TASMANIAN SMART SEAFOOD PARTNERSHIP

OYSTER SENSOR NETWORK (OSN) EDUCATION RESOURCE

Australian Government

Tasmanian Government

oysters TASMANIA

TSIC Tasmanian Seafood Industry Council

NRM SOUTH NATURAL RESOURCE MANAGEMENT

Acknowledgement of Country

We pay respect to the Traditional Owners of lutruwita (Tasmania), the Tasmanian Aboriginal people, and acknowledge their continued survival and connection with their land, sea and sky Country that spans millennia.

We acknowledge the many Nations of Tasmanian Aboriginal people, past and present, as the traditional and ongoing owners of their respective countries within lutruwita and the islands.

We pay respect to those who have passed and acknowledge today's Aboriginal communities who are the custodians of this land and sea.

We acknowledge that all land, sea, and sky Country holds cultural values that provide strong and continuing significance to the Tasmanian Aboriginal communities. We acknowledge that Tasmanian Aboriginal people are part of a continuous culture that holds traditional knowledge about the ecosystems we all depend on.

The Tasmanian Smart Seafood Partnership

The Tasmanian Smart Seafood Partnership project aims to improve the sustainability of processes and practices in the seafood industry to achieve positive outcomes for marine biodiversity in Tasmanian waters. To achieve this, the project creates links between education, training, research, and restoration within the seafood industry.

The Tasmanian Smart Seafood Partnership is a partnership program between NRM South and the Tasmanian Seafood Council (TSIC).

We thank key stakeholders in the oyster industry, education sector, research bodies and state government who have assisted in the development of this education resource.

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Acknowledgements

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Mountain Ash Insights

Supporting healthy future landscapes

INTRODUCTION

This education resource aims to introduce teachers to the Oyster Sensor Network (OSN) and paired ShellPOINT data portal and demonstrate its potential for use in the classroom. To gain login information to ShellPOINT data portal, access requests can be emailed to theteam@oysterstasmania.org The resource supplies several learning scenarios and extension ideas aimed at high school students.

The OSN has been developed by Oysters Tasmania, the Tasmanian Department of Natural Resources and the Environment, NRM South, and environmental software developer eagleio. This tech has been deployed in coastal waters around Tasmania with sensors remotely monitoring temperature, depth, and conductivity, and reporting this data to a centralised portal and dashboard known as ShellPOINT.

This resource is intended for use relating to the oyster industry but has applicability for broader marine farming, fishing, environmental management and monitoring learning opportunities.

Links to the Australian Curriculum

The resource provides scenarios, questions and concepts which align with the learning outcomes:

- Environmental monitoring is important for managing primary production and natural resources.
- Real-world environmental data is used for decision making.
- Environmental data is used to maximise production and sustainability within marine farming.
- A variety of technologies are used to measure the environment.

Teachers are encouraged to integrate these resources across learning areas relevant to their classroom activities. This resource is likely to be relevant for the following areas of the curriculum:

LEARNING AREA	RELEVANT STRANDS/SUBJECTS
Science	Science understanding Science as a human endeavour Science inquiry
Mathematics	Number and algebra Measurement and geometry Statistics and probability
Technologies	Digital technologies
Humanities and social sciences	Geography Economics and business

The resource includes potential for further learning in general capabilities in a number of categories. Critical and creative thinking capability is supported by giving students the opportunity to analyse data, synthesise, evaluate, and problem solve to come to a course of action within the learning scenarios. Information and communication technology is promoted through investigation of questions, topics and problems presented. Students are able to plan information searches from various digital platforms to select and evaluate data. Numeracy is further promoted throughout the resource and provides opportunities for measurement, recognising patterns, and interpreting statistical information.

The cross-curriculum priorities are included in the resource by bringing attention to ongoing and historical oyster harvesting by Tasmanian Aboriginal Peoples, Australia's connection and engagement with Asia through the introduction of the Pacific oyster, and the priority of sustainability within the oyster industry and marine health of waters around Tasmania.

OYSTER AND ENVIRONMENTAL CONDITIONS EDUCATION RESOURCE FACT SHEET

Oysters belong to a large group of animals called molluscs and within this, a subgroup called bivalves (meaning two shells)[1] Aboriginal Australians have been consuming oysters for thousands of years, the remains of which can be found in large kitchen middens along Tasmania's coastlines.[2]

Australia's native oyster is called the angasi oyster, also known as flat or mud oyster and is found across the cooler, southern states. Tasmania is known for farming the angasi oyster *(Ostrea angasi*), as well as their cousin, the pacific oyster (*Crassostrea gigas*), which were introduced to Australia from Japan in the 1940s.[3]

Oyster growing areas spread across north, east and south-east of Tasmania, employing 347 Tasmanians in 2021-22 and producing more than three million dozen Pacific Oysters in the last year across 50 growers in large and small operations.[4] Oysters are fed in hatcheries but once in open water can obtain their own food through filter feeding.

Oyster farming emits lower greenhouse gas emissions than the farming of all other meat, fish and crustaceans.[4] These oyster farms are operated in marine farming zones and each zone has leases which are issued by the Minister for Primary Industries and Water.[5]

In the coastal waters surrounding Tasmania, the OSN has been introduced by the Tasmanian Smart Seafood Partnership in collaboration with Oysters Tasmania. This sensor technology monitors environmental conditions in situ and gives oyster growers important insights to assist them to make management decisions.[6] The information gathered from the OSN is transmitted in real-time and displays this live data on the ShellPOINT dashboard. [7] The OSN currently measures depth, temperature and salinity.

Depth provides an indication of the tidal changes in the bay. Tides are the periodic rising and falling of water depth in the ocean caused by the gravitational interactions between the earth and moon. [8] For optimum harvesting, the tide needs to be low enough to allow the boats to access the beds but not so low that the oysters have been out of the water for a long time.

Water temperature provides a measure of the kinetic energy (the degree of hotness or coldness) of the water. High water temperatures impact the oysters and the water they live in.[9, 10] High water temperatures can see increases in problematic algal blooms and oyster disease (more information provided below).

Salinity measures the content of salts. Salts are highly soluble in surface and groundwater, it can be transported with water movement. Measures of salt provide an indication of how much freshwater has recently entered the bay[11, 12] With freshwater, can come diffuse pollutants from the local catchment and as oysters are filter feeders, they are highly sensitive to these substances which also cause concern for human health.

The oyster industry is regulated so that harvesting is limited while there is a high level of fresh water (or a low salinity reading), allowing time for potential pollutants to flush through the system.

