South East farm, D'Entrecasteaux
Channel Tasmania

Industry Summary **2014**

TSGA

Industry summary **2014**

The Tasmanian salmonid industry ("industry") is committed to the production and sale of premium quality Atlantic salmon and Ocean trout, along with complementary investments in other added-value, premium Tasmanian seafood products.

The industry conducts its operational activities, from salmon farming and processing through to sales and marketing in Tasmania with over 1,552 employees and 1,550 hectares of farming space. Its growing reputation is based on a quality product and an innovative approach to sustainable salmon farming.

We are a dynamic organisation operating in an industry of great importance to the Tasmanian economy and with an international reputation. Our purpose is to build on our potential and our opportunities for growth within the global salmon market through the production and sale of premium Tasmanian salmonids.

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Fast Fish Facts

The Tasmanian Salmonid Growers Association (TSGA)

The Tasmanian Salmonid Growers Association (TSGA) is a not for profit organisation established by its grower members over 21 years ago to represent the Industry.

Significant economic benefits to the State

- The Industry continues to experience strong sales momentum despite the current challenging economic environment ... Salmon & Trout sales are proving resilient
- In 2010 Atlantic salmon became Australia's highest earning fisheries product, surpassing rock lobster
- **43,000t** of Atlantic salmon was harvested in 2012/13
- >**$0.5 billion**, including exports $60M
- Largest aquaculture Industry in Australasia
- Second Largest Farming Industry in Tasmania
- Major employer of Tasmanians in rural and regional areas of the state; **1,552 directly** and **3,600 indirectly**

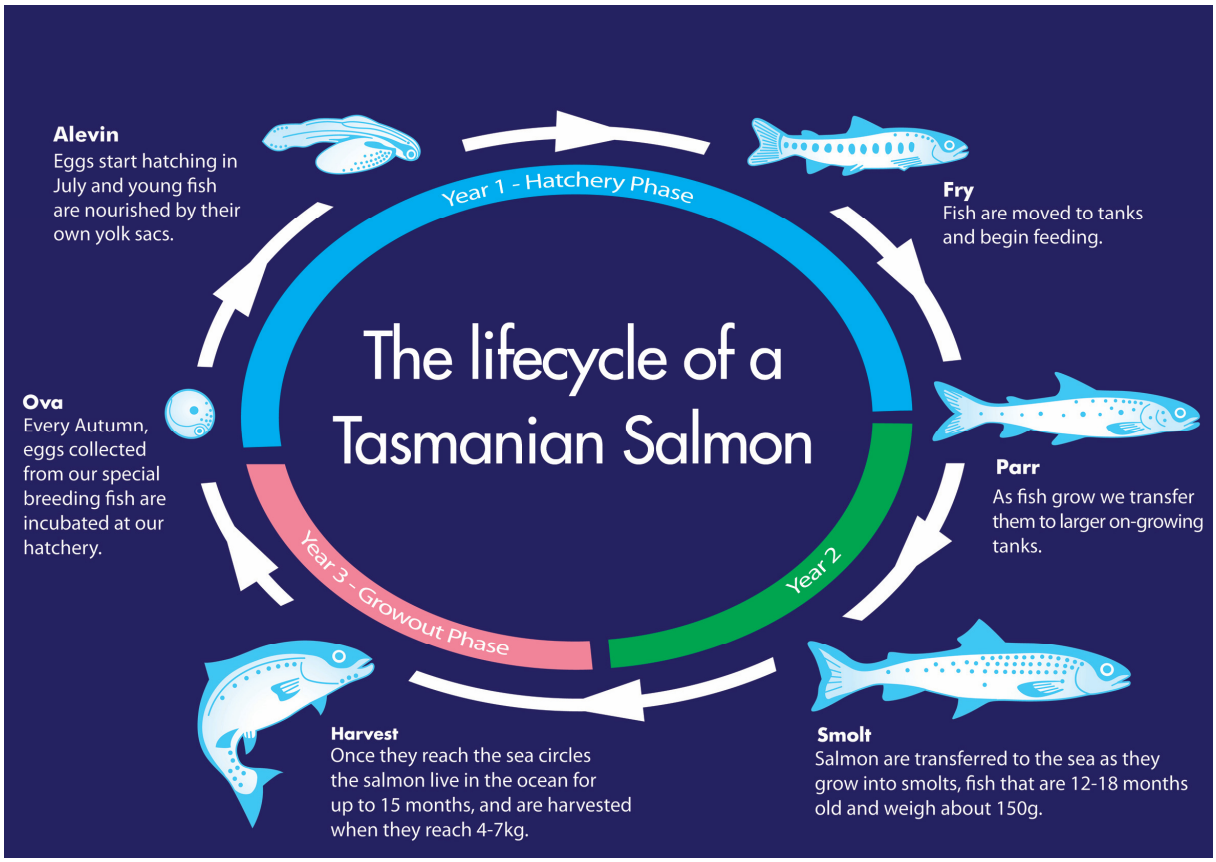
Significant opportunity to grow

- The TSGA believe that the Industry is a **$1 billion** Industry for Tasmania ... and will underpin the success or otherwise of the "Food Bowl" concept
- Demand continues to grow for quality protein which is farmed responsibly
- On average a family of four will consume **6kg** of salmon per year

Underpinned by science

- The salmon farming industry in Tasmania has a long history of supporting and investing in both fundamental and applied research
- The value of TSGAs current R&D portfolio is in excess of **$5 million**.
- Salmon farmers recognise that they must demonstrate their commitment to sound principles of :
    - operational excellence
    - optimal animal welfare and high standards of husbandry
    - achieving the sustainable use and sustainable management of Tasmania's marine resources

Life cycle of Tasmanian Atlantic salmon



What do you see as the key challenges facing the salmon industry?

- Maintaining strict quarantine and biosecurity measures to prevent the incursion of pests and diseases
- Access to water is seen by industry as the main challenge for growing and processing.
- Sustainable industry development - balancing industry expansion with environmental sustainability and community acceptance.
- Increasing the size of existing markets or finding new markets should production increase as expected.
- Sustainability of food stock/fish meal. As global aquaculture production increases accessing sustainable sources of fish protein may become an issue into the future.

