BRUNY SUSTAINABLE AQUACULTURE
OUR SEA · EVERYONES FUTURE

Thursday 28th November 2019

Ms Meg Webb
Inquiry Chair
Finfish Farming Inquiry
Legislative Council Government Administration Committee 'A'
C/O
Mr Stuart Wright Inquiry Secretary
Parliament House, HOBART 7000

Via Email: Finfish@parliament.tas.gov.au

Dear Ms Webb

Re: Legislative Council Inquiry into Finfish Farming (the Inquiry)

Please accept this submission to the Tasmanian Legislative Council's inquiry into Finfish Farming on behalf of Bruny Sustainable Aquaculture (BSA). BSA is a representative body comprising all three registered community organisations on Bruny.

The 3 groups are:

- Bruny Island Community Association Inc. (BICA)
- Friends of North Bruny Inc. (FONB)
- Bruny Island Environment Network (BIEN)

If the opportunity arises, the three BSA community group representatives would be happy to appear before the committee and respond to any questions relating to the submission.

(Further details Appendix A.)

BRUNY SUSTAINABLE AQUACULTURE

Introduction

In his press release of 8.10.19 announcing the release of the D'Entrecasteaux Channel and Huon River Marine Farming Development Plan 2019, the Minister stated:

"The plan supports our vision for the industry to be the most environmentally sustainable salmon industry in the world, helping to deliver even more benefits to Tasmania."[1]

Bruny Sustainable Aquaculture wholeheartedly supports this vision, but there are certainly significant existing problems and there is clearly a need for a review and changes before embarking on the rapid expansion envisaged in the State Government's Sustainable Growth Plan. The intent of this submission is to assist in bringing the vision to reality.

Accordingly, our submission is in two sections:

- Part One outlines existing or recent problems which need to be addressed, and which need to inform future planning and decisions.

- Part Two addresses the structure and attributes of the industry which will fulfill the vision articulated by the Minister, and the changes needed to achieve this.

Part One - Existing industry problem areas

1. Limited economic contribution from the existing industry model.

Bruny Island experiences all the environmental and social impacts resulting from the Salmon Industry, yet it does not receive the corresponding economic returns. The industry employs few residents of Bruny Island and there is limited direct spend by the industry within the businesses of Bruny Island.

[1] http://www.premier.tas.gov.au/releases/sustainable_growth_for_salmon_industry

More importantly, the Australia Institute in their *Making Mountains from Minnows Salmon in the Tasmanian Economy* found that the contribution to Tasmania as a whole was not much better:

The economic benefit of the salmon industry to Tasmania is weighted strongly against its environmental and social impacts. Yet it accounts for just 1%of jobs in the state. Over 5 years $3.8 billion worth of fish were sold, but just $64 million tax paid, while $9.3 million in subsidies were received in 2 years. Changing generous leasing arrangements to the Norwegian model could raise $2 billion for community development[2]

A full copy of this report is attached as Appendix B to this submission.

The Australian Institute Report also found:

"While there has been growth in the salmon industry's output since 2014, the trend towards automation in the industry is likely to have kept jobs numbers down. Tassal is investing in automated feeders and camera-based monitoring and has a "completely integrated automation solution" for its new smolt tanks. Huon feeds its fish "from a central feeding room in Hobart", with software adjusting feeding rates automatically based on on-site video feeds, and it is moving to "fully automated and unmanned feed barges".

Since job levels are decreasing with the ongoing development of the finfish industry, if Tasmanian's are to benefit, it is imperative to review existing arrangements so as to ensure that the State economy and affected communities receive adequate financial returns.

The waters in which the fish are farmed are a shared public resource. Internationally there is very little water available in which to farm fin fish, making these waters extremely valuable. Under the current arrangements the small rent received is nowhere near commensurate with the value and does not create proportionate economic benefits to Tasmania.

In addition to the question of the salmon industry's limited (and often over-stated) positive contribution to Tasmania's economy, it is important to be cognizant of the *negative* economic impact which is now emerging.

Failure to manage industry development and operations to world best environmental practice and community standards risks major economic loss through impacts to its markets, as was seen to such a devastating degree in our forestry industry debacle. Consumer awareness of environmental issues and

[2] https://www.tai.org.au/sites/default/files/P73320Mountains20out20of20minnows205BWeb5D.pdf

desire for safe, unadulterated natural foods is increasingly driving choices and behaviour. This is well known to play a large role in the growth of tourism and export of Tasmanian foodstuffs.

However, the salmon industry is already having a negative impact on Tasmania's reputation and brand image. The Australian Marine Conservation Society has recently created *Australia's Sustainable Seafood Guide* as Australia's "independent guide to sustainability of seafood found in Australian fishmongers, supermarkets, fish and chip shops and restaurants".

https://goodfish.org.au/species/atlantic-salmon/

The website has a downloadable App designed to help people make informed seafood choices and play a part in swelling the tide for sustainable seafood in Australia.

Farmed Tasmanian Atlantic salmon is currently rated "Say No".

However, perhaps even more disturbingly the guide goes on to draw attention to their preferred alternative to Tasmanian salmon, as follows:

"King salmon farmed and imported from New Zealand is rated green, Better Choice in the Guide."

(Australian Sustainable Fish Website page printout (Appendix C)

2. Lack of a science-based approach to aquaculture management and consequent environmental issues.

Finfish farming is an intensive industry which requires the addition of significant nutrients and energy inputs resulting in substantial and often unintended environmental impacts. This has been only too visible in Macquarie Harbour and the D'Entrecasteaux Channel. Environmental impacts include:

- Nutrient loading and increase in algal growth and slimes;
- Build-up of organic material and algal mats in areas surrounding fish farms;
- Changes to sediment chemistry and the benthos;
- Dead zones underneath and surrounding pens;
- Escape of an introduced carnivorous species;
- Marine farming debris, nets, ropes and plastic pipes; and
- Loss of native fish.

- Loss of farmed fish, increased costs and reduced production from aquaculture;
- The frequent requirement for large volumes of fresh water to treat Amoebic Gill Disease is in conflict with the needs of community and agriculture;
- Negative impact on the increasingly-valuable Clean and Green image – both Tasmania's and that of the salmon it produces and attempts to sell at premium prices.

It is important to emphasise that the environmental problems impact significantly on the industry itself, undermining itsprofitability and ability to compete, and ultimately itslong-term sustainability.

A fundamental cause of these problems is that the current plan is not based on solid scientific assessment of the suitability and capacity of Storm Bay; of the impact on the environment and communities; and of the appropriate regulatory and operational regimes required to successfully manage such a complex undertaking in a shared public space.

It is unacceptable to continue with the ambitious growth plans for expansion into Storm Bay, given that the scientific basis is limited to three separate, but siloed, lease EIS analyses, plus the limited data from the 5 year, 5 site survey of Storm Bay reported in the 2017 FRDC study. The fact that it is intended to respond to this lack of a thorough scientific basis by using a so-called Adaptative Management approach is a tacit admittance of inadequate information. It does nothing to allay concerns, given that this was the management system operating at the time of the Macquarie Harbour debacle.

It should be noted that the CSIRO has commenced a detailed study "*Storm Bay biogeochemical modelling and information system: supporting sustainable aquaculture in Tasmania FRDC 2017-215 Technical Milestone Report March 2019*", however this will take 2 years to complete.

Critically, there has been no analysis of the environmental effects of the combined and cumulative nutrient loads in Storm Bay, and the CSIRO study will not address this aspect. These nutrient loads are derived from:

- the natural environment, seasonally,
- the Total Permissible Dissolved Nitrogen Output (TPDNO) authorised by the EPA for each of the Bay's leases

- the Sewage Treatment Plants of the nine municipalities that drain their effluents into the Derwent R. and Storm Bay
- the existing flow through Finfish Hatcheries and the proposed Meadowbank Dam RAS hatchery for Tassal
- The residual dissolved Nitrogen from the 2100Tonnes TPDNO authorised by the EPA in the D'Entrecasteaux/Huon/Esperance MFDP's which exhaust to Storm Bay with the daily tides of the Channel

The industry's plan to rapidly expand marine farming within Storm Bay by up to 80,000 tonnes per annum based on the discredited "in-shore" model defies logic – both commercial and environmental.

In this context there is clearly an urgent need for a review before embarking on the rapid expansion envisaged in the State Government's Sustainable Industry Growth Plan

The recent report *State of Storm Bay, Tasmania: An Overview of current Information and Values* C.A. Coughanowr for Environment Tasmania 5.8.19 is an invaluable source of current objective scientific information on this subject and we respectfully draw it to the Committee's attention. See Appendix D

3. Regulation and Management

It is clear that current regulation and management of the industry is failing, as evidenced by the environmental impacts resulting from finfish farming in Macquarie Harbour and the D'Entrecasteaux Channel.

The EPA must enforce its own regulations and take strong and timely action against companies which fail to comply with regulations, specified management regimes or relevant standards.

There is a lack of transparency across the Marine Farming Development Plans as they have been principally driven by and written by the industry without appropriate oversight and direction being taken by the EPA to set nutrient loading limits, areas available for farms and the future direction for the industry overall.

The EPA is under-resourced to provide the essential close oversight and monitoring by an independent authority. Only when the EPA is adequately resourced will management and regulation of the industry be accountable and transparent.

The funding required to adequately resource the EPA and the MFPRP will be readily available if the licence fee regime is changed such that fees paid are commensurate to the real commercial value of the resource to the applicant.

4. Proximity of Bruny Island and its economy to planned aquaculture expansion.

Bruny Island is at the epicentre of proposed future growth for the finfish farming industry. It is surrounded by Marine Farming Development Areas, as shown in figures 1, 2 and 3 which are taken from the:

- Trumpeter Bay North Bruny Island Marine Farming Development Plan;
- Storm Bay North Marine Farming Development Plan; and
- D'Entrecasteaux Channel and Huon River Marine Farming Development Plan.

Furthermore, no waters surrounding Bruny Island are off limits to Marine Farming as the Marine Farming Development Plans can be amended and expanded to incorporate any new areas at the discretion of the regulatory authority (the EPA).

Moreover, the Minister for Primary Industries Water and Environment, Guy Barnett, announced on 9 November 2019 [3] his intention to consolidate all the Channel plans into a single plan

If this approach were to be applied to Storm Bay and its 3 Marine Farming Development Plans were to be incorporated into one plan, then Bruny Island could be entirely surrounded by Development Plans and potentially fish farms. There are substantial areas of the Bruny Island Coastline where it would be entirely inappropriate to locate fish farming. Areas such as Adventure Bay, Cape Queen Elizabeth, South Bruny National Park, Fluted Cape, Bay of Islands and Great Bay must be prohibited from finfish farming.

It is important to emphasise that these and other areas are integral to Bruny's role as one of the drawcards for the State's increasingly successful tourism and food industry. Bruny's importance to this sector has been commented on by the chairman of the Tasmanian Tourism Industry Council, Mr Luke Martin, and in fact Bruny is one of the priority Tasmanian destinations featured in the current international advertising campaign. Moreover, the contribution of this sector to Bruny's economy and employment is far far greater than the relatively insignificant contribution from aquaculture.

[3] http://www.premier.tas.gov.au/releases/sustainable_growth_for_salmon_industry

