Metapopulation distribution shapes year-round overlap with fisheries for a circumpolar seabird

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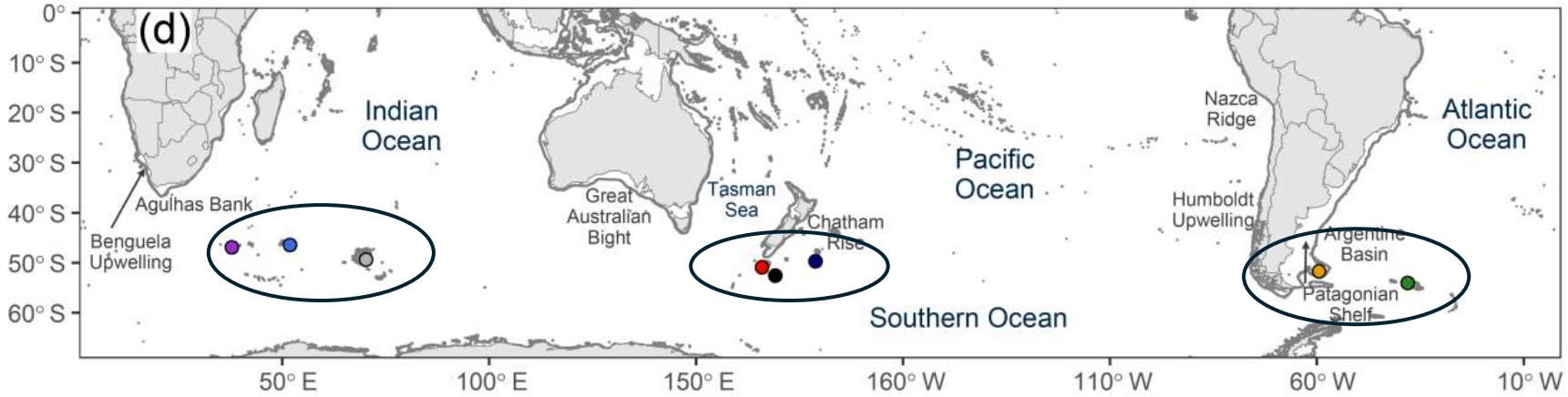
White-chinned petrel *Procellaria aequinoctialis*

- The most bycaught seabird in southern hemisphere:
  - Around 5,000, 1,500 and >1,000 individuals killed each year by pelagic LL, demersal LL and trawl fisheries, respectively.
- Abundant but many populations thought to be declining due to bycatch.
- Challenges for bycatch mitigation:
  - More nocturnal than other species (night setting).
  - Dive down to 20+ m (line weighting).
  - Presence often increases bycatch rates of other species.
  - Widely distributed from Antarctic to subtropical waters.
- Genetically distinct metapopulations according to ocean basin.



Indian Ocean	Prince Edward
	Crozet
	Kerguelen
Pacific Ocean	Auckland
	Campbell
	Antipodes
Atlantic Ocean	Falklands
	South Georgia

Goals

1) Quantify spatial distributions of (meta)populations.

2) Determine regions, populations, seasons and flag states with highest seabird-fisheries overlap.

3) Classify fisheries overlap according to political jurisdiction and RMFO.

4) Calculate contribution of populations to fisheries-overlap hotspots.

5) Examine the extent to which hotspots are covered by bycatch regulations.

