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Research excellence supporting a sustainable ocean

CLIMATE CHANGE AND FISHERIES

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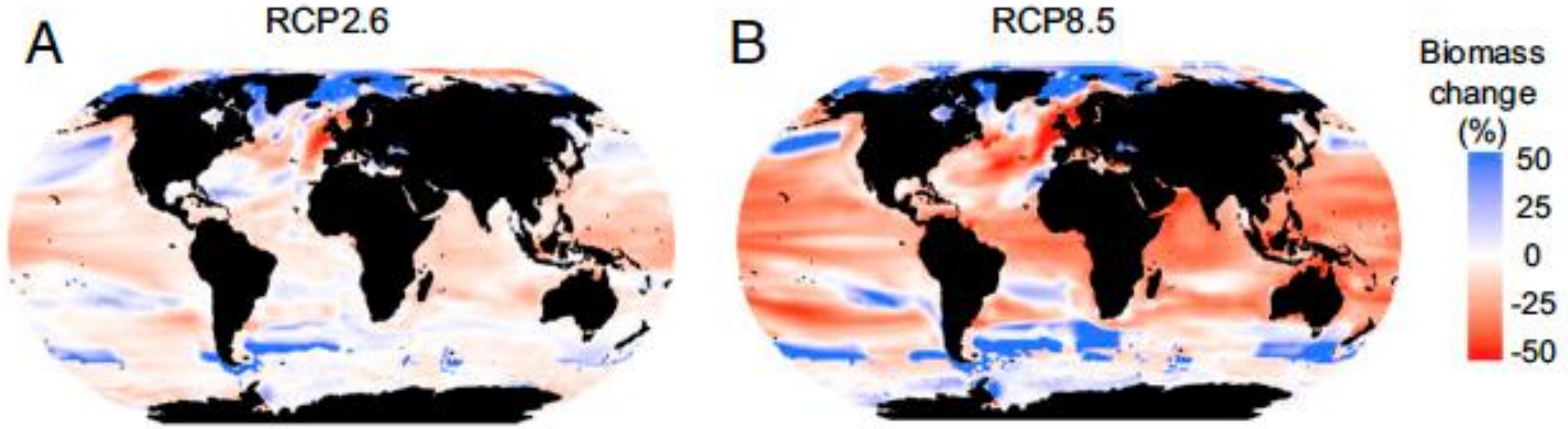
QUICK BACKGROUND

IMPACT OF CLIMATE ON FISH BIOMASS

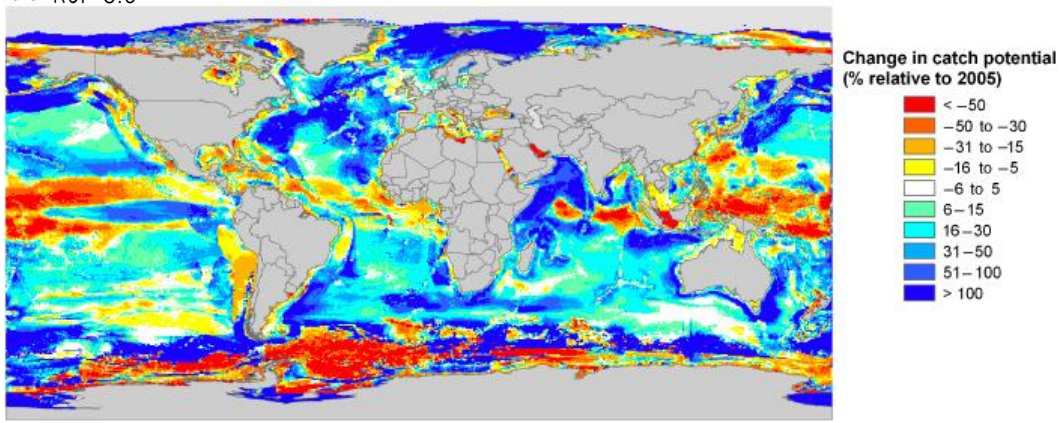


Percent change in total biomass in 2090–2099 relative to 1990–1999 *without* fishing.
Poleward migration and stronger effect in equatorial and tropical regions.

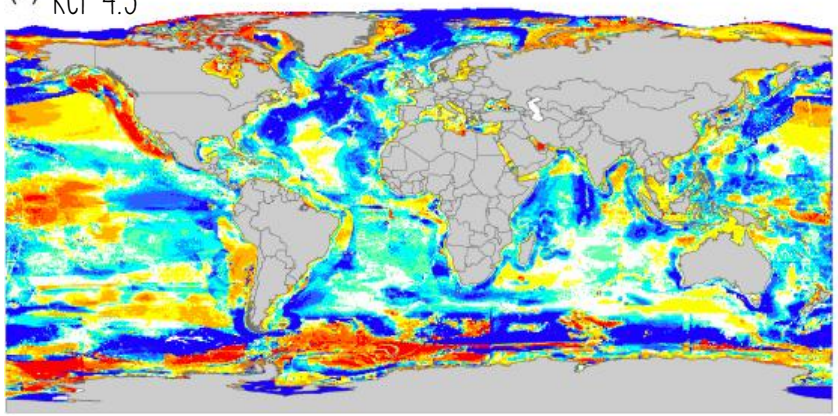
Lotze, H. K., Tittensor, D. P., Bryndum-Buchholz, A., Eddy, T. D., Cheung, W. W. L., Galbraith, E. D., ... Worm, B. (2019). Global ensemble projections reveal trophic amplification of ocean biomass declines with climate change. *Proceedings of the National Academy of Sciences*, *116*(26), 12907-12912. https://doi.org/10.1073/pnas.1900194116

