ZONING IN: South Australian Aquaculture report

2021

Government of South Australia
Department of Primary Industries and Regions

ZONING IN: South Australian Aquaculture Report 2021

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Disclaimer

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Foreword

South Australia is home to a well-established and highly developed seafood industry, with the state's aquaculture sectors producing high value niche products, particularly Southern Bluefin Tuna, Yellowtail Kingfish, Barramundi, Oysters, Mussels and Abalone. Secondary industries have also developed from the aquaculture industry, creating additional economic and employment benefits for the state.

The South Australian Government strongly supports the sustainable growth of the South Australian seafood sector and is working with industry to open up opportunities to expand aquaculture investment and production for the benefit of the state.

Key features of the South Australian aquaculture industry are:

- premium high-value species
- full traceability and advanced logistical infrastructure
- pristine waters and clean environment
- world leading research and development institute based in metropolitan Adelaide
- strong policy and regulatory environment

The South Australian Government is the custodian of the public natural resources that the industry uses and is responsible for ensuring strong environmental performance. The Government's role in the industry's future is to therefore partner constructively with industry and the community to create the right environment for growth.

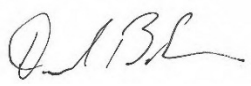
South Australia is recognised as a world leader in the ecologically sustainable development of aquaculture. The *Aquaculture Act 2001* is currently the only dedicated aquaculture legislation of its kind in Australia, providing a comprehensive legislative framework to protect, manage and develop the state's aquatic resources.

The State Government has taken a strategic approach to regulation and aims to proactively plan for the future growth and expansion of the industry. To that end, the Department of Primary Industries and Regions (PIRSA) provides a one-stop-shop approach to aquaculture administration which involves PIRSA coordinating referrals and consultation with other government departments, key stakeholders and the community. This ensures the sustainable development of this industry across the state for both marine and land-based aquaculture activities.

The Government further recognises the importance of the protection of the aquatic environment and through science-based policies, Ecological Sustainable Development risk assessment, environmental monitoring, aquatic animal health programs and strict zoning requirements ensures South Australian seafood retains a high standard of environmental credentials.

The Government recognises the importance of research and innovation and invests significantly in research and development in the state's aquaculture industries. The South Australian Research and Development Institute is a world-class leader in seafood and aquatic species research and works closely with industry to develop and commercialise new projects.

The report entitled 'ZONING IN: South Australian Aquaculture Report 2021' profiles this important industry and details information on current practices, management requirements, environmental monitoring and sector activities. Continued sustainable development of our aquaculture sectors is a priority for the Government of South Australia, providing employment and economic development opportunity for many regional and coastal communities around the state.



Hon David Basham MP
Minister for Primary Industries and Regional Development
15/11/2021

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Background

Purpose

This report provides a summary of aquaculture production and management in South Australia (SA). The report broadly covers aquaculture regulation and management, aquatic animal health regulation and management, production trends, environmental monitoring, socio-economic impacts, key research activities that underpin management, broad sector trends (including species farmed) and challenges. The report presents information in such a way to address components of the Global Sustainable Seafood Initiative (GSSI) that are grouped into two broad categories: environmental monitoring and aquatic animal health. The information presented in this report is for the general public, key stakeholders of the aquatic environment and the seafood industry.

General background

Global demand for seafood is increasing and with wild caught fisheries close to their production limits, aquaculture will play a crucial role in future seafood production (FAO, 2018a). On an international scale, 52% of seafood produced for human consumption and 46% of total seafood production was from aquaculture in 2018 (FAO, 2020). Worldwide expectations are that by 2030, aquaculture will produce 53% of global seafood production (FAO, 2020). Australia's fishery and aquaculture industry is a minor global player, producing around 0.15% of global fishery and aquaculture supply by volume and less than 1% of world trade by value (FAO, 2018b). However, the Australian industry exports a range of high unit value fishery and aquaculture products, and is often a major contributor to regional communities.

In 2017-18 the Gross Value of Production (GVP) of Australia's aquaculture sector was $1.42 billion, increasing its overall contribution to Australian fisheries and aquaculture GVP from 29% in 1999-2000 to 44% in 2017-18 (ABARES 2018). South Australia (SA) is considered to be one of Australia's most valuable aquaculture producing states, worth $229 million in 2019-20, increasing by 8% from 2018-19 (BDO EconSearch, 2021). South Australian aquaculture has a reputation for producing safe, sustainable, high quality and high value seafood products within an internationally recognised, and advanced, regulatory framework. Further advantages for aquaculture in SA include the availability of relatively inexpensive land, pristine environment, and freedom from many known aquatic diseases that can impact aquaculture. These characteristics create significant opportunities for growth in aquaculture activity in SA, including through expanding export markets, growth in trade and attracting investment to the state.

Seafood sustainability standards help ensure consistency and confidence in seafood production. There are multiple environmental and sustainability standards in the seafood industry including the Aquaculture Stewardship Council, Friend of the Sea or the Global Aquaculture Alliance. In SA, some seafood producers, including aquaculture operators, have already applied for and received third party certification in accordance with one or more of these standards. The Global Sustainable Seafood Initiative (GSSI) has developed a benchmark for seafood standards so that a seafood supplier can (a) know which standards meet the benchmark and (b) select one that best fits their requirements, therefore avoiding the need for dual or multiple certifications. The GSSI has the backing of the Food and Agriculture Organisation (FAO) and many countries including Australia, through the Fisheries Research and Development Corporation (FRDC). For more information see www.ourgssi.org and www.frdc.com.au.

This South Australian Aquaculture report provides a summary of the seafood certification programs achieved by the South Australian aquaculture industry. The report also provides some of the regulatory information that industry and third-party accreditors may require for assessment against the GSSI benchmark.

South Australian aquaculture comprises numerous species farmed in both Landbased and marine environments. They predominately include Abalone species, Barramundi, Marron, Yabbies, Silver Perch, Trout, Microalgae species, Murray Cod, Mussels, Oyster species, Southern Bluefin Tuna and Yellowtail Kingfish.

Scope

The South Australian Aquaculture Report 2021 (the report) provides an overview of marine and Landbased aquaculture in SA within the 2019-20 financial year, using the most recent data available. The report provides information directly related to each aquaculture sector (Tuna, Finfish, Abalone, Mussels, Oysters, Landbased and Tourism).

Data sources used for this report include the following:

- 2019-20 BDO EconSearch production and economic data (BDO EconSearch, 2021)
- 2019-20 Environmental Monitoring Program (EMP) data
- 2019-20 PIRSA management activities, industry trends and external factors

Regulatory framework

General aquaculture regulation

South Australia strives to be at the forefront of aquaculture development and planning, and the *Aquaculture Act 2001* is currently the only dedicated aquaculture legislation of its kind in Australia. The Department of Primary Industries and Regions (PIRSA) is the State Government agency responsible for the regulation and management of the state's aquaculture industry.

South Australia has taken a strategic approach to regulation and seeks to proactively plan for the future growth and expansion of the industry. While competition for, and access to, SA's natural resources is increasing, the government is supporting the efficient and effective use of these resources through sound policies and planning and a one-stop-shop approach to aquaculture administration. This involves PIRSA coordinating referrals and consultation with other government departments, key stakeholders and the community. The objects of the *Aquaculture Act 2001* are:

- to promote ecologically sustainable development of marine and inland aquaculture
- to maximise the benefits to the community from the state's aquaculture resources
- to ensure the efficient and effective regulation of the aquaculture industry.

The *Aquaculture Act 2001* establishes the broad framework for the regulation of aquaculture in SA by:

- defining aquaculture as the farming of aquatic organisms for the purposes of trade, business or research
- authorising aquaculture by setting the parameters within which it can occur
- enshrining the principle of ecologically sustainable development (ESD)
- providing for planning for the future of the aquaculture industry through the development of aquaculture zone policies
- maintaining requirements for aquaculture leases and licences.

The *Aquaculture Act 2001* provides that no one may conduct aquaculture in SA unless authorised to do so by an aquaculture licence. There are two types of aquaculture that occur in SA:

- marine aquaculture (aquaculture occurring in State waters)
- landbased aquaculture.

For marine aquaculture, an aquaculture lease is required to provide access to specific areas of state waters and a corresponding aquaculture licence authorises the nature of the activity conducted (e.g. species to be farmed, farming method, amount of stock permitted). For Landbased aquaculture, only an aquaculture licence is required.

In SA, assessment of individual aquaculture licence applications follow strict guidelines. A semi-quantitative risk-based assessment, based on a national best practice Ecological Sustainable Development risk assessment framework (Fletcher *et al.* 2004) is applied to determine the sustainability and outcome of each individual application. The integrity of the assessment process relies on understanding both the nature of the environment in which the intended aquaculture operation occurs, and the manner in which it interacts with or changes the environment that surrounds it.

As part of the assessment process, up to 36 possible risk events that are directly relevant to potential aquaculture influences are considered and applied to both site and regional levels. Risk events are assessed for the construction phase and ongoing activities. Some of the risks that are assessed include impacts to habitats, erosion, sedimentation, access by public, escape, disease management, chemical use, water flow, water quality, nutrient discharge, interaction with threatened and migratory species, and impacts to sensitive habitats.

PIRSA also applies general guidelines to minimise environmental harm. For example, aquaculture activities are not to be placed over sensitive habits (e.g. seagrass or reef) unless the appropriate mitigating strategies are in place to minimise potential environmental harm. Aquaculture activity is excluded in buffer zones around areas of conservation and heritage

significance such as seal colonies, aquatic reserves, shipwrecks and national parks unless the appropriate approval from relevant authorities is secured.

All applications for aquaculture licences are reviewed for environmental issues and referred to the Environment Protection Authority (EPA) for assessment to ensure the proposal meets the objectives of the *Environment Protection Act 1993* and associated Environment Protection Policies (EPPs). Environmental issues of interest to the EPA include protection of water quality, management of noise and air quality, solid waste management and disposal, storage, use and disposal of hazardous substances and ecological impacts from pollution.

Environmental regulation

Under the *Aquaculture Regulations 2016*, all aquaculture licence holders are required to submit an annual Environmental Monitoring Program (EMP) report to PIRSA which provides information on how they have been using the site. This information is vital to the continued sustainable management of the aquaculture industry. Information collected varies for each sector but generally includes:

- site development and productivity (all sectors)
- species farmed (all sectors)
- amount of stock held on site per month (all marine)
- feed and chemical inputs (all sectors)
- water usage and discharge (landbased)
- interactions with site infrastructure and marine vertebrates (all marine)
- escape of stock (all sectors)
- disease incidents (all sectors)
- debris incidents (all marine)
- waste and refuse disposal (all sectors).

Environmentally responsible infrastructure construction, waste disposal and general storage

Under regulation 25 of the *Aquaculture Regulations 2016*, aquaculture farming structures and general infrastructure are required to be maintained in such a condition that will prevent pollution, either at the construction or during ongoing operations. At the decommissioning of a site, operators of marine leases are required to remove all structures and stock and rehabilitate the site to a condition to the satisfaction of the Minister.

Requirements for waste disposal and appropriate storage of chemicals, feed materials and general farm waste are legislated under the *Environment Protection Act 1993*, and associated EPPs. The EPA has also developed specific codes of practice for the Oyster and Abalone industry that highlight the environmental issues in relation to these industries and provide recommendations to assist farmers to meet their legislative requirements under the *Environment Protection Act 1993*.

Impacts on habitat and biodiversity:

Minimising the impacts to the seafloor from marine aquaculture activities is important for ecological sustainable development. To achieve this, aquaculture activities involving feed addition (e.g. Tuna, Finfish and subtidal Abalone) are not to occur over sensitive habitats (e.g. seagrass or reef) unless appropriate mitigating strategies are in place to minimise risk and monitor the seafloor over time. In addition, regulation 25 of the *Aquaculture Regulations 2016* requires that floating structures are kept at least 3 metres (m) above the seafloor to prevent scouring, rubbing or shading of the seafloor unless the licence holder has authorisation to do otherwise (for example subtidal Oyster structures).

There are multiple areas in SA where aquaculture is restricted and require appropriate approvals e.g. around parks declared under the *National Parks and Wildlife Act 1972*, historic shipwrecks declared under the *Historic Shipwrecks Act 1981*, and within some zones of marine parks (*Marine Parks Act 2007*) which further protect sensitive areas. PIRSA also applies an aquaculture exclusion buffer around Australian Sea Lion (ASL) breeding and haul-out areas.

To ensure that aquaculture activities have minimal impact on Threatened, Endangered and Protected Species (TEPS), PIRSA undertakes an ESD Risk Assessment prior to the approval of an aquaculture licence that includes an investigation of the impacts to TEPS that may occur in the area. All aquaculture licence holders are also required to submit a strategy to the Minister on how they will minimise interactions with TEPS (under regulation 18 of the *Aquaculture Regulations 2016*). The strategy must be approved by the Minister and the licence holder is bound by law to comply with the strategy. If an interaction does occur, licence holders are required (under regulation 27 of the *Aquaculture Regulations 2016*) to report the incident as soon as they become aware of the interaction, and work with PIRSA and relevant agencies (e.g. the Department for Environment and Water - DEW) to resolve the incident, and where required, undertake a review of mitigation strategies.

Impacts on water resources:

Nutrients (including faeces and un-utilised feed) released from aquaculture activities can have significant adverse impacts on water quality and benthic environments. To address this, aquaculture zone policies limit the biomass (and by association the amount of feed that is used) that can be farmed in an area. To further understand the impact of aquaculture on water quality, a regional monitoring program was implemented for Lower Spencer Gulf in 2016, in which water quality is a major component (see Tuna and Finfish sections). For Landbased operators, water usage may be legislated by DEW.

Requirements for water quality are legislated under the *Environment Protection Act 1993* and the *Environment Protection (Water Quality) Policy 2015* administered by the South Australian EPA. All aquaculture licensees must comply with EPA legislation and not cause environmental harm.

Species selection and escapes:

The escape of aquaculture stock can have serious implications for wild populations. Therefore, it is important to establish and maintain appropriate containment controls for stock to prevent an escape. There are however situations beyond the control of a licence holder where an escape can occur. To minimise the escape impact, PIRSA has multiple regulatory controls. The stock genetics are considered and all licence holders must keep a stock register that outlines stock movements to and from the aquaculture site (regulation 15 of the *Aquaculture Regulations 2016*). In addition, all aquaculture licence holders are required to submit a strategy to the Minister on how they will minimise stock escapes, including infrastructure maintenance and staff training. The strategy must be approved by the Minister and the licence holder is bound by law to comply with the strategy. If an escape does occur, licence holders are required (under regulation 26 of the *Aquaculture Regulations 2016*) to report the incident within 24 hours and to rectify the cause of escape to prevent further escapes.

Compliance

Planning and compliance inspections are central to a well-established and contemporary industry. To ensure compliance with lease/licence conditions and relevant legislation, PIRSA authorised officers conduct routine field inspections and data audits for each aquaculture sector. Issues such as navigation, location of farming structures, species farmed, impacts to benthic habitats and discharge of water are among those variables that are investigated. Aquaculture site evaluations may also be conducted as part of the initial assessment of an application, generally in response to public concern, as an integral part of the risk assessment process for the licence application or as part of an audit program.

Aquatic animal health regulation

South Australia's freedom from many significant aquatic diseases provides competitive advantages in seafood production and market access. PIRSA has a dedicated aquatic animal health program, which aims to safeguard SA's aquaculture, fisheries and natural resources from the impact of aquatic diseases to maintain their clean, green image. Aquatic Animal Health is regulated under the *Aquaculture Act 2001*, the *Aquaculture Regulations 2016*, the *Fisheries Management Act 2007*, the *Livestock Act 1997*, the *Prohibition of Entry into and Movement within South Australia of Aquaculture Stock* Notice 2020 and the *Prohibition of Entry into South Australia of Unprocessed Abalone (Haliotis spp.) Notice 2021*, which broadly cover the following issues.

Veterinary medicine use:

Veterinary medicines are important disease management tools. When used correctly, veterinary medicines play a valuable role in ensuring animal welfare and maximising the quality and yield of primary produce. Aquaculture farmers must endeavor to use veterinary medicines that are registered under the *Agricultural and Veterinary Chemicals Code Act 1994* (Agvet Code) through

the Australian Pesticides and Veterinary Medicines Authority (APVMA). However, for veterinary medicines that are not permitted or registered with the APVMA, the South Australian *Aquaculture Regulations 2016* (regulation 10) provides a mechanism for off-label use (unregistered with the APVMA) under prescription from a registered veterinarian. Reasons for off-label use include new emergent diseases in aquaculture (a comparably young primary industry), emergencies and experimental treatments to facilitate data collection for APVMA minor use permits or registration.

For off-label veterinary medicine use under the *Aquaculture Regulations 2016*, PIRSA requires a veterinary prescription and information on the product, disease diagnosis, species to be treated, efficacy, host safety and environmental risk (including environmental toxicity). Risk assessment, calculation of environmental trigger values and predicted residue calculations are included in the assessment process agreed to by the EPA. The EPA is consulted with for applications that include discharge to the environment (e.g. sea-pontoon aquaculture). Requests for use of antibiotics are considered in line with the World Organisation for Animal Health (OIE) Aquatic Animal Health Code and in line with Australia's National Antimicrobial Resistance Strategy (AMR); that is, treatments for a diagnosed disease are considered (but not prophylactic treatment).

For further information, see www.pir.sa.gov.au/aquaculture/aquatic_animal_health/veterinary_medicine_use_in_aquaculture

Livestock translocations:

Aquatic livestock translocations are regulated under both the *Aquaculture Regulations 2016* and the *Livestock Act 1997* primarily for the purpose of reducing the risk of disease introduction and spread. Legislative restrictions are in place to mitigate high risk movements of aquaculture livestock, including movements of livestock within SA, wild caught stock brought onto a farm, and importing stock into SA. Currently, there are four Notices under the *Livestock Act 1997* that regulate high risk aquatic livestock movements: (1) the *Prohibition of Entry into and Movement within South Australia of Aquaculture Stock* Notice 2020, (2) the *Prohibition of Entry into South Australia of Unprocessed Abalone (Haliotis spp.) Notice 2021*, (3) *Declaration of Livestock Movement Restrictions in Relation to Pacific Oysters Magallana gigas (syn. Crassostrea gigas)* and (4) *Prohibition of Entry into and Movement within South Australia of Decapod Crustaceans (Order Decapoda) and Polychaete Worms (Class Polychaeta)*. Wild caught stock collected for the purpose of aquaculture may require approval under both the *Fisheries Management Act 2007* (i.e. seedstock and broodstock), as well as Notices under the *Livestock Act 1997* (to bring stock onto the farm site). Assessment of livestock translocation requests may include requirements for veterinary stock inspection, batch testing to rule out notifiable and infectious disease, health certification and requirements for hatchery biosecurity in line with national guidelines: www.agriculture.gov.au/animal/aquatic/guidelines-and-resources.

For further information see: www.pir.sa.gov.au/biosecurity/aquatics/moving_aquatic_animals

Disease management and surveillance:

Disease management includes requirements to report disease (including notifiable diseases), report unusually high and unexplained mortality events, and requirements to maintain stock records (i.e. stock movement, mortality rate). These requirements are for aquaculture licence holders as prescribed under the *Aquaculture Regulations 2016*. In addition to batch testing for livestock translocations, these requirements provide for disease surveillance (passive), and early disease detection that can trigger investigations (e.g. aquaculture mortality or fish kill reports) to rule out disease (to support trade and market access, as well as provide for rapid disease response). Disease management also now includes zoning, for example mollusc Disease Management Areas based on the FRDC 2018-090 project (Roberts et al 2020), which are now adopted in PIRSA's Emergency Response Plans. Emergency disease response protocols are in line with the OIE Aquatic Animal Health Code and Australia's Aquavetplan series of emergency disease response guidelines: www.agriculture.gov.au/animal/aquatic/aquavetplan

Active surveillance is also undertaken by PIRSA as required to confirm disease status or freedom from disease for the purpose of emergency response, to support policy (e.g. livestock translocation) or to support trade and market access requirements. Previous active surveillance in SA has occurred, including for Abalone Viral Ganglioneuritis (AVG), Withering Syndrome and *Perkinsus* (for Abalone), *Bonamia* (for Native Oysters), various notifiable prawn diseases and for Pacific Oyster Mortality Syndrome (POMS).

Disease management in aquaculture can also include farm biosecurity, which may be a requirement for state livestock translocation approvals or a requirement of importing jurisdictions/countries. National guidelines now exist for aquaculture farm biosecurity including:

- generic farm biosecurity guidelines (www.agriculture.gov.au/fisheries/aquaculture/farm-biosecurity-plan), or

- sector specific farm biosecurity guidelines (www.agriculture.gov.au/animal/aquatic/guidelines-and-resources).

PIRSA responds to wild fish kills and suspected disease in aquaculture to primarily rule out infectious and notifiable disease (PIRSA is the hazard leader for animal disease responses), and help determine the likely cause (e.g. human health risks, chemical spill, harmful algae bloom, notifiable disease) and provide response and mitigation options. If disease is detected, mitigation may include control, containment or eradication measures. If disease is ruled out and a chemical spill, oil spill or pollutant is determined to be a likely cause, then the appropriate government department is notified to investigate (e.g. the EPA or Department for Infrastructure and Transport).

