



Tasmanian Marine Heatwave and Related Event Response Plan

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Department of Natural Resources and Environment Tasmania

Tasmanian Government

Acknowledgements

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In recognition of the deep history and culture of this island, we acknowledge the Tasmanian Aboriginal people as the traditional and original owners, and ongoing custodians of land and sea Country of Lutruwita/Tasmania and pay respects to their elders past and present.

In creating a strategic priority to put Tasmanian Aboriginal people at the heart of managing land and sea Country we are committing to becoming more culturally inclusive and respectful in our working relationships with Tasmanian Aboriginal people. We will continue to develop work practices for land, sea and water management that are informed through connection and inclusivity and integrate these learnings into our culture and behaviours, as well as the services we deliver and the work we do.

Image source: Jillian Murphy, Aboriginal Heritage Tasmania

Contents

Executive Summary

Marine heatwaves and events have primarily negative impacts on Tasmania's marine ecosystems, including loss of marine animal and plant life. They can also reduce the productivity, health and sustainability of Tasmania's industries and communities. But opportunities could arise from marine heatwaves, for example, fishing in areas where heatwaves have caused fish abundance or shifts in species range.

Marine heatwaves and events are forecast to increase in frequency, intensity and spatial extent in Tasmania in the face of climate change and rising sea temperatures.

Tasmania's Government, industries and communities must be aware and fully prepared to respond to marine heatwaves and events, to reduce their negative impacts as much as possible.

The Tasmanian Marine Heatwave and Related Event Response Plan (the Plan) aims to guide Tasmania's decision making and coordination in response to marine heatwaves and related events.

The Plan brings together current knowledge of marine heatwaves and related events in Tasmania and outlines current and future steps for Tasmania's Government, industries and community to prepare for, and respond to, marine heatwaves and events. This includes:

1. **Detection:** forecasting and classifying marine heatwaves and events
2. **Risk assessment:** understanding and categorising risks to Tasmania's industries, communities and marine ecosystems
3. **Monitoring and Response:** steps to prepare for marine heatwaves, and how to monitor and report marine heatwaves when they happen
4. **Critical Event Preparation, Response Coordination and Communication Framework:** steps to take when marine heatwaves or events cause public health incidents or unusual mortality events in marine life
5. **Communication:** responsibilities and tasks for communicating marine heatwaves and events to different groups in Tasmania
6. **Evaluation and preparedness:** identifying areas to strengthen our future responses to marine heatwaves and marine events.

This Plan does not replace the response framework under the Tasmanian Emergency Management Arrangements. Where those arrangements are activated, this Plan will play a supporting role.

Why this is important

A significant marine heatwave occurred in Tasmania during 2023–24.

Southern Australian oceans could be in permanent heatwave conditions by 2040 **Source: CSIRO, 2023**	*Marine waters off eastern Tasmania are warming nearly four times faster than the global average* **Source: Hobday et al., 2014**
Marine heatwaves can cause widespread and significant damage to marine ecosystems **Source: Oliver et al., 2018.**	*Marine heatwaves have doubled in frequency in ten years around the world* **Source: International Union for Conservation of Nature, 2021**

Introduction

What are marine heatwaves and related events?

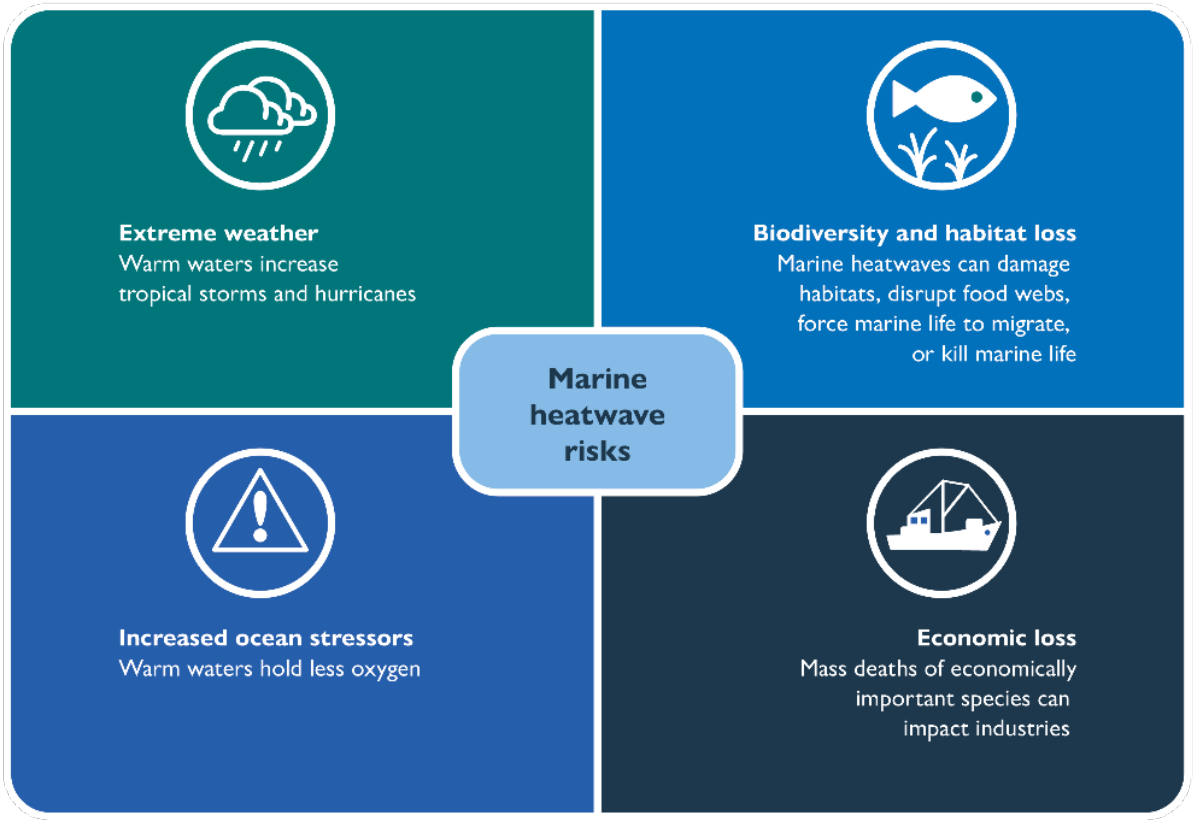
Marine heatwaves are extreme events where ocean temperatures rise above the normal range for more than five consecutive days. They can cause significant damage to marine ecosystems (Oliver et al., 2018).

A related event includes occurrences or incidents relating to environmental conditions. These events may include harmful algal blooms, proliferation of marine organisms including salps and the endemic bacterium, *Piscirickettsia salmonis*.

Climate change is significantly impacting the world's oceans, including the frequency, intensity and duration of marine heatwaves. A range of ocean and atmosphere processes can influence if and how a marine heatwave happens, including:

- strong radiation from the sun into the ocean
- heat advection in ocean currents (where water moves heat horizontally across areas)
- large-scale climate drivers such as El Niño and La Niña (Holbrook et al., 2019)
- in intertidal and shallow coastal shelf waters, factors such as air temperature, cloud cover, wind and rain.

Figure 1: Marine heatwave risks for global systems



Source: NRE Tas. Based on information from the International Union for Conservation of Nature, 2021.

Marine heatwaves and related events can have significant damaging effects to marine ecosystems, including:

- mass deaths and local extinctions of marine animals and plants
- non-lethal long-term effects such as changes to species' potential fertility
- increased exposure to biotoxins and disease.

In turn, these effects can reduce the productivity and sustainability of industries and communities that depend on healthy marine ecosystems.

The impacts of marine heatwaves are primarily negative. But opportunities could arise from marine heatwaves, for example, fishing in areas where heatwaves have caused fish abundance or shifts in species range.

Marine heatwaves and related events may present opportunities for community engagement on the effects of climate change on the marine environment. They may also support Governments, industries and communities to prepare, respond and adapt to future marine heatwaves and related events.

For more information about marine heatwaves, go to the Bureau of Meteorology's webpage, Explainer: what is a marine heatwave?

Marine heatwaves in Tasmania

Key Facts

South-eastern Australia is a climate change 'hotspot'. Waters are warming nearly four times faster than the global average (Oliver et al., 2018, Hobday et al., 2014).

Marine ecosystems that are accustomed to low temperatures are particularly vulnerable to marine heatwaves. This includes the ecosystems around Tasmania, which are already facing pressure from long-term rising water temperature (Oliver et al., 2018).

Tasmania's east coast has experienced several marine heatwaves that have caused significant damage to marine ecosystems and aquaculture production. This includes:

- a die-back of giant kelp (*Macrocystis pyrifera*) in 1988 (Sanderson, 1990)
- a die-back of crayweed kelp beds (*Phyllospora comosa*) in 2000–01 (Oliver et al., 2017 and Oliver et al., 2018)
- mass deaths of Tasmanian abalone (*Haliotis spp.)* in March 2010
- deaths in Atlantic salmon (*Salmo salar*) in 2012 (Oliver et al., 2018).

A major marine heatwave occurred in south-eastern Australian waters in the summer of 2015–16, including in Tasmania. It lasted for 251 days and reached a peak temperature anomaly of 2.9°C above the normal range. Apparent impacts included:

- the first outbreak of Pacific Oyster Mortality Syndrome (POMS) in Tasmania
- regional above-average abalone deaths
- die-back of bull kelp (*Durvillaea spp.*)
- localised bleaching of crayweed (*Phyllospora comosa*)
- out-of-range fish observations (Oliver et al., 2018).

Extensive surveys also found over 30 per cent loss of two kelp species unique to Tasmania – strapweed (*Lessonia corrugata)* and daggerweed (*Xiphophora gladiata)* – and potential increases in abundance of some kelp species such as *Sargassum spp.* and *Cystophora spp.* (Ling & Keane 2018; Mellin et al., 2019; Soler et al., 2022).

A major marine heatwave occurred off eastern Australia in 2023–24. The heatwave was declared from December 2023 to July 2024, with over 197 days with heatwave conditions ranging from moderate to extreme across State waters.

- Severity of conditions varied across the State, with some areas experiencing extreme conditions (>3.8°C Sea Surface Temperature (SST) anomaly) for between 7 and 51 days consecutively.
- All areas in the State experienced at least one event categorised as Moderate, with the duration ranging from 5 to 68 days and the SST ranging from 0.7 to 2.2°C.
- Severe and extreme conditions occurred mostly along the North and North-East coasts.
- An emergency intervention was taken to temporarily collect a population of Red Handfish (*Thymichthys politus*) from south eastern Tasmanian waters to prevent possible extinction of the species.

Impacts of the 2023-24 marine heatwave are still being assessed.

Depending on the intensity, duration and time of year marine heatwaves occur, they are likely to have substantial negative effects, which are outlined in Chapter 2. Risk Assessment.

Tasmanian Marine Heatwave and Related Event Response Plan

The Tasmanian Marine Heatwave and Related Event Response Plan (the Plan) guides Tasmania's decision making and coordination in response to marine heatwaves and events.

The Plan has two objectives:

It will …	It does this by documenting …
explain how and why Tasmania responds to marine heatwaves and related events.	• the risks of marine heatwaves and related events • existing activities to monitor and respond to marine heatwaves and related events • actions and responsibilities to respond to marine heatwaves and related events.
improve Tasmania's resilience to future marine heatwaves and related events.	• current capacity or knowledge gaps in Tasmania's response to marine heatwaves and related events • actions to support future preparedness and adaptation strategies.

As illustrated in Figure 2 the Plan is developed on six action areas.

Each stage of the Plan is adaptable to emerging issues as they arise. The Department of Natural Resources and Environment Tasmania (NRE Tas) will consider and document lessons at each stage, which contribute to planning activities to improve Tasmania's marine heatwave and related event preparedness.

The key elements of the Plan are:

1. Detection: forecasting and classifying marine heatwaves and related events

2. Risk assessment: understanding and categorising risks to Tasmania's industries, communities and marine ecosystems

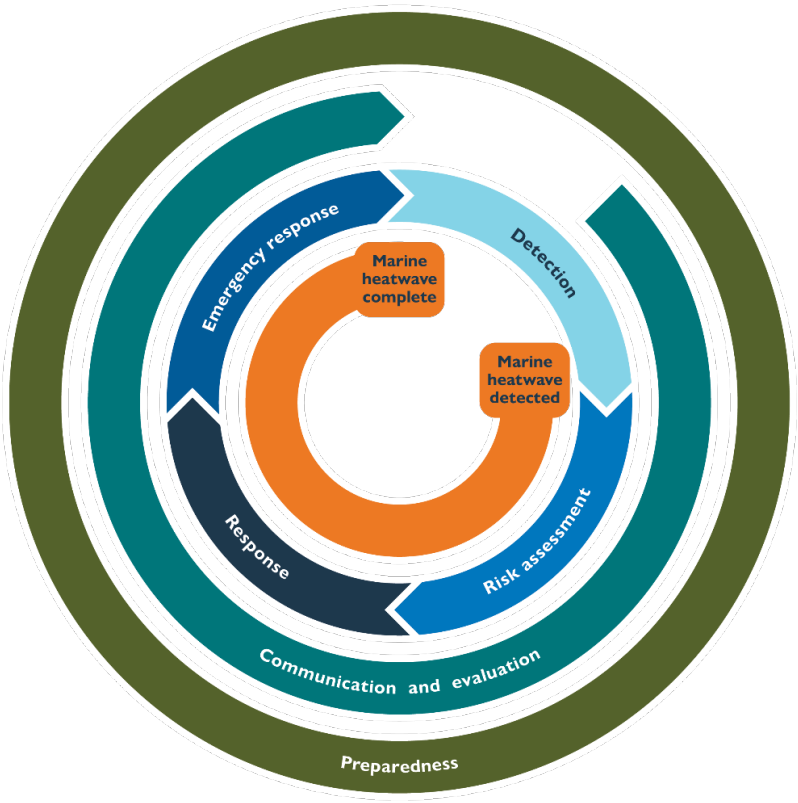
3. Monitoring and Response: steps to prepare for marine heatwaves and related events, and how to monitor and report when they happen

4. Emergency response: steps to take when marine heatwaves and related events cause public health incidents or unusual mortality events in marine life

5. Communication: responsibilities and tasks for communicating marine heatwaves and related events to different groups in Tasmania

6. Evaluation and preparedness: identifying areas to strengthen our future responses to marine heatwaves and related events.

Figure 2: Summary of the Marine Heatwave and Related Event Response Plan action areas.



Notes: Lessons from each stage of a marine heatwave or related event feed into evaluation activities. All activities feed into Tasmania's overall preparedness for marine heatwaves and related events, which improves future responses. Not all marine heatwaves or related events will require an emergency response. Risk assessment may take place as impacts evolve. Source: NRE Tas

Potential impacts by group

Marine heatwaves and related events can impact Tasmanian marine life, industries and communities. Understanding the potential impacts on different groups helps NRE Tas and other stakeholders to prepare for marine heatwaves and related events.

The impacts listed in this Plan are the potential effects of marine heatwaves and related events. These impacts will not necessarily occur during a heatwave or related event, nor be consistent between heatwaves or similar related events. Some potential impacts of higher water temperature and related events are unknown.

