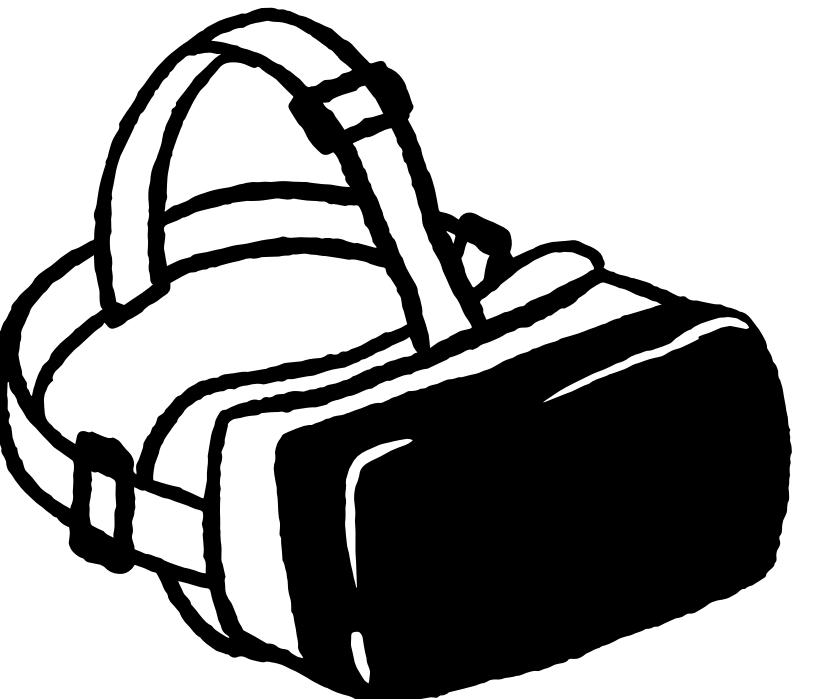
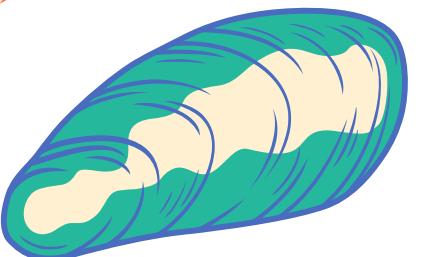
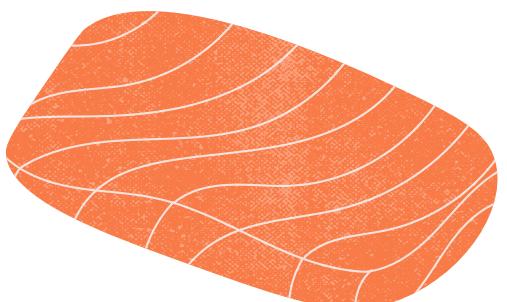


Lesson 1

A **UCHI | SHETLAND**
VR lesson in

Aquaculture



3-Lesson Course

Welcome

UHI | SHETLAND

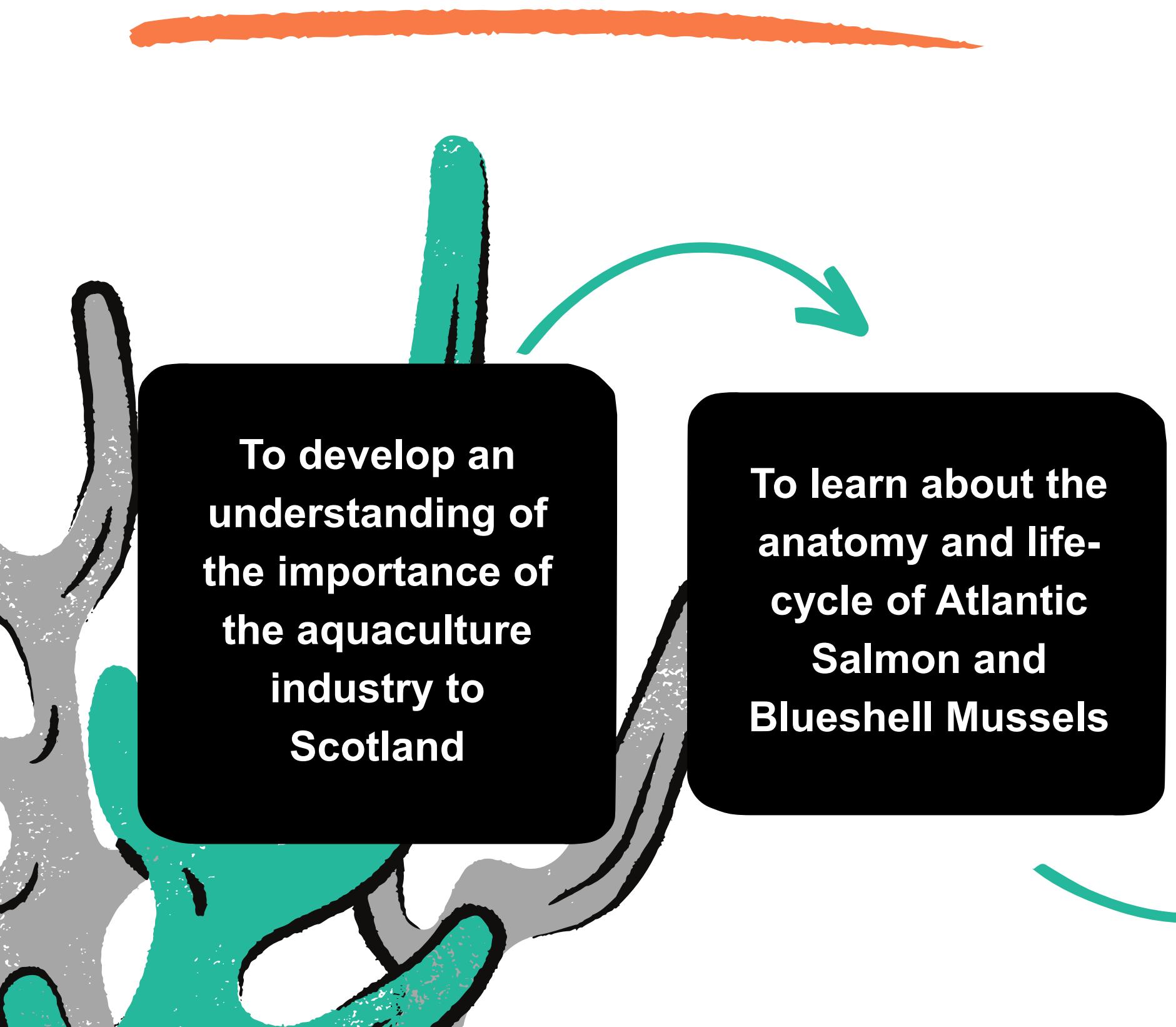
 NTNU

Norwegian University of
Science and Technology

Welcome to UHI Shetland's "**Blue Sector**" Virtual Reality (VR) course. These resources are designed for school pupils aged 12-18 who are interested in learning more about the aquaculture industry in Scotland.

Through the Meta Quest app developed in collaboration with the IMTEL Lab of NTNU, you will have the opportunity to engage with interactive scenarios which represent typical tasks routinely carried out in workplaces of the aquaculture and fish processing industry.

