornamental or display species, stock for pearls, and stockers for conservation purposes. The unit FDFOP2063A Apply quality systems and procedures is to be used in its place.*

Elective Units of Competency

Group A: Aquaculture Specialist Units

| Unit code | Unit title |
|-------------|--|
| SFIAQUA301C | Oversee and undertake effluent and waste treatment and disposal |
| SFIAQUA302C | Construct or install stock culture, holding and farm structures |
| SFIAQUA303C | Coordinate stock handling activities |
| SFIAQUA308C | Maintain water quality and environmental monitoring |
| SFIAQUA309C | Oversee harvest and post-harvest activities |
| SFIAQUA311B | Oversee production and maintain algal or live-feed cultures |
| SFIAQUA313B | Oversee operations of high technology water treatment components |
| SFIAQUA314A | Support hatchery operations |
| SFIAQUA315A | Oversee emergency procedures for on-land operations |
| SFIAQUA316A | Oversee the control of predators and pests |
| SFIAQUA317A | Oversee the control of diseases |
| SFIAQUA318A | Coordinate feed activities |
| SFIEMS301B | Implement and monitor environmentally sustainable work practices |
| SFIEMS302B | Act to prevent interaction with protected species |
| SFIOHS301C | Implement OHS policies and guidelines |
| AHCCHM303A | Prepare and apply chemicals |



AHCLSK319A Slaughter livestock

Group B: Other Elective Units

Aquaculture Operations

| Unit code | Unit title |
|------------------|---|
| SFIAQUA209C | Manipulate stock culture environment |
| SFIAQUA213C | Monitor stock and environmental conditions |
| SFIAQUA217B | Maintain stock culture, holding and other farm structures |
| SFIAQUA220A | Use waders |
| SFIFISH209C | Maintain the temperature of seafood |
| SFISTOR202C | Receive and distribute product |
| SFISTOR204A | Prepare, pack and dispatch stock for live transport |
| SFISTOR205A | Prepare, pack and dispatch non-live product |
| AHCWRK305A | Coordinate work site activities |
| FDFOF2063A | Apply quality systems and procedures |

Crane Operations

| Unit code | Unit title |
|------------------|---|
| TLILIC0012A | Licence to operate a vehicle loading crane (capacity 10 metre tonnes and above) |
| TLILIC3006A | Licence to operate a non-slewing mobile crane (greater than 3 tonnes capacity) |
| TLILIC3008A | Licence to operate a slewing mobile crane (up to 20 tonnes) |

Diving Operations

| Unit code | Unit title |
|------------------|--|
| SFIDIVE309A | Work effectively as a diver in the seafood industry* <i>HLTFA311A Apply first aid</i> |
| SFIDIVE310A | Perform diving operations using SSBA* <i>HLTFA311A Apply first aid</i> |



| | |
|-------------|--|
| SFIDIVE311A | Perform diving operations using SCUBA* <i>HLTFA311A Apply first aid</i> |
| SFIDIVE312A | Undertake emergency procedures in diving operations using SSBA* <i>HLTFA311A Apply first aid</i> |
| SFIDIVE313A | Undertake emergency procedures in diving operations using SCUBA* <i>HLTFA311A Apply first aid</i> |
| SFIDIVE314A | Perform compression chamber diving operations* <i>HLTFA311A Apply first aid</i> |
| SFIDIVE315A | Perform underwater work in the aquaculture sector* <i>HLTFA311A Apply first aid</i> |
| SFIDIVE316A | Perform underwater work in the wild catch sector* <i>HLTFA311A Apply first aid</i> |
| SISOOPS304A | Plan for minimal environmental impact |
| SISOODR302A | Plan outdoor recreation activities |
| SISOSCB301A | SCUBA dive in open water to a maximum depth of 18 metres |

Farm Operations

| Unit code | Unit title |
|------------------|--|
| AHCAGB301A | Keep records for a primary production business |
| AHCARB205A | Operate and maintain chainsaws |
| AHCBIO202A | Follow site quarantine procedures |
| AHCCHM201A | Apply chemicals under supervision |
| AHCCHM304A | Transport, handle and store chemicals |
| AHCMOM305A | Operate specialised machinery and equipment |

