



International  
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Institute



# SEA URCHIN FARMING

An International Specialised Skills Institute Fellowship.

**DR IMOGEN FULLAGAR**

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# Table of Contents

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<b>i. Acknowledgements</b>	<b>3</b>
<b>ii. Executive Summary</b>	<b>5</b>
<b>1. Fellowship Background</b>	<b>7</b>
<b>2. Fellowship Learnings</b>	<b>13</b>
<b>3. Personal, Professional and Sectoral Impact</b>	<b>21</b>
<b>4. Recommendations and Considerations</b>	<b>23</b>
<b>5. References</b>	<b>24</b>
<b>6. Appendix</b>	<b>25</b>

# i. Acknowledgements

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The Fellow would like to thank the following individuals and organisations who generously gave their time and their expertise to assist, advise and guide her throughout her Agribusiness Fellowship.

## Awarding Body – International Specialised Skills Institute (ISS Institute)

The ISS Institute plays a pivotal role in creating value and opportunity, encouraging new thinking and early adoption of ideas and practice by investing in individuals.

The overarching aim of the ISS Institute is to support the development of a “Smarter Australia”. The Institute does this via the provision of Fellowships that provide the opportunity for Australians to undertake international skills development and applied research that will have a positive impact on Australian industry and the broader community.

The International Specialised Skills Institute was founded 28 years ago, by Sir James Gobbo AC, CVO, QC, and former Governor of Victoria, who had a vision of building a community of industry specialists who would lead the up-skilling of the Australian workforce. The Fellowship Program builds shared learning, leadership and innovation across the broad range of industry sectors worked with. Fellows are supported to disseminate learning's and ideas, facilitate change and advocate for best practice through the sharing of their Fellowship learning's with peers, colleagues, government, industry and community.

Since its establishment 28 years ago, ISS Institute has supported over 450 Fellows to undertake research across a wide range of sectors which in turn has

led to positive change, the adoption of best practice approaches and new ways of working in Australia.

The Fellowship Programs are led by investment partners and designed in a manner which ensures that the needs and goals desired by the partners are achieved. ISS Institute works closely to develop a Fellowship Program that meets key industry priorities, thus ensuring that the investment made will have lasting impact.

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## Fellowship Sponsor - Agribusiness

Agrifoods Skills Australia was the Industry Skills Council for the Agrifoods Industry covering rural and related industries such as food processing (including beverages, wine and pharmaceuticals), meat, seafood, and racing. The Fellow, and the project team, would like to thank them for providing funding support for this Fellowship.

## Personal Acknowledgements

This fellowship was awarded on the back of decades of work undertaken by Will James. It is great to be mentored by someone with his commitment. It is also a pleasure to acknowledge the consistent support of Scott Brooks, the international networking genius of fellow Rotarians (Bowen Depke and Eric Jorgensen) and Christine Force, and the swell of support from fellow Tasmanian entrepreneurs. Family logistics were only possible thanks to Edwin, Karri, and Miah.

Dr Fullagar is very proud to be an ISSI fellowship alumni. She thanks the ISSI team and sponsors for their confidence and the opportunity generated by the fellowship, and trusts this report does justice to showing what impact ISSI investment can have.

## ii. Executive Summary

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### Background

The opportunity for a sea urchin industry in Tasmania has existed for well over thirty years. To date, activity within the sector has been opportunistic wild catch, with the exception of the extensive work of Will James who successfully demonstrated marine urchin ranching (most recently at Triabunna, 2009). Development of this industry has been delayed by necessary changes to regulations, and the poor security of supply required to attract a market (i.e. limited producers and poor social capital to accelerate development of technique). Thus, the basis of the original fellowship application was to find and import expertise relating to urchin life cycle husbandry (hatchery and aquaculture).

This report represents ISSI Agribusiness fellowship, sponsored by Agrifoods Skills Australia, awarded in 2017, and taken in 2018. The recipient, Dr Fullagar, is an independent social economist. Her work outlined in this report is the direct result of being motivated by award of the ISSI fellowship and had no other funding.

### Building the fellowship audience

After being awarded the ISSI fellowship, Fullagar looked to ensure the audience for the fellowship by self-funding:

- » Coordination of two public meetings to bring together parties interested in developing an urchin industry in Tasmania
- » Conceptualisation of a fully mature sea urchin industry would look like, and secured endorsement of this vision from interested peers

- » Coordination of multiple regular meetings for interested peers, and peers and used these to prepare a ten year ten-year industry development plan of how these peers could work together realise the industry vision over a period of ten years. This document comprised three successive stages and was peer endorsed.
- » Preparation of a workplan and budget for the first stage of this plan, which integrated urchin aquaculture with growing of urchin feed (seaweed).
- » Fostering the development of networks between Tasmania and mainland urchin enthusiasts (research and industry) via meetings, introductions, and dialogues of information exchange.
- » Integration of above information into a funding proposal for a joint venture proposal with a total value of \$1.85m. This was agreed by the peer network, and submitted via one of the endorsing parties, with the grant component being awarded in early 2018.

The planned focus of the fellowship evolved to accommodate areas of interest that peers had wanted to lead. This resulted in a refocus of the original application on fresh sea urchin feed (seaweed) and the development of the seaweed industry in developed small business economies of Maine (USA) and New Zealand.

### Travel learnings

The fellowship travel provided opportunity to reflect on cultural issues within the seafood sector that were preventing investment necessary to grow an industry. Through the fellowship, Dr Fullagar learned how Maine had developed their

seaweed industry by fostering small scale investment. In New Zealand, Fullagar found product peers who were interested in collaborative development.

## Personal, professional and sectoral impact

The fellowship journey has delivered:

- » Clear structure to what a mature urchin industry in Tasmania will look like
- » An endorsed 10 year plan of how to build that industry (endorsed by both peers and the Australian Government)
- » Successful funding of a \$1.85m project for the first 18 months of that plan (now exclusively focused on development of on-shore aquaponic techniques)
- » Development of an independent partnership focused on a demonstration farm
- » Development of a proposal for the engagement of entrepreneurs in building the Tasmanian urchin industry (currently under discussion with potential partners)
- » Invitation for Dr Fullagar to present at the Tasmanian Macroalgae Interest Group (University of Tasmania)
- » Invitation for Dr Fullagar to speak at a national urchin workshop about industry development.

## Considerations / recommendations

There are three criteria to developing an urchin industry in Australia. These criteria and their status is:

**1. Vision and planning.** It is very hard to secure investment without a clear picture of what you are trying to build, and how.

**Recommendation:** that the industry vision Dr Fullagar coordinated for Tasmania is be adapted and adopted to support the development of a national urchin industry. This is important because no single state has critical mass to generate an urchin industry.

**2. Opportunity.** The aquaculture sector in Australia is framed by mature industries and regulations. Finding pathways to realise 'obvious' opportunities is not trivial.

**Recommendation:** that industry development be recognized as a legitimate workload that warrants resourcing, and that it be included in budgeting of urchin projects.

**3. Social capital for commercial production of commercial operators.** University research into feeds and efficiencies have been progressing rapidly, while development of commercial production of urchin in all States is hampered by entry requirements designed for mature industries. There is a need to provide entry opportunities so the industry can succession, develop experience and cashflow, and grow. Research is currently moving faster than commercial growth, and this is increasing the cost and complexity of becoming a commercial urchin operator.

**Recommendation:** the social capital methods used to build a seaweed industry in Maine be adapted into a proposal to engage entrepreneurs in Australia's urchin industry.

**4. Opportunity.** The aquaculture sector in Australia is framed by mature industries and regulations. Finding pathways to realise 'obvious' opportunities is not trivial.

**Recommendation:** that industry development be recognized as a legitimate workload that warrants resourcing, and that it be included in budgeting of urchin projects.