Key message

When you eat Tasmanian Atlantic Salmon you are supporting a great Australian industry and enjoying the freshest salmon available because it is grown locally.

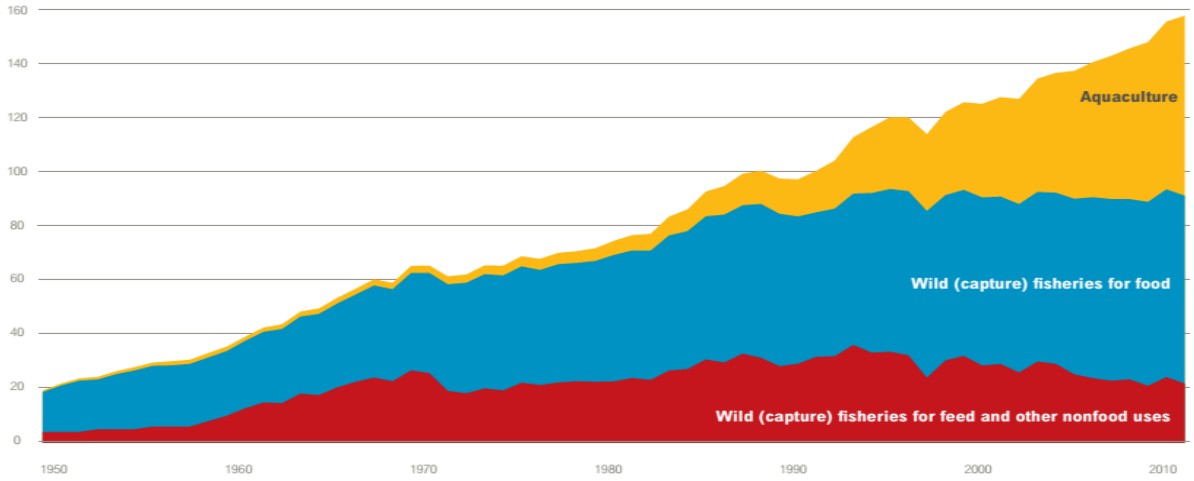
Contents

1. Seafood Production

Global perspective

Fish is a vital source of proteins, minerals, and healthy fatty acids, and organisations such as the Food and Agriculture Organisation of the United Nations expects a significant increase in demand for fish over the coming years as a result of growing world population and increased income levels combined with an increasing amount of easy-to-prepare fish products from the processing industry. According to FAO projections, it is estimated that in order to maintain the current level of per capita consumption, global aquaculture production will need to reach **80 million tonnes by 2050**.

While wild catch of fish generally are experiencing limitations due to growing concerns for overfishing of natural fish stocks, **'aquaculture'** holds a huge potential for increased production both of species already present in aquaculture and to new species being introduced in aquaculture.



Australia 2011–12

- The gross value of Australian commercial fisheries production increased by 3 per cent to **$2.3 billion.**
- **Tasmania** accounted for the largest share of gross value of production (30 per cent), followed by South Australia (19 per cent) and Western Australia (17 per cent). Commonwealth fisheries accounted for 13 per cent of gross value of production.
- The gross value of aquaculture production (including southern bluefin tuna wild-catch input to the South Australian tuna farming sector) increased by $100 million to $1.1 billion, and accounted for 46 per cent of the gross value of Australian fisheries production. The volume of aquaculture production increased by 10 per cent to 84 605 tonnes, accounting for 36 per cent of total Australian fisheries production.

- The value of farmed salmonids rose by 20 per cent to $513 million. Farmed salmonids continue to be the largest aquaculture species group produced, and also the most valuable fisheries product in Australia. Salmonids accounted for 49 per cent of the total value of Australian aquaculture production and 22 per cent of the total value of fisheries production.

- For the first time, salmonids became the largest quantity of any fisheries commodity produced. From 2003–04 to 2010–11 Australian sardine, a relatively low valued product, was the largest single species produced.

Australia 2001–02 to 2011–12

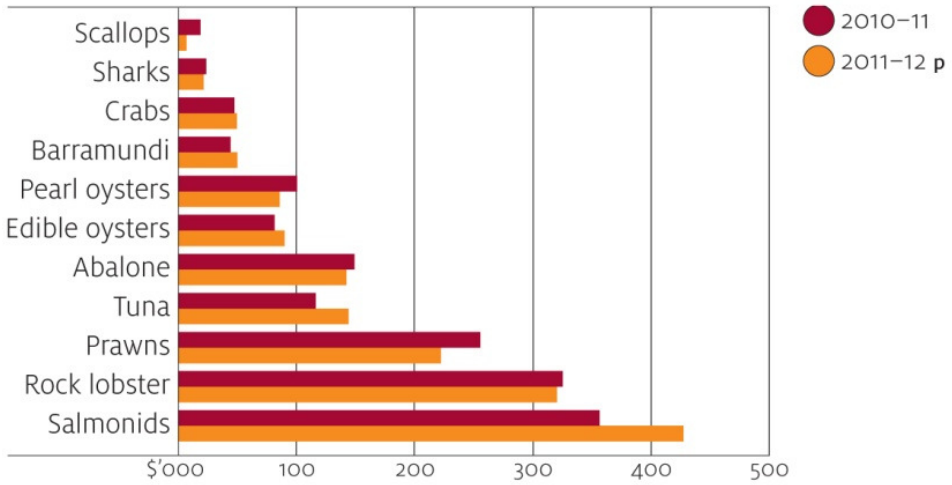
- Total annual volume of fisheries production has decreased by 2468 tonnes (1 per cent), while annual real gross value of production has fallen by $912 million (28 per cent).

- Driving the fall in production value has been the decline in the gross value of tuna, prawns, rocklobster and abalone production. The combined value of these four species groups has fallen by 50 per cent in real terms over this period, with their combined contribution to total fisheries production falling from 61 per cent to 43 per cent.