IMPACT OF CLIMATE CHANGE ON CATCH

(a) "RCP 8.5"



(b) "RCP 4.5"

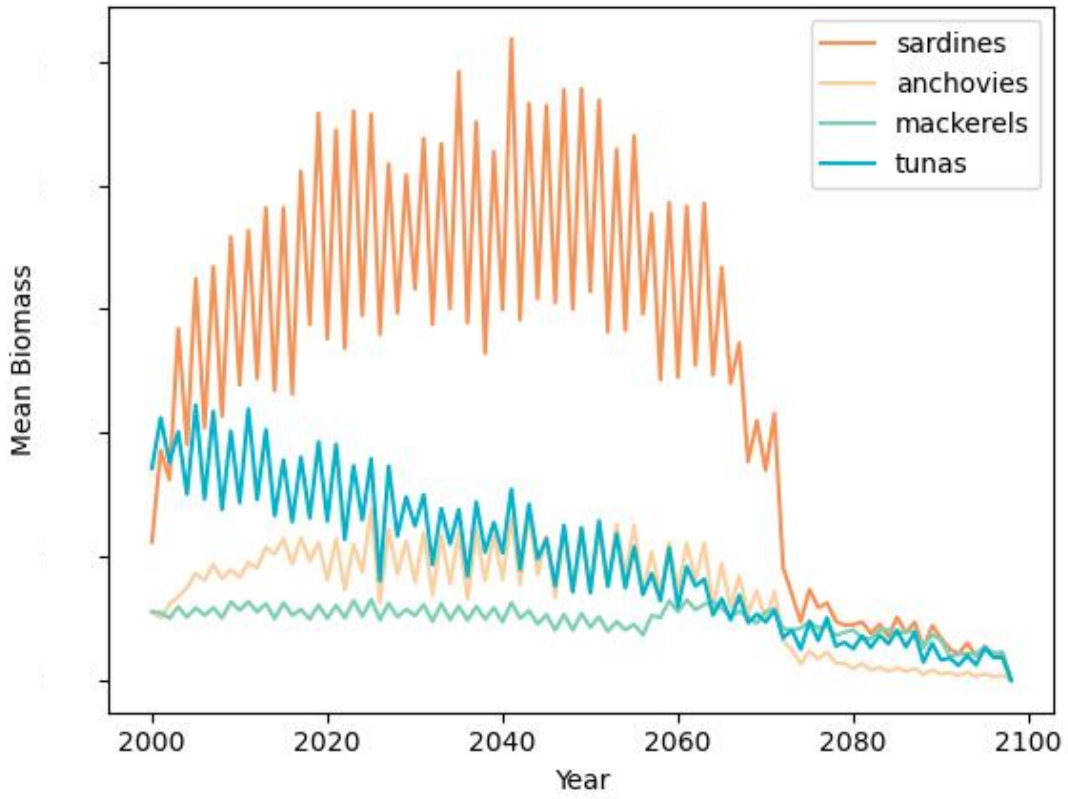


- Impact on maximum *potentia*l catch, comparing 2000-2009 to 2050-2059
- Decline in coastal water
- Potential increase in off-shore high latitude

CHEUNG, W. W. L., LAM, V. W. Y., SARMIENTO, J. L., KEARNEY, K., WATSON, R., ZELLER, D., & PAULY, D. (2010). Large-scale redistribution of maximum fisheries catch potential in the global ocean under climate change. *Global Change Biology*, *16*(1), 24-35. https://doi.org/10.1111/j.1365-2486.2009.01995.x