# 1. Fellowship Background

## Fellowship Context

The purpose of this Fellowship is to realise the environmental opportunity for a commercially viable sea urchin industry in Tasmania. This is important for Australia because sea urchin are both an environmental risk (they decimate natural seaweed stands) and a commercial opportunity (they are a high value product when in good condition). The commercialisation of urchin is a niche activity across Australia. A key ambition of the Fellowship was to foster collaboration and communication across the burgeoning industry at both the State and national scales.

## Fellowship Methodology

The Fellowship was delivered primarily through meetings, research, coordination, and dissemination of information. This included development of an industry brochure, industry partnerships, and industry development project proposals. The travel component of the Fellowship was undertaken in Maine (USA) and New Zealand (North and South Islands).

The itinerary developed focused on Maine (USA) and New Zealand. Table 1 outlines the rationale of these destinations.

Table 1: Comparison of fellowship destinations

	Tasmania	Maine (USA)	New Zealand
Jurisdiction population	0.52 million	1.34 million	4.79 million
Annual value of seafood sector	\$913 million	\$700 million	\$1 000 million
Jobs in seafood sector	3500	5000	13 000
Status of seafood sector	Developed economy, traditionally small business	Developed small-business economy	Developed small-business economy
Feature industries	Salmon aquaculture and wild catch. Other aquaculture: pacific oysters and abalone	Lobster	Diverse. Dominated by wild catch and mussel aquaculture.
Marine changes	Declining upswells of cold, nutrient-rich waters from the poles; strengthening warm, nutrient-poor currents from north (Tasmania) and south (Maine)		Environmental pressures of commercial fishing

	Tasmania	Maine (USA)	New Zealand
Priority issues	Growth of aquaculture; succession (especially outside of salmon sector)	Industry succession and future in light of marine changes (lobsters moving out of State waters)	Balancing growth with environmental values
Trends in industry structure	Growth of the two big salmon companies dominates relevant social and political priorities. Industry development is increasingly specialised to this growth.	Small business dominant by design (lobster licences cannot be accrued)	Small business dominated. Biggest companies are iwi owned (profits go back to Kiwi/ Maori communities). Accelerating trends towards bigger business
Status of urchin industry	Opportunistic wild catch within managed quotas	Managed by quota (selectively harvested wild catch)	Managed by quota (selectively harvested wild catch)
Status of seaweed industry	Minimal; based on wild harvest	Emerging via IMTA initiatives	Cultural; based on beach cast with a range of products/brands developed

## Relevance of Maine (USA) to Tasmania

Although the socio-political focus of Tasmania's seafood sector is shifting from small business, all three sites are developed economies with a small business base. All three economies are dominated by pre-dominantly Anglo-Saxon and English-speaking cultures that date back between 200 and 400 years.

Although in opposite hemispheres, Maine and Tasmania share identical challenges of changes in marine currents, and both claim to be in the highest 1% of changing marine environment across the globe. This makes them particularly fascinating comparisons. While there are environmental similarities between these locations, many species are different. Being in opposite hemispheres their harvest seasons are also off-set. These points make information sharing both relevant and unimpeded by direct competition.

Maine is one of the USA coastal States where individuals have embraced the concept of small scale "integrated multi-trophic aquaculture" (IMTA; mixed seafood/shellfish marine farming). Despite being the home location of a global leader in urchin aquaculture, Steve Eddy, the urchin sector in Maine remains a wild catch fishery. The fellowship opportunity in Maine was to explore the culture underpinning their development of IMTA and understand why urchin aquaculture had not emerged.

### Industry contacts in Maine

- » Todd Jagoutz and David Williams (Sea Greens Farm – kelp farmers/processors)
- » Arthur (Mike) Pivrotto (past kelp harvester)
- » Matt Moretti (Bang Islands Mussels – mixed marine farmer)
- » Joe Leask (urchin harvester – wild catch)

- » Atchan Tamaki (ISF Trading – urchin processor)
- » David Whiston (Chebeague Island Oysters – self-started oyster farm)
- » Nick Battista (Island Institute – local industry support network)
- » Dierdre Gilbert (Director, State Marine Policy, Maine Dept of Marine Resources)
- » Chris Vonderweidt (Gulf of Maine Research Institute)

## Relevance of New Zealand to Tasmania

New Zealand and Tasmania are both small, remote, island economies with fishing sectors based in the Pacific Ocean (Tasmania's western coast borders the Indian Ocean). The concept of IMTA aligns with the environmental values of New Zealand, and the environmental challenges of Tasmania – yet IMTA has not yet emerged in either economy.

The Tasmanian sense is that the New Zealand industry is characterised by innovative entrepreneurs rather than large scale industry. This may help explain the significantly higher jobs to value of seafood sector ratio evident in Table 1.

New Zealand has both a kelp industry (based on beach cast) and a small, culturally driven sea urchin industry. Here sea urchin gonads are called 'kina', and their primary market is based on the profile of kina as a traditional Maori delicacy. While kina is a less selective product than the Japanese uni, they both rely on the product confidence of their respective markets.

The fellowship opportunity in New Zealand was to explore what is driving and sustaining the small business operations in kelp and sea urchin, and to identify whether any of the processes and markets they draw on could be relevant to commercialising kelp and sea urchin in Tasmania.

## Industry contacts in New Zealand

- » Kara Herbert (Sea Urchins New Zealand – urchin processor)
- » Tane and Clare Bradley (Managers, AgriSea New Zealand)
- » Paul Cresswell (Senior Aquaculture Analyst, NZ Ministry for Primary Industries)
- » Thomas Hildebrand (Ngai Tahu Seafood – seafood company of the South Island iwi)
- » Roger and Nicki Beattie (Zelp – successful paua abalone entrepreneurs who have moved into kelp processing)

## Fellowship Period

The Fellowship outlined in this report was awarded in May 2017. Travel was taken in October 2018, and this report was finalized in March 2019. The fellowship period is taken to include relevant unfunded work undertaken by Fullagar during the period May 2017 – March 2019 which were precipitated by her being awarded the fellowship. This definition is adopted to ensure ISSI is appropriately credited with the full impact of the fellowship.

## Fellow's Biography

Dr Fullagar is a social economist with twenty years experience across water policy, regional futures and industry development. She moved her family to Tasmania in 2008. Her interest in urchin and seaweed stems from this background. Following introduction via a mutual peer involved in Tasmanian small business networks, Dr Fullagar was approached by Will James in mid-2016, seeking support to succession his expertise in urchin husbandry and generate a Tasmanian urchin industry.

Dr Fullagar is a strong advocate for growth through collaboration. She is a Rotarian and hence drew on Rotary networks to support the Fellowship.

## Australian Industry Context

The practical context for this fellowship application is an interest in future aquaculture of Tasmania. Tasmania is a developed economy characterised by small business. In 2016-17, the State's economy was valued at \$57 billion.<sup>1</sup> In that year, the gross value of the State's fisheries was estimated at about \$1 billion.<sup>2</sup> This figure has a history of steady sector growth through previous years. The State's fisheries are socially and politically dominated by the two big salmon aquaculture companies: Tassal and Huon Aquaculture. Other sectors are small business dominated. These include abalone, rock lobster, shellfish (particularly Pacific Oysters).<sup>3</sup> As with most small businesses, fishers are attracted to the latter sectors by the opportunity to be independent, autonomous, and build their own brand.

Ownership of small to medium fisher businesses is dominated by males over fifty and succession planning is recognised as a key issue.<sup>4</sup> Many of these people have built their businesses from scratch to operations valued at a few million dollars. A typical succession plan is for a person or company with a few million dollars to buy them out. There are not many young Tasmanians with a few million dollars wanting to enter the fishing sector. Thus, the future labour of Tasmania's fishing sector depends on:

1. Employment through large companies (e.g. as they buy-out businesses),
2. Business succession within a family,

3. Identifying and pursuing innovative low cost entry opportunities that have genuine potential for independent growth (these tend to be high risk, hence undeveloped and lacking support networks).