Fishing Operations

| Unit code | Unit title |
|------------------|--|
| SFIFISH210C | Assemble and repair damaged netting |
| SFIFISH309B | Construct nets and customise design* <i>SFIFISH210C Assemble and repair damaged netting</i> |



| | |
|-------------|---|
| SFIFISH310A | Adjust and position fishing gear |
| SFIFISH311A | Operate vessel deck machinery and lifting appliance |

Maintenance and Operations Support

| Unit code | Unit title |
|------------------|--|
| AHCINF303A | Plan and construct conventional fencing |
| AHCLSC302A | Construct landscape features using concrete |
| AHCLSC303A | Construct brick and/or block structures and features |
| AHCLSC304A | Erect timber structures and features |
| AHCLSK321A | Service and repair bores and windmills |

Maritime Operations

The units in this group include the remaining MAR units required to achieve MAR20313 Certificate II in Maritime Operations (Coxswain Grade 1 Near Coastal). MAR units equivalent to the former Elements of Shipboard Safety are also available in SFI20111 Certificate II in Aquaculture.

| Unit code | Unit title |
|------------------|---|
| MARB001 | Assist with routine maintenance of a vessel |
| MARB002 | Perform basic servicing and maintenance of main propulsion unit and auxiliary systems |
| MARB009 | Manage refuelling |
| MARC003 | Operate and maintain extra low and low voltage electrical systems and equipment |
| MARC005 | Operate inboard and outboard motors |
| MARC006 | Operate main propulsion and auxiliary systems |
| MARC020 | Transmit and receive information by marine radio |
| MARF001 | Apply basic survival skills in the event of vessel abandonment |
| MARF002 | Follow procedures to minimise and fight fires on board a vessel |
| MARF004 | Meet work health and safety requirements |
| MARF005 | Survive at sea using survival craft |
| MARG002 | Manage a small crew |



| | |
|---------|--|
| MARH001 | Plan and navigate a passage for a vessel up to 12 metres |
| MARI001 | Comply with regulations to ensure safe operation of a vessel up to 12 metres |
| MARI002 | Comply with regulations to ensure safe operation of a vessel up to 80 metres |
| MARJ001 | Follow environmental work practices |
| MARK001 | Handle a vessel up to 12 metres |
| MARN002 | Apply seamanship skills aboard a vessel up to 12 metres |
| MARN003 | Perform seamanship operations on board a vessel up to 24 metres |

Occupational Health and Safety

| Unit code | Unit title |
|-----------|-------------------|
| HLTAID003 | Provide first aid |

Ornamental Operations

| Unit code | Unit title |
|------------|---|
| ACMCAS305A | Maintain aquascapes and aquatic animals |
| SIRXICT303 | Operate retail information technology systems |
| SIRXMER303 | Coordinate merchandise presentation |

Quality Assurance, Food Safety and Environmental Management

| Unit code | Unit title |
|-------------|---|
| SFIEMS401B | Conduct an internal audit of an environmental management system |
| BSBRSK401A | Identify risk and apply risk management processes |
| FDFFS3001A | Monitor the implementation of quality and food safety programs* <i>FDFFS2001A Implement the food safety program and procedures</i> |
| FDFFS2001A | Implement the food safety program and procedures |
| FDFOP2013A | Apply sampling procedures |
| FDFTEC3001A | Participate in a HACCP team* <i>FDFFS2001A Implement the food safety program and procedures</i> |



Seafood Processing

| Unit code | Unit title |
|-------------|------------------------------------|
| SFIPROC302C | Handle and pack sashimi-grade fish |
| SFIPROC304B | Boil and pack crustaceans |
| MTMSR303A | Smoke product |

Seafood Transport and Storage

| Unit code | Unit title |
|-------------|--|
| SFISTOR301C | Operate refrigerated storerooms |
| SITXINV201 | Receive and store stock |
| SITXINV202 | Maintain the quality of perishable items |
| SITXINV401 | Control stock |
| TLILIC2001A | Licence to operate a forklift truck |