- In contrast, farmed salmonids, predominantly from Tasmania, has increased significantly in both value and volume terms. Over this period, the value of farmed salmonids increased by 211 per cent ($348 million) while its production volume rose by more than 171 per cent (27 769 tonnes).

Top five, by volume in 2011–12 (wild–catch and aquaculture)		**Top five, by value in 2010–11** (wild–catch and aquaculture)	
Salmonids	43 989 tonnes	Salmonids	$513 million
Australian sardine	41 319 tonnes	Rocklobster	$384 million
Prawns	22 537 tonnes	Prawns	$266 million
Oyster	15 745 tonnes	Abalone	$172 million
Tuna	10 071 tonnes	Tuna	$170 million

Value of Australian fisheries production, by species group, 2010–11 and 2011–12



Tasmania production

In 2011–12, the gross value of Tasmanian fisheries production increased by 13 per cent ($78 million) to $690 million, while the volume of production increased by 17 per cent (7577 tonnes) to 52 554 tonnes. Most of Tasmania's fisheries production comes from the aquaculture sector, which contributed 92 per cent (48 284 tonnes) to total production in volume terms and 78 per cent ($537 million) in value terms. The wild-catch sector accounted for the remaining 8 per cent (4270 tonnes) of production volume and 22 per cent ($153 million) of production value.

Compared to 2010–11, Tasmanian aquaculture production rose by 20 per cent (7970 tonnes) in 2011–12. This was primarily driven by an increase in salmonids production. Salmonids is the largest aquaculture species group in Tasmania, in both value and volume terms. In 2011–12, salmonids production accounted for 90 per cent of Tasmania's aquaculture production volume and 82 per cent of the total volume of fisheries production. In value terms, salmonids constituted 94 per cent of Tasmanian aquaculture production and 73 per cent of total fisheries production in Tasmania in 2011–12. Both the value and volume of salmonids production increased in 2011–12.
The volume of salmonids production increased by 21 per cent (7564) tonnes to 43 249 tonnes while production value by 21 per cent ($89 million) to $506 million.

2. Salmonid net-pen aquaculture

Introduction

The following table summarises the main features of the salmonid industry grow-out sector.

Species	**Atlantic salmon**	**Ocean trout**
Location	Tasmania	Tasmania, Victoria, New South Wales, Western Australia
Length of production cycle	12–29 months	7-22 months
Product	Fresh, processed and smoked product	Fresh, processed and smoked product
Annual production (tonnes, 2011–12) (ABARES2013)	43 989 (includes salmon and trout production)	
$ value (2013-14)	$552.6 million	
System	Net-pen culture	Net-pen / pond culture
Feed used	Dried pelleted ration	Dried pelleted ration

The Ocean trout (*Oncorhynchus mykiss*) and Atlantic salmon (*Salmo salar*) stocks used by the Tasmanian salmonid aquaculture industry are fully domesticated. The species were introduced to Australia from the 1864-1870, but did not establish self-sustaining populations. They were reintroduced in 1963–65. Between 1968 and 1999, legislation prevented the import of fresh salmonid products to Australia. A moratorium remains on imports of all fresh salmonid products into Tasmania.

Atlantic salmon require water temperatures of 4–16°C to maintain optimal growth and good health. Temperatures above 18°C may cause stress to the salmon and affect their growth and health. Ocean trout can tolerate similar water temperatures to Atlantic salmon in freshwater, but are slightly less tolerant of high water temperatures at higher salinities.

3. Salmon hatcheries and raceways

Introduction

Although salmon can be produced in fresh water, most salmon spend only the first part of their life cycle in freshwater before being moved to net-pens. Production of fish fully in freshwater occurs in Victoria and species farmed are Atlantic (*Salmo salar*). Chinook (*Oncorhynchus tshawytsha*) salmon are produced in a hatchery in Victoria for stocking purposes.

The fresh water/seawater production style is common in Tasmania. For further information on the adult phase of salmon kept in freshwater, see the description under the next Section.

Practices

The salmon farming industry can be subdivided into separate stages of the production process which progress from the broodstock to the hatchery production of fry and smolts, to marine grow-out, to the distribution of the final product in domestic and export markets. The broodstock may be maintained at either freshwater or seawater farm sites, where they start to mature during late summer and early autumn (February-March). At freshwater sites the broodstock are either held in flow-through raceways or closed RAS tanks. It should be noted that broodstock are exposed to wild aquatic animals which may harbour potential pathogens (e.g. birnaviruses in marine finfish and invertebrates). Some hatcheries are now avoiding the use of broodstock which may have been exposed to marine pathogens such as birnavirus and reovirus. The broodstock become fully mature and ripen in late autumn (May) at which time the milt (sperm) and ova (eggs) may be stripped and mixed to facilitate fertilisation and the generation of a new year-class of stock.

Fertilised ova (six to eight millimetres in diameter) are maintained at the hatchery facility while the embryos progress through the green and eyed stages until they hatch as alevins (yolk-sac fry) and develop into first-feeding fry (approximately 0.2 g) ready to commence exogenous feeding. When the fry have established a feeding pattern, they continue to be maintained in the hatchery facility until they develop into parr (1-2 g fish which display characteristic colouration) a process that takes a further two to three months (October–November). Subsequently, parr are transferred to smolt-rearing facilities where they are maintained until smoltification: the physiological metamorphosis that facilitates the fish's survival in the marine environment. Typically, smoltification takes place approximately 15-16 months after fertilisation (in September-October) and occurs in response to the increase in day-length associated with the onset of spring. In some cases the development of fish to the smolt stage can be advanced by up to five to six months (in March-May) through photoperiod manipulation.

Smolts (60-100 g fish which resemble adults and are capable of surviving in the marine environment) are transferred to marine farms for grow-out where they are maintained in floating net-pens as they develop into salmon (adult fish) ready for harvest. This process takes a further 12-20 months.

At all stages, salmonids require cool water, ideally 10-15° Celsius, with high levels of dissolved oxygen (generally greater than 80 % saturation or five milligrams per litre).