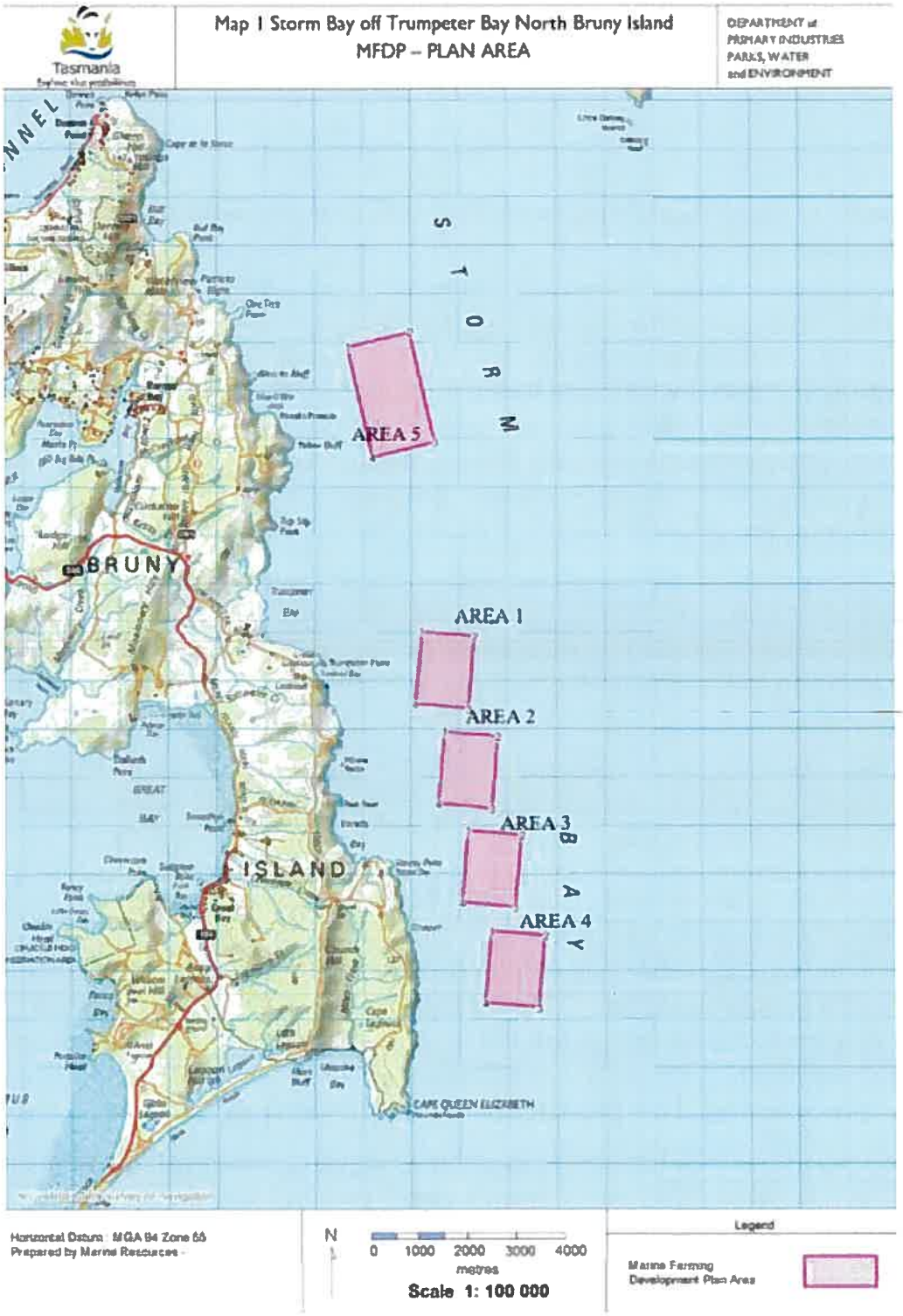


Figure 1: Trumpeter Bay off North Bruny Island Marine Farming Development Plan

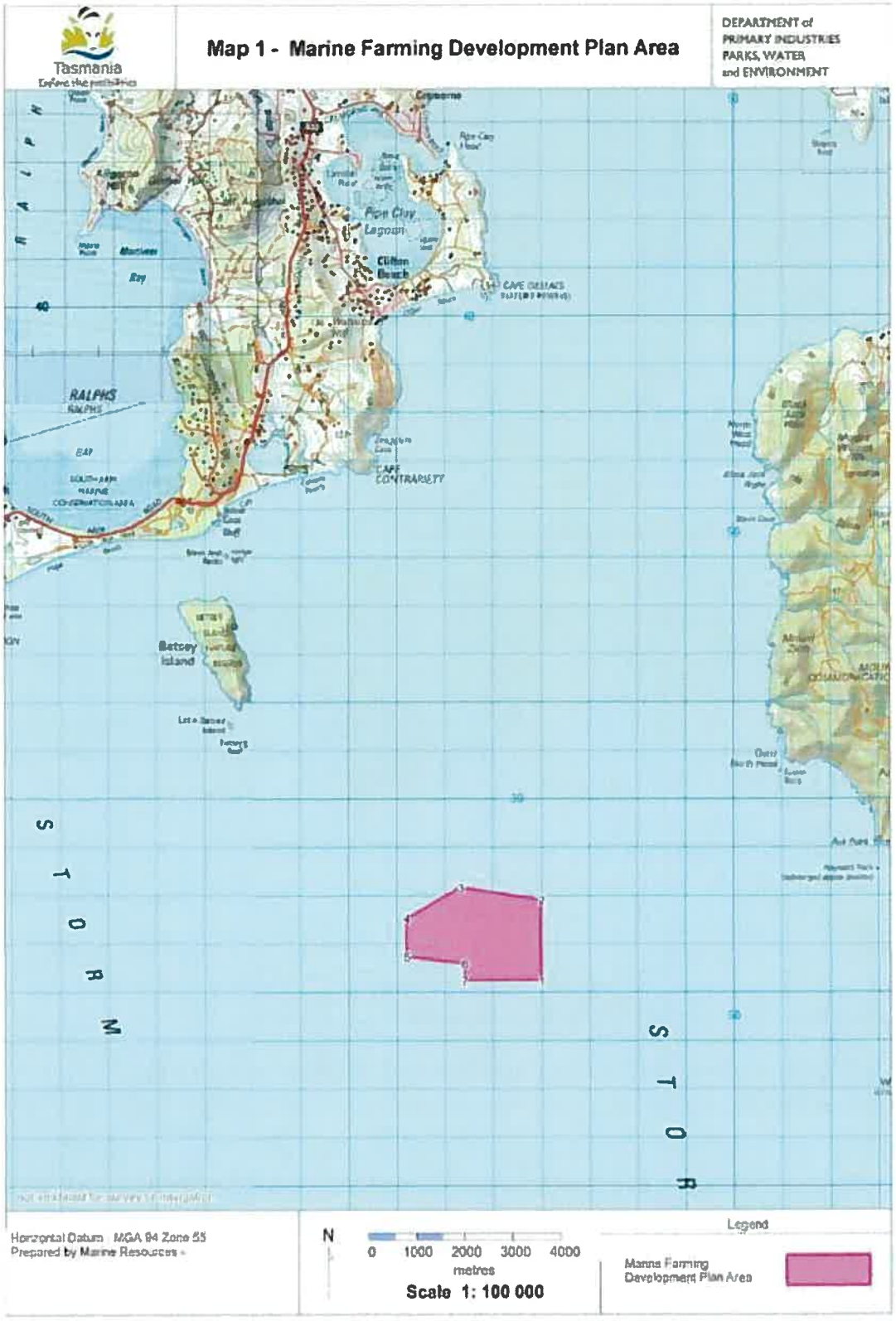


Figure 2: North Bruny Marine Farming Development Plan

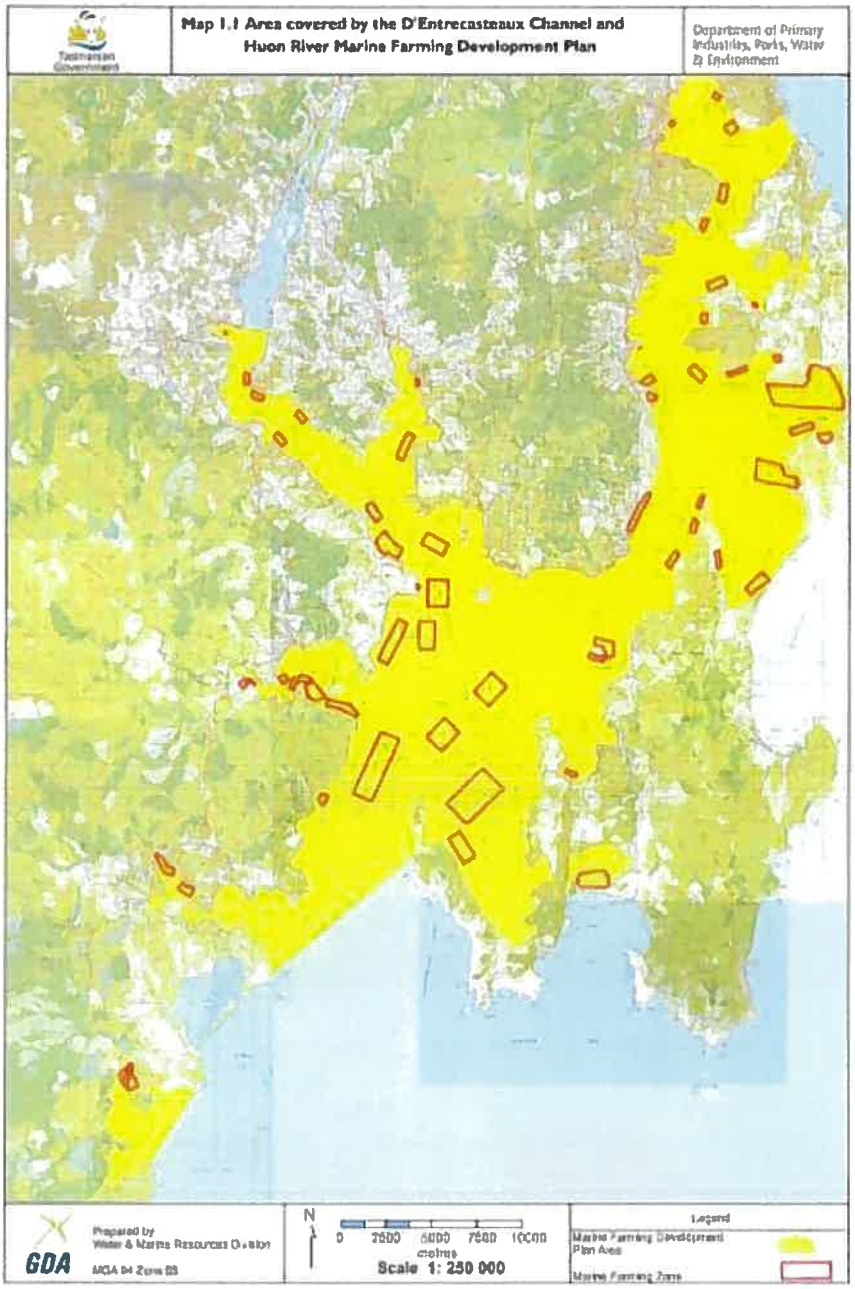


Figure 3: D'Entrecasteaux Channel and Huon River Marine Farming Development Plan

There being no defined geographical boundaries, Zones can be expanded or relocated anywhere within the broad undefined area covering all of Storm Bay and North Bruny, if they comply with relevant provisions of the *Marine Farming Planning Act 1995*. This provides no surety for other water users or surrounding landowners and presents as inappropriate land/water use planning.

If not addressed this will lead to future land/water use conflicts, particularly relating to Bruny, where the potential impact on the growing tourist industry and the community is so significant.

5. Production model: near-shore vs. off-shore and/or on-land

In the context of the preceding section regarding the proximity of Bruny to existing and potential Marine Farming Areas, the unsuitability of the discredited "near-shore" aquaculture model takes on even greater significance.

The marine farms off North Bruny are located less than 1 nautical mile from the coast - this is not offshore, but "near-shore". Offshore means at least 3 or 5 nautical miles offshore. This would lead to improved nutrient dispersion, reduction in visual impacts and a lack of land use conflicts between finfishfarming and other land users and recreational boaters and sailors.

Another option in operation in other countries is on-land salmon aquaculture.

Either way, the "near-shore" production model currently in use has shown itself to be unsustainable due to its impact on the environment and communities as well as the production risks it creates. The problems are manifest even at current production levels – it would be foolish to assert that it is an appropriate model for the rapid expansion of the industry.

6. Community Consultation

Bruny Island and Storm Bay are at the epicentre of Salmon Farming Expansion and yet the Bruny Island Community, businesses and organisations have been given little if any real meaningful opportunities for input into the development and proposed expansion of the Salmon Industry surrounding the island. BSA and the Bruny Island Environment Network, Friends of North Bruny and the Bruny Island Community Association do not consider that they have been consulted nor do they support the current Marine Farming Development Plans and the processes for their development. Numerous businesses, industries and communities are directly impacted by finfish farming from the following issues:

- Impacts upon shore-based businesses;
- Visual impacts from multiple salmon pens close to shore;
- Noise pollution from salmon boats;

- Light pollution from salmon pens and boats;
- Marine debris, discarded ropes and lost marine farming infrastructure/pens;
- Environmental impacts from increased nutrient loads and slimes in enclosed bays;
- Loss of recreational fishing areas and ability to catch fish; and
- Increased seal and shark populations;
- Seasonal algal bloom biofouling of agricultural freshwater dams on Bruny caused by daily bathing by sea birds visiting from nearby pens, e.g. weetapoona/Murrayfield.

The majority of these issues are not considered within the Marine Farming Plans nor do they seem to have been given any consideration in the State Government's Sustainable Industry Plan.

If the industry is to be sustainable then it must be supported by the community, and this cannot occur unless the community feels that it has been genuinely engaged with and consulted.

If the Marine Farming Development Plans and the industry is as sustainable as stated in the State Government's recent announcement on 9 November 2019 *(Sustainable growth for salmon industry)*[4] then it should positively encourage public involvement rather than the secrecy which has surrounded the expansion of the industry to date

Part Two - Achieving the Vision: An environmentally sustainable and economically productive salmon industry

Background:

(a) Environmental and community issues:

Given that the Government's aim, which we endorse, is for the salmon industry to become the most environmentally sustainable in the world, it makes sense to consider what steps other major world salmon-producing countries have taken to address issues relating to the environment and to the impact of the industry on the community.

The fact that all major salmon producing countries have been investing substantial effort and financial resources into changing production

[4] https://www.tas.liberal.org.au/news/sustainable-growth-salmon-industry

systems so as to reduce the impact of the industry shows clearly that existing near-shore model of aquaculture is not considered sustainable or acceptable to the communities on which it impacts. This also means that if we are to be a world-leader, then we must learn from and improve on these developments.

The most significant new development is land-based salmon aquaculture, which is now operating on a significant commercial scale in several major producing countries including Canada, Norway, Scotland and USA.

The other system which is being trialled is true "off-shore" (i.e. greater than 6 km) salmon aquaculture, however the potential success of this model in terms of reducing impact on the environment, community and other mariners will vary depending on specific location.

(b) Economic and community issues

The appended Australia Institute analysis of the industry[5] is essential reading when it comes to understanding the relatively limited contribution of the industry to communities and to the finances of the state. Although this may appear similar to many industries however the critical difference is that the salmon industry is based on the industrial-scale use of a public resource, does so in direct competition with other community and commercial users and impacts heavily and deleteriously on the environment of this shared public resource.

However, as mentioned earlier, under the current industry structure in Tasmania the only benefit accruing to communities is in employment, and this is relatively low, around 1% direct employment, and is likely to fall, due to automation, despite increasing production.

This contrasts sharply with the Norwegian model, where licences are put up for tender, with funds raised shared between the municipality and the government. As the Australia Institute summarizes the Tasmanian situation:

Over 5 years $3.8 billion worth of fish were sold, but just $64 million tax paid, while $9.3 million in subsidies were received in 2 years. Changing generous leasing arrangements to the Norwegian model could raise $2 billion for community development.

[5] https://www.tai.org.au/sites/default/files/P73320Mountains20out20of20minnows205BWeb5D.pdf

Such an approach, where the industry pays licence fees which are commensurate with the economic utility of the licence, would transform the impact of the industry on the community and the economy. Furthermore, the re-investment of these funds by both community and government would in turn produce more employment and economic growth – in other words an economic virtuous circle.

Required steps towards an environmentally sustainable and economically productive industry.

BSA believes that the following steps are essential in order to achieve the best outcome for the community, the industry and the Tasmanian economy:

1. **Economic review of the industry and the potential for revision of the licence regime to re-balance the economic benefit to Tasmania**

The review should include:

a. A full and thorough Cost/Benefit Analysis of the economic impact of the industry, including the returns to the Tasmanian and regional economies, under its current licence and regulatory structure.
b. The assessment of the potential effects of utilising alternative approaches to licencing and regulation of the industry, particularly the Norwegian model. This assessment should include Cost/Benefit Analyses which *inter alia* consider the potential economic multiplier effects and flow-on social benefits from changes to the amount of funds raised and the outcome from sharing of these funds between state government, local government and affected communities. These funds could be used to not only offset the impact of aquaculture on communities but also to boost other areas of commercial activity and economic development.

2. **Apply a science-based approach to the planning and regulatory supervision of the salmon industry**

BSA is of the opinion that a moratorium on any further expansion of the industry within Storm Bay must be applied pending:

a) The release of the findings of the CSIRO detailed study *"Storm Bay biogeochemical modelling and information system: supporting sustainable aquaculture in Tasmania FRDC 2017-215 Technical Milestone Report March 2019"*[6]

b) A comprehensive analysis being undertaken of the environmental effects of the combined and cumulative nutrient loads in Storm Bay derived from:

- the natural environment, seasonally,
- the Total Permissible Dissolved Nitrogen Output (TPDNO) authorized by the EPA for each of the Bay's leases
- the Sewage Treatment Plants of the nine municipalities that drain their effluents into the Derwent R. and Storm Bay
- the existing flow through Finfish Hatcheries and the proposed Meadowbank Dam RAS hatchery for Tassal.
- The residual dissolved Nitrogen from the 2100 Tonnes TPDNO authorised by the EPA in the D'Entrecasteaux/Huon/Esperance MFDP's and which exhaust to Storm Bay with the daily tides of the Channel.

c) A comprehensive Environmental Risk Assessment is undertaken which is informed by the CSIRO study and the analysis of cumulative nutrient loads mentioned above, and which addresses the economic, social and environmental risks of expanding the Industry.

3. Reduce problems arising from proximity of Bruny Island and its economy to planned aquaculture expansion.

BSA request that the Government:

[6] https://publications.csiro.au/publications/#publication/PIcsiro:EP194124

a. Utilise the findings of the Biogeochemical Study currently underway as a basis for revising the published Salmon Growth Plan to include new areas that prohibit Finfish Farming.
The areas of greatest concern to BSA and Bruny Islanders are Adventure Bay, Cape Queen Elizabeth, South Bruny National Park, Fluted Cape, Bay of Islands and Great Bay which must be prohibited from new finfish farming.
However, the Finfish Industry, has already laid claim to a research facility at Cape Connella, with three 50ha lots. It is this conflict zone in particular which requires urgent resolution and should not proceed, beyond research status.

b. Impose a limit on the number of pens and the subsequent biomass of fish which can be farmed within the Marine Farming Plan Area. This would reduce the potential for land use conflicts and minimise environmental and visual impacts.

4. **Production model: near-shore vs. off-shore and/or on-land**

BSA requests that the Government assesses international initiatives currently in progress in the Northern hemisphere that utilize new and innovative methods of finfish farming in HIGH ENERGY ENVIRONMENTS. These projects include the use of submersible pen constructions to mitigate and minimize wave intrusion and recently, the deployment of recycled ex oil carriers anchored offshore as secure fish pens.
Any such evolution to offshore will of course involve the use of Commonwealth waters.
The assessment must also include the on-land systems of salmon aquaculture currently operating in Scotland, Norway, Canada and USA

5. Regulation and Management

BSA requests that:

- the legislation/regulation of this industry be reviewed and amended so as to ensure that EPA and the MFPRP processes and decisions become largely transparent to the public.
- the Government give the MFPRP a broader representation of independent scientists and other users of our waterways.
- the MFPRP have an independent community representative.
- The funding provided to both EPA and MFPRP be increased sufficiently to ensure they are adequately resourced to carry out their respective roles in a comprehensive and timely manner.

6. Community Consultation

BSA requests that the Government:

a. Legislate the requirement that there be comprehensive community consultation during the preparation of Marine Farming Development Plans, community consultation sessions and including briefings at public venues and a mechanism for submissions to the MFPRP be considered before finalising draft Plans. For Bruny, BSA would be willing to assist with these sessions and would distribute invitations to its broad membership base.

b. Legislate for a Fisheries Industry Ombudsman. The benefits to the community of such a first port of call and major reference resource would be invaluable going forward.

As the industry continues to expand and comes into social, environmental and economic conflicts with elements of affected communities, the Office of the Fisheries Ombudsman could be a valuable resolution hub for the Government.

c. Request that IMAS establish a committee, including industry and community representation, to initiate and distribute

research which will provide both guidance for future planning and management of the aquaculture industry and assist the wider community in making informed decisions about the management of Tasmania's marine estate.
The intent would be that the research facilitates the best possible planning and decision making for both the prudent conservation and the sustainable economic development of food production, tourism and mineral and energy resources on, in and under Tasmania's coastal waters.

Bruny Island Community Association (BICA)

Per Margaret Wallace
M: 0458 086 076
E: maragretlwallace@bigpond.com

Friends of North Bruny Inc. (FONB)

Per Alex Matysek
M: 0407 099 634
E: alexmat@netspace.net.au

Bruny Island Environment Network (BIEN)

Per Paul Davis
M: 0412 221 147
E: pmdavis4@bigpond.com

APPENDIX A

Bruny Island Sustainable Aquaculture (BSA).

BSA is a representative body comprising all three registered community organisations on Bruny Island

- Bruny Island Community Association Inc.;
- Friends of North Bruny;
- Bruny Island Environment Network.

It is an action group tasked to undertake activities that will promote and ensure best environmental practice in finfishfarming in the waters surrounding Bruny Island.
(Information about BSA activities can be seen on its Facebook page - Facebook or website)
http://www.brunysustainableaquaculture.org

Friends of North Bruny Inc. (FONB)

With a membership of over eighty people, represents North Bruny Island – Deep Bay, Killora, Barnes Bay, Apollo Bay and Dennes Point and Great Bay. FONB's membership is open to all residents of North Bruny Island, as are its General Meetings. Its Committee is elected by the membership.
FONB facilitates cooperation between North Bruny's communities, Kingborough Council, State and Commonwealth Government departments and others, focusing on issues like:

- Safety, public access and amenities.
- Safeguarding our environmental and heritage values.
- Other issues impacting on the North Bruny Island community and lifestyle.

Specifically, we:

- Make representations to and on behalf of the above bodies in relation to technical assistance, specialist knowledge, sponsorship, materials or other assistance with projects.
- Promote and encourage a "Coastcare" ethic in the general community and to organise social activities for this purpose for the whole community.
- Obtain funding assistance through local fundraising, government programmes and sponsorship.