Methods

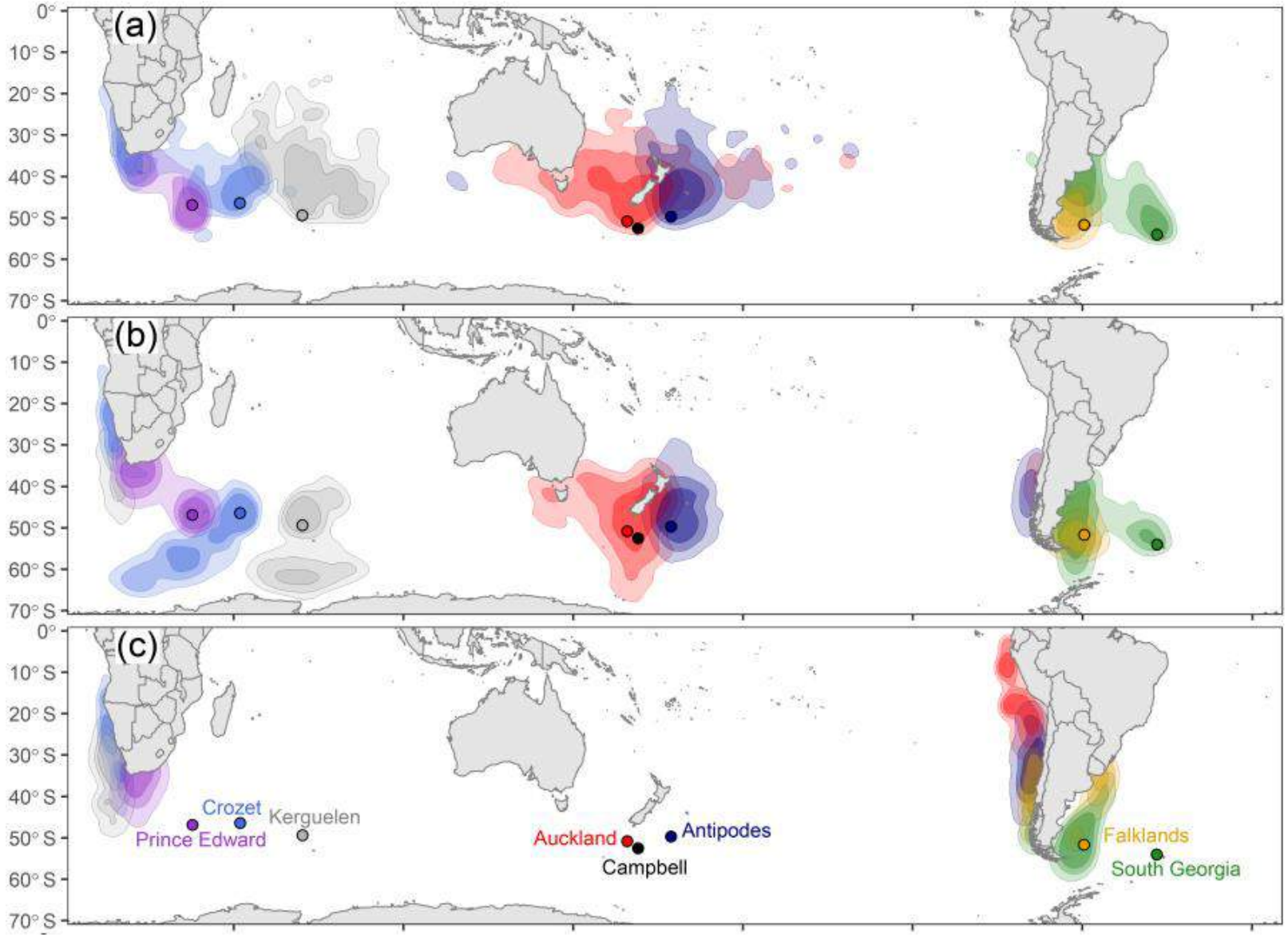
- 132 birds tracked with geolocators from 7 populations comprising three metapopulations (98% of global numbers).
- Fishing effort data sourced from RFMOs (logbook; monthly and 5° resolution) and Global Fishing Watch (AIS; monthly and 2° and 5° resolution).
- Monthly population utilization distribution (UD) grids multiplied by fishing effort to calculate fisheries-overlap.
- Fisheries-overlap grids overlaid with geographic boundaries of RFMOs, RFMO seabird bycatch mitigation areas and Exclusive Economic Zones (EEZs).
- Fisheries-overlap hotspots calculated at the species-level by weighting grids according their population size and summing across populations.

Year-round distributions

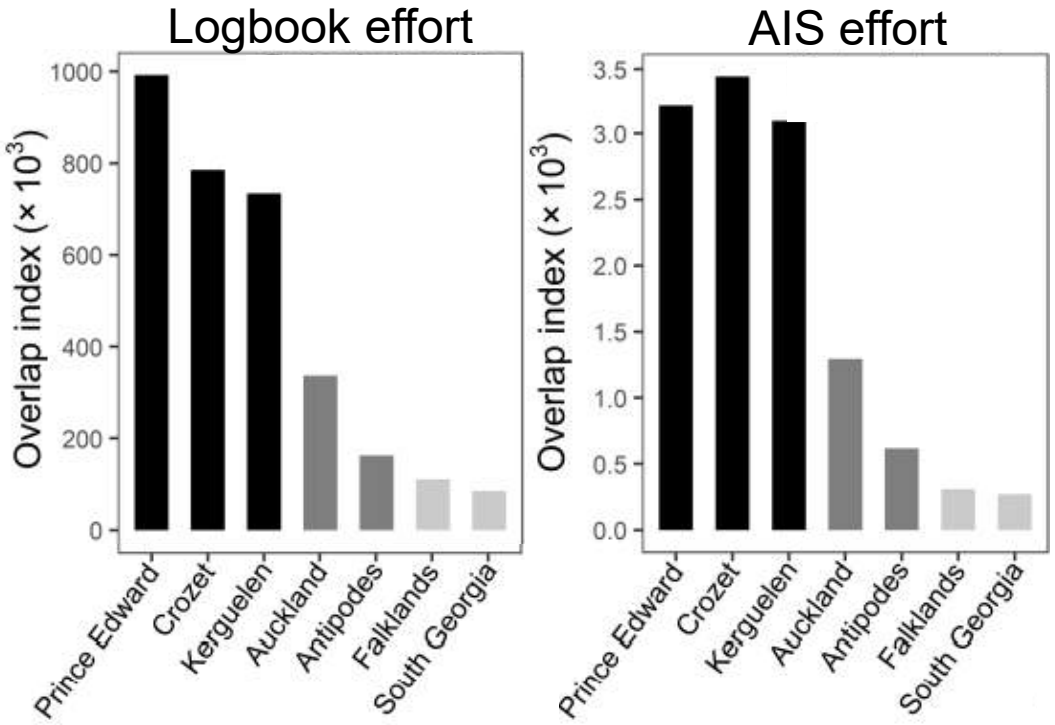
Pre-laying exodus
(October-November)