The Pacific Oyster Mortality Syndrome (POMS) is a devastating virus with a 100% mortality rate. Its appearance in Tasmanian waters in 2016 is associated with long term changes in the marine conditions of Tasmania's east coast. Here, the traditional cold upwellings of cold, nutrient rich Antarctic waters from the south have been lessening, while at the same time the East Australian Current of warm, nutrient poor waters from the north have been strengthening. In tandem, this has given the Tasmanian waters a 'double-whammy': not just a loss of the cold nutrients, but their replacement with hot, nutrient depleted waters. This puts these waters in the highest 1% of sea temperature change in the world.

From a socio-economic point of view, this represents a significant change in risk to Tasmanian small fishing businesses and their dependent workforces. At the same time, the global population is increasingly protein-hungry, the salmon sector is booming, and Tasmania has high quality waters with significant production potential. This means there are political, social, economic, and environmental reasons to consider sustainable aquaculture developments for existing and new commercial sectors. Developing these will require the innovation of new investment, new ideas, new labour. Investment opportunities are both risky and exciting.

Changing marine conditions make the migration of new marine species inevitable. The retention of endemic marine communities in a context of such change is challenge without precedent. Of particular environmental interest are the seaweed communities that historically dominated the outer estuaries along the Tasmanian

1 Tasmanian Chamber of Commerce and Industry (2017) Tasmania Report 2017 [www.tcci.com.au/getattachment/News-Media/Latest-News/TCCI-Tasmania-Report-2017/TCCI-Tasmania-Report-Web-LR-Final.pdf.aspx](http://www.tcci.com.au/getattachment/News-Media/Latest-News/TCCI-Tasmania-Report-2017/TCCI-Tasmania-Report-Web-LR-Final.pdf.aspx)

2 Tasmanian Seafood Industry Council website: [www.tsic.org.au](http://www.tsic.org.au), sighted 20 November 2018

3 Tasmanian Seafood Industry Council (2017) Seafood Industry Workforce Profile [https://www.tsic.org.au/uploads/9/6/8/7/96879568/1\\_final\\_seafood\\_industry\\_workforce\\_profile.pdf](https://www.tsic.org.au/uploads/9/6/8/7/96879568/1_final_seafood_industry_workforce_profile.pdf)

4 Tasmanian Seafood Industry Council (2017) 5-10 Year Strategic Workforce Profile [https://www.tsic.org.au/uploads/9/6/8/7/96879568/2\\_final\\_5-10\\_year\\_strategic\\_workforce\\_profile\\_compressed.pdf](https://www.tsic.org.au/uploads/9/6/8/7/96879568/2_final_5-10_year_strategic_workforce_profile_compressed.pdf)

coastline. These communities are recognised as wild fish nurseries, and important habitat for several wildfish sectors including rock lobster and abalone. One of the food sources for rock lobster are sea urchin. Figure 1 provides a snapshot of the system.

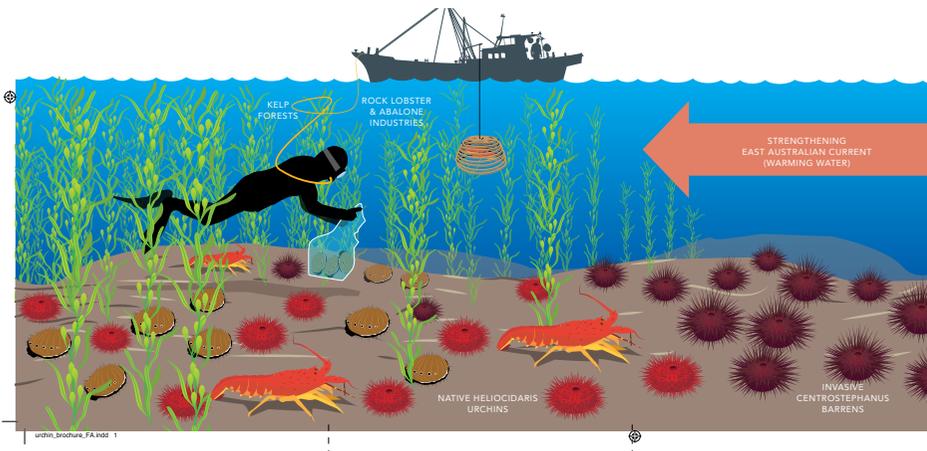


Figure 1: Illustration of the urchin environment in Tasmania

Between 1990 and 2010, a Tasmanian fisher named Will James made repeated efforts to establish farming of the sea urchin that is endemic to Tasmanian waters: *Heliocidaris erythrogramma*. Mr James was able to prove his seaweed-fed farming concept, optimise cage design, and confirm the uni (tongues of urchin roe/gonads) met the exacting standards of the top end of the Japanese market. Unfortunately, regulatory matters required more time to resolve before the urchin could be commercialised. Financial considerations required Mr James to return to fishing other species.

By 2010, growing populations of the invasive sea urchin, *Centrostephanus rodgersii*, were starting to cause concern within Tasmania's wild fishery circles, particularly in context of declining *Macrocystis pyrifera* communities. The uni

of this species is larger than that of *Heliocidaris erythrogramma*, has a different texture, a different taste, and requires development of a consumer market.

Thus, the contemporary commercial opportunity of sea urchin wildcatch in Tasmania includes:

1. an endemic species, which had uni of a high value, but a harvest limited by regulation,
2. an invasive species, which had uni of low value but no harvest limit.

Although representing different opportunities, these species have complementary harvest periods. Sea urchin is a labour-intensive industry: every hour of diving labour requires about twelve hours of processing labour. The complementary harvest periods of the two sea urchin species found in Tasmania means there is potential for a sea urchin industry to create on-going employment opportunities rather than seasonal employment opportunities.

Further, the volumes of wildcatch are naturally limited and opportunistic. While several Tasmanian businesses participate in opportunistic wildcatch of sea urchin, the development of a secure sea urchin industry is dependent on adoption of aquaculture techniques.

These techniques require consideration of:

- » Sea urchin larvae supply (e.g. a sea urchin hatchery)
- » Sea urchin grow-out (i.e. husbandry techniques)
- » Feed capable of producing uni that meets demanding market standards
- » Processing techniques that meet demanding market standards

Figure 2 provides a schematic overview of what a fully mature urchin aquaculture industry would look like.

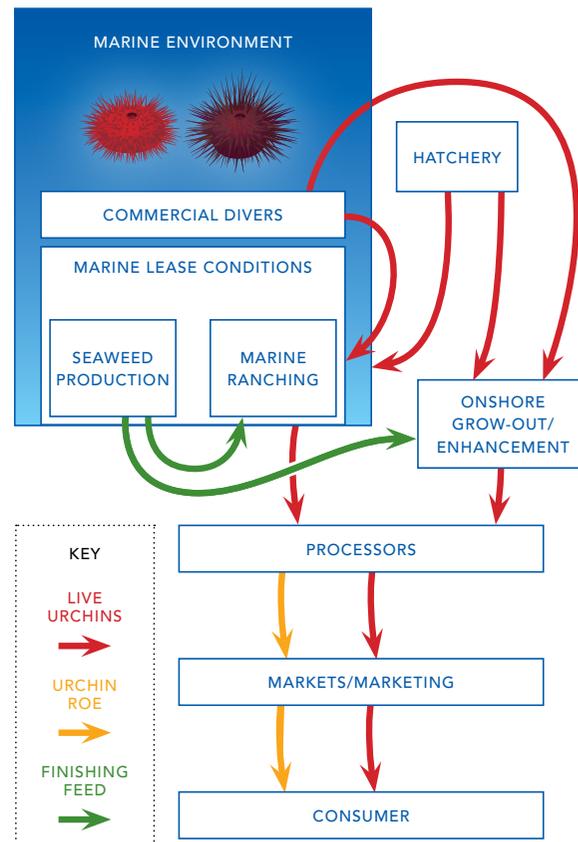


Figure 2: Components of a fully mature urchin aquaculture industry<sup>5</sup>

## Preparing for the ISSI fellowship travel

The award of the ISSI fellowship provided a tangible focus to pull together Tasmanian entities who had responded to the call for expressions of interest in

building an urchin industry. With the exception of Dr Fullagar, all these small operations had a working history in the fishing industry. Driven to secure this audience for the ISSI fellowship, Dr Fullagar invested the next 12 months in:

- » Preparation of an endorsed 'industry potential' brochure (see Appendix)
- » Development of an endorsed ten year cooperative seaweed-fed urchin supply chain business plan,
- » A successful joint grant application to support the development phase of the business plan (budgeted at \$1.85 million);
- » Development of lateral networks and communication with
  - » National urchin industry peers (industry and research)
  - » Environmental opportunities inherent to development of a sea urchin industry.