Vessel Operations

| Unit code | Unit title |
|-------------|---|
| SFIFISH215B | Apply deckhand skills aboard a fishing vessel |
| SFISHIP202C | Contribute to safe navigation |
| SFISHIP206C | Operate a small vessel |
| SFISHIP207C | Operate and maintain outboard motors |
| SFISHIP211C | Prepare for maintenance |

Business Services

| Unit code | Unit title |
|------------|--|
| BSBADM311A | Maintain business resources |
| BSBCUS301B | Deliver and monitor a service to customers |
| BSBFIA301A | Maintain financial records |
| BSBFIA302A | Process payroll |
| BSBFIA303A | Process accounts payable and receivable |



| | |
|------------|---|
| BSBFIA401A | Prepare financial reports |
| BSBINM301A | Organise workplace information |
| BSBITU306A | Design and produce business documents |
| BSBITU307A | Develop keyboarding speed and accuracy |
| BSBITU309A | Produce desktop published documents |
| BSBRKG304B | Maintain business records |
| BSBSUS201A | Participate in environmentally sustainable work practices |

Corporate Management

| Unit code | Unit title |
|------------------|--|
| BSBFLM303C | Contribute to effective workplace relationships |
| BSBFLM306C | Provide workplace information and resourcing plans |
| BSBFLM309C | Support continuous improvement systems and processes |
| BSBFLM311C | Support a workplace learning environment |
| BSBFLM312C | Contribute to team effectiveness |
| BSBINN301A | Promote innovation in a team environment |
| BSBWOR301B | Organise personal work priorities and development |

E-Business

| Unit code | Unit title |
|------------------|--|
| BSBITU305A | Conduct online transactions |
| BSBRES401A | Analyse and present research information |
| BSBRKG402B | Provide information from and about records |

Training and Assessment

| Unit code | Unit title |
|------------------|--------------------------------|
| TAEASS301B | Contribute to assessment |
| TAEDEL301A | Provide work skill instruction |



Certificate IV in Aquaculture

Description

This qualification specifies the competencies relevant to people working as aquaculturists in a supervisory or leadership capacity. A person operating at this level may be expected to comply with legislative requirements as well as implement a range of enterprise policies and procedures. They will also use their knowledge and skills to solve problems, plan for future work activities and take responsibility for others.

The qualification will have application for people working:

- on aquaculture farms or fishout/put-and-take operations
- in hatcheries and nurseries
- in live post-harvest holding facilities, such as processing plants, wholesalers or transporters
- in pet shops, public aquaria, zoos or other facilities with aquatic animals
- for companies providing contract specialist services for aquaculture operations
- for companies providing consultancy, advisory, equipment sale or other services.

Job Role

A person operating at this level supervises or coordinates a broad range of duties appropriate to work in this sector of the seafood industry which may include:

- coordinating stock-related activities, such as:
 - feeding, handling, harvesting and controlling pests, predators and disease
- coordinating the monitoring and maintaining of stock and the aquaculture environment
- managing the installing, constructing and maintenance of stock holding and culture systems, and other farm structures
- ensuring safe and efficient procedures for production of quality product
- responsibility for:
 - use of mechanisation, automation or technology to improve production
 - training and induction of staff, including emergency procedures
 - compliance with occupational health and safety (OHS), environment, animal welfare and food safety regulations.

Work may vary between aquaculture and live holding enterprises.

Job role titles may include:

- harvest manager
- head supervisor
- gear supervisor
- safety officer
- senior or head technician
- shift leader



- quality assurance or environmental officer.

Pathways into the Qualification

Pathways for candidates considering this qualification include:

- direct entry with prior experience in aquaculture or related field
- SFI30111 Certificate III in Aquaculture
- vocational and tertiary studies related to environmental sustainability
- maritime skills, including certifications, such as Coxswain.

Pathways from the Qualification

After achieving this qualification, candidates may undertake:

- SFI50111 Diploma of Aquaculture.

Licensing, Legislative, Regulatory or Certification Considerations

Licences for operating motor vehicles, tractors, forklifts, vessels and other plant apply to some competencies. OHS, food safety, and environmental protection regulations apply to aquaculture enterprises.