Marine ecosystems and species

Marine heatwaves and related events could impact marine ecosystems and species through:

- population-level impacts such as:
    - unusual mortality events
    - sick, dying or dead animals
    - starving animals (due to shift of prey species)
    - early senescence
    - population declines
    - localised extinctions
    - increased stress
    - shifts in timing of spawning
    - species migration to cooler waters
    - growth and reproductive biology
    - population explosions (in certain species)
    - susceptibility to disease
- disease, biotoxin and microbiological events including Abalone Viral Ganglioneuritis (AVG), Harmful Algae Blooms (HABs), Pacific Oyster Mortality Syndrome (POMS), vibrios and *Piscirickettsia salmonis*.
- ecosystem impacts including:
    - low dissolved oxygen
    - habitat damage
    - species sensitive to temperature, light and nutrient levels
    - changes to ecosystem range
    - increased competition for resources.

Vulnerable marine ecosystems and species include:

- abalone, rock lobster, scallops, and other shellfish
- reef communities
- seaweeds (e.g., kelp forests and seagrass beds)
- seabirds (e.g., little penguin, shearwater, albatross)
- marine mammals
- shallow water species.

Shallow water species may routinely experience fluctuations in temperature and extreme conditions. They may have the capacity to withstand short-term increases in temperature but prolonged exposure to warm water temperatures is likely to be harmful.

If temperatures increase beyond the range that a species can tolerate or acclimatise to, it may seek refuge at greater depths or expand their range towards cooler water. This may not be possible for marine species in Tasmania that are site-attached and have limited capability to disperse.

Industries

Marine heatwaves and related events could disrupt Tasmanian aquaculture and wild fishery industries through loss of income due to:

- area/fishery closure or unsaleable product
- mass mortality of cultured organisms
- being unable to get live produce to market
- heat stress related impacts on production (e.g., disease)
- increased likelihood of poorer product quality and mortality
- increased disease risk
- waste disposal of mortalities
- market access after unusual mortality event.

Vulnerable industries include:

- farmed oysters, seaweed, and abalone (noting land-based aquaculture systems require a large volume of sea water flow)
- wild catch abalone, rock lobster, scallops, periwinkles, and other shellfish
- wild catch live scalefish fisheries
- farmed finfish in coastal waters
- birding for short-tailed shearwater (Muttonbird), which is a unique cultural practice and commercial industry managed and owned by the Tasmanian Aboriginal community.

Communities

Marine heatwaves and events could impact Tasmanian communities through:

- a public health incident (from seafood contamination)
- non-commercial impacts such as on subsistence harvesting or rotting fish after unusual mortality event
- cultural impacts including on:
    - important social, cultural, spiritual and economic resources
    - commercial birding, and associated continuity of cultural knowledge and practice of birding.

Vulnerable communities include:

- Tasmanian Aboriginal community
- subsistence and recreational fishers

- communities that have high exposure to loss of income from fishery closures, tourism downturns, or opportunities for new businesses (such as iconic species moving into new areas).

See Appendix 1 for an initial assessment of potential impacts by species, including for aquaculture, wild fisheries, marine mammals, threatened species and impacted stakeholders.

1. Detection

The window of time before a marine heatwave or related event is an opportunity to assess risks, prepare responses and communicate with stakeholders. This chapter of the Plan describes current activities to forecast and classify marine heatwaves.

Forecasting marine heatwaves

Marine heatwaves can be predicted days, weeks, or potentially years in advance. Early warning of a possible marine heatwave helps all stakeholders to prepare and respond.

Expert marine heatwave forecasting provides information to strengthen Tasmania's response efforts. National and regional ocean temperature forecasts indicate when a marine heatwave is likely to happen. NRE Tas uses this information to monitor, plan and take the required actions.

Forecasts to detect a marine heatwave include:

- ongoing targeted monitoring to detect sea surface temperature (SST) anomalies and communicate ocean environmental conditions by the Bureau of Meteorology
- regular climate briefings hosted by the Fisheries Research and Development Corporation (if the Bureau of Meteorology declares a marine heatwave)
- automated daily analyses of the SST anomaly to detect and categorise the marine heatwave
- marine heatwave tracking via online tools (e.g., the Marine Heatwave Tracker, State of the Ocean from Worldview, and Ocean Current from Australia's Integrated Marine Observing System)
- targeted biological monitoring to detect and prepare for impacts
- targeted monitoring to detect SST anomalies using temperature loggers in coastal waters

Forecasts can be useful tools, particularly when marine heatwaves start and peak quickly (known as the "rate of onset") or when the characteristics of marine heatwaves change.

However, the accuracy of marine heatwave forecasting depends on several regional and local factors. Forecasts are less accurate in shallow inshore areas and intertidal zones, where the ecosystem impacts of high sea temperatures are also influenced by air temperature, cloud cover, rain and wind.

A marine heatwave includes four time periods of interest for decision makers in government and industries (Spillman et al., 2021):

1. preparation window: between a forecast being issued and the start of a marine heatwave
2. reaction window: from the start of a marine heatwave to its peak
3. coping window: from the peak of a marine heatwave to its end
4. recovery window: between the end of a marine heatwave and the start of the next one.

Classifying marine heatwaves

A marine heatwave is a period of unusually warm ocean water that:

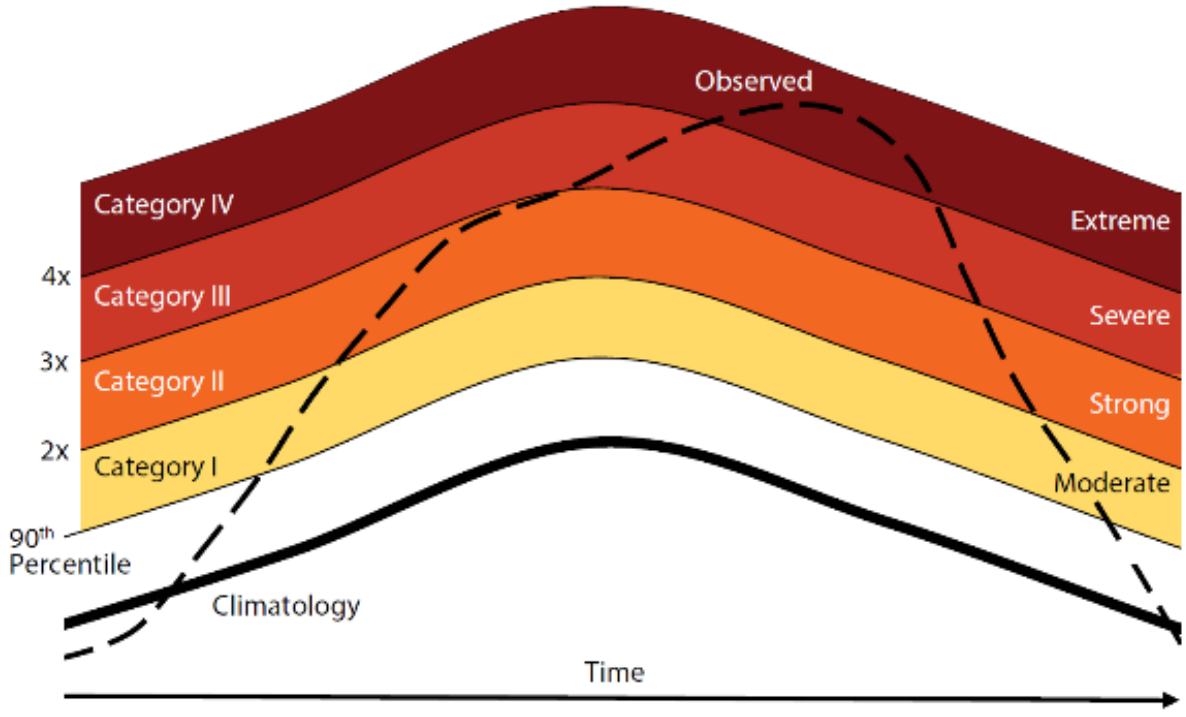
- lasts five or more days
- is warmer than the 90th percentile of a 30-year baseline period.

Real-time SST reporting helps to classify marine heatwaves as they happen. There are four classification categories of intensity, from moderate to extreme (see Figure 3). After a marine heatwave, post-event reporting can define its maximum classification (Hobday et al., 2018).

There are limitations to heatwave classification, which include:

- past marine heatwaves within the same category have had different impacts on marine ecosystems due to local conditions and varying thermal tolerances of marine organisms
- ocean temperatures that are above average, but do not meet the conditions of a marine heatwaves, can also impact marine ecosystems
- current classifications do not account for a marine heatwave's duration, intensity, size and rate of onset
- marine heatwave definitions are less useful in foreshore areas that are also influenced by air temperature, rain and wind.

Figure 3: Marine heatwave classification showing an extreme marine heatwave example



Notes: Schematic shows observed temperature over time (dashed line), long-term regional climatology (bold line) and the 90th percentile climatology (thin line). Long-term regional climatology is a region's typical climate based on historical data. Each marine heatwave category is a multiple of the 90th percentile of this baseline figure. In this example, the observed temperature over time shows the marine heatwave enters the IV category, so it would be classified as Extreme.

Source: Hobday et al., 2018

2. Risk Assessment

Risk assessment is an essential step to prepare an effective response to marine heatwaves and events. This chapter of the Plan describes the potential risks for Tasmanian marine ecosystems, industries, communities, including vulnerable species, sectors and groups.

Understanding risk

There are several risks to ecosystems and stakeholders during a marine heatwave or event. Some are more severe than others.

NRE Tas assesses risk in an ongoing process before, during and after a marine heatwave or event and as their impacts evolve.

Following a return to normal or average conditions, NRE Tas will continue to monitor and assess impacts which may be attributable to the period of elevated temperatures.

Categorising risks helps NRE Tas to understand a marine heatwave or event, coordinate the necessary response and support future preparedness. A marine heatwave's or event's risk level depends on the following factors:

- its classification (intensity and duration)
- the vulnerability of affected marine species
- the preparedness of affected industries.

Three categories are used to classify for marine heatwave risk (Pecl et al., 2014):

1. high risk: high sensitivity, low capacity to respond
2. moderate risk: medium sensitivity
3. low risk: Low sensitivity, high capacity to respond.

During a marine heatwave or related event, NRE Tas prioritises the species, habitats, populations and locations that may be most impacted. This preliminary prioritisation is based on:

- knowledge from a previous marine heatwaves or related event's impacts
- existing and updated vulnerability assessments, including for threatened species and vulnerable marine habitat
- marine species' exposure to a predicted marine heatwave or related event
- understanding how sensitive marine species are to higher ocean temperatures, including on their growth and reproduction.

See Appendix 1 for a preliminary risk assessment of potential impacts on Tasmanian marine species).

Major Risks

A major risk of marine heatwaves on Tasmanian marine life, industries and the community is disease, biotoxins and microbiological events.

Marine heatwaves and events can influence how widespread and severe marine infectious diseases are. They can also drive the spread of disease from other regions into Tasmanian waters, introducing new disease to previously naive stocks.

There are global examples of mass mortality events in fish populations linked to marine heatwaves because of these events.

Marine heatwaves increase the prevalence and severity of several known marine diseases, both because pathogens thrive in warmer water and because host organisms may be weaker and more susceptible to disease.

Information on the main disease, biotoxin and microbiological event risks for Tasmania include:

- Abalone Viral Ganglioneuritis (AVG) - Fact Sheet 1
- Harmful Algal Blooms (HABs) - Fact Sheet 2
- Pacific Oyster Mortality Syndrome (POMS) - Fact Sheet 3
- Vibrio Fact Sheet 4
- *Piscirickettsia salmonis* - Fact Sheet 5

See Appendix 2 for Fact Sheets.

3. Monitoring and Response

Marine heatwaves and related events need appropriate and timely responses. This chapter of the Plan starts with a description of potential response approaches to marine heatwaves or related events. It then lists specific responses for Tasmanian stakeholders.

Types of responses

It is not usually possible to prevent a marine heatwave or related event. Therefore, the Plan's response includes improving monitoring technologies to measure the impacts of marine heatwaves and events and track recovery after they occur. This will help NRE Tas to prepare for future marine heatwaves and events.

There are many options to respond to a marine heatwave or related event. The level and type of response depends on the severity (or potential severity) of a marine heatwave or related event and its impacts.

Tasmania currently responds to a marine heatwave or related event in the following ways:

- monitoring
- reporting
- management response

Monitoring

Monitoring is an important part of building Tasmania's resilience to marine heatwaves and related events. Monitoring programs need to be widespread, diverse, accessible and adequately funded to support Tasmania's marine heatwave preparedness.

Monitoring helps NRE Tas to:

- identify marine heatwaves or related events
- classify their severity
- identify their impacts.

Several groups carry out monitoring in Tasmania, but most programs are currently focused on the aquaculture industry and, to a lesser extent, the commercial abalone sector.

Activities include monitoring SST and for signs of marine heatwave impacts (for example, fish deaths or disease).

Monitoring species movement

Redmap is a national project that invites Australians to share sightings of marine species that are uncommon to their local seas.

Redmap uses this citizen-science data to map marine species that may be extending their distribution range (aka moving house) in response to changes in the marine environment, such as marine heatwaves.

Reporting

Reporting is when an action is taken to notify the relevant authority of an observed impact of a marine heatwave. Reporting usually happens after:

- heat-stressed or sick marine animals, or damage to habitats, is detected during monitoring activities
- someone notices an unusual event as part of their daily activities (for example, observing dead animals during aquaculture operations).

Anyone can report a sign of a marine heatwave, including members of the public, aquaculture and wild fishery workers, conservation organisations and researchers. Table 1 provides a quick guide on how to report signs of marine heatwaves.

Table 1: Signs of marine heatwaves and actions to take

Sign of marine heatwave	Action
Primary hotlines	
Large numbers of sick or dead marine fish (including shellfish, crustaceans and other marine molluscs)	Call the 24-hour **Emergency Animal Disease Hotline** on **1800 675 888**. For more information, go to Animal Health Laboratory | NRE Tas.
Sick or dead marine mammals and seabirds	Call the **Marine Wildlife Hotline** on **0427 942 537**. Act as soon as possible. Time is critical during a rescue attempt or for testing deceased animals to determine cause of death. For more information, go to Marine Mammal Incident Response | NRE Tas.

Sign of marine heatwave	Action
Specialist hotlines	
Mass fish kills	Call the **Environment Protection Authority (EPA) Incident Response Hotline** on **1800 005 171**. To minimise potential risk to yourself, do not: • touch the fish or water in the area • collect fish for bait or other purposes (such as garden fertilisers) – See notes at end of table. • consume any fish that you have caught in the area. For more information, go to Fish and Fish Kills | EPA Tasmania.
Small numbers of sick or dead fish (including shellfish, crustaceans and other marine molluscs)	Call **Biosecurity Tasmania (during office hours)** on **03 6165 3777,** email **animaldisease.enquiries@nre.tas.gov.au** or complete the Report Signs of a Marine Heatwave online form.
Any impact on the threatened Maugean skate, handfish or Tasmanian live-bearing seastar	Contact **Fishing Tasmania** via the Report Signs of a Marine Heatwave online form
Warm-water species outside their normal range	Contact **Redmap** via **www.redmap.org.au** or make a report on the Redmap app (download from Google Play or the App Store). You will need to include photos in your report.
Bleached kelps and/or seagrass dieback	Contact **Fishing Tasmania** via the Report Signs of a Marine Heatwave online form.
Other observations (non-urgent)	Contact **Fishing Tasmania** via the Report Signs of a Marine Heatwave online form. Do not use the form to report marine mammals and seabirds or potential disease-related emergencies.