Overall Learning Outcomes

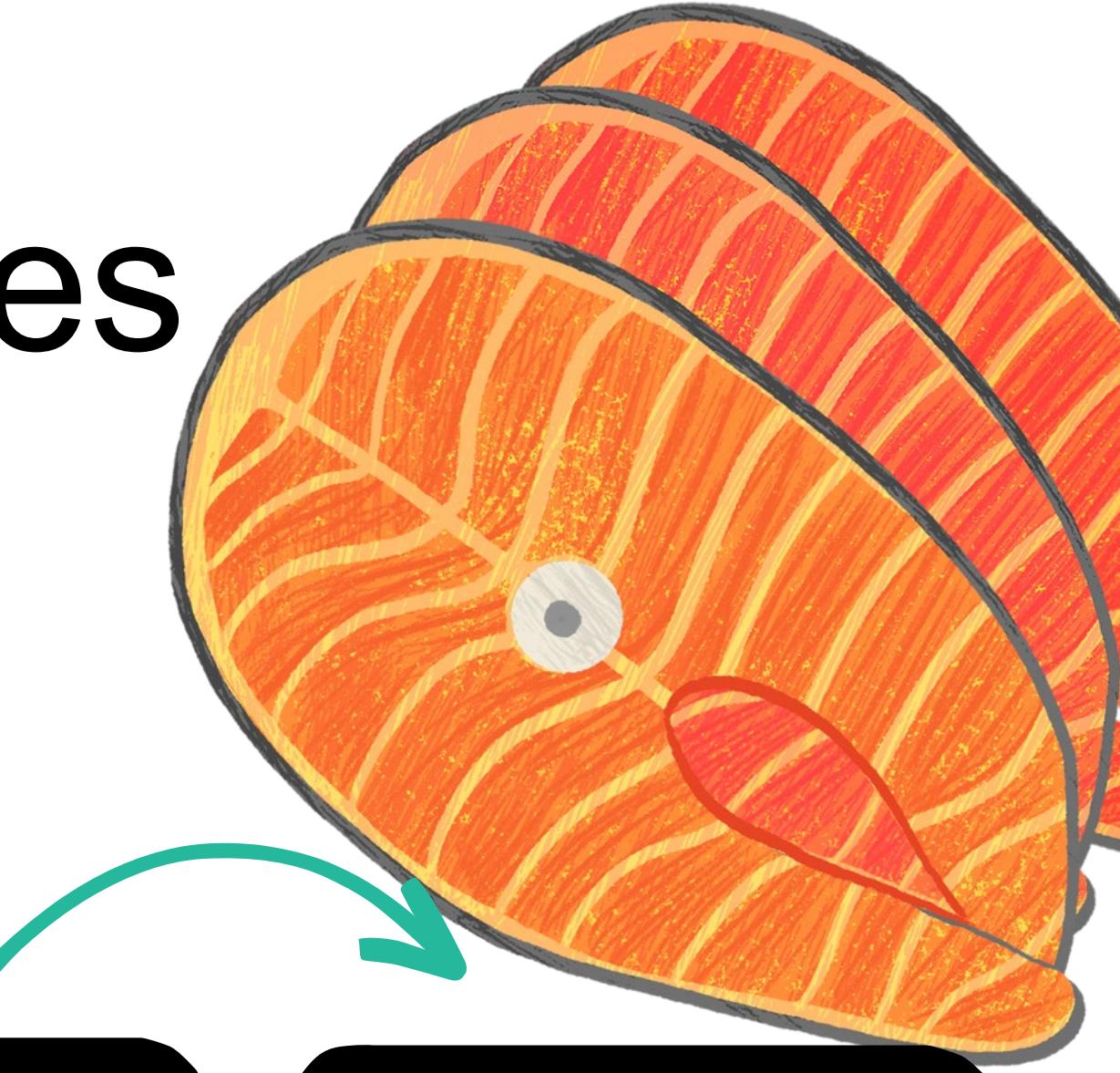
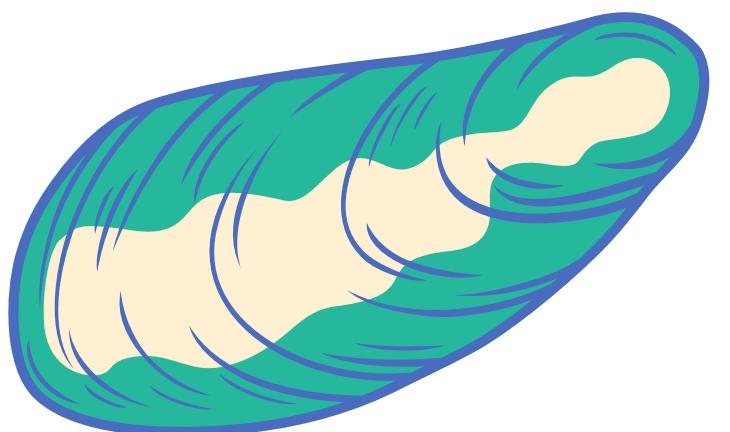


To develop an understanding of the importance of the aquaculture industry to Scotland

To learn about the anatomy and life-cycle of Atlantic Salmon and Blueshell Mussels

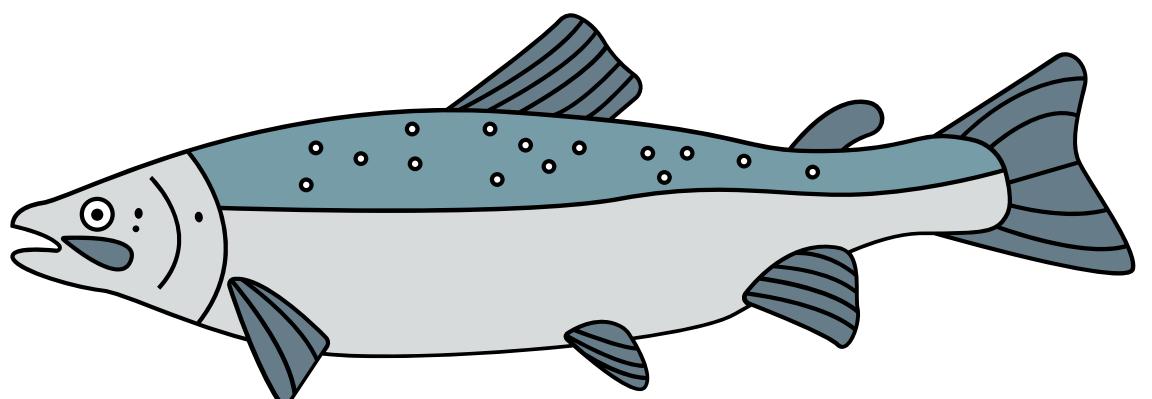
To explore the conditions required to care for salmon and mussels

To find out more about careers in the aquaculture industry

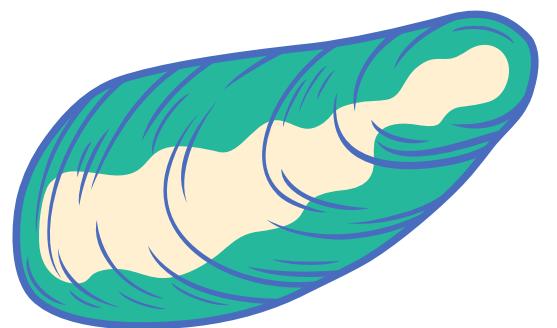


What is aquaculture?

