Pacific Coastal Fisheries and Climate Change

David Welch, Johanna Johnson, Elizabeth Fulton, Julia Blanchard, Brad Moore, Denisse Fierro Arcos, Katie Sambrook, Jessica Zamborain-Mason, Andrew Halford, Bianca Molinari and Dieter Tracey

C2O Fisheries
Coasts | Climate | Oceans

University of Tasmania
IMAS
Institute for Marine and Antarctic Studies

Pacific Community
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Today

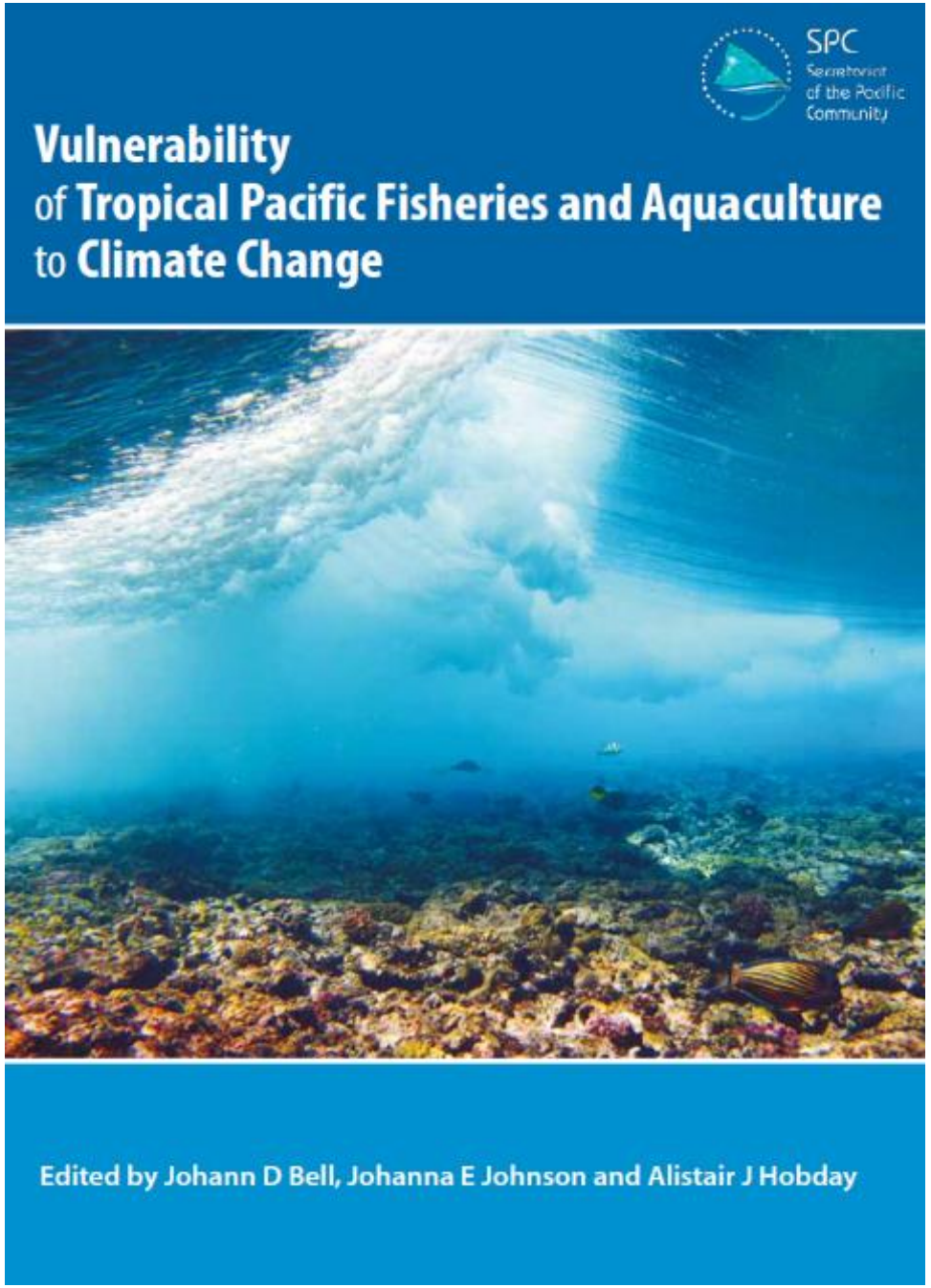
What we'll cover

- Direct and indirect impacts of climate change to Pacific coastal fisheries.
- Projected impacts of climate change on Pacific coastal fisheries catches.
- Status of and adaptive capacity of Pacific coastal fisheries.

What we won't cover

- Deepwater fisheries
- Aquaculture
- Impacts to fishing infrastructure, markets and economies

This presentation is based on the coastal fisheries chapter for the updated Vulnerability Assessment; results are preliminary



