Regional Organization for the Protection of the Marine Environment (ROPME)

ROPME POLICY BRIEF

CORALS CLIMATE CHANGE ADAPTATION

Corals in the ROPME Sea Area (RSA) are in serious decline due to climate change and local human activities. The most important climate change risks are increasing sea temperatures and coral bleaching in the Inner RSA, and cyclones and changing ocean circulation patterns in the Middle and Outer RSA.

Key Adaptation Actions

- Protecting and restoring corals requires rapid action.
- Active restoration interventions, such as coral planting and breeding resistant corals, can be implemented to improve the resilience of corals to climate change.
- Coral restoration interventions need to be carefully designed to ensure the most appropriate methods are applied in the right areas.
- Removing existing pressures affecting corals, such as pollution and fishing impacts, is essential for coral conservation and to allow corals to build natural resilience to climate change.
- Taking action to control emissions and reduce climate change is necessary to avoid the worst impacts of climate change affecting corals.

Impacts | Adaptation options | Overcoming barriers

2022

CORALS IN THE RSA

Reef-building corals are keystone species and play a fundamental role in supporting healthy and productive marine ecosystems. They are found across very different environmental conditions in the RSA and represent the most diverse ecosystem within this arid region, supporting many unique species of coral, as well as fish and invertebrates. Their degradation can seriously impair ecological functioning of the reef and the surrounding marine and coastal environment.

In the RSA there are over 2,000 km^2 of coral reefs, with around 40 different species of reef-building corals and 200 species of reef fish. The extreme conditions in the RSA mean they host many species found nowhere else in the world. These reefs are often found associated with other important marine habitats, such as seagrass meadows, mangroves and sabkhas.

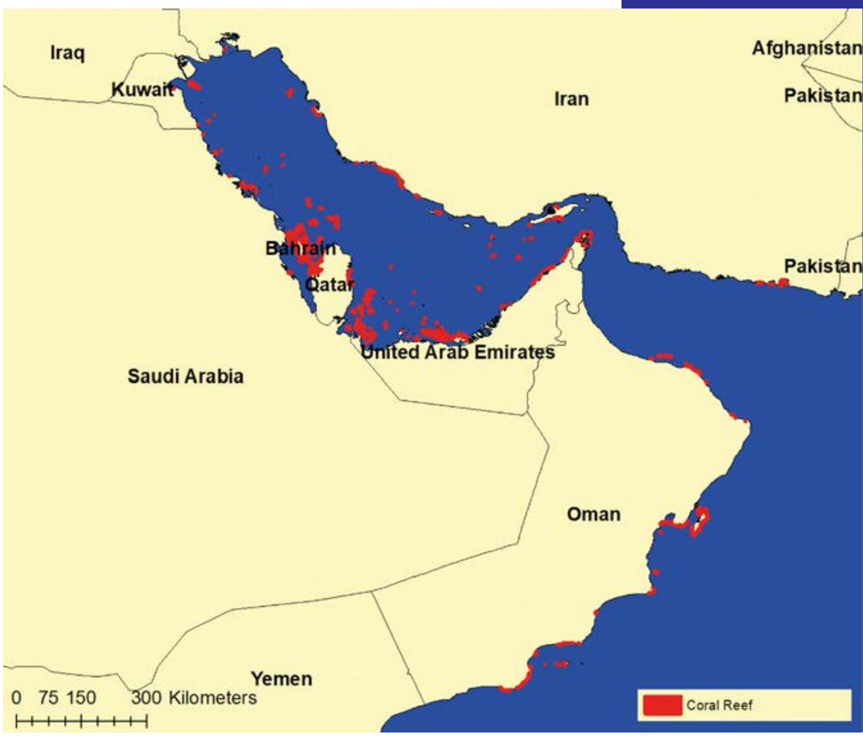
Coral reefs in the RSA provide important direct socio-economic benefits. For example, the fish they support provide an important food source and contribute to a fishing sector valued at 37 billion USD per year for the region. They also generate an estimated 1.3 billion USD per year through reef tourism.