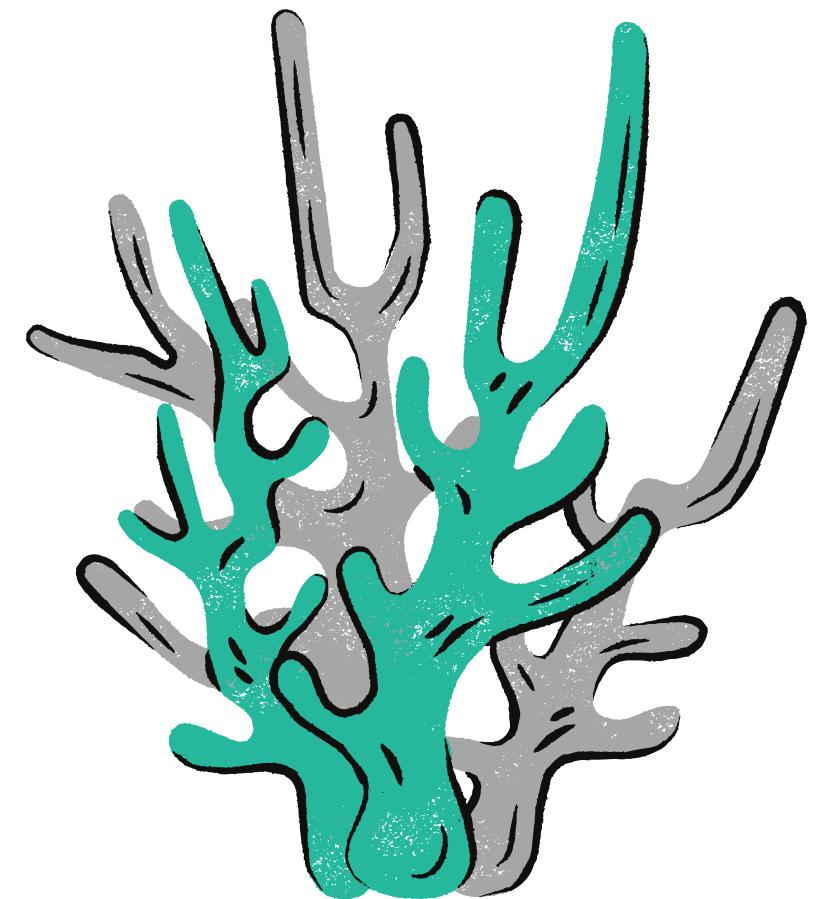
Aquaculture is the rearing of animals and the cultivation of plants in any aquatic (water) environment



Finfish (e.g Salmon)



Shellfish (e.g Mussels)

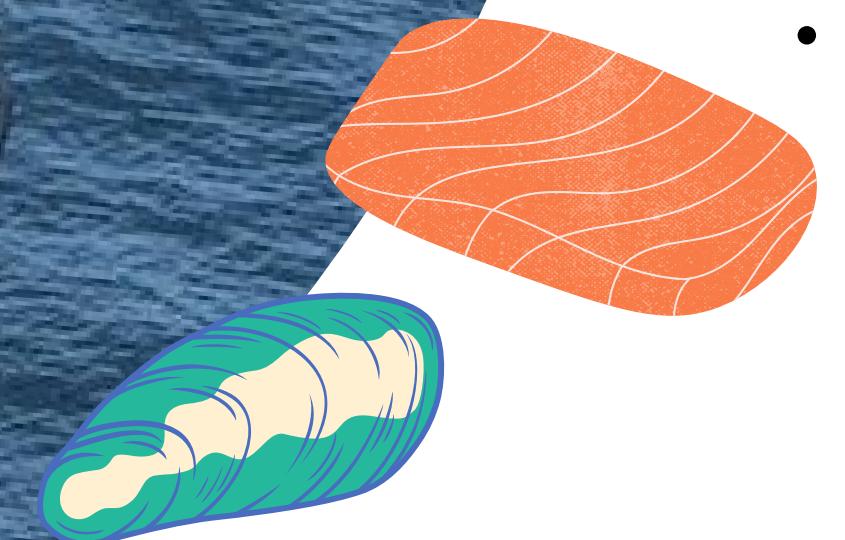


Algae (e.g Seaweed, not covered in this course)



Why is aquaculture important to Scotland?

- The farming of Scotland's seas contributes over **£1.8 billion** annually to the Scottish economy (Scottish Government 2021).
- Salmon is the **second largest food export in the UK**, after whisky with ~350 active farms harvesting **>200,000 tonnes annually**.
- **81%** of all Scottish Mussels are grown in **Shetland**.
- By 2030 the number of **jobs** supported by the sector could reach **18,000**. To thrive globally, the Scottish aquaculture sector needs a diverse workforce with the right skills - for 5 years' time, 15 years' time and beyond.



Nutritional benefits of Seafood

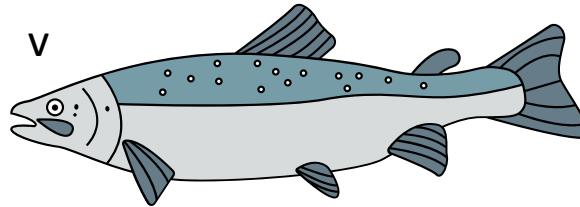


- A **healthy, balanced diet** should include at least **2 portions of fish a week**, including 1 of oily fish.
- Fish and shellfish are good sources of many **vitamins and minerals**
- **Oily fish** – such as salmon and sardines –are particularly high in long-chain **omega-3** fatty acids, which can help to keep your **heart healthy**.
- Shellfish are: **low in fat**, a source of **selenium, zinc, iodine and copper**
- <https://www.nhs.uk/live-well/eat-well/food-types/fish-and-shellfish-nutrition/>

Atlantic Salmon (*Salmo salar*)



- Atlantic salmon, also known as the “king of fish” live in coastal seas and feed on pelagic invertebrates and some fishes.
- They are **anadromous**, meaning they **migrate** from the **sea into fresh waters** to spawn. This is the opposite of the common eel which leaves fresh waters to spawn in the sea and is instead called **catadromous**.
- They are an **indicator species**; the health of salmon populations closely reflects the status of their larger marine ecosystem.
- They can grow to a very large size, the heaviest one caught in the wild weighed 49 kg and was found in the river Hope



Juvenile salmon (parr) only have the physiological mechanisms needed for surviving in freshwater. However, as **smolt** they **migrate downstream** to the estuary and ocean. They must therefore **adapt** their **kidney function** to cope with the salt-water conditions and develop **protective silvery scales**

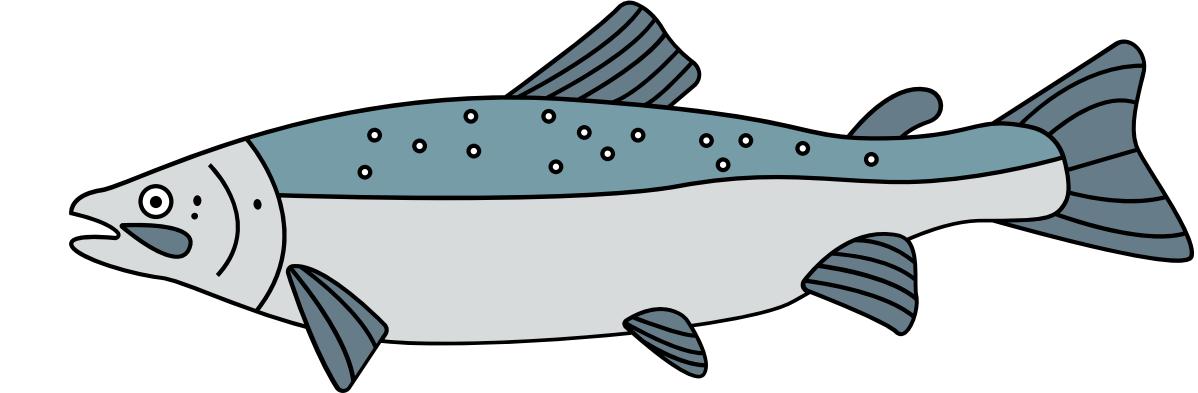


2

Female salmon swim upstream to lay their eggs in **cold freshwater** as their eggs, alevins and fry cannot survive in the salty and unprotected conditions of the sea. They are buried in **gravel** and the flow of **running water** provides a source of **oxygen**

1

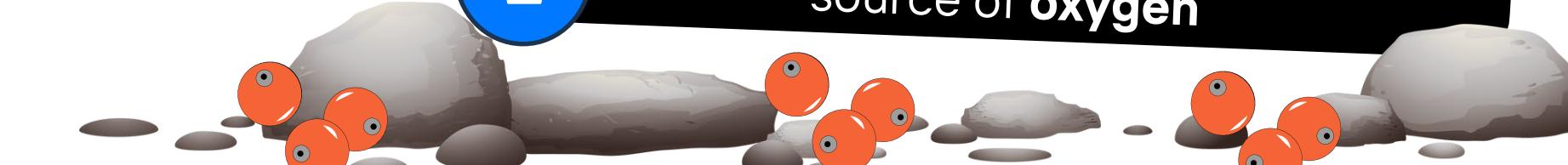
In the Wild



Most salmon spend the first part of their adult life in coastal waters, then **migrate** further **out to sea** where they spend from **1 to 7 years**. They can travel up to 50km a day in a large school and **return to their home stream or lake** to breed.