Breeding
(December-April)

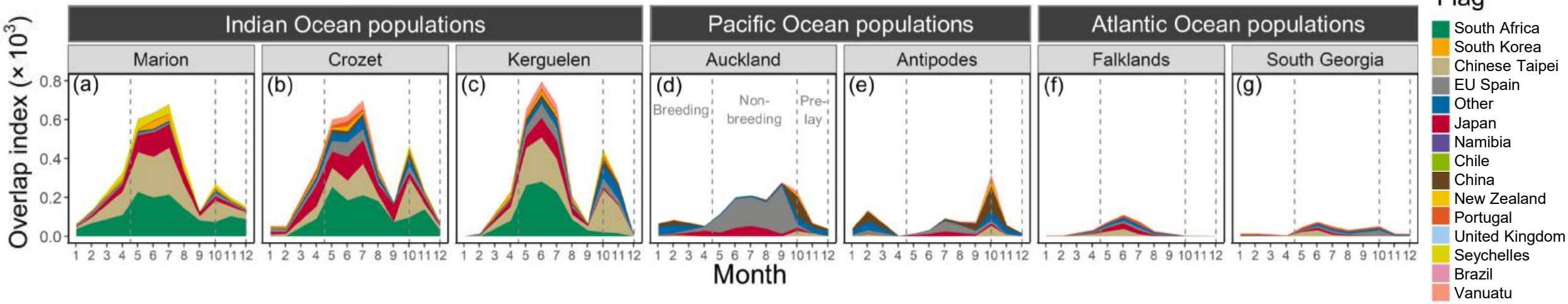
Non-breeding
(May-September)