Employability Skills Summary

EMPLOYABILITY SKILLS QUALIFICATION SUMMARY

SFI40111 Certificate IV in Aquaculture

The following table contains a summary of the employability skills as identified by the aquaculture sector for this qualification. This table should be interpreted in conjunction with the detailed requirements of each unit of competency packaged in this qualification. The outcomes described here are broad industry requirements and may vary from one agency to another.

| Employability Skill | Industry/enterprise requirements for this qualification include: |
|---------------------------|--|
| Communication | <ul style="list-style-type: none"> ▪ calculating perimeters, area, volume, angles and scientific concepts, such as concentration ▪ confirming production requirements and environmental monitoring requirements with senior personnel ▪ explaining roles and responsibilities to staff ▪ providing feedback on performance to staff ▪ writing and presenting reports to management. |
| Teamwork | <ul style="list-style-type: none"> ▪ identifying and using the strengths of other team members ▪ liaising with emergency agencies ▪ supporting staff to meet work schedules and production outcomes ▪ working with diverse individuals and groups. |
| Problem solving | <ul style="list-style-type: none"> ▪ applying a range of strategies in problem solving ▪ developing measurement methods for monitoring non-routine water quality and environment parameters ▪ diagnosing health problems ▪ identifying husbandry practices to solve stock health issues. |
| Initiative and enterprise | <ul style="list-style-type: none"> ▪ adapting to new situations ▪ assessing options for mechanisation or automation of process or activity |



| | |
|-------------------------|---|
| | <ul style="list-style-type: none"> ▪ evaluating the benefits of contracted specialist labour ▪ identifying improvements to the aquaculture enterprise, including efficiencies, productivity and systems, such as OHS, environmental management and quality assurance ▪ manipulating water chemistry to improve water quality ▪ reporting non-compliances and non-routine matters. |
| Planning and organising | <ul style="list-style-type: none"> ▪ developing routines for stock health management ▪ interpreting stock health and other production plans to develop yearly calendar of activities, monitoring schedules and performance benchmarks ▪ managing time and priorities ▪ organising personnel into an efficient aquaculture operation ▪ sequencing activities for safe and efficient operation. |
| Self-management | <ul style="list-style-type: none"> ▪ being timely and effective in responding to enterprise needs within work role ▪ carrying a fair share of the workload ▪ managing personal stress ▪ prioritising work and related activities ▪ taking responsibility and being accountable for planning and work outcomes. |
| Learning | <ul style="list-style-type: none"> ▪ being open to learning, new ideas and techniques ▪ coaching staff within the enterprise to improve performance ▪ contributing to the learning of others ▪ learning in order to take up new opportunities ▪ participating in ongoing learning. |
| Technology | <ul style="list-style-type: none"> ▪ using high technology components for waste treatment in recirculating aquaculture systems (RAS) ▪ using technology and computer software to record and analyse data ▪ using technology to monitor environmental factors in culture or holding structures ▪ using technology to monitor expenses and budgets ▪ using technology to present information, such as graphs and tables. |

Core Units of Competency

| Unit code | Unit title |
|--------------|--|
| SFICORE101C* | Apply basic food handling and safety practices |
| SFICORE103C | Communicate in the seafood industry |
| SFICORE105B | Work effectively in the seafood industry |
| SFICORE106B | Meet workplace OHS requirements |

** Note: SFICORE101C is not a required unit for operations that are growing or holding species not destined for human consumption. This includes ornamental or display species, stock for pearls, and stockers for conservation purposes. The unit FDFOP2063A Apply quality systems and procedures, is to be used in its place.*