3

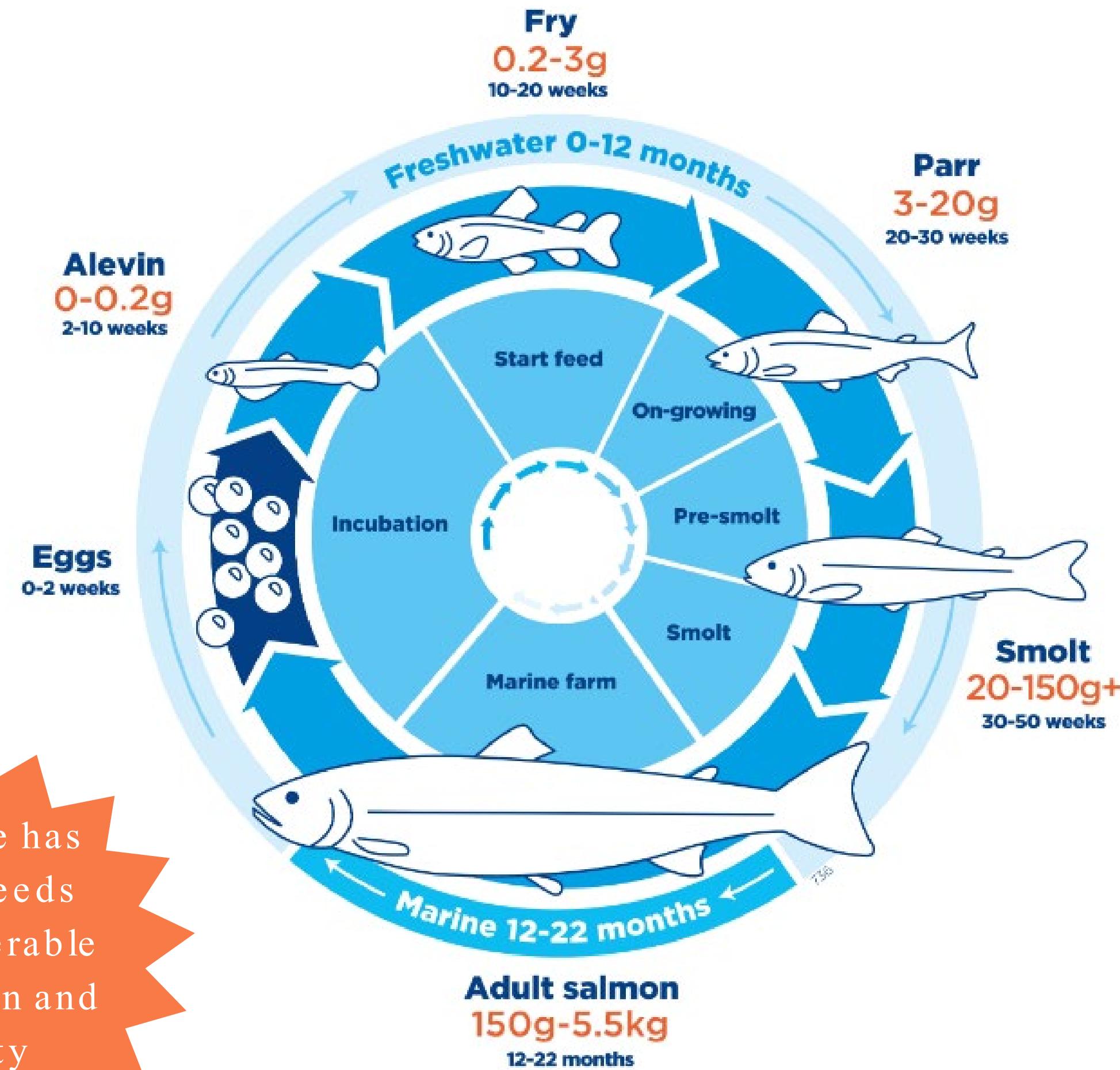
Anadromous fish migrate from salt water to spawn in fresh water

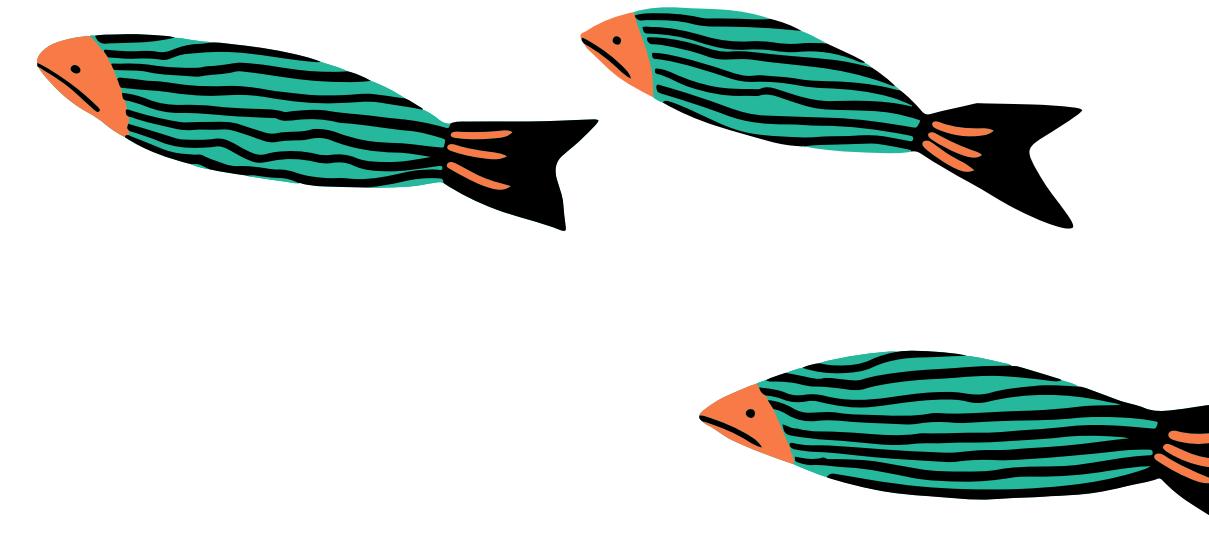


The Salmon Lifecycle

(Reared in captivity)

