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

ROPME POLICY BRIEF

MARINE FISHERIES CLIMATE CHANGE ADAPTATION

Marine fisheries and aquaculture are important for countries bordering the ROPME Sea Area, but they are at risk from climate change impacts.

Key Adaptation Actions

- All stakeholders in fisheries, including managers, fishers, aquaculture operators and processors can implement adaptation actions.
- Healthy fish stocks and ecosystems are more resilient to climate change.
- Good fisheries management is a key part of climate resilience.
- Actions to protect coastal and marine infrastructure will build resilience to the physical impacts of climate change.
- Catching and processing a wider range of species will help spread the risk of climate change impacts on the sector.
- Minimising loss and maximising added value in the supply chain can support economic resilience in the face of declining fishery harvests.

THIS WORK FOCUSES ON HOW CLIMATE CHANGE CAN BE ADDRESSED IN THE RSA, LOOKING AT:

Impacts | Adaptation options | Overcoming barriers

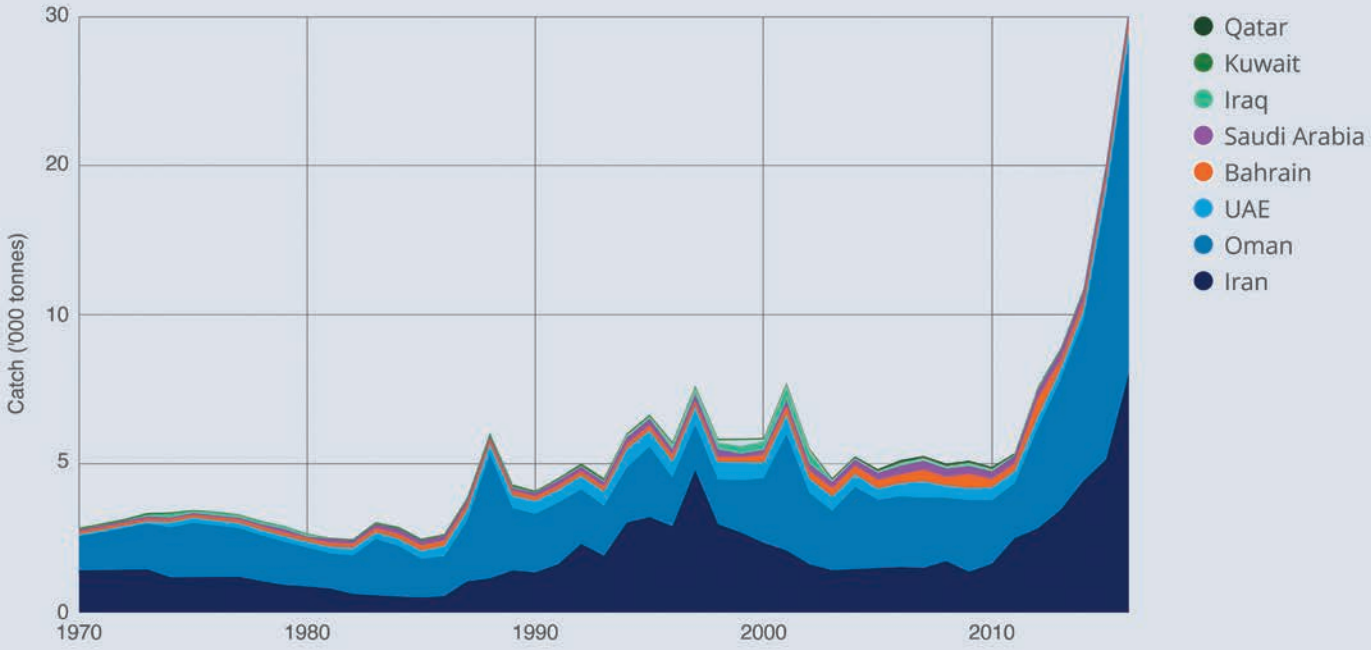
2022

THE ROPME SEA AREA

The ROPME Sea Area (RSA) covers the territorial waters of the eight ROPME Member States: Bahrain, Iran, Iraq, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates. The RSA is divided into three distinct Sub-Regions, the shallow, semi-enclosed Inner RSA, the transitional waters of the Middle RSA and the oceanic Outer RSA.

A ROPME Regional Climate Change Risk Assessment was completed in 2021 across a range of sectors, with some of the greatest threats being to fish and fisheries. This policy brief looks at how fisheries in the RSA can adapt to improve their resilience to climate change.

ANNUAL FISH CATCH FROM THE ROPME SEA AREA BY ROPME STATES



Source: Sea Around Us (2016)

FISHERIES AND AQUACULTURE IN THE ROPME SEA AREA

Around 1.5 million tonnes of fish are caught each year in the region, mostly by Iran and Oman[1]. The main fisheries in the RSA are skiff, dhow and industrial fisheries, catching mixed demersal (bottom-dwelling) species, such as the giant catfish, small pelagic (oceanic) fish such as sardines, and large pelagic fish such as tuna, and shrimps. Skiffs and dhows deploy a range of gears including nets, lines, trawls and traps (gargoors). Industrial fisheries use trawls and seine nets.