Elective Units of Competency

Group A: Aquaculture Specialist Units

| Unit code | Unit title |
|-----------|------------|
|-----------|------------|



| | |
|-------------|--|
| SFIAQUA308C | Maintain water quality and environmental monitoring |
| SFIAQUA316A | Oversee the control of predators and pests |
| SFIAQUA317A | Oversee the control of diseases |
| SFIAQUA401C | Develop and implement a stock health program |
| SFIAQUA402C | Coordinate construction or installation of stock culture, holding and farm structures |
| SFIAQUA404C | Operate hatchery |
| SFIAQUA406C | Seed and harvest round pearls |
| SFIAQUA407C | Coordinate sustainable aquacultural practices |
| SFIAQUA408C | Supervise harvest and post-harvest activities |
| SFIAQUA409B | Implement, monitor and review stock production |
| SFIAQUA410B | Implement a program to operate, maintain or upgrade a system comprising high technology water treatment components |
| SFIAQUA411A | Manage water quality and environmental monitoring in enclosed systems |
| SFIAQUA413A | Develop emergency procedures for an aquaculture enterprise |
| SFIOHS301C | Implement OHS policies and guidelines |
| ACMCAS403A | Design, construct and maintain aquascapes |
| AHCWRK403A | Supervise work routines and staff performance |
| BSBRK401A | Identify risk and apply risk management processes |

Group B: Other Elective Units

Aquaculture Operations

| Unit code | Unit title |
|------------------|--|
| SFIAQUA309C | Oversee harvest and post-harvest activities |
| SFIAQUA314A | Support hatchery operations |
| SFIAQUA318A | Coordinate feed activities |
| SFIEMS301B | Implement and monitor environmentally sustainable work practices |

Farm Operations

| Unit code | Unit title |
|------------------|-------------------|
|------------------|-------------------|



| | |
|------------|---|
| AHCBUS402A | Cost a project |
| AHCBUS404A | Operate within a budget framework |
| AHCCHM401A | Minimise risks in the use of chemicals |
| AHCCHM402A | Plan and implement a chemical use program |
| AHCINF301A | Implement property improvement, construction and repair |
| AHCMOM402A | Supervise maintenance of property machinery and equipment |

Ornamental Operations

| Unit code | Unit title |
|------------------|---|
| SIRXMER004A | Manage merchandise and store presentation |

Occupational Health and Safety

| Unit code | Unit title |
|------------------|-------------------|
| HLTAID003 | Provide first aid |

Quality Assurance, food safety and environmental management

| Unit code | Unit title |
|------------------|---|
| SFIEMS302B | Act to prevent interaction with protected species |
| SFIEMS401B | Conduct an internal audit of an environmental management system |
| BSBAUD402B | Participate in a quality audit |
| MTMCOR402C | Facilitate Quality Assurance process |
| MTMPSR412A | Participate in product recall |
| MTMPSR414A | Establish sampling program |
| MTMPSR406B | Manage and maintain a food safety plan |

Business Services

| Unit code | Unit title |
|------------------|-------------------------------|
| BSBADM407B | Administer projects |
| BSBADM409A | Coordinate business resources |



| | |
|------------|--|
| BSBCUS401B | Coordinate implementation of customer service strategies |
| BSBEBU401A | Review and maintain a website |
| BSBFIA302A | Process payroll |
| BSBFIA401A | Prepare financial reports |
| BSBITU203A | Communicate electronically |
| BSBITU305A | Conduct online transactions |
| BSBITU404A | Produce complex desktop published documents |
| BSBPUR401B | Plan purchasing |
| BSBPUR402B | Negotiate contracts |
| BSBRES401A | Analyse and present research information |
| BSBWOR301B | Organise personal work priorities and development |
| SITXMPR401 | Coordinate production of brochures and marketing materials |
| TLIR4002A | Source goods/services and evaluate contractors |

Frontline Management

| Unit code | Unit title |
|--------------|---|
| BSBATSIC411C | Communicate with the community |
| BSBINM401A | Implement workplace information system |
| BSBHRM404A | Review human resource functions |
| BSBHRM405A | Support the recruitment, selection and induction of staff |
| BSBINN301A | Promote innovation in a team environment |
| BSBLED401A | Develop teams and individuals |
| BSBMGT401A | Show leadership in the workplace |
| BSBMGT403A | Implement continuous improvement |

Industry Leadership Focus A – Sector Representation

| Unit code | Unit title |
|-------------|--|
| SFILEAD401B | Develop and promote knowledge of the industry sector |
| SFILEAD402B | Negotiate effectively for the sector |



SFILEAD403B Demonstrate commitment and professionalism

Industry Leadership Focus B – Resource Management Group Membership

| Unit code | Unit title |
|------------------|--|
| SFILEAD407A | Provide expert information to a resource management group |
| SFILEAD408A | Analyse information to develop strategic seafood management options |
| SFILEAD409A | Negotiate collective outcomes within the resource management group process |

