

Australian Fisheries & Climate Change

Australian marine systems are undergoing rapid environmental change, with some of the largest climate-driven changes in the Southern Hemisphere. While rapid change is predicted to continue, the magnitude of change will differ place-to-place around Australia. These changes will flow on to affect local communities and Australian fishing businesses. The fishing industry and fisheries managers will need to integrate climate effects into both public policy and private enterprise to maintain sustainable fishing and profits in the medium to long term. Management that is coordinated across State and Commonwealth fisheries and has strong links with other users of marine waters will be best placed to cope. Keeping fisheries sustainable and profitable will also require information services that are updated regularly with the latest understanding of what Australia's climate, fish, ecosystems and fisheries are doing. Such information should highlight those species that may be at risk, those that might benefit, and what actions are needed to mitigate undesirable outcomes and make the most of any new opportunities.

Climate change has already arrived

Australia's oceans are undergoing rapid change, warming much more rapidly than most of the world's oceans and this is already affecting the ocean ecosystems. There have also been a series of marine heatwaves and other extreme events that have harmed Australia's seagrass, kelp forests, mangroves and coral reefs. Over 100 Australian marine species have moved towards cooler southern waters.

These changes in the distribution, abundance and species composition of Australia's marine ecosystems mean that Australia's fisheries are already being affected by climate change. More change will come as the ocean has a long memory, with the effects of past and present human activities locking the world in to a further 0.5-1 °C warming.

This is why fisheries managers (e.g. at AFMA) have asked for a thorough update of information around climate change and fisheries - they can base their strategic planning on the latest and best information.

Species sensitivities

Experts from around Australia have rated the sensitivity of Australia's key target species to climate change based on factors that effect:

- abundance (the age at which a species matures, how often they reproduce, the number of eggs, their diet and habitat needs);
- movement and spatial distributions (the distance they can move, their present geographic range, available habitats);
- behaviour (are specific cues needed to triggers for reproduction or migration, are there particular behaviours that only occur for short periods of the year)

Across all Australia 70% of all key target species are have moderate to high sensitivity in one of these factors. As a group, invertebrates have the highest sensitivities.

Model projections

The entire set of available models for Australian ecosystems were used to explore what future marine ecosystems might look like.

The modelling work found that the different ecosystems around Australia face different types and levels of climate change – including temperature changes, changes in rainfall patterns, ocean acidification, shifting ocean oxygen levels and differing levels of sea level rise and associated impacts on low lying areas. For fisheries as large as the SESSF, different parts of a fishery will be undergoing different levels of change. In most instances, larger changes in the climate led to larger model

responses. The tropics, however, might see some large changes despite only small effects because those effects will influence the productivity of phytoplankton that supports the entire food web and because inundation due to sea level rise has the potential to influence coastal processes.

The models indicate that changes to future ecosystems will be complicated. Some species will decline, but others will benefit and grow in abundance, though perhaps living in new locations. Demersal food webs, comprised of species that live near to or amongst habitats on the seabed, appear to be more strongly affected by climate change. Pelagic food webs, where species live up in the water column, appear less sensitive and may even benefit from the changes.

Next steps

Human responses to all these changes are an additional complexity when projecting the future. Well-informed decisions are one of the best ways of avoiding negative outcomes and maximising opportunities. AFMA has already begun the process of reviewing its management approaches and seeing how they can be adapted to be more climate robust

A nested approach – where models and vulnerability assessments are used to identify the most at risk species and locations – appears to be the best way of targeting monitoring and management responses.

A number of actions have been identified that can be taken to help fisheries adapt:

- A staged management response will likely be best. Management decision making will need to explicitly prioritize (i) easy actions (e.g. adjust the timing or location of management actions to ensure they continue to match fish behaviour and distributions), (ii) the most sensitive species and fisheries. (iii) Frank discussions will need to be held if environmental change reaches a level at which some species will no longer sustain harvests.
- Ecosystem changes will span state and national boundaries. Greater coordination is needed across all Australian jurisdictions and between all the users of the marine environment, especially conservation and fisheries management.
- Fisheries policy, management and assessment methods need to allow for the concept of regime shifts and

extreme events and for contextual management decision making. This will likely need new forms of management, as the old concepts are incompatible with the level of change occurring.

- A flexible no-regrets adaptive approach will be required so that action can be taken quickly and adjusted when new information becomes available.

Reliable information sources will be needed so that managers know when they need to adjust acceptable levels of fishing pressure and protection. This will require:

- high quality industry data (which is one of the longest running data sources on Australian fisheries);
- data collected by the broader community and ships of opportunity ('smart' phones have cameras, sensors and on-board computing power that is more powerful than what was available to scientists as little as a decade ago)
- data on the physical environment and the ecosystem - both so we can see what the current state is, but also so we can learn how the ecosystems changes and how processes function. Unfortunately, there are still fundamental gaps in our understanding of some important ocean processes, which means it is not yet clear what future primary productivity will look like around Australia. We need that information to provide reliable forecasts of the future.

Facing the challenge together

Change can bring uncertainty and anxiety. However, Australians have faced adversity before and by working together new approaches can be found to help provide sustainable fisheries now and into the future.

Partnerships, such as that between the CSIRO, its collaborators, fisheries managers and the fishing industry help deliver the information for good decision making, allowing fisheries to be better prepared in the face of climate change.



Photo: Australian fishing vessel (CSIRO).

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