During the freshwater stages of production, the majority of husbandry activities are associated with spawning, feeding and grading fry and parr, and the transport of smolts.

Premises and equipment

The majority of salmon hatcheries are located on the upper reaches of major river systems, where relatively consistent supplies of water can be extracted from areas with minimal industrial, agricultural and domestic sources of pollution. There are generally separate egg incubation, larval-rearing and broodstock holding areas.

Egg incubators, larval-rearing tanks are generally constructed from fibreglass and/or plastics. Their size is determined by life history stage and the scale of the operation. For example, first feeding tanks may range in volume from approximately one to ten m^3, while smolt production tanks can range from four to 60 m^3. Some hatcheries undertake smolt production in large closed RAS, with extremely high levels of ozone and UV sanitation, to produce pathogen-free smolt. Raceways for holding broodstock are constructed from concrete and may be placed in series or in parallel.

Broodstock are rarely sourced from net-pen sites, due to the risk that they have been exposed to potential pathogens which may be transferred with the broodstock fish to hatchery sites.

In the unlikely event of movement of viable salmonid gametes, fertilised ova or live fish (hereafter referred to as 'stock') from marine sites to hatcheries is required, stock is transferred from a marine zone to the freshwater zone under a Movement Permit issued by the CVO (valid for 12 months). The adopted barriers for this type of transfer are described in the agreed *Tasmanian Broodstock Movement Protocol* (DPIPWE 2008)

Under these circumstances, it is important that broodstock are maintained in facilities completely separate from egg incubation and larval rearing areas. In addition, it is advisable to maintain individual lines of eggs in separate areas with individual clean water supplies.

System inputs

Animals

Whether maintained entirely in freshwater, or returned to freshwater sites for spawning after a period of seawater residence, broodstock represent a possible vector for both vertical (primarily viruses) and horizontal (primarily bacteria and protozoa) transmission of pathogens to other stock held at hatchery sites. Similarly, at sites where year-classes of stock overlap, the older cohort is a potential source of infection for the younger cohort. Any transfers of new stock onto a site (e.g. the return of broodstock for spawning or the relocation of other life-history stages) may introduce disease organisms. Depending on the level of pre-filtration on hatchery source water, small stages of wild fish and other aquatic organisms may be able to enter the hatchery site.

Water

Variable levels of pre-filtration are undertaken on intake water at hatcheries. Salmon require a high standard of water quality to maintain growth and health. The water supply represents a route for the entry of pathogens (principally bacteria) and parasites (mainly protozoa) shed from wild fishes inhabiting the watercourse, or other fish farmed upstream. For conventional flow-through systems

this is the most significant source of infection for farmed stocks. There can be multiple farm sites on one river, in addition to runoff from agriculture, stormwater and municipal wastewater.

With the adoption of water recirculation technology, the volumes of water extracted from the source can decline and reduce the likelihood of disease introduction. The most sophisticated systems achieve a 95 % reduction in water requirement and use systems which facilitate complete disinfection (e.g. using ozone and ultraviolet light) of any make-up water introduced into the farm.

Equipment

Equipment used includes egg incubators, tanks, aerators, pumps, ultraviolet sterilisers, ozone generators, airlines, biofilters, nets, bulk oxygen supplies and spare parts.

System outputs

Animals

Smolts are the primary product and are transferred directly to marine grow-out facilities using specially designed truck-mounted tank systems. On arrival they are discharged into net-pens.

Groups involved

Groups involved include:

- Australian Trout and Salmon Growers Association
- Western Australian Trout Growers Association
- Tasmanian Salmonid Growers Association
- Victorian Trout Association
- Aquaculture Council of Western Australia
- National Aquaculture Council
- state departments of agriculture and fisheries
- water authorities
- environmental protection agencies and other environmental groups and agencies.

Occupational health

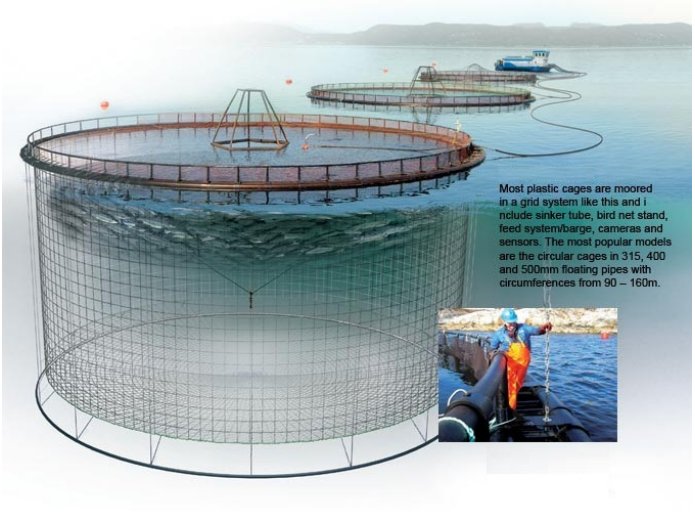
Occupational health issues to be aware of include:

- use of heavy equipment
- Farms are often located on cold, fast running rivers. These rivers are potentially dangerous for workers if they are required to enter them.