• Increase awareness about our coastal and landcare issues (including vegetation) through consultation with Coast Care, Landcare, Green Corps and similar groups.
• Ensure the whole community is aware of, and has input into, any developments or proposals put forward by Kingborough Council, Parks and Wildlife or other groups or organisations.
We work closely with the Bruny Island Community Association (BICA) and the Bruny Island Environment Network (BIEN) on matters of mutual interest.

Bruny Island Community Association Inc.(BICA)

Established in 1980, BICA's membership is open to all residents of Bruny Island, as are its General Meetings. Its Committee is elected by the membership.

The objects of the Association include:

(a) to maintain and develop the quality of life on Bruny Island.

(b) to preserve the important elements of the special character of Bruny Island; and to support any development of or alteration to the attributes and qualities of the island that contribute in a positive way to the enhancement of its character.

To pursue these aims, BICA's activities include:

(a) affiliation with community organisations or groups having similar or related objectives;

(b) make such representations to Federal, State and Local Government as May be appropriate. In this regard, Kingborough Council officially deals only with BICA in matters that affect Bruny Island.

(c) BICA produces and sells The Bruny News, a monthly newsletter, which is the primary source of fundraising for Bruny Island community projects and needs.

(d) The Association also supports and participates in community events; and organises special community consultations, as needed, to inform actions that enhance the quality of life of the Bruny Island community.

BICA collaborates with BIEN and FONB on issues and projects of mutual interest.

Bruny Island Environment Network (BIEN)

The Bruny Island Environment Network Inc. was established in January 2009 as a not for profit organisation run totally by volunteers. It is a network of individuals and groups with an interest in the conservation of the natural resources and biodiversity of Bruny Island. Current membership is 79.

The aims and purpose of the network are to:

1. Promote the biodiversity, cultural heritage and scenic values of Bruny Island and generate resources and support for their protection.
2. Support economic activity on Bruny that is ecologically sustainable, generates sustainable livelihoods on the island and enhances its values.
3. Provide information and support for landholders, the wider Bruny community and visitors about environmental and conservation issues.
4. Work with private and public landholders to improve environmental outcomes, particularly:
    - Vegetation management,
    - Improved environmental management practices,
    - Environmental education,
    - Management of reserved and protected areas, and
    - Coastal and marine conservation and management.

Current projects include:

1. Partnership with Kingborough Council, BICA, TLC and UTAS in developing and implementing the Bruny Island Cat Management By-Law and research and control of feral cat populations.
2. eCond - Development of a set of environmental accounts for Bruny in collaboration with UTAS, Tourism Tasmania, Bruny community, organisations and businesses.
3. Coordination and conducting of the biennial Bruny Island Bird Festival with the support of Birdlife Tasmania and Inala Nature Tours.
4. Community education, monitoring and protection of shorebird nesting sites - specifically Hooded plover and Pied oyster catcher.
5. Conducting a trial of electronic fencing to assess its efficacy in reducing wildlife roadkill.

https://www.bien.org.au/

The Australia Institute
Research that matters.

Making mountains out of minnows

Salmon in the Tasmanian economy

The economic benefit of the salmon industry to Tasmania is weighted strongly against its environmental and social impacts. Yet it accounts for just 1% of jobs in the state. Over 5 years $3.8 billion worth of fish were sold, but just $64 million tax paid, while $9.3 million in subsidies were received in 2 years. Changing generous leasing arrangements to the Norwegian model could raise $2 billion for community development.

Discussion paper

Leanne Minshull
Bill Browne
July 2019

ABOUT THE AUSTRALIA INSTITUTE

The Australia Institute is an independent public policy think tank based in Canberra. It is funded by donations from philanthropic trusts and individuals and commissioned research. We barrack for ideas, not political parties or candidates. Since its launch in 1994, the Institute has carried out highly influential research on a broad range of economic, social and environmental issues.

OUR PHILOSOPHY

As we begin the 21st century, new dilemmas confront our society and our planet. Unprecedented levels of consumption co-exist with extreme poverty. Through new technology we are more connected than we have ever been, yet civic engagement is declining. Environmental neglect continues despite heightened ecological awareness. A better balance is urgently needed.

The Australia Institute's directors, staff and supporters represent a broad range of views and priorities. What unites us is a belief that through a combination of research and creativity we can promote new solutions and ways of thinking.

OUR PURPOSE - 'RESEARCH THAT MATTERS'

The Institute publishes research that contributes to a more just, sustainable and peaceful society. Our goal is to gather, interpret and communicate evidence in order to both diagnose the problems we face and propose new solutions to tackle them.

The Institute is wholly independent and not affiliated with any other organisation. Donations to its Research Fund are tax deductible for the donor. Anyone wishing to donate can do so via the website at https://www.tai.org.au or by calling the Institute on 02 6130 0530. Our secure and user-friendly website allows donors to make either one-off or regular monthly donations and we encourage everyone who can to donate in this way as it assists our research in the most significant manner.

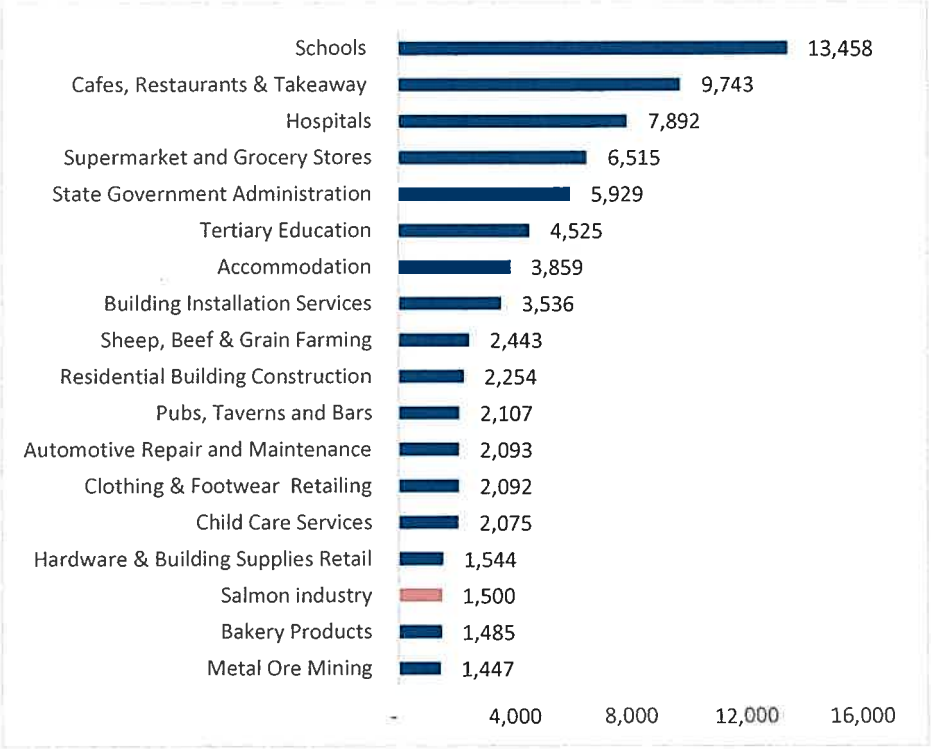
Level 1, Endeavour House, 1 Franklin St
Canberra, ACT 2601
Tel: (02) 61300530
Email: mail@tai.org.au
Website: www.tai.org.au
ISSN: 1836-9014

Summary

Political leaders routinely exaggerate the salmon industry's economic role in Tasmania. The Tasmanian Government describes it as "critically important" and trade unions have called it Tasmania's "brightest economic prospect". With views like this, the relative cost to the environment imposed by the industry can be skewed. This is concerning, because economic data does not support the claims of the industry's importance.

Employment: The salmon industry is the 40th largest sector by employment in Tasmania, employing fewer than car repairs or child care. It employs about 1,500 people, or 0.6% of total employment in the state.

Employment in Tasmania, selected industries



Source: ABS (2016) *Census* and salmon industry calculations above.

Gross state product: Industry figures put salmon aquaculture's contribution to Gross State Product at somewhere between 0.6% and 2.3% of total Gross State Product. Tasmania, like other Australian states, is largely a services economy.

Production, income and taxes: Over the five years from 2013 to 2018 the Tasmanian salmon industry sold 255,000 tonnes of fish, worth $3.8 billion. This revenue produced $416 million in taxable income, an approximation of profit. $64 million in tax was paid, equal to 2% of production value and 15% of taxable income.

Subsidies: The industry has benefited from significant state and federal subsidies, with at least $9.3 million paid in the last two years.

State and local payments: The salmon industry does not pay council rates on its marine leases, putting it at an advantage compared to land-based industries. When councils considered charging rates on marine leases, the Tasmanian parliament legislated to remove that power from them.

Annual lease and licence fees are paid to the State Government, of approximately $923,000 for the entire industry. This represents 0.1% (one-thousandth) of the total farmgate production of the salmon industry in Tasmania, and 0.02% of total state revenue. Changing the current licensing regime to one similar to the Norwegian system could return between $707 million and $2 billion at government auction.

Introduction

The Tasmanian Government describes the state's salmon industry as "critically important" and "important to the economic future of the state". If industry plans to almost double in size are met, it will be "one of the largest industries in the Tasmanian economy".[1]

Then Opposition Leader Bill Shorten said in 2017 that the industry accounted for "literally thousands of local jobs" and was "an important part of the Tasmanian economy".[2] Shorten's union, the Australian Workers Union, describes salmon as Tasmania's "brightest economic prospect" and a "critical growth industry".[3] Even Tasmanian chef and SBS personality Matthew Evans, who has since been critical of the salmon industry, said that in Tasmania "everyone knows someone who works in the salmon industry."[4]

Everyone seems to know that salmon is big business and critical to Tasmania. Some believe this perception has resulted in the environmental impacts of the industry being brushed aside.[5] This report puts Tasmania's salmon industry into its wider economic context.

---

[1] Tasmanian Liberals (2019) *Labor's deal to devastate the Salmon industry*, https://www.facebook.com/watch/?v=821201188242813; Tasmanian Government (2018) *Tasmania Delivers ... The perfect environment for an innovative and successful aquaculture industry*, https://web.archive.org/web/20190306111042/https://www.cg.tas.gov.au/__data/assets/pdf_file/0003/123447/Tasmania_Delivers_-_Aquaculture.pdf

[2] O'Connor (2017) *The Australian Workers Union enlists @billshortenmp to drum up support for Tasmania's salmon industry.*, https://twitter.com/TedOConnor4/status/821972594081415169

[3] AWU (n.d.) *Tassie Salmon*, https://www.tassiesalmon.com.au/

[4] Dubecki (2017) *Are we eating too much salmon?*, https://www.goodfood.com.au/recipes/news/are-we-eating-too-much-salmon-20170921-gylrqu

[5] Konkes (2017) *Bender's choice*, https://www.themonthly.com.au/issue/2017/october/1506780000/claire-konkes/bender-s-choice

Employment

The salmon industry is a small employer in Tasmania. While there are various estimates, the entire industry represents around one percent of the 216,547 Tasmanians in work at the last census. According to a 2015 report commissioned by the Tasmanian Salmonid Growers Association, written by KPMG:

> The total contribution of the combined aquaculture firms to the Tasmania economy is 2.3% of State GSP and 1.2 % of State employment.

In other words, 99% of Tasmanians do not work in the salmon industry, according to the industry itself.

In fact, this represents a substantial overestimate of the size of employment in the salmon industry. The 1.2% estimate refers not just to people employed in the salmon industry, but also includes jobs 'supported' in other industries:

> [The salmon industry provides] support for approximately 2,786 FTE jobs (full time positions employed in, or supported by the industry).[6]

By reporting jobs 'supported' rather than direct numbers of employees, the industry exaggerates its economic impact. If all industries added up the number of jobs they support in other industries this would double or triple count many jobs, giving a total far greater than the number of employees in the economy. While the impact of the salmon industry on other industries may be debated, the total numbers estimated by KMPG are of limited use as they estimate the impact of the entire industry, as if the entire industry's presence or absence could be a subject of policy debate.

In reality, it is marginal expansions or contractions of the industry that are affected by policy decisions. With supply and marketing chains already established, marginal expansions are likely to have a minimal impact on 'supported' employment.

Because of its tendency to overstate employment impacts, the class of economic model used by KPMG has been described by the Productivity Commission as widely "abused", "biased" by the Australian Bureau of Statistics and "deficient" by the NSW Land and Environment Court.[7]

---

[6] KPMG (2015) *Economic Impact Assessment: Tasmanian Aquaculture Industry*, p. ii, https://www.tsga.com.au/wp-content/uploads/2014/11/TSGA15-Economic-Impact-Report.pdf

[7] Gretton (2013) *On Input-output Tables: uses and abuses*, https://www.pc.gov.au/research/supporting/input-output-tables; ABS (2010) Input output multipliers,

While the modelled figure including 'supported' jobs is used in KPMG's percentages, in its headline figures and executive summary, the report does include a figure of direct industry employees in Tasmania – 1,365. This represents 0.6% of Tasmanian jobs.

KPMG's report is based on 2014 data. While the value of salmon production has increased by 20% since then, employment is unlikely to have had a similar boost. A 2018 report by the International Salmon Farmers Association, that Tasmania's industry contributed to, says only vaguely:

> The salmon and trout farming industry currently create over 1,500 direct jobs [in Tasmania]. [8]

While there has been growth in the salmon industry's output since 2014, the trend towards automation in the industry is likely to have kept jobs numbers down.[9] Tassal is investing in automated feeders and camera-based monitoring, and has a "completely integrated automation solution" for its new smolt tanks.[10] Huon feeds its fish "from a central feeding room in Hobart", with software adjusting feeding rates automatically based on on-site video feeds, and it is moving to "fully automated and unmanned feed barges".[11]

How this will affect salmon industry employment in the future is not clear. In 2017, Senator Peter Whish-Wilson revealed leaked documents from Tassal that showed that an automated feed method would allow them to employ one third as many feed staff

---

https://www.abs.gov.au/AUSSTATS/abs@.nsf/Previousproducts/5209.0.55.001Main%20Features4Final%20release%20200607%20tables?opendocument&tabname=Summary&prodno=5209.0.55.001&issue=Final%20release%202006-07%20tables&num=&view=; Preston (2013) *Bulga Milbrodale Progress Association Inc v Minister for Planning and Infrastructure and Warkworth Mining Limited*, NSW Land and Environment Court

[8] International Salmon Farmers Association (2018) *Salmon farming: Sustaining communities and feeding the world*, pp. 14, 23, https://www.tsga.com.au/wp-content/uploads/2018/06/ISFA-Socio-Economic-report-2018.pdf

[9] Fantin (2017) *Tassal trading halted while $100m in capital raised*, https://www.abc.net.au/news/2017-03-02/tassal-trading-halted-while-$100m-in-capital-raised/8317942; Mereghetti (2017) *Chile's Blumar invests $7m in upgrading salmon feeding systems, automation*, https://www.undercurrentnews.com/2017/09/04/chiles-blumar-invests-7m-in-upgrading-salmon-feeding-systems-automation/; Sinefa (2018) *Case Study - Huon aquaculture*, https://web.archive.org/web/20180528141024/https://www.sinefa.com/case-study-huon-aquaculture

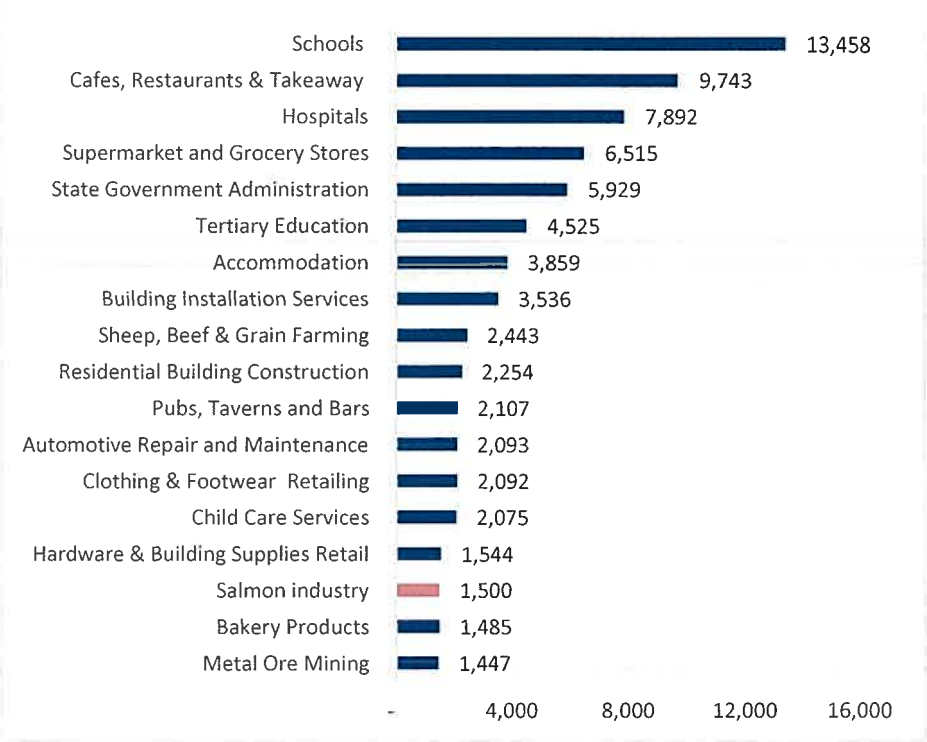
[10] NHP Electrical Engineering (n.d.) *Nothing mainstream about Tassal salmon*, https://www.nhp.com.au/files/editor_upload/File/Case%20Studies/Tassal%20Salmon.pdf; SBS News (2017) *Bigger fish means bigger profit for Tassal*, https://www.sbs.com.au/news/bigger-fish-means-bigger-profit-for-tassal

[11] Huon Aquaculture (2018) *Annual Report 2018*, p. 8, http://investors.huonaqua.com.au/investors/?page=Annual-Reports

as would be employed for their current method. Instead of feed staff numbers increasing from 65 to 105 by 2025, they would fall to 35.[12]

Assuming current industry employment of 1,500 people, as stated by the International Salmon Farmers Association, the industry represents 0.7% of Tasmanian employment. Comparing this figure to ABS data on other industries, the salmon industry is the 40th largest employing sector in Tasmania. Figure 1 below shows a selection of Tasmanian industries:

Figure 1: Employment in Tasmania, selected industries



Source: ABS (2016) *Census* and salmon industry calculations above.