The data received from ShellPOINT through the OSN assist oyster growers in monitoring the health of oysters in their leases. Two such issues that the oyster industry faces are Pacific Oyster Mortality Syndrome (POMS) and *Vibrio*. POMS affects Pacific oysters and is caused by a virus called OsHV-1 micro variant. It causes rapid death and high mortality rates in farmed pacific oysters – up to 100% within days of being detected. POMS can spread quickly if introduced. POMS does not affect human health.[13,14]

Vibrio are a genera of bacteria which naturally occur in most aquatic environments. While majority of *Vibrio* are considered non-pathogenic to humans, some are known to cause illness in humans.[15, 16, 17]

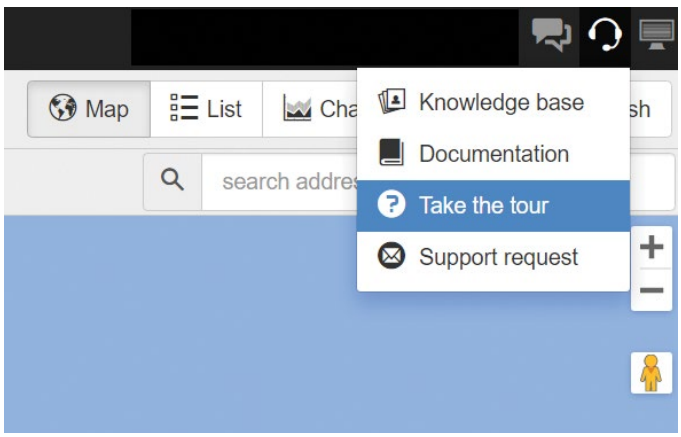
At high temperatures the *Vibrio* bacteria can rapidly multiply in the oyster making them unsafe for human consumption. Oyster farms operating in areas where *Vibrio* is known to be an issue will have a control plan to limit the risk of this disease. Oyster farmers can manage *Vibrio* risk by quickly getting the oysters into cold storage, thereby limiting the growth of the bacteria.[15]

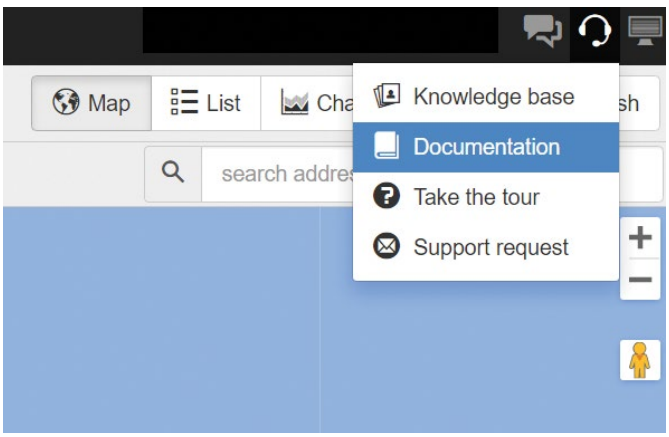
ACCESS GUIDE

ShellPOINT

When accessing ShellPOINT for the first time, a tour of the data portal can be found in the top righthand corner under the headphone icon.

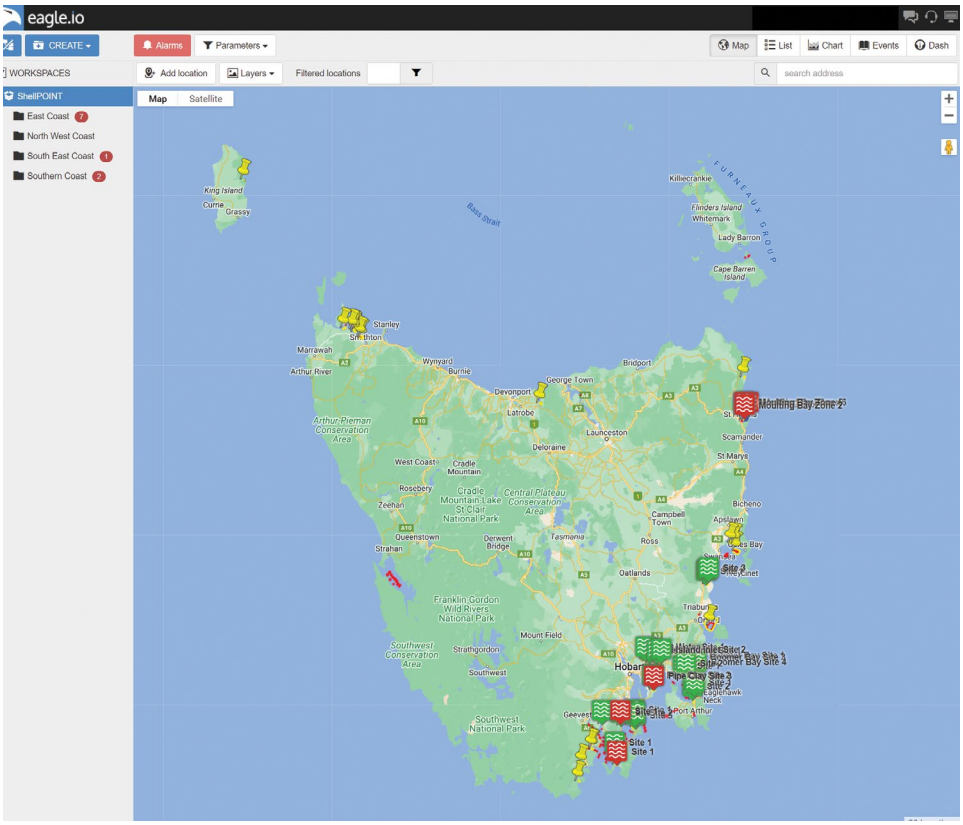
Further introductions on navigating ShellPOINT can be located under Documentation.