Over this time, the focus of the ISSI fellowship evolved, with key influences being accommodation of:

- a. Increasing ownership of the hatchery opportunity by the preferred R&D provider;
- b. One business's desire to retain full custody of interactions with Japan (the target market for product);
- c. Growing interest in the USA of small scale entry to aquaculture via mixed farming ("integrated multi-trophic aquaculture" - IMTA) of seaweed and shellfish. This technique, spearheaded by GreenWave ([www.greenwave.org](http://www.greenwave.org)), is a direct mirror of the model advocated by Will James for urchin ranching in lieu of regulatory limits on more environmentally integrated options.

## 2. Fellowship Learnings

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Prior to undertaking this Fellowship, Dr Fullagar's involvement in industry development had been based on stitching together intermittent paid opportunities with government(s).

In 2012, the Fellow was overseeing a marine environmental awareness program (the D'Entrecasteaux & Huon Collaboration) through which Dr Fullagar became aware of the general opportunity represented by sea urchin. The topic was subsequently raised in discussion with a fisherman at a Tasmanian small business forum in 2016, resulting in an introduction to Will James. With the encouragement and confidence of Mr James and his experience and expertise, Dr Fullagar coordinated calls for expressions of interest in building a Tasmanian sea urchin industry. The priority here was to coordinate a seed supply chain that would start as a coordination of businesses with broad interests, and gradually increase their focus on urchin as it became viable to do so.

While relevant institutions showed some interest in the topic, in practice this did not extend to engaging small businesses in building the opportunity – the coordination risk was too high to warrant priority. Also, at this time an international company was fostering high level discussion on development of sea urchin aquaculture based on their pellet feeds and cage design.

While sound in concept, these aquaculture techniques options were a tricky fit with Tasmania because:

- » The cage designs were too expensive for locally-unproven start-up investment,
- » Franchise style production arrangements compromise the autonomy and brand opportunities attracting Tasmanians into small business,

- » There are many hundreds of urchin species in the world with different palates; there is no certainty that a pellet designed for one species will appeal to another species
- » Available information indicated the cage design best suited to *Heliocidaris erythrogramma* is different from those developed for northern hemisphere urchin
- » The top end of the urchin market has a well-developed palate: it is looking for seaweed-fed product
- » A small company in Melbourne, Aquatrophic, had developed a feed for the *Heliocidaris erythrogramma* species. Initial figures indicated this feed had stronger growth benefits for this species than alternative pellet feeds.

Despite the separation from institutional thinking of the time, a group of small business peers with potential to represent an industry supply chain emerged.

An oyster farmer, Scott Brooks, spurred on by Will James' and Dr Fullagar interest, supported the effort by housing a trial of *Heliocidaris erythrogramma* husbandry with (international) pellet feed in retriulated holding tanks. The effort indicated these urchin were not attracted to these pellets (this was subsequently and independently confirmed by a trial the University of Tasmania secured funding to undertake), and that confirmed husbandry of urchin is non-trivial. This highlighted the value in succession confirmed the succession of Will James' method and expertise as an important priority for supporting development of a Tasmanian urchin industry.

Some thought was then put into the options for building a commercial supply of urchin. These options and their respective challenges are provided in Table 2.

Table 2: Options for building a commercial supply of urchin

Supply management option	Challenge
Contracted urchin harvest to manage level of predation on endangered and protected seaweed communities in marine reserves	Regulatory prevention
Sustainable urchin harvest from natural seaweed communities outside of marine reserves	Requires a level of collaboration that is inconsistent with opportunistic 'boom and bust' culture of Tasmania's urchin history
Sustainable urchin harvest from commercial seaweed plantations	Conservation value of a plantation could be used to prevent commercial harvest and management
Enhance wildcatch in cages within a commercial seaweed plantation that is pruned to feed the urchin*	
A mixed farm of rope-grown seaweed and caged urchin aquaculture*	No precedent for doing this
Pellet fed off-shore urchin aquaculture*	Expense of development of pellet feed
Pellet fed on-shore urchin aquaculture*	Expense of infrastructure and development of pellet feed
Feed on-shore urchin aquaculture* using farmed seaweed	Expense of infrastructure and access to seaweed

\* Industry development of these options would require an urchin hatchery to be established within about five years

For reasons summarised in this table, developing a good quality supply of urchin in Tasmania cannot (yet) be distinguished from ensuring a good quality supply of seaweed. This conclusion favours exploring the potential to seed urchin aquaculture by mixed farming techniques of roped seaweed and caged urchin ranching ('ranching' indicates enhancement of wild catch rather than life cycle grow-out associated with fully developed aquaculture). Once this was established, the logical next step would be to overcome the limits of relying on wild catch by developing an urchin hatchery and nursery.

These conclusions are influenced by the three year lifecycle of Tasmanian sea urchin species which means on-shore production represents an initial three year period before there is any chance of cashflow. It is worth noting that hatchery expertise and production risk of species with six month life cycles (as are found in South Australia and Queensland) lend themselves to development of an industry via on-shore production. One of the communication benefits of the industry framework prepared via the ISSI Fellowship (see Figure 2) is that it encompasses both opportunities.

## Farming techniques

### Urchin

In Maine, the urchin regulations are fairly complex and access to the harvest rights felt to be competitively protected. In New Zealand, the regulations seemed simpler: there is a limited season and allocation of harvest across zones. The allocation of harvest is traded.

While both locations have healthy (if niche) wildcatch urchin industries, there is no evidence of urchin ranching or aquaculture currently being practiced in either Maine nor New Zealand. Both countries base wild harvest on the principle of sustainable environmental harvest. Maine's Centre for Cooperative Aquaculture Research hatches and grows urchins for clients to restock the seaweed beds they

harvest from. Circumstance did not allow exploration of how effective this was, however, discussions with urchin divers and processors indicated restocking was not a common practice.



Figure 3. Mr Steve Eddy, urchin extraordinaire and microalgae for urchin larvae (both images of Centre for Cooperative Aquaculture, University of Maine)

An opportunistic visit cannot do justice to Steve Eddy and the diverse works at the Centre for Cooperative Research Aquaculture. This is a Maine contact Tasmania should be partnering for research on industry adaptation to warming seas. Dr Fullagar introduced Steve Eddy (University of Maine) and Dr John Keane (University of TasmaniaTas) with this recommendation.

In New Zealand, the kina market is recognised as ‘niche’ and has only been commercialised by a couple of companies, despite having a high cultural value and financial viability. Communication with commercial parties in New Zealand were free of any confidentiality concerns that suggested commercial insecurity. Although these companies referenced ongoing interest from Asian markets, they felt the processing overheads and logistics of those markets meant those markets were not competitive with the kina market.