Figure 1 above shows that education and health services are the highest employing sectors in Tasmania, as they are in most of Australia. Service industries dominate employment in most developed economies. Tasmania's tourism focus is shown in the large employment shares of accommodation, retail and hospitality sectors.

The salmon industry by contrast employs fewer people than child care, car repairs, or hardware stores. It employs slightly more people than baking (not to be confused with

[12] Whish-Wilson (2017) *ADJOURNMENT - Tasmania: Aquaculture Industry*, https://www.aph.gov.au/Parliamentary_Business/Hansard/Hansard_Display?bid=chamber/hansards/38a7c160-c946-4e90-b0c4-7c50493e1073/&sid=0221

retail bakeries, likely to employ more) or metal ore mining – most mining other than quarries in Tasmania.

Another estimate of salmon industry employment can be made from company annual reports and public statements. Tasmania's salmon industry is dominated by just three companies – Tassal, Huon and Petuna. There are only a handful of small businesses outside of these three. Tassal reports 1,261 employees and Huon reports 659. Petuna reportedly employs 264.[13] This sums to a total of 2,184 employees. This includes employees in other states and territories. Huon has employees in "most" states, including sales in Perth, Brisbane and Melbourne.[14] Their Sydney operations have both sales and processing facilities.[15] Tassal has operations in Sydney and prawn farms in Queensland.[16] Petuna is not listed and is privately owned by the Rockliff family and New Zealand-Japanese firm Sealord group. It does not publish detailed annual reports.

[13] Bingham (2018) *Shock as Petuna axes 22 senior jobs*, https://www.theadvocate.com.au/story/5230450/shock-as-petuna-axes-22-senior-jobs/; Huon Aquaculture (2019) *Sustainability Dashboard*, http://sustainability.huonaqua.com.au; Tassal (2018) *Employees*, http://dashboard.tassalgroup.com.au/our-people/employees/

[14] Wiley & Co (2015) *$12 million salmon processing facility opens in Tasmania*, http://foodprocessing.com.au/content/the-food-plant/article/-12-million-salmon-processing-facility-opens-in-tasmania-605318147

[15] Huon (2019) *Our locations*, https://www.huonaqua.com.au/working-at-huon-2/our-locations/

[16] Tassal (2019) *Join our team*, http://tassalgroup.com.au/our-people/join-our-team/

Gross state product

Tasmania's Gross State Product ("GSP") in financial year 2018 was $30,266 million.[17]

Estimates of the salmon industry's contribution vary significantly, even between industry groups, at between 0.6% and 2.3% of Tasmania's GSP.

The most recent estimate of the salmon industry's contribution to Gross State Product is from the International Salmon Farmers Association, of which the Tasmanian Salmonid Growers' Association is a member. The International Salmon Farmers Association said in 2018 that the salmon and trout farming industry in Tasmania "currently" contributes $190 million to Tasmanian GSP.[18] This would represent about 0.6% of Tasmanian Gross State Product, or about 7% of agriculture, forestry and fishing's GSP contribution ($2.7 billion).

By contrast, the KPMG report commissioned by the Tasmanian Salmonid Growers Association found the industry in 2015 had a "value added or net additions to GSP" of $626 million, or 2.3% of GSP. The GSP contribution consists of $264 million for "final demand", $79 million for "industry effects" and $283 million for "consumption effects".[19] These latter effects are those "supported" in other industries, which suffer from the same problems discussed above. Even so, $626 million would represent about 23% of agriculture, forestry and fishing's GSP contribution in 2018.

For context, Deloitte Access Economics calculated for Tourism Tasmania that tourism directly contributes $1.4 billion to Gross State Product, which would represent about 5% of GSP.[20] As Deloitte itself acknowledges, calculating tourism's economic contribution is difficult,[21] but the satellite accounts allow for the general comparison: which shows that tourism's GSP contribution is twice or more larger than that of the salmon industry.

---

[17] ABS (2018) *5220.0 - Australian National Accounts: State Accounts, 2017-18*, http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/5220.0Main+Features12017-18?OpenDocument

[18] International Salmon Farmers Association (2018) *Salmon farming: Sustaining communities and feeding the world*, p. 23

[19] KPMG (2015) *Economic Impact Assessment: Tasmanian Aquaculture Industry*, pp. 7–13

[20] Tourism Tasmania (2019) *Tourism Fast Facts*, https://www.tourismtasmania.com.au/industry/facts

[21] For methodology and details about Deloitte's use of Tourism Research Australia's satellite accounts, see for example Deloitte Access Economics (2017) *Tasmanian Regional Tourism Satellite Accounts 2015-16*, https://www.tourismtasmania.com.au/__data/assets/pdf_file/0016/60622/Tasmanian-RTSA-2015-16-Report_FINAL.pdf

Overall, primary and secondary industries like mining, agriculture and manufacturing contribute 26% to Tasmanian GSP, compared to 54% from service industries.[22]

[22] The reminder consists of the "mixed" industry of electricity, gas, water and waste services; taxes less subsidies; and ownership of dwellings. ABS (2012) *Main Features - Service industries*, https://www.abs.gov.au/ausstats/abs@.nsf/Lookup/1301.0Main+Features332012; (2018) *5220.0 - Australian National Accounts: State Accounts, 2017-18*

Subsidies

The salmon industry receives several subsidies, including the unquantified public costs of regulating and managing the industry as well as specific grants and funding that can be quantified.

While outside the scope of this paper to calculate, the public costs for management, research and compliance serve as a subsidy to the salmon industry.[23]

Tassal records $2.3 million in government grants in 2017 and $3.2 million in 2018.[24] In 2014, it received a $3.85 million federal government grant for its Triabunna Processing Facility; this represents about three-quarters of the expected cost of the facility.[25]

Huon Aquaculture records $724,000 in government grants in 2017 and $807,000 in 2018.[26] In each of 2017 and 2018, $463,000 of the grant reflects the amortising of $5 million of grants for its Parramatta Creek Smokehouse and Innovation Centre, which Huon received in 2015.[27] The grants, consisting of a $3.5 million federal government contribution and $1.5 million state government contribution, reflect about two-fifths of the $12 million cost of the smokehouse.[28]

The government also co-funds the Aquatic Animal Health and Vaccines Centre of Excellence[29] and in 2017 contributed $2.3 million to BioMar's $56 million fish feed production facility,[30] due to open in late 2019. BioMar is an international fish feed

[23] For discussion of the similar issues around public costs and public benefits for wild-catch fisheries, see for example Ogier et al. (2018) *Economic and Social Assessment of Tasmanian Fisheries 2016/17*, pp. 11, 21, http://www.imas.utas.edu.au/__data/assets/pdf_file/0007/1144582/EconSocial-Assessment-Tasmanian-Fisheries-2016-17.pdf

[24] Tassal Group (2018) *Annual Report 2018*, p. 44, http://tassalgroup.com.au/investors/reports/annual-reports/

[25] Clark (2014) *Fishy future for former forestry town*, https://www.news.com.au/national/tasmania/tassal-reels-in-38m-in-federal-funds-for-fish-protein-and-oil-facility-at-triabunna/news-story/51c70990ae36a60bda0b4698fc9107e8#.nr9xy

[26] Huon Aquaculture (2018) *Annual Report 2018*, p. 56

[27] Huon Aquaculture (2018) *Annual Report 2018*, p. 93

[28] Slessor (2015) *$12m factory creates jobs*, https://www.theadvocate.com.au/story/3189375/12m-factory-creates-jobs/

[29] DPIPWE (n.d.) *Sustainable industry growth plan for the salmon industry*, p. 21, https://dpipwe.tas.gov.au/Documents/salmonplan.pdf

[30] BioMar (2017) *New Factory in Tasmania*, https://www.biomar.com/en/australia/articles/biomar-to-establish-new-factory-in-tasmania/

manufacturer, and already supplies the Tasmanian market from its Chile and Scotland factories.[31]

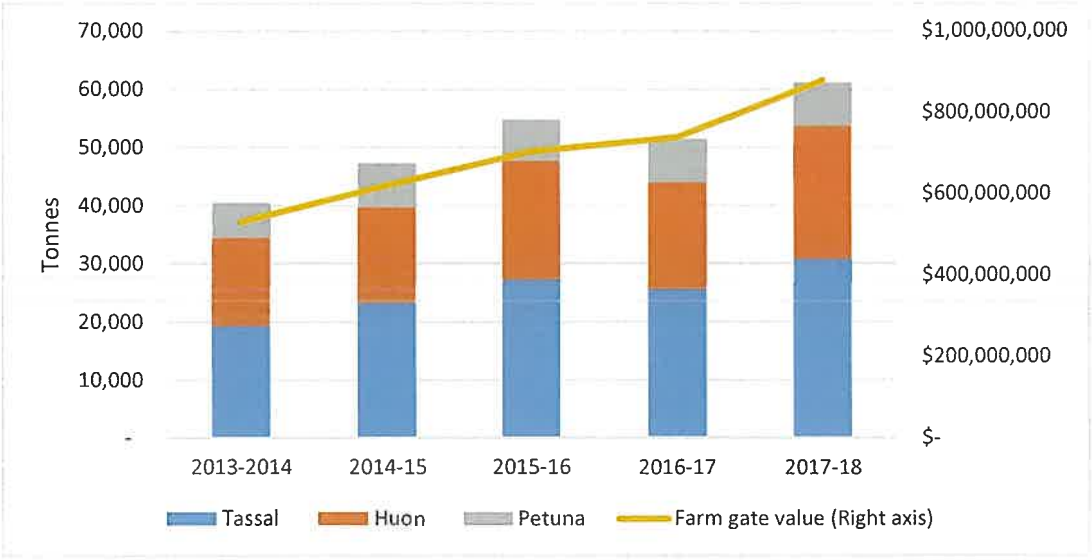
Between the Tassal and Huon grants and the BioMar facility, this represents about $9.3 million in quantifiable state and federal government subsidies to the salmon industry in the two years 2017 and 2018.

[31] Grain Central (2018) *BioMar eyes late 2019 opening for Tasmanian aquafeed plant*, https://www.graincentral.com/trade/biomar-eyes-late-2019-opening-for-tasmanian-aquafeed-plant/; The Advocate (2019) *Wesley Vale's $56m aqua feed plant to start recruiting workers soon*, https://www.theadvocate.com.au/story/6185647/fish-food-factory-open-day/

Production, income and taxes

Production of salmon has increased by more than 50% in the last five years, both in terms of tonnes produced and total value. Figure 2 below shows this increase and the production shares of the three main companies:

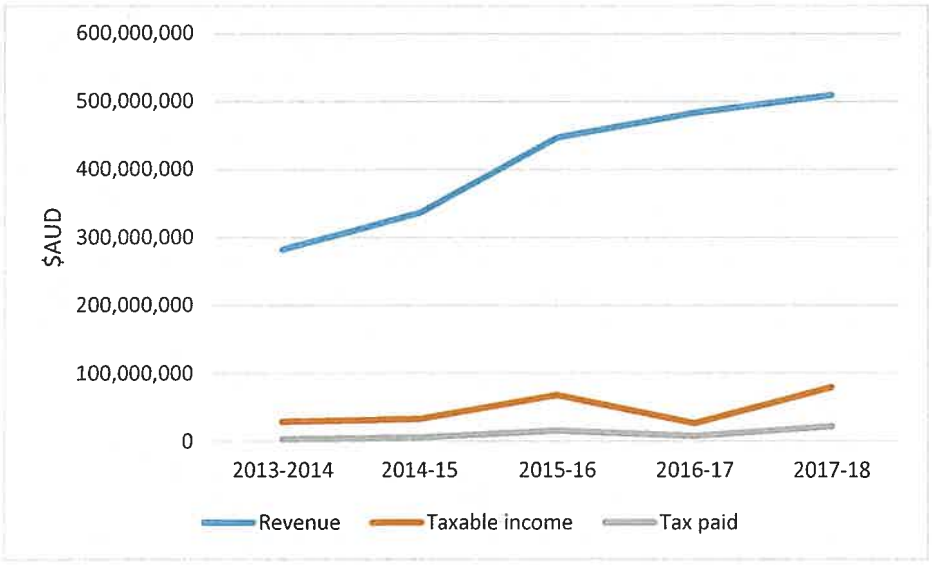
Figure 2: Tasmanian salmon production by company 2013-14 to 2017-18



Sources: Company annual reports; ABARES (2017, 2018) *Fisheries and aquaculture statistics*; author calculations. Note: Petuna do not report volumes, here calculated as ABARES total production estimate less reported totals for Tassal and Huon.

Figure 2 shows that in 2013–14, the industry produced 40,405 tonnes of salmon. By 2017–18, this had grown to 61,033 tonnes. Reflecting their growth in production, the industry has grown substantially and has made large profits. Figure 3 below shows total income, taxable income and tax paid by Tassal over the last five years:

Figure 3: Tassal income and tax 2013-14 to 2017-18

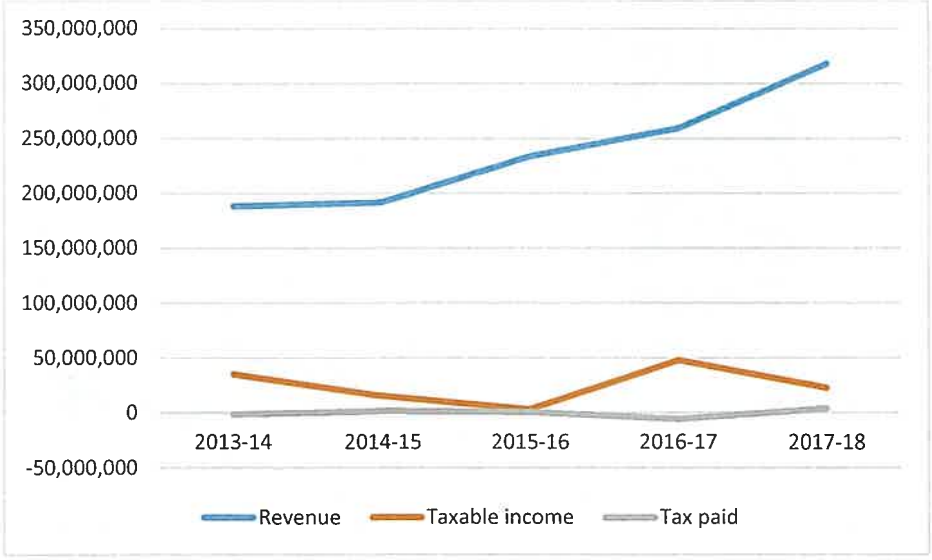


Sources: ATO corporate tax transparency, Tassal (2018) Annual report

Figure 3 shows that over the last five years, Tassal had income of just over $2 billion, including taxable income of $236 million. On that taxable income, Tassal paid $54 million, or an effective tax rate of about 23%.

Over the same five-year period, Huon had income of $1.2 billion, including taxable income of $124 million – as shown in Figure 4. Huon received a net $1 million tax refund over the period.

Figure 4: Huon income and tax 2013-14 to 2017-18



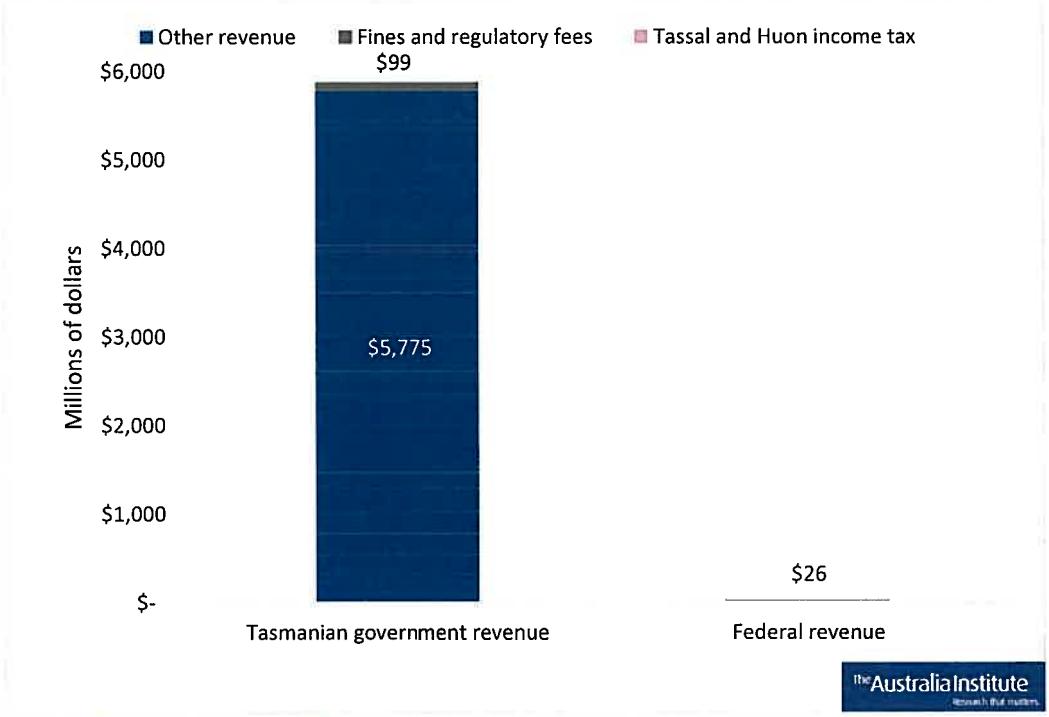
Sources: Huon annual reports, author calculations

We estimate that Petuna's revenue over the same period was $512 million. This is Petuna's production estimate in Figure 2 over the five years (35,343 tonnes) multiplied by the average revenue per tonne for Tassal and Huon. Based on Huon and Tassal's taxable income and tax paid per tonne we estimate the company would have made $56.8 million in taxable income and paid $8.4 million in corporate tax.