Notes: For all signs of a marine heatwave, take photos if possible and include details of what you have observed, the time and your location. Samples may be requested by the Chief Veterinary Officer.

Management response

Management responses are designed to limit the potential impacts of marine heatwaves. They help improve resilience to, and recovery from, marine heatwaves.

Most management activities focus on preventing the spread of disease, biotoxins or microbiological events caused by marine heatwaves. Therefore, management activities are generally based on measures such as best practice animal welfare and food safety in seafood processing.

NRE Tas works with stakeholders to design specific management responses for marine heatwaves, depending on its severity and the impacted habitats and species.

See the Response approaches by group section of this chapter for information about current management activities for marine heatwaves and their impacts.

Disease, biotoxin and microbiological events

Tasmania runs monitoring and management responses for diseases, biotoxins and microbiological events that may be worsened by marine heatwaves.

Shellfish Market Access Program

The Tasmanian Government runs a Shellfish Market Access Program (ShellMAP) to make sure Tasmanian shellfish is enjoyed safely and growers can retain market access.

ShellMAP has a Tasmanian Bivalve Biotoxin Management Plan 2019, which outlines sampling, testing and reporting requirements for Tasmania's wild fisheries industry.

Biotoxins that cause paralytic shellfish poisoning are of primary concern. To avoid risks to human health, ShellMAP:

- monitors for toxic phytoplankton
- tests shellfish meats for biotoxins
- runs monitoring programs to test species such as abalone, rock lobster and scallops.

Any increase in biotoxins or HABs during monitoring triggers an increase in sampling, as per the relevant Biotoxin Management Plan.

ShellMAP closes and re-opens areas where foodborne illness has occurred from seafood products affected by vibrio or other pathogens. It does this with guidance from NRE Tas's Biosecurity Tasmania's Primary Produce Safety Program.

NRE Tas and the rock lobster industry also monitor biotoxins in mussels during the higher-risk period between June and November, as per the Rock Lobster Biotoxin Management Plan 2023.

The scallop industry runs an independent biotoxin monitoring program. During the June to December fishing season, it tests scallops for toxins (including paralytic, diarrhetic and amnesic shellfish toxins) that can cause human poisoning.

Biotoxin News

ShellMAP produces a weekly Biotoxin News update using data from all biotoxin monitoring programs. It is widely circulated to fisheries managers, industry groups and government agencies.

POMS movement permits

The Tasmanian Government is managing the potential spread of POMS by controlling the movement of oysters across the State.

As the virus is now established in Tasmania, it could naturally spread. Controlling movement of oysters will slow the spread of the virus and allow the oyster industry to manage this disease.

To move oysters and/or oyster equipment, aquaculture operators must meet the conditions and schedules of the Group Permit under the *Biosecurity Act 2019.* For movements that do not meet these conditions and schedules, operators must seek approval from the Chief Veterinary Officer through an individual permit or a prohibited dealing permit. Three risk levels determine if and how a movement permit can be issued (see Table 2).

Table 2: Classification status under POMS movement control measures

Status	Description
POMS free	No virus detected, no signs of disease, geographically isolated from infected areas. The area across the north of Tasmania is POMS free.
POMS intermediate	No virus detected, may/may not experience signs of disease, geographically close to infected area, risk of natural transfer.
POMS infected	Evidence of disease and positive tests for POMS.

For more information go to NRE Tas's webpage, Oyster Farming.

Response approaches by group

Tasmanian industries and communities can help prepare for, and respond to, marine heatwaves in different ways. NRE Tas has identified current and potential activities of the following groups which have been identified as being vulnerable to marine heatwave impacts:

1 Aquaculture
2 Wild fisheries
3 Marine mammals, seabirds and threatened species
4 Tasmanian Aboriginal community.

Aquaculture

Tasmania's aquaculture industry produces several commercially farmed species, including:

- salmonids (Atlantic salmon and trout)
- Pacific oysters
- abalone
- blue mussels (*Mytilus edulis*)
- native oysters (*Ostrea angasi*).

Salmonid farming is Tasmania's largest primary animal industry. Marine heatwaves increase salmonids' vulnerability to disease, so careful monitoring and management is important to reduce potential impacts to the industry.

Monitoring activities

The aquaculture industry carries out monitoring activities, which can help identify signs of marine heatwaves. This includes:

- water quality monitoring in salmon growing areas under the Broadscale Environmental Monitoring Program, since 2009. The Program monitors water quality and levels of phytoplankton and harmful algal species
- the Tasmanian Salmonid Health Surveillance Program, which monitors fish health to detect new or emerging diseases in conjunction with the Centre for Aquatic Animal Health and Vaccines (CAAHV)
- real-time water quality monitoring in 30 oyster growing areas. The sensors have potential to be used as part of a broader monitoring program to inform aquaculture producers and coastal communities about water quality changes in near-shore waters and estuaries
- water quality data collection from other aquaculture sectors as relevant to their operations. Some of this data is available to NRE Tas as part of its permit and licencing conditions.

The EPA also runs water quality monitoring and other monitoring in marine-based farming regions. Find information at EPA independent monitoring.

Reporting activities

The aquaculture sector is well-placed to report signs of marine heatwaves. Operators and workers should use the hotline numbers in Table 1 to report any suspected marine heatwave impacts. The aquaculture sector is most likely to observe:

- AVG in abalone (operators should report any suspicion of AVG immediately)
- incidents of dead or dying wild fish around aquaculture zones (where appropriate, samples can be collected for analysis by NRE Tas's Animal Health Unit)
- unusual ecosystem-related occurrences or HAB locations in or around aquaculture zones or during transit
- unusual aquaculture mortality events

- instances where there is no capacity in existing waste disposal or composting facilities.

Management activities

The aquaculture industry can improve its resilience to marine heatwaves by adjusting how it manages stock during an event. Many responses are designed to prevent stress, illness and the spread of disease in farmed stock. This includes:

- in salmon farming:
  - reduce stocking densities in pens, vary feed formulations, transfer fish to different locations within a region and implement disease management plans (Spillman and Hobday 2016; Hobday et al. 2016)
  - selectively breed animals for heat tolerance
  - design stock management strategies to avoid holding stock vulnerable to heat stress during summer
  - vaccinate fish for likely diseases where possible
  - implement biosecurity measures to prevent pathogen spread between operations in close proximity
- in land-based farming operations:
  - extend or deepen marine water intakes
  - increase shade protection over tanks
  - paint or cover black/dark intake pipes
  - install or increase the effectiveness of cooling capabilities for inflowing water
- in shellfish production:
  - make sure harvest practices minimise sediment disturbance and maintain adequate distance from seafloor
  - harvest at the coolest time of day
  - enter products into the cold chain as soon as possible (post-harvest cold chain management can minimise the risk of foodborne illness from vibrio)
  - develop a Food Safety Management System for live Tasmanian farmed bivalve mollusc operations.

Biosecurity Tasmania's Primary Produce Safety Program and the Department of Health will manage any cases of foodborne illness because of vibrio or any other pathogen in seafood products. This includes working directly with growers to make sure all potentially impacted product is removed from the marketplace in a timely manner.

Aquaculture operators can also:

- attend producer preparedness education events to support adaptation planning
- consider options for support if restocking/reestablishment is required after a marine heatwave, or if farm decommissioning is required
- develop mass mortality plans for their respective operations, which is required by the New Environment Standard for Marine Finfish Farming.

Onshore disposal of fish after significant mortality events (e.g., burying, burning or composting) could be a major issue for the aquaculture industry. Operators need to take steps to prepare for this possibility and design responses accordingly. Tasmanian

Government agencies can provide permits and approvals where required, for example to establish a fish waste composting operation.

The aquaculture industry in conjunction with the Tasmanian Government and the Fisheries Research Development Corporation is leading and funding research into vaccine development for salmonid diseases via the Centre for Aquatic Animal Health and Vaccines (CAAHV).

Appendix 4 outlines the potential impact, responses, response leader and impacted stakeholders during a marine heatwave or event. Table 7 details potential impacts for different aquaculture species during marine heatwaves. It also maps responses, response leaders and impacted stakeholders.

Tools for shellfish growers

Biosecurity Tasmania's Food Safety Management System Template provides tools for Tasmanian live-farmed bivalve mollusc accredited producers to manage risks of disease.

Oysters Tasmania's Vibrio Best Practice Guide for Tasmanian Shellfish Growers provides management response guidance for Tasmanian growers.

Wild fisheries

Tasmania's wild fisheries have varied fishing techniques, species, business models and equipment. Under this Plan, wild fishing also includes recreational, subsistence and Aboriginal fishing.

Not all fisheries and operators are exposed to the same risks from marine heatwaves, nor have the same capacity to adapt. But there are several ways fishing operators and individuals can support marine heatwave monitoring, reporting and management activities.

Monitoring activities

The Institute for Marine and Antarctic Studies (IMAS) has led a short-term targeted monitoring project to collect ocean temperature data. In trials of two seafood supply chains in early 2024 (octopus and rock lobster fisheries), operators used devices on their fishing gear to record water temperature at different depths when deployed and in wells where live catch is stored on vessels. The final report can be viewed at: Development of a temperature monitoring framework for Tasmania's seafood industry during marine heatwaves | FRDC

IMAS is combining data from new and existing projects to gain insights into temperature conditions at depths relevant to wild fisheries. Projects include:

- Institute of Marine and Antarctic Studies (IMAS) Effect of Temperature on Abalone Condition
- Fisheries Research and Development Corporation (FRDC) Fisheries Aggregation Devices
- The Tasmanian Giant Kelp Restoration Project.

IMAS will then use its findings to trial and evaluate methods that could help support marine heatwave preparedness. The program is being funded by the FRDC and NRE Tas.

Reporting activities

Wild fishery operators and workers should use the hotline numbers in Table 1 to report any suspected marine heatwave activities. Wild fisheries are most likely to observe:

- death of catch on vessels
- mass fish kills, which could be due to a marine heatwave or related disease, biotoxin or microbiological event
- spread of range extending and invasive marine species.

Management activities

Wild fisheries management responses to marine heatwaves vary from fishery to fishery. Some fisheries require more active support than others.

When a marine heatwave is forecast and/or underway, NRE Tas will design and communicate non-emergency management actions on a case-by-case basis, in consultation with IMAS. This will require the necessary resourcing and capacity.

Communication will involve easily accessible information about the marine heatwave including:

- its potential impacts
- options for mitigating these impacts
- available support options.

Appendix 4 outlines the potential impact, responses, response leader and impacted stakeholders during a marine heatwave or related event, Table 8 details potential impacts for different wild fishery species during marine heatwaves. It also maps responses, response leaders and impacted stakeholders.

AVG management

The wild fisheries sector should be aware of AVG, as outbreaks have historically happened in facilities holding live, wild-capture abalone.

Disease typically occurs when abalone from different areas are mixed. Therefore, a facility live-holding out-of-area abalone should treat discharge water as required by the Fisheries (Biosecurity) Order 2024.

Wild fisheries sector can support AVG management by reporting any signs of AVG to the relevant reporting hotline in Table 1 and take actions detailed in Table 8.

Marine mammals, seabirds and threatened species

Marine heatwaves can negatively affect seabirds and marine mammals by:

- heat stress
- redistributing their prey
- causing death or sickness through eating prey affected by disease or biotoxins.

Marine mammals' and seabirds' interactions with wild fisheries and aquaculture may change because of marine heatwaves. The breeding success of some animals may also be compromised if they are pushed to forage further from their natural breeding grounds.

Marine heatwaves could also increase the risk of other threats such as high pathogenicity avian influenza (HPAI), which has the potential to reach Tasmania.

As well as marine mammals and seabirds, Tasmanian threatened fish species are at potential risk from marine heatwaves, which is a concern for conservation values. Species of particular concern are both vulnerable to marine heatwaves and are already threatened, as of July 2024, include:

- Maugean Skate (*Zearaja maugeana*)
- Red Handfish (*Thymichthys politus*)
- Spotted Handfish (*Brachionichthys hirsutus*)
- Ziebell's Handfish (*Brachiopsilus ziebelli*)
- Tasmanian Live-bearing Seastar (*Parvulastra vivipara*)
- Derwent River Seastar (*Patiriella littoralis*)
- Bruny Island Seastar (*Smilasterias tasmaniae*)
- Pink Handfish (*Brachiopsilus dianthus*)
- Gunns Screw Shell (*Gazameda gunnii*).

Further, potential new listed species which are not included in this list (i.e. not listed during the time that this Plan was drafted and prepared) should also be considered at the time of any given marine heatwave.

Intervention and action in response to a marine heatwave to mitigate the impacts to marine threatened species has the potential to be both costly, and risky for a species. Any potential intervention resulting from the impacts of a marine heatwave will have to be considered through prioritisation and risk principles.

Monitoring activities

NRE Tas directly and indirectly, through other organisations and community groups, monitor population trends, habitat use and behaviours in marine mammals and seabirds through its Marine Conservation Program. This includes monitoring:

- established and emerging breeding colonies of two fur seal species breeding in Tasmania, the Australian Fur Seal (*Arctocephalus pusillus doriferus*) and Long-nosed Fur Seal (*Arctocephalus forsteri*)
- Short-tailed Shearwater (*Ardenna tenuirostris*) colonies in the Furneaux Islands and at Fort Direction through Short-tailed Shearwater Monitoring
- Little Penguin (*Eudyptula minor*) colonies across the State through Little Penguin Monitoring and Protection Measures

- Shy Albatross (*Thalassarche cauta*) species, under the *National Recovery Plan for albatrosses and petrels (2022)* and international commitments under the Agreement on the Conservation of Albatrosses and Petrels.

For more information, visit NRE Tas's Marine Conservation Program webpage.

Reporting activities

Any signs of marine heatwaves on marine mammals, seabirds and threatened species should be directed to the relevant hotline numbers in Table 1.

Management activities

When large numbers of marine mammals or seabirds die due to a marine heatwave, it is likely to be classified as an unusual mortality event. See Chapter 4: Emergency response for information on how NRE Tas manages unusual mortality events. Responses aim to:

- minimise deaths
- determine the cause of the event
- determine the effect of the event on the population
- identify the role of environmental parameters (such as marine heatwaves) in the event.

Appendix 4 outlines the potential impact, responses, response leader and impacted stakeholders during a marine heatwave or related event, Table 9 lists the potential impact, responses, response leader and impacted stakeholders during a marine heatwave.

Tasmanian Aboriginal community

The Tasmanian Aboriginal community has a longstanding and unique knowledge of sea Country. All marine users can take action to reduce the impact that marine heatwaves may have on Tasmanian Aboriginal people and cultural resources.

Monitoring activities

The Tasmanian Aboriginal community carry out monitoring programs that honour their culture, Country and community. This presents opportunities to integrate Aboriginal knowledge into marine heatwave response strategies.

Current programs include:

- monitoring short-tailed shearwater rookeries located on Aboriginal lands, run by the Pakana Rangers (the Tasmanian Aboriginal community can commercially harvest short-tailed shearwaters, including in Australia's largest shearwater rookery)
- mapping seagrass beds and giant kelp forests, including collecting giant kelp spores from kelp in the proposed Tayaritja Milaythina Muka Indigenous Protected Area for storage in the IMAS seed bank
- monitoring sea temperatures around Tayaritja Milaythina Muka, to understand how culturally significant areas are responding to marine heatwaves.