INDIA RELEVANT PROJECTIONS

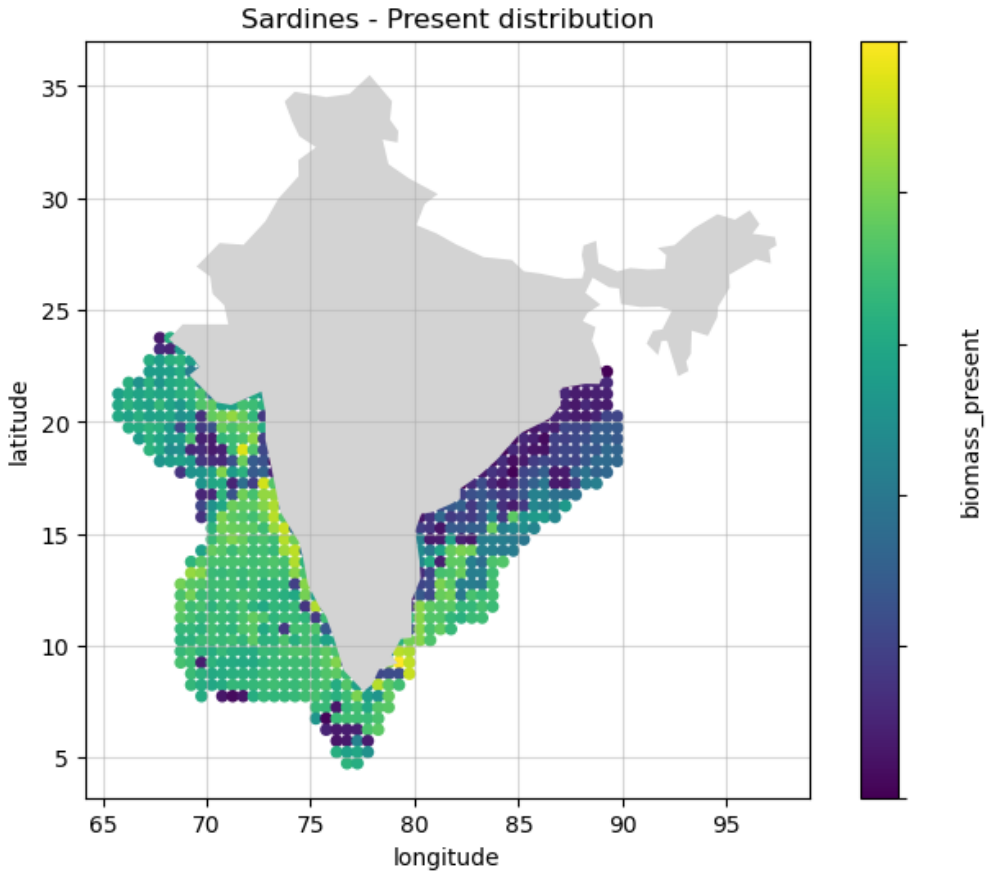
IMPACT OF CLIMATE CHANGE ON KEY FISH

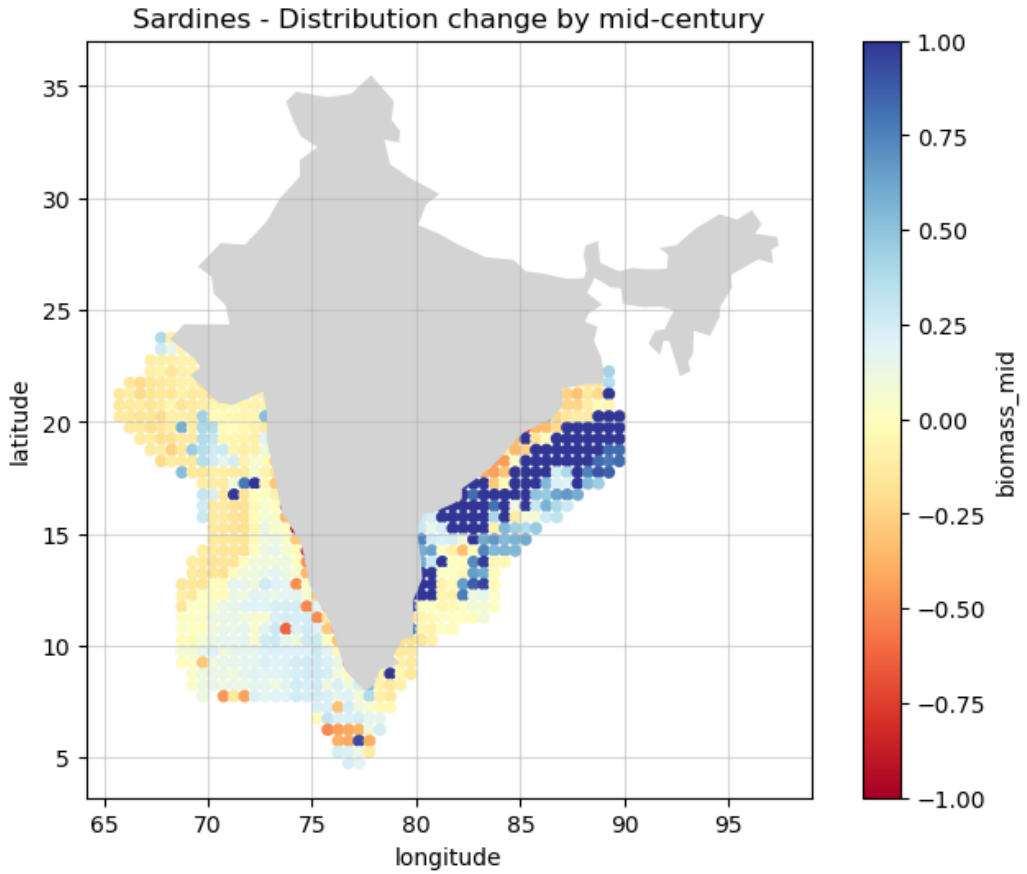


- Fish biomass model run done using RCP8.5 climate scenario (high emissions, no mitigations)
- The model is species specific, but here grouped by type of fish (9 sardines, 3 anchovies, 6 mackerels and 6 tunas)
- Outputs averaged over India's EEZ