Small Business Management

| Unit code | Unit title |
|------------------|--|
| BSBINM201A | Process and maintain workplace information |
| BSBSMB301A | Investigate micro business opportunities |
| BSBSMB401A | Establish legal and risk management requirements of a small business |
| BSBSMB402A | Plan small business finances |
| BSBSMB403A | Market the small business |
| BSBSMB404A | Undertake small business planning |
| BSBSMB405B | Monitor and manage small business operations |
| BSBSMB406A | Manage small business finances |
| BSBSMB407A | Manage a small team |

Training and Assessment

| Unit code | Unit title |
|------------------|---|
| TAEASS401B | Plan assessment activities and processes |
| TAEASS402B | Assess competence |
| TAEASS403B | Participate in assessment validation |
| TAEDEL402A | Plan, organise and facilitate learning in the workplace |

Diploma of Aquaculture

Description



This qualification represents the competencies relevant to people working in the aquaculture sector of the seafood industry at a management level.

The qualification will have application for people working:

- on aquaculture farms or fishout/put-and-take operations
- in hatcheries and nurseries
- in live post-harvest holding facilities, such as processing plants, wholesalers or transporters
- in pet shops, public aquaria, zoos or other facilities with aquatic animals
- for companies providing contract specialist services for aquaculture operations
- for companies providing consultancy, advisory, equipment sales or other services.

Job Role

A person operating at this level will have a wide range of technical skills and/or managerial, coordination and planning responsibilities which may include:

- complying with a wide range of local, state, territory and federal government regulations and restrictions, including human resources, aquaculture operations, occupational health and safety (OHS), environment, animal welfare and food safety
- designing and planning culture and holding systems and other structures
- developing policies and procedures ensuring continual improvement throughout the business
- implementing new technologies and ideas
- managing risk and implementation of effective controls and corrective actions
- managing the production system
- sourcing external contractors and services.

Work may vary between aquaculture and aquatic holding enterprises.

Job role titles may include:

- owner/manager
- farm manager
- hatchery manager
- production manager
- quality manager
- compliance manager
- marketing manager
- new technology/automation specialist.

Pathways into the Qualification

A person operating at this level will have a wide range of technical skills and/or managerial, coordination and planning responsibilities which may include:

- complying with a wide range of local, state, territory and federal government regulations and restrictions, including human resources, aquaculture operations, occupational health and safety (OHS), environment, animal welfare and food safety
- designing and planning culture and holding systems and other structures
- developing policies and procedures ensuring continual improvement throughout the business
- implementing new technologies and ideas
- managing risk and implementation of effective controls and corrective actions



- managing the production system
- sourcing external contractors and services.

Work may vary between aquaculture and aquatic holding enterprises.

Job role titles may include:

- owner/manager
- farm manager
- hatchery manager
- production manager
- quality manager
- compliance manager
- marketing manager
- new technology/automation specialist.

Pathways from the Qualification

After achieving this qualification, candidates may undertake professional development activities in areas of benefit to their workplace and their personal aspirations.

Licensing, Legislative, Regulatory or Certification Considerations

Licences for operating motor vehicles, tractors, forklifts, vessels and other plant apply to some competencies. OHS, food safety, and environmental protection regulations apply to aquaculture enterprises.

Employability Skills Summary

EMPLOYABILITY SKILLS QUALIFICATION SUMMARY

SFI50111 Diploma of Aquaculture

The following table contains a summary of the employability skills as identified by the aquaculture sector for this qualification. This table should be interpreted in conjunction with the detailed requirements of each unit of competency packaged in this qualification. The outcomes described here are broad industry requirements and may vary from one agency to another.