In the Middle and Outer RSA, tuna make up 40% of landings, alongside catches of sardines, seabreams, groupers and shellfish. The Inner RSA has high landings of shrimps, as well as more coastal fisheries, such as kingfish, angelfish, groupers and seabreams. Some traditional fish stocks are now depleted, and so fishers are landing more low value species such as crabs.

Smaller fisheries in the RSA include inshore tidal weir (hadrah) fisheries, a deep-water mesopelagic fishery in Iran and an industrial horse mackerel fishery has recently been established in Oman.

Aquaculture (fish and shellfish farming) is growing in the region with commercial facilities developing in recent years. There is potential and ambition however for aquaculture on a larger scale, as an alternative to wild-capture fisheries. Aquaculture can be carried out on land, the coast or at sea, using sea cages, coastal ponds or recirculating systems. There are also a range of species that can be cultured, including fish, shrimps, shellfish and algae.

HOW CLIMATE CHANGE IS AFFECTING THE ROPME SEA AREA

Overall, the shallow and semi-enclosed Inner RSA is expected to see a greater increase in sea temperature and salinity than the deeper waters of the Middle and Outer RSA. The Inner RSA will also be more vulnerable to sea level rise and coastal flooding with its low-lying and highly developed coastline. The Middle and Outer RSA are more likely to experience changes in upwelling, currents, oxygen and cyclone actvity.

In 2020, mass fish kills were reported in Kuwait Bay, occurring at the same time as a heat wave and extremely high sea temperatures.[8] The highest sea surface temperature recorded was 37·6°C. This illustrates the impact that rising sea temperatures may have on fish and fisheries in the future.

Sea temperature The seas of the Inner RSA are warming faster than the deeper waters of the Middle and Outer RSA. Sea surface temperatures could increase between 2.5 and 4.3 °C by the end of century.[2]

Salinity Salinity of the Inner RSA surface waters has increased in the past 60 years and is expected to increase further. Changes will be lower in the Middle and Outer RSA.

Circulation The vertical mixing of water is projected to decrease, causing more water to flow through the Strait of Hormuz.[3] Global weather changes may also affect upwelling in the Middle and Outer RSA.

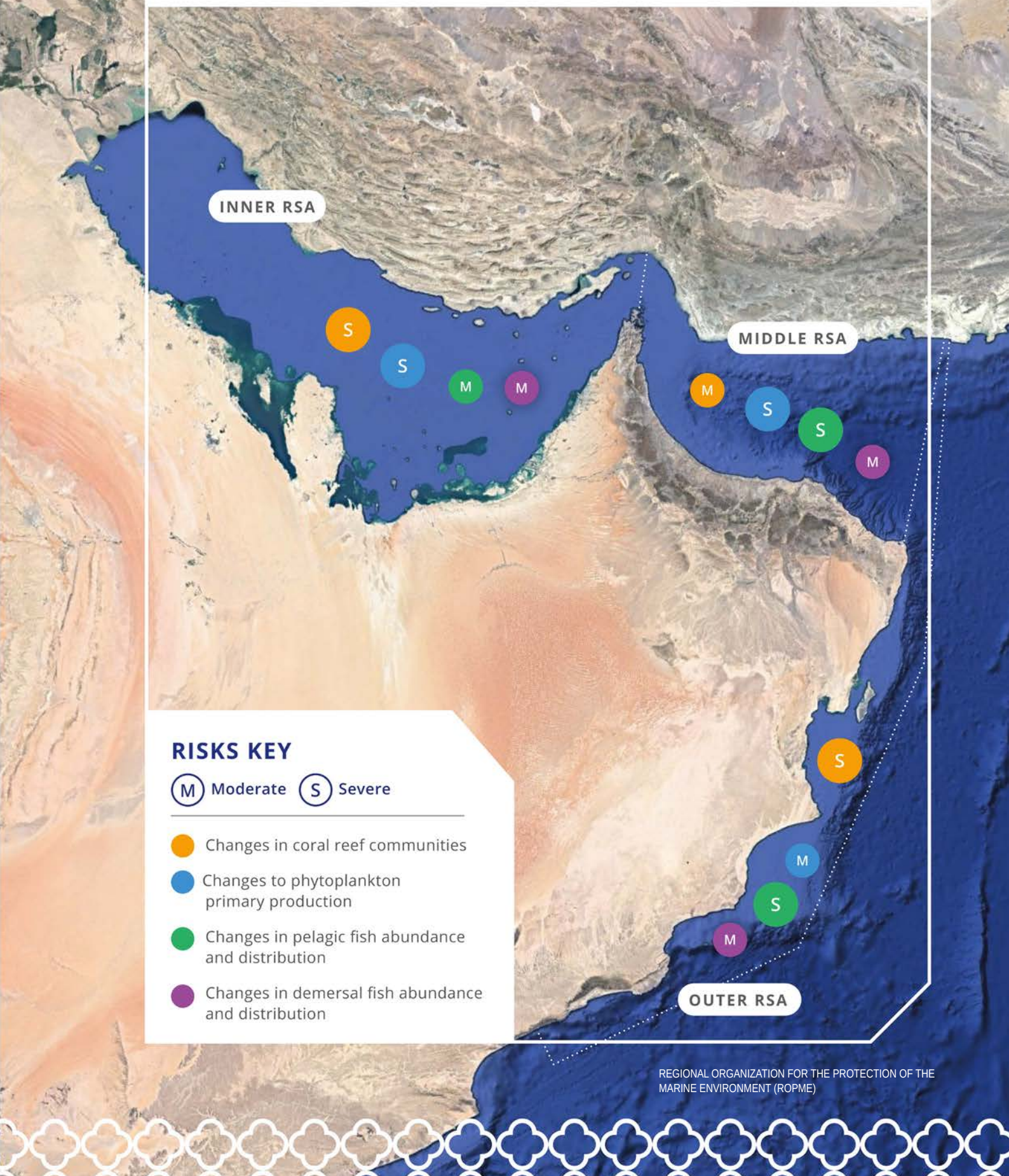
Sea-level rise Sea-level is already rising in the RSA, at a slightly higher rate in the Inner RSA.[4] Sea level is expected to continue throughout this century, with a global estimated rise of 0.84 m by 2100.[5]