Fish kills are a global phenomenon and can be attributed to natural oceanographic cycles, disease outbreaks, harmful algal blooms (HABs), coastal pollution, marine heatwaves or climate change (Roberts et al 2019). In SA, many small-scale fish kills investigated have been attributed to shallow, unprotected waters that are greatly influenced by extreme weather conditions including temperature (i.e. peak summer and peak winter), dodge or minimal tides, anoxia (low dissolved oxygen), HABs, 'blackwater' events in freshwater systems (flooding and associated anoxic water from high organic loads) and acid sulphate soil disturbance. Susceptible species are generally those in shallow water environments (including juveniles of economically important species), particularly benthic and intertidal species. Common species associated with natural fish kill events include Bony Bream, Carp, Mullet, Garfish, Crabs and various molluscs (including Abalone). Furthermore, causes of individual fish kill events can often remain unknown due mostly to the mortality not being observed and reported until fish wash ashore, which impedes appropriate sample collection and analyses. Investigations sometimes rely on anecdotal evidence and climatic weather observations as the basis for attributing "likely causes", with the situation closely monitored.

South Australian Shellfish Quality Assurance Program

The South Australia Shellfish Quality Assurance Program (SASQAP) is part of PIRSA's Biosecurity Division within the Food Safety Program. Biosecurity is the principal government agency charged with monitoring and maintaining shellfish food safety in SA (www.pir.sa.gov.au/biosecurity/food_safety/shellfish_sasqap).

SASQAP is a regulatory testing body that provides consumer protection and ensures development of domestic and international markets through the monitoring and testing of shellfish and water in shellfish growing areas in SA. Bivalve molluscs such as Oysters, Mussels, Cockles and Pipis are filter feeders that have the ability to concentrate bacteria, parasites, viruses, toxins and heavy metals.

If adverse conditions are likely to arise in a shellfish harvesting area, for example as a result of heavy rainfall events causing runoff from the land into the marine environment, SASQAP acts to close these areas as a precautionary measure to prevent contamination of the shellfish in the area. This serves to ensure only safe product reaches the market.

There are currently 24 classified shellfish harvesting areas in SA, the majority of which are located on the west coast of the Eyre Peninsula. There are also some other areas within Spencer Gulf, Gulf St Vincent and on the coast of Kangaroo Island.

National Aquaculture Strategy

In October 2017, the Federal Department of Agriculture and Water Resources (DAWR) released a National Aquaculture Strategy, which was developed with, and supported by state and territory jurisdictions and industry (https://www.agriculture.gov.au/sites/default/files/sitecollectiondocuments/fisheries/aquaculture/national-aquaculture-strategy.pdf). The strategy is a national document designed to complement policy priorities and activities underway in jurisdictions aimed at supporting growth of the aquaculture industry. The strategy represents an important document that provides an Australia-wide approach and multiple actions to target significant growth within the industry; a doubling of the current value to $2 billion per year by 2027.

The strategy aims to streamline regulatory framework and enhance research, development and extension for aquaculture in Australia. Further, this strategy supports aquaculture by promoting opportunities for Aboriginal communities and integrated multi-trophic aquaculture (IMTA). South Australia has been meeting goals of the strategy by creating two new zones at Point Pearce that allow for aquaculture activity that is in the interest of the local Aboriginal community. This is a first for SA and provides opportunities for IMTA in the *Aquaculture (Zones-Eastern Spencer Gulf) Policy 2005*.

Aquaculture activity in South Australia

Socio-economic data for 2019/20

Based on the most recently published BDO Econsearch Report, the state's total value of seafood production (landed) in 2019-20 was $461.8 million, of which aquaculture contributed almost half ($229.0 million) and wild catch fisheries contributed the balance ($232.8 million) (BDO EconSearch, 2021).

The aquaculture industry in SA has developed significantly since the Oyster sector first began commercial production in the 1980s. South Australia is now home to the most diverse range of aquaculture sectors in Australia. The largest single sector in the state's aquaculture industry is Tuna, which accounted for approximately 60% of the SA's gross value of aquaculture production in 2019-20. Other contributing sectors include marine Finfish (17%), Oysters (11%), Mussels (10%) and Landbased (9.5%; includes freshwater Finfish, Oyster hatcheries, Microalgae, Yabbies, Marron and Abalone) (Figure 1) (BDO EconSearch, 2021).

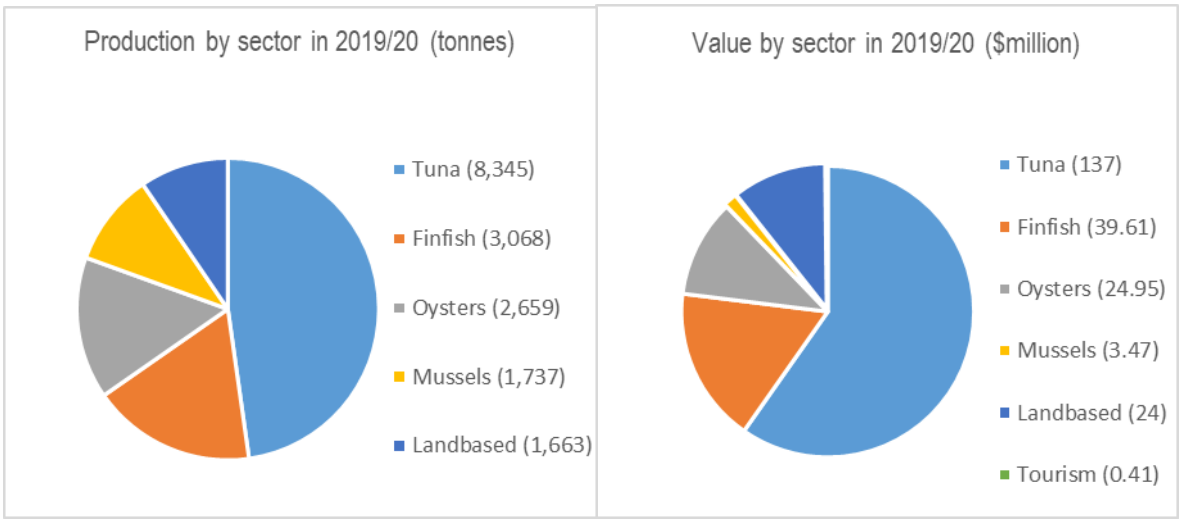

Figure 1. SA aquaculture production (tonnes) and value ($ M) in 2019/20 by sector
Note: Tourism production is not represented due to no farming of stock occurring for tourism activities, revenue is based on ticket sales

Aquaculture production and value of production between 1999-2000 and 2019-2020 is shown in Figure 2. Factors that have influenced aquaculture production and value in SA include the fluctuating dollar against the Japanese Yen, which impacted on the price received for Tuna when exported to Japan, the increased Southern Bluefin Tuna quota allocation, reduction in Oyster spat availability (due to the occurrence of POMS in Tasmania) and innovation and expansion of other aquaculture sectors – such as the fluctuating production of Microalgae in recent years. The impact of the falling yen is demonstrated in the decrease in aquaculture value of production in 2013-14. Similarly, the impact of a reduction in Oyster spat availability is demonstrated in the decrease in aquaculture value of production in 2016-17 and 2017-18. To assist with the recovery of the Oyster sector, fees were waivered for the period 1 January 2018 to 30 June 2020.

From November 2019 to January 2020, significant bushfires occurred in four regions of SA, including the South-east, Yorke Peninsula, Kangaroo Island (KI) and the Adelaide Hills. A large proportion (70%) of the bushfire damage (300,000 hectares) occurred on KI, resulting in 60% of the total primary production area being damaged (187,000 hectares). A total of 19 properties licensed to conduct aquaculture on KI were affected by the bushfires. This was either through loss of stock, damage to aquaculture infrastructure (e.g. netting, fences), or access to processing facilities/local purchasers. Fires within the other regions of the state did not come in contact with registered aquaculture licences.

In March 2020, the Coronavirus (COVID-19) was declared a global pandemic, which resulted in the closure of restaurants and food outlets, and a reduction or loss in access to domestic and export markets for South Australian seafood industries. Despite this, the value of production in the aquaculture industry increased by 8 per cent in 2019/20 from the previous year (BDO EconSearch 2021). The majority of aquaculture sectors however reported negative impacts to their businesses from the pandemic, in particular the mussel industry, which reported significant impacts to the value of their production as a result of COVID-19 restrictions decreasing access to export markets and dampening of domestic food service consumption. To assist the recovery of the SA aquaculture industry from the impacts of COVID-19, the collection of 2020-21 aquaculture sector fees

was deferred for six months and any outstanding 2019-20 fees were also deferred. The next round of fees was not collected until January 2021.

In 2019-20, SA's aquaculture industry created an estimated 1084 Full Time Equivalent (FTE) jobs (724 on-farm and 360 in downstream activities) through direct employment and 1,423 flow-on jobs, giving total employment of 2 506 FTE. Approximately 70% of these jobs were generated in regional SA (BDO EconSearch, 2021). In regional areas, the contribution of the aquaculture industry in 2019-20 was concentrated in the Eyre Peninsula region, reflecting the dominance of Tuna and also the majority of production of Oysters, Finfish and Mussel farming.

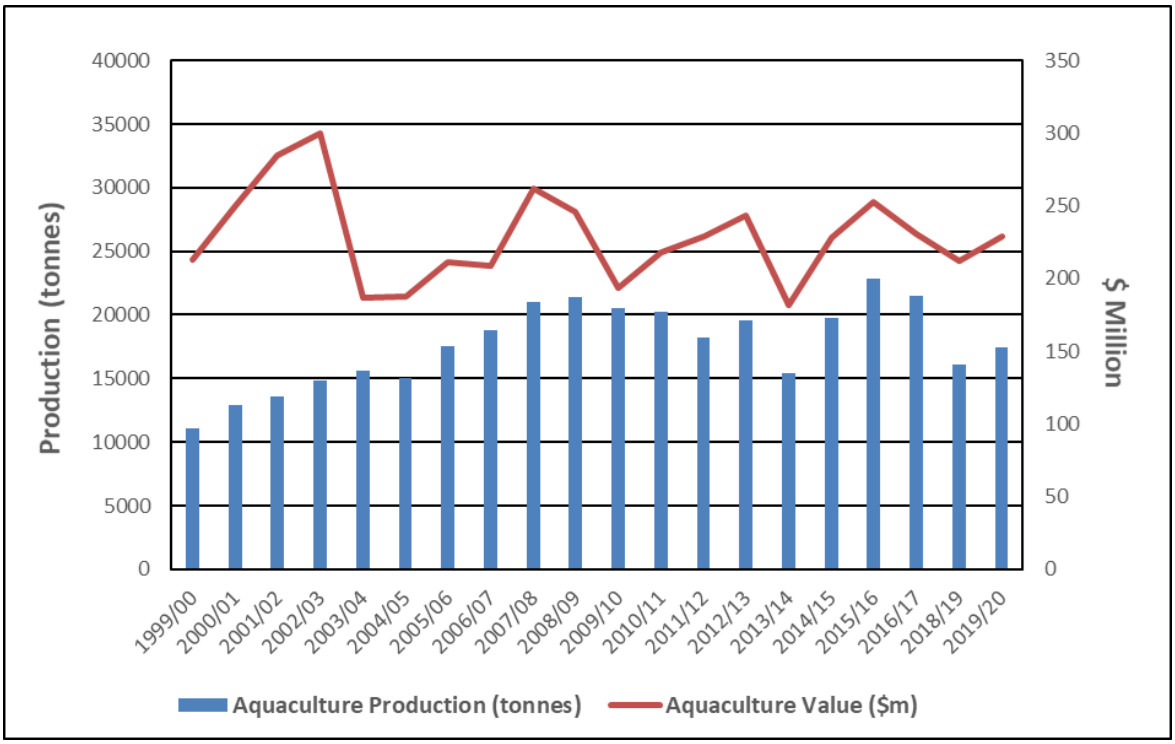

Figure 2. SA aquaculture production (tonnes) and value ($ M) from 1999-00 to 2019-20

Industry licence holders

The total number of aquaculture licences operating in SA during 2019-20 was 494, comprising 423 marine sites and 71 Landbased sites (Figure 3). Included in these licence numbers are 6 marine maintenance sites used by the Tuna sector to hold and maintain sea-pontoons and one marine site used for tourism. A full list of the aquaculture licences for which this report relates is provided in Appendix 1.

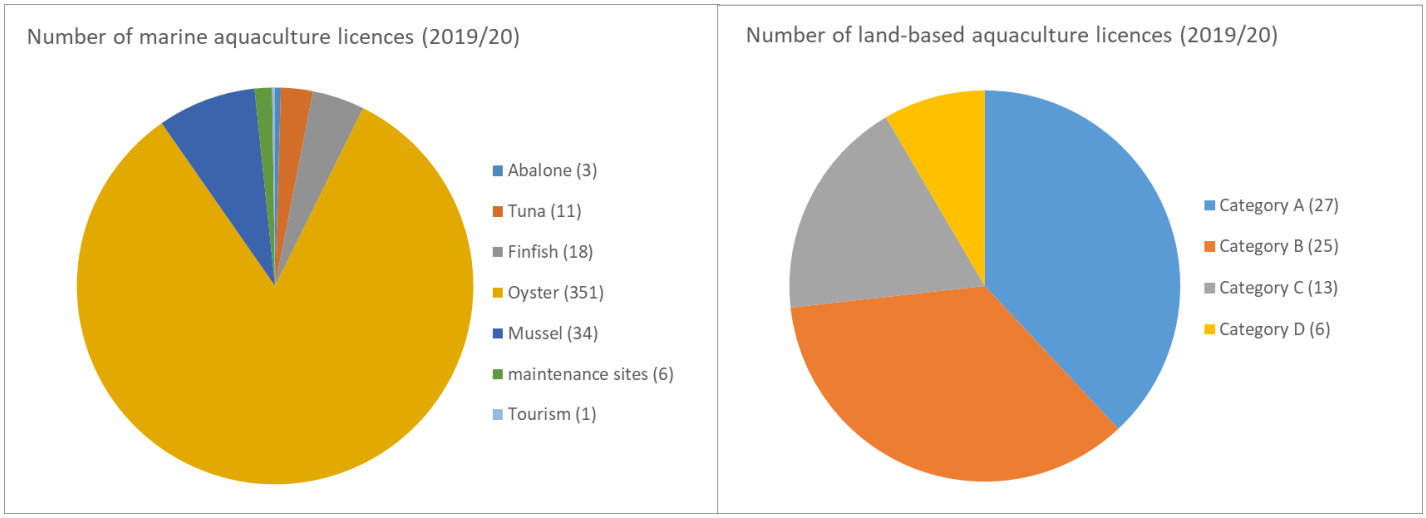

Figure 3. A summary of SA marine and land-based aquaculture licences 2019-20

Aquaculture applications processed by PIRSA

PIRSA processes a range of applications each year, which are requested from the aquaculture industry to improve/change the activities of their business. Lease and licence changes managed by PIRSA can include, for example, assessments for new licences, movements of leases, variations of leases/licences (e.g. species additions, divisions and amalgamations, infrastructure changes), transfers, renewals and surrenders. Table 1 represents the number (total 227) and type of application processed by PIRSA in 2019-20.

A summary of aquaculture applications assessed

Application type	2019/20
New lease and licence	8
Lease and licence movement	23
Licence variation	41
Lease and/or licence division	9
Lease and/or licence amalgamation	32
Lease and/or licence transfer	66
Lease renewal	46
Lease/ licence surrender	2

Aquaculture policy

Summary of aquaculture zone policies in South Australia

Aquaculture zone policies set out considerations for aquaculture that are specific to the environmental, sociological or geographical characteristics of the zone area. Aquaculture zones prescribe the maximum hectares (ha) that can be developed and the class of species permitted for the purposes of aquaculture. Dependent on the species considered, a maximum biomass (tonnage) can also be prescribed. The prescribed criteria are determined by the physical and biological characteristics of the zone and the biological requirements and typical farming infrastructure of the species being considered for the zone. An aquaculture zone identifies a general area in which aquaculture has been deemed suitable, noting that any specific application to undertake aquaculture within a zone is still assessed on its merits and for the specific location.

There are twelve aquaculture zone policies prescribed in SA (Figure 4), which represent management areas where aquaculture is either excluded or permitted. These zone policies occupy approximately 425,024 ha or 7% of our state waters (Appendix 2). Ten of the zone policies are located off the coast of the Eyre Peninsula, one off the western side of the Yorke Peninsula and one in the state's south east. More than half (52%) of the area allocated to aquaculture zone policies in SA is comprised of aquaculture exclusion zones where no aquaculture activity is permitted. Exclusion zones generally include sensitive habitats or areas that have been identified as important for other users of the marine environment (e.g. commercial and recreational fishers). The remaining 48% is set aside to allow aquaculture production to occur and these are known as aquaculture zones. In general, between 5-10% of an aquaculture zone is allocated for aquaculture at any one time. This equates to approximately 0.2% of state waters currently available for aquaculture, of which 0.06% was held as aquaculture leases in 2019-20.

The Eyre Peninsula aquaculture zone is the largest in terms of total area within the state and produces the most diverse range of species. The most recent zone policy is located off the coast of Tumby Bay on the Eyre Peninsula. Details on each policy are provided in Appendix 2 or at www.pir.sa.gov.au/aquaculture/policy_and_legislation_for_aquaculture/zone_policies.

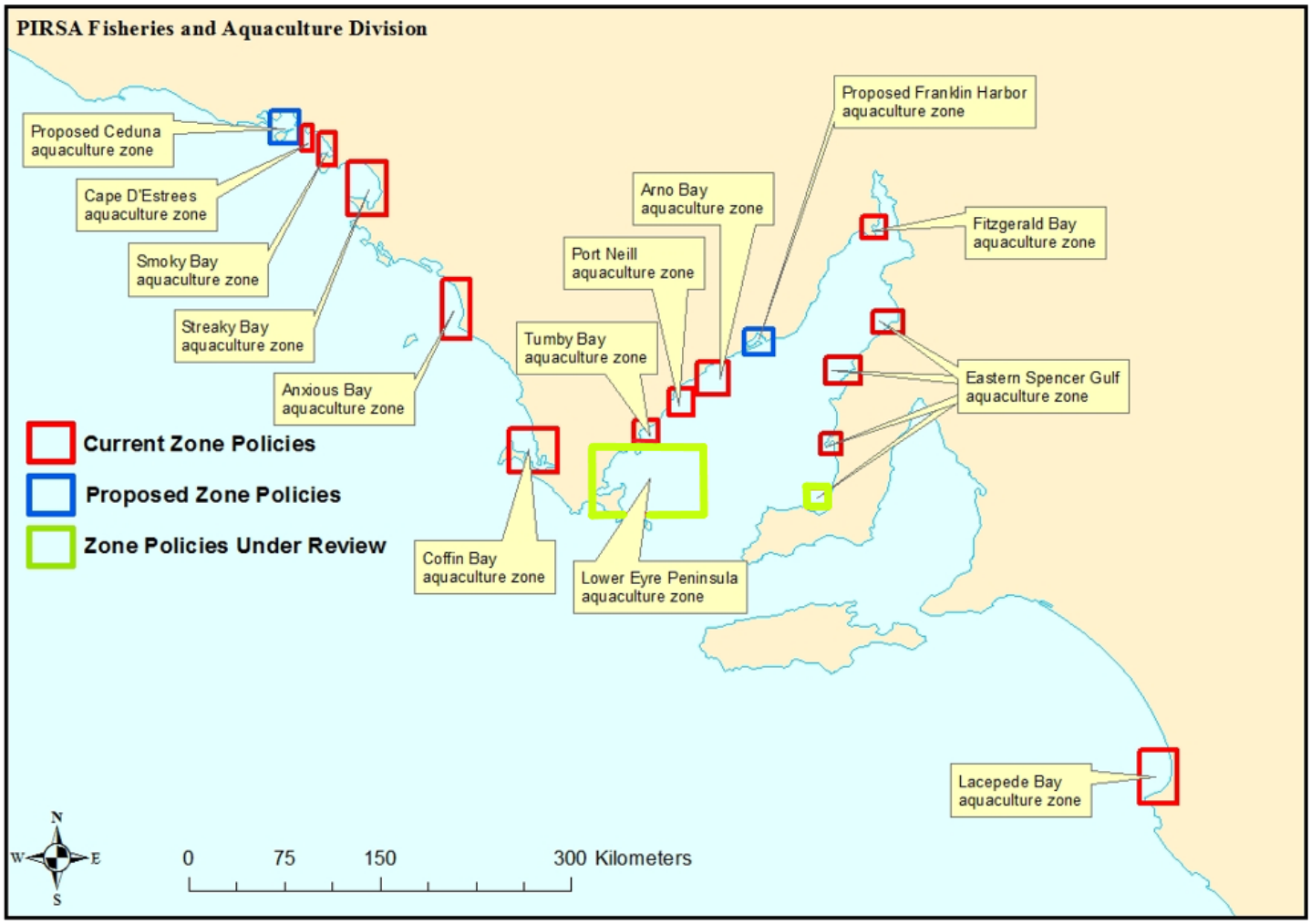

Figure 4. Aquaculture zone policies in SA (current and proposed)

The prescribed classes of aquaculture considered for an aquaculture zone can include:

- the farming of aquatic animals (other than specified animals) in a manner that involves regular feeding (i.e. prescribed wild-caught Tuna, Finfish, Abalone or any other species requiring supplementary feed)
- the farming of molluscs (i.e. Abalone and filter feeding organisms such as Oysters, Mussels, Scallops)
- the farming of bivalve/filter feeding molluscs (i.e. filter feeding organisms such as Oysters, Mussels, Scallops) and
- the farming of algae.

Aquaculture zone policy development and review 2019-20

2019-20 Aquaculture zone policy ~ Development

There were no new zone policies finalised in 2019-20, however, two new zone policies continue to be developed within the Franklin Harbor and Ceduna growing regions to consolidate existing aquaculture activity occurring within these two regions.