IN THE RSA THERE ARE...

2,000km^2 ...OF CORAL REEF

40 ...DIFFERENT SPECIES OF REEF-BUILDING CORALS*

200 ...SPECIES OF REEF FISH*



*Estimated

Coral reef distribution in the RSA (copied from the ROPME Report, Status and Trends of Coral Reefs in the ROPME Sea Area. (Past, Present and Future)

CLIMATE CHANGE RISKS TO CORALS IN THE RSA

A combination of climate change and other pressures have caused a dramatic decline in the extent of live hard corals in the last two decades. In the Inner RSA, the harsh environment and impacts from extracting activities and rapid urban development have contributed to the most significant losses, with reefs being less diverse and more patchy than in the Middle and Outer RSA. It is estimated that more than 70% of reefs in the Inner RSA have been effectively lost.

The majority of coral reefs in the RSA will be at a critical threat level by 2050. The nature of climate change risks differ across the RSA. Coral bleaching events have been most intense in the Inner RSA but are not uncommon elsewhere in the region. Sea surface temperatures in the Inner RSA are currently rising at twice the global average rate, and it is highly likely that severe bleaching will reoccur every year by the second half of this century.

Increased storms and cyclones are the main climate change risk to reefs in the Outer and Middle RSA, as strong wave action and increased turbidity cause substantial and long-lasting damage. Between 2007 and 2021, six tropical cyclones reaching category 3 or higher have made landfall in the RSA: Gonu (2007), Phet (2010), Ashobaa (2015), Mekunu (2018), Kyarr (2019) and Shaheen (2021), with super cyclonic storm Gonu being the strongest storm on record to reach the RSA. In the future, more intense storms and cyclones are expected to occur in the Outer and Middle RSA, and may even reach the Inner RSA.

Stronger monsoons and seasonal upwelling are creating a more hostile environment for corals through increased nutrients and decreased pH. Depletion of dissolved oxygen across the region, and in particular the intensification and expansion of the permanent oxygen minimum zone in the Outer RSA, is threatening not just corals but other marine life as well.