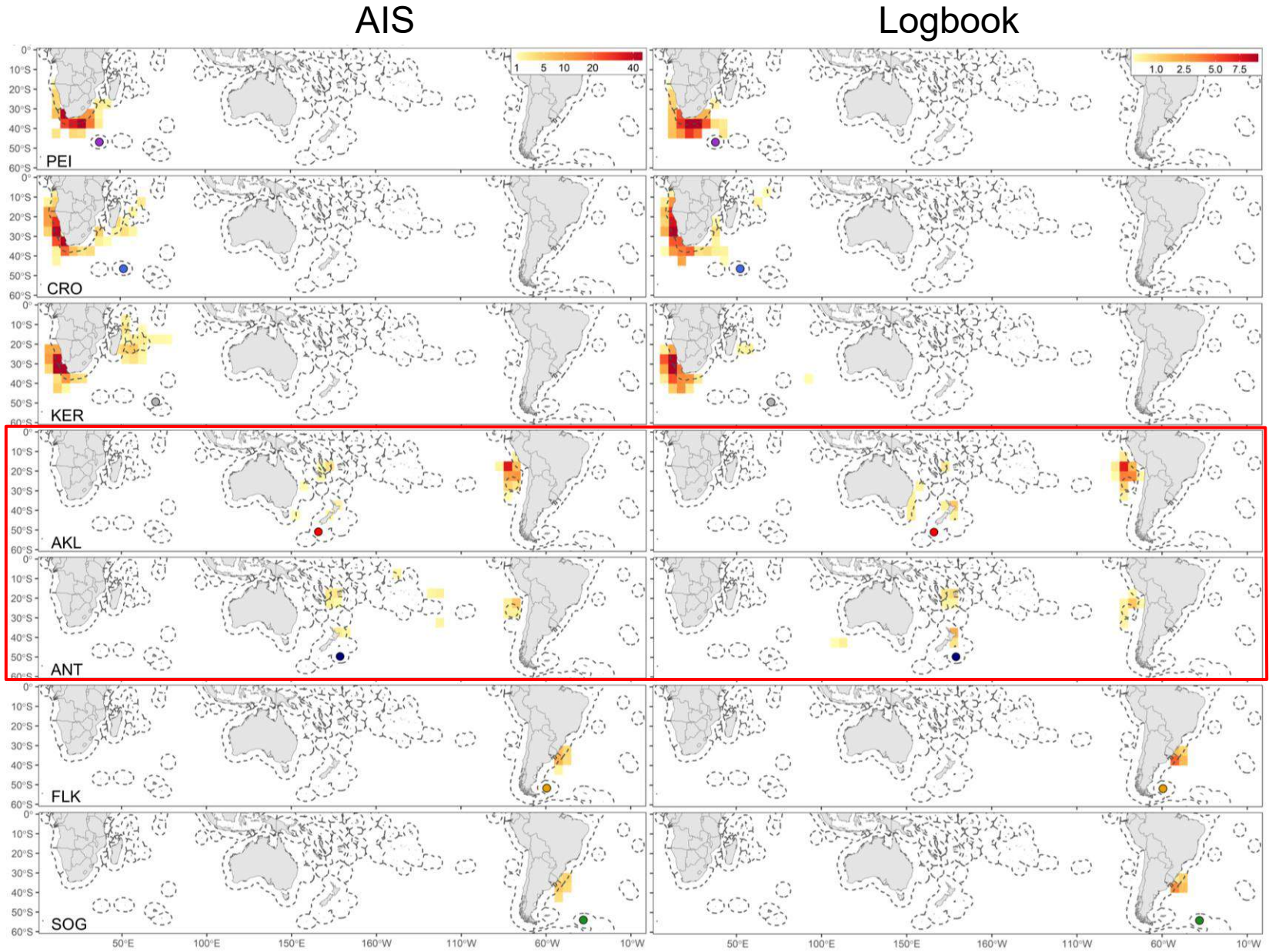
Population-level fisheries overlap



- Fisheries overlap highest for Indian Ocean, then Pacific then Atlantic populations.
- Highest during May-August (non-breeding) with another peak in October-November (pre-laying exodus).
- All pops logbook: Chinese Taipei, Japan, Spain, South Africa, Namibia (89.4%).
- All pops AIS: South Africa, Taiwan, Japan and Spain (79.3%).
- For NZ populations, most overlap with fleets of Spain (61%, 25%), China (12%, 29%) and Japan (15%, 10%).