Reporting activities

The Tasmanian Aboriginal community may observe marine heatwave impacts as part their daily activities. Any potential marine heatwave impacts should be directed to the relevant hotline numbers in Table 1.

Management activities

Engagement, inclusion and collaboration with Aboriginal community-controlled organisations is an important part of marine heatwave monitoring and response. NRE Tas plans to:

- communicate further with the Tasmanian Aboriginal community to help share information about the risks that the marine heatwave poses to sea Country and human health
- provide further opportunities for the Tasmanian Aboriginal community to become more engaged in monitoring the health of sea Country
- inform the Tasmanian Aboriginal community about the government's response to marine heatwaves
- support self-governance across the Tasmanian Aboriginal community around managing sea Country to improve resilience to future marine heatwaves
- work further with Tasmanian Aboriginal knowledge holders to embed their knowledge into management responses.

NRE Tas's staff will continue to develop its cultural awareness, cultural safety and cultural competency with support from its Aboriginal Cultural Fisheries Officer, Pakana Sea Country Rangers, Parks and Wildlife Service, Working on Country Rangers and

Tasmanian Aboriginal community organisations. For more information, see Chapter 6: Evaluation and preparedness.

4. Critical Event Preparation, Response Coordination and Communication Framework

Marine heatwaves and related events may occasionally cause threats to human health or marine ecosystems. This chapter of the Plan describes actions and responsibilities when a marine heatwave or related event requires an emergency type response.

Defining an emergency

Currently, marine heatwaves are not identified as emergencies in the Tasmanian Emeregency Management Arragements (TEMA). However, some marine heatwaves may require an emergency type response.

This framework sets out how Tasmania prepares for, coordinates and communicates during marine heatwave events and related marine critical incidents. It ensures a structured, whole of government approach tailored to the marine environment, enabling government, industry, and communities to respond effectively and recover quickly.

Scope and triggers

This framework is activated when marine heatwave conditions or related events:

- exceed defined ecological or industry thresholds,
- pose risks to public health, or
- cause cascading impacts requiring multi-agency coordination.

It operates in parallel with TEMA and will escalate into broader state arrangements if required, which are outlined in Appendix 2.

Principles

The framework is grounded in evidence, collaboration, adaptability and transparency, ensuring actions are coordinated, scalable and trusted by government, industry and the community.

1. Evidence based - actions guided by monitoring, science and risk assessments.
2. Collaborative - coordinated across government, industry and community.
3. Adaptive - scalable and flexible as event conditions evolve.
4. Transparent - clear, timely and consistent communication.

Preparedness

Preparedness positions Tasmania to anticipate and manage marine risks. Monitoring, agency readiness and proactive engagement with stakeholders enable early warning and rapid activation when thresholds are exceeded.

- Maintain continuous monitoring of marine conditions and early warning systems.
- Ensure agency readiness, with NRE Tas Marine Resources leading coordination across Biosecurity Tasmania, the Department of Health and the Environment Protection Authority (EPA).
- Engage industry, researchers, and communities before high-risk seasons.
- Maintain and test contact lists, key messages, and rapid notification tools.

Response

Response is coordinated by NRE Tas's Marine Resources supported by partner agencies. Scalable activation and centralised reporting provide clarity, speed and a single source of truth to guide timely and effective action.

- NRE Tas's Marine Resources acts as the Coordinating Agency.
- Agencies activate functions in a coordinated, non-hierarchical structure.
- Activation is scalable, from enhanced monitoring and warnings to multi-agency coordination.
- Centralised situation reporting ensures a single source of truth.

Coordination

The Critical Event Coordination Cell (CECC) brings together government, science and industry to provide shared assessments, coordinated messaging and advice to government, ensuring resources and expertise are applied efficiently.

CECC: convened when thresholds are met. Chaired by Marine Resources, it includes representatives from NRE Tas (Biosecurity, Environment and Communication teams), the Department of Health, the Department of State Growth, the Department of Premier and Cabinet, the EPA, and advisors from IMAS, CSIRO and industry.

Functions: daily briefings, joint situation reports, coordinated public messaging and recommendations to government.

Resource sharing: scientific expertise, compliance, testing and health support.

External links: national agencies and scientific partners engaged for intelligence and technical support.

Communication from the CECC

Communication is timely, accurate and consistent, with NRE Tas coordinating a single government voice. Public updates, stakeholder briefings and two-way engagement ensure clarity, manage uncertainty and support informed decision making.

- Communication is timely, accurate, transparent and tailored for audiences.

- NRE Tas coordinates a single government voice, avoiding mixed messages.
- Public updates are issued through media, websites, hotlines and mapping tools.
- Industry, councils and communities receive targeted briefings and advisories.
- Communications differentiate between scientific uncertainty and confirmed impacts.
- Two-way engagement captures local intelligence and informs decisions.

Transition and Recovery

Transition and recovery support ecological restoration, industry resilience and community wellbeing. Lessons learned through after-action reviews strengthen future preparedness, communication and coordination systems.

- Stabilisation: Coordination scaled back as risks ease, with monitoring maintained.
- Recovery: Support ecological recovery, industry resilience and community wellbeing including mental health impacts where relevant.
- Review: After-action reviews improve preparedness, coordination and communication for future events.

5. Communication

Clear communication is essential to effectively prepare for, and respond to, a marine heatwave. This chapter of the Plan describes NRE Tas's communications strategy.

Communications strategy

NRE Tas leads the communications strategy for marine heatwaves. The strategy covers all stages of a marine heatwave from preparation, detection, risk assessment and response.

Prompt, regular and relevant communication is critical to educate, coordinate and mobilise stakeholders when a marine heatwave happens. It also improves decision making for government, industries, communities and individuals during an event.

Stakeholders

Stakeholders are the individuals and organisations that NRE Tas will communicate with before, during and after a marine heatwave. See Table 3 for a list of marine heatwave response stakeholders.

There are two stakeholder groups:

- primary stakeholders: directly involved in addressing marine heatwaves and their impacts
- secondary stakeholders: affected by marine heatwaves and their impacts but are not directly involved in the response.

Table 3: Primary and secondary communications stakeholders under the Plan

Category		Stakeholder
Primary stakeholders	Internal (NRE Tas)	• Biosecurity Tasmania • Marine Resources • Marine Conservation Program • Threatened Species Section • Corporate Communications
	External	• EPA • Department of Health – Food safety • Seafood Industry Tasmania • Tasmanian Association for Recreational Fishing • Tasmanian Rock Lobster Fishermen's Association • Tasmanian Abalone Council Limited

Category		Stakeholder
		• Tasmanian Aboriginal community-based organisations (see the Department of Premier and Cabinet's list of Tasmanian Aboriginal organisations) • Salmon Tasmania • Oysters Tasmania • Australian Abalone Growers Association • Relevant research organisations (e.g. IMAS, CSIRO)
Secondary stakeholders	Community	• Natural Resource Management groups • Tackle stores • Tasmanian Diver's Group • University of Tasmania Dive Club • Marine and Safety Tasmania • Parks and Wildlife Service (including visitor centres) • State Emergency Service • Coastal councils • Recreational fishers • Eco-leisure divers • Commercial fishers • Coastal tourism operators • Boaters • General public

Key channels and messages

NRE Tas communicates key messages over several channels according to the specific marine heatwave's conditions and impacts.

Communication is tailored to Tasmania's diverse communities and businesses, including the Tasmanian Aboriginal community, culturally and linguistically diverse households, and people with disability.

Marine heatwave webpage

NRE Tas's dedicated Marine Heatwave webpage is a central hub to publish the latest information on marine heatwaves. NRE Tas updates the webpage with information as required during a heatwave. This includes:

- updates on marine heatwave status
- affected area maps
- risk levels
- reporting hotlines.

The webpage also includes marine heatwave factsheets, Frequently Asked Questions and how to identify and prepare for a marine heatwave.

Marine heatwave status updates

When a marine heatwave is forecast or underway, NRE Tas will send regular emails to primary stakeholders with status updates about a marine heatwave's severity, location and duration. It will also post the updates on the marine heatwave webpage.

Marine heatwave forecast briefings

NRE Tas will plan and deliver forecast briefings with industry sectors when a marine heatwave is detected. Specific information and audiences will be determined on a case-by-case basis, depending on the location and severity of the marine heatwave.

Channels

NRE Tas has several channels to maximise the reach of its messages about marine heatwaves. The main channels used to share general information with stakeholders are listed in Table 4. Additional channels may be identified and included during communications planning.

Table 4: Key communication channels and products

Stakeholder	Communication channel	Product/s
All	• Fishing Tasmania website • NRE Tas website (homepage, aquaculture, biosecurity and Marine Conservation Program pages) • Links to the Fishing Tasmania website from the NRE Tas website • Facebook (Fisheries Tasmania, Biosecurity Tasmania, NRE Tas) • Instagram (Fisheries Tasmania)	Marine heatwaves webpage
Primary stakeholders	Email	Marine heatwave status updates
Community stakeholders	Service Tasmania including the call centre and in shops	Marine heatwaves webpage
	In-person engagement via Fishcare Tasmania	Marine heatwave factsheet

Stakeholder	Communication channel	Product/s
Community (recreational fishers)	Email	• Recreational Fishing Newsletter • Marine heatwaves webpage
Community (Tasmanian Aboriginal)	Email	• Marine heatwaves webpage • Marine heatwave factsheet • Marine heatwave forecast briefings • Marine heatwave status updates

Messages

NRE Tas will distribute information about marine heatwaves depending on its severity and potential impacts. A set of key messages offers a framework for NRE Tas's communications.

All stakeholders

The following messages will be used in communications to all stakeholders:

- A marine heatwave has been forecast/ is underway.
- Find the current status of the marine heatwave in different locations around the Tasmanian coast on NRE Tas's marine heatwaves webpage.
- Find general information about marine heatwaves:
    - View up-to-date global and local SSTs and anomalies on the Bureau of Meteorology website.
    - Learn more about marine heatwaves from the Bureau of Meteorology, the CSIRO and the Fisheries Research and Development Corporation including their Fisheries Climate Briefings.
    - View a map of global SST anomalies at State of the Ocean by Worldview and with the Marine Heatwave Tracker or the CSIRO/BOM Ocean Currents for Australian waters.
- Read about Tasmania's response to marine heatwaves with the Tasmanian Marine Heatwave and Related Event Response Plan. Find it on NRE Tas's marine heatwaves webpage.
- Marine heatwaves can have significant impacts on plants, animals and the marine environment. This can affect the people, communities and industries that rely on them:
    - Fisheries and aquaculture are key industries for Tasmania. Marine heatwaves may impact marine species for these industries, which could disrupt businesses and income.

- Recreational fishing plays a prominent role in Tasmania's lifestyle and economy. But marine heatwaves can cause disruptions if large numbers of marine animals die or become sick. It is possible that marine heatwaves may create new sea fishing opportunities, for example, if warmer waters mean species increase in numbers or move out of their natural ranges into Tasmanian fishing zones.
- As a member of the community, you may see unusual things in the marine environment because of the marine heatwave, such as habitat loss, fish kills and algal blooms.

- If you see the signs of a possible marine heatwave, take action to report it as soon as possible. Find hotlines to report signs on the marine heatwaves webpage or the reporting hotlines section of the Tasmanian Marine Heatwave and Related Event Response Plan. Remember to take photos and include as much detail as possible when reporting.
- NRE Tas has prepared for a forecasted marine heatwave. The Tasmanian Marine Heatwave and Related Event Response Plan identifies:
  - risks to Tasmanian aquaculture, wild fisheries, marine mammals and seabirds, and threatened marine species
  - existing capabilities in industry and government to respond to potential impacts
  - channels to increase public awareness of what a marine heatwave is, what community might see and how to report concerns.

  This Plan (the Tasmanian Marine Heatwave and Related Event Response Plan) was developed with the input of research organisations, industries, Tasmanian Aboriginal community and other Tasmanian Government agencies. Find it on NRE Tas's marine heatwaves webpage.

Community stakeholders

NRE Tas will communicate the following messages to community stakeholders during a marine heatwave:

- Be cautious when eating or using wild caught seafood.
  Harmful algal blooms and diseases are more common during marine heatwaves, including paralytic shellfish toxins (the most common form of shellfish poisoning in Tasmania).
  Harmful algal blooms and diseases can increase your risk of getting sick from eating wild-caught. Visit the Department of Health's website for advice and current public health alerts. Commercially harvested seafood supplied to shops and restaurants is managed under strict controls to minimise consumer risk. The Tasmanian Shellfish Market Access Program (ShellMAP) monitors biotoxin risk in commercial species to ensure areas identified in the biotoxin warning are either closed or restricted accordingly.

- Be vigilant about biosecurity.
  Diseases and bacteria, like Abalone Viral Ganglioneuritis and vibrio, are a higher risk during marine heatwaves. To help prevent the spread of disease:

- wash down boats, fishing and dive gear when moving between areas
- if you catch your own bait, source it from the same area where you fish.

- Report signs of marine heatwaves.

  You can help NRE Tas respond to and reduce the impact of marine heatwaves on the environment, industry and the community. During a marine heatwave, you may see:

  - fish and shellfish (including abalone, rock lobster and scallops) becoming sick or dying (e.g., sluggish or wasting animals, unusual piles of shells, discoloured or poor meat)
  - changes to seagrass beds, kelp forests and other marine habitats
  - unusually large numbers of fish dying (and more rarely, birds, seals, dolphins, or whales)
  - tropical or warmer water fish in Tasmanian waters.

  If you see signs of a possible marine heatwave, please report them. Your observations are crucial for helping us respond to and reduce the impact of marine heatwaves on the environment, industry and wider community.

  Find hotlines to report signs on the marine heatwaves webpage or the reporting hotlines section of this Plan.

Specialised industry messages

Tasmania has a diverse marine industry that requires specific communications messages. NRE Tas will identify needs and develop specialised industry messages on a case-by-case basis during a marine heatwave or event.

6. Evaluation and Preparedness

Learning from experience helps to improve Tasmania's marine heatwave and related event preparedness. This chapter outlines evaluation activities, current capacity gaps and plans for the future.

Evaluation activities

A key element of any marine heatwave or related event response is learning from experience. The Plan places significant emphasis on reviewing the actions taken and assessing their effectiveness, benefits and costs.

After a marine heatwave or related event, NRE Tas will evaluate the response and identify capacity gaps, including:

- which actions were effective
- which activities should continue
- what needs to be modified in future versions of the Plan.

Preparing for the future

Marine heatwaves and related events are expected to become a regular occurrence by 2040. Preparing for and responding to these involves a range of social, economic, cultural, ecological and policy factors. Significant investment is needed to:

- monitor marine heatwaves and events and their impacts
- provide flexible responses
- support adaptation
- support recovery.

NRE Tas intends to develop a critical event preparedness, communication and coordination management framework to detail the processes, structures and responsibilities required to respond to marine heatwave or event emergencies. However, intervention and action in response to a marine heatwave or event to mitigate the impacts to marine threatened species has the potential to be both costly, and risky for a species. Any potential intervention resulting from the impacts of a marine heatwave or related event will have to be considered through prioritisation and risk principles.

Preparing for disease, biotoxins and microbiological events

Monitoring for biotoxins is currently focused on commercially caught marine species or shellfish and salmonid aquaculture. This leaves gaps in existing biotoxin monitoring programs, which increases the risk of public health incidents for:

- seafood taken for subsistence purposes in remote areas.
- species that are not subject to commercial fishing or testing.