In total, we estimate over this five-year period the Tasmanian salmon industry sold 255,000 tonnes of fish, worth $3.8 billion. This revenue produced $416 million in taxable income, an approximation of profit. $64 million in tax was paid, equal to 2% of production value and 15% of taxable income.

While income taxes are paid to the federal government rather than the state government, for the purposes of illustration the $26 million in income tax paid by Huon and Tassal in 2018 represents 0.4% of Tasmanian government revenue. The Tasmanian government makes about four times as much from fines and regulatory fees as the Federal Government makes in income tax from the two largest salmon farmers in Tasmania.[32]

Figure 5: Comparison of revenue sources



Sources: Tasmanian Budget Papers, company annual reports

[32] Tasmanian Government (2018) *2017-18 Tasmanian Budget - Budget Paper Number 1*, pp. 6, 10, https://www.treasury.tas.gov.au/budget-and-financial-management/2018-19-tasmanian-budget/budget-papers-archive/2017-18-tasmanian-budget

OWNERSHIP

From their annual reports, it appears that Tassal's largest shareholders are institutional investors, while Huon is majority owned by its (Tasmania-based) founders.[33]

According to the Tassal Group share registry as of February 2017, 366 shareholders (4.3% of all shareholders) had Tasmanian postcodes, and together these Tasmanians owned 1.1% of all Tassal shares.

In 2010, global seafood enterprise Sealord Group bought 50% of privately-owned Petuna from Devonport-based founders Peter and Una Rockliff. The Rockliff family are still joint owners,[34] although it is unclear if they still own a 50% share.

[33] Huon Aquaculture (2017) *Annual report 2017*, p. 103; Tassal (2017) *Annual report 2017*, p. 81

[34] Petuna Seafood (n.d.) *Our Story - Peter and Una Rockliff*, http://www.petuna.com.au/our-story/

State and local payments

More publicly-available information on the salmon industry's payments to government would allow for a clearer picture of the industry. However, information that is public allows us to estimate that the salmon industry pays the state government about $920,000 in annual lease and licence fees on its fish farm leases.

We estimate that industry levies amount to $1.1 million, as well as $500,000–$730,000 for the EPA Tasmania levy.

Public information about payments from the salmon industry to the government is scattered, and in some cases incomplete. The number of leases, and the hectares that they cover, is known, and in some cases can be compared to lease, licence and levy fees. However, it is difficult to tell if these represent the total payment because it is not always clear if some leases have been grandfathered, whether all leases are currently licensed, and so on.

LEASES AND LICENCES

In Tasmania, lessees of finfish farms (including salmonids) must pay annual lease fees, which currently consist of an annual fee of $2,673 plus $302.94 per hectare.[35] Since Tasmania has 44 leases occupying a total of 2,257 hectares,[36] this would result in an annual lease fee of $801,348 for the entire industry.

Marine farming licence fees are $2,765 per lease for one species of finfish (e.g. *Salmo salar,* the Atlantic salmon).[37] Not all of Tasmania's 44 leases necessarily have current licences. However, if assuming they did, licence fees would amount to $121,660 per year for the industry.

[35] ABLIS (2019) *Marine Farming Lease - Tasmania*, https://ablis.business.gov.au/; Tasmanian Government (2019) *Gazette No. 21,870*, p. 143, http://www.gazette.tas.gov.au/?a=449648

[36] EPA Tasmania (n.d.) *Environmental management*, https://epa.tas.gov.au/regulation/salmon-aquaculture/environmental-management

[37] Trout is also farmed in some cases, but adding an additional finfish species to a lease only costs $158. DPIPWE (2018) *Application for the grant of a Marine Farming Licence in respect to a lease over an area in state waters*, https://dpipwe.tas.gov.au/Documents/Licence-WB%20GRANT%20MF%20Application.pdf

The estimated total lease and licence fees of $923,008 represents about 0.1% (one-thousandth) of the total farmgate production of the salmon industry in Tasmania, and 0.02% of total state revenue.

Other jurisdictions with large salmon farming operations use different licensing and leasing structures. For example, Norway's licensing system consists of perpetual licences that are limited by biomass. Each salmon farming licence allows the holder to farm up to 780 tonnes of salmon at one time (the "maximum allowed biomass" or MAB). New licences are made available infrequently. Since 2017, production capacity will rise or fall on a biennial basis depending on sea lice levels in the area.[38]

An auction of licences last year raised NOK 2.9 billion ($468 million) for licences covering 14,945 tonnes of MAB.[39] Since 2016 in Norway, 80% of the revenue from the growth in the salmon industry is allocated to municipalities with aquaculture operations.[40]

In Tasmania, salmon stocking densities of between 10 and 28 tonnes per hectare have been reported.[41] If the 2,257 hectares of salmon leases in Tasmania leases were valued the same way as the Norwegian biomass licences, they would be worth between $707 million and $2 billion at government auction.

Another advantage of the Norwegian system is its transparency, with public disclosure of areas, winning bidders, volume purchased and price per tonne – as shown in Figure 6, below. Transparent and readily-available details about payments by industry should be available for all jurisdictions.

---

[38] Marine Harvest (2017) *Salmon Farming Industry Handbook 2017*, p. 70, https://web.archive.org/web/20180219002701/http://marineharvest.com/globalassets/investors/handbook/salmon-industry-handbook-2017.pdf

[39] FishFarmingExpert.com (2018) *Norwegian salmon licence auctions raise NOK2.9bn*, https://www.fishfarmingexpert.com/article/norwegian-salmon-licence-auctions-raise-nok29bn/

[40] Olsen (2018) *The salmon license auction completed*, https://salmonbusiness.com/the-salmon-license-auction-completed/

[41] Meldrum-Hanna & Balendra (2017) *Salmon farmer accuses government of failing to protect World Heritage area*, https://www.abc.net.au/news/2017-02-06/huon-aquaculture-lawsuit-tasmania-government-macquarie-harbour/8244330; Ryan & Creswell (2017) *Tassal Group Limited: FY2017 Roadshow*, p. 7, http://www.tassal.com.au/wp-content/uploads/2017/09/1711197-FY2017-investor-relations-roadshow.pdf

It is worth noting that Norway has other taxes and fees on its salmon industry and is considering introducing more; the public benefit to Norwegians from the salmon industry is not limited to the perpetual biomass licences.[42]

Figure 6: Example of public disclosures of winning bids, Norway

FINAL LIST:

Area of production	Bidder	Volume tonnage	Price per tonn in euros
1: Swedish border to Jæren	EIDE FJORDBRUK AS	100	13,941
	MARINE HARVEST NORWAY AS	493	13,941
	EMILSEN FISK AS	400	23,868
	NORSK HAVBRUKSSENTER OPPDRETT AS	265	23,868
7: Nord-Trøndelag with Bindal	MIDT NORSK HAVBRUK AS	600	22,292
	MIDT NORSK HAVBRUK AS	180	22,079
	SALMAR FARMING AS	183	22,292
	SALMAR FARMING AS	260	22,079
8: Helgeland to Bodø	LOVUNDLAKS AS	1,850	26,623
	EDELFARM AS	604	22,219
	BALLANGEN SJØFARM AS	200	24,510
	BALLANGEN SJØFARM AS	50	24,096
	CERMAQ NORWAY AS	2,000	24,510
9: Vestfjorden and Vesterålen	CERMAQ NORWAY AS	30	24,096
	EIDSFJORD SJØFARM AS	200	24,510
	LOFOTEN SJØPRODUKTER AS	53	24,510
	LOFOTEN SJØPRODUKTER AS	20	24,096
	LOFOTEN SJØPRODUKTER AS	32	24,510

Source: Olsen (2018) *The salmon license auction completed*, https://salmonbusiness.com/the-salmon-license-auction-completed/

[42] Jensen (2017) *New tax slapped on Norwegian salmon*, https://www.fishfarmingexpert.com/article/new-tax-slapped-on-norwegian-salmon/; KPMG Law (2019) *Taxation of aquaculture – a country overview*, pp. 19–20, https://home.kpmg/no/nb/home/nyheter-og-innsikt/2019/05/taxation-of-aquaculture.html; SalmonBusiness (2019) *Controversial salmon farm resource rent tax scrapped by Parliament*, https://salmonbusiness.com/controversial-salmon-farm-resource-rent-tax-scrapped-by-parliament/

LEVIES

Three levies apply to salmon farms in Tasmania. The Tasmanian Seafood Industry Council levy is $442.40 per lease. The Salmon Industry Planning Levy is $474 per hectare and the EPA levy is $322.32 per hectare. This would represent annual levies of $19,465 for the Seafood Industry Council, $1,069,818 for the Salmon Industry Planning Levy and $727,476 for the EPA levy – provided that all leases have current licences. The latest EPA Tasmania annual report (financial year 2017–18) gives the levy's size as $500,000 for that year, or 3.8% of EPA Tasmania's operating budget.[43]

The Seafood Industry Council and Salmon Industry Planning levies are primarily for the direct benefit of the industry. The planning levy is intended to help fund "the assessment of industry proposals, tactical research and scientific projects specifically focused on expanding industry production".[44]

COUNCIL RATES

Councils do not charge rates on marine farming leases. After West Coast Council considered charging rates on salmon aquaculture leases in Macquarie Harbour, the Tasmanian Parliament legislated in 2017 to prohibit councils from charging rates on marine farms. Land-based salmon farms are still charged rates.[45]

In June 2019, the West Coast Council significantly increasing council rates for the salmon industry's on-land assets, especially Strahan's "aquaculture hub". The rates will go from "several thousand dollars" to about $70,000 per year.[46] In response, the

[43] EPA Tasmania (2018) *Annual report 2017-18*, p. 41, https://epa.tas.gov.au/Documents/EPA%20Annual%20Report%202017-18.pdf

[44] Rockliff (2016) *Supporting the growth of salmon farming*, http://www.premier.tas.gov.au/releases/supporting_the_growth_of_salmon_farming

[45] Department of Premier and Cabinet (n.d.) *Local Government Amendment (Rates) Act 2017*, http://www.dpac.tas.gov.au/divisions/local_government/legislation/draft_local_government_amendment_rates_bill_2017; Whiting (2017) *Push to exempt marine farms from council rates*, https://www.abc.net.au/news/2017-04-05/legal-move-to-free-salmon-companies-from-paying-council-rates/8416860; Woodruff (2017) *Mates' rates just smell fishy*, https://www.themercury.com.au/news/opinion/talking-point-mates-rates-just-smell-fishy/news-story/e693b3b16f5b509e162dbd5818d4d6bd

[46] Ford (2019) *West Coast Council draft budget targets salmon farmers*, https://www.theadvocate.com.au/story/6239544/west-coast-council-draft-budget-targets-salmon-farmers/

Tasmanian Salmonid Growers Association called on the state government to "intervene in this immediately", and may consider legal appeals.[47]

Australia Institute polling shows that 70% of Tasmanians think that intensive fish farms should pay rates to local governments.[48]

ROYALTIES

Some fish harvests in Tasmania, particularly abalone fishing, require royalty payments. The abalone royalty rate varies depending on the deed, but new deeds have a royalty of 7% of average beach price.[49] It should be noted that because the public funds fisheries management, research, compliance and the crown prosecutor, public costs may exceed the public benefit from the abalone royalty.[50]

Royalty payments are intended to compensate the community for the harvesting of a public resource.[51] As such, aquaculture operations such as salmon farming are not expected to pay them as they provide their own fish. However, if the public resource were conceived of as a community's waterways, rather than a community's fish, then the intellectual case for a royalty on aquaculture operations could be made.

[47] Ford (2019) *West Coast salmon farming rates hike might end up in court*, https://www.theadvocate.com.au/story/6242285/west-coast-salmon-farming-rates-hike-might-end-up-in-court/

[48] The Australia Institute (2016) *Intensive salmon farming in Tasmania*, p. 6, http://www.tai.org.au/content/intensive-salmon-farming-tasmania

[49] Ogier et al. (2018) *Economic and Social Assessment of Tasmanian Fisheries 2016/17*, pp. 20–21

[50] Ogier et al. (2018) *Economic and Social Assessment of Tasmanian Fisheries 2016/17*, p. 11

[51] Ogier et al. (2018) *Economic and Social Assessment of Tasmanian Fisheries 2016/17*, pp. 20–21

Conclusion

Political leaders have overstated the importance of the salmon industry for the state's economy. Salmon farms should be considered on their own economic, environmental and social merits, instead of the industry being treated as essential or as a major part of the Tasmanian economy. The industry is accounts for around 1% of the state's employment and just 1 to 2% of Gross State Product.

Tasmanian salmon companies have gone through a period of growth. This growth has not led to a commensurate growth in returns to the state government, or the communities that bear the environmental costs of the industry.

SAY NO

Farmed

Region: TAS

- **Key Facts**

  - Atlantic salmon is a non-native species that is farmed in sea cages off the coast of Tasmania.
  - Significant environmental impacts of salmon farming have been recorded in Macquarie Harbour, which is a unique and sensitive waterway adjacent to a World Heritage Area.
  - Low levels of oxygen and dead zones have been found in the harbour, which scientists believe are linked to high salmon production. The effects of salmon farming have been recorded in the Macquarie Harbour Wilderness World Heritage Area.
  - More than a million farmed fish have died over the 2017/18 summer in Macquarie Harbour from disease exacerbated by environmental stress including low oxygen levels in the harbour.
  - Major fish escapes have also occurred in 2018 following storm events.
  - Management actions to minimise the effects of salmon farming include reducing the amount of salmon that can be farmed and temporarily destocking some areas. It is not yet clear if these measures will be effective.
  - There are concerns that plans to dramatically expand the amount of salmon farmed in other areas of the Tasmanian coastline are not suitably cautious and could lead to high environmental impacts.
  - Interactions with Australian fur seals have been reduced through improved net designs aimed at preventing entanglements; some companies have committed to no longer euthanizing seals.
  - Over 2,000 seals were relocated from around the salmon farms in 2016. Relocations were banned in 2017, but it is not clear how seal interactions are now being mitigated.
  - The salmon farms in Macquarie Harbour also threaten an endangered marine species called the Maugean skate, which is possibly the world's rarest skate.

  - The salmon farming industry has made improvements in other areas, such as no longer using copper-based paints to prevent marine fouling of nets and not using antibiotics since late 2016.
  - Atlantic salmon are carnivorous fish that are dependent on wild caught fish that is manufactured into fish feed. While the amount of wild caught fish used in feed has been reduced over recent years, it is currently higher than the amount of salmon that is grown in the farms, resulting in a net burden on our wild fisheries.
  - There is a strong potential for this rating to improve in future, provided that producers reduce the impact of salmon farming on Macquarie Harbour's environment. If there is expansion, the impacts of salmon farming must be avoided in those areas.

  - **Note:** Imported farmed Atlantic salmon is available in Australia but has not been assessed in Australia's Sustainable Seafood Guide. For more information on imported product, look for country of origin labelled on the packaging and refer to seafood guides produced in that country. King salmon farmed and imported from New Zealand is rated green, 'Better Choice' in the Guide.

+ **More information**

STATE OF STORM BAY, TASMANIA

An Overview of Current Information and Values

Version 3 – 5 August 2019

Prepared by C A Coughanowr for

Environment Tasmania

OVERVIEW

This report has been prepared in response to a planned expansion of salmon farming into Storm Bay, which seeks to more than double Tasmania's current production (@55,000 tonnes per year) by another 40,000 to 80,000 tpa. As of August 2019, three new farming areas have been approved (North Bruny, West of Wedge, Betsey Island). Numerous concerns have been raised about the potential impacts of these developments, including how the planned expansion may impact on the natural, community and economic values of the region.

While there is a considerable body of information in the public domain, this is widely dispersed and difficult to access at short notice. A 'State of the Bay' report is urgently needed to collect, compile and document existing values and scientific information about Storm Bay and associated areas (including Frederick Henry Bay, Norfolk Bay and the east coast of Bruny Island). This document would benefit the community (as well as research scientists, regulators and a range of relevant industries) by providing an unbiased and independent source of information, as well as by identifying key gaps and uncertainties. Without this information, it is difficult to engage in meaningful debate in a scientific manner. Information about the Derwent estuary is not included here, as there is a considerable body of information available through regularly published *State of the Derwent* reports.