Each Stage has specific needs and is vulnerable to disruption and mortality





How to Care for Salmon CORE ACTIVITIES

UHI | SHETLAND



Incubation and
hatching



Marine Farm



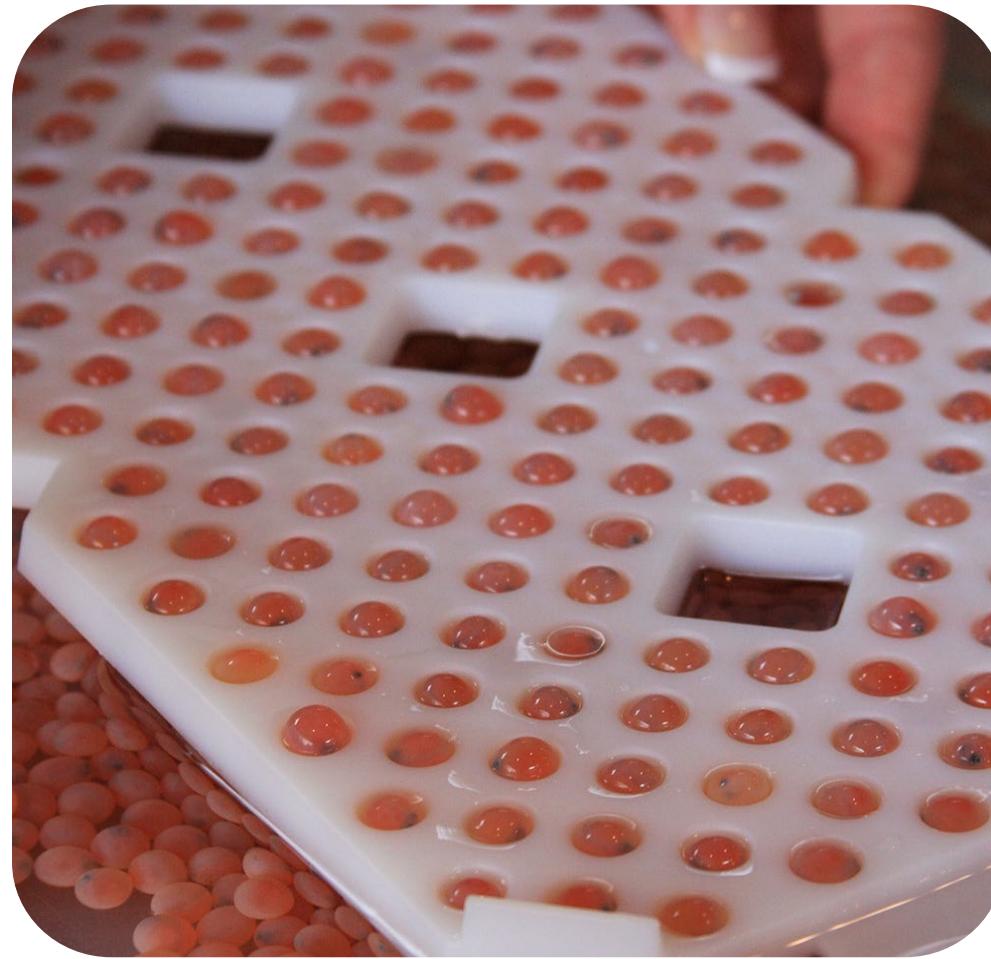
Harvesting



Processing

Incubation and hatching

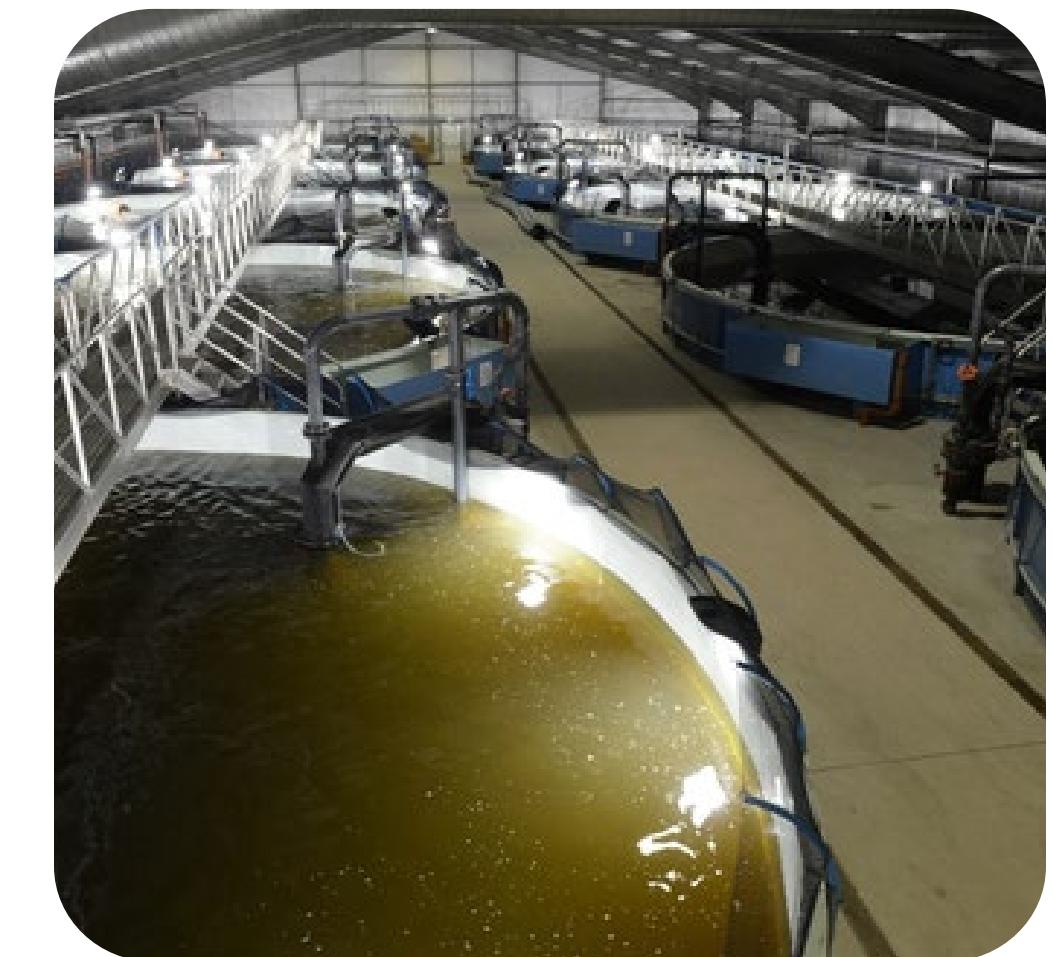
Brood stock are manipulated to produce eggs. Fertilised eggs are transferred to trays and placed in the incubation room. This is the freshwater stage of salmon rearing to mimic real world conditions.



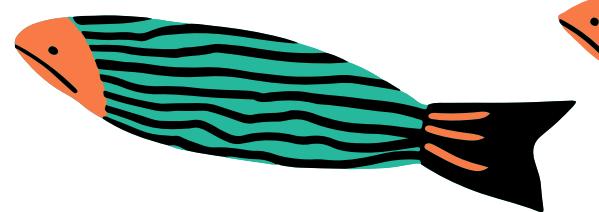
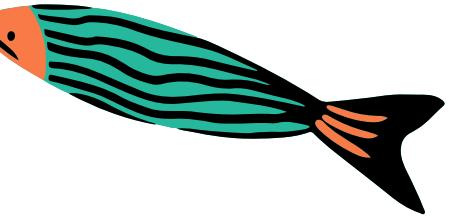
Salmon eggs in
Incubation trays