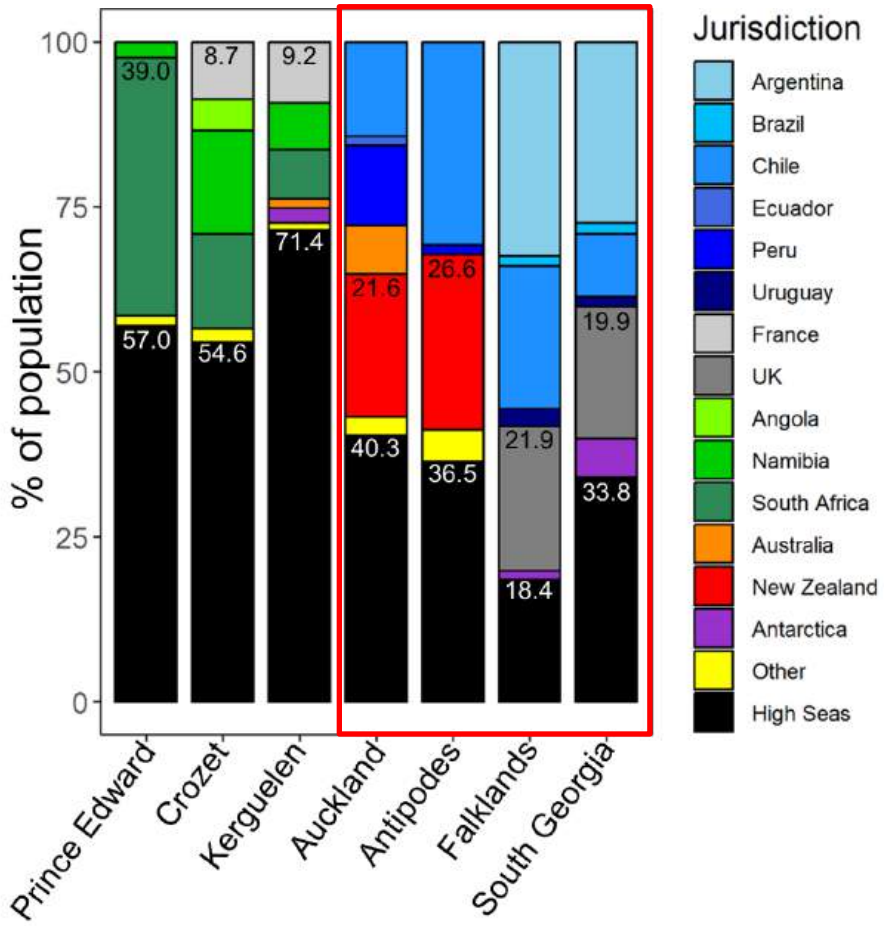


Population-level fisheries overlap



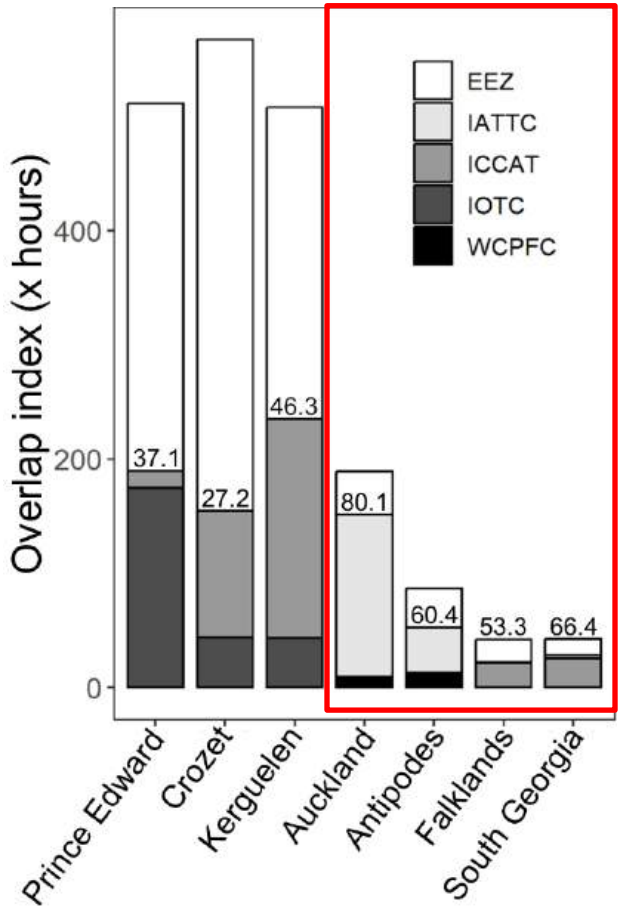
Political and management responsibility

Time spent according to jurisdiction



- 18-40% of time spent in High Seas by IATTC populations.
- For NZ populations, around 30% of time spent in Chile, Ecuador, Peru.