Figure 4. Thomas Hildebrand (left) of Ngai Tahu and Dr Fullagar

Twenty percent of the seafood wild harvest allocation in New Zealand is owned by the iwi (Maori). Ngai Tahu is the aquaculture company of the South Island iwi, and employer of Thomas Hildebrand (introduction thanks to Assoc Prof Catriona McLeod, University of TasmaniaUTas). Ngai Tahu has an interest in opportunities that ensure iwi benefits (social, environmental and economic) from iwi resources, and this extends to being interested in small business opportunities that iwi could develop from their wild harvest allocation. To date, this has not been progressed for urchin.

## Seaweed

Kelp stringing and grow-out techniques are fairly well established: those being used in Maine are identical to those used in Tasmanian research trials. While

there is incentive to provide 'kelp strings' free of charge in both locations, it seems unlikely this would indefinitely be a free service. Many of the parties spoken to in Maine were interested in the idea of linking seaweed production and urchin ranching. However, from a practical perspective, their seaweed industry is being fostered via integration with shellfish production, so the opportunity of urchin ranching may be more trouble to develop than people are willing to take on.

In New Zealand the seaweed sector is based on beach cast (seaweed washed up onto shore). At the time of the fellowship legalities were underway to determine who had rights to harvest seaweeds anchored in the tidal zone (i.e. whether this resource belonged to the land owner or whether it was a public asset available to whoever has a relevant allocation of harvest).

## Process techniques

### Urchin

The processing of urchin in Maine was done by hand (sample delivery shown in Figure 5 picture). 95% of the Maine harvest was sold to the domestic USA market. The processor had relocated from Iceland where business had become non-viable because of labour costs. It was ventured this would also be an impediment to establishing an urchin industry in Australia.



Figure 5. Urchin delivered for processing in Portland (Maine); consumer packaging for kina (New Zealand)

In New Zealand the processing was also done by hand and sold exclusively in New Zealand and Australia. The Maori taste differentiate national product (New Zealand waters only have one urchin species the kina of which is bigger but less sweet in the colder waters of the South Island than the warmer waters of the North Island). Unlike Maine and Australia, the processing of the kina does not select gonad tongues on the basis of colour or size. Rather, the natural diversity of the harvested roe is fully represented in each 'pot' (pot samples shown in Figure 5 by here by my NZ contact, Kara Herbert). The New Zealand roe recovery is about 6%. The relative balance of roe recovery, processing overheads, and market values indicated that the commercial viability of urchins in Maine, New Zealand, and Tasmania are very closely matched.

## Market development

The global market for urchin exceeds supply. For this reason, market development in the urchin sector is about a grower or processor targeting their produce to a particular market. Maine targets the USA market (big enough to avoid export complexities); New Zealand targets the kina market (valuable enough to avoid the qualities demanded by Asian markets); Tasmania targets the Japanese market (extremely particular qualities; highly priced). The secret to tapping into these markets seems consistent: there are an abundance of buyers; get out there and engage with the ones you want to do business with.

The market development for seaweed is far more complex. Because seaweed is easy to grow, it has a low market value. The commercial rationale for growing seaweed is for:

- » the halo effect benefit of shellfish (i.e. seaweeds draw nutrients out of the water, which provides a cleaner environment for filter feeders, and results in a higher quality shellfish);
- » as an input to a higher value primary product (e.g. urchin),
- » as an input to higher value processed products



Figure 6. AgriSea, an NZ company commercialising seaweed

Given the niche appeal of wild seaweed harvest and the ease with which seaweed is grown, the commercial requirement for industry development of seaweed farming is in developing a product that warrants bulk. The focus of seaweed market development in Maine was human consumption – this aligns with their access to a huge domestic market. The focus of seaweed market development in New Zealand is fertiliser (e.g. the AgriSea brand) – this aligns with the value New Zealand’s primary production.

The challenge in Tasmania is that while there is no significant seaweed harvest, there is no incentive to develop a seaweed market. While there is no significant seaweed market, there is no incentive to grow seaweed.

So how and why did Maine overcome this conundrum? How have they managed to seed development of their seaweed farming industry?

## ‘Entrepreneurs in aquaculture’ enablers

Looking at urchin, there seem to be two viable industry development approaches:

1. A social/lifestyle driven approach that accepts a lower value market in lieu of less stringent processing requirements (e.g. kina), or

2. A profit driven approach that targets a higher value market with stringent processing requirements (e.g. uni for the Japanese market).

The domestic USA market that Maine targets is effectively a hybrid of these approaches.

The profit-driven approach is highly competitive, and aligns with Tasmania’s business culture and, Australian Government industry development strategies.<sup>6</sup> By contrast, both Maine and New Zealand, the industries felt more socially driven – maximising profit at the business level did not feel to be an ambition that over-whelmed the longer term returns of fostering peers and generating local employment. This was most clearly evident in the confident way businesses in Maine and New Zealand referred each other. Although it was hard to open meetings while in Tasmania, as a visitor to in Maine and New Zealand, Dr Fullagar had more meeting and workshop invitations than she could possibly attend, and information was shared far more openly (even when local ‘competitors’ were present). Relative to Tasmania, businesses were more culturally inclined to recognise industry peers than competitors. This is not to deny competition – certainly there was some evidence of this! – but it was culturally tempered by recognition that industry development is better served by ‘growing the pie’ than unfriendly competition.

The two things that really stood out from visiting New Zealand and Maine were:

1. **New Zealand’s strong cultural regard for people willing to take risk**
  - Paul Cresswell (Fisheries New Zealand) commented along the lines of ‘if someone has a genuinely good idea, it doesn’t matter how small the start is as long as there is a start. We try to focus on enabling innovators within regulations rather than drowning them with regulations.’
2. **Maine’s ability to grow a seaweed industry from grassroots** – this was despite the absence of a seaweed market.

6 Australia’s national rural R&D entity, Agrifutures, prioritises industry opportunities on the basis of financial potential rather than jobs potential

Currently Tasmanian aquaculture networks seem to advocate future growth in the sector, while also being protective of new industry development. Control is maintained by challenging grassroots 'industry social capital'. This is consistent with the boom and bust fatigue of an island economy, and increasing dependence on large, vertically integrated companies. It is also highly discouraging for locals with entrepreneurial desires to invest, engage, and build – there is no 'place' for them in the system.

Yet, for all this, it is self-evident that at the individual scale, most Tasmanians are hugely talented and hoping for each other's support – it is only a defensive history that prevents collaboration. Local development of local aquaculture opportunities depends on finding pathways that respect established securities and local entrepreneurs. Without this, the aquaculture potential of Tasmania is only an industry opportunity for international investors, and the existing major players. These options shift the management and opportunity of Tasmanian resources out of the hands of Tasmanians, and into the hands of international shareholders. It erodes the very value of being Tasmanian: having access to, and responsibility for, Tasmania'sour amazing islands and the resources and opportunities they represent.

For this reason, the industry development methods adopted by Maine for their seaweed industry was of enormous interest.

## What Maine did to seed their seaweed industry

Ten years ago, the Maine aquaculture industry was bought together by the undeniable evidence that lobsters, the mainstay of Maine aquaculture, were heading north. This movement of wild stock was consistent with the declining cold, nutrient-rich currents from the north being replaced by strengthening warm, nutrient-poor currents from the south.



*Figure 7. Maine State Representative Erik C Jorgensen (left) and Diedre Gilbert, Director of Marine Policy, Maine Department of Marine Resources*

Courtesy of introduction via one of Maine's State Representatives, Erik C Jorgensen (a connection made via Rotary), Dr Fullagar was lucky enough to have Maine's response outlined to me by Deidre Gilbert, Director of State Marine Policy (pictured right with Maine local hosts and local member, Eric Jorgensen). Deidre confirmed Maine had taken initiatives in response to there was unambiguous and agreed need to develop new aquaculture opportunities as Maine's marine temperatures increased. This adaptation was the only way to retain the value of existing businesses.