Pacific coastal fisheries



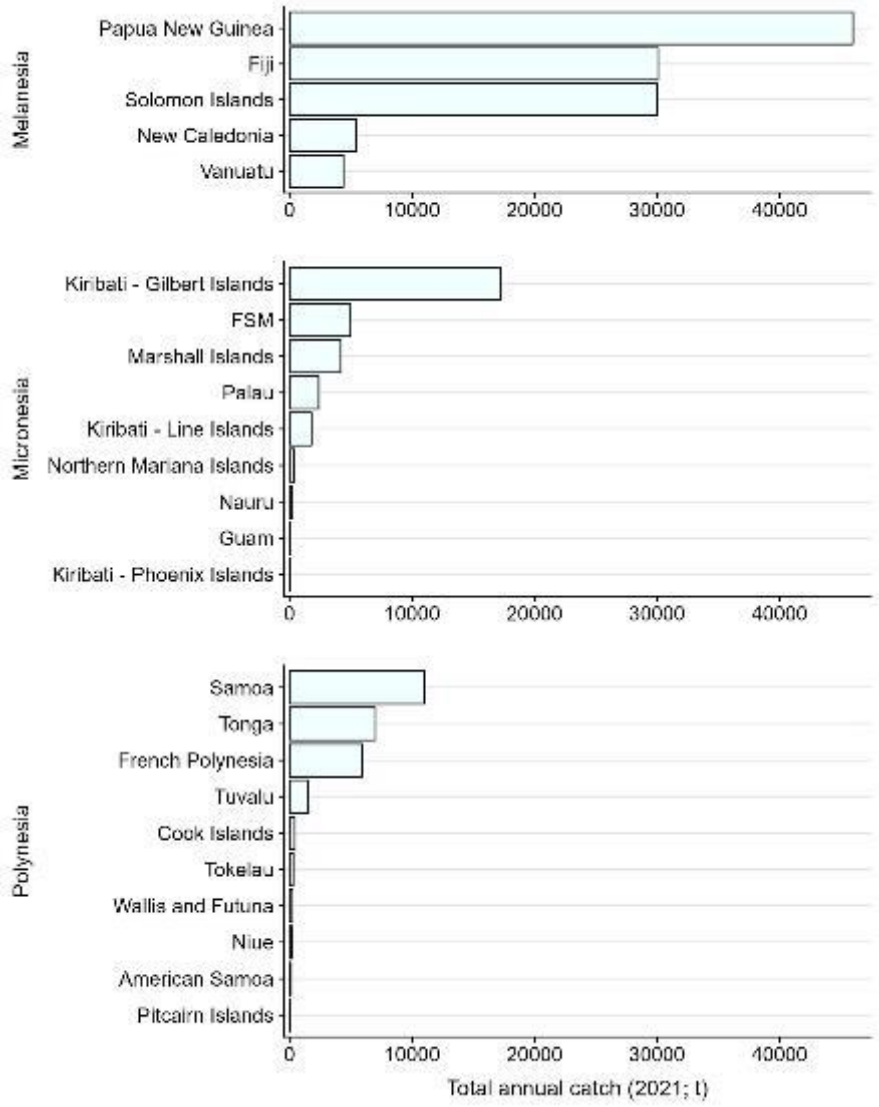




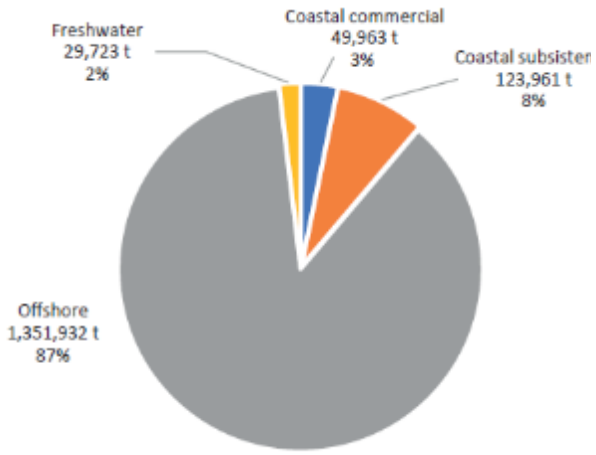




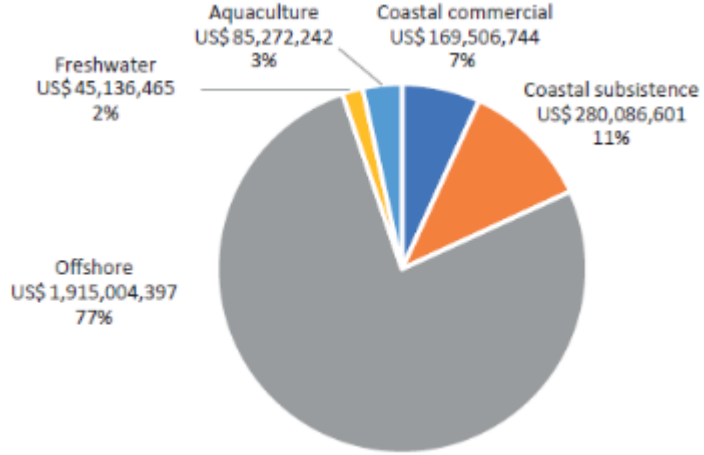

Pacific coastal fisheries



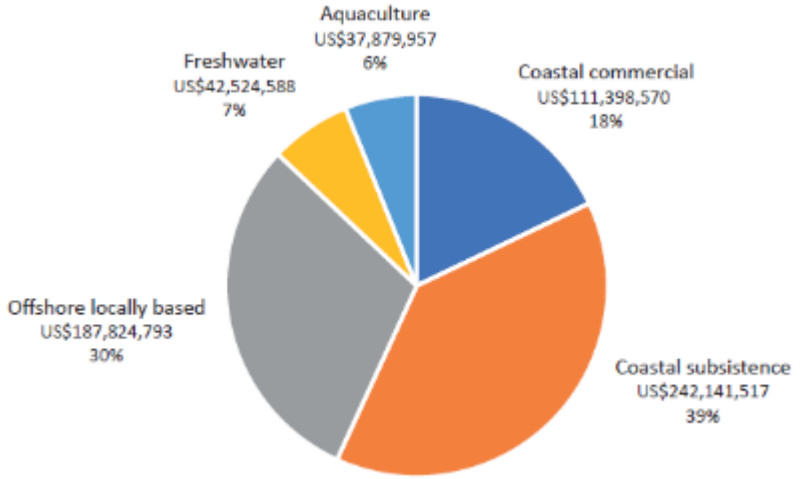
Volume (t)



Value (USD)



Contribution to GDP



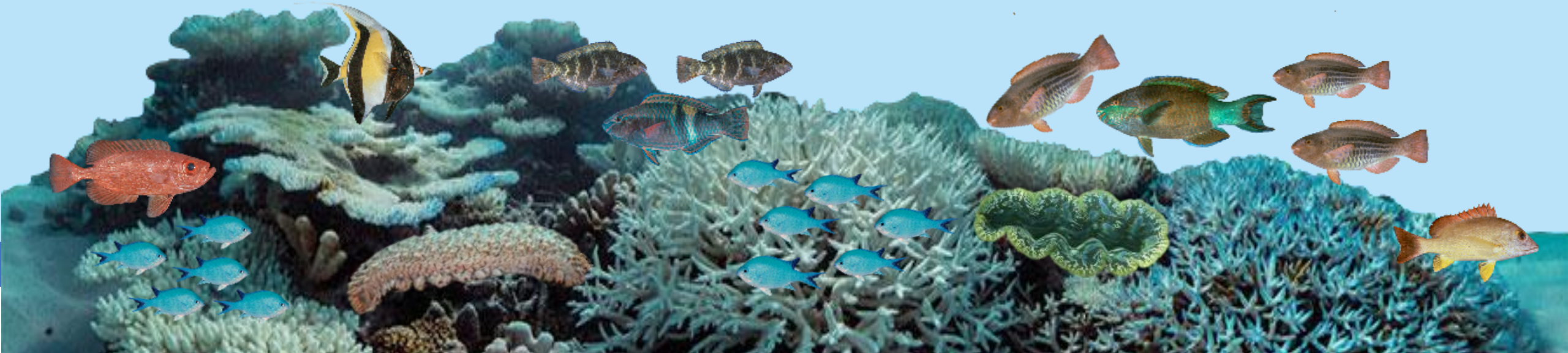
Gillett & Fong (2023; Benefish study)