THREATS TO CORAL REEFS IN THE RSA FROM BLEACHING STRESS AND CYCLONE IMPACT SINCE THE 1980s

NUMBER OF SUMMERS WITH BLEACHING STRESS 1985–2020

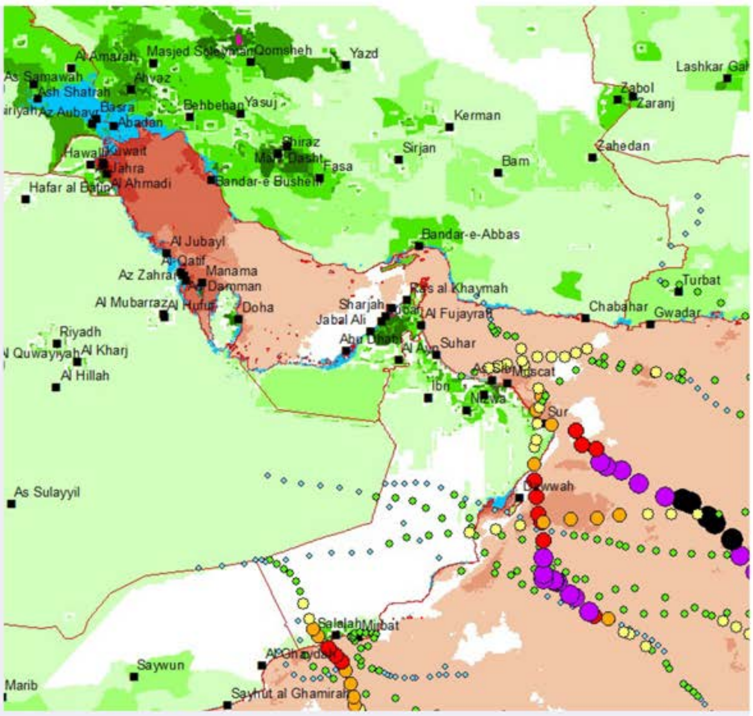
- 0
- 1–4
- 5–8
- 9–12
- 13–16
- 17–20

POPULATION PER KM² IN YEAR 2000

- 0
- 1–10
- 10–20
- 20–50
- 50–100
- 100–500
- >500

PATH AND CATEGORY OF CYCLONES MAKING LANDFALL IN THE RSA

- Tropical Depression
- Tropical Storm
- Category 1
- Category 2
- Category 3
- Category 4
- Category 5
- Land >5m Above Sea Level

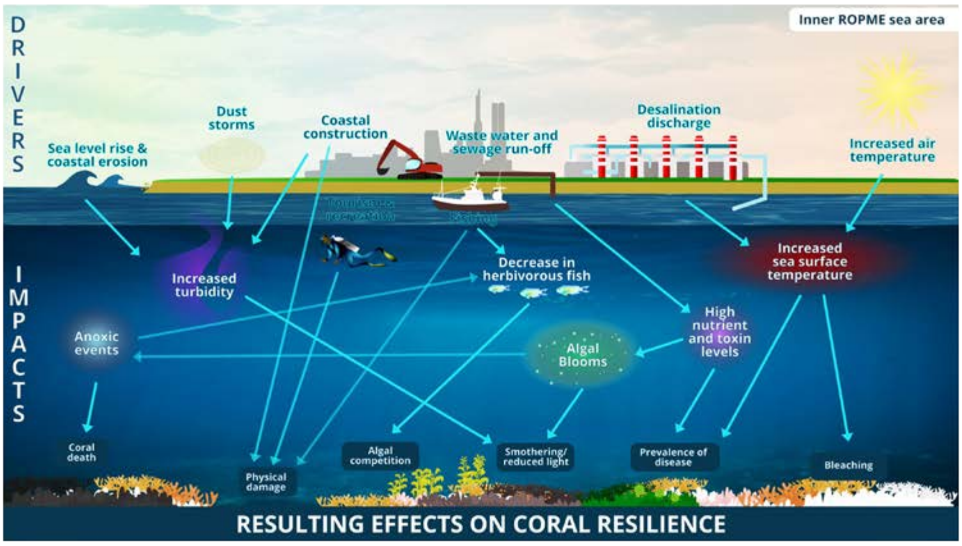


Human pressures on the marine environment are greatest around areas of high population density

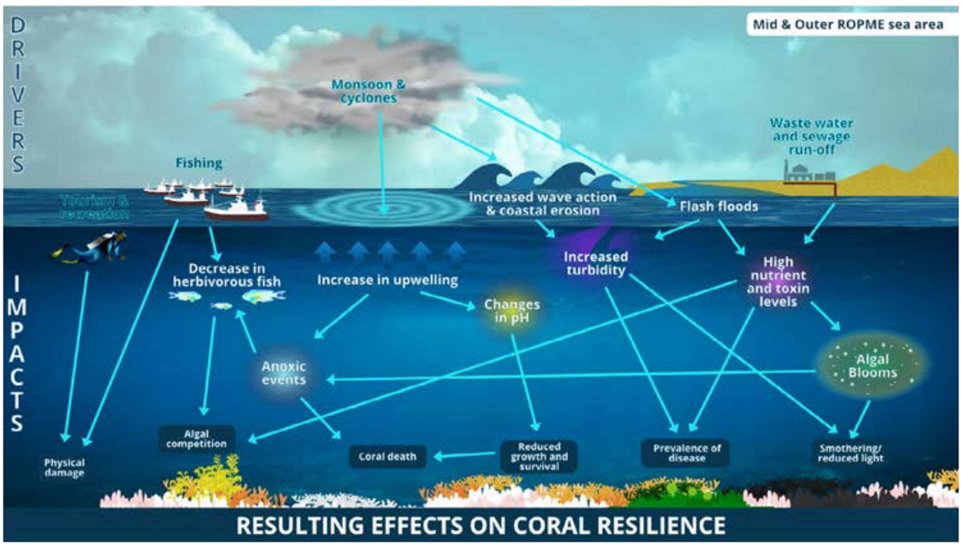
CLIMATE CHANGE PRESSURES AND HUMAN ACTIVITIES