Coinciding with this awareness was the emergence of small scale ‘integrated multi-trophic aquaculture’ (IMTA) of seaweed and shellfish. This was an industry initiative driven by small, environmentally aware fishers, who realised they needed to diversify for both environmental reasons and to spread their economic risk. In this way, the industry emergence of IMTA was an unfunded adaptation of small players with limited ability to take risk – it was designed by and for players whose only option was low risk, low cost adaptation.

This opportunity of this coincidence was fostered by the Maine State, who introduced 400ft<sup>2</sup> (i.e. equivalent of 400 x 1 square feet – these are small leases) pre-approved 12-month leases that were available to anyone who wanted to ‘have a go’ at seaweed farming, shellfish farming, or a combined IMTA effort. These leases were available independent of whether applicants you had an existing aquaculture operation or not: one simply had to nominate a plot of water, which was then assessed for things like boat traffic interference before being approved.



Figure 8. Nick Battista of the Island Institute (Maine)

This in itself is not enough to attract entrepreneurs. A lease of this size and security cannot justify training, purchasing boats, researching farm techniques, finding markets, and so forth. Local economic development entities (public and private) such as the Island Institute (their policy officer, Nick Battista pictured in Figure 8 – it would have been useful to have longer to explore their work and soak in their contagious belief in locals, futures and took on the networking and information sharing responsibilities. Social profile was awarded to existing operators who took on mentoring of entrepreneurs. In this way, the knowledge, capability, and social support of entrepreneurs supported quick development.

It has taken ten years for this ‘program’ to evolve. During those ten years, over 500 of these ‘micro-licenses’ have been issued, something in the order of 300 new players (such as Matt Moretti of Bangs Island Mussels, pictured in Figure 9 with me here) have been attracted into Maine’s aquaculture, the risk of failure and the knowledge benefits of success have been distributed. A mass of farmed seaweed has been created alongside social demand for a viable market. Some of the early growers have stepped up into processing and market development.

The amount of interest and investment from large organisations, interested in catching the wave of new industry, has grown. Discussion on the street about seaweed, shellfish, environment, new food markets, fertilisers, biofuels, bioplastics is inter-generational, positive, and cuts across the whole spectrum of stakeholders (entrepreneur, existing industry player, community development, rich investors, State regulators). The culture is motivated and it is going to make this opportunity work simply because everyone participating in the effort is recognised and valued.



Figure 9. Dr Fullagar (left) and Matt Moretti of Bangs Island Mussels, Portland, Maine

## Summary of Learnings

The learnings from the Fellowship were:

### **a) Tasmanian small businesses are genuinely unfamiliar with industry development as an investment.**

It has taken until March 2019 for relevant small businesses to realise and acknowledge that industry development covers a significant workload over and above 'small business development' in strategizing, coordinating and motivating supply chains, fostering partnerships, encouraging collaboration, opening doors, negotiating pathways, maintaining records, developing references, and generating momentum required for investment confidence.

An industry cannot accelerate without some form of industry development support. Clearly a lack of peer recognition makes it hard for any investor to commit to collaborative industry development. One response has been to use the Tasmanian experience to focus on the role and benefits of industry development when talking to national urchin industry networks.

### **b) The impact of vision and planning on investor confidence.**

The small businesses that agreed to collaborate to enable the project did not anticipate the project would attract funding. A lack of small business experience with government funding programs has left small businesses unaware that, the amount of funding requested is often less important than the way a proposal is structured and presented.

It was a pleasure to be able to demonstrate the impact of structure to peer interests in an developing an urchin industry. The industry vision and plan created for Tasmanian peers will be presented as something available for national adaptation and adoption later in 2019.

### **c) The need to generate social capital in the commercial sector of the industry**

One of the key findings from the travel undertaken via the ISSI Fellowship was how universally difficult it is to grow new industries when relevant networks are male and in the 60-70 year old age bracket. Limited diversity inherently discourages outward thinking. Further, these businesses survived and grew in a time that pre-dates globalization. Their security is vested in being bought out – an option that is often well beyond the scope of entering entrepreneurs. Maine had taken a ten-year strategic approach to attracting and enabling entrepreneurs to enter the aquaculture industry by fostering low-cost/low-return, mentored opportunities to 'have a go'. This is how they have seeded their seaweed industry.

Dr Fullagar has taken these principles and prepared a farm proposal that is based on providing entrepreneurs with similar opportunities in the seaweed/urchin space. This proposal is currently under negotiation with potential partners.

### **d) Realising opportunities in the aquaculture sector is not trivial**

The journey through the ISSI Fellowship has confirmed that the aquaculture sector is mature, and has regulatory frameworks designed for this context. While the opportunity for an urchin industry is self-evident, there are significant challenges to overcome in securing access to water, andwater and understanding and meeting all the monitoring and regulatory requirements that affect a viable supply chain. This challenge is largely cultural – although the experience of regulatory impediments was common in Australia and Maine, it was not a significant factor affecting development in New Zealand.

This finding advocates the collaborative industry development strategies. However, this is a bit of a catch-22: collaboration can help lever existing skills and knowledge, but it is also very resource intensive to foster and coordinate (see learning a) above!).

# 3. Personal, Professional and Sectoral Impact

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## Personal

The Fellowship taught a lot about resilience and the value of networks. Partly because of the evolving focus of the Fellowship travel, it was quite difficult to create a secure travel itinerary. People are busy, and it is easier for them if fellows take their chances and give them a call when passing through. It is quite nerve-racking designing an international travel itinerary on this security.

Rotary networks were hugely helpful in this regard, most especially in Portland, Maine. These networks really took charge and did everything possible to help. It made a huge difference to confidence and enjoyment of the travel. The help of Bowen Depke (Portland Club of Rotary, Maine) was beyond what thanks can adequately honour.

The ISSI alumni networks have also been fantastic. It was very worthwhile following other fellows for tips of what to make time for. This network also offered support after the travel, just by keeping in touch and being interested in each other's experience.

## Professional

In relation to professional impact, one of the things precipitated by the Fellowship experience was an introduction by the Australian Government to one of Tasmania's biggest investors. This has led to a trial partnership for seaweed/urchin which will have its first harvest in late 2019.

As a result of this Fellowship Dr Fullagar plans to:

- » step back from taking the full risk of all the preparatory work for collective progress of existing small businesses,
- » focus on working with the network of expertise created via the Fellowship have built to develop a commercial seaweed-urchin IMTA farm that incorporates resourcing support for small leases that will be available to other entrepreneurs looking to 'have a go',
- » seek the sponsorship and support of the salmon sector by offering to align this proposal with rehabilitation of sites they are looking to retire,
- » provide the social space and practical stepping-stone that local entrepreneurs need to grow Tasmania's future aquaculture,
- » to undertake the development work required to make this happen, including finding and supporting a future market for Tasmanian seaweed.

## Sectoral

More broadly, the Fellowship has, without question, been hugely influential in promoting the profile of Tasmania as a potential site for urchin aquaculture. Tasmania now has key recognition with the national urchin networks (these are networks Dr Fullagar introduced to Tasmania to help develop the audience for the ISSI Fellowship), and the development of plans and projects has greatly advantaged the development of relationships with Japan (Tasmania's target market for urchins).

Key sectoral impact from this Fellowship has been:

1. development of industry IMTA networks within Tasmania,
2. development of networks across Australia's urchin sector (Dr Fullagar presented at a national urchin workshop in March 2019),
3. vision and structure for a mature Tasmanian urchin industry,
4. a ten-year plan to bridge the 'now' and that vision,
5. recruitment of funds that is now being used to develop the on-shore capabilities of that vision,
6. insights into the limitations of Tasmania's culture in the aquaculture sector,
7. a practical understanding of how to help existing players and entrepreneurs bridge that cultural divide,
8. determination to see it happen (initial proposals and funding applications have been prepared and submitted),
9. an awareness of the value of the entrepreneurs of Tasmania and the opportunities of being Tasmanian.