Climate change impacts to coastal fisheries

Indirect:
Impacts to habitats

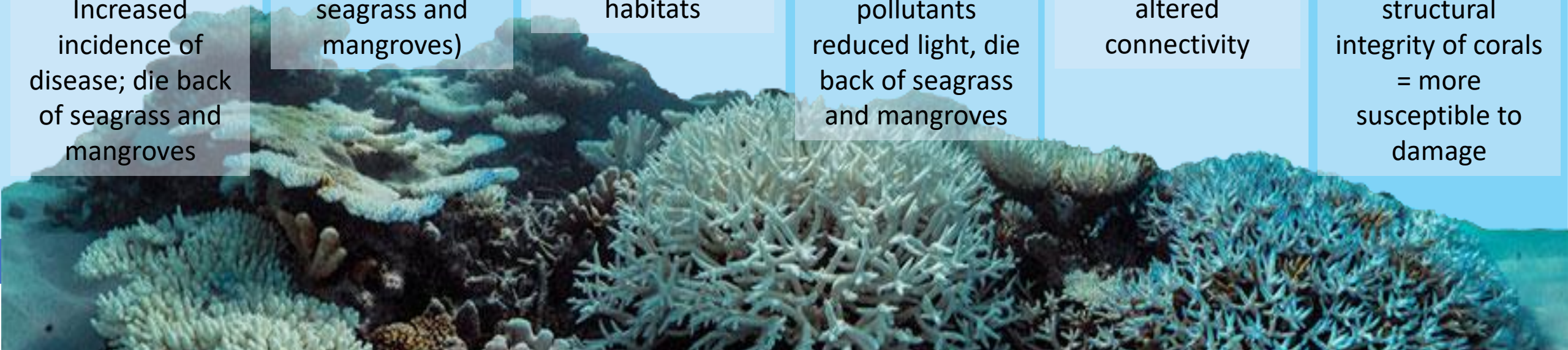
Direct:
Impacts to species

Effects will vary by species, life stage, spatially, temporally…
Compound effects (e.g. changes in predator-prey relationships, food web dynamics, and competition)



Impacts to habitats

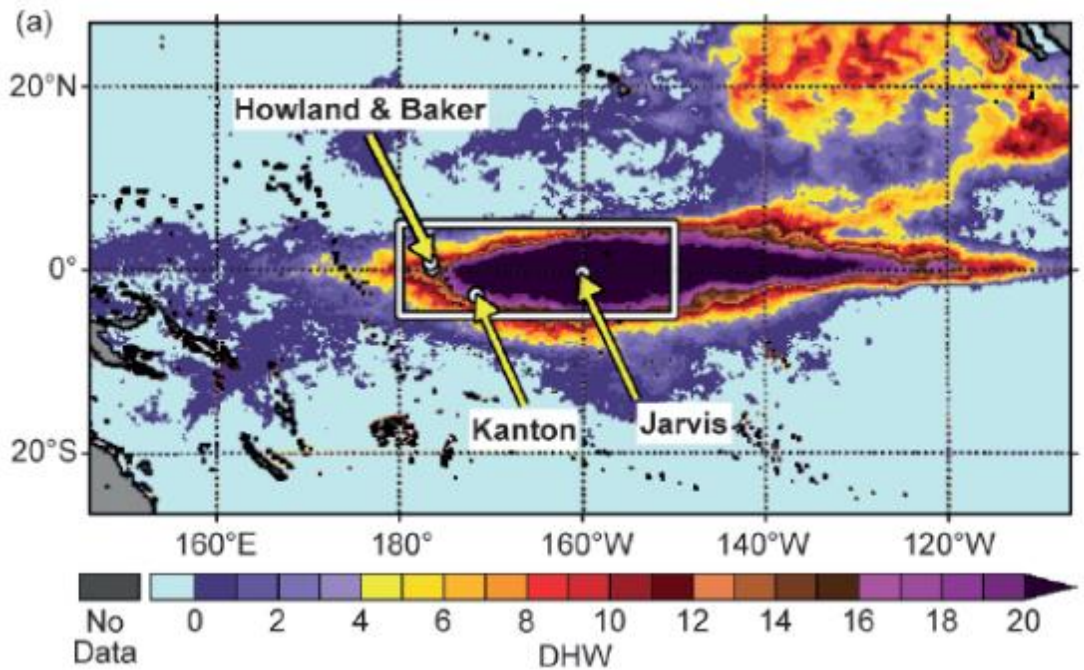
Warming ocean Marine heatwaves	Changes in sea levels	Changes in storm patterns	Changes in rainfall	Altered ocean currents	Ocean acidification
Thermal stress Deoxygenation	Rising sea levels	More intense storms and cyclones(?)	Increased / decreased runoff of freshwater, droughts	Reduced upwelling; Strengthening / weakening of ocean currents	Reduction in pH levels
e.g. Coral bleaching, Increased incidence of disease; die back of seagrass and mangroves	e.g. Drowning of habitats (esp. seagrass and mangroves)	e.g. Physical destruction of habitats	e.g. Increased sedimentation, pollutants reduced light, die back of seagrass and mangroves	e.g. Changes in food availability; altered connectivity	e.g. Decreased growth rates and structural integrity of corals = more susceptible to damage