2019-20 Aquaculture zone policy ~ Review

In 2020, a targeted review commenced for the *Aquaculture (Zones – Eastern Spencer Gulf) Policy 2005,* to permit the farming of algae in the three Hardwicke Bay aquaculture zones following an expression of interest by the Narungga Nations Aboriginal Corporation. No further amendments were proposed to existing aquaculture zone boundaries or prescribed criteria of any other aquaculture zone prescribed within the zone policy. Public consultation for the proposed amendments contained within the *draft Aquaculture (Zones – Eastern Spencer Gulf) Amendment Policy 2020* and supporting report commenced on 20 August 2020

and ended on 23 October 2020. No further amendments were made to the draft policy and the policy was approved on 11 May 2021 by the Minister for Primary Industries and Regional Development. In addition, the policy was amended via a notice in the Government Gazette to revoke the designation of the Point Peace (east) and Point Pearce (west) intertidal aquaculture zones as a public call area. This amendment was made to stimulate aquaculture development to support the local Aboriginal community, consistent with the prescribed criteria of these aquaculture zones.

Further, in 2020 a review commenced for the *Aquaculture (Zones – Lower Eyre Peninsula) Policy 2013* following requests from the aquaculture industry. The review will ensure the zone policy continues to maximise the use of marine resources for the purposes of aquaculture and provide sustainable industry growth. A Ministerial Advisory Committee was established, including members from the Tuna, Finfish and Mussel aquaculture sectors, the Environment Protection Authority, and PIRSA (including SARDI) to inform the review. A draft policy and supporting report are expected to be developed for public consultation in 2021, with finalisation to occur thereafter as per the requirements of the *Aquaculture Act 2001*.

Public call for aquaculture zone policy tenure 2019-20

Once an aquaculture zone policy is legislated after the aquaculture zoning process, an aquaculture lease and licence are required to undertake farming activities within the zone. It is important to distinguish between aquaculture zoning and individual site allocation and management. Aquaculture zone policies provide a broad overview of the ecological environment and establish areas in which aquaculture is deemed appropriate to occur, while controls relating to the performance of farm operations are applied through marine aquaculture leases, licences and the *Aquaculture Regulations 2016*.

Applications for lease tenure within an aquaculture zone are referred to the Aquaculture Tenure Allocation Board (ATAB). If a zone is prescribed as a public call area within an aquaculture zone policy, a public call is made inviting applicants to submit their proposal on the required application form. There are three aquaculture zones which do not require a public call to be made: Lincoln (inner) sector of the Lincoln aquaculture zone; Point Pearce (east) intertidal aquaculture zone; and Point Pearce (west) intertidal aquaculture zone. Table 2 outlines lease tenure allocation for public and non-public call areas between 2018 and 2020. These applications are assessed by the ATAB which then makes a recommendation to the Minister responsible for the administration of the *Aquaculture Act 2001* on which applications should proceed. The successful applicant will be invited to submit an aquaculture licence application, which will be subject to a comprehensive risk assessment conducted by PIRSA and provision to mandatory referral agencies for comment. Applications for pilot leases outside an aquaculture zone are not subject to a competitive allocation process. The competitive allocation process ensures a fair and efficient means of allocating the state's marine aquaculture resources. The allocation process is used to determine which applicant will use the public resource at an optimum level in terms of the quality and quantity of output relative to the capacity of the environment.

Lease tenure allocation for public and non-public calls within aquaculture zones between 2018 and 2020

Year	Zone Policy	Zone	Hectares released	Hectares allocated
2018	Aquaculture (Zones – Fitzgerald Bay) Policy 2008	Fitzgerald Bay aquaculture zone	123	123
2018	Aquaculture (Zones – Streaky Bay) Policy 2011	Haslam (north bank) aquaculture zone	8.481	6
2018	Aquaculture (Zones – Streaky Bay) Policy 2011	Point Gibson aquaculture zone	10	10
2018	Aquaculture (Zones – Lower Eyre Peninsula) Policy 2013	Lincoln inner sector of the Lincoln aquaculture zone	NA*	125
2020	Aquaculture (Zones – Lower Eyre Peninsula) Policy 2013	Louth Bay aquaculture zone	51	51 pending
2020	Aquaculture (Zones – Lower Eyre Peninsula) Policy 2013	Boston Bay and Boston Island (east) sectors of the Boston Bay aquaculture zone	19	19 pending
2020	Aquaculture (Zones – Lower Eyre Peninsula) Policy 2013	Lincoln outer sector of the Lincoln aquaculture zone	5000	0
2020	Aquaculture (Zones - Anxious Bay) Policy 2007	Anxious Bay aquaculture zone	120	120
2020	Aquaculture (Zones – Tumby Bay) Policy 2015	Tumby Bay aquaculture zone	1295	800 pending
2020	Aquaculture (Zones – Coffin Bay) Policy 2008	Kellidie Bay aquaculture zone	3	3 pending
2020	Aquaculture (Zones – Streaky Bay) Policy 2011	Streaky Bay aquaculture zone	40	5 pending
2020	Aquaculture (Zones – Streaky Bay) Policy 2011	Blanche Port aquaculture zone	37.5	0
2020	Aquaculture (Zones – Eastern Spencer Gulf) Policy 2005	Point Peace (east) intertidal aquaculture zone	NA*	10, 10 pending
2020	Aquaculture (Zones – Eastern Spencer Gulf) Policy 2005	Point Pearce (west) intertidal aquaculture zone	NA*	30, 10 pending

* Hectares released not applicable as aquaculture zone not designated as a public call area.
Pending – pending outcome of applications in progress

Aquaculture zone policy tenure allocation overview

PIRSA monitors the tenure (leasable ha) and biomass limits prescribed within each zone policy to ensure that tenure allocated is within the defined limits. The following figures (5-13) provide an indication of the tenure that is available within each of the zone policies listed in Appendix 2.

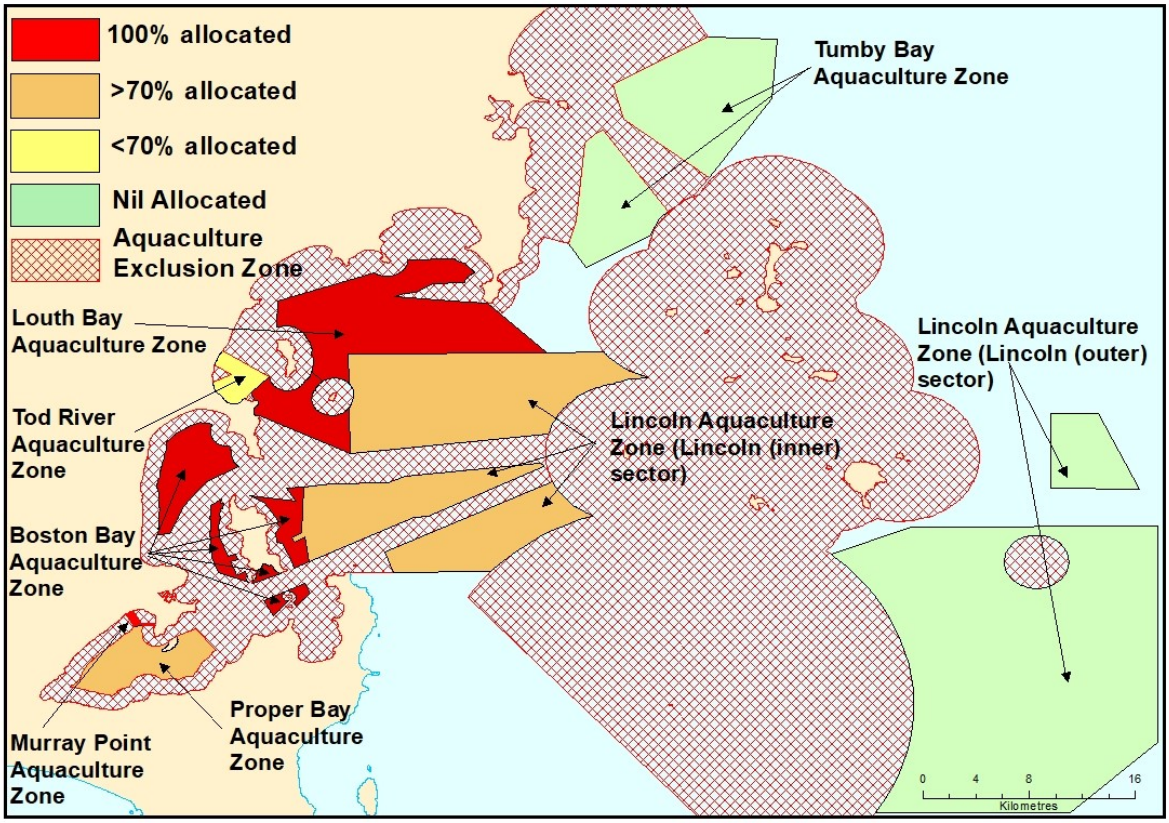

Figure 5. Tenure indication within the *Aquaculture (Zones – Lower Eyre Peninsula) Policy 2013* and *Aquaculture (Zones – Tumby Bay) Policy 2015* (pending application assessment process).

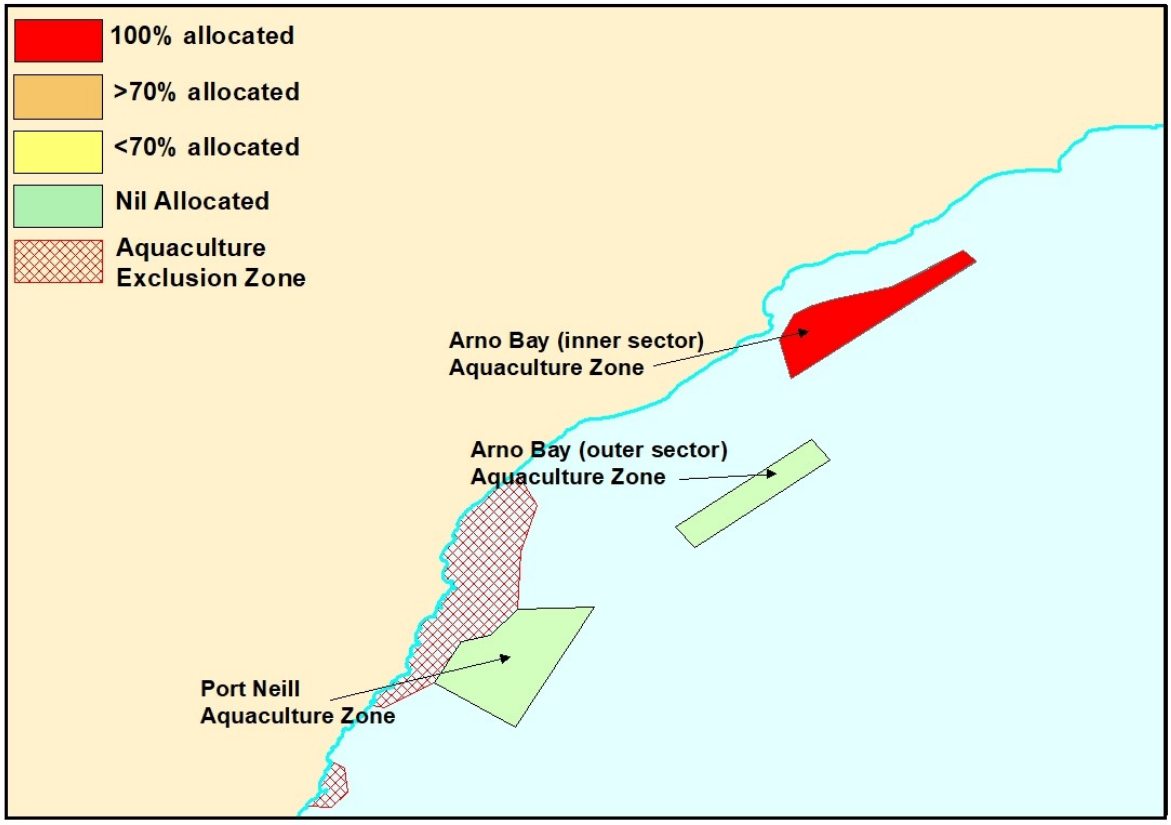

Figure 6. Tenure indication within the *Aquaculture (Zones – Port Neill) Policy 2008* and *Aquaculture (Zones – Arno Bay) Policy 2011*

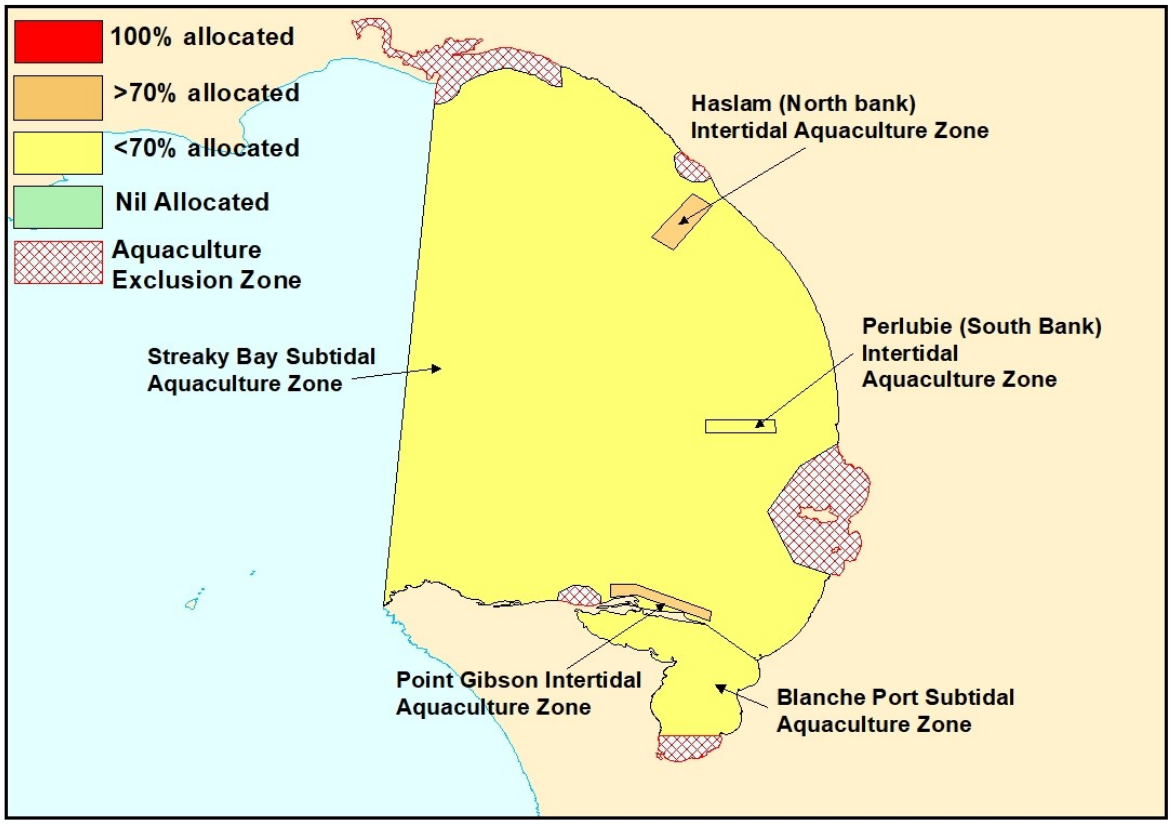

Figure 7. Tenure indication within the *Aquaculture (Zones – Streaky Bay) Policy 2011* (pending application assessment process).

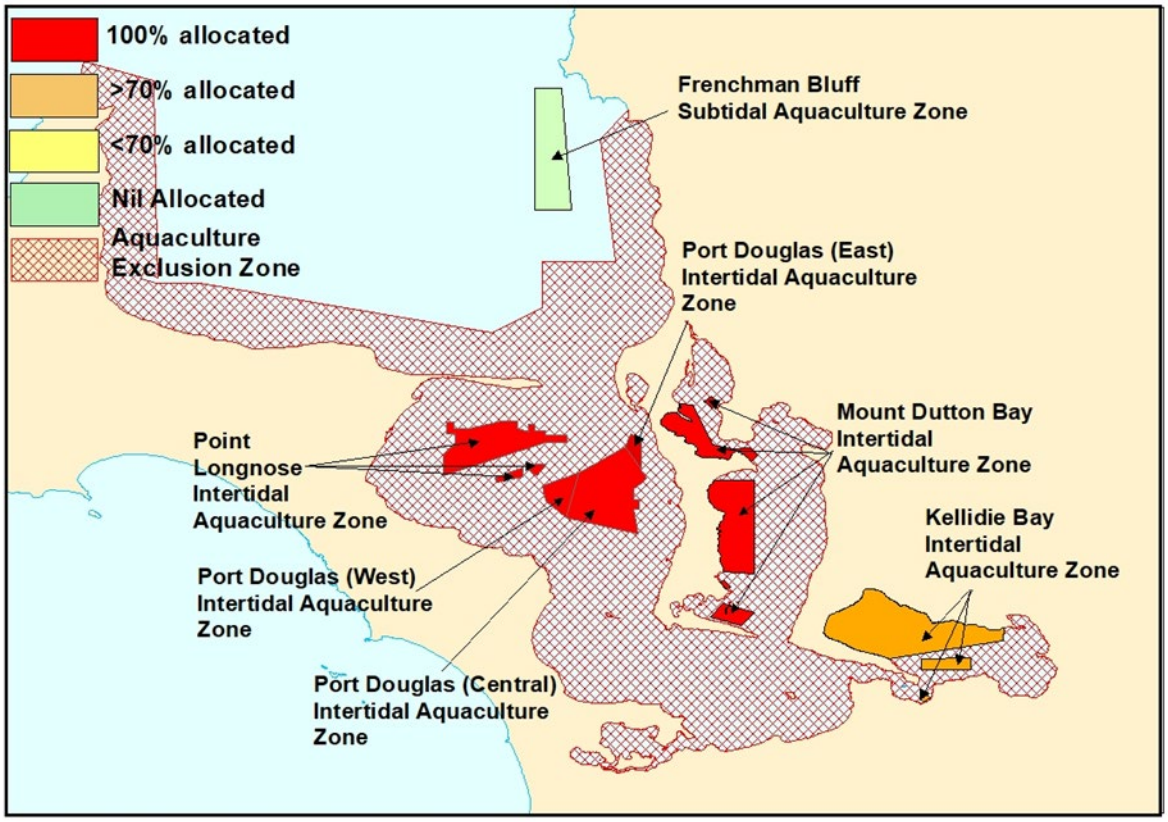

Figure 8. Tenure indication within the *Aquaculture (Zones – Coffin Bay) Policy 2008* (pending application assessment process).

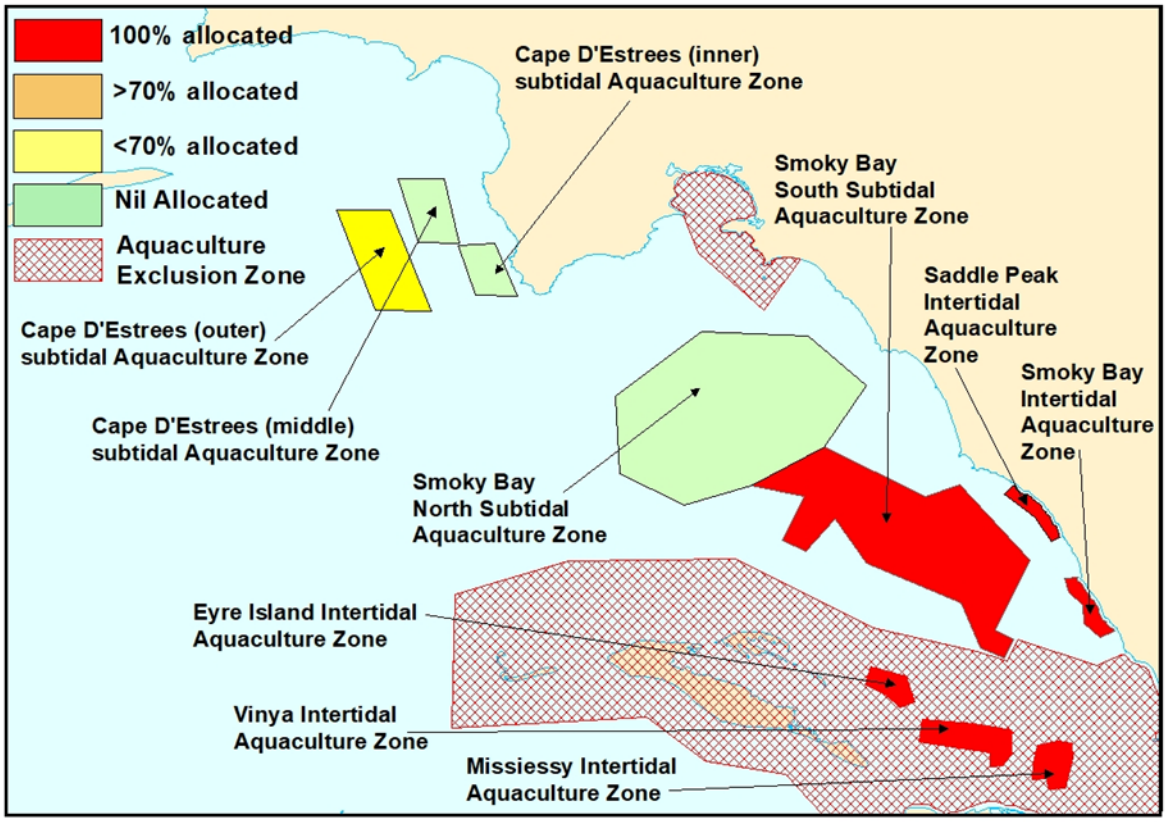

Figure 9. Tenure indication within the *Aquaculture (Zones – Cape D'Estrees) Policy 2006* and *Aquaculture (Zones – Smoky Bay) Policy 2007*.