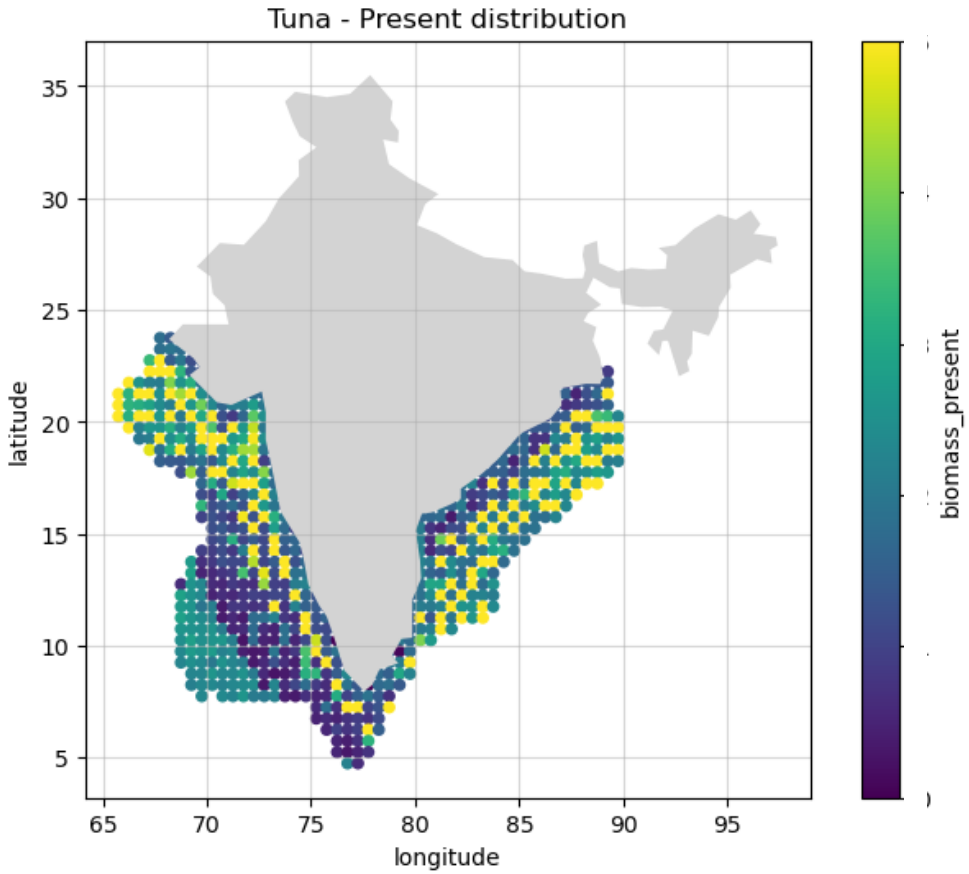
- Was done for a Western Indian Ocean project (results published - Wilson, Sailley et al., 2021, 10.1016/j.ocecoaman.2021.105921)