Storminess The Outer RSA is projected to experience more tropical cyclones by the end of the century.[6] These may become more intense and extend further north than in the past.

Oxygen The RSA already contains oxygen minimum zones, and dissolved oxygen concentrations are declining further, particularly in the Inner RSA and in the southern areas of the Middle and Outer RSA.

pH Models project that pH in the RSA could decrease by 0.25 units in the second half of this century, leading to more ocean acidification.[7]

SEVERITY OF CLIMATE CHANGE RISKS TO FISHERIES ACROSS THE ROPME SEA AREA



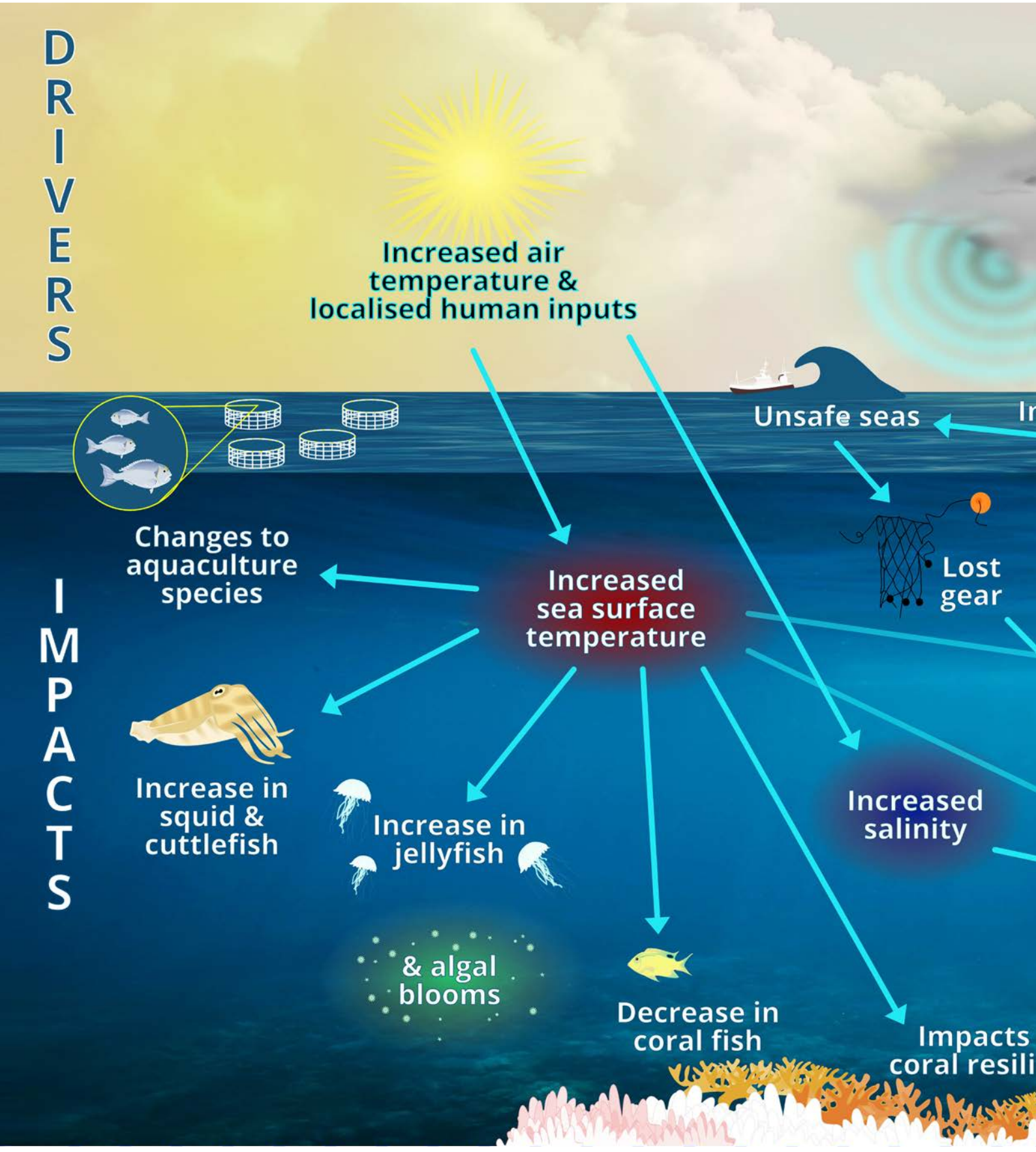
RISKS KEY

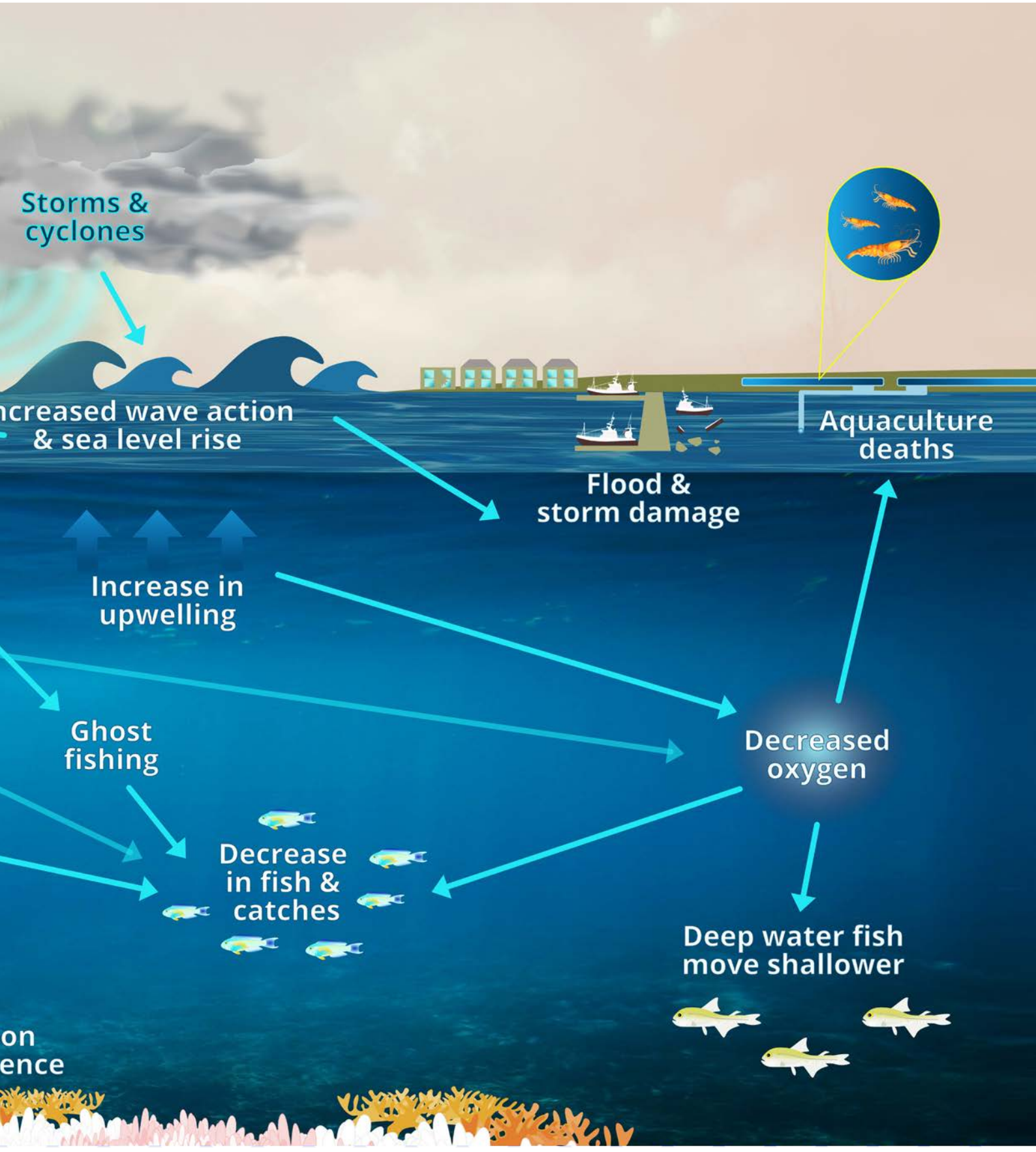
(M) Moderate (S) Severe

- Changes in coral reef communities
- Changes to phytoplankton primary production
- Changes in pelagic fish abundance and distribution
- Changes in demersal fish abundance and distribution

REGIONAL ORGANIZATION FOR THE PROTECTION OF THE MARINE ENVIRONMENT (ROPME)

HOW FISHERIES AND AQUACULTURE IN THE ROPME SEA AREA ARE AFFECTED BY CLIMATE CHANGE

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CLIMATE CHANGE IMPACTS ON FISHERIES AND AQUACULTURE IN THE ROPME SEA AREA

Marine fisheries and aquaculture will be affected by climate change impacts on fish habitat suitability, fish health (e.g. disease and harmful blooms) and the availability of prey or feed. Impacts on fishery and aquaculture operations will also be important.

Future climate modelling projects a decline in species richness of up to 35% by 2090 for the most important commercial fish in the RSA, with the southwestern Inner RSA particularly affected[9].

In the RSA, especially the Inner RSA, many fish species are highly adapted to their conditions, so are very sensitive to future changes. Overall, a decline in commercial species is expected to result in lower catches.