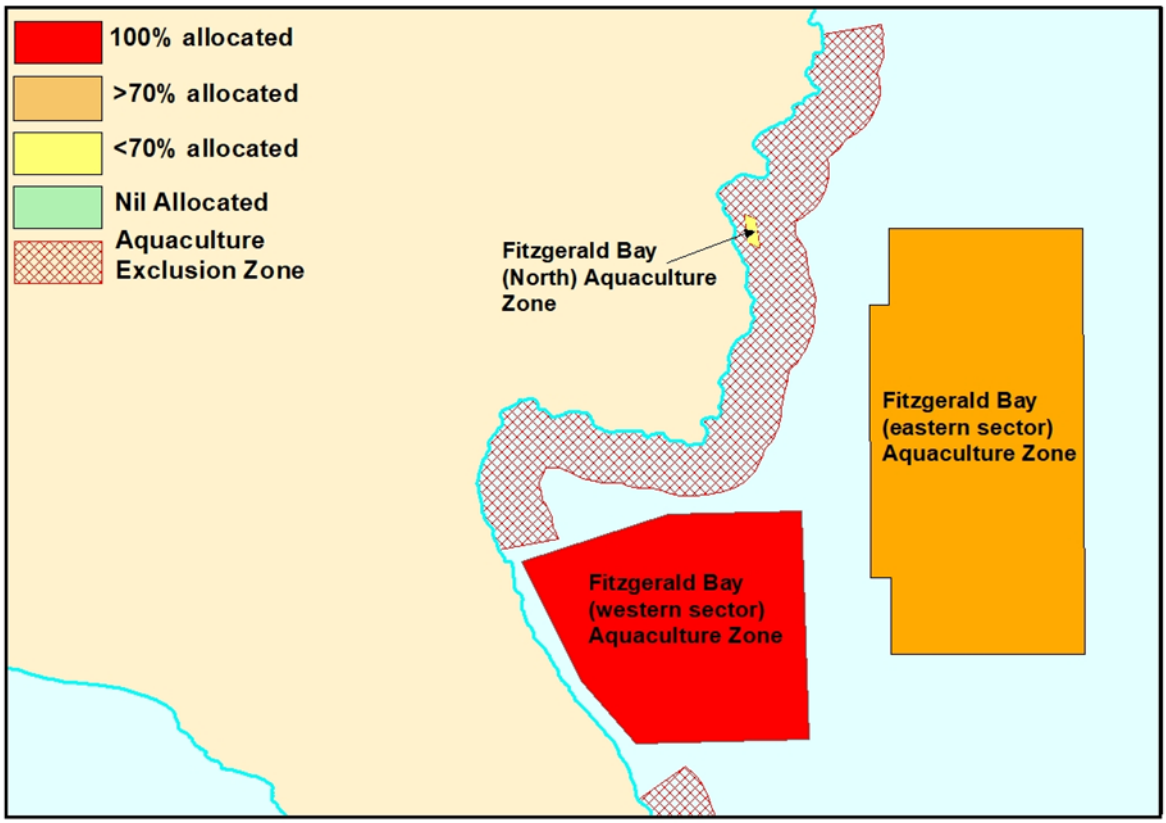

Figure 10. Tenure indication within the *Aquaculture (zones – Fitzgerald Bay) Policy 2008.*

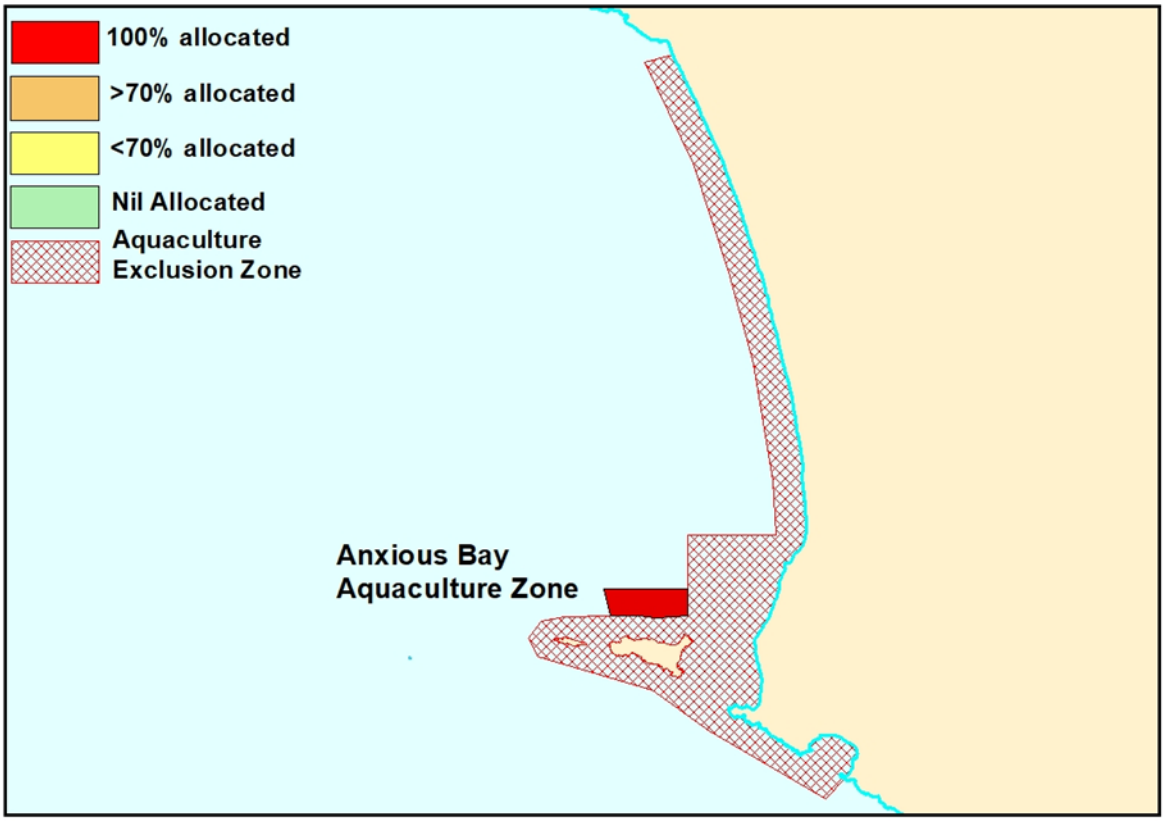

Figure 11. Tenure indication within the *Aquaculture (Zones – Anxious Bay) Policy 2007.*

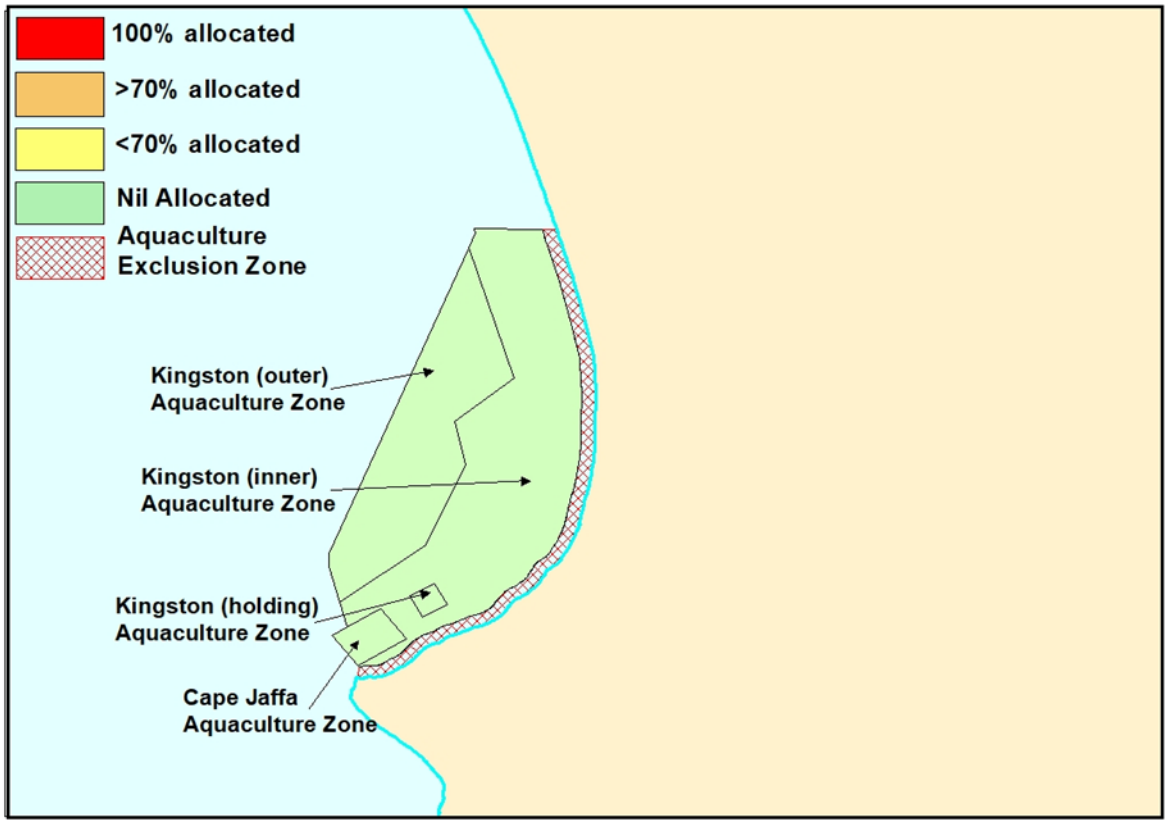

Figure 12. Tenure indication within the *Aquaculture (Zones – Lacepede Bay) Policy 2012.*

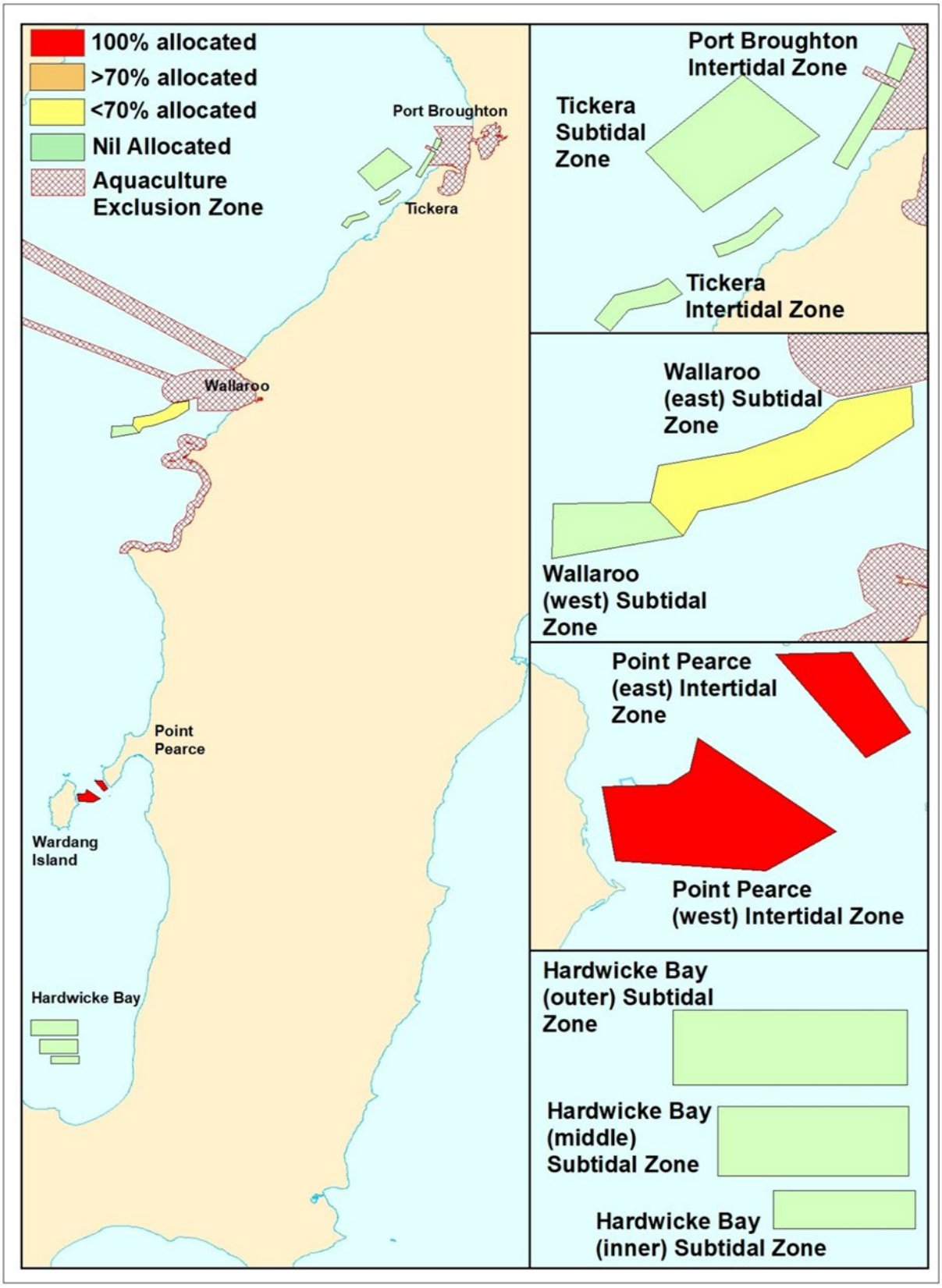

Figure 13. Tenure indication within the *Aquaculture (Zones – Eastern Spencer Gulf) Policy 2005* (pending application assessment process).

Aquaculture outside zone policies in South Australia

Aquaculture can take place inside or outside designated aquaculture zones. The advantage of applying for aquaculture activities within an aquaculture zone are the prior regulatory and assessment processes that are maintained by the relevant policy. Specifically, a number of legislated referrals to other agencies, and technical investigations to provide environmental information are conducted when a zone is being developed and is therefore not required to be duplicated for applications inside a zone. However, it is recognised that the location of aquaculture zones may not suit some aquaculture activities and in SA, aquaculture activities also occur outside existing aquaculture zone policy areas in waters off Kangaroo Island, Yorke Peninsula, Victor Harbor, Ceduna and Cowell.

Draft Aquaculture (Standard Lease and Licence Conditions) Policy 2019

Following consultation with key industry sectors and other stakeholders in 2019, PIRSA developed the draft Aquaculture (Standard Lease and Licence Conditions) Policy 2019 to provide a more flexible, contemporary, and simplified regulatory framework for aquaculture operators. The draft policy aims to encourage aquaculture development by simplifying, standardising and clarifying lease and licence conditions across aquaculture sectors. It also aims to improve transparency and equity for the aquaculture industry and creates efficiencies in the administration of aquaculture leases and licences. All lease and licence conditions were reviewed as part of the draft policy development process, and those relevant for standardisation were included. A supporting draft policy report was also developed to provide an explanation of the purpose and effect of the draft policy. The draft policy and supporting draft policy report underwent a two-month public consultation period in 2019, with finalisation expected to occur in 2021.

Changes to the *Aquaculture Act 2001*

In 2018, the State Government made an election commitment to explore options to develop and increase investment in the state's aquaculture industry. To meet this commitment, in 2019 PIRSA made amendments to the *Aquaculture Act 2001* to increase the maximum term that may be given to an aquaculture production lease from 20 years to 30 years, and to enhance notification to registered third party interests on leases prior to a lease being cancelled. To provide existing aquaculture production lease holders an earlier opportunity to achieve longer lease terms, rather than wait until their next renewal date, amendments were also made to permit them to apply to the Minister for a one-off extension of their lease term of up to 30 years. Application forms and further information surrounding the one-off extension opportunity were made available on the PIRSA website. These changes will increase certainty for financiers and may increase the access of capital to aquaculture operations. It will also provide the aquaculture industry with more certainty and security in their rights moving forward.

Tuna

Overview of the industry

The Tuna aquaculture sector is well established, with significant growth in production since its initiation in the 1990s. The species targeted by this sector is the Southern Bluefin Tuna (SBT) (*Thunnus maccoyii)*.

SBT farming represents a high performing sector of the South Australian aquaculture industry. In 2019-20, there were 11 Tuna farms licensed by PIRSA which occupied 1,815 ha of water. The majority of these (10) were located east of Boston Island, near Port Lincoln. The remaining site was located in Arno Bay which was used to hold broodstock. Individual Tuna aquaculture licences are listed in Appendix 1.

The industry is based on the wild capture of SBT juveniles between December and March each season, the amount of which is restricted by an annual quota determined by the Commission for the Conservation of Southern Bluefin Tuna (CCSBT). Over 85% of Australia's SBT quota is used for farming in SA. The global and Australian quota has continued to increase from 2012, when the CCSBT adopted a Harvest Strategy that uses a scientific model to determine the sustainable catch and quotas. Since then, Australia's quota has increased gradually from 4,015 tonnes (t) in 2011 to 6 238 t per annum for 2021-2023. The quota for 2024-2026 will be set in October 2022. Note that 95% of the Australian SBT quota is automatically allocated by legislation to the commercial sector and 5% for catch by the charter/recreational sector.

Juvenile SBT are moved to off-shore sea-pontoons (40-50 m diameter) where they are grown out to market size. SBT are held in sea-pontoons for a grow-out period of approximately 6-8 months during which time they can double their whole weight on average. During grow-out, Tuna are typically fed wild caught fresh sardines caught under the sardine catch quotas.

Farmed Tuna are Australia's largest aquaculture export. Historically, exports have almost totally gone to Japan, however, in recent years exports to Korea and China have grown to be almost 10% of total harvest in some years. In addition, the Australian domestic market has grown quickly, including development of new value-added products.

The environmental impact of off-shore sea-pontoon SBT farming has been well described and can include impacts associated with dissolved nutrients and chemicals from fish metabolism, and solid waste from faeces and un-utilised feed. These are predominantly dispersed in the water column (~85%), with the remainder deposited on the underlying seafloor (Fernandes *et al*. 2007a and 2007b, Tanner and Volkman 2009).

To ensure the impacts are managed, carrying capacity modelling developed by SARDI is used to set precautionary biomass limits for both individual sites and the Tuna zone. Zone policies are developed to protect the environment from significant ecological impacts that the Tuna sector may have within their growing regions, and to ensure husbandry standards are enforced. The environmental monitoring program (EMP) process provides ongoing environmental monitoring information required to identify and control the occurrence of any impacts the Tuna sector may present on both an individual site level and a

whole of sector level. In addition, it is a legislative requirement for licence holders to fallow or move sea-pontoons each year to provide the seafloor time to recover. The tuna farming cycle allows the seafloor time to fallow between the end of harvest (beginning of August) for up to six months. Pens are re-stocked between January and March the following year.

The wider ecological benefit of Tuna farming is that in the wild the SBT age-groups captured for farming have a high annual natural mortality of 20-30% from predators and periods of starvation. They are also believed to have a relatively poor feed conversion ratio (FCR) in the wild because of the high energy used in escaping predators and in annual migrations from the Indian Ocean to the Great Australian Bight. In contrast, in farms the natural mortality is less than 1% in the grow-out period and much more of the energy from feed goes into growth rather than escaping predators and migration. In addition, tuna farming maximises the seasonal grow-out (summer) and the quality (fat) content in autumn/winter before harvest.

Environment

Regional environmental monitoring program (AEMP)

In 2015, a new regional aquaculture environmental monitoring program (AEMP) was developed for the Finfish and Tuna aquaculture sectors in lower Eyre Peninsula. The program was designed over a four-year cycle with a review in the fourth year to inform the design of the next four-year cycle. The program was designed to describe the overall health of the region with respect to aquaculture impacts rather than monitoring at the site or lease scale, in response to recognition that the majority of nutrient waste from Finfish and Tuna licensed sites is dissolved in the water column and is carried offsite. The monitoring program was developed in consultation with the Tuna and Finfish aquaculture industries, PIRSA (including SARDI) and the EPA.

The program was divided into a pelagic and oceanographic component and a benthic component. Information collected and analysed for the first four-year regional program (2015-2019) included water quality, oceanography, nutrients, bacteria and benthic infauna, all of which contribute to understanding impacts of aquaculture at a regional and zone scale and to an existing hydrodynamic and biogeochemical model.

The objectives of the pelagic and oceanography component were to:

- determine baseline values and the extent of environmental, chemical and biological variability in relation to water quality and planktonic ecosystem composition to assess past (if available) and future changes in the trophic state of the Boston Bay and the Lincoln (inner sector) aquaculture zones and connected coastal systems, and
- use the collected data and aquaculture feed inputs to update and validate the oceanographic model for Spencer Gulf to assist in regional aquaculture planning and management.

The objectives of the benthic component were to:

- determine if there is any regional scale effect of Tuna and Finfish aquaculture on infauna in and around the Boston Bay and the Lincoln (inner sector) aquaculture zones,
- determine if the infauna assemblages show any change between 2016 and 2018, the two years in which sampling was undertaken, and
- analyse the time series of infauna data sampled for the Tuna and Finfish sectors between 2005 and 2014 to determine any temporal and spatial patterns in the data.