Salmon Alevin



Salmon fry in indoor tanks
UHI | SHETLAND



Marine Farm

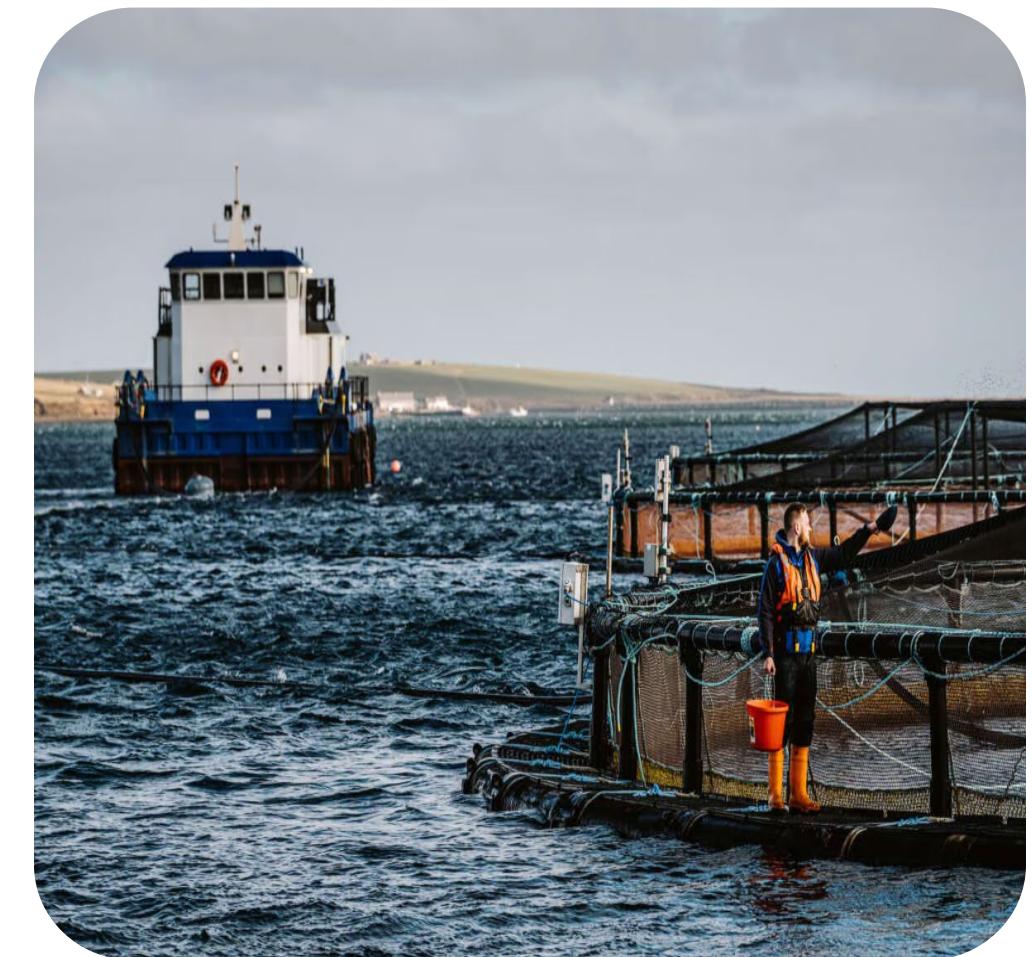
When the salmon are ready to be transferred to the sea, they are kept in cages usually situated in sheltered sea locations. Feeding of the salmon is controlled remotely from a feed barge or hut and delivered through a system of pipes to the cages.



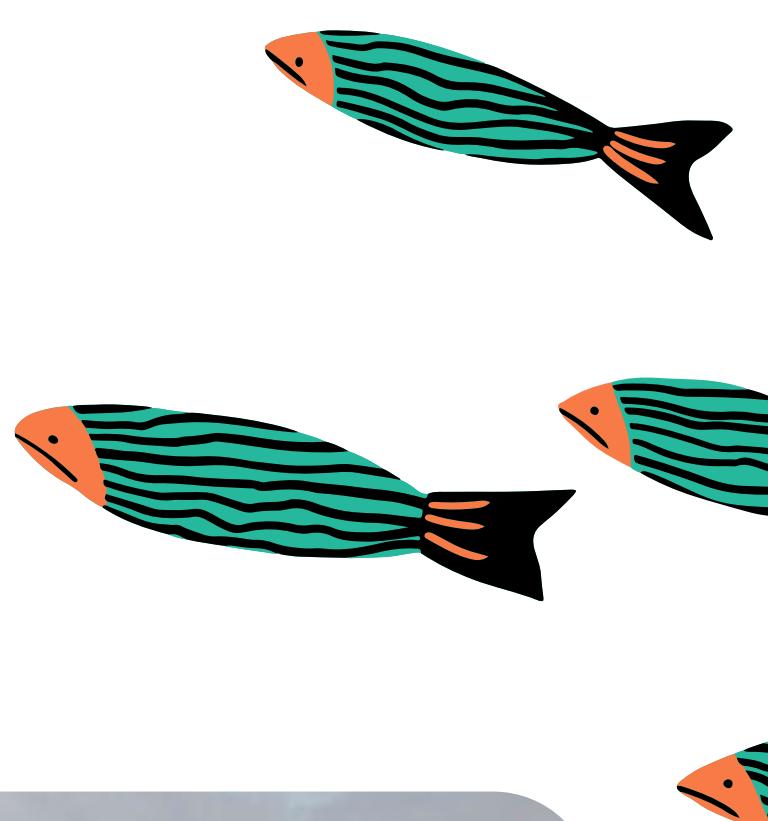
Marine cages



Remote feeding system



Feed barge at cage site



Harvesting

Specifically designed “well boats” are used to transport the mature fish back to land for processing. Anaesthetic is pumped into the water to calm the fish before they are humanely killed by a machine which administers a blow to the head. Salmon are bled straight away by a cut to their gills.



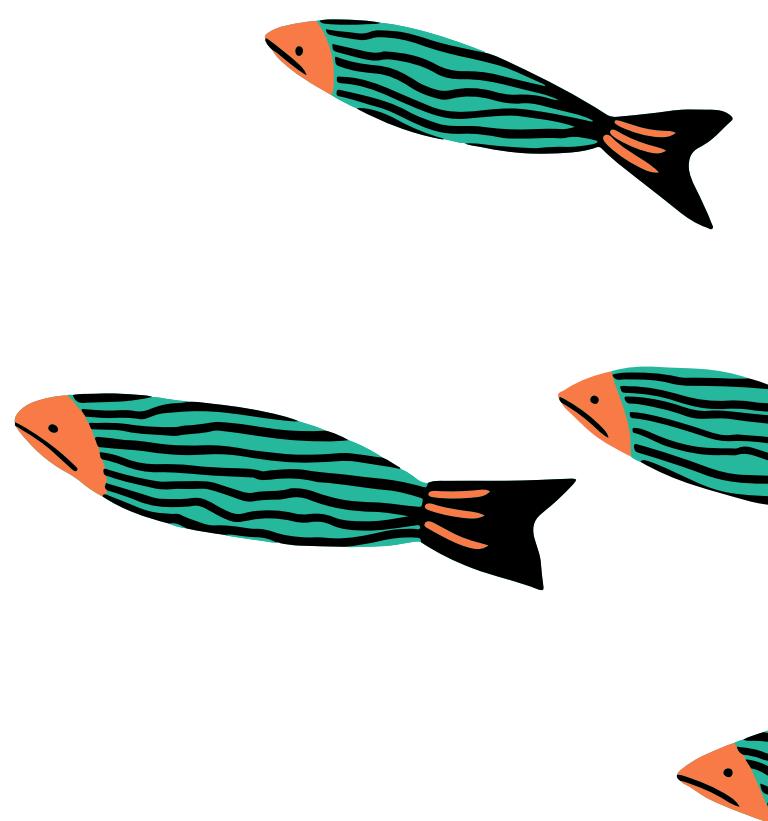
Marine cages



Well boat at cage site



Well boat
UHI | SHETLAND



Processing

To distribute salmon to market it must be cleaned, gutted, graded, and packed in a factory setting to complete the process of primary processing. It may subsequently go through secondary processing to produce fillets for market.