CLIMATE CHANGE AND HUMAN DRIVERS IMPACT THE MARINE ECOSYSTEM IN VARIOUS WAYS, AND ULTIMATELY REDUCE CORAL RESILIENCE.

In the shallow enclosed Inner RSA, increasing temperatures severely threaten corals through coral bleaching. However, coral resilience is also highly impacted by local pressures of desalination outflow, wastewater runoff and coastal construction, which exacerbate thermal stress, while causing poor water quality and turbidity.



In the Middle and Outer RSA, changes in monsoon conditions, upwelling and cyclones, are the main climate change threats, and may impact coral resilience through physical damage from intensifying winds and waves, low oxygen events, ocean acidification and harmful algal blooms. The main human pressure in the Outer RSA is fishing.



KEY COMPOUNDING PRESSURES ON CORALS

WATER QUALITY

Untreated sewage and other sources of pollution, most notably after heavy rain events, is contributing to poor water quality that particularly affects nearshore coral reefs. Discharge of heated, hypersaline effluents from desalination plants can also lead to adverse conditions for corals. The loss of coastal mangroves, which help filter runoff from land, has further exposed nearby reefs to pollution, siltation and turbidity.

COASTAL DEVELOPMENT

Pressures from activities around populated coastal areas and industrial sites such as land reclamation, coastal development, oil and gas operations, and shipping and anchoring, can damage corals and result in reef degradation and loss.

FISHING

Fishing in and around coral reefs can have negative impacts, either through direct damage by gear coming into contact with the reef, or indirectly by removing key species necessary for ecological reef functioning. Overfishing is causing a decline in herbivorous fish as well as sharks in the RSA. A loss of herbivorous fish allows algae to entrench over corals and inhibits their recovery potential after disturbance, while sharks help maintain a balanced species composition in reef areas. Other sources of acute or chronic damage to corals in the RSA include anchoring and entanglement of lost, discarded or abandoned fishing gear.

TOURISM AND RECREATION

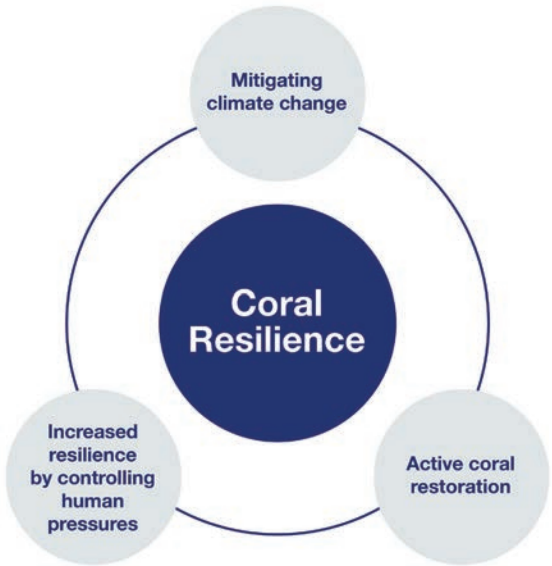
Well managed tourism can act as a sustainable source of income that promotes conservation activities. However, behaviours such as anchoring on corals, curio collection and the indiscriminate use of motorboats and jet skis can cause direct physical damage to corals and reef structures.