Results from the 2015-2019 regional AEMP found:

- significant spatial and temporal variations in the physical environment, circulation, water quality and planktonic ecosystem composition, including:

- nutrients, chlorophyll *a*, phytoplankton abundance, and community composition, harmful algal bloom (HAB) species and frequency, and planktonic community size structure and composition, showed inshore sites within Boston and Louth Bay's differ significantly from offshore sites. Collectively, these trends are consistent with impacts expected from anthropogenic nutrient enrichment, which there are a number of sources in the area including aquaculture. The results are supported by oceanographic modelling, which provides a greater understanding of natural and anthropogenic nutrient supply, connectivity, and dispersal in the region and at the scale of Spencer Gulf

- nutrient and chlorophyll *a* concentrations at the regional scale were elevated above background levels but they were generally low and below the Australian and New Zealand Environment and Conservation Council (ANZECC) water quality guidelines 2000

- the planktonic assemblage and water quality results provide enough sensitivity to indicate that aquaculture is having a detectable impact on water quality and trophic state at the inshore sites within Boston and Louth Bay's. The results also provide a baseline and a set of multiple, complementary indicators for explaining future changes, natural or anthropogenic.

- both spatial and temporal variation were detected in the infaunal assemblages in the Boston Bay and Lincoln (inner) aquaculture zones, but there was no indication that aquaculture has a significant impact on infauna. Instead, there were differences between control groups in both zones, consistent with a north-south gradient in infaunal assemblages. A similar result was found for time series analysis undertaken on samples collected between 2005 and 2014.

Given that the pelagic and oceanographic results from the 2015-19 AEMP indicated that aquaculture may be having some effect on ecosystems at the regional scale, as expected, the 2019–2023 AEMP is undertaking more detailed investigations into the magnitude of the impact and how these nutrients might be affecting sensitive benthic habitats in the region. The benthic component of previous monitoring programs focused on infauna and did not demonstrate an impact at compliance sites outside of lease boundaries, or on a regional scale and hence this component of the AEMP has been scaled back to approximately every five years. The 2019-23 AEMP instead focuses on seagrass communities located with the bays near Port Lincoln and Louth Bay. Combined with pelagic (lower trophic) ecosystem, water quality, and oceanographic monitoring, and hydrodynamic and biogeochemical modelling, this next monitoring program (first sampling occurred in early 2020) will determine whether or not aquaculture is having a sustained impact on key ecosystem assets in the region.

The results of these environmental monitoring programs will also become important to help quantify the benefits of the growing seaweed aquaculture industry in terms of nutrient offsets and Integrated Multi-trophic Aquaculture (IMTA) for example, which is discussed later in the report.

Annual environmental monitoring reports

Submission rates for EMPs for the Tuna sector were 100% in 2019-20. Note: the reporting period for the Tuna sector is from December 2019 to November 2020 to align with the Tuna production cycle.

Development

Of the 11 reports submitted for the 2019-20 EMP reporting period, 9 reported to be actively farming. One site was recently approved and not yet farmed, the remaining site was used as a broodstock tuna site and no commercial production occurs on this site.

Biomass

Wild caught juvenile SBT were moved to off-shore sea-pontoons between December 2019 and March 2020 at an average whole weight of 13.88 kilograms (kg). Harvesting of SBT largely occurred 6-8 months later during July-August 2020. The average whole weight of farmed SBT at harvest in 2019 was 27.71 kg.

At the site level, individual licence conditions state that the maximum biomass of SBT held on an aquaculture site at any one time cannot exceed 6 t of stock per ha. In 2019-20, no sites were reported to exceed this stocking density.

The maximum amount of farmed SBT was recorded in May during the 2019-20 reporting period, totaling approximately 7,126 t (representing an average of 4 t per farmed ha).

Feed inputs

Farmed SBT are fed a diet of small baitfish presented whole, which is largely sourced locally from the commercial sardine fishery that operates in Spencer Gulf and along SA's West Coast (including Kangaroo Island). This fishery is sustainably managed under the South Australian Sardine Fishery Management Plan. Approximately 58,269 t of baitfish were used by the Tuna industry in 2019-20, of which around 10,000 t (17%) were imported. Imported baitfish are managed under strict quarantine guidelines stipulated by the Commonwealth Department of Agriculture, Water and the Environment.

Reported interactions and escapes

As part of marine licence EMP reporting requirements, licence holders are required to submit information regarding any negative interactions with seabirds and large marine vertebrates that occurred on their licensed site during each reporting year. There were no reported negative interactions on a licensed Tuna aquaculture site during 2019-20.

The Tuna sector uses 3 m high seal jump fences, which are considered by the industry to be highly effective in minimizing interactions with Long-nosed fur seals and Australian sea-lions. Daily removal of any dead or sick SBT also contributes to a low level of interactions in the Tuna sector.

Licence holders are also required to submit information regarding any stock escape events that occurred on their licensed sites. There were no escape events reported by the Tuna sector in 2019-20. There is some poaching reported by the industry, and this is reflected in annual audits of numbers of SBT in and out of the farms by the Australian Fisheries Management Authority.

Aquatic animal health management

Veterinary medicine use

Off-label approvals under *Aquaculture Regulations 2016*:

A total of 3 requests (veterinary prescriptions) for the use of Praziquantel from the Tuna sector were assessed and approved in 2019-20. Praziquantel is used by the industry, under veterinarian supervision, to successfully reduce parasitic blood fluke (*Cardicola forsteri*) infestations in SBT and maintain fish health. Praziquantel (used in medicines for humans and other livestock industries) has reduced SBT mortalities from approximately 14% per year to less than 1% per year in 2020. Off-label use assists industry with data collection towards permitting or registration of the product with the APVMA. A final application was submitted in late 2017 to the APVMA for national registration of Praziquantel and on 14 December 2018, the APVMA issued a Minor Use Permit (PER 85738) for the substance "Parapraz Flukicide", containing 42 g/L Praziquantel as the only active constituent for the treatment of blood fluke in SBT. The permit is limited to the jurisdiction of SA and further limited to people employed by a SBT farm for the treatment of SBT for blood fluke, who are using the product under the direction of a veterinarian. A second Minor Use Permit for the use of Praziquantel in SBT has since been issued by the APVMA (PER 88128).

One request (veterinary prescriptions) for the use of Emamectin Benzoate from the Tuna sector was assessed and approved in 2019-20. Emamectin Benzoate is used by the industry, under veterinary supervision, to treat isopod sea lice (*Caligus* sp.) infections in SBT stock and reduce stock loss due to mortalities. Emamectin Benzoate treatments were prescribed for broodstock SBT that were not for human consumption.

Reported APVMA registered and permitted veterinary medicines:

A total of nine Tuna sites reported the use of a permitted veterinary medicine (Praziquantel – APVMA Permit PER 85738 and PER 88128) during the 2019-20 EMP reporting period.

Livestock translocations

No livestock translocations were approved during 2019-20 for the Tuna sector.

Disease management and surveillance

No unusually high and unexplained mortalities, nor suspected or confirmed notifiable diseases were reported to PIRSA during the 2019-20 period for the Tuna sector. Similarly, no disease investigations or emergency disease responses were required for the Tuna sector during this period.

Finfish

Overview of the industry

The marine Finfish aquaculture sector is well established, with significant growth in production over the years. The species farmed by this sector is the Yellowtail Kingfish (YTK) (*Seriola lalandi)*.

Marine Finfish farming represents a high performing sector of the South Australian aquaculture industry. In 2019-20, there were 18 Finfish farms licensed by PIRSA, occupying 638 ha of water and operated by one company. Finfish licences were located in waters along the west coast of Spencer Gulf at Fitzgerald Bay, Arno Bay, and Louth Bay and Boston Bay near Port Lincoln. Individual Finfish aquaculture licences are listed in Appendix 1.

The industry is based on the on-growing of hatchery-reared YTK fingerlings from selectively bred broodstock originally caught in South Australian waters. Juveniles are moved to sea-pontoons (40-44 m diameter) where they are grown out to market size. Fingerlings are transferred to marine sea-pontoons at ~15-30 g, fed on specially formulated manufactured diets, and grown out at sea for ~12–32 months until they are harvested at either 1-1.5 kg or 4.5 kg.

The environmental impacts of sea-pontoon Finfish farming have been well described and include impacts on biogeochemical processes, seagrasses and benthic communities (Tanner and Bryars 2007, Tanner *et al*. 2007). These impacts are primarily associated with dissolved nutrients and chemicals from fish metabolism and solid waste from faeces and excess feed, which are predominantly dispersed in the water column (~85%), with the remainder deposited on the underlying seafloor.

Biomass limits for both individual sites and zone policies are developed to minimise the effects on the environment from any ecological impacts that the Finfish industry may have within their relative growing regions. The EMP process provides ongoing environmental monitoring information required to identify and control the occurrence of any impacts the Finfish sector may present on both individual sites and a whole of sector level. In addition, it is a legislative requirement for licence holders to fallow or move sea-pontoons each year to provide the seafloor time to recover unless otherwise approved by the Minister.

Environment

Site-specific environmental monitoring programs

The holders of Finfish aquaculture licences are required to undertake specific EMPs that are tailored to the area in which they operate. These EMPs are designed by PIRSA and the Environment Protection Authority (EPA). The specific purpose of the EMP varies but the overall aim is to monitor changes in the environment that may reflect an impact as a result of Finfish aquaculture.

The Boston Bay and Louth Bay EMPs aim to assess the impact of an increased biomass at a site and regional level. The site level EMPs comprise of benthic video to monitor the benthic habitat at and near the sea-cages for accumulation of debris, waste feed, build-up of harmful algal matts, and changes to the quantity and health of seagrasses. The regional level EMPs, introduced in 2020-21, comprise of benthic video and are designed to specifically monitor changes to the quantity, condition and health of seagrasses that are in the plume of Finfish nutrients. Regional EMPs are also designed to be the same methodology as the regional environmental program described below to increase the amount of data collected.

The Boston Bay EMP has been in place since 2016, and results to date demonstrate no significant impact of Finfish farming at the site level. In 2021, the EMP was amended to focus on off-site locations and seagrass health. A Louth Bay EMP was implemented in October 2017 when the site was first used to hold stock, comprising benthic video on the site. An amended Louth Bay EMP was introduced in April 2020 in response to higher biomass held on the site. The new program includes site benthic video and regional benthic video that focusses on seagrass condition and density. Data from these programs will contribute to the regional aquaculture environmental monitoring program (AEMP) detailed below.

The Arno Bay EMP was originally designed in 2019 to use benthic video footage to monitor changes in unidentified benthic matts (noting benthic algal matts are an environmental signal of nutrient enrichment) and changes to the small amount of seagrasses that occur within the Arno Bay aquaculture zone. Two years of data collection and confirmation that the unidentified matts were mussel shell accumulation and not benthic algal matts, led to a revision of the Arno Bay EMP in 2021 to focus on site level video and areas where seagrass was previously identified. Site level video is designed to monitor the benthic habitat at and near the sea-cages for accumulation of debris, waste feed, potential build-up of harmful algal matts, and changes to the quantity and health of seagrasses.

The Fitzgerald Bay EMP comprises site and regional monitoring through benthic video footage. The benthic habitat at the Fitzgerald Bay sites is sand, however, there are significant seagrass meadows near-by. Site level video is designed to monitor the benthic habitat at and near the sea-cages for accumulation of debris, waste feed and potential build-up of harmful algal matts. The regional level monitoring contributes to a research project being undertaken by SARDI and the EPA on potential impacts of Finfish nutrients on seagrasses. Using benthic video, changes to the seagrass density, health and condition will be monitored. This program is set to commence in 2021 when Finfish farming starts in Fitzgerald Bay.

A research project has been developed to assess the influence of Finfish aquaculture derived nutrients on seagrasses in Fitzgerald Bay. The four-year research project, developed by SARDI, PIRSA, Clean Seas and the EPA, was approved by the FRDC and commenced in July 2019, with the first sampling undertaken in May 2020. This research will provide a better understanding of potential impacts and help inform future management strategies if required. One of the outputs of this research will be a model to assess future management of aquaculture to minimise any future impacts on seagrasses at Fitzgerald Bay and other locations where Finfish farming occurs. https://www.frdc.gov.au/project?id=5443

Lower Eyre regional aquaculture environmental monitoring program (AEMP)

In 2015, a new regional aquaculture environmental monitoring program (AEMP) was developed for the Finfish and Tuna aquaculture sectors in lower Eyre Peninsula. The program is designed over a four-year cycle with a review in the fourth year to inform the design of the next four-year cycle. The program is designed to describe the overall health of the region with respect to aquaculture impacts rather than monitoring at the site or lease scale, in response to recognition that the majority of nutrient waste from Finfish and Tuna licensed sites is dissolved in the water column and is carried offsite. The monitoring program was developed in consultation with the Tuna and Finfish aquaculture industries, PIRSA, the EPA and SARDI.

The program was divided into a pelagic and oceanographic component and a benthic component. Information collected and analysed for the first four-year regional program (2015-2019) included water quality, oceanography, nutrients, bacteria and benthic infauna, all of which contribute to understanding impacts of aquaculture at a regional and zone scale and to an existing hydrodynamic and biogeochemical model.

The objectives of the pelagic and oceanography component were to:

- determine baseline values and the extent of environmental, chemical and biological variability in relation to water quality and planktonic ecosystem composition to assess past (if available) and future changes in the trophic state of the Boston Bay and the Lincoln (inner sector) aquaculture zones and connected coastal systems, and

- use the collected data and aquaculture feed inputs to update and validate the oceanographic model for Spencer Gulf to assist in regional aquaculture planning and management.

The objectives of the benthic component were to:

- determine if there is any regional scale effect of Tuna and Finfish aquaculture on infauna in and around the Boston Bay and the Lincoln (inner sector) aquaculture zones, and

- determine if the infauna assemblages show any change between 2016 and 2018, the two years in which sampling was undertaken.

- analyse the time series of infauna data sampled for the Tuna and Finfish sectors between 2005 and 2014 to determine any temporal and spatial patterns in the data.

Results from the 2015-2019 regional AEMP found:

- significant spatial and temporal variations in the physical environment, circulation, water quality and planktonic ecosystem composition, including:

    - nutrients, chlorophyll *a*, phytoplankton abundance, and community composition, harmful algal bloom (HAB) species and frequency, and planktonic community size structure and composition, showed inshore sites within Boston and Louth Bay's differ significantly from offshore sites. Collectively, these trends are consistent with impacts expected from anthropogenic nutrient enrichment, which there are a number of sources in the area including aquaculture. The results are supported by oceanographic modelling, which provides a greater understanding of natural and anthropogenic nutrient supply, connectivity, and dispersal in the region and at the scale of the gulf

    - nutrient and chlorophyll *a* concentrations at the regional scale were elevated above background levels but they were generally low and below the Australian and New Zealand Environment and Conservation Council (ANZECC) water quality guidelines 2000

    - the planktonic assemblage and water quality results provide enough sensitivity to indicate that aquaculture is having a detectable impact on water quality and trophic state at the inshore sites within Boston and Louth Bay's. The results also provide a baseline and a set of multiple, complementary indicators for explaining future changes, natural or anthropogenic.

- both spatial and temporal variation were detected in the infaunal assemblages in the Boston Bay and Lincoln (inner) aquaculture zones, but there was no indication that aquaculture has a significant impact on infauna. Instead, there were differences between groups of reference sites in both zones, consistent with a north-south gradient in infaunal assemblages. A similar result was found for time series analysis undertaken on samples collected between 2005 and 2014.

Given the pelagic and oceanographic results from the 2015-19 AEMP indicated that aquaculture may be having some effect on ecosystems at the regional scale, the 2019-2023 AEMP will undertake more detailed investigations into how these nutrients might be affecting sensitive benthic habitats in the region. The benthic component of previous monitoring programs focused on infauna and did not to demonstrate an impact at compliance sites outside of lease boundaries, or on a regional scale and hence this component of the AEMP has been scaled back to approximately every five years. The 2019-23 AEMP will instead focus on seagrass communities located with the bays near Port Lincoln and Louth Bay. Combined with pelagic (lower trophic) ecosystem, water quality, and oceanographic monitoring, and hydrodynamic and biogeochemical modelling, this next

monitoring program (first sampling occurred in early 2020) will determine whether or not aquaculture is having a sustained impact on key ecosystem assets in the region.

The results of these environmental monitoring programs will also become important to help quantify the benefits of the growing seaweed aquaculture industry in terms of nutrient offsets and Integrated Multi-trophic Aquaculture (IMTA) for example, which is discussed later in the report.

Annual environmental monitoring reports

Submission rates for EMPs for the Finfish sector were 100% in 2019/20. Note: the reporting period for the Finfish sector is from December 2019 to November 2020 to align with the Finfish production cycle.

Development

Of the 18 reports submitted for the 2019-20 EMP reporting period, 15 licences were reported to have farming structures (sea-cages) on site. Fourteen of these reported to be actively farming Yellowtail Kingfish (YTK) and one site was used for maintenance of sea-cages.

Biomass

The maximum amount of YTK farmed across all sites within the marine Finfish sector was recorded in March (4,930 t) during the 2019-20 reporting period. Six of these sites are located within the Arno Bay aquaculture zone policy which reported a maximum amount of Finfish on site during the month of April (2,521 t). The remaining 9 sites are located within the Lower Eyre Peninsula aquaculture zone policy and reported a maximum amount of Finfish on site during the month of February (2,506 t). The marine production cycle for YTK can take up to 32 months, therefore the stock on site at any one time does not necessarily reflect the total annual production sold (3 068 t in 2019/20). At the site level, individual licence conditions state that the maximum biomass of Finfish held on an aquaculture site at any one time cannot exceed 15 t of stock per ha (unless otherwise approved by the Minister). In 2019-20, 7 of the 8 Finfish sites in Boston Bay were licensed to farm at 20 or 41.25 t of stock per ha with a maximum biomass across all sites not to exceed the aquaculture zone biomass limit of 1,750 t. The licensee notified PIRSA that one site held stock above the permitted zone biomass limit for one month (February – 1,853 t) due to a decrease in anticipated sales, a direct result of COVID-19 impacting market sales. In 2019-20, the one Finfish site located in Louth Bay was licensed to farm 25 t of stock per ha with a maximum biomass (recorded in April – 765 t) not to exceed the aquaculture zone biomass limit of 1,520 t.

Feed Inputs

Farmed YTK are fed commercially produced manufactured pellets. A total of approximately 9,191 t of pellets were used across all sites within the marine Finfish sector in 2019-20. Sites located within the Arno Bay and Lower Eyre Peninsula aquaculture zone policies reported a total of 3,975 t and 5,216 t, respectively.

Reported interactions and escapes

As part of marine licence EMP reporting requirements, licence holders are required to submit information regarding any negative interactions with seabirds and large marine vertebrates that occurred on their licensed site during each reporting year. A total of 12 interactions, involving 33 Long-nosed fur seals were reported on licensed Finfish sites in the Boston Bay aquaculture zone (Bicker Isles sector) during 2019/20. None resulted in harm to the seal. All reported interactions were from the one licensed site where seals gained entry into the pen through holes in the netting.

Licence holders are also required to submit information regarding any stock escape events that occurred on their licensed sites. In 2019-20, a total of 6 Finfish escape events were reported for Arno Bay, Louth Bay and Boston Bay aquaculture zones, resulting in a total of approximately 6,837 fish escaping. Of the escaped fish, 4,440 were reported to have been recaptured. A summary of the escape events can be found at www://pir.sa.gov.au/aquaculture/monitoring_and_assessment/register_-_finfish_escape.

Aquatic animal health management

Veterinary medicine use

Off-label approvals under *Aquaculture Regulations 2016*:

A total of 25 requests (veterinary prescriptions) for the use of Praziquantel from the Finfish sector were assessed and approved in 2019-20. Praziquantel has been used by the industry, under veterinarian supervision, to successfully reduce parasitic blood (*Paradeontacylix* spp.), skin (*Benedenia seriolae*) and gill fluke (*Zeuxapta seriolae*) infestations. In addition, one request (veterinary prescription) for the antibiotic Oxytetracycline was approved as a treatment to control systemic bacterial infections. Twenty nine requests (veterinary prescriptions) for the use of AQUI-S were approved for anesthetic purposes (routine husbandry requirement). On 19 February 2020, the APVMA issued a permit to Clean Seas to allow the supply and minor use of Praziquantel for the control of gill fluke in YTK (PER 87336 – expires 28 February 2023). The permit allows Praziquantel to be used on YTK for the treatment of gill fluke (*Zeuxapta seriolae*) at a dose rate of 70 mg/kg BW/day for three days, at one dose per day.

Reported APVMA registered and permitted veterinary medicines

A total of six Finfish sites reported the use of the permitted veterinary medicine, Hydrogen Peroxide (APVMA Permit PER 88576), to control fluke infestations in stock during the 2019/20 EMP reporting period. A total of 7 Finfish sites also reported the use of the permitted veterinary medicine, Praziquantel (APVMA Permit PER 87833 and 87336), to control parasites.

Livestock translocations

The existing licence holder within the Finfish sector supplies their own fingerlings from a purpose-built hatchery located at Arno Bay. As such, no livestock translocation requests were approved during the 2019-20 period for the marine Finfish sector.

Disease management and surveillance

One unusually high mortality event was reported to PIRSA during the 2019-20 period for the Finfish sector, the cause was attributed to environmental conditions.

Marine Abalone

Overview of the industry

The sector is typically based on the grow-out of hatchery reared Greenlip Abalone (*Haliotis laevigata*) spat, which are moved to subtidal structures (e.g. sea-cages) where they are grown out to market size. Other subtidal structures for the farming of Abalone stock are currently being trialed and include uncontained benthic structures ('Abitats') made from concrete. Abalone are held for a grow-out period of approximately three years and are typically fed naturally occurring marine algae that drifts past the Abalone.

In 2019-20, there were two marine Abalone sites licensed by PIRSA which occupied 39 ha of water. Individual marine Abalone aquaculture licences are listed in Appendix 1.

The marine Abalone sector is still trialing suitable benthic farming methods and production in this sector in 2019-20 was minimal.