## 4. Recommendations and Considerations

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There are three criteria to developing an urchin industry in Australia. These criteria and their status is:

**1. Vision and planning.** It is very hard to secure investment without a clear picture of what you are trying to build, and how.

**Recommendation:** that the industry vision Dr Fullagar coordinated for Tasmania is adapted and adopted to support the development of a national urchin industry. This is important because no single state has critical mass to generate an urchin industry.

**2. Opportunity.** The aquaculture sector in Australia is framed by mature industries and regulations. Finding pathways to realise 'obvious' opportunities is not trivial.

**Recommendation:** that industry development be recognized as a legitimate workload that warrants resourcing, and that it be included in budgeting of urchin projects.

**3. Social capital for commercial production.** University research into feeds and efficiencies have been progressing rapidly, while development of commercial production of urchin in all States is hampered by entry requirements designed for mature industries. There is a need to provide entry opportunities so the industry can succession, develop experience and cashflow, and grow.

**Recommendation:** the social capital methods used to build a seaweed industry in Maine be adapted into a proposal to engage entrepreneurs in Australia's urchin industry.

## 5. References

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Fullagar, 2017, Sea Urchin Industry Opportunities in Tasmania (brochure – attached as Appendix)

Tasmanian Chamber of Commerce and Industry (2017) Tasmania Report 2017 [www.tcci.com.au/getattachment/News-Media/Latest-News/TCCI-Tasmania-Report-2017/TCCI-Tasmania-Report-Web-LR-Final.pdf.aspx](http://www.tcci.com.au/getattachment/News-Media/Latest-News/TCCI-Tasmania-Report-2017/TCCI-Tasmania-Report-Web-LR-Final.pdf.aspx)

Tasmanian Seafood Industry Council website: [www.tsic.org.au](http://www.tsic.org.au) , sighted 20 November 2018

Tasmanian Seafood Industry Council (2017) Seafood Industry Workforce Profile [https://www.tsic.org.au/uploads/9/6/8/7/96879568/1\\_final\\_seafood\\_industry\\_workforce\\_profile.pdf](https://www.tsic.org.au/uploads/9/6/8/7/96879568/1_final_seafood_industry_workforce_profile.pdf)

Tasmanian Seafood Industry Council (2017) 5-10 Year Strategic Workforce Profile [https://www.tsic.org.au/uploads/9/6/8/7/96879568/2\\_final\\_5-10\\_year\\_strategic\\_workforce\\_profile\\_compressed.pdf](https://www.tsic.org.au/uploads/9/6/8/7/96879568/2_final_5-10_year_strategic_workforce_profile_compressed.pdf)

## 6. Appendix

The following outputs of this ISSI Fellowship are attached:

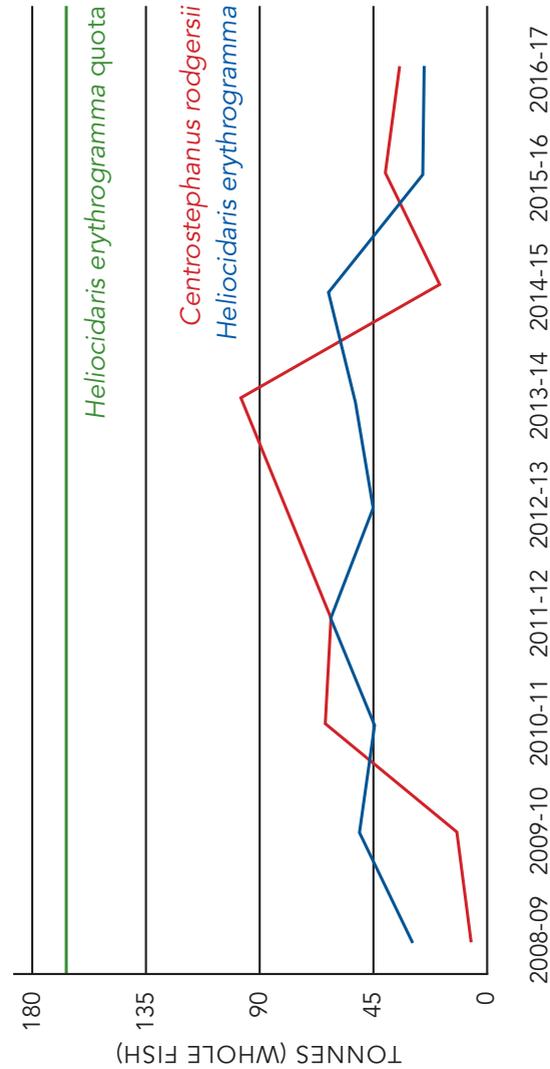
- » Tasmanian Urchin Industry brochure (Fullagar, 2017)

This brochure is produced by the Huon Urchin Alliance partners:



Contact: [ifullagar@weatheringchange.com.au](mailto:ifullagar@weatheringchange.com.au)  
 Brochure content reviewed and endorsed by the  
 Tasmanian Commercial Divers Association.

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### History of wildcatch

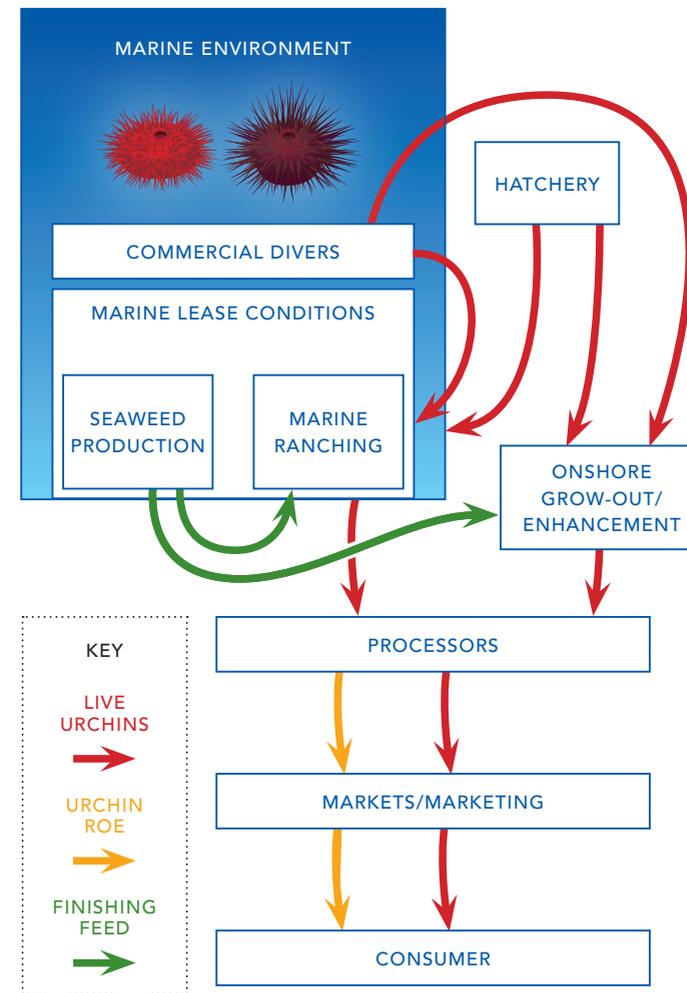
Wild catch urchin quotas apply only to *Heliocidaris erythrogramma* and are announced annually by the Tasmanian Department of Primary Industry, Parks, Water, and the Environment. Total wild catch is limited to 166 tonnes across the State, which is applied through four zones.

### A fully developed industry supply chain

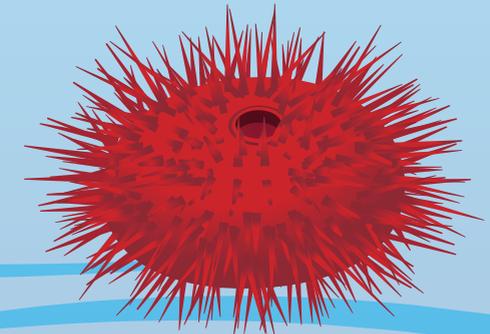
*Heliocidaris erythrogramma* and *Centrostephanus rodgersii* are different urchin species with different market opportunities.