Fisheries-overlap according to management body



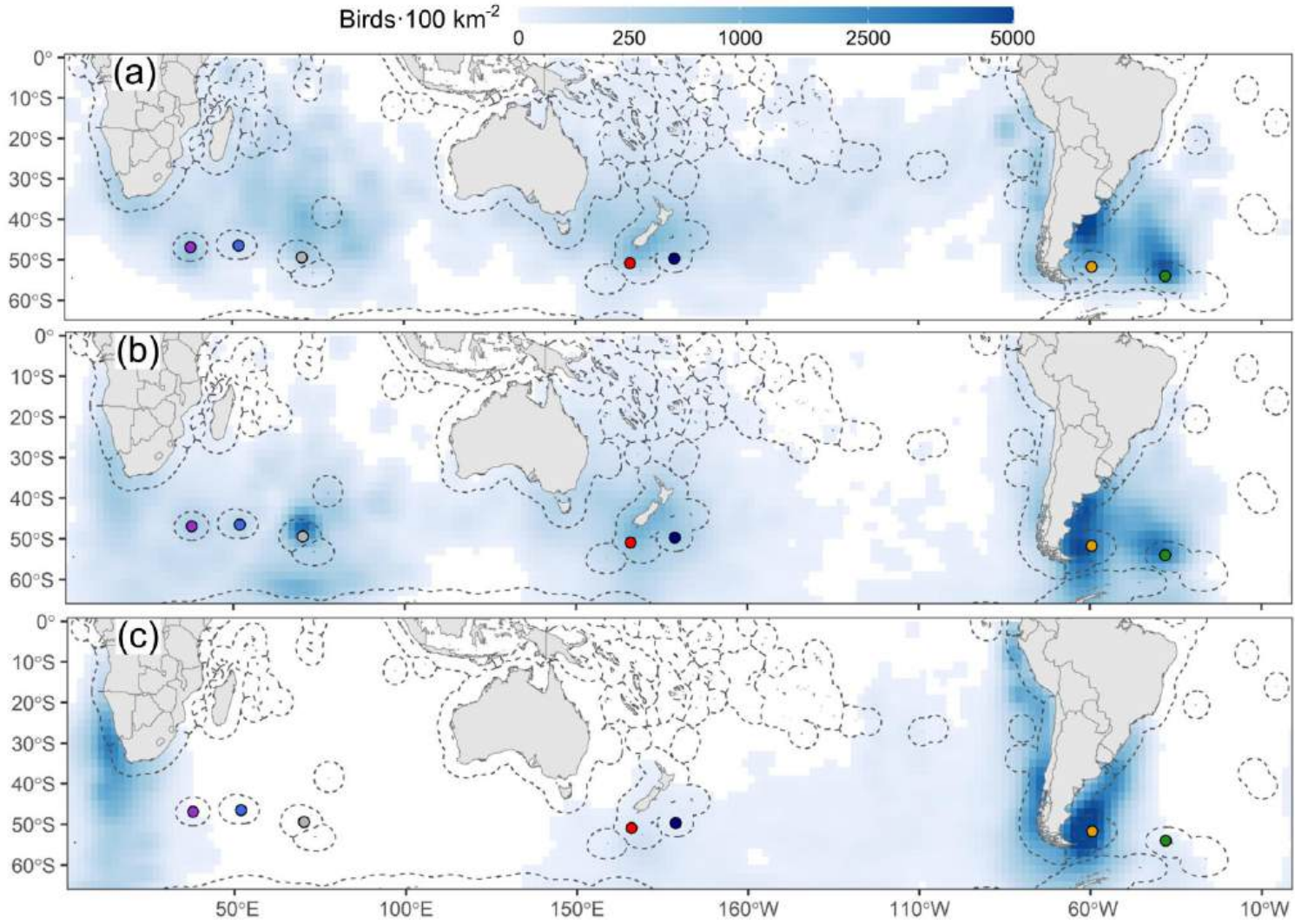
- 53-80% of overlap in High Seas component of RFMOs.
- For NZ populations, 75 and 46% of High Seas overlap is within the IATTC.

Species-level distribution

Pre-laying exodus (October-November)

Breeding (December-April)

Non-breeding (May-September)



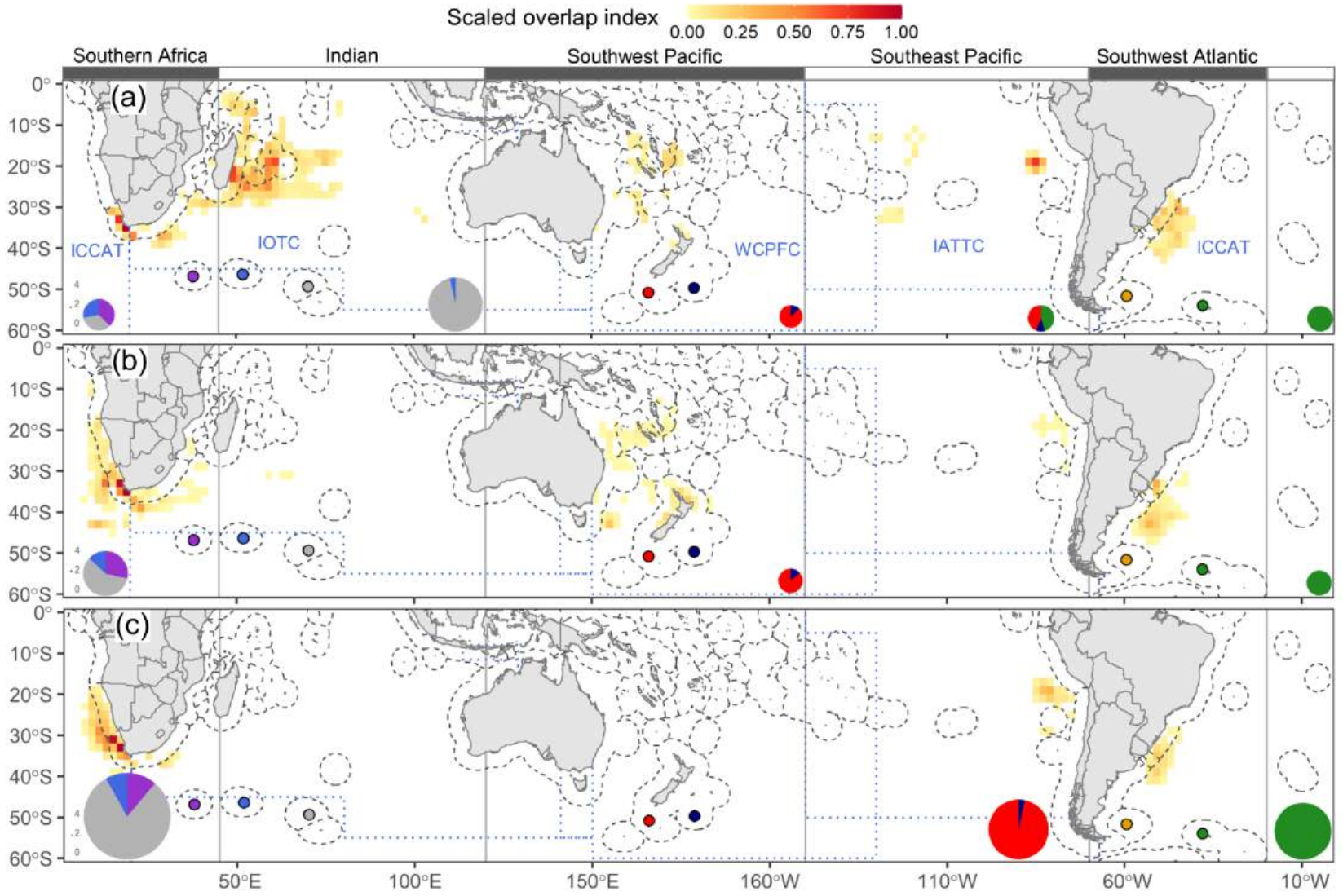
Population	% global numbers
Prince Edward	2.7
Crozet	1.8
Kerguelen	18.0
Auckland	14.2
Antipodes	2.0
Falklands	<0.1
South Georgia	59.5