FRAMEWORK FOR CORAL ACTION

Corals are being impacted by climate change and other human pressures at the same time. These pressures lead to the direct loss of corals and reduce the resilience of surviving corals to cope with the effects of climate change.

Minimising human impacts on the marine environment to allow corals to rebuild natural resilience is the first step to ensuring healthy and vibrant coral communities that can withstand climate change.

Similarly, the greater the increase in sea surface temperature due to climate change, the more difficult it will be to protect corals. Reducing emissions to mitigate climate change is an essential action for coral protection.



There are a range of active coral restoration techniques available to managers that can increase climate resilience in local reefs. These active interventions are normally only applied at the local scale, and can be expensive to implement. Any active local actions to build coral resilience should be undertaken in combination with efforts to mitigate climate change and reduce other pressures.

Interventions to restore corals without managing existing pressures affecting corals, and without addressing the causes of climate change, are unlikely to succeed.

The actions described over the next few pages on enhancing natural resilience, coral restoration and RSA initiatives were informed by regional experts at a ROPME coral resilience workshop.

ENHANCING NATURAL RESILIENCE

Controlling human activities that are impacting corals encourages natural resilience and is an essential step towards protecting corals from climate change.

Management of corals should be an integrated part of wider management of marine ecosystems.

Good fisheries management and effective regulation of coastal developments and sewage discharges will help build natural resilience of corals to climate change and improve the overall health of the marine environment.

PRIORITY ACTIVITIES IN THE ROPME SEA AREA THAT NEED MANAGING TO BUILD NATURAL RESILIENCE IN CORALS ARE:

	INNER RSA	MIDDLE & OUTER RSA
High	Coastal development	Fishing
	Fishing	Coastal development
	Desalination & industrial discharges	Tourism and recreation
	Sewage & wastewater	Desalination & industrial discharges
Low	Tourism and recreation	Sewage & wastewater

Managing the activities that are impacting corals can be achieved through effective implementation of existing regulations as well as introduction of new measures.

As coastal cities and settlements continue to develop and expand in the region there will be an increase in demand for desalinated water and sewage treatment. If growth in these sectors is not carefully managed this will lead to further impacts on corals.

Application of nature based solutions, such as man made oyster reefs and vegetated foreshores (e.g. saltmarshes and mangrove forests) can improve coastal water quality and protection, benefiting corals.

Natural coral resilience in the RSA could be further supported through the establishment of an effective network of Marine Protected Areas.

ACTIVE CORAL RESTORATION

THERE ARE AN INCREASING RANGE OF TECHNIQUES AVAILABLE TO CORAL MANAGERS AT THE LOCAL SCALE TO SUPPORT CORAL RESTORATION AND BUILD RESILIENCE TO CLIMATE CHANGE. EFFECTIVE RESTORATION OFTEN REQUIRES A COMBINATION OF METHODS.

Many of these techniques are in an early stage of testing and development and not all of them will be practical and successful in every instance. Sharing knowledge and experience of the application of these new methods within the RSA, and internationally, is essential to the rapid development and implementation of coral restoration techniques.

Active restoration methods can be expensive and are often only feasible over limited local areas, therefore coral restoration plans need to be effectively designed and careful site selection is required to ensure they target the most suitable areas.

A TOOLBOX OF CORAL RESTORATION AND RESILIENCE BUILDING METHODS

A range of approaches for coral restoration are being applied and tested internationally, and an increasing amount of information is becoming available to guide the design and implementation of successful coral restoration plans. The range of different techniques being applied and tested across other coral reef regions of the world include the following.

Transplantation is used to relocate corals that would otherwise be killed during the construction of new coastal developments. This can boost recovery of degraded natural reefs and create novel reef habitat.

Coral gardening uses fragments of wild corals to asexually propagate many new colonies that can be used to repopulate reefs. This activity is popular with tourists who can help fund and maintain coral nurseries located in shallow bays near resorts.