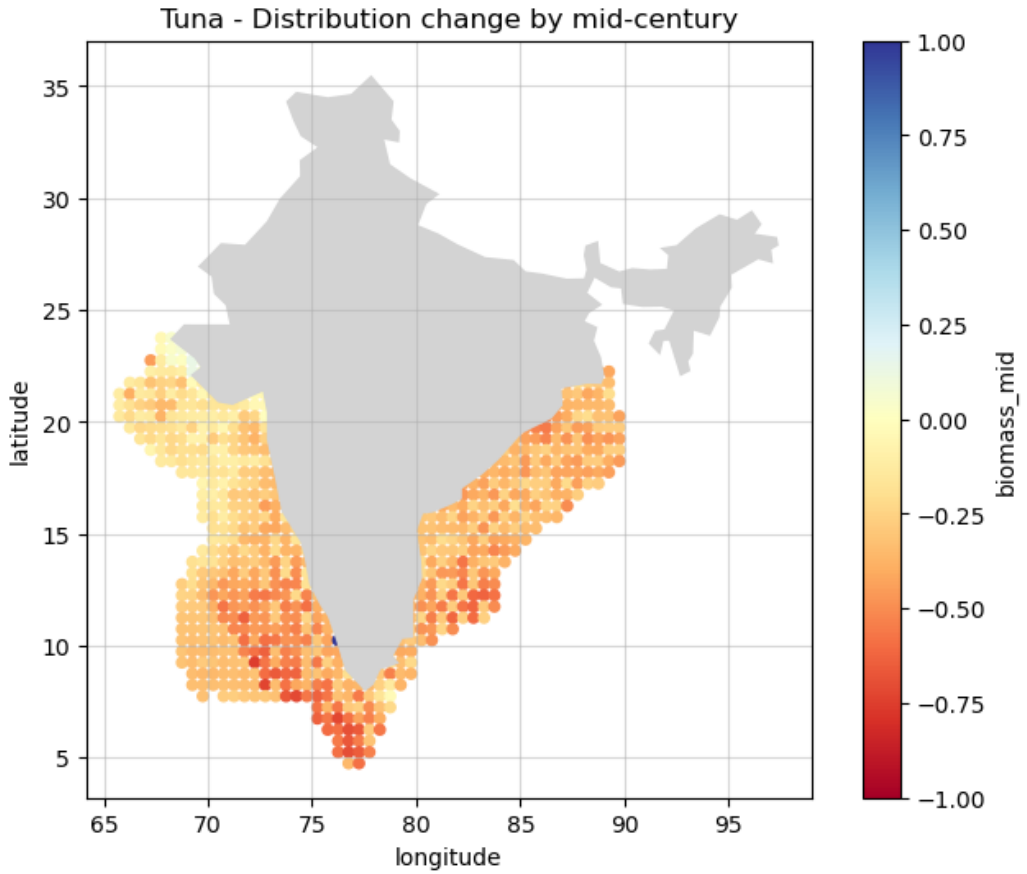
IMPACT OF CLIMATE CHANGE ON SARDINES



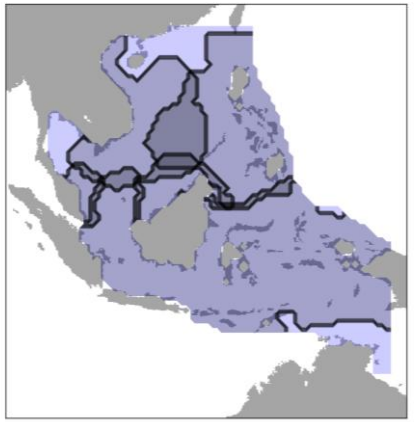


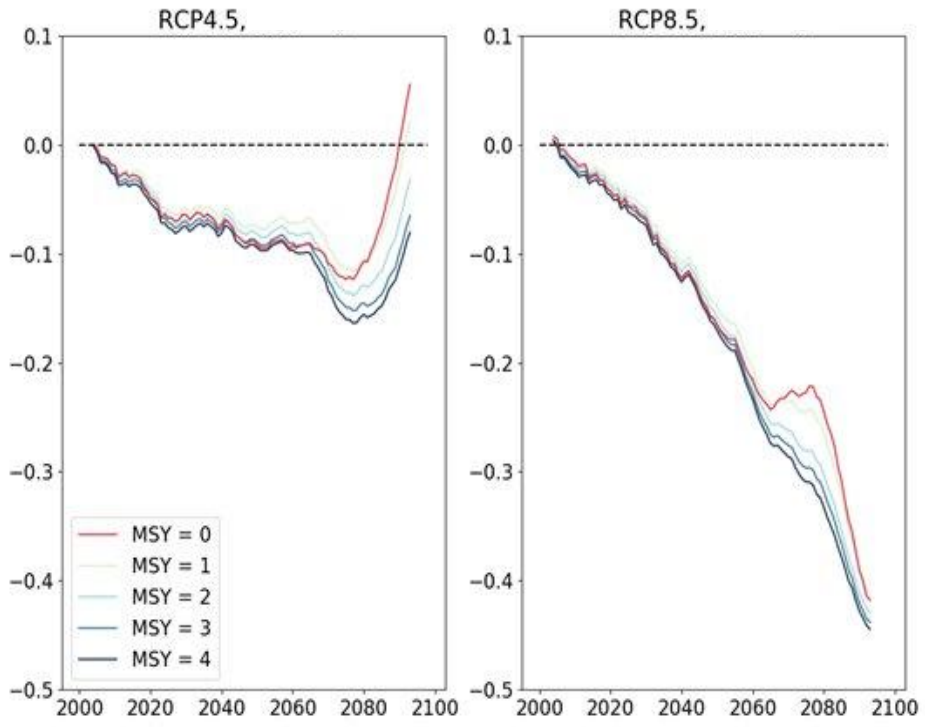
IMPACT OF CLIMATE CHANGE ON TUNA





INTERACTION BETWEEN FISHING AND CLIMATE





- Comparison of impact of fishing at ditterent Maximum Sustainable Yield
- Exacerbate the effect of climate - can delay recovery and accelerate decline.

- From past project in South-East Asia (Sailley, Kay, et al., Impact of climate and fishing effort on the productivity and diversity of the Southeast Asia Seas fisheries. In prep)

KEY POINTS

- Climate will have an impact on abundance and distribution of fish.
- Potential for high contrast between species and regions.
- Management of fisheries within sustainable yield is crucial for mitigating effect of climate change.

NOTES

- Climate and fishing are not the only stressors.