This report consists of three main elements:

- A brief summary of the key natural, community and economic values of Storm Bay along with associated 'values maps', as a basis for further consultation. (Appendix A)
- A draft Table of Contents for a comprehensive 'State of Storm Bay' report (Appendix B)
- A compilation of existing reports and other relevant references for Storm Bay, with some annotations (Appendix C)

Based on a review of available reports, key information gaps include:

- Regional marine habitat mapping is over 20 years old, is at a relatively coarse scale, and does not include areas of Storm Bay deeper than the 40m contour
- Seagrass/*Caulerpa* algae beds have not been assessed in any detail
- Giant kelp forest (EPBC-listed) mapping is out of date, currently being updated
- Baseline surveys of rocky reef communities are spatially and temporally limited, do not include many vulnerable areas, and the most recent studies have not yet been published (e.g. FRDC 2015-024)
- Baseline water quality monitoring has not been carried out in sheltered embayments such as Frederick Henry Bay and Norfolk Bay, which are more susceptible to problems; there is also limited information about water quality responses during and immediately after storm events;
- Lack of recent recreational fishing report (due out soon)
- Risks to biosecurity and fish health have not been fully addressed, and information on this is not readily available
- Toxic algae and jellyfish risks have not been fully assessed
- Information on net-cleaning methods and risks is very limited
- Information on shark and seal populations/interactions is very limited.

In conclusion, there would be considerable merit in producing an independent *State of Storm Bay Report*, to ensure that existing information is readily available, major gaps can be highlighted, and a case made to address these as a prerequisite to full expansion.

The estimated cost to produce this report would be in the order of $30,000 to 40,000, not including graphic design or printing.

APPENDIX A

THE NATURAL, COMMUNITY AND ECONOMIC VALUES OF STORM BAY

Storm Bay covers an area of approximately 1000 km^2 and is bordered by Bruny Island to the west, the Tasman Peninsula to the east and the sheltered coastal waters of the Derwent estuary, Frederick Henry Bay and Norfolk Bay to the north. Weather patterns are variable and frequently extreme, with prevailing winds generally from the west/southwest and prevailing waves from the south. Coastal currents and water masses also have a major influence, with East Australian Current water (warm, low nutrients) prevailing in summer, and Southern Ocean water (cold, high nutrients) in winter. This region is characterised by its variability and diversity – weather, coastal currents, landscapes, biota, etc – and the values described below reflect this. Storm Bay is also a climate change hotspot, and is increasingly being affected by invasive species including nuisance and toxic algal blooms, jellyfish, fish/shellfish diseases and sea urchins.

NATURAL VALUES

Storm Bay falls within the Bruny Bioregion, which is particularly noted for its biodiversity and endemism. There are a number of useful reports on the natural values of the Storm Bay region – in particular, Barrett et al, 2001 mapped the key habitats within the region, including important seagrass/*Caulerpa* algae beds in Norfolk Bay, and extensive fringing reef communities across the region. Unfortunately, this mapping is now over 20 years old and does not extend beyond the 40m contour. This urgently needs to be updated.

Storm Bay is a biodiversity hotspot for the spotted and red handfish, endemic seastars, rare saltmarsh moths, a variety of protected birds (both resident and migratory), southern right whale (nursery), and numerous species of rare algae and protected coastal plants. Important seagrass habitat and giant kelp forests are also found here, as is the internationally significant Ramsar wetlands at Pittwater. There is also a Marine Reserve at Tinderbox, and two Marine Conservation Areas at Sloping Island and Monk Bay (Tasman Peninsula).

While there have been a number of studies of reef and intertidal communities, including assessment of impacts associated with salmon aquaculture (see Appendix C), these have been largely focussed on the Channel area, or have not yet been finalised (e.g. FRDC-024), and findings have not been conclusive (e.g. Oh et al, 2016; Valentine et al, 2016; Crawford and Harwin, 2018).

Of particular value are the extensive seagrass and *Caulerpa* algae beds found in Norfolk Bay and to a lesser extent in other areas (e.g. Nubeena, White Beach, Adventure Bay). These habitats provide essential shelter, spawning and nursery areas for many fish, calamari and invertebrates, and have been shown to be sensitive to high nutrient loads. These seagrass/*Caulerpa* habitats are not well documented and no local studies were identified. The sheltered waters of Frederick Henry Bay, Norfolk Bay and the Derwent estuary are also protected as shark nurseries, and sharks are regular visitors/residents in the Bay.

Storm Bay is an important migration pathway for whales (southern right and humpback), with increasing numbers spotted here each year. The associated sheltered bays were historically an important nursery area for southern right whales, and it appears the whales may be returning with births and/or very young whales recorded in recent years.

The extensive sandy beaches, tidal flats and saltmarshes around Storm Bay also provide valuable habitat for a variety of species – including protected resident and migratory birds and rare saltmarsh moths.

Finally, Storm Bay sets the background water quality for the Derwent estuary, Frederick Henry Bay and Norfolk Bay, and as such a decline in offshore water quality could have far-reaching effects. An increase in nutrient levels – particularly during summer months and/or following storm events – could stimulate planktonic or filamentous algal blooms, leading to impaired water quality (e.g. water clarity) and

degradation/loss of seagrass and reef communities (caused by overgrowth/shading). Where algae sink and decompose, low oxygen levels at depth can displace or kill benthic organisms. In the Derwent, this is further exacerbated by potential remobilisation of heavy metals from contaminated sediments (Coughanowr et al, 2015). While water quality has been monitored at a number of sites in Storm Bay (e.g. Swadling et al, 2017), monitoring sites have generally been located in well-mixed areas of the bay, and more sheltered areas of Frederick Henry Bay and Norfolk Bay have not been included. Further, very little monitoring has been undertaken during or immediately after major storm events, when sediment and organic matter at depth is resuspended.

Figure 1 highlights some of the key natural values of the region.

COMMUNITY AND RECREATIONAL VALUES

Over 40% of Tasmania's population (>210,000) live in the Storm Bay region (including the associated Derwent, Frederick Henry Bay and Norfolk Bay) and this is the State's most densely populated and fastest growing region. Most live in the Hobart metropolitan area, but approximately 11,000 people live in the nearby towns bordering on Storm Bay, with the majority in the Dodges Ferry/Carlton/Primrose Sands area (>4600), Cremorne/ Lauderdale/Seven Mile Beach area (>4200) and Nubeena/White Beach (>750) (ABS Census, 2016). Many more regularly use holiday homes in the region or visit for recreational purposes. This region is also increasingly popular with residents who commute to Hobart, as well as 'seachange' and retired residents. The demand for, and value of coastal properties is rising quickly – driven in large part by the region's varied and wild coast and multiple recreational opportunities, combined with proximity to Hobart and its airport. A visual scan of land tenure maps indicates that well over 50% of the immediate shoreline is in some form of public ownership, either as national parks, Crown land, state or council reserves.

Recreational activities include boating, fishing, swimming and surfing, and enjoyment of the many beaches and coastal reserves that border on the Bay. Recreational boating and fishing are particularly popular in the region, due to a combination of diverse habitats, sheltered waterways and over 16 boat ramps. This region has the highest level of boat ownership in Tasmania, as well as the greatest participation in recreational fishing, particularly for rock lobster, abalone and flathead (Lyle et al, 2014). These recreational fisheries provide important social, cultural and economic values to the region.

Storm Bay occupies the heart of the southeast recreational fishing region (Area 1), and accounted for 45% of the state-wide recreational harvest of crayfish and 58% of the total effort in 2017/18. For abalone, Area 1 accounted for 61% of the recreational harvest, and 49% of the total effort. (Lyle, 2018). The latest 5-year recreational fishing survey has not yet been released, but the previous report (2013/14) highlighted a number of features of the Storm Bay region, specifically (Lyle et al, 2014):

- Highest level of participation (27% of population, as compared with 22% state-wide)
- General decline in recreational fishing across the state, but this is less pronounced in the southeast region
- Flathead is the primary scalefish target, particularly in sheltered waters of Frederick Henry Bay and Norfolk Bay, where catches are large and account for >80% of species caught. In 2013/14 the state-wide recreational catch of flathead was estimated at 236 tonnes, almost six times the commercial catch. While the recreational catch of most species has declined over the years, that of calamari and squid has increased.
- High economic value of goods and services associated with recreational fishing, as well as boats (see next section for details)
- Perceptions that the recreational fishery has declined, with Frederick Henry/Norfolk Bay and D'Entrecasteaux/Channel areas rated as among the poorest performing

The Storm Bay region has some of the most diverse and spectacular beaches in Tasmania, some with associated tidal flats and dunes. These include both open ocean beaches such as those along the Bruny Island Neck, Clifton Beach, South Arm, Seven Mile Beach and Roaring Beach, as well as more sheltered

beaches (e.g. Lauderdale, Primrose Sands, Norfolk Bay beaches, Lime Bay, Slopen Main and White Beach). There are also a number of popular and iconic surfing sites (e.g. Shipstern Bluff, Roaring Beach, Clifton Beach, Carlton, South Arm).

Finally, there are numerous coastal walks throughout the region, many with spectacular views of Tasmania's ocean wilderness. These include those within national parks (e.g. Cape Raoul, Fluted Cape), as well as numerous state and council reserves.

Figure 2 highlights some of the key community and recreational values of the region.

ECONOMIC VALUES

Economic activities associated with Storm Bay, the Derwent estuary, Frederick Henry Bay and Norfolk Bay are highly diverse and include the general commerce and services of the growing Hobart metropolitan area, commercial fisheries, aquaculture and tourism. Economic values of the Bay also include those associated with recreational activities (e.g. boating and fishing) and other 'lifestyle' values. Recent studies have documented the high values associated with coastal real estate, particularly the premium placed on sites with unimpeded views, as well as the less tangible values or 'environmental services' that healthy coastal ecosystems provide, such as fish nurseries, erosion control and water quality protection. It is difficult to place a dollar on these less tangible values and we tend to take them for granted. This is an important area for further investigation, for example along the lines of recent studies of Sydney Harbour (Hoisington, 2015). This summary report attempts to roughly estimate the dollar values of various activities in Storm Bay based on existing reports, however these values should be considered as indicative and require further assessment.

Commercial fishing in Storm Bay is predominantly focused on abalone, rock lobster and some scale-fishing. The bay is also an important transit area for fishing boats en route to southeastern and southwestern fishing grounds.

Storm Bay falls within the Eastern Zone of the abalone fishery, and there are five designated fishing blocks in the Storm Bay/Frederick Henry/Derwent area (Blocks 16 through 20); of these, blocks 16 and 20 are most productive. Total catch over the past 3 seasons has ranged from 40 to 81 tonnes, which is about 2 to 4% of the total landings for the state. The Eastern zone has been doing poorly in recent years – particularly along the east coast – due to a combination of previous overfishing, marine heat waves, predation by urchins and a major storm in 2017. The Total Allowable Catch for the Eastern Zone was further reduced for 2018, from 446t to 294t. (Mundy & McAllister, 2018). Based on a statewide value of $79.7M for the abalone fishery (ABARES, 2017 cited Browne, 2018) and assuming the Storm Bay fishery accounts for 3% of this – the value of the Storm Bay abalone fishery would be worth about $2.4M.

Storm Bay falls within Area 1 of the commercial rock lobster fishing zone, and is further subdivided into about a dozen smaller blocks. Of these, block 7G2G at the southern end of the Tasman Peninsula is the most productive (Tassal, 2018). The most recent rock lobster fisheries assessment report (Hartman et al, 2018) found that Area 1 comprised approximately 80t or about 8% of the total commercial catch for the state (1051t), and notes the general decline of this fishery. In terms of economic value, based on a statewide value of $92.9M for the abalone fishery (ABARES, 2017 cited Browne, 2018) and assuming the Storm Bay fishery accounts for 8% of this – the value of the Storm Bay rock lobster fishery would be worth about $7.4M.

The scalefish fishery is managed at a national level by AFMA and at a state level by DPIPWE, and limits are set by through e.g. quotas, capped license numbers, closed areas/seasons and gear restrictions. For the state as a whole, there has been a general decline in production, from a high of >1100 t in the mid-1990s to about 300 t in recent years (Moore et al, 2018). Commercially-targeted species of scalefish in the region include blue grenadier, tiger flathead, school whiting, silver warehou, gummy shark, pink ling, calamari, garfish, Australian salmon, banded morwong, squid, southern calamari, octopus, wrasse,

flounder (Tassal, 2018; Petuna, 2018; Moore et al, 2018). Two Danish seine net trawlers operate in Storm Bay and parts of the lower Derwent and Frederick Henry Bay, primarily targeting school whiting and tiger flathead.

There is limited information for the Storm Bay fishing blocks in the most recent 2017/18 Scalefish Fishery Assessment Report (Moore et al, 2018), with the exception of the three estuarine areas. These areas have had highly variable landings since the mid-1990s, with significant declines in Frederick Henry Bay and Norfolk Bay. In 2016/17, 26 t of fish were taken from the Derwent estuary (predominately whiting), 4 t from Norfolk Bay (mostly octopus and some calamari) and 4 t from Frederick Henry Bay (mostly calamari). These three blocks alone account for more than 10% of the state total. If the 17t from the two eastern Storm Bay blocks is included (Tassal, 2017), Storm Bay would account for at least 17%. Further work is needed to compile the regional scalefish harvest for Storm Bay. Based on a statewide value of $9.7M for the 'other wild-caught species' (ABARES, 2017 cited Browne, 2018) and assuming the Storm Bay fishery accounts for 20% of this – the value of the Storm Bay scalefish fishery would be worth about $1.9M.

Marine farming activities in the Storm Bay region include both shellfish (oysters and mussels) and finfish (Atlantic salmon). There are three Marine Farming Development Plans for this region: Storm Bay - Trumpeter Bay/North Bruny; Storm Bay North; and Norfolk Bay/Tasman Peninsula). According to these plans there are currently 30 areas zoned marine farming across the Storm Bay Region, of which 20 allow for finfish production. There are also over 30 additional zones, primarily for shellfish, in the sheltered waters of Pipeclay Lagoon, Pittwater and Blackman Bay. It is difficult to determine which of these zones are currently under production.

The current harvest from existing finfish leases in Storm Bay is approximately 4000 to 4500t for those in the Nubeena area (Tassal Public Information Meeting, Feb 2019), and 8000 to 12,000t for those in the Trumpeter Bay region (HAC, 2017). Based on a value of $704M for 55,000t (ABARES, 2017 cited Browne, 2018), this would suggest a current value of $154M to $211M. Projected tonnage for the approved expansion is likely to be in the order of 30,000t in the short term and could expand to 40,000 to 80,000 t in the longer term, which - using the values above – would yield values of $384M, $512M and $1.02B, respectively.

Values associated with oyster and mussel aquaculture are more difficult to estimate, without a regional breakdown on the location of these leases. There are, however, significant numbers of leases in the sheltered waters of Frederick Henry & Norfolk Bay, Pittwater and Blackmans Bay, and recent studies suggest that oyster aquaculture in the Hobart and Southeast ABS regions account for 25% and 24% of employment in these sectors, respectively (Brown, 2018). Based on a statewide value of $23.5M for oyster and blue mussel aquaculture (ABARES, 2017 cited Browne, 2018) and assuming the Storm Bay fishery accounts for at least 25% of this – the value of Storm Bay shellfish aquaculture would be worth at least $5.9M.

The value of recreational fishing in southeastern Tasmania is estimated to generate $20M/year, while the value of recreational boats is estimated at $170M (replacement value) (Lyle et al, 2014). Assuming a 10-year depreciation period, this would amount to $17M/year, for a total combined value of $37M/year.

It is difficult to estimate the value of Storm Bay-associated tourism, events and other recreational activities, and particularly how a loss of environmental quality/amenity might affect these. Activities most directly affected could include major yacht races, boat tours (e.g. Hobart to Betsey Island, Port Arthur, Bruny Island), fishing charters, scuba and snorkel tours, and coastal walks. Further analysis is recommended.

Coastal real estate values are increasing rapidly in southeastern Tasmania, with a premium placed on unobstructed ocean views. A recent study of Sydney Harbour found that coastal real estate accounted for by far the largest proportion of economic values in dollar terms (Hoisington, 2015). This also merits

further consideration, as does how the installation large and visually prominent coastal infrastructure may influence property values (e.g. Jensen et al, 2018).

Finally, the value of 'ecosystem services' provided by healthy coastal habitats also requires further consideration, as well as the estimated losses associated with varying levels of impairment. In particular, the value of healthy reef communities and seagrass beds should be considered, together with the services they provide, such as:

- Water quality improvement
- Shoreline protection/sediment stabilisation
- Habitat, shelter and spawning/nursery areas for commercial and recreational species
- Habitat, shelter and spawning/nursery areas for protected and threatened species

Figure 3 highlights some of the key economic values of the Storm Bay region.