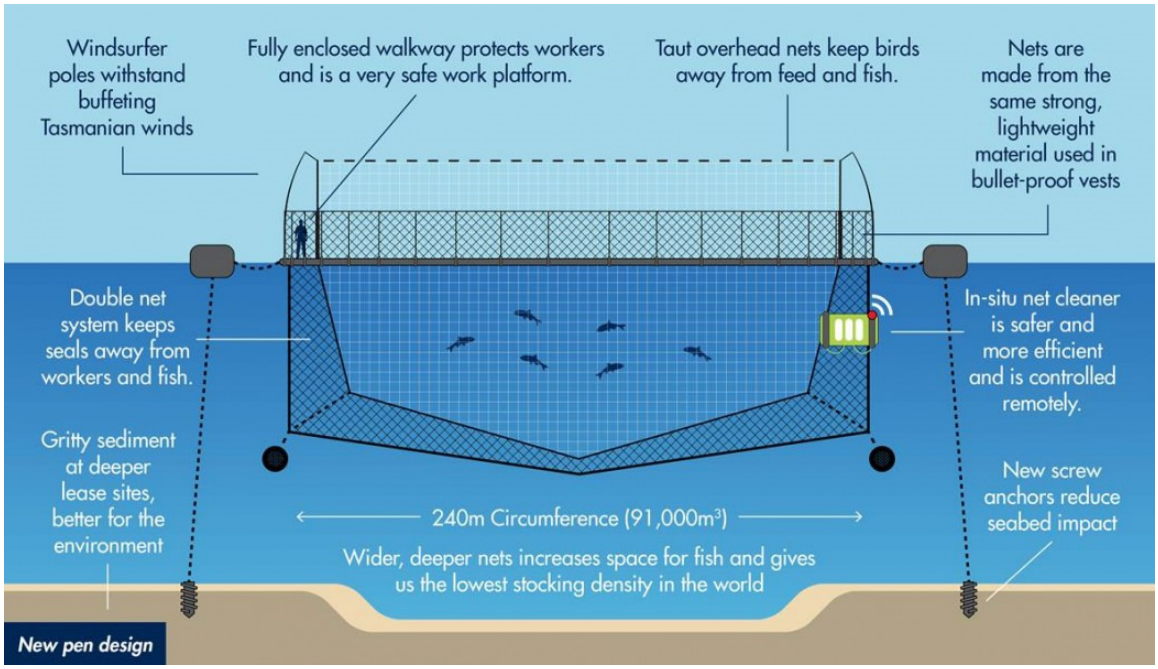
4. Marine husbandry practices

Atlantic salmon net-pen culture

Atlantic salmon farming consists of a freshwater hatchery stage and an estuarine/marine grow-out stage. Young salmon (smolt or pre-smolt) are usually introduced into the marine environment when they are between 10 and 17 months old and weigh 45–100 g. Special trucks are used to transport young salmon from the inland hatchery to the marine site. Fish are then either transferred into net-pens at the marine-site land base or shipped by barge to net-pens in remote marine sites. Most hatcheries retain their broodstock in freshwater to minimise risk of disease introduction from marine areas.



Floating net-pens, of either individual circle or square-grid system design, are used to house the salmon in the marine environment. A circular net-pen consists of a circular plastic support to which is attached a circular nylon net. Net-pens have a circumference of 40–240 m, and the nets have a depth of 8–25 m. Circular net-pens may be placed as close as 25 m to one another within a lease. A system net-pen consists of a grid of plastic pontoons and steel walkways that support a number of square nylon or brass nets in close proximity to one another (2–3 m between neighbouring net-pens). Each square net is 25 m wide and 8–15 m deep. All net-pens are moored within a grid comprising an elaborate system of ropes and structures anchored to the sea bed, and can be towed between mooring systems. Additional predator nets to protect stock from large predators, such as birds and seals, are usually installed to surround individual net-pens or raft systems.



Most net-pens are located in areas moderately well protected from wind and wave action; however, industry expansion is now resulting in placement of net-pens in new, more exposed lease areas. Salmon are usually on-grown in net-pens for 12–18 months. There are usually 10 000– 60 000 fish in each net-pen, depending on its size and the size of the fish. This results in a stocking density of 4–15 kg per m^3 of water. Salmon are graded during grow-out, ensuring that fish in the same pen are of similar size.

Fish are fed a commercial dry pelleted ration. The majority of the larger grow out diets are produced in Australia. However, some fish feed is imported. During the warmer months, fish may be fed up to 3% of their bodyweight per day, while in winter the rate can be as low as 0.5%. Feed is usually delivered to the farms by truck in 1 tonne bags. Feeding methods vary between farms. On some farms, the fish are fed by automatic feeders that consist either of individual units on each net-pen or a central control unit that feeds a number of net-pens. On other farms the fish are fed from boats, either by hand with feed scoops or using a manually operated cannon feeder, which blows the feed into the net-pens.

Salmon are usually harvested when they weigh 2.5–4.5 kg head-on, gilled and gutted (HOGG). Some farms have a processing facility near the marine sites, and net-pens are towed to this site for harvesting. Other farms conduct harvesting 'on the water', using barges or boats. The Tasmanian industry almost exclusively uses automated percussive stunning and gill cutting equipment during harvesting, which serves to maintain high flesh quality as well as high fish welfare standards.

During harvesting, fish are crowded in the pen and drawn from the water, most commonly using a fish pump but sometimes using a brail net (usually 20–30 at a time), to be delivered into the automated percussion stunning and killing unit. Once stunned, the fish are cut, usually near the base of the gills, to allow bleeding. Alternatively some farms now swim fish into a percussion stunning unit to maintain high fish welfare standards. In either case, fish are placed into ice slurry within a few minutes of bleeding out. If processing is on site, the fish are eviscerated and cleaned, and then either packaged or forwarded to a value-adding section (e.g. for smoking or preparation into portions). If the processing site is distant from the harvesting site, the fish are trucked in bins (in ice slurry) to the processing facility. Fish may be kept in the ice slurry for up to 24 hours before processing, but are usually kept for less than 12 hours.

Harvest bins and equipment are sanitised between use and processing facilities meet export standards approved by Department of Agriculture. Approximately 5% of fresh fish are airfreighted overseas to reach the market within 24 hours of harvesting. Most of the remainder is airfreighted to the mainland wholesale markets in Melbourne and Sydney, with some going directly to restaurants and retailers.

At water temperatures above 18°C, salmon are more susceptible to disease agents, and farmers will often not feed fish under such conditions. Warm summers with high water temperatures may impact the growth and general health of the fish. Farm personnel regularly sample a small number of fish from each of the grow-out pens to inspect them for growth and health status.

Freshwater bath treatments are used to control amoebic gill disease. These treatments require plastic liners, a source of fresh water and adequate oxygen supply. Where required to control disease, other treatments such as antibiotics may be coated onto the feed.