The varying fishing activities and target species across the RSA differ in their exposure and vulnerability to future climate change.

IMPACTS ON FISH SPECIES AND HABITATS

PELAGIC FISH

There have already been changes in the abundance and distribution of pelagic fish, such as mackerel in the Inner RSA and tuna in the Outer and Middle RSA. In the Inner RSA, rising temperatures, changes in salinity and freshwater inputs are projected to cause declines and extinctions of some species. In the Outer and Middle RSA, impacts are expected from decreases in oxygen, changes in monsoons and upwelling.

DEMERSAL FISH

Demersal fish are already under pressure from intensive fishing, and climate change could further impact fisheries. Higher water temperatures and reduced oxygen levels could lead to lower abundance and slower growth of demersal species. Distributions may shift, but this may be limited by availability of suitable habitat.

AQUACULTURE

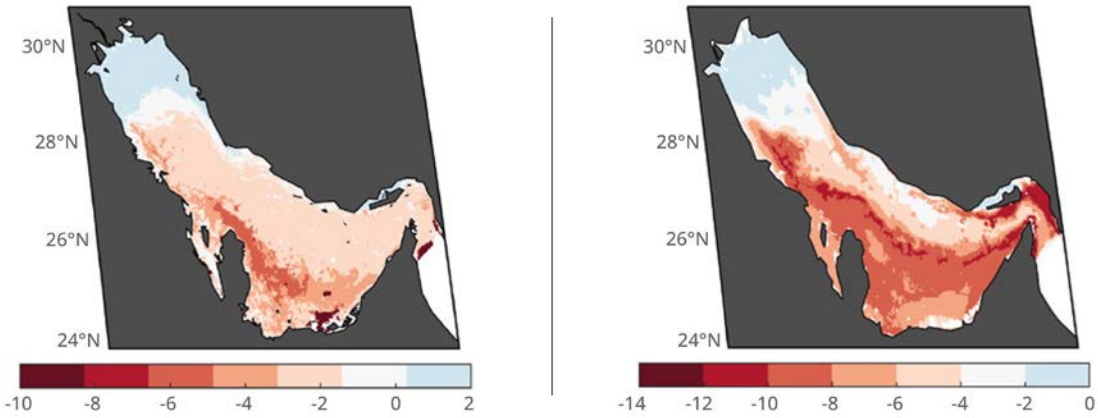
Sea temperatures may alter the areas which are suitable for fish and shrimp farming. An increase in harmful algal blooms, jellyfish and diseases could result in negative impacts on production.

CORAL REEF FISH

Human activities and climate change are causing coral cover and health to decline across the RSA. Coral death and bleaching is caused by high sea temperatures, storms, turbidity, low oxygen and pH. Harmful algal blooms also affect coral health. The corals in the Inner RSA are more impacted by these pressures, with consequences for the fisheries that rely on them. Sea temperature is also expected to directly affect the species composition and abundance of coral reef fish.

OTHER FISHERIES

The deep waters of the Middle and Outer RSA, where there are mesopelagic fish, are expected to experience decreases in oxygen in the 21st century[10]. This could intially increase landings for small scale fisheries as the fish move into shallower water, but could also make them more vulnerable to overfishing, ultimately having a negative impact on the stock. Other species that could be exploited, including squid and cuttlefish may become more abundant in the RSA as seas warm.



Model projections of the species richness (left) and suitable habitat (right) for the 47 priority fish species in the Inner RSA. The change by 2090 relative to 2010 under RCP8.5 is shown.

Source: AGEDI, 2015 (BIOCLIM model results)

IMPACTS ON SOCIETY

COASTAL FISHING COMMUNITIES

Climate change is expected to have direct impacts on communities living by the coast, including those who work in the fishing industry. Lower catch diversity means that alternative fishing opportunities may be limited in the Inner and Middle RSA.

Sea-level rise and extreme weather events will increase flooding and erosion risk, with impacts on human health and wellbeing. Coastal communities may be forced to retreat, especially in low lying population centres in the Inner RSA.

FISH CATCH AND FOOD SECURITY

In the Inner RSA, local losses are likely to be greater than numbers of new species arriving, and so catch potential is likely to decline. In the Outer RSA, overall fisheries yields are likely to decline, but squid populations may benefit, offering some more fishing opportunities. Overall, ROPME member states are likely to see a decline in fish catch.

FISHING OPERATIONS

Any increase in cyclone activity is likely to disrupt fishing operations, affecting safety at sea, suitable days for fishing, gear use and gear loss, particularly in the Middle and Outer RSA. Dust storms can also create visibility problems for fishers.

Sea-level rise and an increase in cyclones and storms is likely to cause damage to boats, gear, and ports and harbours, with more frequent flooding expected in the future. Landing sites on beaches will be more exposed than more resilient built structures.

AQUACULTURE OPERATIONS

Aquaculture facilities are at risk of damage from an increase in flooding and cyclones. Land or shore-based facilities are most vulnerable to impacts from rainfall, flooding, and high winds, whereas sea cages are more affected by changes in sea conditions.