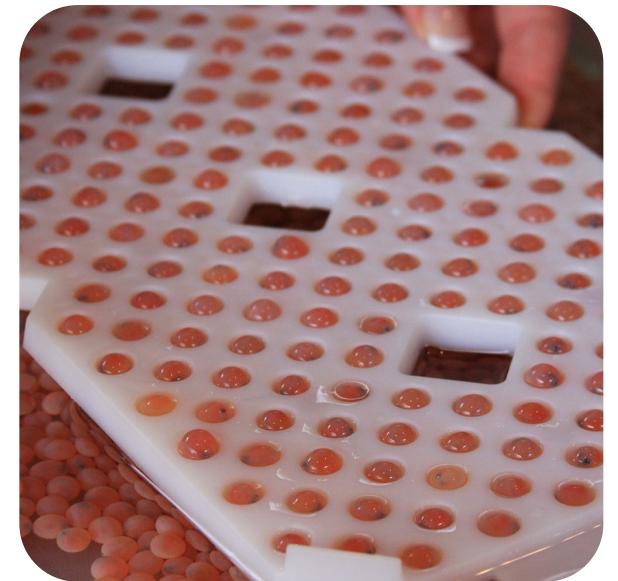
A gutted salmon



Primary processing



Secondary processing



1. _____

Salmon eggs are hatched in incubators



2. _____

Alevins are kept in trays



3. _____

Growing salmon are sorted by size and kept in indoor tanks

4. _____



Some fish are selected as broodstock to provide the eggs and milt required to produce new generation.

7. _____



8. _____



When ready to harvest, adult salmon are transported by wellboats and taken to the factory for processing



6. _____

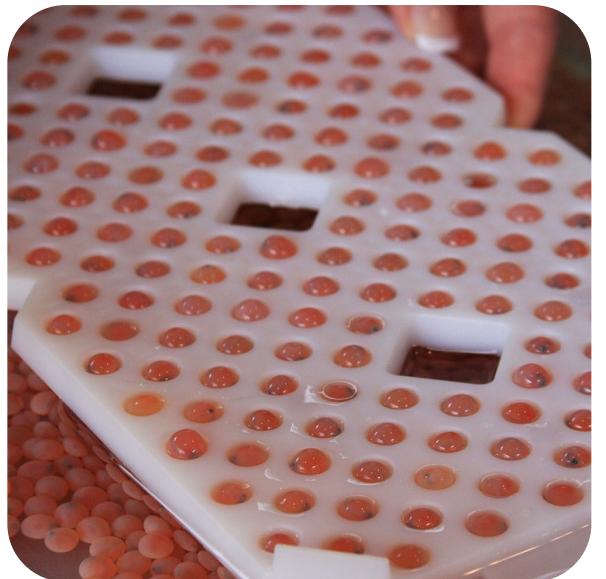


5. _____



When their bodies have matured enough to survive in saltwater they are moved to marine cages

Salmon eggs



Salmon eggs are hatched in incubators

Alevins



Alevins are kept in trays

Fry

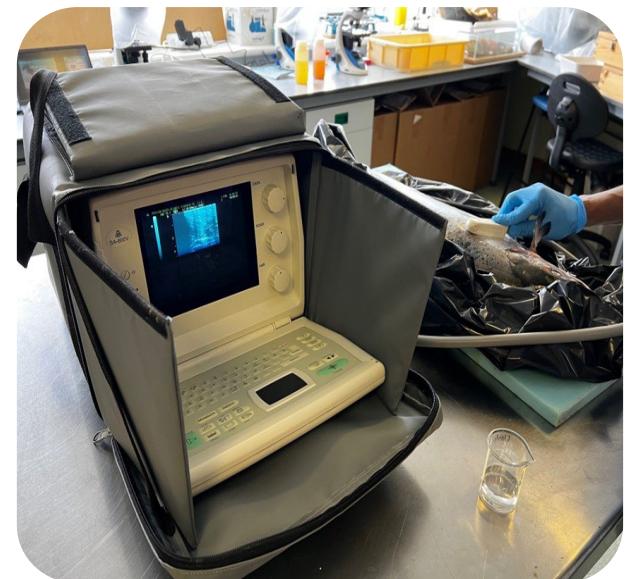


Growing salmon are sorted by size and kept in indoor tanks

Parr



Broodstock



Some fish are selected as broodstock to provide the eggs and milt required to produce new generation.

Processing



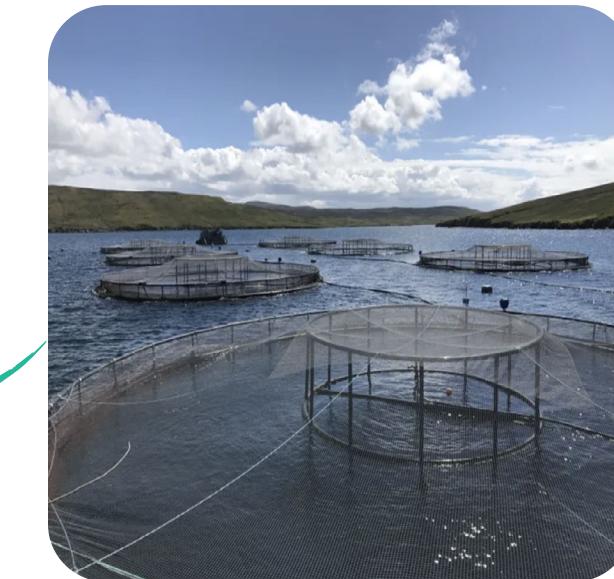
When ready to harvest, adult salmon are transported by wellboats and taken to the factory for processing

The Salmon Production Cycle

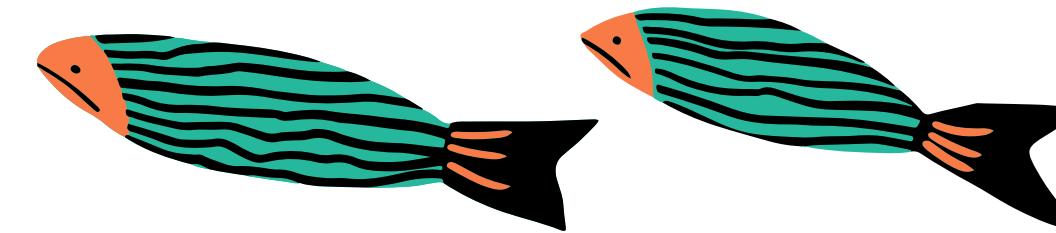
Adult Salmon



Smolt



When their bodies have matured enough to survive in saltwater they are moved to marine cages



How to Care for Salmon

SUPPORTING
ACTIVITIES



Fish welfare



Feed production



Broodstock selection



Fish Welfare

Good husbandry to promote fish welfare includes farming at locations with good quality water and oxygen content, stocking the cages in low densities, protecting the fish from predation and disease, and carrying out environmental monitoring. Fish welfare can be monitored by checking gill health and performing lice counts.