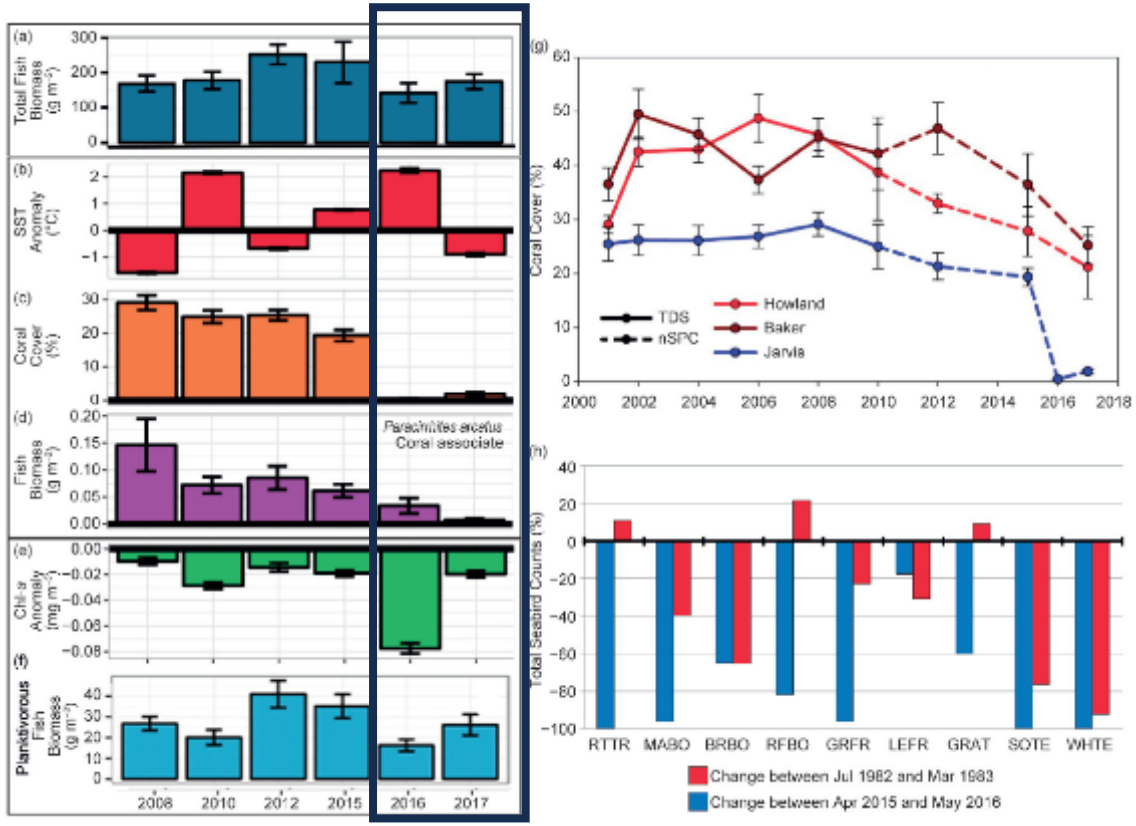


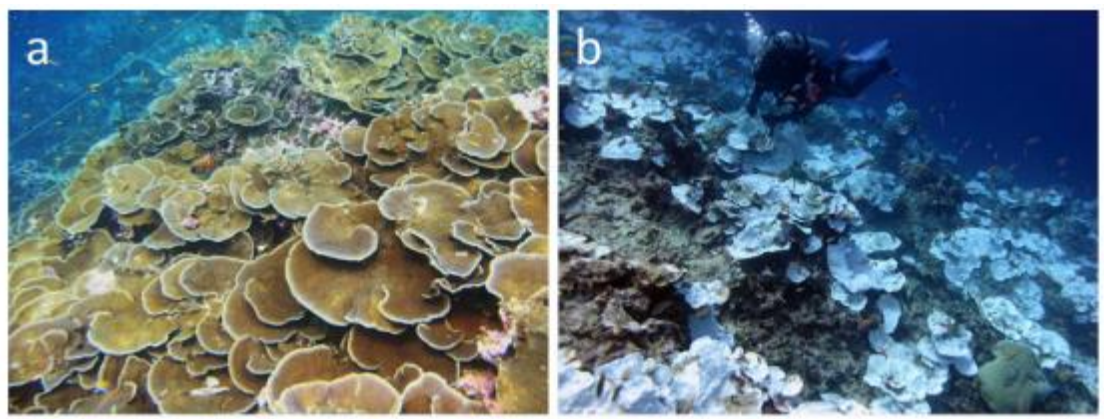
5. ECOLOGICAL IMPACTS OF THE 2015/16 EL NIÑO IN THE CENTRAL EQUATORIAL PACIFIC

Russell E. Brainard, Thomas Oliver, Michael J. McPhaden, Anne Cohen, Roberto Venegas, Adel Heenan, Bernardo Vargas-Ángel, Randi Rotjan, Sangeeta Mangubhai, Elizabeth Flint, and Susan A. Hunter

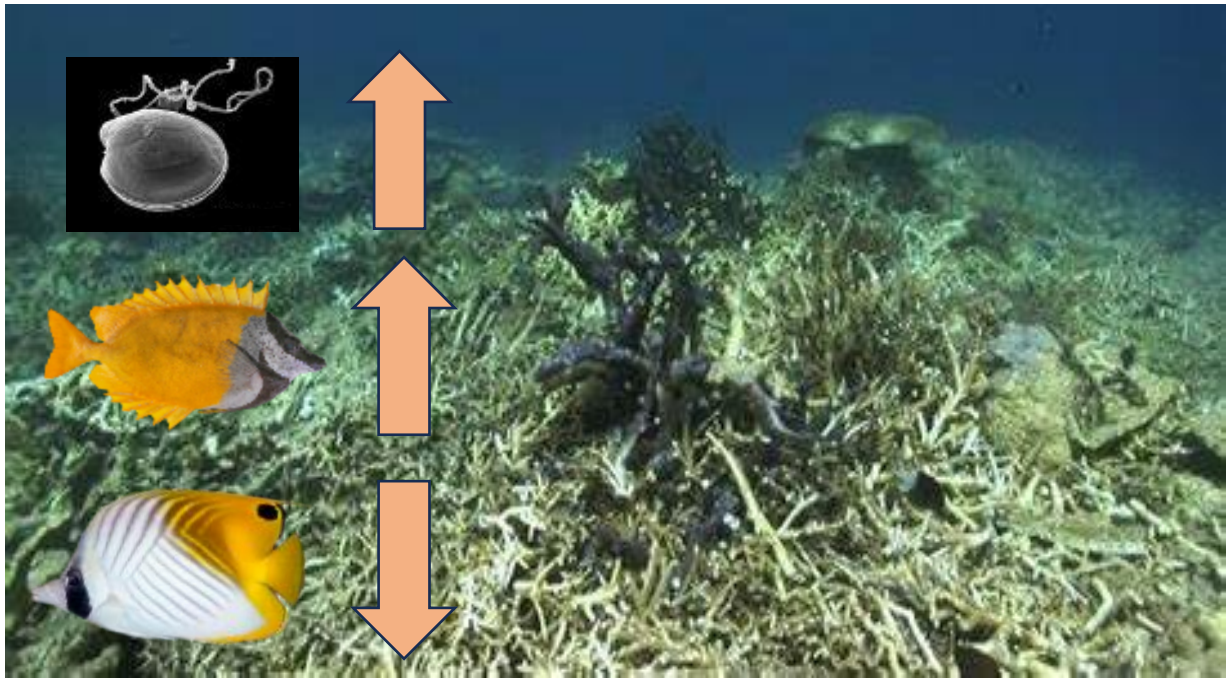
Coral reef and seabird communities in the central equatorial Pacific were disrupted by record-setting sea surface temperatures, linked to an anthropogenically forced trend, during the 2015/16 El Niño.