ADAPTING FISHERIES AND AQUACULTURE TO CLIMATE CHANGE

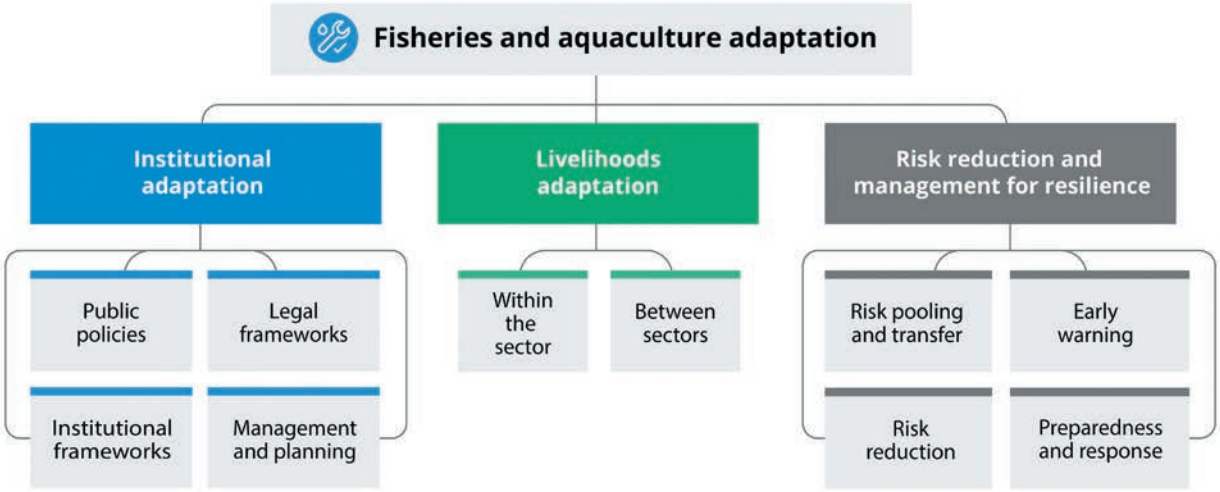
All stakeholders have a role to play in building economic, physical, social and ecological resilience in fisheries including policy makers, managers, fishers, aquaculture farm managers and processors. They can be implemented individually, or in combination, to address different aspects of climate risk.

The benefits of early action to climate change are greater than the costs of inaction. Climate resilient fisheries and aquaculture will reduce the detrimental effects of climate change on food security, livelihoods and biodiversity. Maintaining the health and resilience of industries and communities that rely on fishery and aquaculture production requires accelerated adoption of adaptive management measures, including new management approaches and technology.

To develop climate adaptation for fisheries, there are some key elements:

- Healthy populations and ecosystems are resilient populations and ecosystems. Good fisheries management is a key part of building resilience.
- There is a need to consider physical resilience of infrastructure as well as ecological resilience.
- Ecological diversity in fisheries, and diversity of species and products in processing will support resilience throughout the supply chain.

MAIN CATEGORIES OF ADAPTATION ACTION



Source: FAO Fisheries and Aquaculture Technical Paper 627

IDENTIFYING ADAPTATION OPTIONS FOR THE ROPME SEA AREA

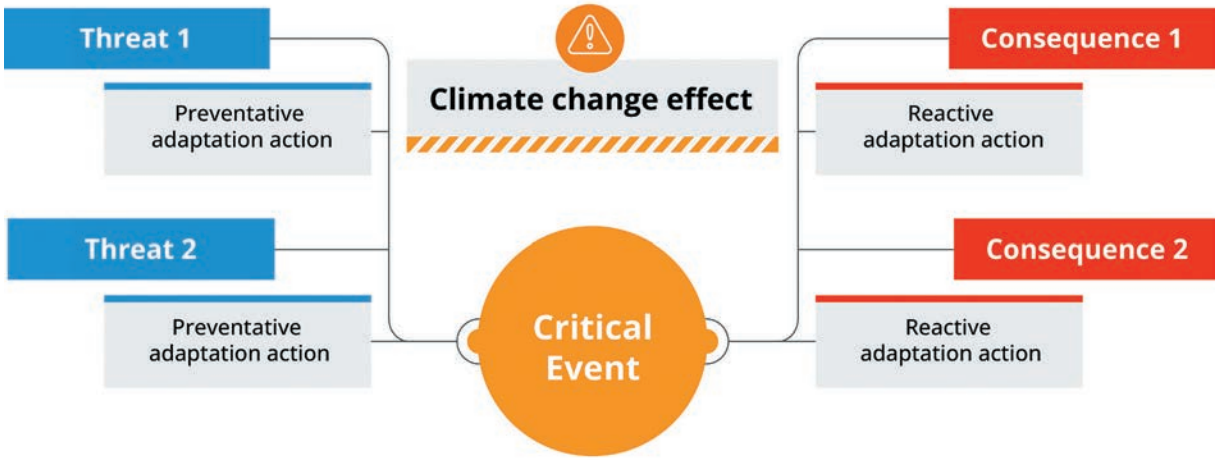
A regional workshop was held to identify adaptation actions that could be implemented to support climate resilience in fisheries across the ROPME Sea Area. The workshop participants included fisheries managers and researchers from across the ROPME region and representatives from the Regional Commission for Fisheries (RECOFI) and the Food and Agriculture Organization (FAO). The adaptation actions presented here are based on the workshop outputs and best practice guidance from across the world.