- Marine planning has to account for multiple – often competing – interests

- All the points made apply to aquaculture as well, while distribution will remain unchanged there is the potential for reduction of growth of the farmed species due to reduced suitability of the site

SUSTAINABLE MANAGEMENT THAT IS CLIMATE RESILIENT

(UK EXAMPLE)

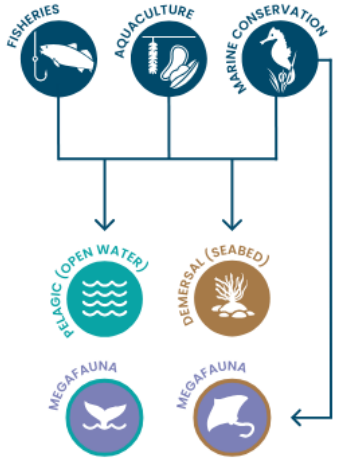
CLIMATE-SMART MANAGEMENT OF UK SEAS

Climate change is already affecting species and habitats in UK seas. These effects are set to markedly increase if greenhouse gas emissions continue to rise and accelerate global warming. Given this urgency, more specific guidance and support is needed to enable planners and other marine managers to implement climate-smart solutions.

This infographic illustrates the projected impacts of climate change on the marine conservation, fisheries, and aquaculture sectors in the UK Exclusive Economic Zone (EEZ), by showing where, and for how long, environmental conditions remain favourable for these sectors over this century.

1

The effects of **climate change** on **fisheries**, **aquaculture** and **marine conservation** were explored for pelagic (open water) and demersal (seabed) environments. Megafauna were analysed for marine conservation only.



2

State of the art **climate modelling** was used to simulate **two emissions scenarios**:

1. **2°C global warming future** — **moderate emissions scenario**
2. **4°C global warming future** — **high emissions scenario**

3

Each area of the UK EEZ was then categorised according to whether they would become '**Climate Change Hotspots**' or '**Climate Change Refugia**'.

- **Climate Change Hotspots**
  = areas where climate-related pressures drive the natural ecosystem into a different state **(a negative effect)**.
- **Climate Change Refugia**
  = areas that exhibit long-term climate change resilience **(remaining similar to present day)**.

4

FISHERIES

Identified **widespread long-term Climate Change Refugia could support pelagic fisheries** under a moderate emissions scenario, but are **greatly reduced under high emissions**.

Climate change impacts are expected to be widespread by mid-century under both emissions scenarios. **Management measures may support more resilient target species** (e.g. hake and saithe).

AQUACULTURE

Under both emission scenarios, Climate Change **Hotspots would emerge throughout the UK EEZ** and may **reduce the growing potential of currently farmed species in coming decades**.

Under both emissions scenarios, widespread Climate Change **Refugia could support sector expansion for shellfish aquaculture.**

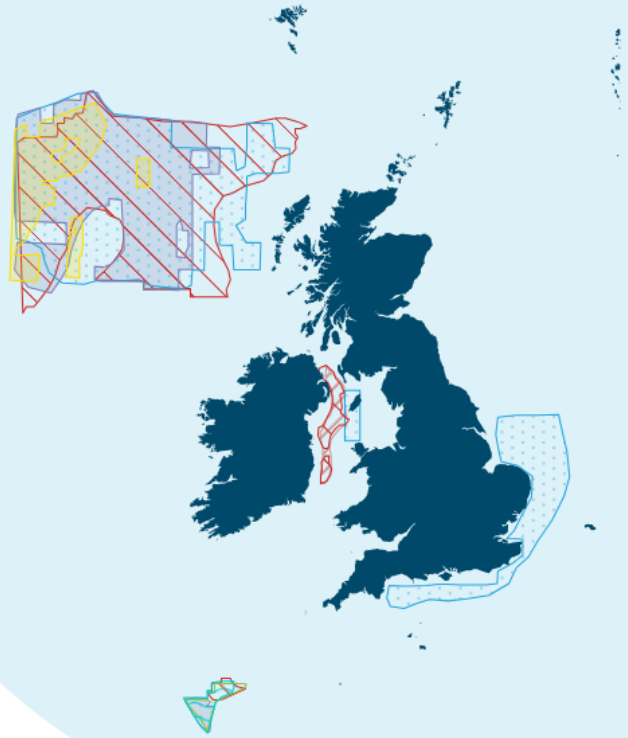
MARINE CONSERVATION

Under a moderate emissions scenario, Climate Change **Refugia are expected to be widespread**, but are substantially reduced by the next decade under high emissions.

Under both emissions scenarios, Climate Change **Hotspots are widespread** as early as the **2030s**.

Climate Change **Hotspots are expected to encompass many existing conservation sites**, but some long-term climate change refuges could be identified. Other uses of the marine environment may exacerbate climate effects.

Under a moderate emissions scenario, Climate Change **Refugia are expected to be widespread**, but are **substantially reduced under high emissions**.



This map illustrates the **location of sites identified as long-term marine Climate Change Refugia**, with high confidence (both emissions scenarios assessed).

Map key:

- PELAGIC FISHERIES
- DEMERSAL FISHERIES
- PELAGIC MEGAFAUNA
- DEMERSAL MEGAFAUNA
- PELAGIC AQUACULTURE
- DEMERSAL AQUACULTURE
- DEMERSAL HABITATS

*Pelagic habitats were not visualised from this analysis because there were no long-term Climate Change Refugia when both emissions scenarios were assessed together.