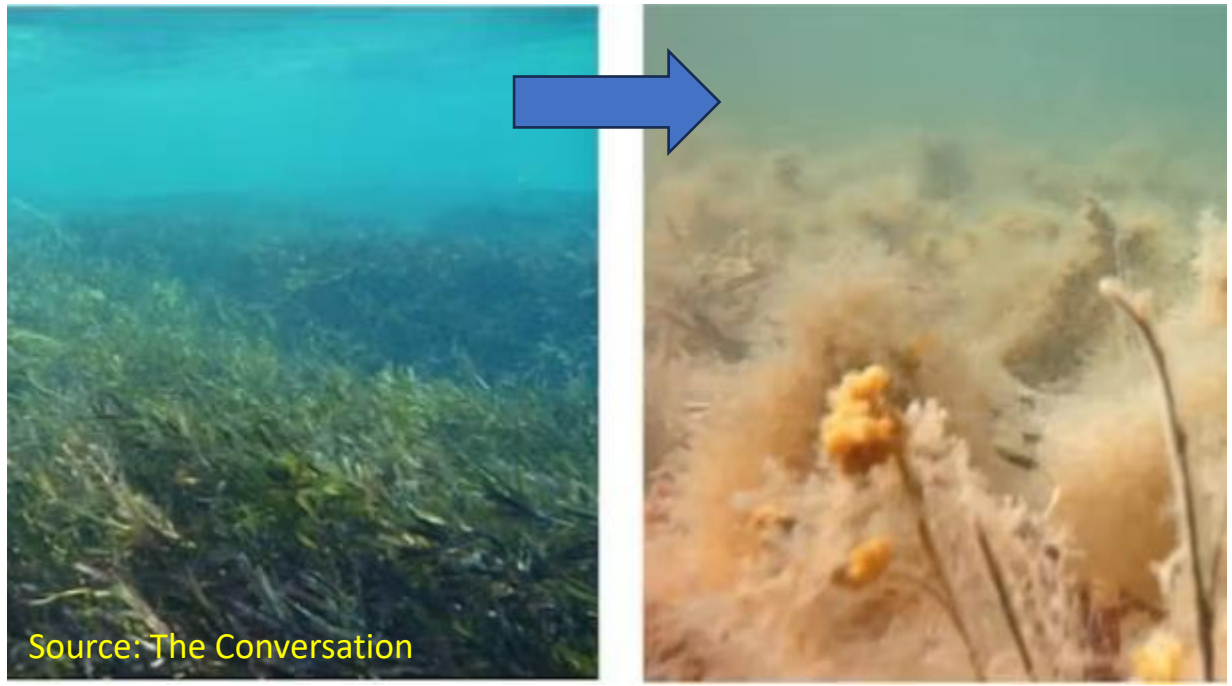






Vargas-Ángel et al. 2019 Coral Reefs




Source: The Conversation

Impacts to species

Warming ocean
Marine heatwaves

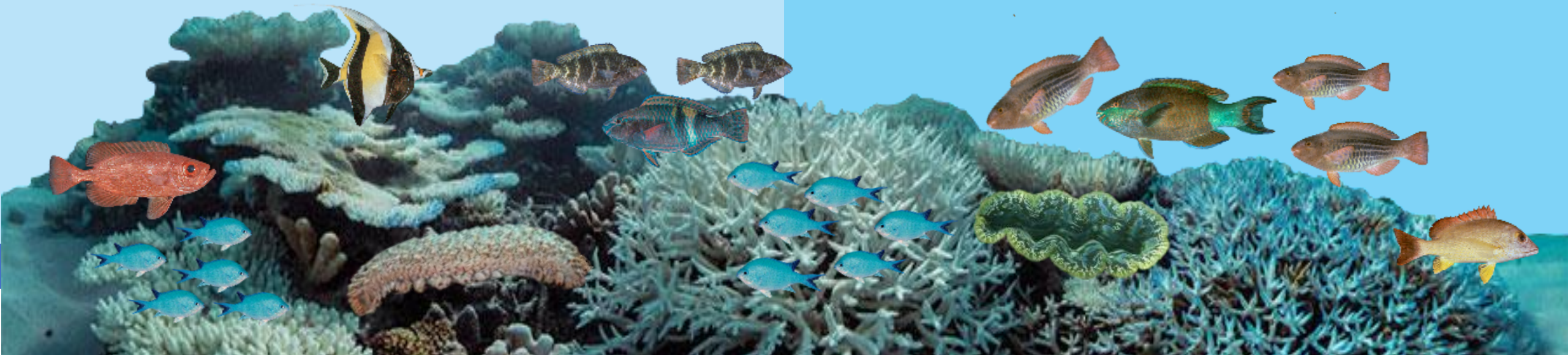
Thermal stress
Deoxygenation

e.g. Changes in distribution, growth, reproduction, fish kills

Ocean acidification

Reduction in pH levels

e.g. Changes in behaviour, impacts to calcification






NAS

Warming-induced reductions in body size are greater in aquatic than terrestrial species

Jack Forster[a], Andrew G. Hirst[a,1], and David Atkinson[b]

[a]School of Biological and Chemical Sciences, Queen Mary University of London, London E1 4NS, United Kingdom; and [b]Institute of Integrative Biology, University of Liverpool, Liverpool L69 7ZB, United Kingdom

Edited by James H. Brown, University of New Mexico, Albuquerque, NM, and approved October 2, 2012 (received for review June 22, 2012)

LETTERS

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nature climate change

Shrinking of fishes exacerbates impacts of global ocean changes on marine ecosystems

William W. L. Cheung[1]*, Jorge L. Sarmiento[2], John Dunne[3], Thomas L. Frölicher[2], Vicky W. Y. Lam[1], M. L. Deng Palomares[1], Reg Watson[1] and Daniel Pauly[1]

ELSEVIER

Science of The Total Environment

Volume 858, Part 1, 1 February 2023, 159804

Ocean acidification alters the acute stress response of a marine fish

Arianna Servili [a], Etienne Lévêque [a], Olivier Mouchel [a], Jimmy Devergne [a], Christophe Lebigre [b], Sabine Roussel [a], David Mazurais [a], José-Luis Zambonino-Infante [a]