Biomass limits for both individual sites and zone policies are developed to protect the environment from any ecological impacts that the marine Abalone sector may have. Licence conditions on existing marine Abalone sites require placement of any benthic concrete structures to be at least 3 m from seagrass or sensitive habitat to protect the habitat.

Site-specific monitoring programs are in place for the marine Abalone sector however as there is no commercial-scale production, these have not yet been implemented. The monitoring programs comprise benthic video and will provide the ongoing environmental monitoring information required to adaptively identify and manage any impacts Abalone aquaculture may have. Specifically, monitoring is designed to assess any impacts to nearby seagrass species from feed inputs.

Environment

Annual environmental monitoring reports

Submission rates for EMPs for the marine Abalone sector were 100% in 2019-20.

Development

Both Abalone licences reported having farming structures on site during the 2019-20 reporting period as they are conducting trials.

Biomass

During the 2019-20 reporting period, only one site reported to have stock on site, with a maximum biomass of 0.092 t in any one month.

Feed Inputs

Farmed Abalone can be fed commercially produced manufactured pellets or naturally occurring drift algae. No feed was used during 2019-20.

Reported Interactions and escapes

No interaction or escape events were reported by the marine Abalone sector during 2019-20.

Aquatic animal health management

Veterinary medicine use

Off-label approvals under *Aquaculture Regulations 2016*:

No chemical use approvals were requested by the marine Abalone sector in 2019-20.

Reported APVMA registered and permitted veterinary medicines

No chemical use was reported by the marine Abalone sector in 2019-20.

Livestock translocations

One livestock translocation approval was requested by the marine Abalone sector for 2019-20. Hatchery reared Greenlip Abalone were translocated from a South Australian Land-based site to a South Australian in-sea site.

Disease management and surveillance

No unusually high and unexplained mortalities, nor suspected or confirmed notifiable diseases were reported to PIRSA during the 2019-20 period for the marine Abalone sector. One site reported a number of Abalone had been eaten by Whelks and all mortalities were removed from site. No disease investigations or emergency disease responses were required for the sector during this period.

Mussels

Overview of the industry

The Mussel sector is well established in the waters of Boston Bay, near Port Lincoln, with 34 farms covering 542 ha in 2019-20. Individual Mussel aquaculture licences are listed in Appendix 1. The species farmed by this sector is the Blue Mussel (*Mytilus galloprovincialis*), and trials of red algae (*Asparagopsis armata*). Blue Mussels are grown using long-line culture. Long-lining involves a system of horizontal ropes with buoys to provide flotation, to which vertical droppers are attached every 1–4 m, depending on site conditions. Long-lines are used for spat collection, as well as for on-growing juvenile Mussels to market size.

Currently, Blue Mussel spat are collected from the wild on spat collectors, which are fibrous, 'hairy' looking ropes hung from long-lines during the peak spawning season (June to September) in areas known to have good mussel 'spatfall'. After ~6 months, juveniles (12 millimetres (mm) long) are transferred from the spat collectors to grow-out long-lines. The juvenile Mussels are separated from each other by passing through a mussel de-clumping machine and then feeding them through a funnel onto a grow-out rope. A cotton stocking, known as a 'mussock', is placed around the grow-out rope to hold the juvenile Mussels against the rope. As the Mussels grow, they re-attach themselves to the ropes. In time, the mussock disintegrates leaving the Mussels to grow for a further 8–12 months. Mussels are generally harvested after a period of 18 months at ~10–11 centimetre (cm) length.

Blue Mussel spat collection from the wild can be unreliable and inconsistent, and in poor collection seasons can impact the industry significantly. Many factors influence the number of spat collected, including: water currents, climatic variations or bio-fouling on the ropes, which can all prevent spat from settling.

Environment

Annual environmental monitoring reports

Submission rates for EMPs for the Mussel sector were 85% in 2019-20. PIRSA follow up all late or non-submitted EMP reports with licence holders. Education about the importance of the information for regulating the aquaculture industry is promoted. However, failure to submit an EMP report where required may result in the matter being referred to the PIRSA Compliance Unit for further action.

Development

Of the 29 reports received for the 2019-20 EMP reporting period, 25 or 86% of the Mussel licensees reported having farming structures and stock on the site.

Biomass

Licence conditions limiting the amount of Mussels farmed on a site relate to infrastructure not biomass, and state that the total length of backbone (the supporting structure on the surface for all underwater lines on which the Mussels are attached) held on site does not exceed 560 m per ha with no more than 15 m of submerged line per metre of backbone (unless otherwise approved by the Minister).

During the 2019-20 EMP reporting period, all licensees reported being within the total allowable length of backbone and submerged line on the site. On average, the length of backbone infrastructure across all farmed sites within the region during the 2019-20 reporting period was approximately 297 m of backbone per ha, and 8.56 m of submerged line per metre of backbone.

Feed Inputs

Mussels are filter feeders and do not require supplementary feed.

Reported Interactions and escapes

No interaction or escape events were reported during 2019-20.

Benthic Video

Benthic video footage submitted by the Mussel sector as part of their 2019-20 EMP requirements has demonstrated Mussel shell accumulation under some of the Mussel sites. The cause of this is likely to be natural settlement of Mussel and Oyster spat on adult Mussels, the additional weight of which results in the Mussels falling off the long-line. The Mussel sector is working with PIRSA to address the issue, including reviewing harvesting and settlement practices to avoid “double settlement” and loss of Mussels during the harvest process.

Aquatic animal health management

Veterinary medicine use

Off-label approvals under *Aquaculture Regulations 2016*:

No chemical use approvals were requested by the Mussel sector in 2019-20.

Reported APVMA registered and permitted veterinary medicines

No chemical use was reported by the Mussel sector in 2019-20.

Livestock translocations

No livestock translocation approvals were requested during 2019-20 for the Mussel sector.

Disease management and surveillance

No unusually high and unexplained mortalities, nor suspected or confirmed notifiable diseases were reported to PIRSA during the 2019-20 period for the Mussel sector. Consequently, no disease investigations or emergency disease responses were required for the sector during this period.

Oysters

Overview of the industry

The Oyster sector is well established in SA. The majority of farmed Oysters are Pacific Oysters (*Crassostrea gigas*), with some farmers trialing Native Oysters (*Ostrea angasi*). Oysters are farmed in SA in 7 main growing regions (Coffin Bay, Streaky Bay, Smoky Bay, Cowell, Denial Bay/Ceduna, Kangaroo Island, Yorke Peninsula) with 351 licensed sites covering approximately 1,037 ha in 2019/20. Individual Oyster aquaculture licences are listed in Appendix 1.

Up until January 2016, the majority (80%) of Pacific Oyster spat were sourced from Tasmania. However, an outbreak of Pacific Oyster Mortality Syndrome (POMS) in Tasmania in January 2016 resulted in SA implementing a ban of Oyster imports from Tasmania (see Section 16 for more detail) as a biosecurity measure to protect SA Oyster stocks. Since then, the South Australian Government, Tasmanian Oyster hatcheries and South Australian Oyster farmers have developed or expanded their own hatcheries in SA to be able to provide locally grown stock. To facilitate this, the South Australian Government has provided grants to two local South Australian Oyster hatcheries, increased capacity at SARDI to produce spat for the industry, and fast tracked two new Oyster hatchery developments.

South Australian Oysters are predominately grown intertidally using a rack and rail system, a long-line system or a combination of both. Fixed 'rack and rail' culture systems have been shown to cause localised impacts to some seagrass species, as the racks and baskets are stationary and can shade the seagrass beneath. Now Oyster farmers mainly use the Baker-Schultz-Turner (BST) long-line system developed by the Turner family of Cowell, to allow Oyster growers to alter the height of the free-swinging Oyster baskets in the water column to reduce exposure to storm events, high air temperatures and mudworm. This system creates minimal shading effect on seagrass.

Innovative new methods of farming Oysters have been trialed in SA. Floating Oyster mesh bags and grow out tumblers attached to longlines are new farming methods developed by Zapco Aquaculture. The Oyster mesh bags expose Oysters to nutrient and oxygen rich surface water which enables the Oysters to grow much faster than traditional intertidal Oyster farming methods. The grow out tumblers rotate with the tide, promoting faster spat growth and allowing Oysters to develop a uniform shape. Similarly, Flip Farm Systems have developed a basket system attached to a single longline that is extremely robust and efficient. The rotation system uses a mechanical action device mounted to the side of a boat to flip baskets as the boat moves along the line. These new farming methods are less labour intensive and rely on less infrastructure (e.g. posts) in comparison to current systems. A reduced amount of posts means less physical disturbance to the benthic environment and associated

sedimentation effects on surrounding habitats. The long-lines also move with the tide which reduces the effect of prolonged shading from Oyster baskets or bags on seagrass habitat.

Typically Oyster spat are placed into baskets at ~5–15 (mm) shell length and on-grown for ~12-24 months. During this time, Oysters are removed from the baskets and graded several times before they are sold. Grading the Oysters minimises shell fouling and helps the development of optimal shell quality for marketing. Since 2016 and until 2019-20, the local hatcheries were having difficulty in producing spat larger than 3 mm for on-growing which has had longer term issues with survivability of the spat and overall production of mature Oysters. Local hatcheries are currently working towards improving spat survivability, for example by on-growing small spat on Oyster leases to achieve larger sizes prior to being grown on commercial leases.

Environment

Annual environmental monitoring reports

Submission rates for EMPs for the Oyster sector were 89% in 2019-20; 55% of these were up to five months late. The remaining 11% did not submit an EMP report for 2019-20 because there was either no development on site or they had transferred the licence to another party and were therefore no longer responsible for the licence.

PIRSA follow up all late or non-submitted EMP reports with licence holders. Education about the importance of the information for regulating the aquaculture industry is promoted. However, failure to submit an EMP report where required may result in the matter being referred to the PIRSA Compliance Unit for further action.

Development

Of the reports received for the 2019-20 EMP reporting period, 273 (88%) reported having farming structures and 241 (75%) reported having stock (Pacific Oyster) on the site.

Biomass

Licence conditions limiting the amount of Oysters farmed on a site relate to infrastructure not biomass, and state that the licence holder must ensure that the structures used to farm Oysters on site do not exceed a specified amount per ha (e.g. do not exceed 3 km of longline per ha, 1 km of baskets on racking per ha, and/or must not exceed a specified amount of baskets on longline per ha).

Of the reports received for the 2019-20 EMP reporting period, 95 license holders (or 31%) reported having exceeded the total allowable length of line on the site. While this does not necessarily translate to an environmental impact, PIRSA has been working with the South Australian Oyster Growers Association (SAOGA) to address the issue and have developed a draft Standard Lease and Licence Condition Policy (see Aquaculture zone policy tenure allocation overview) that addresses new biomass limits for some of the Oyster growing regions, based on historical use and previous research undertaken by SARDI to determine carrying capacity (biomass) in Oyster growing regions.

Feed Inputs

Oysters are filter feeders and do not require supplementary feed.

Reported Interactions and escapes

During the 2019-20 reporting period, one sea lion and one sting ray were observed swimming on two separate sites, but the animals swam away once work activities had commenced.

Feral oysters

Of the reports received for the 2019-20 EMP reporting period, 42 (13%) stated feral Oysters (wild Pacific Oysters) were found in the lease area. All feral Oysters were reported to have been removed from the area and disposed of at Landbased facilities.

Feral oyster populations within, and adjacent to, growing regions pose a potential POMS risk to the Oyster industry. To reduce this potential risk of disease, the growing regions participate in a feral Oyster monitoring and management program. Organised by SAOGA, feral Oyster knock down events are organised as needed to reduce feral oyster numbers in the growing region.

Aquatic animal health management

Veterinary medicine use

Off-label approvals under *Aquaculture Regulations 2016*:

No chemical use approvals were requested by the Oyster sector in 2019-20.

Reported APVMA registered and permitted veterinary medicines

No chemical use was reported for the Oyster sector in 2019-20.

Livestock translocations

There were no translocation approvals during 2019-20 for the Oyster sector.

Disease management and surveillance

Four mortality events were reported to PIRSA during the 2019-20 period for the sector. In response to these events, the PIRSA Pacific Oyster Mortality Syndrome (POMS) Disease Response Plan was enacted and the events investigated. No notifiable or infectious diseases were detected through laboratory testing (PIRSA's primary role as hazard leader for animal disease emergency responses). From the available information at the time, these mortality events were likely caused by a combination of high water and air temperatures, low tides, non-optimal water quality and handling stress.

In 2017, PIRSA developed a surveillance strategy for POMS to enhance early detection and rapid response to the disease. Since this time, Oysters have been regularly submitted to the South Australian veterinary laboratory for testing as part of the statewide early detection of POMS. In 2019-20, a total of 2,518 (670 individual or pooled samples) Oysters from across SA (hatcheries, nurseries, grow-out and feral oysters in growing regions) tested negative for OsHV-1 microvariant, which is the virus that causes POMS. For further information on the Tasmanian outbreak of POMS and the indirect effect on SA's oyster industry, see section 15 below.

Landbased

Overview of the industry

The Landbased sector is the most diverse of the South Australian aquaculture industry in terms of farming systems and culture species (see below for species farmed). In 2019-20, there were 71 Landbased aquaculture licences in SA, comprising Category A (27), B (25), C (13) and D (6). Licences include private businesses, hatcheries (Abalone, Oysters and Finfish), educational and research facilities, as well as Tourism and hobby farm businesses. Individual Landbased aquaculture licences are listed in Appendix 1.

The Land-based Abalone, Oyster and Finfish hatcheries contribute significantly to regional economies, creating the majority of the 89 direct jobs in 2019-20, and producing the spat and/or juvenile stock used for marine based aquaculture activities.

Landbased aquaculture licences are located all over SA including the Eyre Peninsula, Yorke Peninsula, Kangaroo Island, Adelaide Hills, Murraylands, Fleurieu Peninsula and South East. A number of production systems are used by the Landbased aquaculture sector. The most popular systems are pond culture, recirculating aquaculture systems and flow-through systems.

PIRSA regulate the Landbased sector by categorising each licence based on the level of work required by PIRSA to manage the risks associated with the activity. The criteria for each category are listed below:

Category A: Small scale operators, which do not discharge wastewater off site, and require minimal aquatic animal health legislation requirements and environmental monitoring e.g. Yabby and Marron.

Category B: Small scale operators, which may potentially discharge some waste-water off-site, or farm a species with applicable aquatic animal health legislation e.g. Native Finfish.

Category C: Intensive and/or large-scale operators with waste-water discharge off-site and/or farm a species with applicable aquatic animal health legislation e.g. Oyster hatcheries.

Category D: Intensive and/or large-scale operators with waste-water discharge off-site into the marine environment and/or farm a species with applicable aquatic animal health legislation e.g. Abalone farms.

Environment

Annual environmental monitoring reports

Of the 71 Landbased aquaculture licences, 63 (89%) EMPs were submitted in 2019-20; 48% of these were up to 4 months late.

PIRSA follow up all late or non-submitted EMP reports with licence holders. Education about the importance of the information for regulating the aquaculture industry is promoted. However, failure to submit an EMP report where required may result in the matter being referred to the PIRSA Compliance Unit for further action.

Development

Of the reports received for the 2019-20 EMP reporting period, 56 (89%) reported having stock at the facility.

Species farmed

In 2019-20, the Landbased species farmed included Barcoo Grunter (*Scortum barcoo*), Barramundi (*Lates calcarifer*), Blacklip Abalone (*Haliotis rubra*), Brown Trout (*Salmo trutta*), Golden Perch (*Macquaria ambigua*), Greenlip Abalone (*Haliotis laevigata*), Marron (*Cherax tenuimanus*), Murray Cod (*Maccullochella peelii peelii*), Native Oyster (*Ostrea angasi*), Pacific Oyster (*Crassostrea gigas*), Rainbow Trout (*Oncorhynchus mykiss*), Silver Perch (*Bidyanus bidyanus*), Yabbies (*Cherax destructor*), Yellowtail Kingfish (*Seriola lalandi*), as well as a variety of microalgae species.

Reported Interactions and escapes

No interaction or escape events were reported during 2019-20.

Aquatic animal health management

Veterinary medicine use

Off-label approvals under *Aquaculture Regulations 2016*:

A total of 13 requests (veterinary prescriptions) for the use of veterinary medicines (Praziquantel and AQUI-S) from the Landbased sector were assessed and approved in 2019-20. These chemicals were used primarily for the treatment of parasites and to address husbandry issues in Finfish hatcheries.

Reported APVMA registered and permitted veterinary medicines

The use of APVMA veterinary medicine products by the Landbased sector were reported in annual EMPs for six sites in 2019-20. These included the APVMA registered chemical products AQUI-S and 2-Phenoxyethanol (Aquatic Anaesthetics: APVMA Product 48157 and 83233), as well as a permitted veterinary chemical product to induce Oyster settlement (Epinephrine–APVMA Permit PER80085).

Livestock translocations

Eight livestock translocation approvals were requested during 2019-20 for the Landbased sector. Species included Sea Urchins, Barramundi, Silver Perch, and Brown and Rainbow Trout. Two Abalone farm biosecurity audits were undertaken for the purposes of livestock trade or translocation requirements during this period.

Disease management and surveillance

Two mortality events were reported to PIRSA, and subsequently investigated, during the 2019-20 period for the sector. No notifiable diseases were detected, hence no emergency disease responses were required during this time.

A total of 1,957 samples were submitted to the South Australian veterinary laboratory for the purpose of health certification (e.g. export requirements for livestock), including 1,530 for the Landbased Finfish sector, and 427 for the Landbased Abalone sector. *Perkinsus olseni* (Perkinsus) was detected in one Abalone, which was incidental and not clinical. Perkinsus is known to be endemic within SA. Clinical disease and mortality events attributed to Perkinsus have not been reported in South Australian Land-based aquaculture farms. In all other cases, no notifiable or infectious diseases were detected.

In 2019-20, Oysters from the Landbased Oyster sector (hatcheries) were submitted to the South Australian veterinary laboratory as part of the state-wide early detection of POMS. A total of 78 samples from the Landbased Oyster sector (hatcheries) tested negative for OsHV-1 microvariant, which is the virus that causes POMS.

Marine Algae

Overview of the industry

There is an increasing focus on farming marine macroalgae for commercial purposes. In particular, the farming of a bioactive (Bromoform) that will provide global environmental benefits by substantially reducing methane greenhouse emissions in the livestock industry. The farming of marine algae is also a sequester of carbon, resulting in the reduction in the amount of carbon dioxide in the atmosphere with the goal of mitigating global climate change. The sustainable wild harvest of the required levels of algae is unlikely and therefore an algae industry needs to be based on aquaculture. South Australia has a competitive advantage over other states based on:

- a highly diverse endemic seaweed flora
- large areas of suitable in-sea and onshore coastal water/land for farming
- a suitable marine environment, and
- an international reputation for high quality seafoods.

Another key benefit of farming marine algae in South Australian waters is the reduction in coastal anthropogenic dissolved nitrogen, including from waste products (via absorption by the culture stock) produced by aquaculture stock. Farming algae adjacent to Tuna and Finfish farms will allow excess nutrients to be taken up by the algae and reduce the overall nutrient load from the sector. The development of Integrated Multi-trophic Aquaculture (IMTA) systems provide a more sustainable farming method and reduces the farm's environmental 'footprint'.

Over the past two years there has been an increasing interest in the production of marine algae using similar farming structures used by the Mussel aquaculture sector. PIRSA has recently approved the development of two new algae farms at Point Pearce (*Aquaculture (Zones – Eastern Spencer Gulf) Amendment Policy 2017),* with a number of other licence applications currently being assessed. In addition, marine algae species have been added to many marine aquaculture licenses to undertake trials for the development of farming practices.

A pilot cultivation trial of marine algal species *Asparagopsis taxiformis* and *Asparagopsis armata*, led by SARDI / PIRSA, has been awarded funding of $175,000 from FRDC with a co-investment of $378,331 from CH4 Global. The research team has made significant progress with development of an in-house protocol for testing the bioactive compound Bromoform responsible for reducing ruminant methane production, hatchery technology and production infrastructure designs and trials of farming marine algae. Both 'at-sea' and land-based trials are currently underway at Port Lincoln, Port Victoria and West Beach, respectively. Additionally, a two-year funding project awarded to SARDI/PIRSA through the Economic and Business Growth Fund (EBGF) seeks to develop a commercial seaweed industry in SA. SARDI has already partnered with seven South Australian based industry partners across the value chain, that will see at-sea and on-land cultivation of seaweeds for a variety of applications in Port Lincoln, Port Victoria, Dry Creek and West Beach.

The aquaculture farming of seaweeds is likely to contribute significantly to regional SA, with increased job opportunities in farming and processing of product, with further jobs created in transport and other flow-on activities. In SA alone, the algae aquaculture industry has the capacity to create an additional 3,000 jobs. At a national level, it is estimated up to 9,000 jobs could be created from the industry. For further information, see the Australian Seaweed Industry Blueprint: https://www.agrifutures.com.au/wp-content/uploads/2020/09/20-072.pdf

Tourism and education

Aquaculture, as well as a primary food source, has an important role in tourism and education. Aquaculture facilities provide an opportunity for students and the public to learn directly about marine and freshwater aquatic environments through a hands-on approach. The Cowell Area School has a current aquaculture program comprising an operating Oyster farm and associated Land-based facilities. There are also a number of other licensed schools and educational facilities (Port Lincoln, Ceduna, Kingston, Lucindale and Kangaroo Island Community Education) that include aquaculture in their curriculum.

In 2019-20, there was only one licensed marine aquaculture tourism site operating (Encounter Bay, near Victor Harbor). This site provides the opportunity for the general public to view, swim with and learn about various marine species found locally in South Australian waters such as Tuna, Abalone, Snapper, Rock Lobster and Yellowtail Kingfish within the safe confines of a sea-cage and floating pontoon equipped with touch tanks. However, in late 2020, the site ceased to operate due to structural work on the Granite Island causeway removing access to the site for the public. The infrastructure was temporarily returned to Port Lincoln until the causeway is complete.