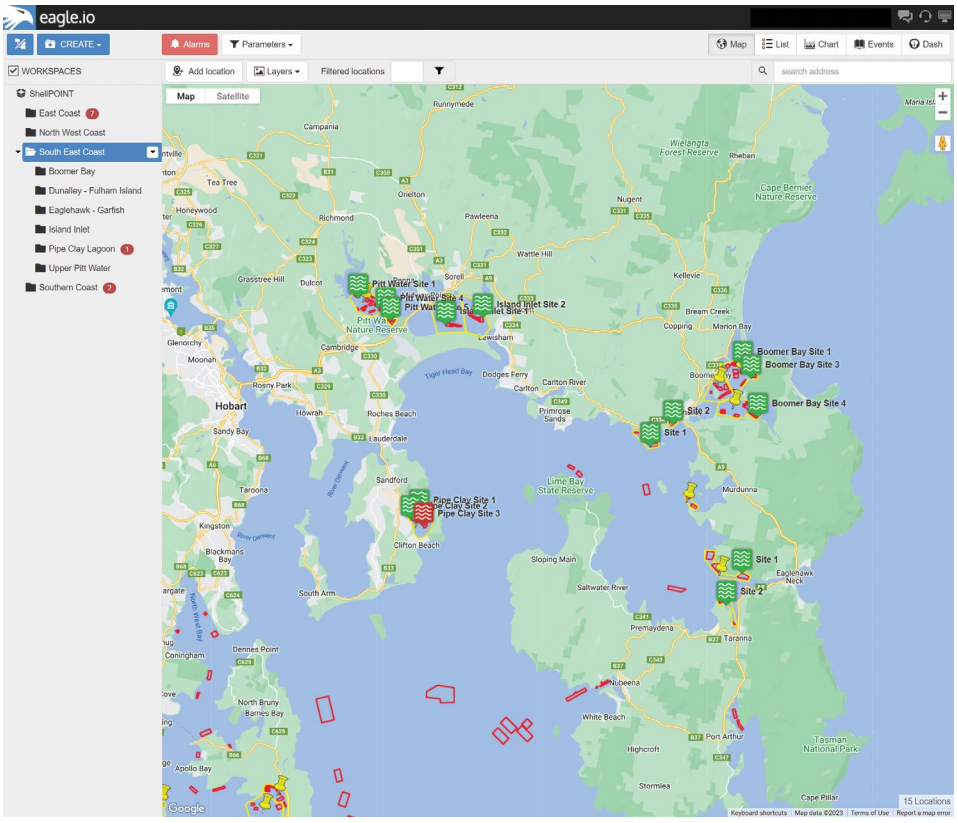
Accessing the main page

The main page of ShellPOINT shows the Oyster Sensor Network sites and location list.



Accessing regions

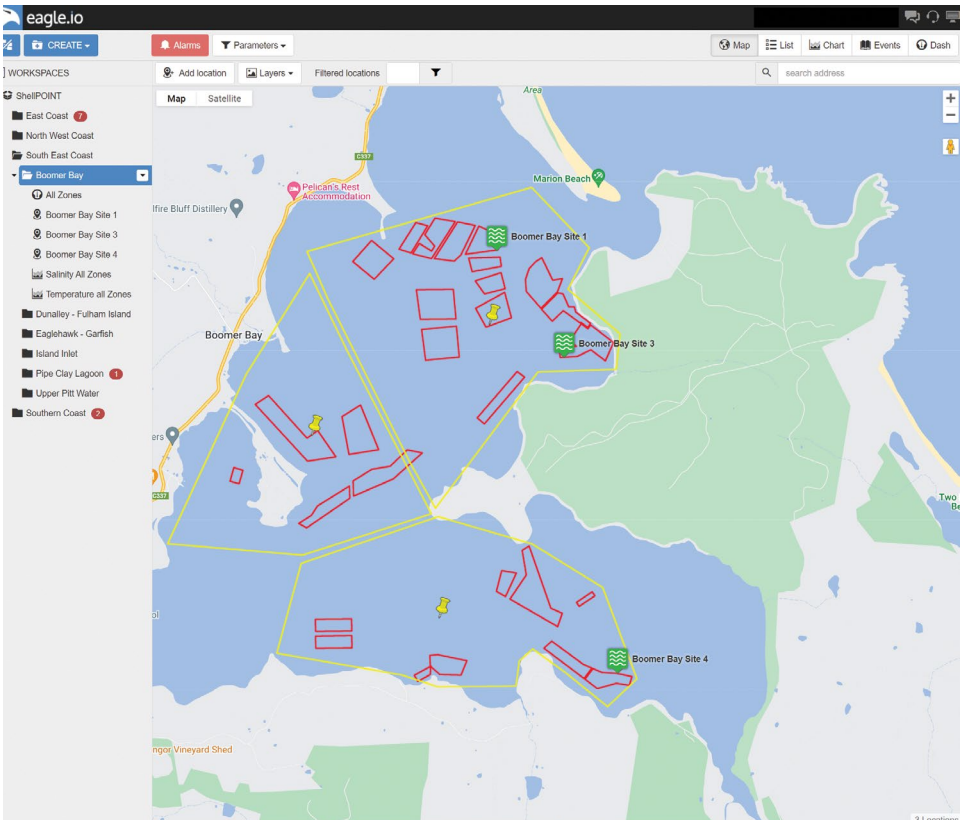
Selecting the desired region on the menu on the left-hand side will take you into a zoomed perspective, i.e., Southeast Coast.



Accessing zones

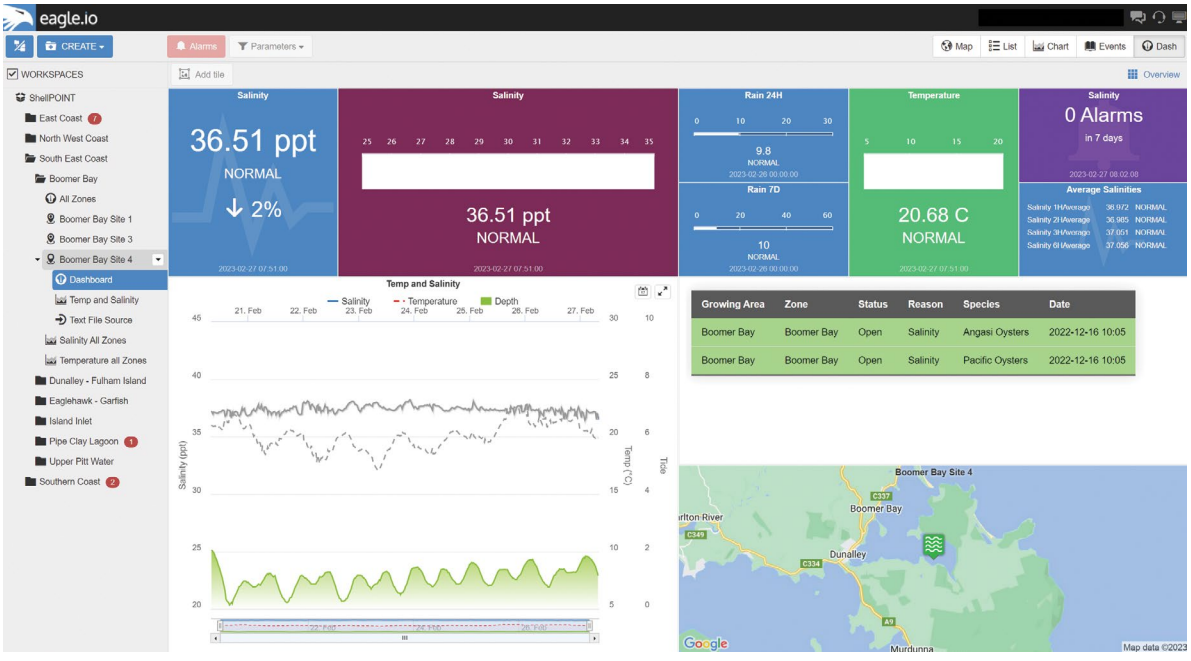
Selecting the desired zone will zoom you to the designated area, i.e., Boomer Bay.

The yellow outlined areas indicate oyster growing areas, and the red outlined areas indicate individual leases held by an oyster grower. The green icons are the OSN sensors. Any red icons are sensors which have triggered an alert in relation to one of the biophysical parameters.