Summary of economic values of Storm Bay (*indicative – requires further analyses*)

Activity/Value	Estimated value
Commercial fishing	
• Abalone	2.4
• Rock lobster	7.4
• Scalefish	1.9
Marine Farming	
• Salmon	$154 to $211M
• Oysters & mussels	$5.9M
Recreational fishing	$37M
Other	
• Swimming, surfing, walking	??
• Tourism and events	??
• Real estate	??
Ecosystem services	??
• Seagrass & Caulerpa beds	??
• Temperate reefs & kelp	??
Total	**$209 to $266M**

APPENDIX B

STATE OF STORM BAY: DRAFT TABLE OF CONTENTS

APPENDIX C

STATE OF STORM BAY: REFERENCES, LINKS & NOTES (as of 27/7/19)

The following list of references has been compiled from a variety of sources and include IMAS scientific and fisheries reports, FRDC reports, State government planning documents, environmental impact assessments and associated reportd, various websites as well as more traditional peer-reviewed journals. References are broadly grouped into topics, with the most recent and relevant references first. Some references include abstracts or key figures, and some include annotated comments in italics (which reflect the views of this author). There is a considerable body of work on Storm Bay that is still in progress, and additional references should be added to this list as they become available.

STORM BAY MARINE FARM DEVELOPMENT PLANS, ENVIRONMENTAL LICENSES AND ENVIRONMENTAL IMPACT ASSESSMENTS

DPIPWE, 2018. Tasman Peninsula and Norfolk Bay Marine Farming Development Plan – September 2018
https://dpipwe.tas.gov.au/Documents/Tasman%20Peninsula%20and%20Norfolk%20Bay%20MFDP%20September%202018.pdf

Sets out marine farming zones and allowable uses in Norfolk Bay, eastern Storm Bay and Long Bay. There are currently 26 designated zones in this region, including 2 in Long Bay. Excluding Long Bay, 10 zones are designated for shellfish and seaweed only and 14 for finfish, shellfish and seaweed. The total zoned area within the Storm Bay region (excluding Long Bay) is 1657 ha, while the maximum leasable area is 828 ha. See table below for details. Of these areas, the area zoned for finfish is 426 ha, with a maximum leasable area of 238 ha.

Table 2.1 - Summary of Zones

Zone	Location	Category of Fish	Zone Area (ha)	Maximum Leasable Area (ha)
1	at Boxall Rock	Shellfish, seaweeds	5.07	5.00
2	at Breaknock Bay	Finfish, shellfish, seaweeds	9.10	9.10
3	west of Fulham Island	Finfish, shellfish, seaweeds	26.95	20.00
4	at Dunalley Bay	Finfish, shellfish, seaweeds	22.28	20.01
5	at Dunalley Bay	Shellfish, seaweeds	15.00	15.00
6A	west of Smooth Island	Finfish, shellfish, seaweeds	63.91	40.00
6B	north of Smooth Island	Shellfish, seaweeds	5.52	5.00
7A	east of King George Island	Finfish, shellfish, seaweeds	34.51	24.02
7B	north of Chronicle Point	Finfish, shellfish, seaweeds	19.54	14.00
7C	south of Chronicle Point	Finfish, shellfish, seaweeds	25.22	20.00
8	at Flinders Reef	Shellfish, seaweeds	58.04	50.00
9A	at Eaglehawk Bay	Shellfish, seaweeds	49.59	32.50
9B	at Boxall Bay	Shellfish, seaweeds	41.05	32.50
10A	south of Dart Island	Shellfish, seaweeds	6.18	5.00
10B	at Garfish Bay	Shellfish, seaweeds	21.55	20.00
10C	at Little Norfolk Bay	Shellfish, seaweeds	5.01	5.00
11	north of Eli Point	Shellfish, seaweeds	132.80	40.00
12	south-east of Ironstone Point	Shellfish, seaweeds	29.51	20.00
13	east of Green Head	Finfish, shellfish, seaweeds	59.23	27.01
14A	south-west of Creeses Mistake	Finfish, shellfish, seaweeds	143.10	48.50
14B	Billy Blue	Finfish, shellfish, seaweeds	3.95	3.00
14C	at Parsons Bay	Finfish, shellfish, seaweeds	17.21	12.00
14D	at Badger Cove	Finfish, shellfish, seaweeds	0.45	0.43
15A	at Long Bay	Shellfish, seaweeds	17.95	17.26
15B	at Long Bay	Finfish, shellfish, seaweeds	24.91	15.01
16	West of Wedge Island	Finfish, shellfish, seaweeds	863.00	360.00
Total			**1700.63**	**860.34**

DPIPWE, 2018. Storm Bay off Trumpeter Bay North Bruny Island Marine Farming Development Plan- Aug 2018
https://dpipwe.tas.gov.au/Documents/Storm%20Bay%20off%20Trumpeter%20Bay%20North%20Bruny%20Island%20MFDP%20August%202018.pdf

Sets out marine farming zones and allowable uses for the North Bruny area. There are currently 5 zones in this region, designated for finfish. The total zoned are within this region is 973 ha, while the maximum leasable area is 530 ha.

DPIPWE, 2017. Storm Bay North Marine Farming Development Plan – November 2017
https://dpipwe.tas.gov.au/Documents/FINAL%20-%20Storm%20Bay%20North%20MFDP%20November%202017.pdf
Sets out marine farming zone and allowable uses for Storm Bay North (SW of Betsey Island). There is one designated zone in this region with an area of 430 ha, with a maximum leasable area is 273 ha. Allowable uses include finfish, shellfish and seaweed.

Huon Aquaculture, 2017. Environmental impact statement to accompany the Draft Amendment No. 3 to the Storm Bay off Trumpeter Bay North Bruny Island, Marine Farming Development Plan, July 1998.
https://dpipwe.tas.gov.au/sea-fishing-aquaculture/marine-farming-aquaculture/marine-farming-development-plans/marine-farm-planning-proposals/storm-bay-off-trumpeter-bay

Petuna Environmental Impact Statement, 2017. Draft Storm Bay North Marine Farming Development Plan.
https://dpipwe.tas.gov.au/sea-fishing-aquaculture/marine-farming-aquaculture/marine-farming-development-plans/marine-farm-planning-proposals/storm-bay-north

Tassal, 2017. Environmental Impact Statement to accompany Draft Amendment No. 5 to the Tasman Peninsula and Norfolk Bay Marine Farming Development Plan, November 2005.
https://dpipwe.tas.gov.au/sea-fishing-aquaculture/marine-farming-aquaculture/marine-farming-development-plans/marine-farm-planning-proposals/tasman-peninsula-and-norfolk-bay

HYDRODYNAMICS, MODELLING & RISK ASSESSMENT

Karen Wild-Allen et al (in progress). Storm Bay biogeochemical model. FRDC 2017-215.
This $1.65M, 3-year project in progress commenced in late 2018. Key objectives are:

- To evaluate the performance of the existing hydrodynamic model of Storm Bay
- To characterise the primary sources of nutrients into Storm Bay from ocean currents, sediment resuspension, river inputs.
- To deliver a validated model of water quality in Storm Bay suitable for assessing future salmon farm expansion.
- To provide an information system comprising model results, observations and synthesis analyses, with links to parallel projects (e.g. monitoring program, decision support tools, seasonal predictions).

See FRDC website: http://www.frdc.com.au/project/2017-215 for further details and updates.

Hadley S, C Mcleod & J Ross (2017). Nutrient dispersion modelling for proposed marine finfish farming zones in Storm Bay. Report prepared for DPIPWE; selected sections provided as Appendix M within Huon Aquaculture EIS.

https://dpipwe.tas.gov.au/Documents/Appendix%20M%20-%20Overview%20Modelled%20Outputs%20for%20Storm%20Bay.pdf

Nutrient dispersion modelling was carried out (using CONNIE) for proposed marine finfish farming zones in Storm Bay. This involved single and combined farm dispersion modelling using particle tracking plus decay rates. Assumptions (Table 1) include a release period of 14 days and decay rate of 4 days. Six figures are provided in this report that integrate nutrient loads from the 3 farming areas based on a 40,000t biomass. These plots show modelled output for nutrients at surface and at depth, both seasonally and for the full year. Figures 2 & 3 show ammonia-N released from the 3 farms as a proportion of the TDN released (surface and depth). Figures 4 & 5 show ammonia-N released from the 3 farms superimposed on background ammonia-N levels. Figures 6 & 7 show ammonia-N released from the 3 farms superimposed on background DIN levels (ammonia + nitrate). There are many caveats around the use of this modelling outlined in Appendix 1 (p 14), including that the intent was to 'inform the design of a monitoring program' and cautionary statements about using results for assessment ('this early stage modelling is only indicative and results should be interpreted with caution'). *I think this model needs to be run using a much wider range of assumptions, and that the full range of outputs should be provided (e.g. sensitivity analyses). Without this, the presentation of selected scenarios and optimistic assumptions could be interpreted as cherry-picking those outcomes that appear to be of minor concern.*

Condie, S.A., R. Gorton, S. Hadley, R. Little, C. MacLeod, E. Ogier, W. Proctor, J. Ross, M. Sporcic and K. Wild-Allen (2017). INFORMD-2. Risk-based tools supporting consultation, planning and adaptive management for aquaculture and other multiple-uses of the coastal waters of southern Tasmania. FRDC 2012-024

http://frdc.com.au/Archived-Reports/FRDC%20Projects/2012-024-DLD.pdf

This project (4-yr, $750,000) developed four new products to assist in planning and ongoing management of aquaculture leases with a focus on the Derwent, Huon and D'Entrecasteaux regions:

(i) A new approach to identifying community, government and industry values (Your Marines Values – YMV) that has facilitated a more informed engagement processes and greater trust between participants. *How effective has this been? Seems like there are still high levels of continuing concern/mistrust across the region.*

(ii) A new biogeochemical model for the waters of the Derwent Estuary, Huon River and D'Entrecasteaux Channel. This model has been validated in detail and is now being used by stakeholders to test scenarios for planning and water quality impact assessment.

(iii) A publicly accessible online decision support tool (CONNIE) that can be used to identify waterborne interactions between aquaculture and other marine activities and assets. This facility is now being used extensively to identify impact zones and quantify pathogen risks.

(iv) A new online decision support tool (MAREE) to be used by government and industry for rapid assessment of the impacts of marine and coastal activities on local water quality. Examples include the impacts of nutrient and sediment loads associated with stocking of salmon leases; sewage treatment plants, other industrial discharges; and altered land-use in local catchments.

Buchanan PJ, KM Swadling, RE Eriksen, K Wild-Allen, 2014. New evidence links changing shelf phytoplankton communities to boundary currents in SE Tas. Reviews in Fish Biology and Fisheries vol 24(2), 427-442.

Storm Bay is affected by the seasonal interplay between the East Australian Current (EAC) and Leeuwin Current (LC). Intensifying EAC current has resulted in seasonal increase in southward penetration, beginning in October. However, tends to be erratic; may still have LC present on shelf in summer (as per HAC EIS, p83).

Herzfeld, 2008. Connectivity in Storm Bay. CSIRO Tech Report (19pp).

Internal report – commissioned by DPIPWE; this does not appear to be a public document, though it is cited in the EIS.

WATER QUALITY & MONITORING

Swadling KM, RS Eriksen, JM Beard and CM Crawford (2017). Marine currents, nutrients & plankton in the coastal waters off SE Tasmania and responses to changing weather patterns (FRDC 2014-31)

http://www.frdc.com.au/Archived-Reports/FRDC%20Projects/2014-031-DLD.pdf

Good overview of various coastal water masses, and increasing influence of EAC.

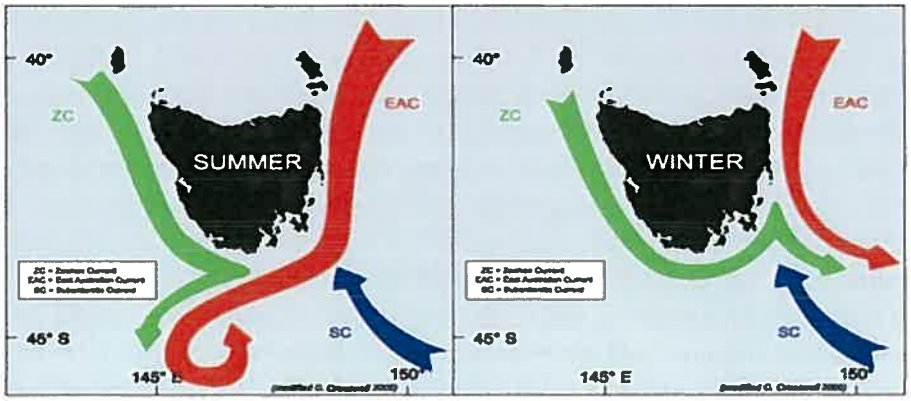


Figure 2.1 Major currents and water masses influencing the east coast of Tasmania, including Storm Bay; ZC = Zeehan Current, EAC = East Australian Current, SC = Subantarctic Current (from Cresswell 2000).

Report on results of 5-year monthly sampling (Nov2009 - Apr2015) at six sites in Storm Bay:

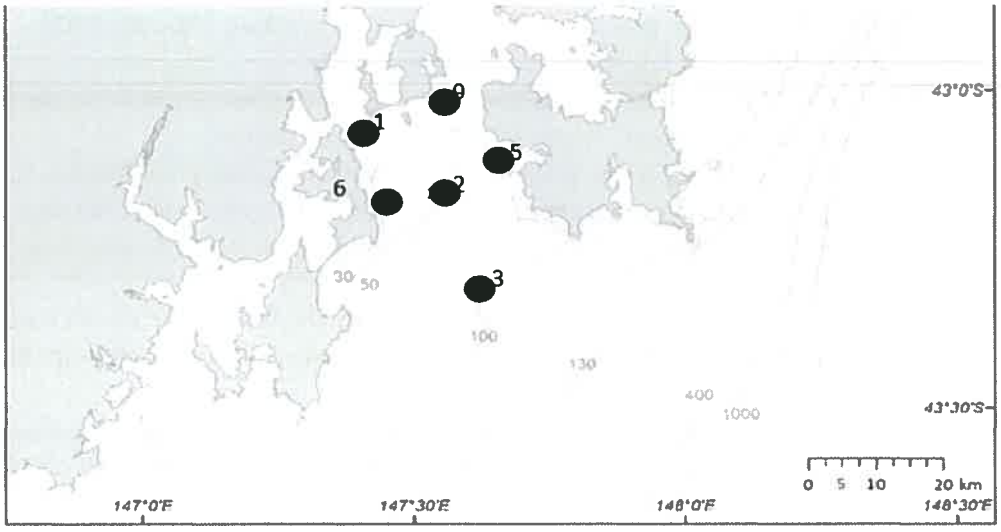


Figure 2.5 Map of Storm Bay showing site locations, and bathymetry (m).

Collected sensor data (temp, salinity, dissolved oxygen, fluorescence) as well as surface, mid (10m) and bottom samples for dissolved nutrients, chlorophyll a, phytoplankton and zooplankton. Data presented as time series and box & whisker plots. Some inclusion of CSIRO glider data as well. Compared 10m results at S2 with CSIRO data collected in 1985-89. During final 12 months also trialled Fast Repetition Rate Fluorometer (rates of primary production) and screened water samples for amoebic gill disease (AGD). Found high level of seasonal and interannual variability, depending on which water body dominates, La Nina vs El Nino conditions, and river flows. Comparison of two data sets indicates increasing water temperature and decreasing NOx and particularly PO4, and overall decline in chla. Found low levels of AGD agent, however this was sufficient to induce AGD under suitable conditions.

- Site 9 (FHB) had lowest NOx and highest chla
- Ammonia values at S6 (Trumpeter Bay) increased from Aug 2011, *presumably due to fishfarm expansion?*
- Response to storm conditions not really explored; did not sample during extreme weather
- Excerpt from page 64:

Low nutrients, especially at the surface in summer and autumn, along with lowest dissolved oxygen concentrations in summer – autumn when the temperatures and biological activity are highest, suggest that a significant increase in nutrients, especially available N, from salmon aquaculture over this period could have a significant effect on the ecology of the system. On the other hand, these increased nutrients could potentially help mitigate the effect of increased penetration of nutrient-poor EAC waters in the region. This is a major factor in the demise of giant kelp (*Macrocystis pyrifera*) beds on the east coast of Tasmania (Johnson et al. 2011). The consistently higher ammonium concentration in bottom waters at site 6 from 2011 also requires further observation as this site is close to a salmon farm that has been in commercial production for around two years.

Crawford C , K Swadling, P Thompson, L Clementson , T Schroeder, K Wild-Allen (2011). Nutrient and phytoplankton data from Storm Bay to support sustainable resource planning. FRDC 2009-067
http://www.frdc.com.au/Archived-Reports/FRDC%20Projects/2009-067-DLD.pdf
Summarises 12 months of monthly monitoring data for six sampling sites in SB: 1 through 4 in a line from Iron Pot to offshore; 5 to N of Wedge Island; 6 off North Bruny. This data is included in FRDC 2014 – 31 (above)

Harris GP, FB Griffiths, LA Clementson, V Lyne and H Van der Doe, 1991. Seasonal and interannual variability in physical processes, nutrient cycling and the structure of the food chain in Tasmanian shelf waters. Journal of Plankton Research 13:109-131.

FISH HEALTH, ANTIBIOTICS AND ANTIFOULANTS
Key issues/diseases include AGD and pilchard orthomyxovirus (POMV). AGD is caused by a parasitic amoeba; thickens gill epithelium, which reduces oxygen diffusion – fish basically suffocates. Fish in first year at sea are the most susceptible. AGD becomes more prevalent with increasing water temperature and when fish are stressed.