Compliance outcomes

PIRSA staff monitor and investigate potential breaches of the *Aquaculture Act 2001*, *Aquaculture Regulations 2016* or other relevant legislation (e.g. environmental), based on random and targeted inspections, information received by the public, other government agencies and other stakeholders (including recreational marine resource users), in an efficient and timely manner.

PIRSA aims to work in collaboration with the industry to address and rectify any issues that arise. Subject to the circumstances of any reported non-compliance, PIRSA will apply the most appropriate measures such as education of licence holders, changes in licence conditions, direction to carry out work or further enforcement actions if required.

During 2019-20, Finfish (Port Lincoln), Oysters (Franklin Harbour, Denial Bay, Smoky Bay, St. Peters Island, Haslam, Southbank, Streaky Bay, Wallaroo, Point Pearce, Perlubie), Mussel (Port Lincoln), Tuna (Port Lincoln), Tourism (Victor Harbour) and Land-based (Tumby Bay, Cowell, Kangaroo Island, Limestone coast, Mallee, York Peninsula) aquaculture sites were inspected by PIRSA staff, with a particular focus on compliance to navigation requirements (marine), rehabilitation of unused sites (marine) and species farmed (Landbased).

Results from these visits indicated most marine sites demonstrated good compliance in relation to navigational requirements (e.g. location and marking of navigational structures, and aquaculture farming structures within the boundaries of the site), and most Landbased sites were compliant with their licence conditions. Where there was evidence of non-compliance (e.g. incorrect marking of navigation structures, failure to rehabilitate a site), lease and licence holders were contacted, and areas requiring attention were raised. Follow-up inspections of non-compliant sites were undertaken to ensure actions had been taken to address the issue.

In addition to targeted inspections, Fisheries Officers continued to collect feral Pacific Oyster samples as part of the POMS surveillance program from the Ceduna, Coffin Bay, Yorke Peninsula and Kangaroo Island areas. POMS related signage was also maintained within the Port River system. Fisheries Officers addressed several queries regarding Oyster biosecurity related rules and preventative measures including translocation risks. Furthermore, PIRSA responded to several inquiries regarding reports of escaped Finfish.

PIRSA also undertook the following activities:

- provided assistance to the tourism sector in relation to investigating theft of stock
- inspected and audited a Land-based site suspected of undertaking aquaculture activities prior to development approval
- liaised with impacted growers to finalise the rehabilitation of Oyster sites in Streaky Bay affected by a storm in September 2016
- conducted extensive monitoring of Port Lincoln based launch sites and undertook sea-based patrols and surveillance to monitor Tuna theft
- liaised with Tuna growers and conducted surveillance and inquiries regarding a high number of Tuna mortalities (deliberately harmed)
- conducted a vessel hull inspection which confirmed biofouling containing mussels were destroyed during treatment prior to entry into SA.

Aquatic animal health and biosecurity

Fish kill and fish health investigations

This section provides a comparison between aquaculture mortality or disease investigations (reported above) and wild fish kill or wild fish health investigations conducted by PIRSA.

For 2019-20, there were 8 aquaculture related mortality events investigated compared to 22 wild fish kill events reported and investigated (Figure 14). The aquaculture related mortality events were caused by environmental conditions or husbandry practices. The wild fish mortality events were due primarily to environmental or natural occurrences (e.g. water quality, weather event, unusually high or low water temperature and harmful algae bloom). South Australia has a list of 61 notifiable diseases pursuant to the *Livestock Act 1997*, which are required to be reported if suspected or detected. *Perkinsus olseni* (Perkinsus) was detected in both aquaculture and wild abalone, which was incidental and not clinical. Perkinsus is known to be endemic within SA. No other notifiable diseases were detected as a result of fish kill (or fish health) investigations.

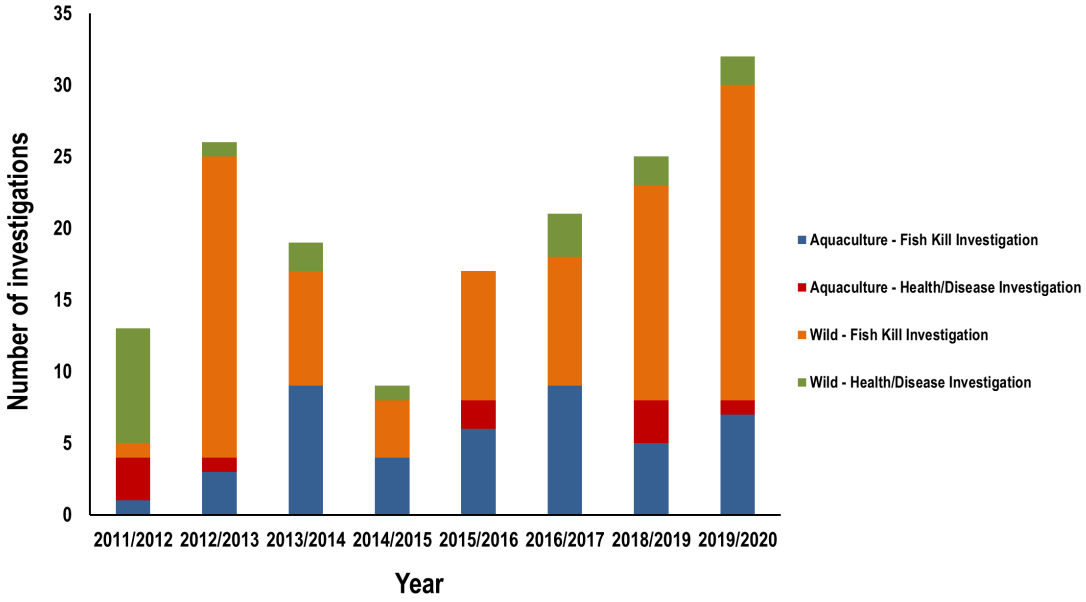

Figure 14. A summary of SA fish kill (mortality) and fish health (disease) investigations in wild fish and aquaculture sectors from 2011-2012 to 2019-20.

Industry initiatives

Marine debris

A need for a collaborative approach to the regular collection of debris from local beaches on the Eyre Peninsula was identified in 2011 and the local aquaculture industry agreed to undertake marine debris beach clean ups.

Led by the Australian Southern Bluefin Tuna Industry Association (ASBTIA) and supported by the Finfish and Mussel industries, the Adopt-a-Beach Program is a debris clean-up program that covers a coastal area of approximately 160 km located in the Lower Spencer Gulf region, from MacLaren Point to Cape Euler. It includes a number of islands within the Boston Bay area and Spilsby Island (Sir Joseph Banks Group), with the area divided into 15 individual zones which are assigned to/adopted by individual Tuna, Finfish and Mussel companies. Adopted areas range from 6 to 19 km (see www://pir.sa.gov.au/aquaculture/monitoring_and_assessment/adopt_a_beach_program).

Beach clean ups are undertaken a minimum of four times a year, with clean-up data collected and submitted to the ASBTIA for collation and reporting to PIRSA. Information collected for each "beach" includes the five most common types of items, unusual items and total weight. In 2019-20, approximately 2,448 kg of marine debris was collected from a total of 173 km of beach, over a total of 18 clean up days. Debris consisted predominantly of rope, plastic, drink containers, household rubbish and buoys/floats.

The program also encompasses the collection of non-aquaculture related debris and its disposal in a responsible manner. While some debris, such as ropes and some plastics may be attributed to aquaculture, it is clear that debris originated from a range of sources including commercial and recreational fishing, Landbased operations, commercial shipping and the general public.

South Australian Oyster Growers Association (SAOGA) - Coastline Debris Recovery Program

To address legislative requirements, the South Australian Oyster industry cleans up debris from the coastline near their farming sites. This has been an ad hoc process with little documentation of what has been achieved. A number of these clean-ups have been coordinated and carried out with the Department for Environment and Water (DEW) staff. The clean-ups are somewhat targeted with some sites identified from DEW marine debris surveys and mapping.

A need for a more collaborative, coordinated, documented and efficient approach to regular debris collection from the local coastline was identified. In September 2015, SAOGA developed a clean-up program called the 'Coastline Debris Recovery Program' in collaboration with PIRSA and DEW.

This Coastline Debris Recovery Program involves clean-ups identifying areas in eight different regions between Coffin Bay and Denial Bay, SA. Hot spots are identified through DEW staff and oyster growers, specifically Coffin Bay, Ceduna and Smoky Bay. Coordinated clean-ups will occur approximately two times per year. Recent clean ups by growers have occurred at Cowell, Haslam and Smokey Bay, however, little documentation is available (see SAOGA's March Newsletter). The Yorke Peninsula farming area covers a small section of the coast between Port Vincent and Stansbury and growers regularly monitor for debris during their farming activities. No debris has been sighted along the coast for some time. Kangaroo Island growers also regularly monitor beaches for debris and have recently undertaken an extensive beach patrol, but no documentation is available on what debris (if any) was collected.

This program is the responsibility of SAOGA, as well as Oyster licensees, and will be supported and monitored by the South Australian Government to achieve its desired outcomes.

Oyster Hub project

The Oyster Hub project is being developed by the Oyster sector with financial support from the South Australian Government. The purpose of the Oyster Hub project is to provide a web-based tool for the effective management of Oyster stock such as grow-out, conditioning, mortality and translocation. It provides a framework for farmers to record key information for better decision-making and dissemination to maximise production efficiency through improved husbandry methods.

The web-based tool now called miShell was launched at the South Australian Oyster Growers Seminar in Smoky Bay in August 2018. Currently, over 30 growers are using the application and interest has also been shown from interstate.

Oyster basket recycling

In 2013, the EPA, working collaboratively with the South Australian Oyster sector, Regional Development Australia Whyalla and Eyre Peninsula, and the Department for Manufacturing, Innovation, Trade, Resources and Energy, undertook a feasibility study into the recycling of plastic Oyster baskets (see http://www.epa.sa.gov.au/files/477882_oyster_basket_study.pdf).

The aim of the South Australian Oyster Basket Recycling Feasibility Study was to 'identify cost-effective Oyster basket recycling options that will value add to the efficient operation of the industry as a whole'. The Oyster industry uses 2.5 million baskets annually. Each year about 5–10%, or 150–200 t, of these plastic baskets reach their end of life and must be disposed of.

Instead of sending the baskets to landfill, many Oyster growers have been stockpiling them on their properties until a more environmentally sustainable disposal by recycling option becomes available.

The Oyster industry developed an Expression of Interest to identify recycling companies that would be interested in taking the baskets at zero cost to industry. One company was identified and commenced a trial of collecting, mulching and recycling the baskets at the agreed zero cost. However, China changed its policy on taking recycled waste in 2018 and it was not financially viable for that company to continue. Since this time, the industry has continued to recycle plastic baskets by using a portable plastic shredder on the back of a truck but it comes with a cost to growers. However, this is the preferred option to dumping at a landfill facility which also incurs a cost. The method of shredding is also very labour-intensive as all baskets need to be free of any contaminants (i.e. metals and non-shredding plastics). SAOGA continues to search for alternative methods and grant opportunities to achieve a cost-effective resolution to recycling waste infrastructure. In late 2020, 40 t of plastic baskets from the Smokey Bay growing region were recycled and the clean-up was reported in SAOGA's December Newsletter.

Seafood certification

Third-party aquaculture certification schemes not only provide consumers with assurance that their seafood is sustainably and ethically produced, but also provide producers in some instances with greater market access, whilst encouraging them to implement and maintain responsible farming practices throughout their operations. There are multiple worldwide certification programs available to aquaculture, with the South Australian industry successful in achieving certification to some that are considered some of the most robust, reputable and recognised programs in the world.

Friend of the Sea Sustainable Aquaculture certification has been achieved for many of the South Australian aquaculture companies (Clean Seas Seafood Ltd (Australia), Angel Oysters Australia Pty Ltd, Australian Southern Bluefin Tuna Industry Association and all the Tuna companies, and Eyre Peninsula Seafoods Pty Ltd - see www.friendofthesea.org/ for information about this certification). The Friend of the Sea Sustainable Aquaculture certification provides independent assurance to markets that the product has been produced in a healthy, safe and sustainable environment. It involves a rigorous environmental sustainability performance assessment that assesses the whole supply chain from the catch in the wild, through the value adding aquaculture process to final harvesting.

The Aquaculture Stewardship Council (ASC) is an independent, global, non-profit organisation whose role is to recognise, via a certification program, responsibly farmed seafood and to harness consumer preference for seafood products bearing the ASC label of approval. Successful certified aquaculture companies are audited annually to ensure they maintain the ecological sustainable standards of the ASC. The accreditation process is extensive and in February 2018, Cleans Seas Seafoods Ltd commenced the formal process to seek certification from the ASC for conforming to the ASC Seriola 2016 Standard. Certification was achieved in 2019, 2020 and is pending for 2021 (see https://www.asc-aqua.org/find-a-farm/ASC01211/). Yumbah Aquaculture Ltd has recently achieved ASC certification for their Kangaroo Island Abalone farm and has commenced the formal process to seek certification from the ASC for their Port Lincoln Abalone farm (Find a Farm - Aquaculture Stewardship Council (asc-aqua.org).

Research

As part of its commitment to supporting industry growth and developing an adaptive resource management framework, PIRSA plays a key role in supporting a number of strategic research initiatives. Many of these projects are led and conducted by SARDI, the research division of PIRSA, which offers an integrated research and development (R&D) capability to sustainably create, nurture and grow aquaculture industries.

SARDI and PIRSA work closely with the aquaculture sector to produce applied research outcomes and timely delivery. SARDI's aquaculture research program is uniquely set up to provide support across the whole spectrum of industry research needs, including:

- developing novel technologies, species and sites
- environmental assessment, monitoring, oceanography and carrying capacity modelling
- improving spawning, and larval and juvenile rearing of stock
- developing and evaluating improved and more cost-effective sustainable feeds
- providing advice and support on selective breeding programs and aligned molecular technologies
- enhancing algal production and systems to produce biomass for a diverse range of products.
- addressing disease and pest issues, through support with chemical registration, monitoring and surveillance, evaluation of therapeutics and development of improved husbandry practices
- pre- and post-harvest product safety and quality, including developing novel products and packaging
- trade and market access.

The outcomes of such initiatives are integrated into decision-making processes such as those associated with aquaculture zoning, disease control, managing interactions with protected wildlife species and environmental management. A large number of aquaculture related research projects have been undertaken over the years, most of which can be found at: www.pir.sa.gov.au/research/research_specialties/aquatic_sciences and www.frdc.com.au/

A strategic research initiative is the Innovative Solutions for Aquaculture Planning and Management suite of projects (IS). Commenced in 2004, this program was a joint initiative between PIRSA and the FRDC to fund research to foster the continued sustainable development of the SA aquaculture industry.

Stage One of IS involved a site or species focus. Projects included an environmental audit of marine aquaculture, spatial impacts and carrying capacity for Finfish aquaculture, Finfish parasites, seal interactions and the development of rapid environmental assessment and monitoring techniques. In addition, a communication and extension strategy was developed to disseminate project outcomes to industry.

The particular focus of the second stage of the IS program was to facilitate further economic growth of the aquaculture industry and to provide information to improve the management of aquaculture resources. Projects completed under Stage Two have included oceanic and biological modelling of Spencer Gulf, biosecurity, new technologies and new species and improving programs for environmental monitoring.

More recently a project investigating interactions of sharks with marine activities (e.g. aquaculture and fisheries) in southern Spencer Gulf was finalised. The project focused on the movement dynamics of two pelagic sharks, the White Shark (*Carcharadon carcharias*) and Bronze Whaler (*Carcharinhus brachyurus*), in SA. Specific aims were to: (1) determine if aquaculture activities correlated with patterns on fidelity and migration; and (2) assess and compare the use of natural foraging areas and areas used during human marine activities. Additional objectives included the development of industry guidelines for removal and release of pelagic sharks from finfish aquaculture pontoons, and surveys to collect baseline information on perceptions of shark associations with aquaculture and other marine activities. A key outcome for this project was that there was negligible overlap between sharks and aquaculture activities in Spencer Gulf, suggesting that aquaculture does not lead to aggregations of sharks to an area. The final report for this project can be downloaded at http://www.frdc.com.au/project/2014-020.

The Future Oysters CRC-P program was developed in conjunction with the Oyster industry, FRDC, and the Commonwealth Government to undertake the research needed to rebuild and evolve the Australian Oyster aquaculture industry in the face of POMS and other diseases affecting Oysters. The research focusses on breeding disease-resistant Oysters, improving disease

management, increasing productivity and profitability, and diversifying risks to allow the industry to grow and supply domestic markets and a growing global consumer demand for seafood. Improved diagnostic technologies for POMS are being developed, including more efficient approaches to area surveillance, a test using flow cytometry for better quantification of the POMS virus in water, and a better understanding of sampling to test for POMS. This program is also investigating the causes and approaches to managing Winter Mortality in Sydney Rock Oysters and mortalities of unknown cause in the South Australian Pacific Oyster industry. More on this project can be found at http://www.frdc.com.au/project?id=21.

A current project is underway, which aims to identify the feeding requirements of Pacific Oysters, Cockles and Mussels, investigate the factors influencing food availability in South Australian Oyster farming regions and improve our understanding of the relationship between food availability, bivalve feeding and farm production/productivity, and the potential implication of aquaculture development on different species. This project is scheduled to be finalised in 2021. More information on this project can be found at http://www.frdc.com.au/project/2014-027.

In 2019, PIRSA's Aquatic Animal Health Unit completed a project to improve early detection surveillance and emergency disease response to POMS using a hydrodynamic model to predict the dispersion of OsHV-1. This project provided a case study for how such a model can predict pathogen spread to underpin improved surveillance designs, effective emergency disease response (identified disease management areas around the state) and appropriate biosecurity zoning for translocation protocols. More on this project can be found at https://www.frdc.com.au/project/2018-090.

In June 2020, PIRSA's Aquatic Animal Health Unit completed another project, which developed national guidelines to provide the Australian sea-cage Finfish (non-salmonid) industry with the tools and templates to create an auditable farm biosecurity plan. Consideration was given to the current farming of Yellowtail Kingfish (*Seriola lalandi*), Southern Bluefin Tuna (*Thunnus maccoyii*) and Cobia (*Rachycentron canadum*). More on this project can be found at https://www.frdc.com.au/project/2019-088.

Another project being undertaken by PIRSA's Aquatic Animal Health Unit is investigating risk factors and management strategies associated with summer mortality in Australian Abalone. The project aims to summarise current Abalone health and summer mortality research, and retrospective mortality investigations and laboratory submissions for Australian Abalone, develop a case definition for summer mortality and investigate summer mortality events during the life of the project to comprehensively rule out primary pathogens and infectious agents, in both control and impacted Abalone populations. More on this project can be found at https://www.frdc.com.au/project/2019-147.

During 2019-2022, an FRDC project assessing the capacity for sustainable Finfish aquaculture in the vicinity of seagrasses is being undertaken. The project was prompted by the re-establishment of Yellowtail Kingfish aquaculture in Fitzgerald Bay. The outcomes of the project will: (1) determine cost-effective approaches to assessing the influence of Finfish aquaculture derived nutrients on seagrasses, and using Fitzgerald Bay as a case study what that influence is; (2) Develop a predictive modelling ability to estimate carrying capacity and allow scenario analysis of future aquaculture developments and how it might affect seagrasses. The model will also allow managers to make informed decisions about where to place future developments, and how much to allow existing developments to expand; (3) Also, use Fitzgerald Bay as a case study to document seagrass condition using a range of metrics both before the commencement of Finfish aquaculture, and once production has reached a substantial level; and (4) Develop a range of cost-effective indicators for monitoring the effects of aquaculture on adjacent seagrass beds. More on this project can be found at https://www.frdc.com.au/project/2018-186.

External factors or events affecting the aquaculture industry in South Australia

Coronavirus (COVID-19)

In March 2020, the Coronavirus (COVID-19) was declared a global pandemic, which resulted in the closure of restaurants and food outlets, and a reduction or loss in access to domestic and export markets for South Australian seafood industries. For example, the Mussel and Oyster industries were significantly impacted from the restrictions of access to export markets and dampening of domestic food service consumption. To assist the recovery of the South Australian aquaculture industry from the

significant impacts of COVID-19, the collection of 2020-21 aquaculture sector fees was deferred for six months and any outstanding 2019-20 fees were also deferred. The next round of fees was not collected until January 2021.

The demand for South Australian Oysters in Australia has now soared since growers were forced to innovate and diversify during the COVID-19 pandemic. Growers shifted from international exports to local retail and tourism opportunities, including online and pop-up shops, and oyster experiences on floating pontoons. Growers have experienced record sales for the past few quarters which have been attributed to more people spending money on local experiences, produce and tourism, and good spat survivability. Restaurant orders have almost returned to pre-COVID-19 levels and with a highly successful local market, the Oyster industry is flourishing again.

Tuna quota

Southern Bluefin Tuna (SBT) is a highly migratory species found in several parts of the Southern Ocean, including the Great Australian Bight in SA and Western Australia. SBT migratory patterns mean international agreements are required to ensure sustainable global management of this species throughout its full range of distribution. The Commission for the Conservation of Southern Bluefin Tuna (CCSBT) manages SBT stock levels under an international agreement. Following recommendations from an independent scientific committee, the CCSBT set the Australian Total Allowable Catch (TAC) allocation at 6,165 t per annum for 2018 to 2020, an increase from 5,665 t in 2017.