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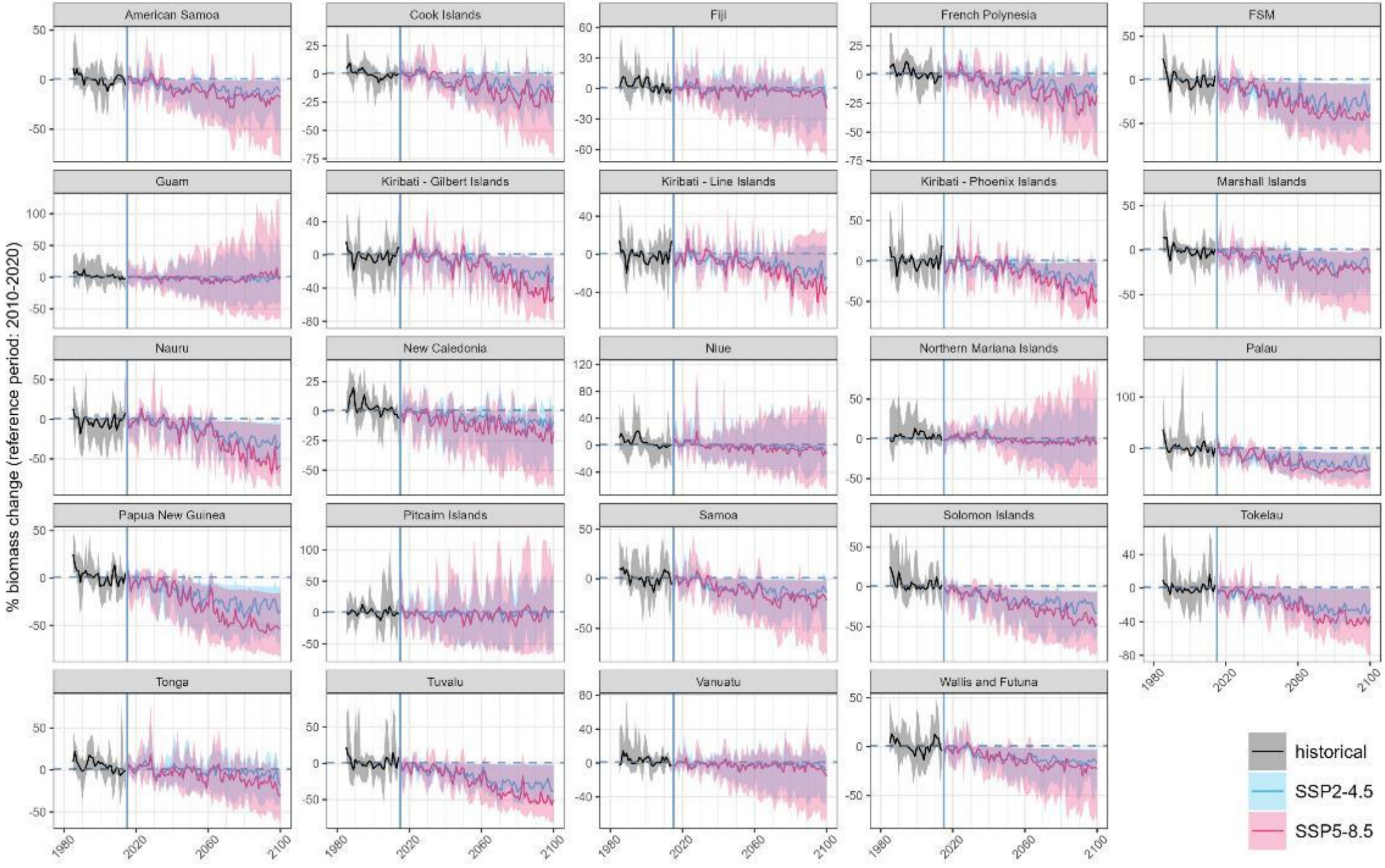
Elevated CO_2 affects anxiety but not a range of other behaviours in juvenile yellowtail kingfish

Michael D. Jarrold [a], Megan J. Welch [a], Shannon J. McMahon [a], Tristan McArley [b], Bridie J. M. Allan [a,c], Sue-Ann Watson [a,d], Darren M. Parsons [b,e], Stephen M.J. Pether [f], Stephen Pope [e], Simon Nicol [g], Neville Smith [h], Neill Herbert [b], Philip L. Munday [a,*]