5

Conclusions:

- Spatially explicit strategies are now needed to address the effects of climate change though marine planning and other spatial management mechanisms across the UK nations and regions.
- Identified marine Climate Change Refugia could be used as part of those strategies, focused on sites that exhibit natural climate change resilience. The location of identified marine Climate Change Hotspots may be used, in turn, to inform the development of spatially explicit climate change adaptation strategies.
- Impacts may arrive earlier and be more widespread under high emissions. Strong curbs to greenhouse gas emissions represent the best hope for UK marine ecosystems, and a sustainable blue economy.

The summary report and full report can be found here.

MSPACE Marine Spatial Planning Addressing Climate Effects

MCCIP Marine Climate Change Impacts Partnership

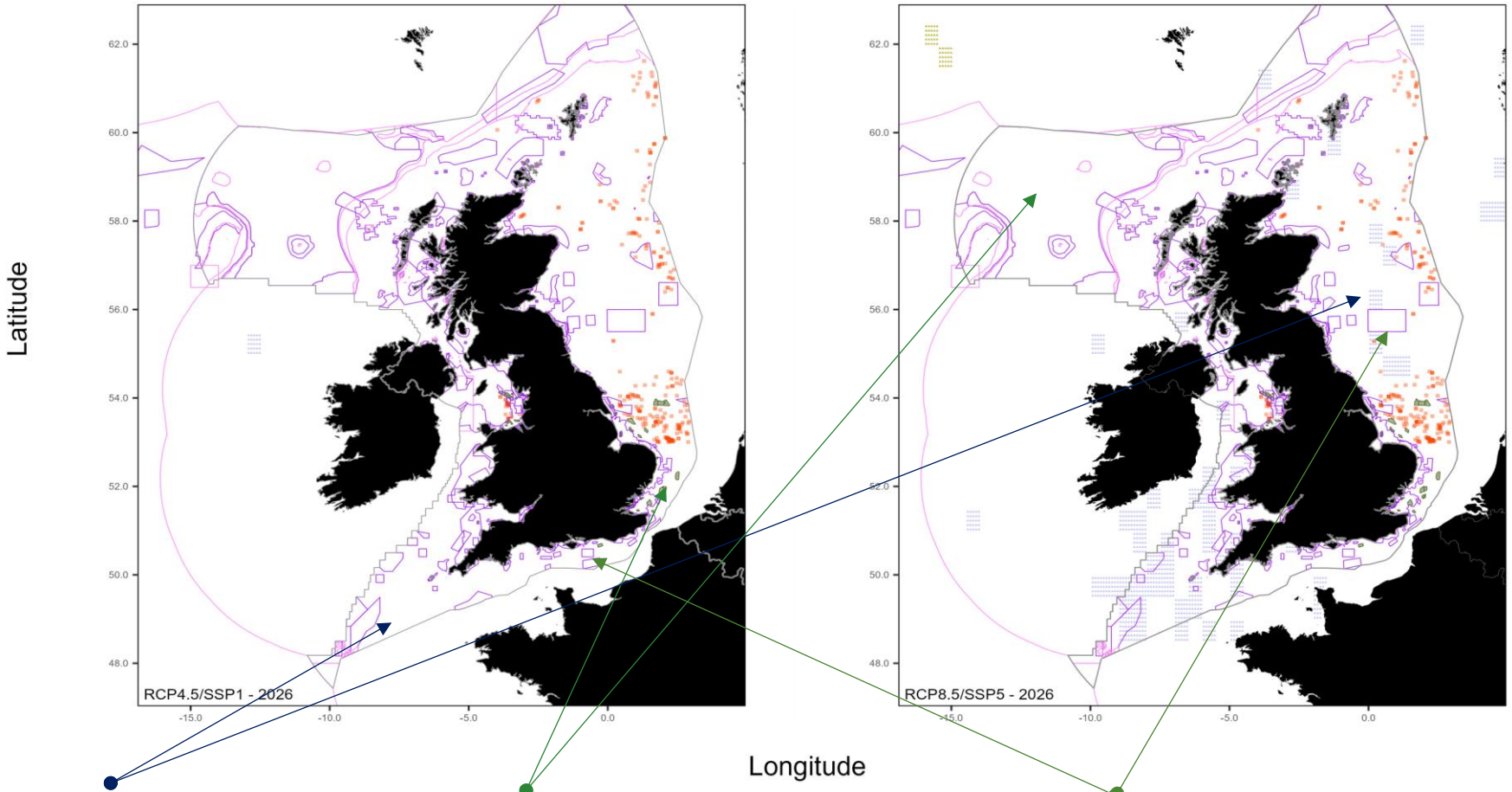
Curated by Mindfully Wired Communications

Speaker: Dr Ana Queiros anqu@pml.ac.uk @DrAna Queiros

Early warning system example: UK pelagic fisheries under climate change

Oil/gas platform
MPA
Climate change hotspot
Wind farm
Restricted fishing (pelagic gears)
Climate change brightspot

Introduces time dimension to MSP / EBM.