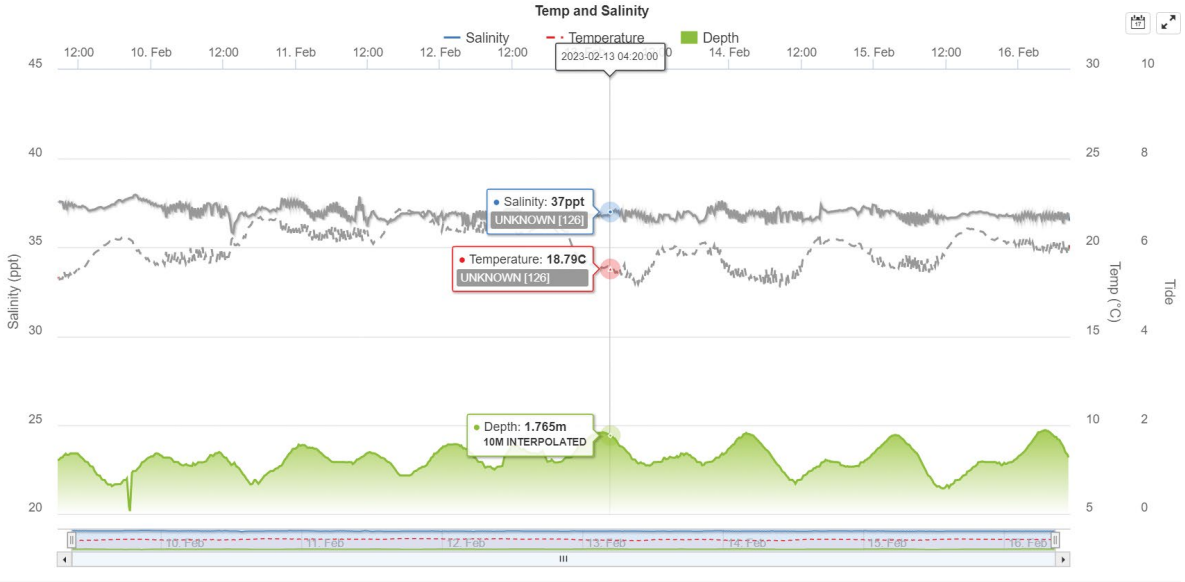
Accessing the site dashboard

Selecting the desired site will take you to the ShellPOINT dashboard for that location, i.e., site 4.



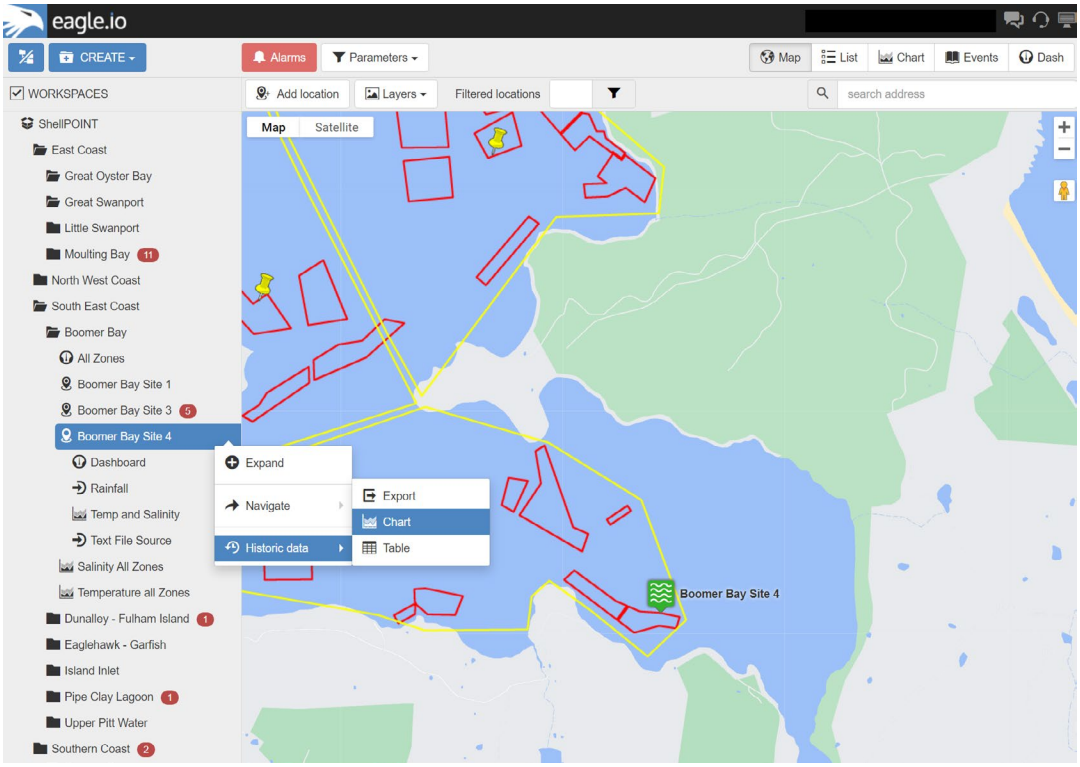
Dashboard - Monitoring live data

Salinity, temperature and water depth can be accessed on the dashboard.

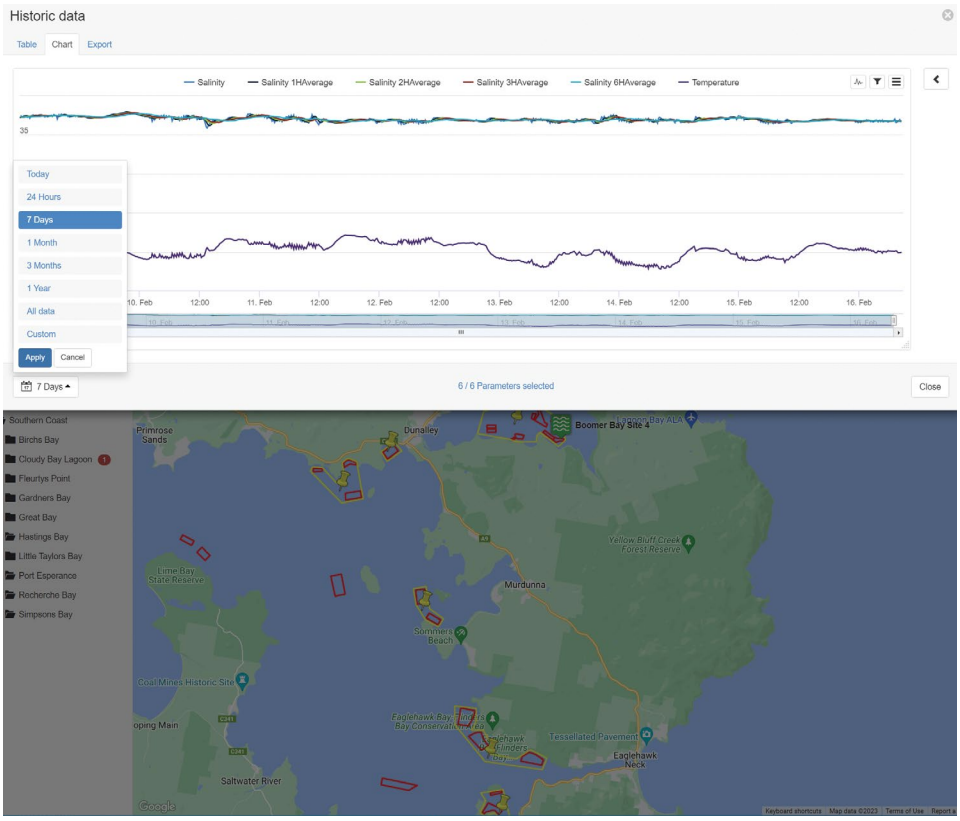


Dashboard – Accessing historical data

Historical data for that site can be accessed on the dashboard pathway shown below.