The Plan recommends the following improvements to biotoxin monitoring, to reduce these risks for seafood sectors, recreational fishers and the Tasmanian Aboriginal community:

- increase phytoplankton monitoring during bloom events to better understand biotoxin risks and behaviours.
- increase vibrio monitoring to:
    - better understand the environmental variables contributing to the growth of pathogenic vibrios.
    - create accurate vibrios risk profiles in shellfish growing areas.

Industry and community preparedness

Building industry and community preparedness requires responses from a range of stakeholders, each with different expertise, motivations and approaches.

A well-informed industry and community will be more proactive and effective in their response activities. Therefore, industry and community education are essential for marine heatwave or related event preparedness.

Aquaculture

Tasmania's aquaculture industry is leading a range of activities to detect and respond to marine heatwaves or related events. These activities are effective, but improvements can be made to support the industry and protect it from significant disruption from marine heatwaves or related events.

This Plan recommends the following actions, which include activities for before, during and after a marine heatwave or related events:

- improve preparedness for the aquaculture industry, including research and development, modelling and monitoring, disease diagnosis, wellness organisations and communication. This includes actions to:
    - assess farmed species' vulnerability to increases in water temperature and the associated ecosystem changes.
    - identify mitigation measures to assist in climate change adaptation.
    - identify new, more heat-tolerant, species for future aquaculture farming to limit disruption caused by marine heatwaves.
    - monitor international jurisdiction's approaches to marine heatwaves and associated impacts.
- improve monitoring to better understand marine heatwave or related event impacts, for example:
    - broaden the aquaculture industry's existing temperate reef and seagrass meadow monitoring programs.
    - use data from the Broadscale Environmental Monitoring Program to set a baseline to identify localised change in salmon farming regions.
- explore post-marine heatwave incident or related event industry support if restocking, reestablishment or farm decommissioning is required.
- consider policy, management and assessment methods to evaluate long-term changes and extreme marine heatwave impacts.

Wild fisheries

Wild fisheries management must be as flexible as possible to quickly respond to marine heatwaves or related events as new information arises. For example, fisheries closures may need to be based on water bodies (large areas of water of a specific temperature) rather than fixed geographic locations. Fisheries' management instruments may need to be adapted as part of this work.

Australia's National Fisheries Plan 2022–2030 includes a set of initiatives to adapt to a changing environment, including initiative 6.2 Developing and implementing adaptive management frameworks that can respond to changing environmental conditions.

This Plan makes the following recommendations to support Tasmania's wild fisheries industry to prepare for and respond to future marine heatwaves or related events:

- identify species' and fisheries' vulnerability to increases in water temperature and the associated ecosystem changes (acknowledging that some species are already depleted or depleting).
- introduce climate and ecosystem status report cards for sensitive species and fisheries, similar to those produced by CSIRO for the Bass Strait Central Zone Scallop Fishery and the Southern Squid Jig Fishery.
- invest in research on fish behaviour and distributions, including the effect of marine heatwaves on fish abundance, growth and reproduction.
- design agile management responses for fisheries in areas of rapid climate change.
- assess the potential need for fisheries to target new species and/or reduce their catch due to disruption in species abundance or behaviour in fishing zones.
- consider strategies to encourage consumers to change the seafood species they purchase, where required.
- improve coordination to manage ecosystems that spread across state and Commonwealth waters.
- coordinate between fisheries management, research scientists, the Tasmanian Aboriginal community, the general community and conservation groups to support improved monitoring, management, and resilience.
- consider policy, management and assessment methods for long-term changes and extreme marine heatwave events.

If large environmental changes occur because of marine heatwaves, decision makers will need to either:

- explicitly prioritise resources and awareness around vulnerable/sensitive species and fisheries.
- assess if this will affect sustainable fishery targets to the extent that they are no longer achievable through reasonable management actions (i.e., if the marine heatwave has "shifted" baseline population sizes so they are no longer valid measurements).

Marine mammals, seabirds and threatened species

As marine heatwaves become more common in Tasmania, it is vital to support conservation efforts for our threatened species and marine mammals and seabirds.

This Plan recommends the following actions to be incorporated in the drafting of future conservation plans and recovery strategies:

- establish long-term monitoring regimes for key species to identify short and long-term impacts of marine heatwaves on marine populations.
- investigate options to reduce the impacts of marine heatwave on marine populations.

Tasmanian Aboriginal Community

Strategic Priority 3 of the NRE Tas Strategic Plan 2022–2027 puts Tasmanian Aboriginal people at the heart of managing land and sea Country.

NRE Tas has committed to becoming more culturally inclusive and respectful in our working relationships with Tasmanian Aboriginal people. This Plan sets out the following actions for NRE Tas and builds on other work already underway:

- develop work practices for land, sea and water management that are informed through connection and inclusivity. NRE Tas will integrate learnings into its culture, behaviours and services.
- establish partnerships with government and research institutes to build Tasmanian Aboriginal community's capacity to care for and manage sea Country.
- increase opportunities for Aboriginal-led management projects and programs to develop resilience to future marine heatwaves. It also presents opportunities to integrate Aboriginal knowledge into marine heatwave monitoring and response strategies.
- help to establish sea Country restoration and cultural resource conservation projects to restore habitat affected by marine heatwaves (e.g., seagrass beds and kelp forests). This includes supporting Tasmanian Aboriginal community led baseline surveys and monitoring programs.

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Appendices

Appendix 1 – Risk assessment of potential impacts on Tasmanian marine species

NRE Tas has completed a preliminary assessment of the potential impacts of marine heatwaves, including acute/emergency impacts and long-term impacts. It highlights sensitivities and risk levels for aquaculture, wild fisheries, marine mammals and threatened species[1].

Climate sensitivity assessments for most of the fisheries and aquaculture species listed have been sourced from the *Rapid assessment of fisheries species sensitivity to climate change* project (Pecl et al., 2014). Further work to fully identify and assess risk is required.

Table 5: Climate sensitivity assessments for fisheries and aquaculture species in Tasmania.

Species	Sensitivity level	Acute/emergency impacts	Long-term impacts	Impacted stakeholders
Abalone (black lip and greenlip)	High	**Population-level impact** (moderate risk): • Growth and reproductive biology **Disease, biotoxin and microbiological event** (high risk): • AVG	**Population-level impact:** • Recruitment failure, where sub-lethal physiological effects of warm water reduce abalone spawning and recruitment Sub-lethal effects are not immediately noticeable in abalone as they remain cryptic	NRE Tas Commercial fishing industry Tasmanian Aboriginal community Aquaculture industry Recreational fishers

[1] The list of threatened marine species in Tasmania is subject to change, therefore this list and potential short- and long-term impacts may not be comprehensive at the time of future marine heatwaves.

Species	Sensitivity level	Acute/emergency impacts	Long-term impacts	Impacted stakeholders
		Public health incident (moderate risk): • PST • Vibrios (pre and post-harvest) **Industry impact** (low to moderate risk): • Loss of income due to area of fishery closure or unsaleable fish, mass mortality, and being unable to get live fish to market **Community impact** (low to moderate risk): • Subsistence harvesting **Cultural impact** (high risk): • Important social, cultural, spiritual and economic resource	(hard to find) for five to six years until reaching maturity. This requires precautionary management if recruitment gaps are forecast following a marine heatwave **Industry impacts:** • Stock targets, where less recruitment leads to stock-rebuilding target adjustments (i.e., slowing down the rate of rebuilding stocks after a marine heatwave) • Loss of market share, where failure to supply market demand during marine heatwaves results in consumers shifting to alternative products	IMAS General public
Rock lobster	High	**Population-level impact** (risk unknown): • Long-term declines in recruitment • Declines in biomass	Please note, the following is from a report to the Australian Department of Climate Change in 2009 **Population-level impacts:** • Recruitment failure, with the potential for long term declines	NRE Tas EPA Commercial fishing industry

Species	Sensitivity level	Acute/emergency impacts	Long-term impacts	Impacted stakeholders
		Public health incident (low risk): • PST • Vibrios (post-harvest) **Ecosystem impact** (high risk): • Low dissolved oxygen (in well boats, particularly when anchored for long periods at night in areas of low water movement) Rock lobsters are more active at night so use more dissolved oxygen. Large drops in dissolved oxygen causes damage to gills and weakens the rock lobster. It can also cause post-harvest mortality. Rock lobsters don't live transport well, despite seeming healthy **Population-level impact** (moderate risk): • Unusual mortality event (of rock lobsters stored on fishing vessels or in cauf storage, or due to low dissolved oxygen in	in recruitment of lobsters. Under both the mid-range and high climate change scenarios shown in the 2009 report on the vulnerability of the east coast rock lobster fishery to climate change (Pecl et al., 2009), northeastern and eastern regions of Tasmania are expected to experience declines in larval settlement Potential for declines in rock lobster biomass, are predicted to occur initially in the northern and north–eastern regions, according to (Pecl et al., 2009), before eventually also declining in the south The impacts are likely to vary between regions, as opposed to statewide, noting the southwestern region is predicted to increase or maintain catches longer than other regions (Pecl et al., 2009)	Tasmanian Aboriginal community Recreational fishers IMAS General public

Species	Sensitivity level	Acute/emergency impacts	Long-term impacts	Impacted stakeholders
		live fish wells or tanks on a fishing vessel) **Industry impact** (low to moderate risk): • Loss of income due to area of fishery closure or unsaleable fish, mass mortality, and being unable to get live fish to market **Community impact (low to moderate risk):** • Subsistence harvesting **Cultural impact** (low to moderate risk): • Important social, cultural, spiritual and economic resource		
Shellfish (e.g., scallops, *angasi* and Pacific oysters, periwinkles, maireener shells, clams and cockles,	High	**Public health incident** (high risk): • PST (human health) • Vibrios (post-harvest) **Population-level impact** (moderate to high risk): • Unusual mortality event	**Population-level impacts:** • Warming water can trigger spawning in scallops, which may result in significant mortality events. This could potentially exacerbate natural boom and bust cycles	NRE Tas EPA Commercial fishing industry Aquaculture industry

Species	Sensitivity level	Acute/emergency impacts	Long-term impacts	Impacted stakeholders
and other culturally significant shellfish)		• Population declines • POMS (in oysters – noting *angasi* appear to be resistant to POMS) **Industry impact** (low to moderate risk) • Loss of income due to area of fishery closure or unsaleable fish, mass mortality, and being unable to get live fish to market • Waste disposal after mass mortality (farmed shellfish) **Non-commercial impact** (low to moderate risk): • Subsistence harvesting **Cultural impact** (high risk): • Important social, cultural, spiritual and economic resource including culturally significant shellfish such as maireener shells		Tasmanian Aboriginal community Recreational fishers IMAS General public
Fish	High	**Population-level impact** (low to moderate risk):	Unknown (further research is needed)	NRE Tas

Species	Sensitivity level	Acute/emergency impacts	Long-term impacts	Impacted stakeholders
	(King George whiting and black bream) Medium (flathead, garfish, snapper, yellowtail kingfish, Australian salmon, Australian sardine, blue warehou, silver warehou, banded morwong, jackass morwong, wrasse, small pelagics and baitfish)	• Population declines • Starving animals (due to shift of prey species) **Biotoxin event** (low risk): • HABs resulting in low dissolved oxygen **Non-commercial impact** (low to moderate risk): • Subsistence harvest (particularly for highly sensitive species) **Cultural impact** (low to moderate): • Important social, cultural, spiritual and economic resource • Rotting fish after unusual mortality event (farmed salmon) **Industry impact** (low to moderate risk): • Loss of income due to area of fishery closure or unsaleable fish, mass mortality, and being unable to get live fish to market		EPA Commercial fishing industry Aquaculture industry Recreational fishers Tasmanian Aboriginal community IMAS General public

Species	Sensitivity level	Acute/emergency impacts	Long-term impacts	Impacted stakeholders
		• Waste disposal after mortality event (farmed salmon) • Market supply due to unusual mortality event (farmed salmon) **Species-specific impact** (risk unknown): • Heat-stress during salmon production can result in increased food conversion ratios, reduced growth, fish anorexia, fillet colour loss, increased stress indicators and susceptibility to disease and mortality • Marine heatwaves can increase the likelihood of jellyfish and biofouling hydroid		
Cephalopods (squids, e.g., calamari), octopus, cuttlefish	Moderate to high	**Population-level impact** (moderate risk): • Population declines or explosions (squids) • Shifts in timing of spawning • Species migration to cooler waters (calamari)	**Population-level impacts:** • Growth and reproductive biology, where warmer waters will lead to faster egg development and earlier hatching at a smaller size Subsequent juvenile to adult	Commercial fishing industry Aquaculture industry Recreational fishers Tasmanian Aboriginal community IMAS

Species	Sensitivity level	Acute/emergency impacts	Long-term impacts	Impacted stakeholders
		Non-commercial impact (low to moderate risk): • Subsistence harvest (particularly in moderately sensitive species) **Cultural impact** (low to moderate): • Important social, cultural, spiritual and economic resource	growth may also be faster (subject to adequate food availability) with a smaller adult size reached Cephalopod species generally have a short lifecycle (12 to 18 months) and stocks can be impacted in both positive and negative ways subject to their respective reproductive biology	General public
Native seaweeds and kelp (farmed and wild)	High	**Ecosystem impact** (high risk): • Habitat damage (including *Asparagopsis*) • Species sensitive to temperature, light and nutrient levels • Changes to ecosystem range **Population-level impact** (high risk): • Population declines **Industry** (moderate to high risk): • Loss of income due to area closures and abundance decline (wild harvest)	**Ecosystem impacts:** • Abundance decline and range retraction (e.g., in *Lessonia corrugate*) resulting in changes in species composition across the broader ecosystem (i.e., some species will become more dominant/common, while other species will decline/disappear) **Cultural impact:** • High-risk of loss of social values, culture spiritual and economic resource, including native food sources	Tasmanian Aboriginal community Wild harvest industry Aquaculture industry Dive tourism operators General public Conservation organisations

Species	Sensitivity level	Acute/emergency impacts	Long-term impacts	Impacted stakeholders
		• Loss of income due to pre-harvest die off (farmed) • Heat stress related impacts on production (e.g., vibrios) **Cultural impact** (high risk): • Important social, cultural, spiritual and economic resource	Tasmania has more than 750 species of seaweeds, but in most cases there is limited monitoring of their abundance or range changes	
Introduced seaweeds (farmed and wild *Undaria*, devil's tongue weed and *Grateloupia* ***spp***.)	Unknown	**Disease, biotoxin and microbiological event** (risk unknown): • Vibrios (post-harvest) • HABs (risk under evaluation by IMAS)	**Population-level impacts:** • Population explosions **Ecosystem impacts:** • Increased competition for resources (with native species). • Changes to ecosystem range due to water temperatures	NRE Tas Aquaculture industry Wild harvest industry Tasmanian Aboriginal community General public
Sea urchins – native (shortspined)	Unknown	**Population-level impact** (risk unknown): • Population declines • Starving animals (due to shift of prey species) • Population explosions (may become a biofouling species – noting *Undaria* is an annual	Unknown (further research is needed)	Commercial fishing industry Tasmanian Aboriginal community Recreational fishers IMAS General public

