Australian Government
Great Barrier Reef Marine Park Authority

Reef Authority

20 REEF 25 FORUM

Climate Scenario Cards

50 YEARS GREAT BARRIER REEF MARINE PARK

Climate Scenario #1: Warming reaches 1.3°C by 2035, stabilising by 2100

Effects

Coral bleaching:

- Up to 60% of coral bleached with 15% mortality of hard corals in each bleaching event.

Cyclone:

- Up to 60% of coral lost in direct path of cyclone and south of the eye of the cyclone.
- Large coral rubble fields created.
- Seagrass meadows reduced by cyclone and sedimentation.

Flood:

- Freshwater inundation from the flood event, coral mortality up to 40% on inshore reefs.
- Flood plume extends to mid-shelf reefs reducing visibility and stressing corals.
- Island erosion and sedimentation run-off.
- Turtle nests inundated on some islands.

Impacts expected (next 10 -15 years)

- **Six marine heatwaves** cause widespread coral bleaching events in the next ten years (two back-to-back).
- **One category 4 cyclone** crosses the coastline, impacting the bottom section of your region.
- **Two major flood events** in ten years, impacting inshore region.
- Ongoing crown-of-thorns starfish outbreak.

Effects

Crown-of thorns starfish:

- Coral predation of fast-growing reef building corals.

Cumulative Effects

- Reef retains significant ecological function.
- Notable levels of local biodiversity still in place.
- Partial recovery of coral and seagrass between impact events.
- Some coral reefs never fully regain pre-bleaching coral cover:
    - recovering corals must expend more energy rebuilding.
    - a significant reduction in fast growing corals,
    - coral community composition shifts toward hardy taxa and algae in damaged areas,
    - some particularly sensitive coral species decline.
- A reduction in fish habitat and a reduction in some fish species numbers.
- Sea turtle nesting success impacted.
- Dugong foraging grounds temporarily shrink after cyclone and flood.

Climate Scenario #1: Warming reaches 1.3°C by 2035, stabilising by 2100

Community Effects

- Cultural values are impacted in areas, but Traditional Owner connections remain strong.
- Remote coastal communities displaced after major flood.
- Disruption from road closures and town services.
- Reduction in tourism causes job losses, effecting services and town liveability.
- Reef-dependent coastal communities adapt.
- Coastal infrastructure is impacted from cyclone and flood events, taking time and costing money to repair.
- Global concern remains on the World Heritage status of the Great Barrier Reef, causing reputational risks for Australia.

Industry Effects

- Reef tourism remains viable, although disrupted by bleaching and storm damage.
- Location and permission dependent – tourism operators adjusts products/ primary locations and messaging in response to impacted coral state. Those that cannot shift focus are under pressure and see reduction in business viability.
- Challenge meeting visitor expectations.
- Tourism industry impacted by perceptions of declining Reef health but remains viable with strong stewardship programs.
- Tourism and local economies continue with temporary adaptation.
- Higher operating costs, insurance premiums put additional pressure on businesses.
- Decline in investor confidence could impact on future industry viability.
- Fisheries generally maintain productivity but catches of coral trout and some other reef-dependent species have started to trend down.

Climate Scenario #2: Warming reaches 1.5°C by 2035, reaching 1.8 °C by 2100

Effects

Coral bleaching:

- Up to 60% of coral bleached with 15% mortality of hard corals in each bleaching event.

Cyclone:

- Up to 60% of coral and 20% of Reef structure lost in direct path of cyclone and south of eye of cyclone.
- Large coral rubble fields created.
- Sedimentation smothers seagrass meadows.

Flood:

- Freshwater inundation from the flood event, coral mortality up to 40% on inshore reefs.
- Flood plume extends to mid-shelf reefs reducing visibility and stressing corals.
- Island erosion and sedimentation run-off.
- Turtle nests inundated on some islands, nesting success impacted.

Crown-of thorns starfish:

- Coral predation of fast-growing reef building corals.

Impacts expected (next 10 -15 years)

- **Marine heatwaves** cause widespread coral bleaching events every other year.
- **Two cyclones** (Category 4-5, with the second crossing within 4 years of the first), they cross from Reef to coastline, impacting the southern section of your region.
- One coral bleaching event overlaps with a category 5 cyclone causing a **major rain and flood event.**
- **Three major floods** in ten years, with two back-to-back, impacting your whole region.
- Ongoing crown-of-thorns starfish (COTS) outbreak.

Cumulative Effects:

- Reef retains ecological function.
- Notable levels of local biodiversity still in place.
- Certain upwelling corridors, deeper coral reefs, or thermally buffered coral reef areas persist as refugia with relatively intact coral cover.
- Coral reefs, seagrass meadows, mangroves continue to function but in a fragmented state.
- Partial recovery of coral and seagrass between impact events.
- Significant reduction in fast growing plate and branching corals, structural complexity is lost in heavily impacted locations.

Cumulative Effects:

- Many coral reefs never fully regain pre-bleaching coral cover:
  - some coral species decline.
  - some coral reefs shift to heat and stress tolerant corals (encrusting, massive corals).
  - some coral reefs shift toward algal dominance and macroalgae beds.
  - coral loss over wide areas limits coral larval supply and has the potential for habitat fragmentation.
- A reduction in fish habitat and loss of coral-dependent fish species, reduction in number of larger predatory fish.
- Seabirds dependent on fish prey reduce breeding success.
- Herbivorous fish dominate but are unable to keep pace with the rate of algae growth, especially on inshore reefs so turf algae dominate recruitment spaces.
- Combined stressors (marine heatwaves, runoff, storm) cause regional seagrass die-offs.
  - Dugong and turtle populations decline due to loss of feeding grounds.
- Some seagrass and mangrove habitats retreat due to temperature and coastal pressures, reducing fish nursery habitats and coastal protection.