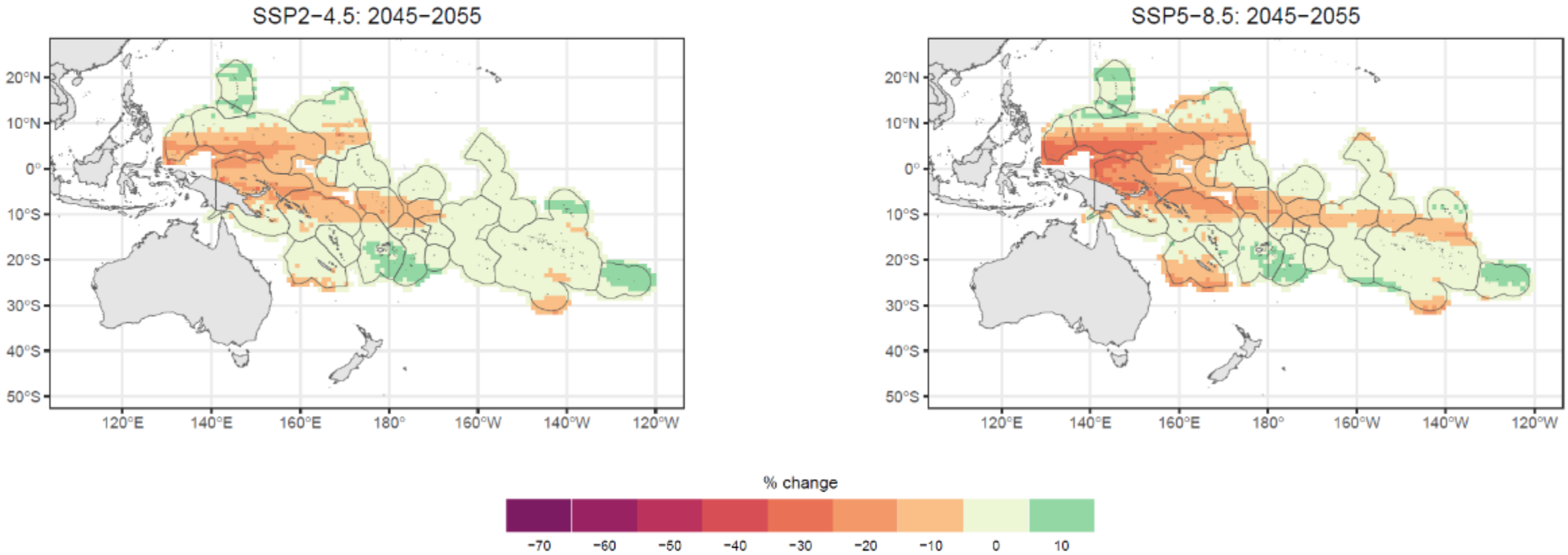
Predicting impacts to coastal fisheries

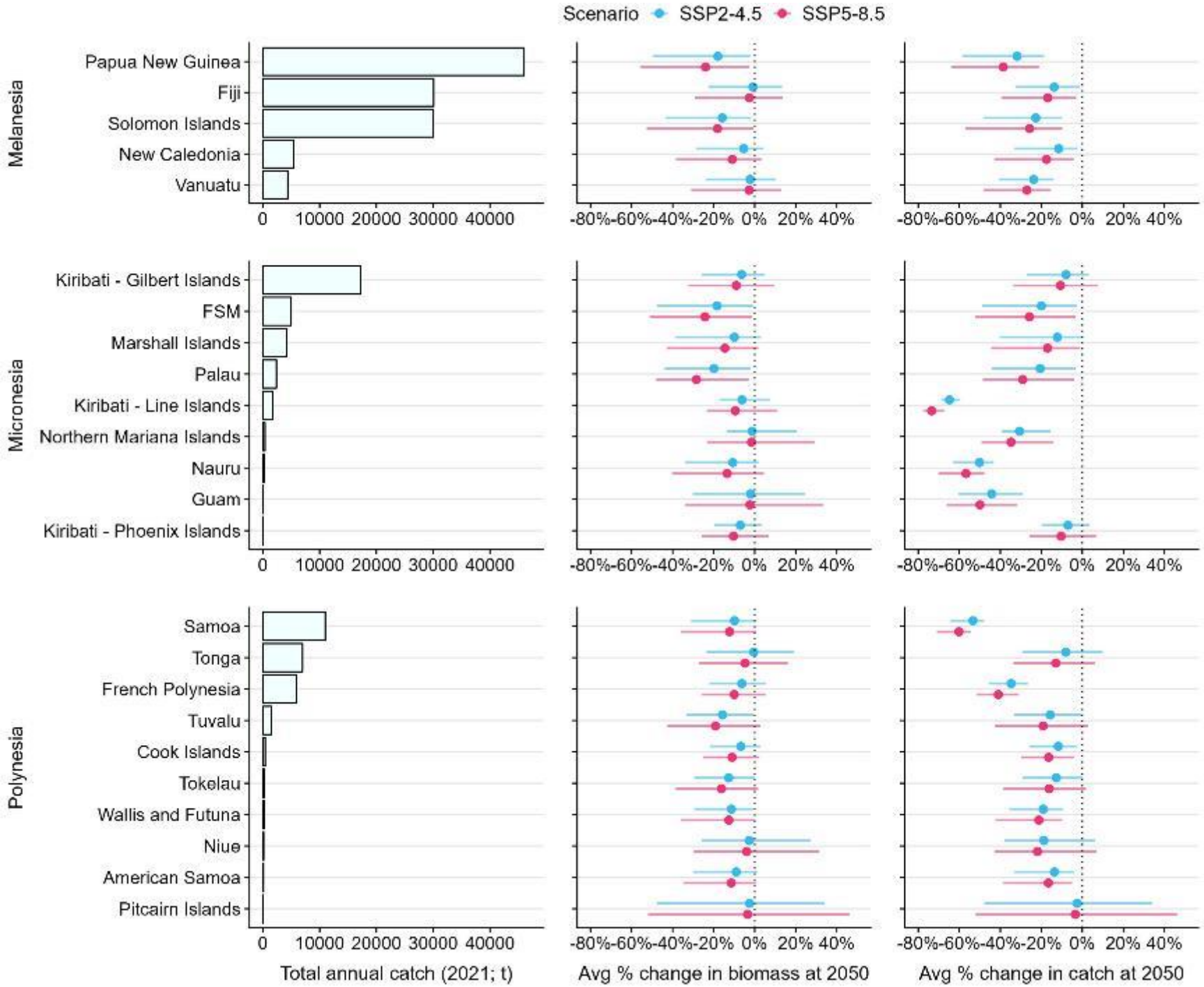
- To estimate projected changes under SSP2-4.5 and SSP5-8.5 we incorporated the projected direct effects on fish and invertebrate biomass and the projected indirect effects due to changes in habitat
- Changes in fish biomass over time were estimated from ecosystem model ensembles forced by climate models under FishMIP
- Projected catches for each PICT were estimated by:
  1. Calculating current yield (=current estimated coastal fisheries catch / current estimated habitat area)
  2. Applying the average relative change (%) in fish & invertebrate biomass between 2041 and 2060 to the current yield to estimate projected yield for ‘2050’
  3. Multiplying the projected yield with the projected habitat area to estimate projected catch for ‘2050’

FishMIP
Fisheries & Marine Ecosystem Model Intercomparison Project


American Samoa
Cook Islands
Fiji
French Polynesia
FSM
Guam
Kiribati - Gilbert Islands
Kiribati - Line Islands
Kiribati - Phoenix Islands
Marshall Islands
Nauru
New Caledonia
Niue
Northern Mariana Islands
Palau
Papua New Guinea
Pitcaim Islands
Samoa
Solomon Islands
Tokelau
Tonga
Tuvalu
Vanuatu
Wallis and Futuna
% biomass change (reference period: 2010-2020)
1980
2020
2060
2100
historical
SSP2-4.5
SSP5-8.5

Mean % change in fish biomass from 2010–2020





Left: current catch

Middle: Average % change in biomass in 2050

Right: Average % change in catch in 2050

What is the capacity of coastal fisheries to cope with CC?

- Understanding status is critical for assessing current resilience to effects of climate change
- Zamborain-Mason et al. (2023) developed multispecies reference points for coral reef fish fisheries (B0, MMSY, BMMSY) (25 families)
- Results indicate most of the 14 included PICT coastal fisheries were in good condition