Adams M, A Bridle, C Norte Dos Santos, Y Pennachi and B Nowak, 2016. Comparative susceptibility and host responses of endemic fishes and salmonids to amoebic gill disease in Tasmania. FRDC Project No 2011/070
http://www.frdc.com.au/project/2011-070
Series of experiments whereby endemic fish and Atlantic salmon were infected with AGD. Experiments 1-4 involved 4 species of Tasmanian endemic fish with different life histories (Australian salmon, yellow eye mullet, purple wrasse, sand flathead; collected from Tamar in 2012) – 10-day exposure to relatively high levels of AGD, and compared to parallel experiments on Atlantic salmon. While the endemic fish were variously infected, all showed innate capacity to resist, defend, or tolerate experimental challenge with AGD. Experiment 5 compared responses of cohabiting Atl salmon and YE mullet over 28 days, and found that mullet were able to recover from AGD infection. Second series of experiments studied response of Atl salmon, rainbow and brown trout (incl hybrids) to repeated infections. Rainbows could not acclimatise to marine conditions. Brown trout and hybrids generally more robust. Atl salm tend to build up resistance when re-infected.

Good discussion of other studies of AGD on endemic species both globally and in Tassie on p 16. Globally, AGD has been reported in other salmonid and non-salmonid species including Chinook salmon, Coho salmon, rainbow trout, brown trout, turbot, sea bass, sea bream, ballan wrasse, olive flounder, etc. In Tassie, AGD-like lesions have been observed on couta, bastard trumpeter and mullet (Jones, 88). However, a survey of 12 spp/325 fish caught in vicinity of salmon cages did not find AGD; also were not able to induce AGD in seahorses

McLeod C & R Eriksen, 2009. A review of the ecological impacts of selected antibiotics and antifoulants currently used in the Tasmanian salmonid farming industry (marine farming phase) FRDC 2007-246
http://www.frdc.com.au/Archived-Reports/FRDC%20Projects/2007-246-DLD.pdf

HABITAT MAPPING

The LIST: SE Tas Marine Habitat Map (1:25,000)
https://www.thelist.tas.gov.au/app/content/data/geo-meta-data-record?detailRecordUID=392697df-2ccc-4fc7-ba38-eb24a97c803c
Produced by TAFI based on surveys undertaken from June to Dec 2000. Ran zig-zag transects from 40m contour at 200m intervals. Eleven habitat classifications, including rocky reefs and seagrass beds. See full report below for details.

Barrett N, J.C. Sanderson, M. Lawler, V. Halley and A. Jordan, 2001. Mapping of Inshore Marine Habitats in South -eastern Tasmania for Marine Protected Area Planning and Marine Management. TAFI Technical Report Series #7. Produced for NHT
https://eprints.utas.edu.au/9087/1/Mapping_of_Inshore_Marine_Habitats_Nov2001.pdf
Inventory of habitat types of the shallow coastal zone (to 40m depth) in Bruny Bioregion, as a basis for identifying potential Marine Protected Areas. Started with Bruny Bioregion because of high level of diversity, endemism and relatively high risk due to proximity to Hobart. Includes detailed series of 1:25,000 maps with 4 categories of reef, 4 of seagrass/Caulerpa and 4 of unconsolidated substrate. Also includes bathymetry and wave exposure maps. Based on extensive field surveys with position, depth and bottom type continually logged plus regular video drops. Aerial photos scanned/rectified to provide more detail in shallow water (<10m). Nine mapping units described, including 4 relevant to Storm Bay (Norfolk, Frederick Henry, Betsey and Adventure). Of particular note:

- Large Caulerpa beds in Norfolk Bay
- This bioregion has particularly high abundances of two macroalgal species that are endemic to Tasmania (*Lessonia corrugata* and *Xiphophora gladiata*) and one species whose Australian distribution is restricted to the southern half of Tasmanian waters (*Macrocystis pyrifera*). *Lessonia* is particularly common in the region extending from northern Bruny Island to Cape Raoul, where it appears to replace *Phyllospora*. The distribution of *Macrocystis* extended throughout this bioregion, and while its distribution appears highly variable through time, a number of locations appear to consistently have large beds, including north-east Bruny Island.

Barrett N & V Lucieer, 2008. Inshore habitat mapping in the southeast of Tasmania.
www.nespmarine.edu.au/system/files/Barrett%20and%20Lucieer%20inshore%20habitat%20mapping.pdf
Poster illustrating extremely detailed inshore habitat mapping using multibeam profiler at four sites in SE Tas (none in Storm Bay).

Mount R, V Lucieer, M Lawler and A Jordan (2005). Mapping of estuarine and marine habitats in the southern NRM region.
http://www.imas.utas.edu.au/__data/assets/pdf_file/0005/743090/Southern_Estuaries_Final_Report05.pdf
Mapped 11 estuaries in the southeast region, including Pittwater and Pipeclay Lagoon

ROCKY REEFS & INTERTIDAL AREAS
McLeod et al (in progress). Managing ecosystem interactions across differing environments: building flexibility and risk assurance into environmental management strategies. FRDC 2015-024
Four main objectives:

1. Establish key recovery response principles and benthic condition criteria for all areas in which farming currently occurs – building on existing understanding to identify both generic and regionally specific performance criteria.
2. Improve our understanding of sediment process interactions and recovery responses, in order to ensure that monitoring and management strategies are optimised for each growing region – a key objective will be relating the findings to the most important ecological and resource interactions of salmon farming in each region.

3. To evaluate the potential for interactions between local reef systems and salmon farming – determining the main risk factors, recommending risk appropriate monitoring and assessment approaches and identifying risk mitigation strategies where relevant.
4. To improve our understanding of how local scale (site based) environmental condition data, can integrate with local scale modelling to improve management outcomes – a key goal will be identifying how local scale understanding of sediment processes and benthic pelagic interactions can inform and be informed by regional modelling and management approaches.

Several review papers are being/have been produced, including one on international best practice. Final report for this project is now due i@ Aug 2019, and should include much useful new information.

Crawford C and S Harwin (2018). Reassessment of intertidal macroalgal communities near to & distant from salmon farms and an evaluation of using drones to survey macroalgal distribution. FRDC Project 2014-241
http://www.frdc.com.au/project/2014-241
Revisited intertidal sites previously surveyed in 2002/3 (2 surveys) in autumn/spring of 2015/16 (4 surveys). Sixteen sites across Channel/Huon – 5 close to fishfarms (<1km), 6 mid (1-5 km) and 5 far >7 km (refs). Three transects at each site w/replicate quadrats in mid and lower intertidal. Recorded % algal cover, with a focus on two dominant species - *Ulva* and *Hormosira*. *Ulva* (sea lettuce) typically considered to be a nuisance/nutrient indicator species while *Hormosira* (Neptune's Necklace) is an important 'ecosystem engineer' with a low tolerance for nutrients and sediments; also prefers sheltered sites. Results found that abundance of H had declined significantly since previous survey (nearly gone from mid-tide region). Ulva dominated in spring (esp in 2016) and at mid-tide sites, and % cover of Ulva had increased significantly since 2002/3. However, did not find any significant patterns wrt proximity to fish farms, suggesting that other factors may be in play. Suggest that intertidal algae may not be a useful indicator of nutrient impacts from fish farms, as there are too many other factors (e.g. temperature, wave exposure, substrate, other nutrient sources, incl S Ocean). Also note a number of issues with intertidal monitoring, including access/logistics and the difficulty of finding unimpacted reference sites. Stable isotopes in *Ulva* could be a useful tracer of nitrogen sources – some work on this done by Oakes & Eyre, 2015. Other useful refs: Bellegove et al 2017; Hadley et al, 2016 (IMTA) and McLeod et al 2016 (nutrient additions – see below). Drone surveys were not very successful – could not clearly delineated submerged *Macrocystis*, and intertidal surveys also hard to do because even small water depths caused interference (see report for details).

Macleod C, D Ross, S Hadley, L Henriquez and N Barrett (2016). Clarifying the relationship between salmon farm nutrient loads and changes in macroalgal community structure/distribution. FRDC Project 2011-042
https://www.imas.utas.edu.au/__data/assets/pdf_file/0008/905759/2011-042-DLD-Nutrients.pdf

Set of 2 PhD projects on potential for nutrient impacts on macroalgae: one based on field manipulations, the second on modelling of Integrated Multi-trophic Aquaculture (IMTA) potential.

#1 (Henriquez) looked at impact of nutrient additions to three reef communities in the Channel (TB, Green Isl and 9pin). Work done @2012? Three main components: first added nutrients to established reef communities; second added nutrients to cleared patches and tracked succession; third measured physiological responses (PAM and nutrient tissue levels). Did not find major effect on canopy abundance, but some physiological differences. Effect on opportunistic species was variable – proliferated at one site, not at others. Need to consider combined impacts of light, T, S, nutrients and exposure (waves). Lower & mid channel sites may be influenced by Huon River tannins, & less susceptible?

#2 (Hadley) used models to assess potential for IMTA. Found the was good potential, but location of culture depends on whether using IMTA for profit or nutrient mitigation. Desktop project.

Valentine J, M Jensen, D Ross, S Riley and S Ibbott (2016). Understanding broad scale impacts of salmonid farming on rocky reef communities. FRDC 2014-042

http://www.frdc.com.au/project/2014-042

Two-part study of reef communities. Part 1 analysed long-term database for three Marine Protected Areas (MPAs) at Maria, Tinderbox and Ninepin Pt (1992-2015, autumn sampling events only). No consistent pattern of change, except at central Tinderbox (big increase in *Caulerpa*). Nutrient indicator species (NIS) generally low and variable. Part 2 surveyed broader set of reefs (26 sites) including MPAs, Oakhampton Bay, Storm Bay (N Bruny and Nubeena area) and lower Channel. These were also done in autumn. Again no obvious regional impacts from FFs, and low cover of NIS. Did not match findings by Oh. (*Note: sites were somewhat distant from FFs (>2 km) as focus was on regional impacts, and sampling took place in autumn, when NIS are generally low.*) Recommend that future monitoring be designed to include both rapid assessment methods with a focus on NIS (e.g. 6 monthly) as well as more holistic Edgar-Barrett surveys (3-5 yearly). Extra sites included in 2015 could provide useful baseline.

Oh E, G Edgar, J Kirkpatrick, R Stuart-Smith and N Barrett (2015). Broad-scale impacts of salmon farms on temperate macroalgal assemblages on rocky reefs. Marine Pollution Bulletin 98 (1-2)

A B S T R A C T

Intensive fish culture in open sea pens delivers large amounts of nutrients to coastal environments. Relative to particulate waste impacts, the ecological impacts of dissolved wastes are poorly known despite their potential to substantially affect nutrient-assimilating components of surrounding ecosystems. Broad-scale enrichment effects of salmonid farms on Tasmanian reef communities were assessed by comparing macroalgal cover at four fixed distances from active fish farm leases across 44 sites. Macroalgal assemblages differed significantly between sites immediately adjacent (100 m) to fish farms and reference sites at 5 km distance, while sites at 400 m and 1 km exhibited intermediate characteristics. Epiphyte cover varied consistently with fish farm impacts in both sheltered and exposed locations. The green algae *Chaetomorpha* spp. predominated near fish farms at swell-exposed sites, whereas filamentous green algae showed elevated densities near sheltered farms. Cover of canopy-forming perennial algae appeared unaffected by fish farm impacts.

Good review of opportunistic algal growth on temperate reefs @ FFs; often accompanied by loss of diversity & canopy-forming species. Many macroalgal spp have preference for ammonia-N. Transects & photos at 10 reefs which varied in exposure to wind and swell. Surveys conducted in Nov/Dec 2008, primarily in Channel, but one in Nubeena. Lack of impacts on canopy species could be related to general resilience, insufficient nutrients and/or insufficient time for full effects to become apparent. Possibility that reference sites also influenced by regional enrichment noted. Macroalgae is a useful tool for detecting nutrient impacts (possibly more so than direct water quality measures), and suggest that impacts may extend beyond regulatory compliance boundaries. Impacts could be better assessed/modelled with additional info on prevailing current directions. See Oh, 2009 Thesis for further detail.

Fowles et al, 2018.

Series of paper looking at impacts of pollution from sewage, stormwater, marinas and fishfarms using deployment of paver substrates. Study sites in the Channel and Derwent

SOCIO-ECONOMICS

Browne B (2018). Fishing for compliments: fishing in the Tasmanian economy. Report prepared for the Australia Institute/commissioned by the Tasmanian Abalone Council.

Assessment of the economic value and employment figures associated with salmon aquaculture, shellfish aquaculture, commercial fishing and recreational fishing. Includes both sectoral and regional analyses. Results based on ABC census data are quite different than those based on TSGA figures.

Alexander K, (in progress). Determinants of socially supported wild-catch & aquaculture fisheries.

http://www.frdc.com.au/project/2017-158

Objectives (as set out on FRDC website)

1. To provide a nuanced definition of societal support for wild-catch and aquaculture fisheries in Australia

2. To identify determining factors (social, economic, environmental and political) affecting societal support for wild-catch and aquaculture fisheries in Australia
3. To identify means by which to detect, assess and monitor societal support for wild-catch and aquaculture fisheries in Australia using a risk-based approach

Fudge M, M Anderson and T Lewis (2012). Establishing regional indicators of social sustainability in the Tasmanian aquaculture industry - a pilot study. FRDC 2010/219
http://www.frdc.com.au/project/2010-219

Hoisington C (2015). Our Harbour Our Asset: An overview of economic activities and values associated with Australia's most iconic harbour, and its use by the city that surrounds it, Sydney Institute of Marine Science, Sydney, Australia
Interesting economic assessment of Sydney Harbour, including commercial activities, tourism, real estate, recreation. Real estate by far the largest value.

Jensen CU, TE Panduro, TH Lundhede, ASE Nielson, M Dalsgaard and BJ Thorsen, 2018. The impact of onshore and offshore wind turbine farms on property prices. Energy Policy 116, p 50-59.

JELLYFISH AND HARMFUL ALGAL BLOOMS

Crawford C, N Moltschaniwskyj and S Willcox (2011). Size and characteristics of aggregations of moon jellyfish (*Aurelia sp*) in Tasmania, Australia. Papers and Proceedings of the Royal Society of Tasmania, Volume 145

Willcox S, N Moltschaniwskyj, C Crawford (2008). Population dynamics of natural colonies of *Aurelia* sp. scyphistomae in Tasmania, Australia. Marine Biology 154 (4)

Carl C, J Gunther and L Sunde (2011). Larval release and attachment modes of the hydroid *Ectopleura larynx* on aquaculture nets in Norway. Aquaculture Research 42: 1056-60

Guenther J, E Misimi and L Sunde (2010). The development of biofouling particularly the hydroid Ectopleura larynx on commercial cage nets in mid-Norway. Aquaculture 300:120-127

Holst S and G Jarms (2007). Substrate choice and settlement preferences of planula larvae of five Schphozoa (Cnidaria) from German Bight, North Sea. Marine Biology 151: 863-71

Lo W, J Purcell, J Hung, H Su and P Hsu (2008). Enhancement of jellyfish (Aurelia aurita) populations by extensive aquaculture rafts in a coastal lagoon in Taiwan. ICES Journal of Marine Science 65:453-61.

McLeod D, G Hallegraeff, G Hosie and A Richardson, 2012. et al, 2012. Climate change driven expansion of the red tide dinoflagellate *Noctaluca scintillans* into the Southern Ocean. *Journal of Plankton Research*, Volume 34, Issue 4,

FISH & FISHERIES
Lyle (2018). Tasmanian recreational rock lobster and abalone fisheries: 2017-18 Fishing Season. IMAS report.

Lyle J, K Stark and S Tracey (2014). 2012/13 Survey of recreational fishing in Tasmania. IMAS Report
Next one is due out in 2019

Mundy and McAllister (2018). Tasmanian abalone fishery assessment 2017. IMAS Report.
http://www.imas.utas.edu.au/__data/assets/pdf_file/0006/1162518/AbaloneAssessment2017Web-sm.pdf

Moore B, J Lyle and K Hartmann (2018). Tasmanian scalefish fishery assessment 2016/17. IMAS Report.
http://www.imas.utas.edu.au/__data/assets/pdf_file/0004/1227541/Tasmanian-Scalefish-Fishery-Assessment-2017_18.pdf

Hartmann K, C Gardner, R León, J Rizzari (2019). Fisheries assessment: Tasmanian rock lobster 2017/18. IMAS Report
http://www.imas.utas.edu.au/__data/assets/pdf_file/0011/1245458/RL_Stock_Assessment_2017-19_Final_June_2019.pdf

Tracey S, K Hartmann, E Forbes, J Semmens & J Lyle (2011). Movement of recreational fish species in southeast Tasmania. IMAS Report.
Acoustic tagging study of flathead, bream and trout in the Derwent, Frederick Henry and Norfolk Bay

Stehfest K, J Lyle and J Semmens (2015). The use of acoustic accelerometer tags to determine seasonal changes in activity and catchability of a recreationally caught marine teleost.
Flathead behaviour in Frederick Henry, & links to temperature

Barnett A, K Abrantes, J Stevens, B Bruce, J Semmens (2010) Fine-Scale Movements of the Broadnose Sevengill Shark and Its Main Prey, the Gummy Shark.
Tracking tagged sharks in Derwent and Norfolk Bay