Whilst it is difficult to separate the impacts of fishing, climate change, and other pressures, workshop attendees agreed that climate change is causing declines in species diversity, size and abundance. Some species have declined, and some have locally disappeared, with decreased catches overall. Declines are seen in shrimp, kingfish, sardines and tuna, abalone, parrotfish, pomfret and grouper. Increases in jellyfish have also been observed.

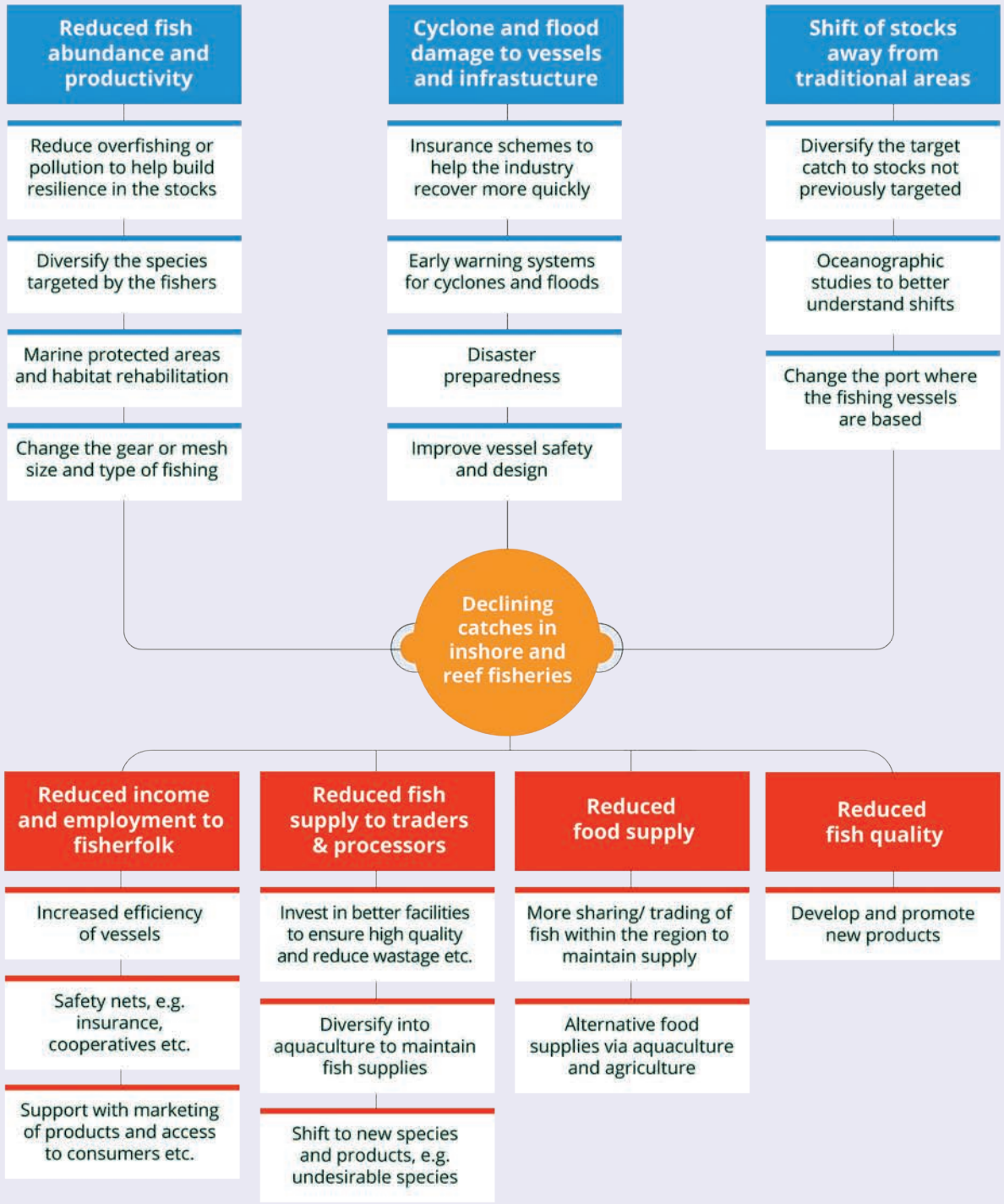
During the workshop, participants identified adaptation actions to reduce risks from climate change for fishers. This was achieved using bowtie causal chain analysis (see diagram below). Bow-tie analyses identify specific threats that can lead to an adverse event occurring. Preventative actions are identified to reduce the likelihood of the event occurring, and reactive actions are identified which reduced the consequences from the event.

The following pages show the main adaptation actions identified at the workshop for inshore and reef fisheries, offshore and large pelagic fisheries and aquaculture.