Species	Sensitivity level	Acute/emergency impacts	Long-term impacts	Impacted stakeholders
		species with low abundance during summer)		
Sea urchins – range-extended (longspined)	Low	**Population-level impact** (high risk): • Species migration to cooler waters **Cultural impact** (high risk): • Important social, cultural, spiritual and economic resources	**Population-level impacts:** • Increased productivity as the species displaces native shortspined sea urchins	Commercial fishing industry Tasmanian Aboriginal community Recreational fishers IMAS Dive tourism General public
Seabirds (e.g., shy albatross, short-tailed shearwater, little penguin etc) Species that breed in Tasmania or have key foraging areas	Unknown	**Population-level impact** (low risk): • Unusual mortality event (the capacity of carcasses from unusual mortality events is limited) • Sick, dying or dead animals (from HPAI) • Starving animals (due to shift of prey species) **Cultural – short-tailed shearwater** (moderate risk):	**Population-level impacts:** • Starving animals (due to shift of prey species) • Population declines • Localised extinctions	NRE Tas Tasmanian Aboriginal community Conservation organisations General public

Species	Sensitivity level	Acute/emergency impacts	Long-term impacts	Impacted stakeholders
in Tasmanian waters		• Important social, cultural, spiritual and economic resources • Commercial birding and associated continuity of cultural knowledge and practice of birding		
Marine mammals (e.g., seals) Species that breed in Tasmania or have key foraging areas in Tasmanian waters	Unknown	**Population-level impact** (low risk): • Unusual mortality event (the capacity of carcasses from unusual mortality events is limited) • Sick, dying or dead animals (which could be due to HABs) • Starving animals (due to shift of prey species)	**Population-level impacts:** • Starving animals (due to shift of prey species) • Population declines • Localised extinctions	NRE Tas Tasmanian Aboriginal community Australian Government – Department of Climate Change, Energy, the Environment and Water (DCCEEW) Conservation groups General public
Whales and dolphins (cetaceans)	Unknown	**Population-level impact** (low risk): • Unusual mortality event (the capacity of carcasses from unusual mortality events is limited)	**Population-level impacts:** • Starving animals (due to shift of prey species) • Population declines • Localised extinctions	NRE Tas Tasmanian Aboriginal community Australian Government – DCCEEW

Species	Sensitivity level	Acute/emergency impacts	Long-term impacts	Impacted stakeholders
		• Sick, dying or dead animals (which could be due to HABs) • Starving animals (due to shift of prey species)	• Species migration to cooler waters (changes in migration and foraging patterns)	Conservation groups General public
Maugean skate	High	**Ecosystem impact** (risk unknown): • Low dissolved oxygen **Population-level impact** (high risk): • Unusual mortality event • Sick, dying or dead animals Reduced Maugean skate catch rates may be observed in stock monitoring surveys	Unknown (further research is needed)	NRE Tas Australian Government – DCCEEW Aquaculture industry Commercial fishers Strahan community Conservation groups Tasmanian Aboriginal community
Handfish (red, spotted, Ziebells and pink)	High	**Population-level impact** (moderate risk): • Unusual mortality event • Sick, dying or dead animals • HABs • Localised extinction **Ecosystem impacts** (risk unknown): • Habitat damage	Unknown (further research is needed)	NRE Tas Australian Government – DCCEEW Conservation groups IMAS CSIRO Tasmanian Aboriginal community

Species	Sensitivity level	Acute/emergency impacts	Long-term impacts	Impacted stakeholders
Tasmanian live-bearing seastar	Unknown	**Population-level impact** (moderate risk): • Unusual mortality event • Sick, dying or dead animals	Unknown (further research is needed)	NRE Tas Australian Government – DCCEEW Conservation groups Tasmanian Aboriginal community
Three-node seaweed	Unknown	**Population-level impact** (risk unknown): • Unusual mortality event • Early senescence **Ecosystem impacts** (risk unknown): • Changes to ecosystem range (absence of three-node seaweed in usual location)	**Population-level impact:** • Depending on the severity of a marine heatwave, increased temperatures may cause altered reproductive activity and may have implications for newly settled propagules • Other long-term impacts are unknown (further research is needed)	NRE Tas Conservation groups Tasmanian Aboriginal community

Appendix 2 – Fact Sheets

Fact Sheet 1: Abalone Viral Ganglioneuritis (AVG)

About AVG	AVG is a viral disease caused by an abalone herpesvirus (haliotid herpesvirus-1; HaHV-1). It affects the nervous system of abalone species (See Link). Blacklip abalone (*Haliotis rubra*), greenlip abalone (*Haliotis laevigata*), and hybrid crosses of these two species are particularly susceptible.
Signs and symptoms	In some affected abalone you might see: • poor suction, where abalone are easily removed from substrate, including rocks in the wild, or holding tanks on farms or in processing plants • an inability for the abalone to right itself when turned over • swollen and protruding mouth parts, or mouth coming out from under the foot • edges of the foot curling inwards, exposing clean shiny shells • excessive mucus on the abalone, or in the water surrounding the infected abalone. • blistering, hardening of foot or tetany Abalone with AVG usually show one or more of these symptoms, but the virus can be present without any visible signs. The most common sign that an abalone has AVG is that it is weak and is able to be easily detached from the reef, it is already detached or it is dead. The presence of many empty shells in the wild may be an indication of infection with AVG.
Human health risk	AVG does not present human health risks. However, because of the significant risk to abalone stocks, AVG could have major economic impacts on the farmed and wild-caught abalone industries and the communities that rely on them.

Reports	The first report of AVG in Australia was in 2005 in Victorian farmed abalone. AVG was also detected in wild abalone in Victoria in 2010, 2021 and most recently in August 2023. On 23 February 2024, AVG was detected in South Australian waters near Port Macdonnell. In response, the Department of Primary Industries and Regions declared a South Australian AVG control area and restrictions are currently in place. In Tasmania, AVG outbreaks were observed between 2008 and 2011, primarily in abalone processing facilities. One outbreak was observed on a farm in 2011, with no further AVG events since 2011. There have been no recorded AVG outbreaks in Tasmanian wild populations, but abalone herpesvirus has been detected in wild abalone. Management strategies are currently in place to reduce the risk of an AVG event.
Marine heatwave risk	Several variants of abalone herpesvirus are known to be present but inactive in wild stocks of abalone. They may become active when abalone are stressed, such as during a marine heatwave. The risk of an AVG outbreak in wild stocks increases when a marine heatwave is forecast, particularly in Tasmania's south-eastern abalone stocks that are used to cooler water temperatures.

Fact Sheet 2: Harmful algal blooms (HABs)

About HABs	HABs are formed when colonies of algae or other tiny marine organisms grow and reproduce rapidly. Many species are heterotrophic (cannot synthesise their own energy) and are limited by the availability of food in the surrounding environment. Range expansion has been influenced by a climate change driven increase in the availability of food and the southern penetration of the East Australian Current. Negative impacts may occur as harmful toxins (e.g., ammonia) are generated by a bloom as it grows, or as dissolved oxygen in the water is consumed when a bloom collapses and is consumed by bacteria (hypoxia). HABs disrupt food webs when marine animals consume the toxins, before being eaten by larger marine creatures. Oysters, mussels, clams, pipis, cockles, wedge shells, abalone, urchins, scallop roes and the intestines and livers of rock lobster can be affected by toxins. HABs can also cause fish kills via toxins or damage to gills. These blooms can persist for weeks and animals may take even longer to depurate or clear the toxins from their flesh.
Signs and symptoms	Many algal blooms that are visible to the human eye are not harmful. For example, blooms of red or pink *Noctiluca spp.* can be highly visible but not harmful to humans and only slightly toxic to fish. In finfish aquaculture, HABs have been associated with: • reduced fish appetite • low dissolved oxygen in water affecting breathing capacity • damage to the protective mucus of the skin and gills • increased mortality. • being a co-contributing factor in disease onset HABs can have lethal and sub-lethal effects on farmed fish populations, as they are unable to escape the blooms.

Human health risk	If harvested and consumed, toxin-affected shellfish can cause serious illness in humans. Symptoms of poisoning occur minutes to hours after eating shellfish. There are four types of shellfish toxins that can cause human poisoning: • paralytic • amnesic • neurotoxic • diarrhetic Paralytic shellfish poisoning is the most common form of shellfish poisoning in Tasmania (Department of Health, 2024). Tasmanian seafood species affected by paralytic shellfish toxins (PST) are varied and currently generate significant revenue for the state. Amnesic and diarrhetic shellfish toxins are generally less prevalent in Tasmania, as levels rarely exceed regulatory limits. But it is unknown how they may behave under marine heatwave conditions. Neurotoxic shellfish toxins are not currently tested for and present an unknown risk under changed climatic conditions. Large algal blooms can also cause skin irritation, so are best avoided for recreational swimming. For further information, visit Derwent Estuary Program - Red Tide Algal Blooms.
Reports	Recurrent HABs in Tasmanian waters (*Gymnodinium spp*. in the South and *Alexandrium spp*. on the East Coast) have impacted oyster, mussel, abalone, urchins, periwinkles, and rock lobster industries. This has required biotoxin monitoring programs and harvest closures during high-risk periods. HABs resulting from warm sea surface temperatures have also caused significant impacts in other parts of the world including mass marine mammal and seabird death. The likelihood of a similar unusual mortality event from HABs occurring in Tasmanian waters is low but cannot be discounted. Increasing phytoplankton monitoring can help to identify the risks associated with biotoxins. Of particular note is the recent occurrence of an extensive and persistent algal bloom in South Australian coastal waters. The bloom of *Karenia Mikimotoi* occured following a marine heatwave that started in September 2024 with sea

	temperatures approximately 2.5ºC warmer than usual, combined with other environmental factors. This resulted widespread lethal and sublethal impacts to marine wildlife, including fish, sharks, rays, and a wide range of invertebrates.
Marine heatwave risk	Predicting the occurrence of HABs is difficult as they respond to, and are triggered by, a complex mix of environmental factors, including temperature. But as water temperatures rise, more areas become habitable for certain HAB-causing species. Many HAB-causing species already exist in Tasmanian waters, including those of highest risk to the marine food web.

Fact Sheet 3: Pacific Oyster Mortality Syndrome (POMS)

About POMS	POMS is a disease event that affects Pacific oysters (*Crassostrea gigas*). It is caused by a pathogen called *ostreid herpesvirus-1*(OsHV-1).
Signs and symptoms	POMS can cause rapid death in infected Pacific oysters. It has a long latency period (the time that passes between being exposed to a virus and having symptoms) so Pacific oysters can be infected for some time without showing symptoms. Any surviving oysters can become long-term carriers, allowing the virus to persist among feral oyster populations.
Human health risk	POMS does not present human health risks. However, POMS has major economic impacts on oyster farmers and communities that rely on oyster farming.

Reports	POMS was first detected in Tasmania when it caused a large number of oyster deaths at a lease in late January 2016. Biosecurity Tasmania led a structured surveillance in 2016–18 and determined three POMS classification statuses, “POMS free”, “POMS intermediate” and “POMS infected” (see Table 2). If OsHV-1 is detected when an oyster is submitted for pathogen screening, Biosecurity Tasmania may change the area’s classification. In February 2024 a previously POMS free area, St Helens (Moulting and Georges Bays) was found to be infected. The cause for the spread has not been determined. Efforts to remove oysters and feral oyster populations that may contain the virus have proven largely unsuccessful. This is likely because there are a large number of feral oysters around the Tasmanian coastline and the virus can be present in oysters that appear. In general, POMS does not appear to be spreading in Tasmanian waters. However, there has not been any structured surveillance since 2019. There has also been a limited number of submissions made to the animal health laboratory during this time. Restrictions on stock movement from POMS infected and POMS intermediate areas may have contributed to this apparent lack of spread.
Marine heatwave risk	POMS is more active in warmer waters. Its presence in Tasmania has been directly linked to the marine heatwave in the Tasman Sea in the summer of 2015–16. Typically, POMS is investigated when the water temperature reaches 16–18ºC.

Fact Sheet 4: Vibrio

About vibrio	Vibrios are a naturally occurring bacteria commonly found in marine environments and thrive in warm sea-surface temperatures. Vibrios are also present in marine animals that feed by filtration, such as shellfish.
Signs and symptoms	There are no visible symptoms of vibrios in fish and shellfish. For example, an oyster that contains vibrios doesn't look, smell or taste different from any other oyster. Certain types of vibrios can cause disease and mortality events in finfish and shellfish.
Human health risk	The vibrio species *Vibrio parahaemolyticus* and *Vibrio vulnificus* are known to cause human illnesses in Australia, although not all strains of these species are pathogenic. *Vibrio parahaemolyticus* and *Vibrio vulnificus* are leading causes of gastroenteritis, which most commonly occurs when fresh or frozen seafood products are consumed either raw or lightly cooked. Vibrios in marine waters may also lead to wound infections and sepsis in humans.
Reports	Vibrio bacteria are not specific to the Tasmanian marine environment, or to shellfish. Internationally, many seafood products have been found to contain vibrio, including shellfish, crustaceans, fish and seaweed products. This highlights the importance of preventative measures for consumer protection across a range of seafood products. There are several *Vibrio spp.* found in Tasmanian and Australian waters*:* • *Vibrio parahaemolyticus* has been associated with farmed and wild harvest oysters in Tasmania and other areas of Australia • *Vibrio anguillarum*, *Vibrio scopthalmi* and *Vibrio tapetis* has been found in Atlantic salmon*. Vibrio tapetis* and *Vibrio penaeicida* has been found in southern rock lobster (*Jasus edwardsii*; Carson et al., 2005) • *Vibrio harveyi* was isolated from a thermally stressed abalone in a fish kill event that occurred during a marine heatwave in South Australia (Roberts et al., 2019).

	Two previous studies of vibrio have been carried out in Tasmania to monitor: • an outbreak in shellfish from Moulting Bay in 2016 (Fisheries Research and Development Corporation [FRDC] project 2015-042) • environmental drivers of vibrio risk over two winters and three summers (FRDC project 2018-031). The second study highlighted the importance of water temperature on pathogenic strains of *Vibrio parahaemolyticus* and *Vibrio vulnificus.* Monitoring occurred during La Niña events. The most reliable control measure for *Vibrio parahaemolyticus* in shellfish is to rapidly enter products into the cold chain to prevent bacterial growth.
Marine heatwave risk	Vibrio bacteria concentrate in marine sediments and seawaters, particularly when water is warmer than 14ºC. This means warmer waters during marine heatwaves can increase the likelihood of vibrio proliferation and contamination.

Fact Sheet 5: *Piscirickettsia salmonis*

About *P. Salmonis*	*Piscirickettsia salmonis* (*P. salmonis*) is a bacterial pathogen that causes disease and death among salmonid fish. *P. salmonis* has demonstrated poor survival in freshwater and is mainly thought to cause disease outbreaks in marine environments. *P. salmonis* is present in many marine waters around the globe. In 2024, *P. salmonis* was identified in Tasmania, with additional investigations determining the bacteria had been present in the east and southeast coast of Tasmania since 2021 and 2023, respectively.
Signs and symptoms	*P. salmonis* causes a range of symptoms in salmonid fish. Affected salmonid may die quickly without exhibiting external symptoms of disease. A symptom of a *P. salmonis* outbreak can include a large sudden mortality event among farmed salmonids. In affected salmonids you may see; Skin that is darker in colour, fish with reduced appetite and that are swimming near the water's surface. External symptoms may include pale gills, bruised fins, and skin lesions. Internal symptoms vary greatly and include a pale and discoloured liver, internal haemorrhages on the heart, swim bladder, and skeletal muscles, and occasional swelling of the kidneys and/or spleen.
Human health risk	There are no known direct human health risks of *P. salmonis*. *P. salmonis* is a fish pathogen and does not cause disease in people, nor does the pathogen cause a direct food safety risk.