Net-pens are monitored for dead fish ('morts') on a regular basis (2–7 days a week). 'Morts' are removed from the pens by various methods, including dip-net, 'mort' retrieval devices and scheduled diving. The collected 'morts' are buried in a designated area on land or processed using ensilage or rendering.

Farmers regularly monitor water quality in all sites. Records may be kept of dissolved oxygen, temperature, turbidity, pH, salinity and identified phytoplankton. Some farms fallow net-pen sites within a lease area for a year or more.

Ocean trout net-pen culture

Net-pen culture of Ocean trout is basically the same as for Atlantic salmon, except that Ocean trout do not go through a smoltification stage in which the fish prepares for the transition from fresh water to salt water. When introduced to brackish or salt water, Ocean trout immediately go through an acclimatisation stage (i.e. there is no prior phase where they 'get ready' for the transfer to salt water). As Ocean trout do not perform well in full salt water (31–35 parts per thousand), they are usually only grown in sites with brackish water (15–21 parts per thousand). Fish are usually transferred to such sites when they are approximately 12 months old and weigh 50–100 g.

Premises and equipment

Boats are the main form of transport on salmon farms. They are used to deliver feed, tow net-pens, clean or change nets, as dive vessels, to transport personnel, for inspection of fish, and to help carry out day-to-day maintenance on net-pens and mooring systems. Most are made of aluminium, are 4.5–7 m long, and have outboard motors. Larger boats and barges may be used for heavier work and are often fitted with Hiab cranes or electric winches.

Most farms have an on-land facility with offices and buildings to house staff, machinery, feed, nets and other equipment. Most also have open work areas on land designated for the net maintenance or for the disposal of dead fish. Some farms have a dedicated laboratory, with a light microscope and equipment for taking pathology samples; most have equipment for sampling live fish. Farms have equipment for grading fish, for transferring fish between net-pens and for freshwater bath treatments to control amoebic gill disease. Forklifts are commonly used around the land-based facilities and trucks are used to transport feed to the farm and harvested fish to processing plants. Harvesting equipment is heavy and not easily transportable, but some farms use a large vessel to move it or to conduct harvesting 'on the water'. Most farms have sanitising treatments to clean equipment.

Most farms fully equip a dive team, but the amount of gear available depends on whether contract divers are used.

System inputs

Aquatic animals

Atlantic salmon and Ocean trout to be used for culture are usually transported by land from freshwater hatcheries to marine sites between March and November. This may involve movement between geographical zones of different disease status. The Tasmanian Salmonid Growers Association (TSGA) and the Tasmania State Government Department of Primary Industries, Parks,

Water and Environment (DPIPWE) have agreed on translocation protocols and movement restrictions between different culture areas to minimise risk of disease translocation. Fish are most stressed after they have been transferred from fresh water to salt water.

Smoltification usually takes place in spring, but with photomanipulation, out-of-season smolts can be ready to go to sea as early as March. Pre-smolts (young salmon that have not fully smoltified) can be transferred to brackish water sites earlier to achieve better growth rates, than in fully fresh water at the hatchery.

On some farms, fish are graded to ensure that the sizes of individual fish are reasonably consistent within the population in any particular net-pen.

Predators

Predators, particularly seals and birds, have a large impact on the health of salmonids in marine farms through stress, injury and mortality. Prevention of stock predation requires anti-predator devices such as protective nets around net-pens. The salmonid industry has operated a trap and relocation program to mitigate the short term damage from seals. Seals are highly mobile and can move vast distances between sites. The DPIPWE under direction of the Marine and Marine Industries Council developed the Seal/Fishery Interaction Management Strategy.

Water

Semi-open systems are located in estuaries and exposed marine areas, so there is no control on the flow of water around net-pens. In some estuarine sites, rivers can be a significant source of fresh water. In places such as Macquarie Harbour, the water column can be stratified under low wind conditions, with a freshwater lens of 1–3 m depth overlaying the higher salinity water.

In Tasmania, water temperature ranges from about 9–10°C in winter to 15–23°C in summer. Temperatures above 18°C may cause stress to the fish and have also been associated with toxic algal blooms. Significant thermoclines may contribute to these effects. Fish are usually not fed during this warm weather.

Each company may own a number of leases and may transfer fish between sites. In some areas, neighbouring leases owned by the same or different companies may be a kilometre apart.

Freshwater is used on some farms as a therapeutic bath to reduce the impact of amoebic gill disease.

Feed

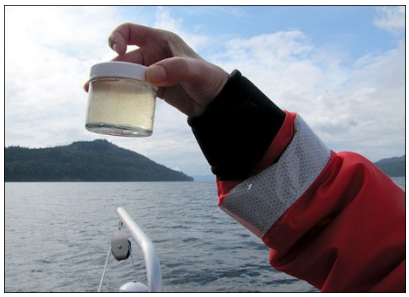
All salmon are fed on a dry, pelleted, commercial ration. The length of pellets varies from 3 mm to 12 mm, according to the size of the fish.

Imported fishmeal and fish oils are used in the manufacture of pellets and the fishmeal component can make up to 10-15% of the ration. The fishmeal and fish oil go through a heating process during extrusion manufacturing, and must be certified free of known pathogens for importation.

Personnel

Practices are similar across farms, so workers from one farm have little difficulty moving between employers. All farms have mess rooms or similar amenities. Larger farms may have up to 50 workers and at any time 30–40 of these may be out on the water. On larger farms, teams often specialise in one particular task, such as net changing or feeding. Each company may own a number of marine leases, and some personnel may move between these sites regularly. In contrast, workers on smaller farms may be involved in more than one type of activity. Companies that own processing and export facilities have teams of specialists to process the fish for market. These teams are relatively static and do not perform tasks on the farms.

Some of the bigger companies employ research staff, fish health veterinarians and technicians.



Contractors may repair and maintain farm equipment. Some farms have contract divers, while others have personnel trained in commercial diving practices. On-farm divers do not disinfect themselves between dives, but contract divers may disinfect and dry equipment between dives at different farm sites.

The level of training and competency of workers is high and the industry has collaborated in some skill areas (such as diving) to ensure that high standards and protocols are maintained. Some farm sites may have regular visitors such as researchers, fish health advisors or other members of the industry.