| Employability Skill | Industry/enterprise requirements for this qualification include: |
|---------------------------|---|
| Communication | <ul style="list-style-type: none"> ▪ calculating design criteria for culture and holding structures ▪ comparing data to determine energy and water efficiency ▪ consulting with industry representatives and experts ▪ drawing up and monitoring budgets ▪ interpreting legislation and regulations ▪ interpreting plans and work specifications ▪ negotiating with contractors and suppliers ▪ researching new technological equipment or processes. |
| Teamwork | <ul style="list-style-type: none"> ▪ leading work teams ▪ sharing information with work team on emergency procedures, sustainable aquaculture practices and production objectives ▪ working with diverse individuals and groups. |
| Problem solving | <ul style="list-style-type: none"> ▪ applying analytical thinking to solve problems in the workplace ▪ developing strategies in response to water quality and stock health issues ▪ solving problems individually or in teams. |
| Initiative and enterprise | <ul style="list-style-type: none"> ▪ evaluating options for improvement ▪ identifying potential improvements ▪ recognising and taking advantage of market opportunities. |



| | |
|-------------------------|--|
| Planning and organising | <ul style="list-style-type: none"> ▪ applying risk management approaches ▪ coordinating production and harvest activities with market requirements, and culture or holding species requirements ▪ planning for production, stock health, construction and finance ▪ setting up and implementing systems, such as quality assurance, food safety, OHS and ecologically sustainable development (ESD). |
| Self-management | <ul style="list-style-type: none"> ▪ following through on commitments ▪ modelling professional behaviour to others ▪ taking responsibility and being accountable for planning and production outcomes. |
| Learning | <ul style="list-style-type: none"> ▪ being open to learning, new ideas and techniques ▪ creating a systematic approach to learning within an enterprise ▪ contributing to the learning of others ▪ learning in order to take up new opportunities ▪ participating in ongoing learning. |
| Technology | <ul style="list-style-type: none"> ▪ applying technology as a production management and monitoring tool ▪ using technology and related workplace equipment ▪ using technology to present information, such as graphs and tables ▪ using technology to manage finances, cash flows and monitor expenses. |

Core Units of Competency

| Unit code | Unit title |
|--------------|--|
| SFICORE101C* | Apply basic food handling and safety practices |
| SFICORE103C | Communicate in the seafood industry |
| SFICORE105B | Work effectively in the seafood industry |
| SFICORE106B | Meet workplace OHS requirements |

** Note: SFICORE101C is not a required unit for operations that are growing or holding species not destined for human consumption. This includes ornamental or display species, stock for pearls, and stockers for conservation purposes. The unit FDFOP2063A Apply quality systems and procedures, is to be used in its place.*

Elective Units of Competency

Group A: Aquaculture Specialist Units

| Unit code | Unit title |
|-------------|---|
| SFIAQUA501C | Develop a stock nutrition program |
| SFIAQUA502C | Develop and implement an aquaculture breeding strategy |
| SFIAQUA503C | Establish an aquacultural enterprise |
| SFIAQUA504C | Plan environmentally sustainable aquacultural practices |
| SFIAQUA505C | Plan stock health management |



| | |
|-------------|--|
| SFIAQUA507C | Plan and design water supply and disposal systems |
| SFIAQUA508C | Plan and design stock culture or holding systems and structures |
| SFIAQUA509B | Develop stock production plan |
| SFIAQUA510B | Select, plan or design a system or facility utilising high technology water treatment components |
| SFIDIST501C | Export product |
| SFIDIST502C | Import product |
| SFIEMS501B | Develop workplace policy for sustainability |
| SFIOHS501C | Establish and maintain the enterprise OHS program |
| AHCAGB603A | Manage the production system |
| AHCBUS505A | Develop a marketing plan |
| AHCBUS506A | Develop and review a business plan |
| BSBR501B | Manage risk |

Group B: Other Elective Units

Aquaculture Operations

| Unit code | Unit title |
|------------------|--|
| SFIAQUA407C | Coordinate sustainable aquacultural practices |
| SFIAQUA408C | Supervise harvest and post-harvest activities |
| SFIAQUA413A | Develop emergency procedures for an aquaculture enterprise |