Reports	*P. salmonis* is considered endemic, or present and not eradicable, in Tasmanian marine waters. A vaccine has been developed for *P. salmonis* and currently farmed juvenile salmonids are administered this vaccine. However, no vaccine is completely protective, and it is unknown how long vaccinated fish will remain protected from disease or if some vaccinated fish remain unprotected. Strict biosecurity standards are in place to prevent the movement of salmonids from marine to freshwater environments. Enforceable biosecurity standards exist to control the movements of fish and fish farming equipment between marine farms and marine biosecurity zones around the state of Tasmania. These standards exist to mitigate the spread of aquatic disease pathogens and pests relevant to salmonid production, which includes *P. salmonis*.
Marine heatwave risk	*P. salmonis* rarely survives in water temperatures exceeding 25°C, however outbreaks among farmed salmonid are commonly seen when water temperatures are between 12°C and 18°C. The impact of a MHW on the occurrence of *P. salmonis* infections or outbreaks is not known. It is possible that a MHW may induce physiological stress within salmonids and make them more susceptible to severe *P. salmonis* infections, resulting in large mortality events among farmed salmon. It may also be possible that during a MHW, throughout waters exceeding 20°C, *P. salmonis* might not survive, and therefore not contribute to a significant proportion of salmonid diseases or deaths. The disease impact of *P. salmonis* on non-salmonids species, including native Tasmanian marine species, is unknown.

Appendix 3 – Emergency response context statements

The following information was sourced from the table in Appendix 7 of the TEMA. It describes how the TEMA defines emergency events and the roles of management authorities, advisory agencies and support agencies.

The TEMA does not specifically consider marine heatwaves. NRE Tas used this information to create the Plan's emergency response approaches.

Table 6: Emergency response context statements for marine heatwaves and other events in Tasmania.

Emergency event	Context statement
Animal, plant, and invasive pest incident	Biosecurity incidents include outbreaks of pest or disease in animals or plants. Uncontrolled incidents can have a highly detrimental effect on the Tasmanian economy, environment, and image. Emergency responses aim to: • prevent the spread of the pest or disease • identify areas of infection • eradicate the pest or disease • control, eradicate and prove freedom from the pest or disease • provide advice and information to communities and industries • support recovery from pest or disease outbreaks. Biosecurity Tasmania, a division of the Department of Natural Resources and Environment Tasmania (NRE Tas), is the management authority for biosecurity incidents. During an emergency response, Biosecurity Tasmania works closely with primary industry producers and industry groups. It is also likely to receive specialist advice and assistance from the Australian Government Department of Agriculture, Fisheries and Forestry, and other states and territories.

Emergency event	Context statement
Food contamination	Foodborne illness results from eating food or drinking water contaminated with disease-causing microorganisms (such as salmonella), harmful chemicals or toxins. These illnesses affect more than 4 million Australians each year. They can be the cause of, or consequence of, an emergency. The Department of Health and NRE Tas are the management authorities for food safety incidents. The Department of Health regulates and monitors food contaminants.
Marine mammal incident	Tasmania is the only Australian state where mass strandings of whales and dolphins regularly occur. NRE Tas's Marine Conservation Program is the management authority for marine mammal incidents.
Public or environmental health incident	A public health incident is defined as an occurrence or imminent threat to human health that poses a substantial risk of a significant number of fatalities, illnesses, or health conditions. Both public or environmental health incidents can be caused by bioterrorism, disease-causing pathogens, chemical or biological toxins, radiological hazard, or a natural hazard. The Department of Health is the advisory agency and response management authority for public or environmental health incidents. See the *Tasmanian Public Health Emergencies Management Plan* for further details.

Source: Tasmanian Government, Tasmanian Emergency Management Arrangements

Appendix 4 – potential impact, responses, response leader and impacted stakeholders during a marine heatwave or related event.

Table 7: Aquaculture impact and response table

Species	Impact	Response	Response leader	Impacted stakeholders
Abalone	**Disease, biotoxin and microbiological event** (high risk): • AVG • Vibrios (pre-harvest) **Public health incident** (moderate risk): • PST • Vibrios (post-harvest)	• Collect samples for animal health lab testing for AVG, vibrio and other relevant pathogens • Chief Veterinary Officer may decide to notify Chief Veterinary Officers in other jurisdictions and how to respond, if at all • Plan industry mass mortality contingency • Support culling of necessary stock and disinfection of affected premises • Support industry to establish insurance broodstock populations	NRE Tas – Marine Resources or Biosecurity Tasmania (if disease impact) or Department of Health (if public health impact) and EPA (mass mortality event waste disposal)	NRE Tas Abalone farms Tasmanian Aboriginal community General public
Pacific oysters	**Disease, biotoxin and microbiological event** (high risk): • POMS	• Submit moribund fish to animal health laboratory for POMS testing • Early mortality report to NRE Tas	NRE Tas – Marine Resources or	NRE Tas Oyster farms General public

Species	Impact	Response	Response leader	Impacted stakeholders
	Public health incident (high risk): • PST • Vibrios (pre and post-harvest)	• Plan industry mass mortality contingency • Industry support for selective breeding of POMS-resistant stock. • Compliance relief during and post marine heatwave (farm maintenance and tidiness may deteriorate as it is unsafe to handle stock in high temperatures) • Appropriate cold chain management of product from harvesting to consumer to stop/slow the growth of any microbiological pathogens after harvest	Biosecurity Tasmania (if disease impact) or Department of Health (if public health impact) and EPA (mass mortality event waste disposal)	
Other shellfish (cultured *angasi* and blue mussels)	**Disease, biotoxin and microbiological event** (high risk): • POMS (noting *angasi* oysters appear resistant to POMS) **Public health incident** (high risk): • PST	• Submit moribund fish • Early mortality report to NRE Tas • Plan industry mass mortality contingency • Compliance relief during and post marine heatwave (farm maintenance and tidiness may deteriorate as it is	NRE Tas – Marine Resources or Biosecurity Tasmania (if disease impact) or	NRE Tas Shellfish farms Tasmanian Aboriginal community General public

Species	Impact	Response	Response leader	Impacted stakeholders
	• Vibrios (pre and post-harvest)	unsafe to handle stock in high temperatures) • Appropriate cold chain management of product from harvesting to consumer to stop/slow the growth of any microbiological pathogens after harvest	Department of Health (if public health impact) and EPA (mass mortality event waste disposal)	
Salmon	**Ecosystem impact** (risk unknown): • Low dissolved oxygen • **Increased ammonia** • **HABs** **Population-level impact** (risk unknown): • Increased stress • Growth and reproductive biology • Gastroenteritis or other digestive health issues • Increased food conversion ratios • Fish anorexia • Fillet colour loss • Susceptibility to disease	• Salmon will down-regulate their feeding during periods of heat stress to reduce metabolic oxygen demand • Industry to monitor oxygen levels. NRE Tas to provide support by promptly authorising oxygenation barges (which may require noise assessment by the EPA and variation to Marine Farm Licence) • Early harvest large adult fish prior to summer (large and sexually mature fish have a lower maximum temperature threshold as compared to parr and smolt) • Industry investment in two (Saltas and Petuna) precision	NRE Tas – Marine Resources or Biosecurity Tasmania (if disease impact) or Department of Health (if public health impact) and EPA (mass mortality event waste disposal)	NRE Tas Salmon farm companies Tasmanian Aboriginal Community General public

Species	Impact	Response	Response leader	Impacted stakeholders
	Disease, biotoxin and microbiological event (risk unknown): • HABs Marine heatwaves can also increase the likelihood of jellyfish and biofouling hydroid.	selective breeding programs that include heat tolerance as a selected trait • Reduce number of fish in pen to improve survival • Send samples of moribund fish to animal health laboratories to exclude disease as causative agent • Ensure implementation of biosecurity measures to reduce pathogen transfer.		
Farmed seaweed *(Asparagopsis)*	**Ecosystem impact** (risk unknown): • Species sensitive to temperature, light and nutrient levels A stronger East Australian Current pushes warmer, low nutrient waters towards Tasmania's East Coast.	• Consider harvesting before marine heatwave and restocking after marine heatwave • Nutrient control where possible in land-based facilities • No cooling of water required for land-based *Asparagopsis* farming	NRE Tas – Marine Resources	NRE Tas – Wild Fisheries Management Seaweed farms Tasmanian Aboriginal Community General public
Farmed seaweed (*Undaria)*	**Population-level impact** (risk unknown):	• Reseed lines in autumn	NRE Tas – Marine Resources	NRE Tas – Wild Fisheries Management Seaweed farms

Species	Impact	Response	Response leader	Impacted stakeholders
	• Population declines (annual species in low abundance during summer)			Tasmanian Aboriginal Community General public

Table 8: Wild Fisheries impact and response table

Species	Impact	Response	Response leader	Impacted stakeholders
Abalone (Blacklip and Greenlip)	**Population-level impact** (moderate risk): • Growth and reproductive biology **Disease, biotoxin and microbiological event** (high risk): • AVG **Public health incident** (moderate risk): • PST • Vibrios (pre- and post-harvest) **Industry impact** (low to moderate risk):	• Tasmanian Aboriginal Community monitor for shellfish mortality events • Commercial or recreational fishers report observations of multiple sick or dead abalone in a specific area • Mandate washing of vessels, fishing gear and dive equipment after each fishing trip and before moving to another area to minimise risk of spreading disease • Biosecurity Tasmania may direct collection of samples of dead/sick fish for Animal Health Lab testing for AVG	NRE Tas – Marine Resources (Wild Fisheries Management) or Biosecurity Tasmania (if disease impact) or Department of Health (if public health impact) and EPA (if fish kill event)	NRE Tas - Aquaculture Fishing industry Tasmanian Aboriginal Community Recreational fishers General public

Species	Impact	Response	Response leader	Impacted stakeholders
	• Loss of income due to area of fishery closure or unsaleable fish, mass mortality, and being unable to get live fish to market **Community impact** (low to moderate risk): • Subsistence harvesting **Cultural impact** (high risk): • Important social, cultural spiritual and economic resource	• Chief Veterinary Officer may introduce a specific area closure for all activities if necessary to reduce spread of disease • Commercial divers in possession of sick or dead fish to notify Chief Veterinary Officer and fish will be seized (does not come off quota) • Chief Veterinary Officer to determine if Chief Veterinary Officers in other jurisdictions are to be notified and response • Commercial fishery on the east coast closed in early 2024 for spawning closure. This may extend if Chief Veterinary Officer requires it • PST risk is low during warmer water, although abalone are known to hold PST in the foot for long duration • Effective post-harvest (cold chain) handling limits Vibrio outbreak	With the support of the Tasmanian Aboriginal Community	

Species	Impact	Response	Response leader	Impacted stakeholders
Rock lobster	**Population-level impact** (risk unknown): • Long-term declines in recruitment • Declines in biomass **Public health incident** (low risk): • PST • Vibrios (post-harvest) **Ecosystem impact** (high risk): • Low dissolved oxygen (in well boats, particularly when anchored for long periods at night in areas of low water movement) Rock lobsters are more active at night so use more dissolved oxygen. Large drops in dissolved oxygen causes damage to gills and weakens the rock lobster. It can also cause post-harvest mortality. Rock lobsters don't live transport well, despite seeming healthy.	• To address low dissolved oxygen, fisheries are to monitor oxygen levels in wells and tanks on fishing vessels and increase oxygen level as necessary • The industry should also: ○ monitor salinity, as there is variation in salinity in some areas ○ anchor in areas where there is good water flow through the well ○ reduce number of fish stored in well or tank by up to one third to improve survival ○ store caufs in deeper, cooler water during a marine heatwave (if cauf is too shallow or in still water, high temperatures and low dissolved oxygen can result in slow, stressed or sick fish) ○ reduce packing density to improve survival ○ consider shorter fishing trips to reduce heat stress impacts • In translocation of lobster from the southwest to the east	Fishing industry or NRE Tas – Marine Resources (Wild Fisheries Management and ShellMAP) and EPA (if mass mortality event) or Biosecurity Tasmania (if biotoxin event) With the support of the Tasmanian Aboriginal Community	Fishing industry Tasmanian Aboriginal Community Recreational fishers (for biotoxin event) IMAS General public (for biotoxin event)

Species	Impact	Response	Response leader	Impacted stakeholders
	Population-level impact (moderate risk): • Unusual mortality event (of rock lobsters stored on fishing vessels or in cauf storage, or due to low dissolved oxygen in live fish wells or tanks on a fishing vessel) **Industry impact** (low to moderate risk): • Loss of income due to area of fishery closure or unsaleable fish, mass mortality, and being unable to get live fish to market **Community impact (low to moderate risk):** • Subsistence harvesting **Cultural impact** (low to moderate risk): • Important social, cultural, spiritual and economic resource	coast, when water temperature in well is above 23°C operators should release fish (observers, DO2 monitors and DO2 system) • For mass mortality of rock lobster stored on fishing vessels, dead fish in pots can be returned to the water and are recorded on return (does not come off quota). Seek advice from EPA for disposal at sea in state waters, noting disposing of dead fish in Commonwealth waters may require a permit. For more than 20 dead fish in wells, make a report to Fisheries Officer for instructions (which may include need for samples subject to Chief Veterinary Officer requirements) and record on return (does not come off quota) • During a biotoxin event, there is no visible presence of PST in a rock lobster (need to be tested). Lobster absorbs		

Species	Impact	Response	Response leader	Impacted stakeholders
		biotoxins through predation of mussels. Biotoxins work through flesh quickly but stays in guts for much longer. Low risk during warmer water events • Effective post-harvest (cold chain) handling limits vibrio outbreak		
Scallops Go to Fishing Tasmania's Scallop Season webpage for information on scallop season dates.	**Public health incident** (high risk): • PST • Vibrios (post-harvest) **Population-level impact** (moderate to high risk): • Population declines • Unusual mortality events (wild scallops) Scallops in already-stressed conditions are more vulnerable. **Industry impact** (low to moderate risk): • Loss of income due to area of fishery closure or unsaleable fish, mass	• Community to monitor for shellfish mortality events • Biosecurity Tasmania and ShellMAP test for PST, AST and DST fortnightly throughout the season when harvesting occurs (as per the Scallop Fishermen's Association of Tasmania Food Safety plan 2022) • Fishing vessels should hold refrigerated spray brine systems and be well set up for post-harvest. Product should be held in bulk bin and below deck and is subject to cold chain management • Vibrio risk would be when bins held on deck on last trip home	Fishing industry or NRE Tas – Marine Resources (Wild Fisheries Management and ShellMAP) and EPA (if mass mortality event) or Biosecurity Tasmania (if biotoxin event)	Fishing industry Recreational fishers (for biotoxin event) Tasmanian Aboriginal community (for biotoxin event) NRE Tas – Aquaculture IMAS General public (for biotoxin event)