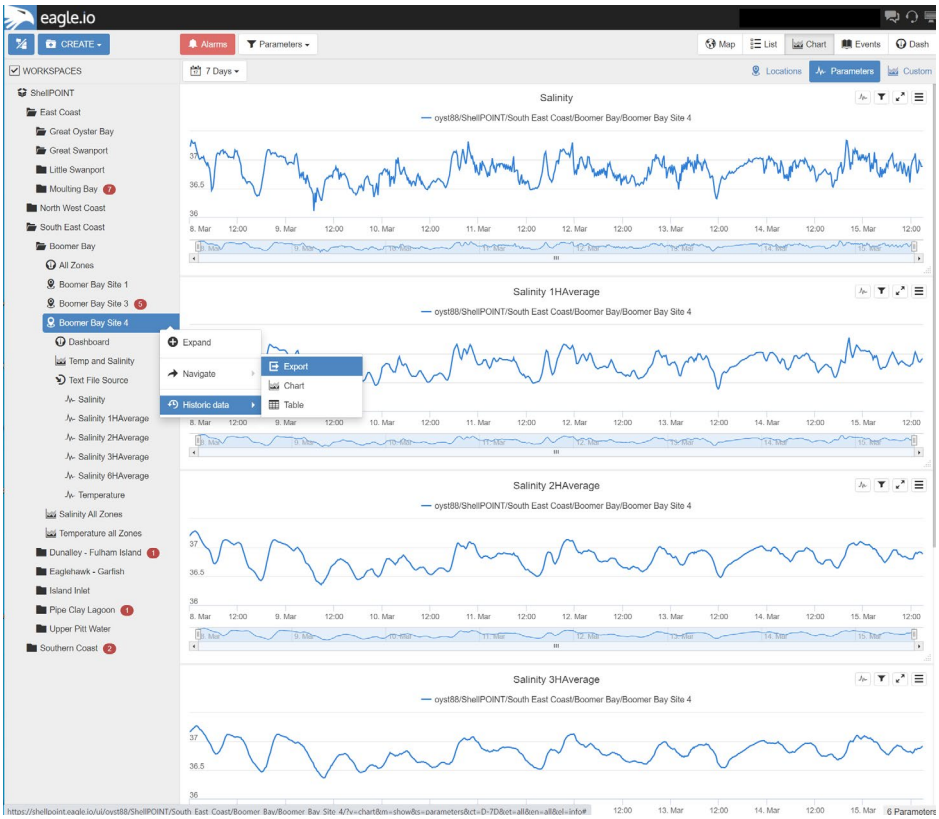


Historical data timeframe can be changed as shown below.