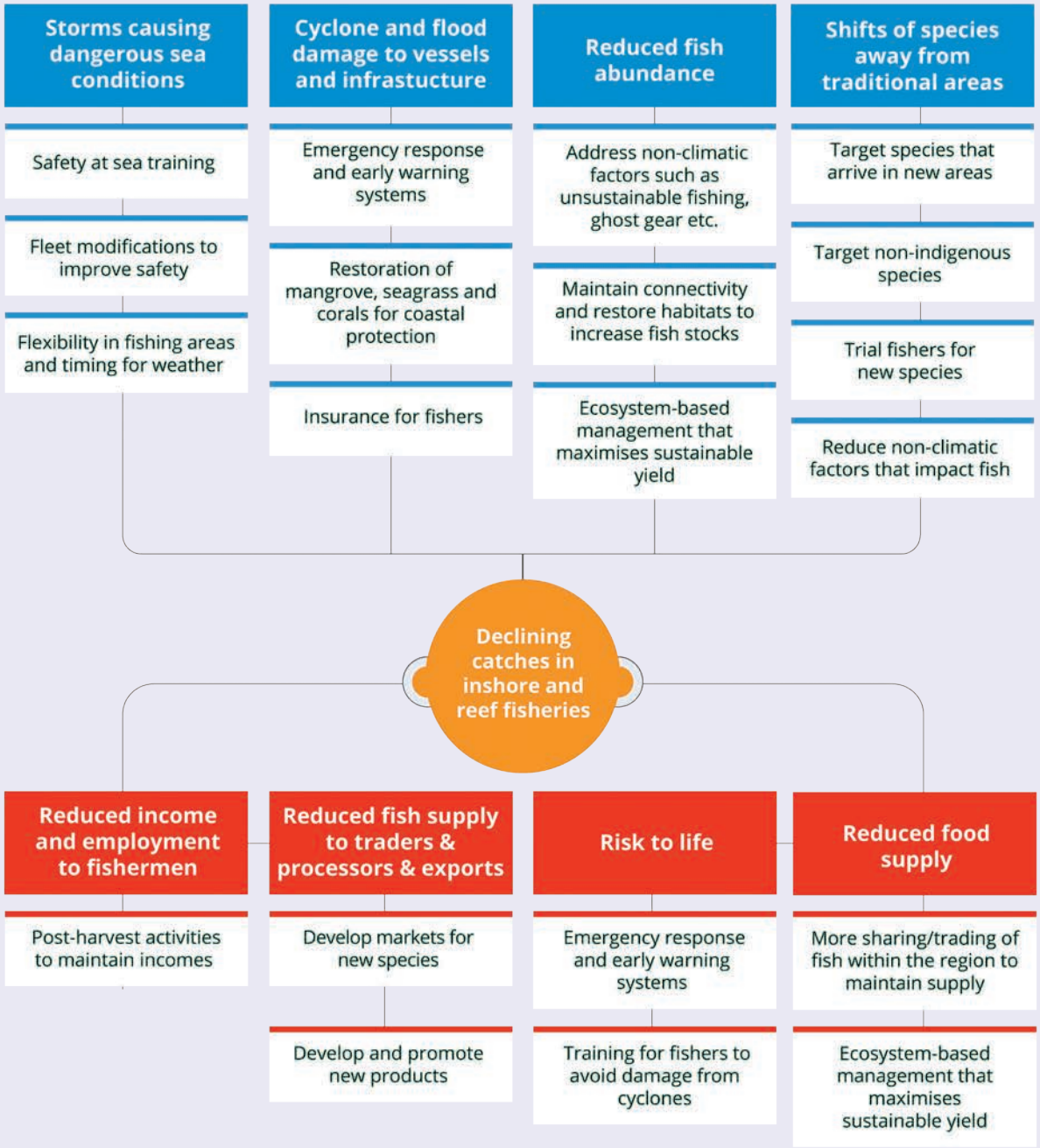
The adaptation actions identified are based on the outcome of the workshop and do not provide a fully comprehensive set or adaptation actions possible, not do they represent the formal views of the workshop participants.



ADAPTATION ACTIONS FOR INSHORE AND REEF FISHERIES



ADAPTATION ACTIONS FOR OFFSHORE AND PELAGIC FISHERIES



ADAPTATION OPTIONS FOR AQUACULTURE

NEXT STEPS

This Policy Brief, and the ROPME Fisheries Climate Resilience Workshop, have been undertaken as 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 that adaptation actions available to build resilience to climate risks.

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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With thanks to all workshop participants and their contributions.

REFERENCES

1. Sea Around Us (2016) www.seaaroundus.org
2. Hoegh-Guldberg *et al.* (2014) The Ocean. Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, 1655 - 1731.
3. AGEDI (2015) Technical report: Regional marine biodiversity vulnerability and climate change. LNRCCP. CCRG/UBC/Changing Ocean Research Unit/ Sea Around Us. Abu Dhabi Global Environmental Data Initiative (AGEDI), 62 pp.
4. Alothman *et al.* (2014) doi.org/10.1016/j.jog.2014.09.002
5. Oppenheimer *et al.* (2019) Sea Level Rise and Implications for Low-Lying Islands, Coasts and Communities. In: Pörtner *et al.* [Eds.]. IPCC Special Report on the Ocean and Cryosphere in a Changing Climate.
6. Murakami *et al.* (2013) doi.org/10.1007/s00382-1407--012z
7. NOAA Climate Change Web Portal_Maps MM (2018) https://psl.noaa.gov/ ipcc/
8. Alosairi *et al.* (2020) doi.org/10.1016/j.marpolbul.2020.111766.
9. Wabnitz (2018) doi.org/10.1371/journal.pone.0194537
10. Stramma *et al.* (2010) doi.org/10.1016/j.dsr.2010.01.005

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