Species	Impact	Response	Response leader	Impacted stakeholders
	mortality, and being unable to get live fish to market **Non-commercial impact** (low to moderate risk): • Subsistence harvesting **Cultural impact** (high risk): • Important social, cultural, spiritual and economic resource	as would not be subject to cold chain management protocols • Northeast and east coast scallop beds are at risk during a marine heatwave. Those surveyed in 2023–24 by NRE Tas and IMAS are likely to be surveyed in the following year to assess any potential impacts from the 2023–24 marine heatwave • Thermal tolerances are unknown. Genetic differences may influence water temperature tolerance	With the support of the Tasmanian Aboriginal Community	
Other shellfish (e.g., clams, *angasi*, periwinkle, common pipi, wild Pacific oysters)	**Disease, biotoxin and microbiological events** (high risk): • PST (human health, noting this risk is lower during warm water events) • Vibrios • POMS (wild Pacific oysters) **Population-level impact** (moderate to high risk):	• Community monitoring for shellfish mortality events • Biosecurity Tasmania may direct collection of samples of dead/sick fish for Animal Health Lab testing • Effective post-harvest (cold chain) handling limits vibrio outbreaks • For clams, current total allowable catch is low	Fishing industry or NRE Tas – Marine Resources (Wild Fisheries Management and ShellMAP) and EPA (if fish kill event)	NRE Tas - Aquaculture Fishing industry Recreational fishers (for biotoxin event) Tasmanian Aboriginal Community NRE Tas IMAS

Species	Impact	Response	Response leader	Impacted stakeholders
	• Population declines (periwinkles, common pipi and George's Bay *angasi*) • Absence (George's Bay clam fishery, noting this is an introduced species) **Cultural impact** (high risk): • Important social, cultural, spiritual, and economic resource (warrener, common pipi, clams, and *angasi*) **Disease, biotoxin and microbiological event** (risk under evaluation by IMAS)	• For *angasi* oysters, stocks are declining, and a future fishery closure is possible outside of a marine heatwave event. Potential reduction in catch limits and closures to vulnerable areas • For periwinkles (warrener), potential reduction in catch limits, closures to vulnerable areas and recreational fishing • For the common pipi, closures to recreational fishing	or Biosecurity Tasmania (if biotoxin event) With the support of the Tasmanian Aboriginal Community	General public (for biotoxin event)
Culturally significant shellfish that support cultural practices These are listed in *Fisheries (General and Fees) Regulations 2016*, Regulation 21,	**Ecosystem impact** (moderate to high risk): • Habitat damage **Cultural impact** (high risk): • Important social, cultural, spiritual and economic resource	• Tasmanian Aboriginal Community to monitor for shellfish mortality events • Community to monitor habitat as necessary, for species such as Maireener	Tasmanian Aboriginal Community	Tasmanian Aboriginal Community

Species	Impact	Response	Response leader	Impacted stakeholders
Schedule 5, Prescribed Fish for Definition of Aboriginal Activity				
Fish High sensitivity fish include King George Whiting and Black Bream. Medium sensitivity fish include Flathead, Garfish, Snapper, Yellowtail Kingfish, East Australian Salmon, Australian Sardine, Blue Warehou, Silver Warehou, Banded Morwong, Jackass Morwong, Wrasse, small pelagics and baitfish.	**Population-level impact** (low to moderate risk): • Population declines • Starving animals (due to shift of prey species) **Disease, biotoxin and microbiological event** (low risk): • HABs (leading to low dissolved oxygen) **Non-commercial impact** (low to moderate risk): • Subsistence harvesting (highly sensitive species) **Cultural impact** (low to moderate): • Important social, cultural, spiritual and economic resource	• Limit or close take to account for ecological needs • Refocus fishing efforts to more resilient species • Fish may be sampled during fish kills to determine causative factor.	Fishing industry or NRE Tas – Marine Resources (Wild Fisheries Management and ShellMAP) and EPA (if fish kill event) or Biosecurity Tasmania (if biotoxin event or fish kill) With the support of the Tasmanian Aboriginal Community	Commercial fishing industry Tasmanian Aboriginal Community Recreational fishers IMAS General public

Species	Impact	Response	Response leader	Impacted stakeholders
Cephalopods	**Population-level impact** (moderate risk): • Population declines or explosions (squids) • Shifts in timing of spawning • Species migration to cooler waters (calamari) **Non-commercial impact** (low to moderate risk): • Subsistence harvest (particularly in moderately sensitive species) **Cultural impact** (low to moderate): • Important social, cultural, spiritual and economic resource	• For Southern Calamari, extend spawning closures and limit commercial and non-commercial catch • For other squid species, limit commercial and non-commercial catch • For Pale Octopus, potential to introduce area closures and catch caps	Fishing industry or NRE Tas – Marine Resources (Wild Fisheries Management) With the support of the Tasmanian Aboriginal Community	Commercial fishing industry Tasmanian Aboriginal Community Recreational fishers IMAS General public
Native seaweeds and kelp	**Ecosystem impact** (high risk): • Changes to ecosystem range due to water temperatures • Habitat damage	• For beach-cast kelp, limit or close take in sensitive regions to account for ecological needs. (currently only able to take 50 per cent on a limited number of beaches) • Appropriate Food Safety Management systems in place	Commercial beach cast collection sector or NRE Tas – Marine Resources	NRE Tas – Aquaculture Tasmanian Aboriginal Community Commercial beach cast collection sector (kelp)

Species	Impact	Response	Response leader	Impacted stakeholders
	• Species sensitive to temperature, light and nutrient levels A stronger East Australian Current pushes warmer, low nutrient waters towards Tasmania's East Coast. **Population-level impact** (high risk): • Abundance decline **Disease, biotoxin and microbiological events** (moderate to high risk): • Vibrios (post-harvest) **Industry impact** (moderate to high risk): • Loss of income due to area closures (wild harvest) • Heat stress related impacts on production (wild harvest) • Market supply due to unusual mortality event (farmed)	• Tasmanian Aboriginal community to monitor and map kelp forests and seagrass beds • Only introduced species are harvested live from the water, no action required for native seaweeds	With the support of the Tasmanian Aboriginal Community (if biotoxin event)	Recreational fishers IMAS General public

Species	Impact	Response	Response leader	Impacted stakeholders
	Cultural impact (high risk): • Important social, cultural, spiritual and economic resource			
Introduced seaweeds (e.g., *Undaria*)	**Disease, biotoxin and microbiological event** (risk unknown): • Vibrio (post-harvest) **Population-level impact** (risk unknown): • Population declines (annual species during summer) **Ecosystem impact** (risk unknown): • Changes to ecosystem range **Industry impact** (risk unknown): • Heat stress related impacts on production	• Potential increase in take • Appropriate Food Safety Management systems in place	NRE Tas – Marine Resources	Harvest industry IMAS Tasmanian Aboriginal Community General public
Sea urchins – native (Shortspined)	**Population-level impact** (risk unknown): • Population declines	• Potential reduction in catch limits	NRE Tas – Marine Resources	Fishing industry IMAS

Species	Impact	Response	Response leader	Impacted stakeholders
	• Starving animals (due to shift of prey species) • Population explosions (may become a biofouling species – noting *Undaria* is an annual species with low abundance during summer) **Disease, biotoxin and microbiological events** (risk under evaluation by IMAS)	• Closures to vulnerable areas	With the support of the Tasmanian Aboriginal Community	Tasmanian Aboriginal Community General public
Sea urchins – range-extending (Longspined)	**Population-level impact** (high risk): • Species migration to cooler waters **Cultural impact** (high risk): • Important social, cultural, spiritual and economic resources	• Communicate outbreaks or increasing barrens • Subsidy applied to priority affected areas to encourage removal • Potential for Tasmanian Aboriginal community to monitor habitat for population range extension	AIRF and NRE Tas – Marine Resources and IMAS With the support of the Tasmanian Aboriginal Community	Fishing industry Tasmanian Aboriginal Community Recreational fishers IMAS General public

Table 9: Marine mammals, seabirds, and other threatened species (non-exhaustive list) impact and response table

Species	Impact	Response	Response leader	Impacted stakeholders
Shy Albatross (monitored by NRE Tas)	**Population-level impact** (low risk): • Unusual mortality event (the capacity of carcasses from unusual mortality events is limited) • Starving animals (due to shift of prey species)	• Call the Marine Wildlife Hotline to report unusual mortality events or large numbers of sick animals • Attending NRE Tas Marine Conservation staff to call Emergency Animal Disease Hotline if suspected contagious disease • Attend to sick and dying animals • If requested, collect samples of dead/sick birds for Animal Health Lab testing for cause of sickness or death • Chief Veterinary Officer to determine if Chief Veterinary Officers in other jurisdictions are to be notified and response	NRE Tas – Marine Conservation Program or Biosecurity Tasmania (if suspected animal disease) With the support of the Tasmanian Aboriginal Community	NRE Tas – Marine Resources Australian Government – Department of Climate Change, Energy, the Environment and Water (DCCEEW) Tasmanian Aboriginal Community Bird conservation organisations/groups General public
Short-tailed Shearwater (monitored by NRE Tas)	**Population-level impact** (low risk): • Unusual mortality event (the capacity of carcasses from	• Call the Marine Wildlife Hotline to report unusual mortality events or large numbers of sick animals • Attending NRE Tas Marine Conservation staff to call	NRE Tas – Marine Conservation Program or	NRE Tas – Marine Resources Tasmanian Aboriginal Community

Species	Impact	Response	Response leader	Impacted stakeholders
	unusual mortality events is limited) • Starving animals (due to shift of prey species) **Cultural – Short-tailed Shearwater** (moderate risk): • Important social, cultural, spiritual and economic resources • Commercial birding and associated continuity of cultural knowledge and practice of birding	Emergency Animal Disease Hotline if suspected contagious disease • If requested, collect samples of dead/sick birds for Animal Health Lab testing for cause of sickness or death • Chief Veterinary Officer to determine if Chief Veterinary Officers in other jurisdictions are to be notified and response	Biosecurity Tasmania (if suspected animal disease) With the support of the Tasmanian Aboriginal Community	Bird conservation organisations/groups General public
Little Penguins	**Population-level impact** (moderate risk): • Unusual mortality event (the capacity of carcasses from unusual mortality events is limited) • Sick, dying or dead animals (from HABs) • Starving animals (due to shift of prey species)	• Call the Marine Wildlife Hotline to report unusual mortality events or large numbers of sick animals • Attending NRE Tas Marine Conservation staff to call Emergency Animal Disease Hotline if suspected contagious disease • If requested, collect samples of dead/sick birds for Animal Health Lab testing for cause of sickness or death	NRE Tas – Marine Conservation Program or Biosecurity Tasmania (if suspected animal disease) With the support of the Tasmanian	NRE Tas – Marine Resources Tasmanian Aboriginal Community Bird conservation organisations/groups General public

Species	Impact	Response	Response leader	Impacted stakeholders
		• Chief Veterinary Officer to determine if Chief Veterinary Officers in other jurisdictions are to be notified and response	Aboriginal Community	
Australian and Long-nosed Fur Seals (monitored by NRE Tas)	**Population-level impact** (low risk): • Unusual mortality event (the capacity of carcasses from unusual mortality events is limited) • Sick, dying or dead animals (from HABs) • Starving animals (due to shift of prey species)	• Call the Marine Wildlife Hotline to report unusual mortality events or large numbers of sick animals • Attending NRE Tas Marine Conservation staff to call Emergency Animal Disease Hotline if suspected contagious disease • Attend to sick and dying animals, includes possible euthanasia as it is unlikely there will be capacity to cure if illness related • If requested, collect samples of dead/sick seals for animal health lab testing for cause of sickness or death • Chief Veterinary Officer to determine if Chief Veterinary Officers in other jurisdictions	NRE Tas – Marine Conservation Program or Biosecurity Tasmania (if suspected animal disease) With the support of the Tasmanian Aboriginal Community	NRE Tas – Marine Resources Australian Government – DCCEEW Tasmanian Aboriginal Community Conservation organisations/groups General public

Species	Impact	Response	Response leader	Impacted stakeholders
		are to be notified and response		
Whales and Dolphins (cetaceans) (monitored by NRE Tas)	**Population-level impact** (low risk): • Unusual mortality event (the capacity of carcasses from unusual mortality events is limited) • Sick, dying or dead animals (from HABs) • Starving animals (due to shift of prey species)	• Refer to the NRE Tas Cetacean Incident Manual • Call the Marine Wildlife Hotline to report unusual mortality events or large numbers of sick animals • Attending NRE Tas Marine Conservation staff should call Emergency Animal Disease Hotline if suspected contagious disease • Attend to sick and dying animals, includes possible euthanasia as it is unlikely there will be capacity to cure if illness related • Chief Veterinary Officer directs sample collection of dead/dying cetaceans for Animal Health Lab testing for cause of dying or death • Chief Veterinary Officer to determine if Chief Veterinary Officers in other jurisdictions	NRE Tas – Wildlife Health and Marine or Biosecurity Tasmania (if suspected animal disease) With the support of the Tasmanian Aboriginal Community	NRE Tas – Marine Resources Australian Government – DCCEEW Tasmanian Aboriginal Community Conservation organisations/groups General public

Species	Impact	Response	Response leader	Impacted stakeholders
		are to be notified and response		
Maugean skate	**Population-level impact** (high risk): • Unusual mortality event • Sick, dying or dead animals Reduced Maugean Skate catch rates may be observed in stock monitoring surveys. **Ecosystem impact** (risk unknown): • Low dissolved oxygen	• Report observed impacts with as much detail as possible to NRE Tas's Threatened Species Section (recovery teams for Maugean skate will be notified)	TBD - depending on the nature of the event, and the need and capacity for a coordinated response based on prioritisation and risk principles With the support of the Tasmanian Aboriginal Community	NRE Tas – Marine Resources NRE Tas – Threatened species Australian Government – DCCEEW Tasmanian Aboriginal Community Strahan community (Macquarie Harbour) Conservation organisations/groups General public
Handfish (Red, Spotted, Ziebell's and Pink)	**Population-level impact** (moderate risk): • Unusual mortality event • Sick, dying or dead animals • HABs • Localised extinction	• Report observed impacts with as much detail as possible to NRE Tas's Threatened Species Section (handfish recovery teams will be notified) • The red handfish project team has placed temperature	TBD - depending on the nature of the event, and the need and capacity for a coordinated response based on prioritisation and risk principles	NRE Tas – Marine Resources NRE Tas – Threatened species Australian Government – DCCEEW

Species	Impact	Response	Response leader	Impacted stakeholders
	Ecosystem impacts (risk unknown): • Habitat damage	loggers near known populations to help identify and quantify any impacts from marine heatwave.		Tasmanian Aboriginal Community Conservation organisations/groups General public
Tasmanian Live-bearing Seastar, Derwent River Seastar, and Bruny Island Seastar	**Population-level impact** (moderate risk): • Unusual mortality event • Sick, dying or dead animals	• Report observed impacts with as much detail as possible to NRE Tas's Threatened Species Section	TBD - depending on the nature of the event, and the need and capacity for a coordinated response based on prioritisation and risk principles	NRE Tas – Marine Resources NRE Tas – Threatened species Australian Government – DCCEEW Tasmanian Aboriginal Community Conservation organisations/groups General public
Three-node Seaweed	**Population-level impact** (risk unknown): • Early senescence Ecosystem impact (risk unknown):	• Report observed impacts with as much detail as possible to NRE Tas's Threatened Species Section	TBD - depending on the nature of the event, and the need and capacity for a coordinated response based on	NRE Tas – Marine Resources NRE Tas – Threatened species Tasmanian Aboriginal Community

Species	Impact	Response	Response leader	Impacted stakeholders
	• Changes to ecosystem range (absence of three-node seaweed in usual location)		prioritisation and risk principles	Conservation organisations/groups General public

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