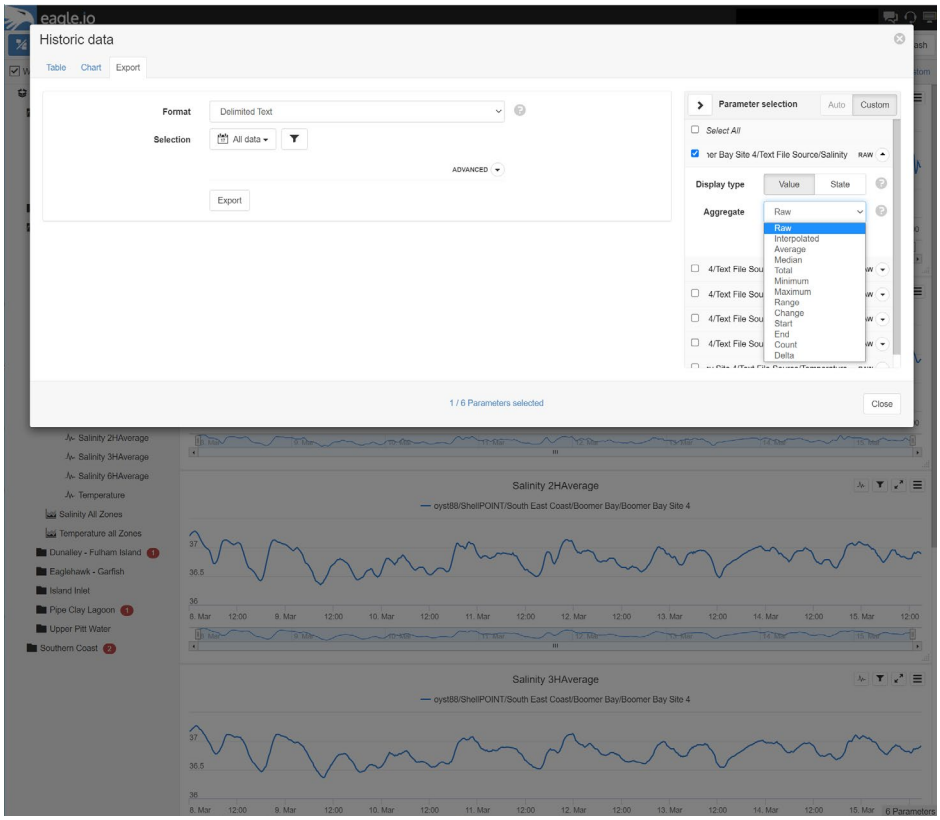


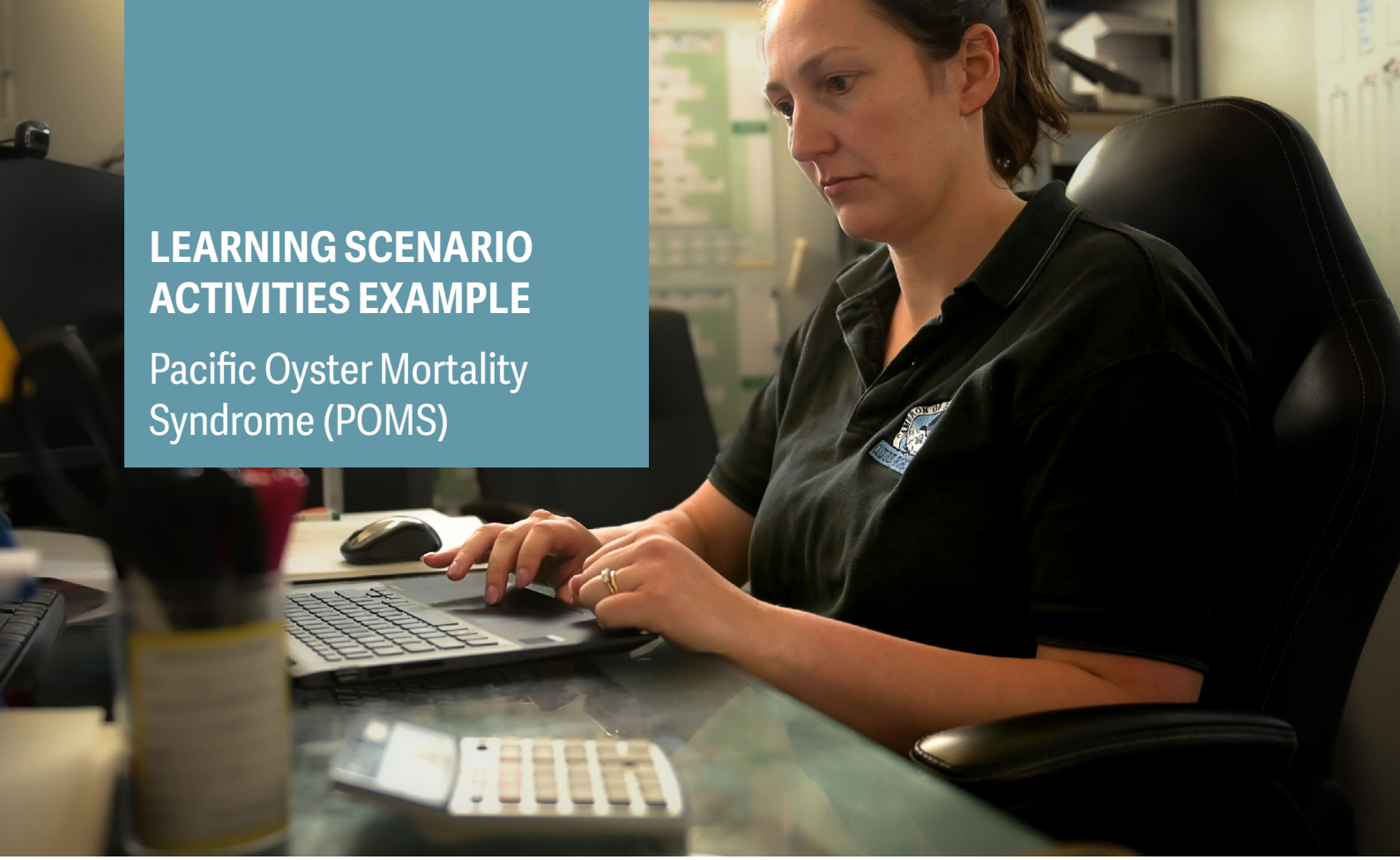
Dashboard - Downloading raw data

Raw data of environmental conditions can be downloaded by accessing the below pathway.



The above pathway will take you to the below page. Here you can export data for your specific requirements.





LEARNING SCENARIO ACTIVITIES EXAMPLE

Pacific Oyster Mortality Syndrome (POMS)

Learning Activity Rationale

This learning activity has been developed to offer teachers example questions relating to real-life oyster management scenarios which have potential for use in the classroom. Relevant links and resources are provided in this teaching package so students can familiarise themselves with the topic. Students can be provided the opportunity to explore further as it fits with lesson plans.

Background:

PACIFIC OYSTER MORTALITY SYNDROME (POMS)

POMS is a real-world management issue that the oyster industry faces throughout Australia.[18] POMS was first seen in Australia in NSW in 2010. The virus was first detected in Tasmania since around December 2015. Since then, biosecurity movement restrictions have been in place on oysters to limit the spread of the disease and manage outbreaks.[20] POMS related mortality starts when water temperatures increase to 16°C. [19]

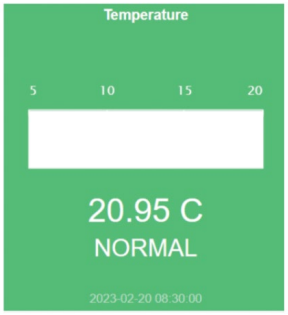
Monitoring temperature during warmer seasons, can indicate whether a potential risk for a POMS outbreak is likely. With the assistance of the Oyster Sensor Network (OSN), oyster growers can accurately monitor water temperature and take management actions if the water is likely to be too warm.

Potential management actions to reduce oyster mortality include:

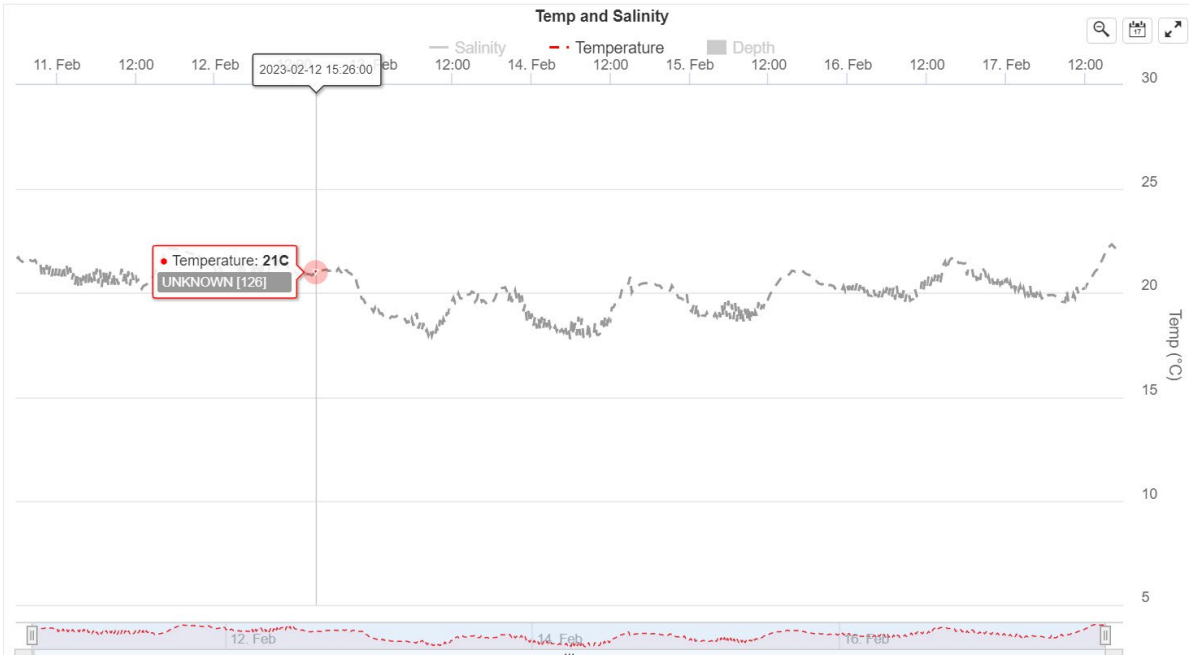
- Lowering the oysters deeper into the water (where it is cooler).
- Moving oysters to other areas of the lease where water is deeper (and therefore cooler).
- Limiting handling oysters which increases stress and makes them more susceptible to POMS.