Climate Scenario #2: Warming reaches 1.5°C by 2035, reaching 1.8 °C by 2100

Community Effects

- Cultural values are impacted in areas, but Traditional Owner connections remain strong.
- Negative impacts on sentiment, culture and human wellbeing, as well as a loss of motivation and hope in the population with flow-on effects for support of management efforts.
- Reef-dependent communities experience economic and social stress from reduced fisheries and tourism income.
- More frequent disaster recovery needed.
- Coastal protection from storm surge weakens with loss of mangroves.
- Coastal infrastructure is impacted from cyclone and flood events, taking time and costing money to repair.
- Infrastructure costs rise steeply for coastal industries.
- Global concern remains on the World Heritage status of the Great Barrier Reef, causing reputational risks for Australia.

Industry Effects

- Reef tourism remains viable but contracts, after disruption from coral bleaching, floods and cyclone damage.
- Location and permission dependent – tourism operators adjusts products/ primary locations and messaging in response to impacted coral state. Those that cannot shift focus are under pressure and see reduction in business viability.
- Tourism and local economies continue with temporary adaptation.
- Potential market shift away from scuba diving, snorkelling, diversifying products.
- Higher operating costs, insurance premiums put additional pressure on businesses.
- Decline in investor confidence could impact on future industry viability.
- All consumer markets impacted in some way with flow-on effects.
- Fisheries productivity drops.

Climate Scenario #3: Warming reaches 2°C by 2035, reaching 2.7 °C by 2100

Effects

Coral bleaching:

- Up to 60% of coral bleached with 15% mortality of hard corals in each bleaching event.
- Repeated bleaching events prevent recovery, coral cover declines steeply.

Cyclone:

- Up to 60% of coral and 20% of Reef structure lost in direct path of cyclone and south of eye of cyclone.
- Extensive damage to reef structure, seagrass meadows, and island habitats.
- Island vegetation reduced, coastal erosion, sand cays reformed impacting Seabird habitat.
- Seagrass meadows reduced by cyclone.
- Shelter-dependent fish species decline in affected areas.
- Large coral rubble fields created.

Flood:

- Freshwater inundation from the flood event, coral mortality up to 40% on inshore reefs.
- Flood plume extends to mid-shelf reefs reducing visibility and stressing corals.
- Island erosion and sedimentation run-off.
- Nesting sites are inundated, driving seabird and turtle population declines.
- In low-lying coastal zones, mangroves retreat.

Crown-of thorns starfish:

- Coral predation from COTS accelerates decline of reef-building corals.

Impacts expected (next 10 -15 years)

- **Marine heatwaves** every year cause annual coral bleaching.
- **Two category 5 cyclones** cross from Reef to coastline (the second crossing within 4 years of the first), impacting the bottom third of the region.
- **Three major flood events** in ten years, with 4 years between each event.
- A coral bleaching, cyclone and flood event occur at the **same time**.
- Crown-of-thorns starfish (COTS) outbreak.

Cumulative Effects:

- Coral reefs, seagrass meadows, mangroves continue to function but in a fragmented and diminished state.
- Biodiversity loss evident, with cascading effects on fish populations and ecosystem services.
- Certain upwelling corridors, deeper coral reefs, or thermally buffered coral reef areas persist as refugia.
- Coral reefs, seagrass meadows, mangroves continue to function but in a fragmented and diminished state.
- Extensive damage to reef structure, mangroves, seagrass meadows, and island habitats.
- Structural complexity is lost in heavily impacted locations.

Cumulative Effects:

- Coral recovery stops and coral reefs shift toward algal dominance:
  - some heat and stress tolerant corals persist (encrusting, massive corals), significant loss of habitat building corals (branching, plate corals).
  - coral loss over wide areas causes habitat fragmentation.
- Reduction in fish habitat cascades through the food web. Coral-dependent fishes decline first, followed by larger predators.
- Seabirds dependent on fish prey reduce breeding success.
- Herbivorous fish dominate but are unable to keep pace with the rate of algae growth.
- Combined stressors (marine heatwaves, runoff, storm) cause regional seagrass die-offs.
  - Dugong and turtle populations decline due to loss of feeding grounds.
- Some seagrass and mangrove habitats retreat due to temperature and coastal pressures, reducing fish nursery habitats and coastal protection.
- Extreme weather events erode coastal mangrove stands, reducing fish nursery habitats and coastal protection.
- Restoration efforts overwhelmed by repeated disturbance.

Climate Scenario #3: Warming reaches 2°C by 2035, reaching 2.7 °C by 2100

Community Effects

- Traditional Owners face profound cultural loss as ecosystems collapse, and sacred places degrade.
- Social, cultural, and economic impacts severe.
- Severe, repeated cyclone and flood damages erode the liveability of coastal towns.
- More frequent disaster recovery needed, increasing disaster recovery costs from cyclones and floods.
- Coastal communities suffer major disruption from erosion, and storm surges.
- Coastal communities face economic stress.
- Negative impacts on sentiment, culture and human wellbeing, as well as a loss of motivation and hope in the population with flow-on effects for support of management efforts.
- Coastal protection from storm surge weakens with loss of mangroves.
- Coastal infrastructure is impacted from cyclone and flood events, taking time and costing money to repair.
- Global concern and reputational risks for Australia.

Industry Effects

- Reef tourism contracts to niche markets, as the Reef loses its visitor appeal and the cost of operating after significant cyclone impacts.
- Rise of insurance costs making it no longer viable.
- Fisheries productivity declines drastically, collapse in key species (e.g. tropical prawns, coral trout).
- Tourism and local economies retract.
- Large infrastructure damage costs, rising costs of insurance.