Equipment

Most farms fully equip a dive team, but the amount available depends on whether contract divers are used. In some cases, divers personally own their dive equipment. This may affect equipment availability, and could potentially be a biosecurity risk if the equipment is used off the farm site.

The type of harvesting equipment varies between farms. Some have equipment permanently installed on land or on boats, some have transportable equipment that is loaded onto boats before harvesting and others have no harvesting equipment but tow the net-pens elsewhere to be harvested. Equipment may include crowd nets, fish pumps, brail scoop nets, air-lift pumps, anaesthetising baths, percussive stunning machinery, bleeding tables, harvest bins, bin liners and aeration/oxygen stones.

Most farms have equipment for sampling live fish from net-pens and inspecting them for weight and health status (specialised sampling nets, anaesthetic baths and recovery bins). Forklifts are ubiquitous throughout the industry. Hiab-type hydraulic cranes and winches are commonly mounted on boats to assist in changing nets, lifting feed, weights, mooring lines etc. Grading equipment may also be available.

Most farms have some form of washing device to clean nets, either on-land or in-water. On raft-system farms, nylon nets are placed above the waterline and allowed to dry in the sun before reuse. Most farms also have a laboratory facility. Some of these have microscopes and pathology sampling equipment, while all have equipment for dissecting fish. Many farms have plastic net-pen liners and other equipment for large-scale therapeutic freshwater bath treatments.

Some farms have a fully equipped workshop on site. Service vessels for feeding and harvesting range in length from 12 m to more than 30 m in length. On most salmon farms, vehicles and boats are used for particular functions, but on smaller farms they may be multifunctional. Some companies own a number of marine leases, and move equipment between these sites regularly.

Stores

Feed is stored on site at land-based facilities for up to two weeks. All farms have stores for gear, but the amount stored varies between farms.

Vehicles

Workers live off-site and drive private vehicles to work. Trucks are used to transport feed, live fish and harvested fish. Forklifts are in common usage.

Other

Farms routinely use anaesthetics and non-prescription disinfectants. Other therapeutic agents, including antibiotics are used where indicated under veterinary prescription, hence farms may store an assortment of these substances. Most farms also use fresh water as a fish therapeutic agent. Anti-foulants are no longer used on nets (2014) but are still used on vessels.

System outputs

Aquatic animals

Salmon are harvested when they weigh 2.5–4.5 kg. Fish are harvested on site, where the necessary facilities are available, or the net-pens are towed to the harvesting site. Processing is usually done away from the farm site. Processed product may be fresh (e.g. head on, gilled and gutted (HOGG), fillets, cutlets or portions), frozen or value added (e.g. smoked). Processing by-products may be on-sold (e.g. rendered offal for inclusion in fertiliser).

Water

Semi-open systems are located in estuaries and exposed marine areas and require an adequate circulation of water through the net-pens. All areas used for salmon farming have some tidal flow. The water in these areas is also affected by weather (wind) and rainfall patterns (freshwater inflow). In Tasmania, many farms are in areas close to human habitation and so can be affected by sewage and stormwater run-off, pesticides and other toxic chemicals and an increased organic component in the water. These are typically diluted in the water mass around the net-pens.

There is no control over the water in and near the net-pens, unless an impermeable liner is placed around the net-pen. Such a liner prevents movement of water in and out of the net-pen, so that oxygen-rich water cannot reach the fish and waste products (e.g. ammonia) inside the net-pen cannot be diluted out. Liners can only be put in place as a very short term measure.

Waste materials

Waste material from farms includes excess feed, fish faeces, mortalities and treatment wastes. Some farms fallow used net-pen sites to minimise accumulation of wastes and allow recovery of the sea floor. Offal (another waste material) can amount to 20–50% of live weight, depending on whether the final product is ‘head-on’ or fillets. The offal is either buried or used in fertiliser production. Dead fish are collected and buried in a designated area on land. Treatment of ‘bloodwater’ (the water in

which the fish lie while bleeding) before discharge back into the marine environment ranges from rudimentary to full treatment. Discharge must meet local requirements, which may include full treatment.

Vehicles and equipment

Workers live off-site and drive private vehicles to work. Boats are used to move between farm sites of the same company and between farm sites of different companies, if these are reasonably close and weather conditions permit. Boats are used to tow net-pens up to 40–50 km between sites. Most equipment on a farm site is usually dedicated to that site. Among nearby sites, there may be some pooling of more expensive equipment, such as fish pumps, graders, percussive stunners or boats.

Groups involved

A large number of groups are involved or actively interested in the operation and regulation of salmon net-pen culture systems in semi-open, semi-closed water, including:

- national, state and local government bodies
- Tasmanian Salmonid Growers' Association
- community groups, such as environment and conservation groups
- recreational fishing groups
- yachting/boating groups
- commercial fishers
- universities and other institutions
- other water users.

Legislation and codes of practice

The *Marine Farming Planning Act 1995* (MFPA) shares the Objectives of the *Resource Management and Planning System.* The MFPA provides for the development of *Marine Farming Development Plans*. These plans identify zones in which marine farming is a permitted activity. Outside of these zones, marine farming is prohibited.

An area management agreement for salmon farming (including fish health issues) in Macquarie Harbour has been jointly developed by industry and the Tasmania State Government Department of Primary Industries, Parks, Water and Environment (DPIPWE). A state wide biosecurity plan is also being developed by these two organisations.