Larval propagation of corals through sexual reproduction. Corals are then released as larvae, or they can be grown in tanks and placed at sea once settled. This can allow selective breeding of corals to withstand climate change threats.

Removal of coral predators such as Crown-of-Thorn-Starfish (COTS) may be necessary if these native species reach plague proportions. In Australia COTS outbreaks in touristic coral reef destinations are usually controlled by divers directly injecting the starfish with effective materials harmless to marine environment.

Artificial reefs can be made from artificial reef modules, sea-walls, decommissioned ships and oil rigs and purpose-built offshore reef structures that also improve coastal protection. Given suitable conditions, the presence of hard substrates naturally encourages the settlement of new coral polyps. Coral gardening and transplantation interventions can help accelerate the colonisation of artificial reefs.

Substrate stabilisation prevents dead coral rubble following storms, coral bleaching or coastal construction, from scouring the seabed, inhibiting larval settlement and causing mortality of young polyps post-settlement and preventing the recovery of the reef. This intervention improves the quality of the substrate for corals and other reef-forming organisms to settle and colonise.

Removal of algae from degraded reefs can help new corals become established.

Shading is a technique that involves generating artificial clouds and surface fog during particularly hot periods to reduce the heat stress experienced by shallow corals. Corals that are protected from prolonged peak high temperatures are less likely to experience bleaching and die during heatwave events.

Cooling inshore reefs by pumping deeper offshore waters into lagoons and bays can help protect these habitats during heatwave events.

EXISTING AND FUTURE INITIATIVES IN THE ROPME SEA AREA

Several coral restoration projects are already underway in the RSA. These include the transplantation of corals and coral gardening, establishment of artificial reefs and breeding corals for their climate resilient properties.

More research is needed into genetics and the symbiotic relationships that enable some corals in the RSA to tolerate extreme temperatures. This will increase the likelihood of suitable heat tolerant corals and microalgal symbionts that are resilient to high temperatures and bleaching being identified and applied to restoration projects.

Better understanding of oceanographic features, such as temperature distribution and currents, and the ecological factors that determine coral growth are needed to optimise the selection of successful restoration sites.

It is necessary to develop approaches for implementing coral restoration in a sustainable manner. Co-culturing coral and commercially valuable species may provide an opportunity for self-sustaining coral restoration projects. Pilot projects implementing self-sustaining restoration approaches should be supported.

As these restoration projects progress, ROPME can become a regional forum for knowledge exchange and sharing best practice to enable more rapid development and upscaling of successful restoration techniques.

RESOURCES TO SUPPORT CORAL RESTORATION

AN INCREASING AMOUNT OF INFORMATION IS AVAILABLE GLOBALLY THAT CAN BE USED TO INFORM THE DEVELOPMENT OF CORAL RESTORATION PROJECTS IN THE ROPME SEA AREA. A SELECTION OF THESE RESOURCES ARE LISTED BELOW.

UNEP / ICRI
Coral Reef Restoration: A guide to coral restoration methods

GBR REEF RESTORATION AND ADAPTATION PROGRAMME
Great Barrier Reef – Reef Restoration Tool Kit

NOAA CORAL REEF INFORMATION SYSTEM
A Manager's Guide to Coral Reef Restoration Planning and Design

NATIONAL ACADEMY OF SCIENCES
A Research Review of Interventions to Increase the Persistence and Resilience of Coral Reefs

NEXT STEPS

This Policy Brief, and the ROPME Coral Resilience Workshop that supported it are part of the ROPME Regional Action Plan on Marine Climate Change.

The ROPME Regional Action Plan is building coordinated regional understanding of the risks of climate change to biodiversity and society in the ROPME Sea Area and identifying adaptation responses for key issues.

The outputs from the ROPME Regional Action Plan are designed to support Member States fulfil commitments under the Paris Agreement.

Copies of this Policy Brief, and of the other outputs from the ROPME Regional Action Plan, are available from http://ropme.org/430_Tech_ Reports_Summary_EN.clx

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