nature communications

Article

https://doi.org/10.1038/s41467-023-41040-z

Sustainable reference points for multispecies coral reef fisheries

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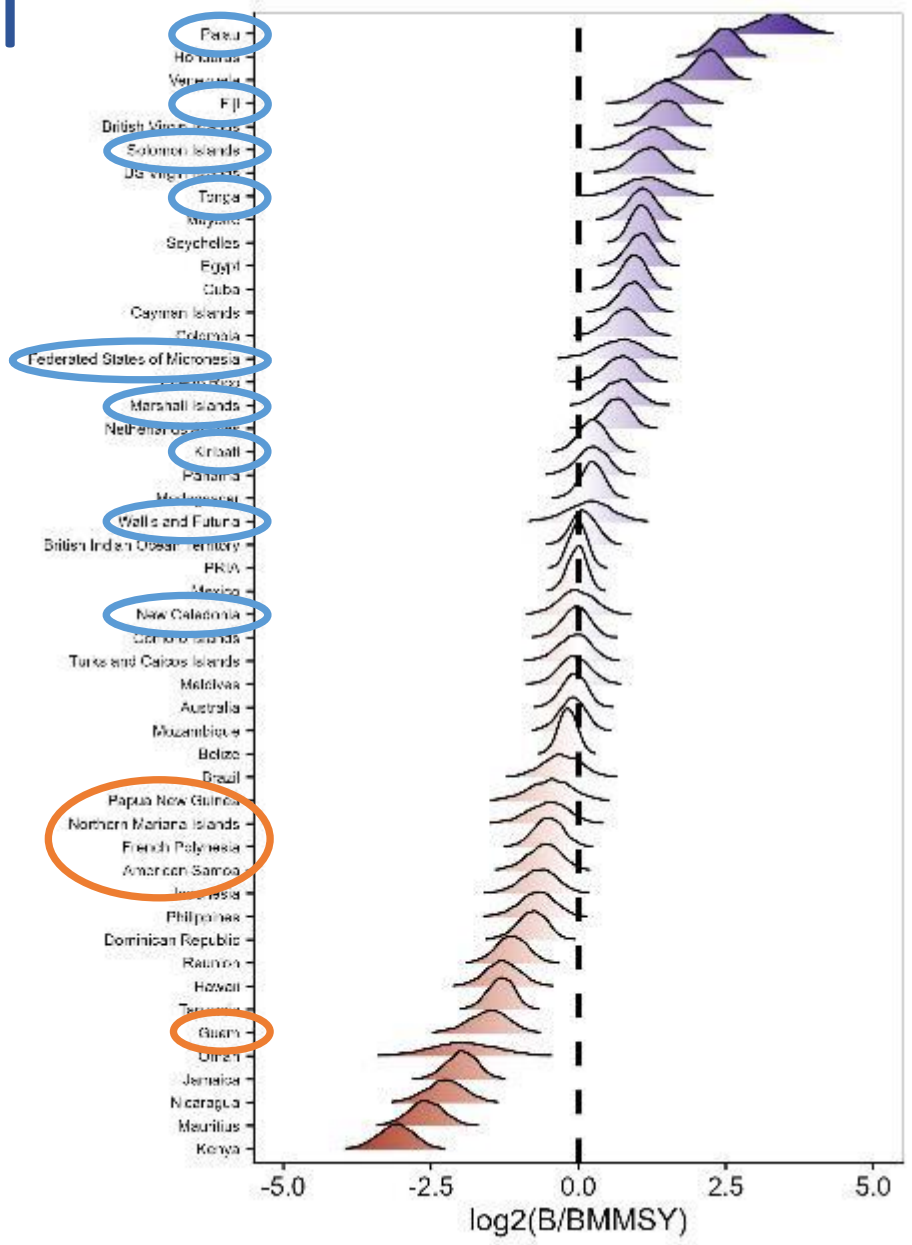
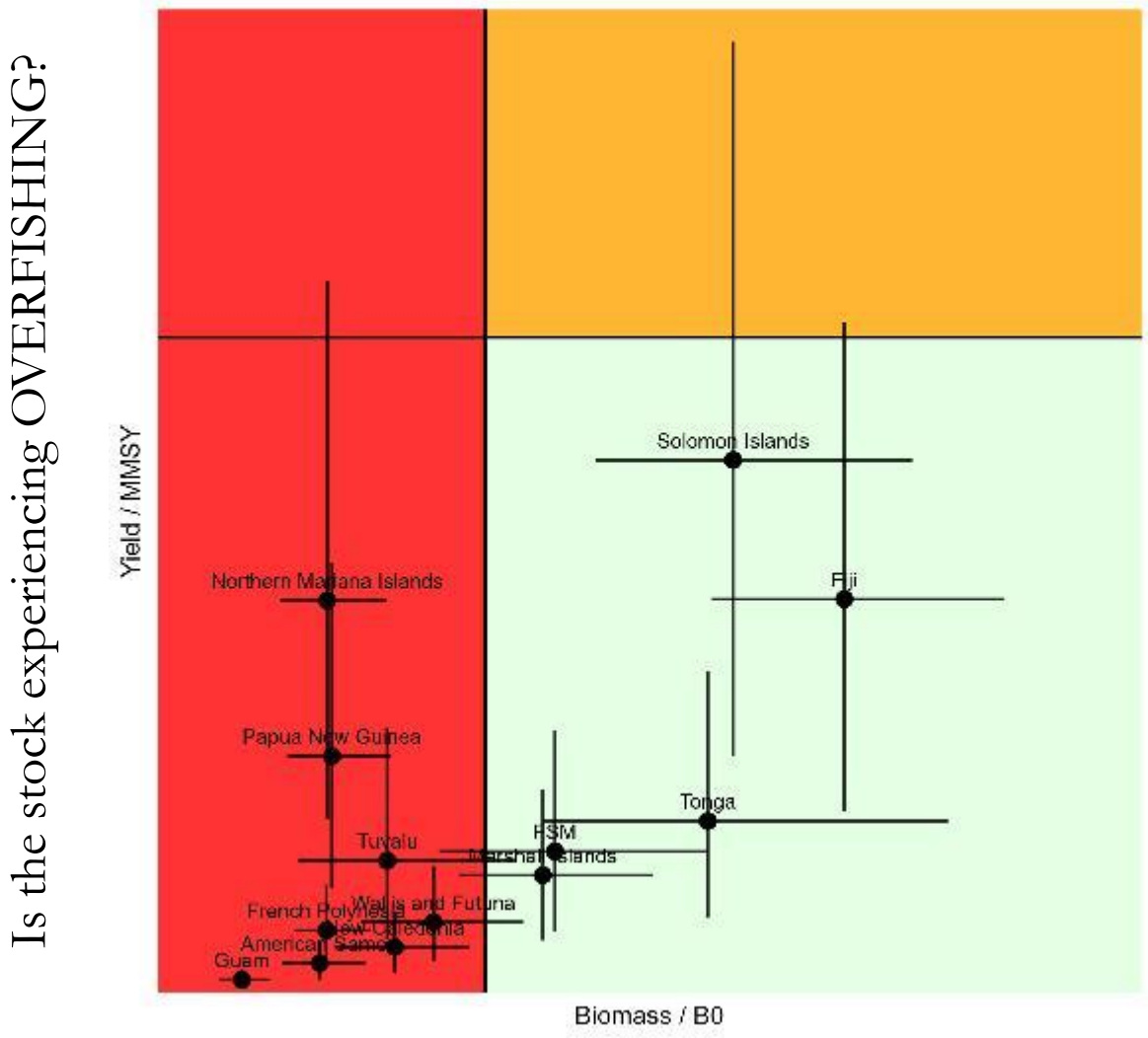
Check for updates

Jessica Zamborain-Mason[1,2,3], Joshua E. Cinner[3], M. Aaron MacNeil[4], Nicholas A. J. Graham[5], Andrew S. Hoey[2,3], Maria Beger[6,7], Andrew J. Brooks[8], David J. Booth[9], Graham J. Edgar[10], David A. Feary[11], Sebastian C. A. Ferse[12,13], Alan M. Friedlander[14,15], Charlotte L. A. Gough[16], Alison L. Green[17], David Mouillot[3,18], Nicholas V. C. Polunin[19], Rick D. Stuart-Smith[10], Laurent Wantiez[20], Ivor D. Williams[21], Shaun K. Wilson[22,23] & Sean R. Connolly[2,24]



What is the capacity of coastal fisheries to cope with CC?

- We developed PICT specific reference points for B0 and MMSY using the approach of Zamborain-Mason et al. (2023)
- Then compared:
  - Biomass from in-water surveys against B0
  - Yields (catch per km^2 per year) against MMSY



Summary & implications

- Climate change is highly likely to cause declines in coastal fisheries catches for all PICTs (although much uncertainty exists and where you are matters!)
- The impact of these declines on food security will depend on:
  - the status of fished populations
  - human population growth (demand for food) and
  - the longer-term capacity for coastal resources in each PICT to support increased harvest

Thank you!

bradley.moore@niwa.co.nz