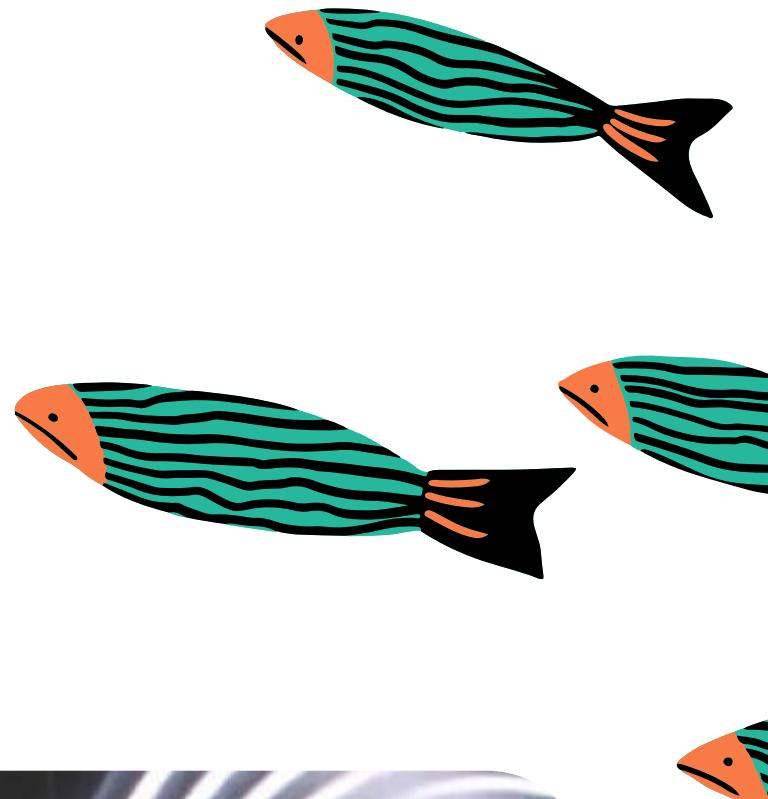
Lice on Salmon



**A lice check
being performed**



Mechanical delousing system
UHI | SHETLAND



Feed production

Feed must be manufactured to meet the salmon's optimum requirements for growth and nutrition at each life stage. This is necessary for preventing deficiencies, malnutrition and disease



Salmon Feed



Feed pipes to
marine cages

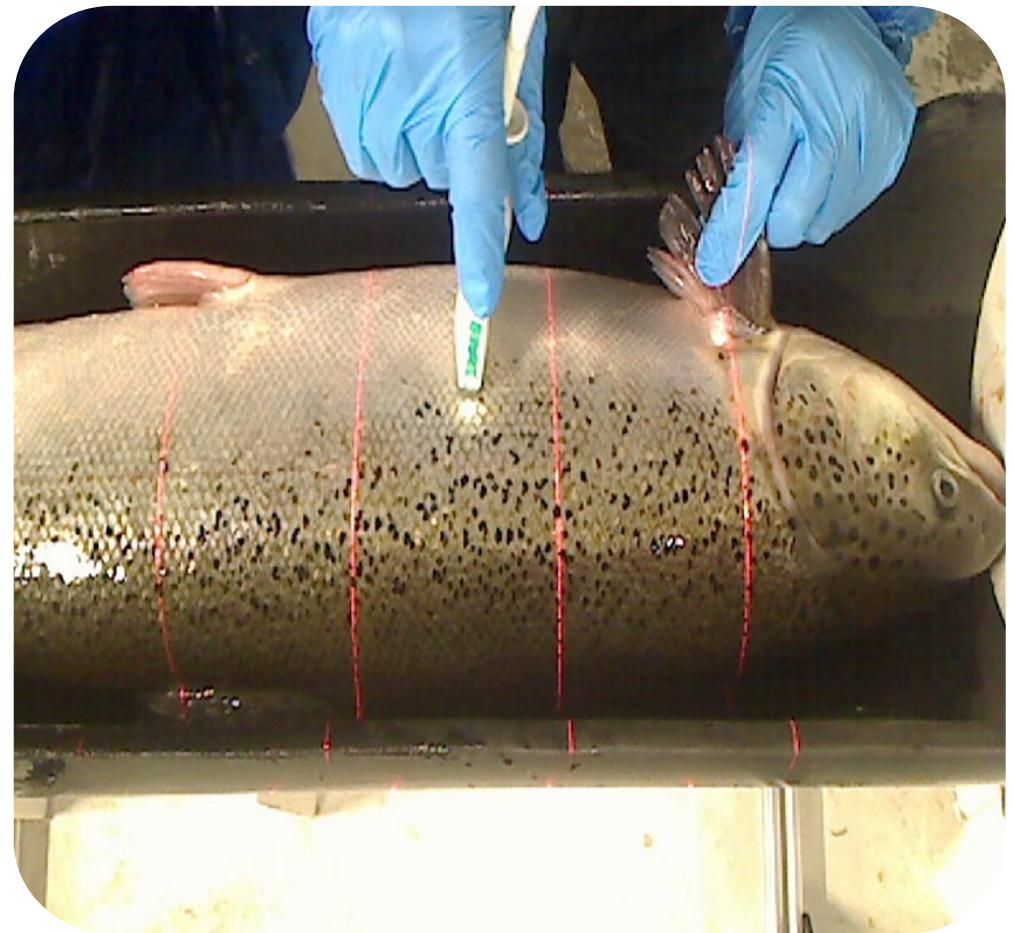


Feed factory
UHI | SHETLAND



Broodstock selection

Some salmon are chosen to produce the next generation. This selection is usually done based upon the physical characteristics such as growth, disease resistance, maturation rate and colour. In Scotland, fertilized eggs are imported to the hatcheries to produce larval and juvenile fish. This increases the population's genetic diversity.



Salmon ultrasound scanning



Salmon ultrasound scanning



Salmon ultrasound scanning
UHI | SHETLAND



Laboratory

Aquaculture laboratories perform microbiological and environmental testing of water samples which helps identify potential issues with salmon welfare, for example by identifying harmful species of jellyfish and plankton.



Plankton analysis



Water samples



Salmon measurement

Blue Mussels (*Mytilus edulis*)



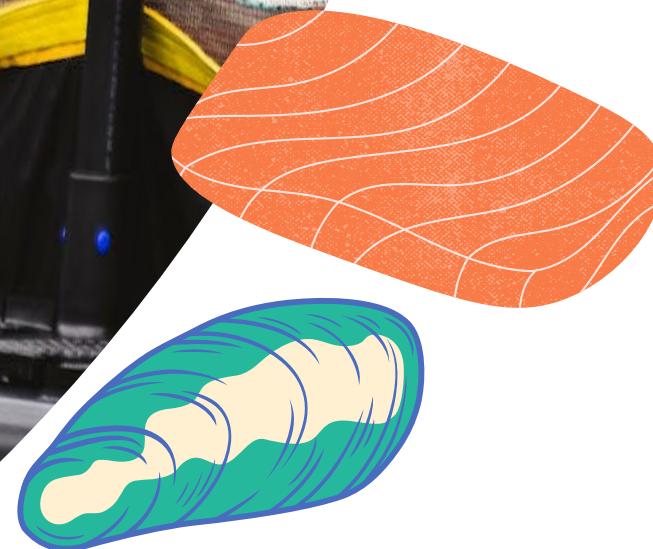
- Common or blue mussels (*Mytilus edulis*) are **bivalve molluscs**, soft-bodied invertebrates which have an external covering that is a two-part hinged shell. They are **filter feeders** and obtain their food by pumping a steady stream of water through a filter to collect plankton. The filters also act as **gills to obtain oxygen** and they **filter debris** from the water and help build habitats for other animals.
- Mussel farms are created by securing long lines of rope in the ocean, held afloat by buoys. Young mussel larvae move in currents for the first few weeks of life before attaching themselves to underwater surfaces such as these ropes and grow until they are harvested.





Careers in the Scottish Aquaculture Industry

- There are a wide range of interesting jobs available within Scotland's aquaculture sector breeding, rearing and harvesting fish and shellfish species for consumption.
- Many of the tasks are done by farm workers, however, specialized work in areas such as stock health, veterinary practitioners, laboratory services and engineering usually have dedicated staff with higher skill levels.
- [Careers and Training in Aquaculture — Seafish](#)





Aquaculture career