Farm Operations

| Unit code | Unit title |
|------------------|---|
| AHCAGB502A | Plan and manage infrastructure requirements |
| AHCAGB503A | Plan and monitor production processes |
| AHCAGB505A | Develop a whole farm plan |
| AHCAGB601A | Develop export markets for produce |
| AHCAGB602A | Manage estate planning |



| | |
|------------|--|
| AHCAGB604A | Analyse business performance |
| AHCAGB605A | Manage business capital |
| AHCBUS501A | Manage staff |
| AHCBUS507A | Monitor and review business performance |
| AHCBUS601A | Manage capital works |
| AHCBUS603A | Develop and review a strategic plan |
| AHCCHM501A | Develop and manage a chemical use strategy |
| AHCMOM501A | Manage machinery and equipment |
| AHCMOM502A | Implement a machinery management system |
| AHCMOM601A | Analyse machinery options |
| AHCWRK501A | Plan, implement and review a quality assurance program |
| AHCWRK502A | Collect and manage data |
| AHCWRK603A | Design and conduct a field-based research trial |

Ornamental Operations

| Unit code | Unit title |
|------------------|-------------------|
| SIRXINV005A | Control inventory |

Quality Assurance and Food Safety

| Unit code | Unit title |
|------------------|--|
| MTMPS5603B | Develop, manage and maintain quality systems |
| MTMPSR5601B | Design and manage the food safety system |

Business Services

| Unit code | Unit title |
|------------------|---------------------------------------|
| BSBADM502B | Manage meetings |
| BSBADM504B | Plan or review administrative systems |



| | |
|------------|---|
| BSBFIM501A | Manage budgets and financial plans |
| BSBFIM502A | Manage payroll |
| BSBMGT515A | Manage operational plan |
| BSBHRM506A | Manage recruitment selection and induction processes |
| BSBINM601A | Manage knowledge and information |
| BSBMGT617A | Develop and implement a business plan |
| BSBPMG522A | Undertake project work |
| BSBPUR501C | Develop, implement and review purchasing strategies |
| BSBPUR502B | Manage supplier relationships |
| BSBPUR504B | Manage a supply chain |
| BSBWRK510A | Manage employee relations |
| FNSORG604A | Establish outsourced services and monitor performance |
| TAADEL502B | Facilitate action learning projects |

Community Management

| Unit code | Unit title |
|------------------|---|
| SFIPROC611C | Participate in a media interview or presentation |
| AHCCCF502A | Facilitate development of group goals and projects |
| AHCCCF503A | Promote group formation and development |
| AHCCCF504A | Support group and community changes in resource management |
| AHCCCF505A | Contribute to regional planning process |
| AHCCCF506A | Manage the incorporation of a group |
| AHCCCF601A | Map regional issues and stakeholders |
| AHCILM506A | Operate within community cultures and goals |
| AHCILM508A | Propose a negotiated outcome for a given area of country |
| AHCLPW601A | Coordinate the preparation of a regional resource management plan |
| AHCWRK503A | Prepare reports |



| | |
|------------|--|
| CHCCD404E | Develop and implement community programs |
| LGACOM502B | Devise and conduct community consultations |
| TLIR4003A | Negotiate a contract |

Industry Leadership Focus C – Strategic Development

| Unit code | Unit title |
|------------------|--|
| SFILEAD501C | Develop and promote industry knowledge |
| SFILEAD502C | Shape strategic thinking |
| SFILEAD503C | Cultivate productive working relationships |
| SFILEAD504C | Plan and achieve change and results |
| SFILEAD505C | Communicate with influence |
| SFILEAD506C | Demonstrate personal drive and integrity |
| SFILEAD507C | Provide corporate leadership |

Strategic Management

| Unit code | Unit title |
|------------------|--|
| BSBATSIC411C | Communicate with the community |
| BSBEBU501A | Investigate and design e-business solutions |
| BSBMGT516C | Facilitate continuous improvement |
| BSBLED501A | Develop a workplace learning environment |
| BSBINM501A | Manage an information or knowledge management system |
| BSBINN502A | Build and sustain an innovative work environment |
| BSBMGT502B | Manage people performance |
| BSBMGT605B | Provide leadership across the organisation |
| BSBMGT616A | Develop and implement strategic plans |
| BSBSUS501A | Develop workplace policy and procedures for sustainability |
| BSBWOR501B | Manage personal work priorities and professional development |



PSPPOL501A

Develop organisation policy



Appendix 4: Proposed New ACAAR Facility