Vulnerabilities **Opportunities (within sector)** **Opportunities (cross-sector synergies)**

MSPACE Project: @mspace_uk

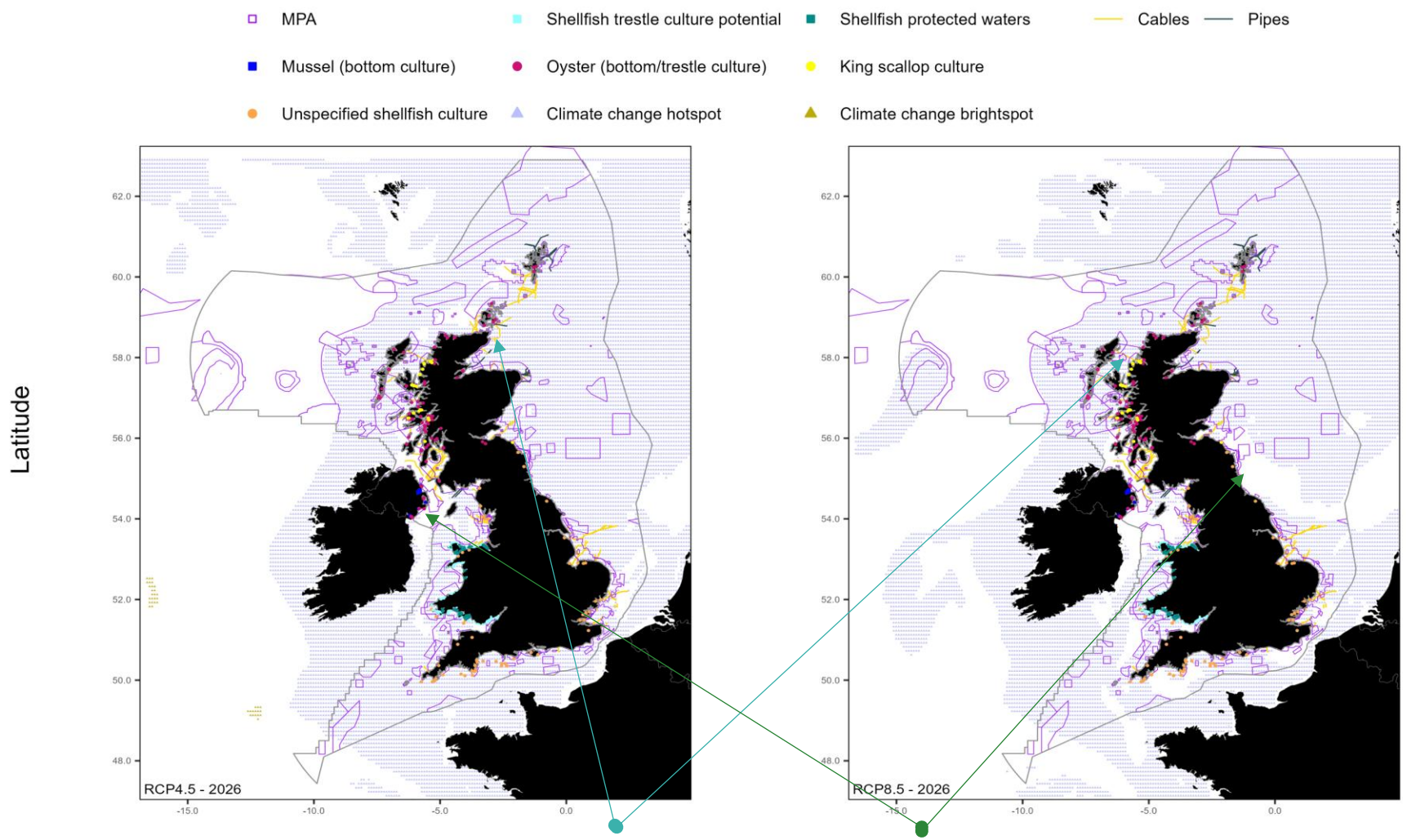
Natural Environment Research Council

MSPACE Marine Spatial Planning Addressing Climate Effects

Credit: Queirós et al. MCCIP, https://www.mccip.org.uk/all-uk/solutions/mspace

Speaker: Dr Ana Queiros anqu@pml.ac.uk @DrAna Queiros

Early warning system example: UK benthic aquaculture under climate change



MSPACE Project: @mspace_uk

Natural Environment Research Council

MSPACE Marine Spatial Planning Addressing Climate Effects

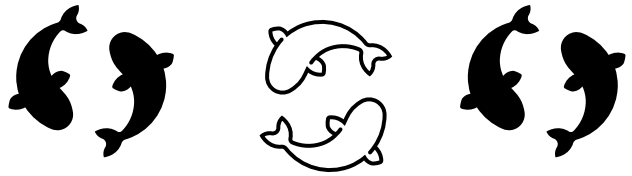
Credit: Queirós et al. MCCIP, https://www.mccip.org.uk/all-uk/solutions/mspace

CONCLUSION

- Climate change effects without any mitigation are serious. Mitigation is important

- It isn't "Doom and Gloom" careful management and mitigations measures can preserve fish biomass and the livelihood of communities reliant on it.

- Tools exist and are being developed to support climate resilient marine planning



THANK YOU FOR YOUR ATTENTION