Accessing temperature on ShellPOINT in relation to POMS

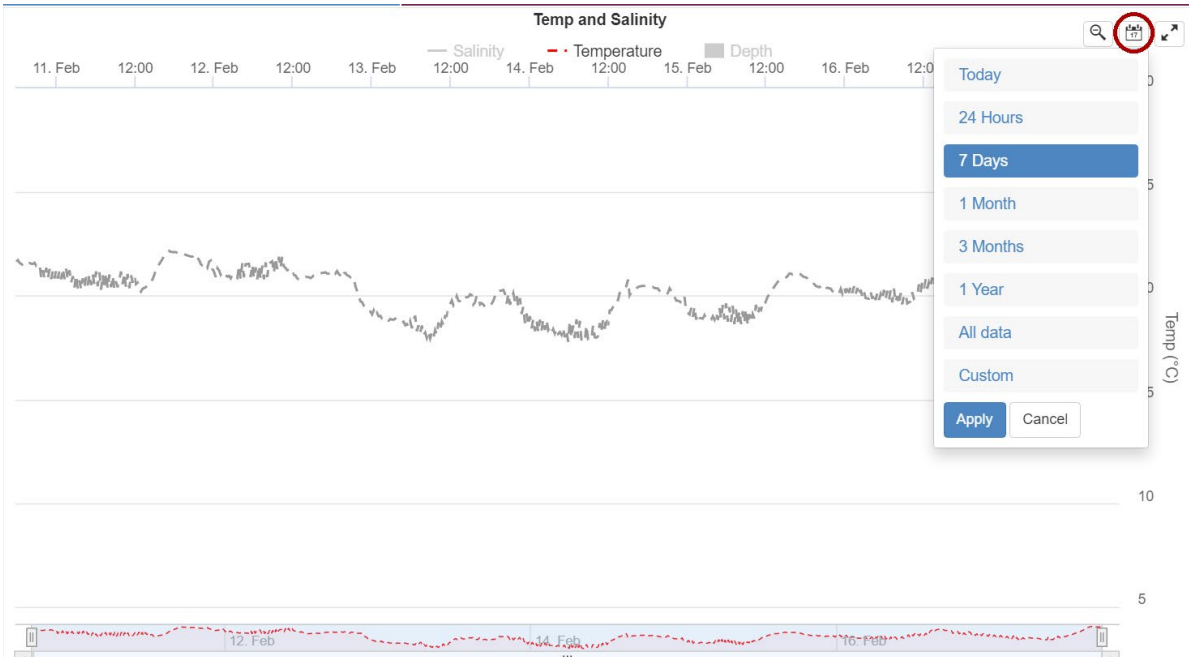
The temperature most recently recorded by the sensor can be seen on the dashboard with the date and time.



Recent temperature data can be accessed and isolated on ShellPOINT through the dashboard by selecting temperature at the top of the environmental conditions graph.



Historical data for temperature can be accessed by selecting change time range from the top calendar icon on the environmental conditions graph.



Example learning activity questions

1. Play the OSN educational video associated with this package.
2. Support students to familiarise themselves with POMS. Depending on year level and/or time dedicated to this learning activity, this could be (for example):
    a. Presented to the students based on the POMS information provided in this package.
    b. Researched using the additional links provided in this package.
    c. Independently sought by students.
3. Support students to familiarise themselves with the ShellPOINT data portal, through the following example approaches:
    a. Support students to log in to ShellPOINT using the ShellPOINT access guide in this package.
    b. Encourage students to explore ShellPOINT and identify:
        i. Your local region on the map (or a favourite holiday location).
        ii. The number of oyster growing regions, oyster leases and sensors in the region.
        iii. The monitoring dashboard for a relevant local sensor.
4. Discuss with students their observations from recent temperature data. To make this an ongoing, interactive learning exercise, students could monitor and graph live temperature records over several days.
5. Have the students download historical temperature data to (depending on year group):
    a. Explore the differences in average temperature between seasons.
    b. Graph temperature changes through a season.
    c. Apply a line of best fit to see trends in the data.
6. Discuss with students, why temperature plays an important role in monitoring oyster health and mortality. Have students determine which days an oyster grower may have needed to pay particular attention regarding monitoring POMS, based on high temperature.
7. For an ongoing, interactive learning exercise, teachers could use a scenario where the students are oyster farmers who need to monitor temperature each day, reflect on whether their oysters are at risk of POMS, and propose management actions.

Opportunities for further extension

- What is biosecurity? Why is it important?
- Investigate biosecurity measures in the oyster industry, what are they?
- What is the main way that the POMS virus is spread through farmed oyster stock?
- For growers to be able to move oysters from one oyster growing area, and place on a farm in another area, a POMS Movement Permit must be issued by Biosecurity Tasmania. Any significant illness, mortality or disease in shellfish within a lease area must be reported to the General Manager of Marine Resources and the Chief Veterinary Officer of Department of Natural Resources and Environment (NRE). Students can create their own POMS management plan including preventative biosecurity measures, reporting, farm management strategies, and links to ShellPOINT data
- What preventative measures can be taken within the student's lives to minimise the risk of spreading the POMS virus?

Further links to readings and resources relating to POMS:

Biosecurity Tasmania
Pacific Oyster Mortality Syndrome (POMS)
https://nre.tas.gov.au/biosecurity-tasmania/aquatic-pests-and-diseases/aquatic-biosecurity-threats/poms

Best Practice Guide for Tasmanian Oyster Producers
Biosecurity and Disease Preparedness, with a focus on POMS
https://www.oysterstasmania.org/uploads/1/1/1/5/111586309/best_practice_guide_for_tasmanian_oyster_producers_-_biosecurity_and_disease_preparedness.pdf

IMAS Institute for Marine and Antarctic Studies
Advanced Understanding of POMS to Guide Farm Management Decisions in Tasmania
https://www.imas.utas.edu.au/research/fisheries-and-aquaculture/projects/projects/future-oysters-crc-p-advanced-understanding-of-poms-to-guide-farm-management-decisions-in-tasmania

Department of Primary Industries
Pacific Oyster Mortality Syndrome (POMS)
https://www.dpi.nsw.gov.au/fishing/aquatic-biosecurity/aquaculture/aquaculture/poms

General information to prevent the spread of Pacific Oyster Mortality Syndrome
https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/637841/general-information-to-prevent-the-spread-of-POMS-information-for-oyster-receivers.pdf

Make 'Clean' part of your routine aquatic cleaning guide
https://www.dpi.nsw.gov.au/fishing/aquatic-biosecurity/recreational-waterway-users/clean-routine

LEARNING SCENARIO ACTIVITIES – INSPIRATION

Vibrio

Learning Scenario Brief Rationale

This learning scenario has been developed to inspire teachers to explore links between the environment, food production and human health in relation to Vibrio. *Teachers may wish to use the following background information, questions, resources and links to work up this scenario as appropriate for their teaching situation.*

Background:

Vibrio rapidly reproduces in warm temperatures. Having a high level of *Vibrio* bacteria in the oyster can cause illness in humans that eat them [15]. Some areas are known to be problematic for *Vibrio* and in these areas oyster farmers must quickly lower the temperature of the oysters as soon as they are harvested to stop the bacteria growing. They achieve this by harvesting the oysters and placing them on ice and getting them into "cool chain" (refrigerated conditions) within a strict number of hours. The Tasmanian government's NRE sets the rules around oyster harvesting in relation to *Vibrio*. They monitor the temperature of the water and "open" or "close" leases depending on temperature "triggers". Using the shellPOINT portal and weather forecasts, oyster farmers can predict when a closure might be approaching and therefore manage their oyster harvest around this.