Species-level fisheries overlap

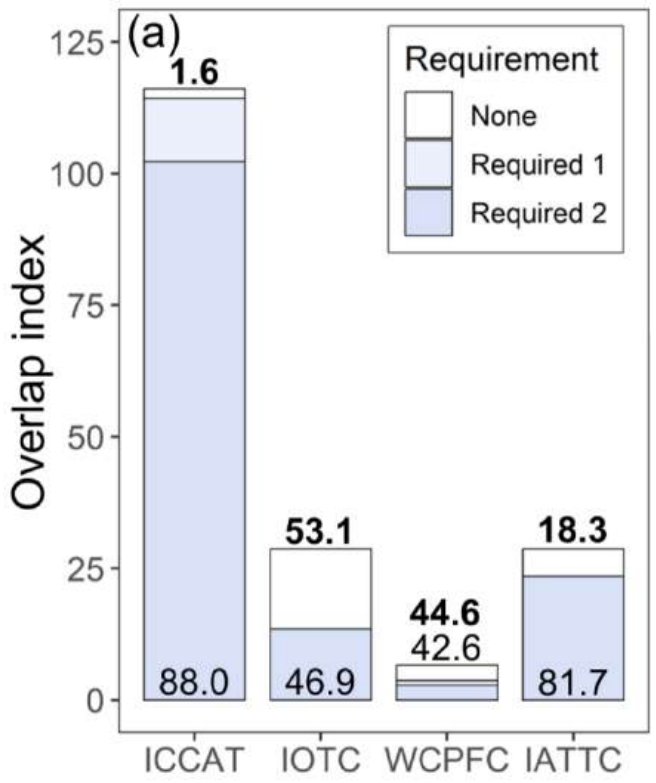
Pre-laying exodus (October-November)

Breeding (December-April)

Non-breeding (May-September)