5. Final word

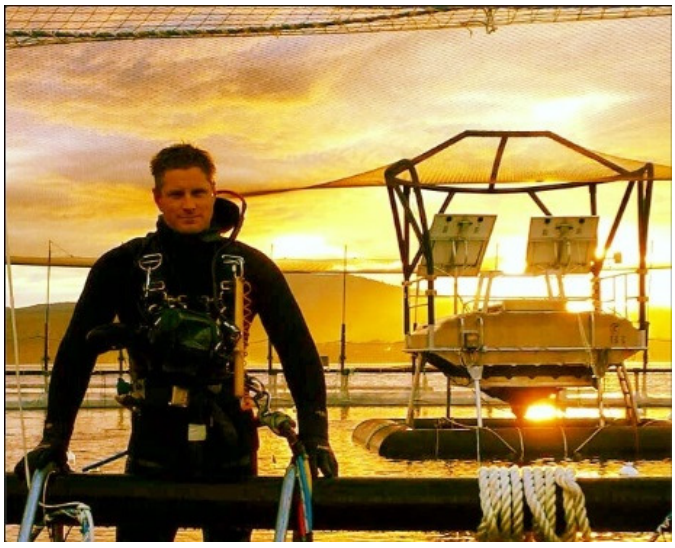
Tasmania's primary industries are the engine room of our economy and salmonid (Atlantic salmon and Ocean trout) aquaculture has the potential to significantly power our state's economic growth. We need to enable primary industry growth underpinned by strong environmental performance.

Within an international market characterised by strong demand for safe and sustainable seafood products, the salmonid aquaculture sector has significant growth opportunities. This growth has to be industry-led and the industry's opportunities and aspirations are reflected in their own goal of growing annual sales to $1 billion in value by 2030. The aquaculture industry has established a strategy to deliver that growth. We need a State Government that is committed to environmentally sustainable, primary sector-led strengthening of the economy and is committed to enabling the salmonid aquaculture industry to reach its goal.

The foundations for growth are already in place. Our aquaculture production is free of many of the issues facing international producers and our environmental and food safety credentials are second to none. Australia has good trading conditions and trade agreements with key and emerging markets. Within these markets, we can leverage off our clean green reputation; world-leading environmental, food safety, animal health and welfare standards; and biosecurity management to secure premiums and market share.

While the foundations for growth are strong, the sector faces particular challenges and has unique characteristics that distinguish it from other primary producers and necessitate a specific Government strategy and action plan. The bulk of aquaculture production comes from the use of public water space, which can only occur in a planning and allocation framework that balances and respects other uses of that space. For this reason, the steps necessary to establish aquaculture operations differ from many other primary producers.

Our strategy is to establish a pathway to enable the aquaculture sector to grow, be it through the development of new farming space, better use of existing space or getting better value from existing production.



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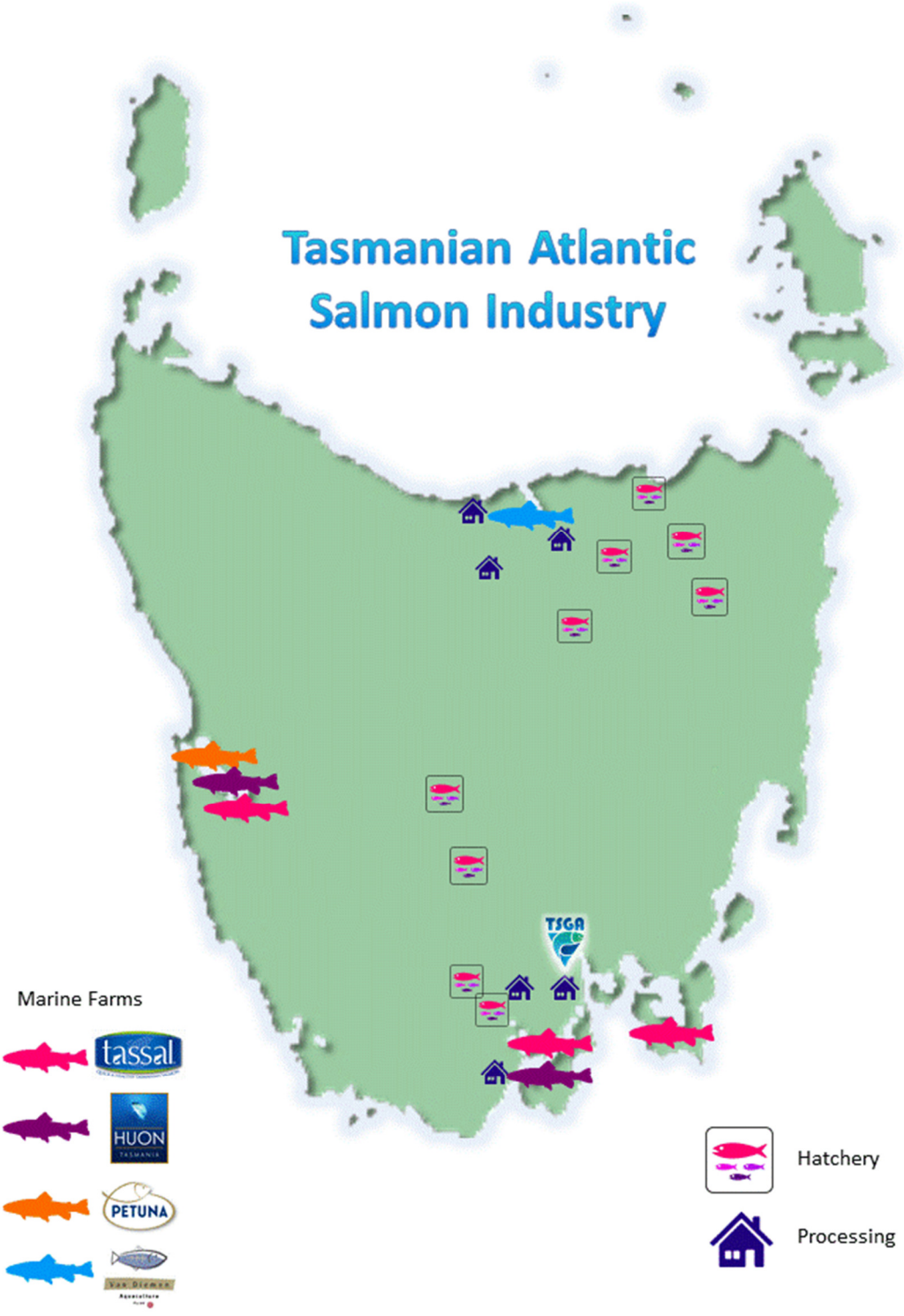
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