Potential Learning Activity Questions

- What is *Vibrio* and how does it impact humans?
- Which environmental conditions are involved when considering *Vibrio*. Explore these through ShellPOINT data portal.
- Students can chart environmental conditions over a period in relation to *Vibrio* using data from ShellPOINT.
- What does it mean to open and close oyster farms and what might the triggers be?
- Explore which natural and human factors can increase the likelihood of *Vibrio* occurring in shellfish.
- How can we test for *Vibrio*?
- What management decisions can be made by oyster growers to reduce the risk of *Vibrio*?
- Explain what the cool chain is and how it can lower the risk of *Vibrio*.

Opportunities for further extension:

Day to Day Management of an Oyster Farm

- What causes oysters to become under stress. How does this stress impact an oyster's health?
- How can the Oyster Sensor Network and ShellPOINT data portal assist oyster growers in reducing stress in an oyster's environment?
- How does tidal depth impact oysters in a farming environment?
- How does temperature impact oysters in a farming environment?
- While accessing the tidal depth data on ShellPOINT, when would you think is the best time to harvest the oysters? What leads you to believe this?
- What is cold storage and why is it useful?
- Investigate which sensor sites on ShellPOINT are seeing greatest fluctuations in tidal depth.
- Envision you are an oyster grower, what practices can you put into place to limit time out of water during oyster harvest?
- What is marine farming debris? Can you think of a ways in which shellfish growers can reduce marine farming debris?

Future Oyster Farming

- Envision you're a marine researcher. Investigate and select a health issue facing the oyster industry in Australia. Consider the environmental conditions involved with this issue, how can this issue be limited by monitoring through ShellPOINT data portal?
- Based on the data available to you on ShellPOINT and considering oysters, climate change and current farming practices, which site do you believe would be best to expand?
- What is catchment run off? How does environmental management in the catchment it impacts the oyster industry and the broader marine environment? How might this data appear on ShellPOINT?
- Investigate what salinity is and why the oyster industry finds this kind of data valuable?
- Explore why an oyster farm closes harvesting when salinity is low.
- Investigate ideas about what might make growing oysters a sustainable food source?
- Research and consider current sustainability practices in the oyster industry, brainstorm ideas around potential future sustainability practices that could be implemented.

Further links to readings and resources relating to *Vibrio*:

Vibrio Parahaemolyticus – A Guide for Tasmanian Shellfish Growers
https://www.oysterstasmania.org/uploads/1/1/1/5/111586309/oysters_tasmania_vibrio_best_practice_guide.pdf
SafeFish – Shellfish Market Access Program (ShellMAP)
https://nre.tas.gov.au/biosecurity-tasmania/product-integrity/food-safety/seafood/shellfish-quality
SafeFish – Vibrio Fact Sheet
https://www.safefish.com.au/technical-program/vibrio-webinar-series
SafeFish – The Australian Shellfish Quality Assurance Program
https://www.safefish.com.au/reports/manuals-and-guidelines/the-australian-shellfish-quality-assurance-program-manual
Department of Health. Communicable Disease Intelligence - Emergence of non-choleragenic vibrio infections in Australia.
https://www1.health.gov.au/internet/main/publishing.nsf/content/8FA6078276359430CA257BF0001A4C42/$File/emergence_of_non_choleragenic_vibrio_infections_in_australia.pdf
Food Standard Code
https://www.foodstandards.gov.au/code/Pages/default.aspx
Hazards of Shellfish Consumption
https://nre.tas.gov.au/biosecurity-tasmania/product-integrity/food-safety/seafood/shellfish-quality/hazards-of-shellfish-consumption
Collecting and eating wild shellfish can cause illness
https://www.health.tas.gov.au/news/health-alerts/collecting-and-eating-wild-shellfish-can-cause-illness

Resources and further reading:

Oysters Tasmania
https://www.oysterstasmania.org/

Natural Resource Management - South
https://nrmsouth.org.au/

Tasmanian Seafood Industry Council
https://www.tsic.org.au/

Bureau of Meteorology Australia
http://www.bom.gov.au/

Oyster Cultivation Best Practice Guidelines – Floating Basket Long Line Oyster Cultivation
https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0009/1371573/Best-Practice-Floating-Basket-Guidelines.pdf

Stressed Young Oysters May Grow Less Meat on Their Shells
https://serc.si.edu/media/press-release/stressed-out-young-oysters-may-grow-less-meat-their-shells

Mariculture – Pacific Oysters
http://www.mesa.edu.au/aquaculture/aquaculture40.asp

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https://www.nswoysters.com.au/uploads/5/7/9/9/57997149/oysterfunkyfacts_factsheets.pdf

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https://www.dpi.nsw.gov.au/content/research/areas/aquaculture/outputs/2001/output-168

[3] **NSW Oysters, Industry Snapshot. Accessed February 2023** https://www.nswoysters.com.au/industry-snapshot.html

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[6] **Natural Resource Management South, The Tasmanian Smart Seafood Partnership. Accessed February 2023**
https://nrmsouth.org.au/the-tasmanian-smart-seafood-partnership/oysters/

[7] **Natural Resource Management South, (2022, June 06) A New Oyster Sensor Network For Tasmania. Accessed February 2023**
https://nrmsouth.org.au/a-new-oyster-sensor-network-for-tasmania/

[8] **Queensland Government, What are tides? (2023, January 23) Accessed February 2023**
https://www.msq.qld.gov.au/Tides/What-are-tides

[9] **Australian Online Coastal Information, Water Temperature. Accessed February 2023**
https://ozcoasts.org.au/indicators/biophysical-indicators/temperature/#:~:text=What%20is%20water%20temperature%3F,the%20ANZECC%20%26%20ARMCANZ%20guidelines1.

[10] **IMOS, Sea Surface Temperature Maps. Accessed February 2023** http://oceancurrent.imos.org.au/sst.php

[11] **Australian Government, Salinity and Water Quality. Accessed February 2023** https://www.waterquality.gov.au/issues/salinity

[12] **NASA, (2013, February 28) Aquarius: One Year Observing the Salty Seas. Accessed February 2023**
NASA| Aquarius: One Year Observing the Salty Seas

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