Fisheries hotspots and RFMO regulations



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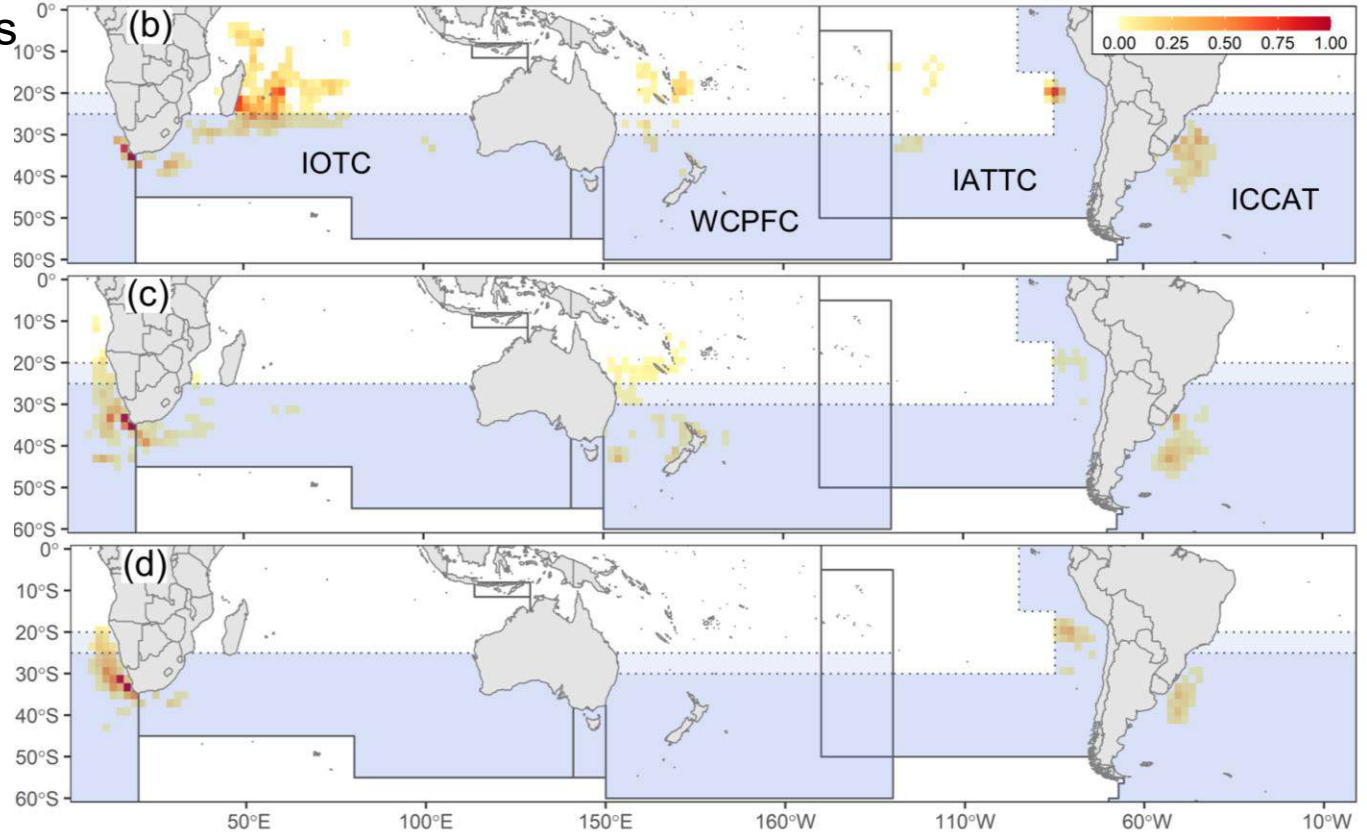

- 18.3% of species-level fisheries-overlap within the IATTC in areas where there are no seabird-bycatch mitigation requirements.
- Fisheries-overlap hotspot straddles boundary at ~20°S, 95°W.

Resolution C-11-02 states that within the mitigation area vessels >20 m should use at least 2 of the following: 1) side-setting with bird curtains and weighted branch lines, night setting, 2) tori lines, 3) weighted branch lines, 4) blue-dyed bait, 5) deep-setting line shooter, 6) underwater setting chute and 7) management of offal discharge, including at least one of 1-4). There are no requirements outside of the specified area.

Discussion

- Fisheries overlap was greater among than within metapopulations, suggesting they should be considered separate management units.

- Three populations contributed to fisheries-overlap scores within the IATTC Convention Area – Auckland, Antipodes and South Georgia.

- Fisheries-overlap within the IATTC Convention Area was highest during non-breeding (May-September), in the High Seas offshore from Chile and Peru, and from the flag states of Spain, China and Japan.

- Fisheries-overlap hotspots were identified within RFMO areas where there are no seabird-bycatch mitigation requirements, representing 1.5%–53.1% (IATTC: 18.3%) of total overlap.

Recommendations to the IATTC EBWG

1. Prioritize research quantifying seabird-fisheries overlap within versus outside of mitigation areas for all threatened species.

2. Improved monitoring of bycatch rates, including increases to observer coverage, for the major fishing fleets identified.

3. Revise IATTC Resolution C-11-02 considering the following:

- **Amend geographic boundaries** of bycatch mitigation area longitudinally to include Nazca Ridge fisheries-overlap hotspot.
  - Extending 85°W boundary (at 15-30°N) by 5° west (to 90°W) increases coverage of WCP-fisheries hotspot regions within mitigation areas from 81.7% to 93.9%.
  - Extending the 30°S boundary to 25°S only increases coverage by another 0.9% (to 94.8%).

- Given the reduced efficacy of line weighting and night setting for WCP, there is a need to combine multiple effective measures, specifically to consider **mandating use of tori lines, weighted branch lines and night setting in combination**, as recommended by ACAP.

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