A fully developed urchin industry supply chain in Tasmania would look something like that shown below.

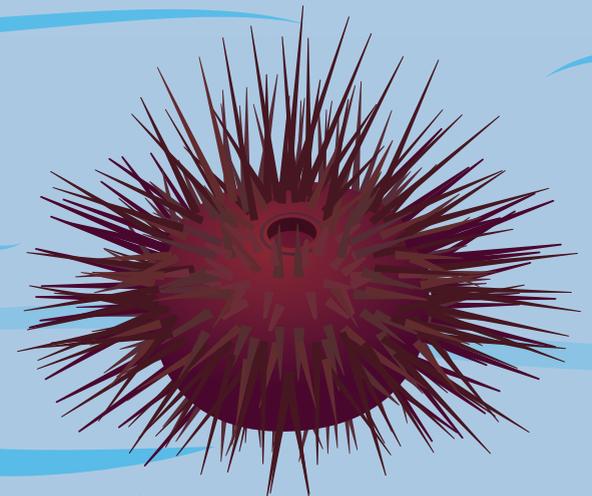
While the Tasmanian urchin industry is currently small, there are Tasmanian businesses active in all aspects of this supply chain except a hatchery.



# Sea urchin industry opportunities in Tasmania



*Heliocidaris erythrogramma*



*Centrostephanus rodgersii*

This brochure is an introduction and overview of the supply chain required to fully develop a Tasmanian urchin industry. It aims to help investors target and assess opportunities to build the industry.

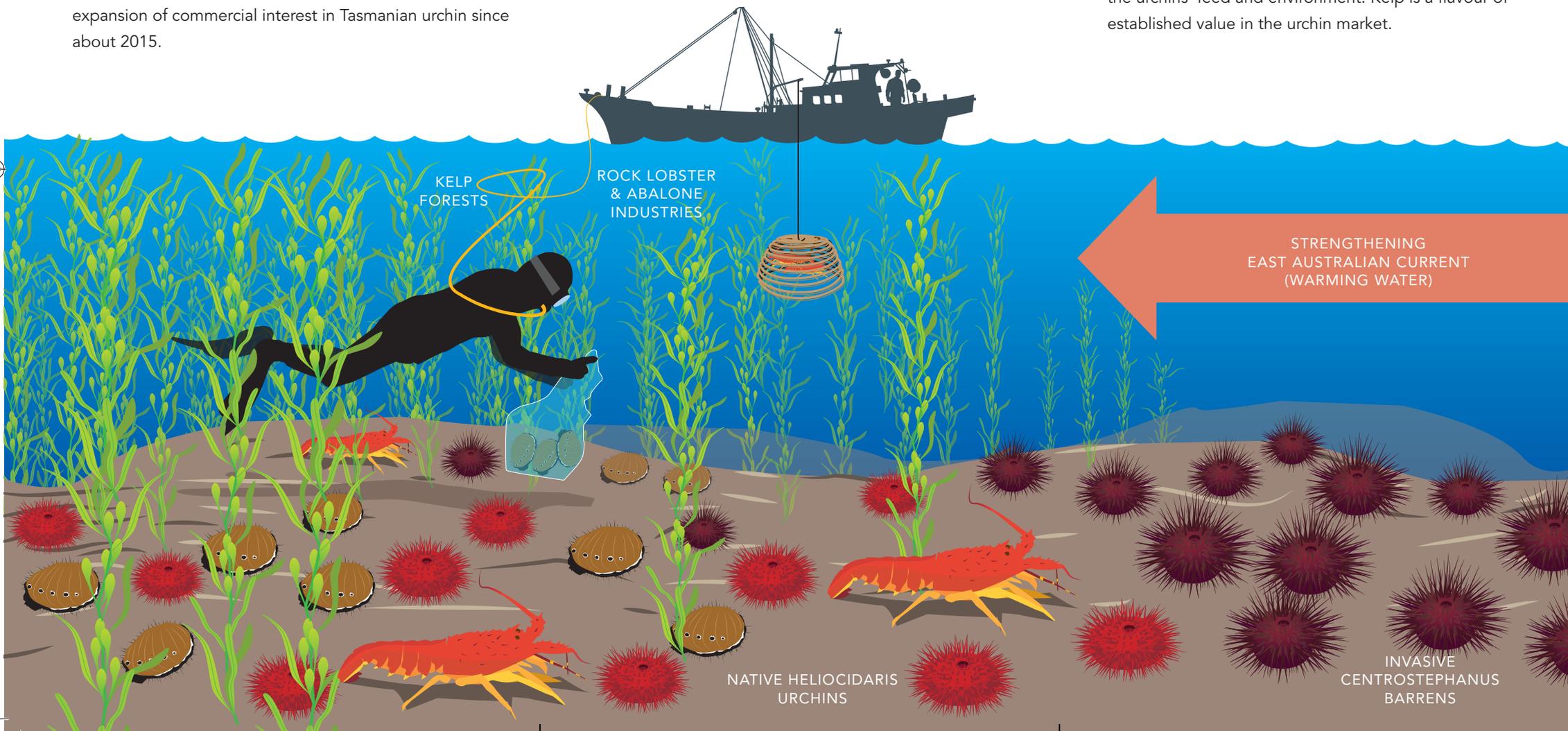
### History

Tasmania has an international reputation for excellent seafood. Urchin has been commercially harvested in Tasmania since the late 1980s. To date this harvest has been a supplementary product to other seafood operations. Today, increasing urchin populations and developments in urchin husbandry represent a step change in the potential of this industry. This is reflected by an expansion of commercial interest in Tasmanian urchin since about 2015.

### The environmental context

- Marine waters around Tasmania are warming as the East Australian Current strengthens.
- This is favouring populations of sea urchins in Tasmanian waters.
- Increasing urchin numbers devastate seaweed communities creating barrens that produce poor quality urchin roe.

- Tasmanian seaweed reserves are in decline. The Giant Kelp Marine Forests characterized by the string kelp *Macrocystis pyifera* were listed as endangered by the Australian Government in 2012.
- An established seafood industry exists for crayfish, which are a local natural predator of urchin
- Wild abalone are a commercialized species that rely on seaweed condition, and may be compromised by uncontrolled urchin numbers
- There is a strong market for urchin roe of optimal condition, taste and flavour. These attributes reflect the urchins' feed and environment. Kelp is a flavour of established value in the urchin market.



### Urchin species in Tasmanian waters

Name*	<i>Helicidaris erythrogramma</i>	<i>Centrostephanus rodgersii</i>
Image		
Status	Native	Invasive
Features	Short spines in a wide range of colours. Seasonal harvest from spring to early summer. Closed seasons for wildcatch zones apply.	Long spines that are typically a dark purple Seasonal harvest from autumn to winter. The harvest season for this species is open.
Habitat	Sheltered to moderately exposed reefs and sea grass beds to depths of about 20 metres.	Moderate to fully exposed reefs to depths of about 30 metres.
Tasmanian regulation	Catch limit applies with minimum shell diameter of 60mm; can only be harvested by commercial divers with a Tasmanian licence	No catch limit; can only be harvested by commercial divers with a Tasmanian licence
Market considerations	Season complements that of the northern hemisphere. Species is well known and well regarded by the market.	Season complements that of the northern hemisphere. Species is new to the market (e.g. larger roe tongues, different flavour and texture)

\* Common names are inconsistently used across the species



**ISS Institute**  
Level 1, 189 Faraday Street  
Carlton VIC 3053

**T** 03 9347 4583  
**E** [info@issinstitute.org.au](mailto:info@issinstitute.org.au)  
**W** [www.issinstitute.org.au](http://www.issinstitute.org.au)

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