In October 2020, the CCSBT increased Australia's TAC to 6,238 t per annum for the 2021-2023 period. In setting the quota, the CCSBT is using data from two new genetic techniques to estimate the spawning stock (close-kin DNA matching) and recruitment to the fishery (gene tagging).

The Commonwealth Government has responsibility for all catch of SBT and is leading the development of a national approach to resource sharing. The approach is aimed at ensuring all catch is covered by Australia's allocation from CCSBT and will involve state and federal government collaboration. To achieve this the Commonwealth Government has legislated in 2020 that 5% of Australia's TAC will be allocated to manage recreational catch for the long term.

Mussel industry

Eyre Peninsula (EP) Seafoods produces about 45 per cent of Australia's Mussel product and was formed in July 2016 from an amalgamation of businesses Kinkawooka Shellfish and SA Seafoods, the state's two main Mussel producers. In November 2017, the Port Lincoln-based mussel company was awarded a $500,000 State Government grant to help build a wet store holding facility. It is a first in Australian technology allowing higher production value and supply throughout the year. The new technology means that EP Seafoods can pursue markets in the United States and Canada along with keeping up with demand, as the new facility meant broken or damaged stock would no longer go to waste. Produce could be stored on site with the ability to hold up to 40 t of product fresh and alive for weeks if needed, meaning no wastage and ensuring there was still product to harvest despite inclement weather.

Oysters - POMS and spat supply

POMS is a disease that affects Pacific Oysters and has not been detected in South Australian Oyster growing regions to date. POMS causes rapid and high mortalities in farmed oysters (up to 100% within days of being detected) and can spread quickly if introduced. There are no human health implications associated with POMS. South Australia produces some of the finest Pacific Oysters on the market and table Oysters purchased from retailers, restaurants and fish processors are safe to eat. For more information about POMS see:www://pir.sa.gov.au/aquaculture/aquatic_animal_health/pacific_oyster_mortality_syndrome.

In February 2016, POMS was detected in Tasmania causing a significant economic impact to that state and SA. Previously, SA received 80% of spat (juvenile Oysters) from health certified hatcheries in Tasmania however a SA ban now exists for live Oysters, including spat, from Tasmania to prevent the risk of POMS entering SA.

PIRSA's response to the detection of POMS in Tasmania included substantial resources and financial assistance for the rapid expansion and establishment of a secure Oyster spat supply in SA. This included PIRSA providing emergency financial assistance ($320,000) for equipment and infrastructure upgrades to two small SA Oyster hatcheries on the Eyre Peninsula (EP Shellfish and Sustainable Aquatic Industries). In addition, SARDI was commissioned by PIRSA ($150,000) to produce spat for industry, condition Oyster brood-stock and produce micro-algae, as an emergency measure for South Australian hatcheries. PIRSA also fast-tracked the assessment and granting of two new land-based oyster hatcheries, Eyre Shellfish Pty Ltd (Cowell) and Cameron of Tasmania Pty Ltd (Port Lincoln), to provide more spat to the South Australian Oyster industry. These contribute significantly to PIRSA's financial assistance to industry by providing additional spat to the South Australian industry.

Continuation of support for recovery of the Oyster sector was estimated to be over $1.3 M in 2018-19. This has continued into 2019-20, with further resources estimated to be over $1 M provided, including the waiving of annual fees ($0.53 M) and application fees for farmers ($0.16 M), assistance in the supply of spat, financial support to the POMS resistant breeding program, state-wide POMS early detection surveillance, hatchery biosecurity, feral Oyster destruction in the Port Adelaide River and Outer Harbor, and an Oyster Industry Liaison Officer and Aquatic Animal Health Officer, both based within PIRSA. As an example, the PIRSA Regional Development Fund provided Eyre Shellfish Pty Ltd $267 500 to assist with biosecurity enhancements to the hatchery, nursery and dam construction, and $250,000 to Yumbah Hatchery to assist with expanding their facility.

It has taken a few years but South Australian Oyster growers are now able to source spat locally within the state. The enhanced South Australian spat production capacity not only safeguards the supply of spat for the South Australian oyster industry but facilitates SA becoming the Oyster capital of Australia.

Availability of suitable sized spat – to date South Australian hatcheries have been able to provide up to 3 mm spat which have been difficult to successfully transition to the marine grow-out sites at such a small size. Industry and the hatcheries have been meeting this challenge by working towards on-growing the small spat to a larger size (4-6 mm) to facilitate successful production to market-size Oysters.

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Glossary

AMR	Antimicrobial Resistance Strategy
APVMA	Australian Pesticides and Veterinary Medicines Authority
ASBTIA	Australian Southern Bluefin Tuna Industry Association
ATAB	Aquaculture Tenure Allocation Board
AVG	Abalone Viral Ganglioneuritis
BST	Baker-Schultz-Turner
CCSBT	Commission for the Conservation of Southern Bluefin Tuna
DEW	Department for Environment and Water
EMP	Environmental Monitoring Program
EPA	Environment Protection Authority
EPPs	Environment Protection Policies
ESD	Ecologically Sustainable Development
FAO	Food and Agriculture Organisation
FCR	Food Conversion Ratio
FRDC	Fisheries Research and Development Corporation
FTE	Full Time Equivalent
GSSI	Global Sustainable Seafood Initiative
HABs	Harmful Algal Blooms
OsHV-1	Oyster Herpesvirus-1 microvariant
OIE	World Organisation for Animal Health
PIRSA	Primary Industries and Regions South Australia
POMS	Pacific Oyster Mortality Syndrome
SA	South Australia
SAOGA	South Australian Oyster Growers Association
SARDI	South Australian Research and Development Institute Aquatic Sciences
SASQAP	South Australia Shellfish Quality Assurance Program
SBT	Southern Bluefin Tuna
TEPS	Threatened, Endangered and Protected Species
YTK	Yellowtail Kingfish

Appendix 1 Aquaculture licences held in South Australia in 2019-20 by sector

Tuna Sector								
Reporting year	**Number of licences**	**Application licence numbers**						
2019-20	11	AQ00030 AQ00047	AQ00053 AQ00057	AQ00058 AQ00060	AQ00169 AQ00170	AQ00398 FB00078	FB00079	

Finfish Sector								
Reporting year	**Number of licences**	**Application licence numbers**						
2019-20	18	AQ00015 AQ00016 AQ00017	AQ00018 AQ00139 AQ00140	AQ00214 AQ00234 AQ00235	AQ00255 AQ00292 AQ00302	AQ00396 AQ00367 FF00037	FF00085 FF00090 FH00003	

Marine Abalone Sector								
Reporting year	**Number of licences**	**Application licence numbers**						
2019-20	2	AQ00290	AQ00327					

Mussel Sector								
Reporting year	**Number of licences**	**Application licence numbers**						
2019-20	34	AQ00041 AQ00067 AQ00101 AQ00108 AQ00141	AQ00109 AQ00190 AQ00192 AQ00193 AQ00209	AQ00215 AQ00392 FS00011 FS00012 FS00013	FS00014 FS00015 FS00016 FS00019 FS00020	FS00021 FS00022 FS00023 FS00029 FS00038	FS00042 FS00071 FS00072 FS00073 FS00082	FS00084 FS00095 FS00097 FS00102

Landbased sector (includes Landbased, Abalone, Finfish and Oyster hatcheries)								
Reporting year	**Number of licences**	**Application licence numbers**						
2019-20	Category A	27	AQ00132 AQ00211 AQ00248 AQ00260 AQ00305	FT00014 FT00133 FT00166 FT00184 FT00234	FT00253 FT00314 FT00323 FT00372 FT00432	FT00485 FT00487 FT00493 FT00502 FT00505	FT00523 FT00543 FT00545 FT00601 FT00685	FT00701 FT00738
2019-20	Category B	25	AQ00246 AQ00270 AQ00280 AQ00281 AQ00361	AQ00364 AQ00429 FT00007 FT00013 FT00069	FT00123 FT00185 FT00365 FT00402 FT00459	FT00464 FT00478 FT00604 FT00607 FT00611	FT00633 FT00687 FT00730 FT00735 FT00745	
2019-20	Category C	13	AQ00131 AQ00353 AQ00365 AQ00409	FT00036 FT00040 FT00043	FT00287 FT00135 FT00158	FT00736 FT00385 FT00676		
2019-20	Category D	6	FT00423	FT00560	FT00558	FT00620	FT00634	FT00702

Tourism Sector								
Reporting year	**Number of licences**	**Application licence numbers**						
2019-20	1	AQ00315						

Oyster sector								
Reporting Year	**Number of licences**	**Application licence numbers**						
2019-20	351	AQ00001 AQ00002 AQ00005 AQ00009 AQ00012 AQ00034 AQ00035 AQ00036 AQ00039 AQ00042 AQ00043 AQ00065 AQ00068 AQ00071 AQ00094	AQ00180 AQ00183 AQ00186 AQ00188 AQ00197 AQ00198 AQ00199 AQ00220 AQ00221 AQ00222 AQ00223 AQ00227 AQ00228 AQ00243 AQ00244	AQ00393 AQ00399 AQ00400 AQ00401 AQ00402 AQ00403 AQ00405 AQ00410 AQ00411 AQ00412 AQ00413 AQ00416 AQ00417 AQ00418 AQ00419	FM00035 FM00036 FM00038 FM00039 FM00040 FM00044 FM00046 FM00047 FM00059 FM00060 FM00061 FM00062 FM00064 FM00065 FM00068	FM00194 FM00212 FM00217 FM00221 FM00307 FM00309 FM00313 FM00315 FM00316 FM00324 FM00325 FM00326 FM00328 FM00329 FM00330	FM00405 FM00406 FM00407 FM00408 FM00410 FM00416 FM00417 FM00420 FM00422 FM00423 FM00424 FM00425 FM00426 FM00427 FM00428	FM00495 FM00496 FM00497 FM00498 FM00500 FM00504 FM00510 FM00514 FM00515 FM00517 FM00518 FM00519 FM00520 FM00524 FM00525

Oyster sector								
		AQ00099	AQ00256	AQ00420	FM00069	FM00331	FM00432	FM00531
		AQ00100	AQ00257	AQ00421	FM00072	FM00332	FM00434	FM00538
		AQ00102	AQ00263	AQ00422	FM00075	FM00335	FM00436	FM00539
		AQ00103	AQ00277	AQ00423	FM00076	FM00336	FM00437	FM00542
		AQ00104	AQ00278	AQ00424	FM00082	FM00346	FM00439	FM00546
		AQ00105	AQ00282	AQ00425	FM00088	FM00347	FM00440	FM00547
		AQ00106	AQ00284	AQ00426	FM00094	FM00348	FM00441	FM00550
		AQ00107	AQ00295	AQ00427	FM00095	FM00349	FM00443	FM00552
		AQ00110	AQ00297	AQ00428	FM00099	FM00351	FM00451	FM00553
		AQ00127	AQ00312	AQ00430	FM00101	FM00352	FM00452	FM00554
		AQ00133	AQ00313	AQ00431	FM00117	FM00353	FM00453	FM00555
		AQ00137	AQ00317	AQ00432	FM00139	FM00354	FM00454	FM00556
		AQ00138	AQ00322	AQ00433	FM00140	FM00355	FM00455	FS00079
		AQ00145	AQ00323	AQ00435	FM00144	FM00358	FM00456	FS00080
		AQ00146	AQ00324	AQ00436	FM00145	FM00359	FM00457	FS00085
		AQ00148	AQ00329	AQ00437	FM00146	FM00366	FM00458	
		AQ00149	AQ00335	AQ00438	FM00149	FM00373	FM00459	
		AQ00150	AQ00350	AQ00439	FM00151	FM00374	FM00460	
		AQ00152	AQ00351	AQ00440	FM00153	FM00375	FM00461	
		AQ00153	AQ00366	AQ00441	FM00154	FM00376	FM00462	
		AQ00156	AQ00367	AQ00442	FM00155	FM00377	FM00463	
		AQ00157	AQ00368	AQ00443	FM00156	FM00379	FM00464	
		AQ00158	AQ00369	AQ00444	FM00160	FM00380	FM00465	
		AQ00159	AQ00378	AQ00445	FM00161	FM00382	FM00466	
		AQ00160	AQ00379	AQ00446	FM00162	FM00384	FM00467	
		AQ00161	AQ00380	AQ00447	FM00163	FM00385	FM00468	
		AQ00162	AQ00381	AQ00448	FM00165	FM00387	FM00471	
		AQ00163	AQ00381	AQ00449	FM00166	FM00389	FM00474	
		AQ00164	AQ00383	AQ00450	FM00167	FM00391	FM00476	
		AQ00167	AQ00386	AQ00451	FM00170	FM00392	FM00477	
		AQ00168	AQ00387	AQ00452	FM00171	FM00393	FM00478	
		AQ00172	AQ00388	AQ00454	FM00173	FM00400	FM00479	
		AQ00175	AQ00389	AQ00455	FM00175	FM00401	FM00480	
		AQ00176	AQ00390	FH00002	FM00177	FM00402	FM00482	
		AQ00177	AQ00391	FM00015	FM00178	FM00403	FM00484	
		AQ00178	AQ00392	FM00017	FM00181	FM00404	FM00485	

Appendix 2 Aquaculture zone policies in South Australia

Policy	Zone	Sector	Total area (ha)	Leasable (ha)	Species
Aquaculture (Zones – Cape D'Estrees) Policy 2006	Cape D'Estrees (inner) subtidal aquaculture zone	NA	145	60	Molluscs (other than filter feeding molluscs) & algae
	Cape D'Estrees (middle) subtidal aquaculture zone	NA	198	60	Molluscs (other than filter feeding molluscs) & algae
	Cape D'Estrees (outer) subtidal aquaculture zone	NA	392	60	Molluscs (other than filter feeding molluscs) & algae
	Laura Bay aquaculture exclusion zone	NA	534	Nil	NA
Aquaculture (Zones – Smoky Bay) Policy 2007	Eyre Island intertidal aquaculture zone	NA	81	21	Bivalve Molluscs (other than mussels) & research
	Missiessey intertidal aquaculture zone	NA	108	24	Bivalve Molluscs (other than mussels) & research
	Saddle Peak intertidal aquaculture zone	NA	62	21	Bivalve Molluscs (other than mussels) & research
	Smoky Bay aquaculture emergency zone	NA	171	Not defined	Bivalve Molluscs (other than mussels)
	Smoky Bay (holding) intertidal aquaculture zone	NA	4	0.35	Holding Bivalve Molluscs (other than mussels)
	Smoky Bay intertidal aquaculture zone	NA	73	20.9	Bivalve Molluscs (other than mussels) & research
	Smoky Bay north subtidal aquaculture zone	NA	2 166	40	Bivalve Molluscs (other than mussels)
	Smoky Bay south subtidal aquaculture zone	NA	1 621	40	Bivalve Molluscs (other than mussels)
	Vinya intertidal aquaculture zone	NA	180	61	Bivalve Molluscs (other than mussels) & research
	Eyre Island aquaculture exclusion zone	NA	9 784	Nil	NA
Aquaculture (Zones – Streaky Bay) Policy 2011	Blanche Port aquaculture zone	NA	2 799	77.5	Bivalve molluscs (other than mussels)
	Haslam (north bank) aquaculture zone	NA	342	50	Bivalve molluscs (other than mussels)
	Perlubie (south bank) aquaculture zone	NA	224	40	Bivalve molluscs (other than mussels)
	Point Gibson aquaculture zone	NA	265	70	Bivalve molluscs (other than mussels)
	Streaky Bay aquaculture zone	NA	45 334	40	Molluscs (other than mussels)
	Streaky Bay aquaculture exclusion zone	NA	3 748	Nil	NA
Aquaculture (Zones – Anxious Bay) Policy 2007	Anxious Bay aquaculture zone	NA	452	120	Molluscs (other than mussels or oysters) & algae
	Anxious Bay aquaculture exclusion zone	NA	8 634	Nil	NA

Policy	Zone	Sector	Total area (ha)	Leasable (ha)	Species
Aquaculture (Zones – Coffin Bay) Policy 2008	Frenchman Bluff aquaculture zone	NA	388	90	Supplementary fed organisms (other than finfish) that involves regular feeding, algae & research
	Kellidie Bay aquaculture zone	NA	732	23	Bivalve molluscs (other than mussels), storage & research
	Mount Dutton Bay aquaculture zone	NA	601	32	Bivalve molluscs (other than mussels) & research
	Point Longnose aquaculture zone	NA	379	63	Bivalve molluscs (other than mussels), algae & research
	Port Douglas (central) aquaculture zone	NA	446	50	Bivalve molluscs (other than mussels) & research
	Port Douglas (east) aquaculture zone	NA	34	4	Bivalve molluscs (other than mussels) & research
	Port Douglas (west) aquaculture zone	NA	90	10	Bivalve molluscs (other than mussels) & research
	Coffin Bay aquaculture exclusion zone	NA	15 686	Nil	NA
Aquaculture (Zones - Lower Eyre Peninsula) Policy 2013	Boston Bay aquaculture zone	Bicker Isles sector	243	368	Supplementary fed species (i.e. wild-caught tuna, finfish, abalone etc.), bivalve molluscs & algae
		Boston Island (east) sector	855		
		Boston Bay sector	2 702		
	Lincoln aquaculture zone	Lincoln (inner) sector	18 447	1825	Prescribed wild-caught tuna & algae
		Lincoln (outer) sector	35 024	5000	
	Louth Bay aquaculture zone	NA	9 443	270	Supplementary fed organisms (other than wild-caught tuna), bivalve molluscs & algae
	Murray Point aquaculture zone	NA	72	2	Bivalve molluscs (other than mussels)
	Proper Bay aquaculture zone	NA	2 356	60	Bivalve molluscs & algae
	Tod River aquaculture zone	NA	747	38	Bivalve molluscs (other than mussels)
	Lincoln aquaculture exclusion zone	NA	27 383	Nil	NA
	Sir Joseph Banks aquaculture exclusion zone	NA	96 723	Nil	NA
	Buffalo Reef aquaculture exclusion zone	NA	1 255	Nil	NA
Aquaculture (Zones - Tumby Bay) Policy 2015	Tumby Bay aquaculture zone	NA	10 324	1300	Supplementary fed organisms (other than wild-caught tuna), bivalve molluscs (i.e. mussels), & algae
	Tumby Bay aquaculture exclusion zone	NA	13 765	Nil	NA

Policy	Zone	Sector	Total area (ha)	Leasable (ha)	Species
Aquaculture (Zones - Port Neill) Policy 2008	Port Neill aquaculture zone	NA	4 913	565	Prescribed wild-caught tuna broodstock, supplementary fed organisms (other than wild-caught tuna), bivalve molluscs & algae
	Port Neill aquaculture exclusion zone	NA	7 227	Nil	NA
Aquaculture (Zones - Arno Bay) Policy 2011	Arno Bay aquaculture zone	Arno Bay (outer) sector	2 209	80	Prescribed wild-caught tuna broodstock & supplementary fed organisms (other than wild-caught tuna)
		Arno Bay (inner) sector	3 494	200	
Aquaculture (Zones – Fitzgerald Bay) Policy 2008	Fitzgerald Bay aquaculture zone	Eastern Fitzgerald sector	2 849	550	Supplementary fed organisms (other than wild-caught tuna), bivalve molluscs & algae
		Western Fitzgerald sector	1 705		
	Fitzgerald Bay (north) aquaculture zone	NA	10	10	Bivalve molluscs & algae
	Fitzgerald Bay aquaculture exclusion zone	NA	2 148	Nil	NA
Aquaculture (Zones – Eastern Spencer Gulf) Amendment Policy 2017	Hardwicke Bay (inner) subtidal aquaculture zone	NA	420	60	Molluscs & algae
	Hardwicke Bay (middle) subtidal aquaculture zone	NA	1 053	60	Molluscs & algae
	Hardwicke Bay (outer) subtidal aquaculture zone	NA	1 402	60	Molluscs & algae
	Port Broughton intertidal aquaculture zone	NA	356	65	Bivalve molluscs & algae
	Tickera intertidal aquaculture zone	NA	512	45	Bivalve molluscs & algae
	Tickera subtidal aquaculture zone	NA	2 398	60	Bivalve molluscs & algae
	Wallaroo (East) aquaculture zone	NA	1 394	350	Supplementary fed organisms (other than tuna) that involves regular feeding, algae, filter feeding bivalve molluscs & algae
	Wallaroo (West) aquaculture zone	NA	500	50	Bivalve molluscs & algae
	Point Pearce (East) intertidal aquaculture zone	NA	135	20	Bivalve molluscs & algae
	Point Pearce (West) intertidal aquaculture zone	NA	365	40	Supplementary fed organisms (other than finfish & abalone) that involves regular feeding, filter feeding bivalve molluscs & algae
	Point Riley aquaculture exclusion zone	NA	9 639	Nil	NA

Policy	Zone	Sector	Total area (ha)	Leasable (ha)	Species
	Port Broughton aquaculture exclusion zone	NA	4 384	Nil	NA
	Port Hughes aquaculture exclusion zone	NA	3 407	Nil	NA
	Wallaroo aquaculture exclusion zone	NA	10 889	Nil	NA
Aquaculture (Zones – Lacepede Bay) Policy 2012	Cape Jaffa aquaculture zone	NA	1 316	40	Supplementary fed organisms (other than wild-caught tuna & abalone)
	Kingston aquaculture zone	Kingston (holding) sector	416	5	Supplementary fed organisms (other than wild-caught tuna & abalone)
		Kingston (inner) sector	25 560	80	Supplementary fed organisms (other than wild-caught tuna & abalone)
		Kingston (outer) sector	14 899	200	Supplementary fed organisms (other than wild-caught tuna & abalone)
	Kingston aquaculture exclusion zone	NA	4 712	Nil	NA