A DECADAL NATIONWIDE ASSESSMENT OF CLIMATE-DRIVEN SPECIES REDISTRIBUTION USING CITIZEN SCIENCE DATA

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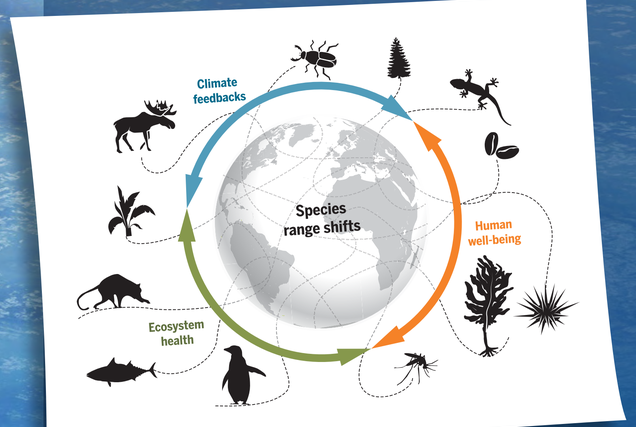
BACKGROUND



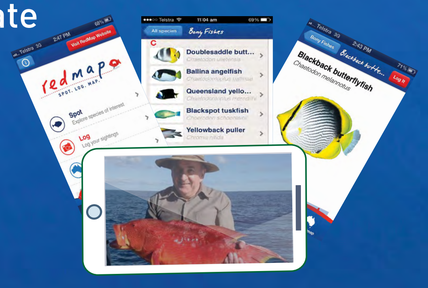
Approximately half of all studied plants and animals globally, on land and in the ocean, are moving poleward to find conditions they can survive and thrive in as the climate around them changes (IPCC 2022), with widespread impacts on human and natural systems.

Many changes in distribution are being reported but there is limited systematic surveying and subsequent analysis to observe and assess range shifts.

However, citizen-science programs provide high-quality evidence of range extensions via repeated observations of species beyond the limits of their historical distributions.

Our OBJECTIVES were to...

1. Draw upon the existing knowledge of marine citizen scientists to identify climate-driven range shifts within the Australian marine estate; and
2. Develop products to communicate and engage with the public on issues of climate change and biodiversity using their own citizen science information.



METHODS

We collated and assessed out-of-range observations from:

redmap SPOT. LOG. MAP.

The Redmap (Range Extension Database and Mapping Project) Australia project, a national initiative since 2012 that invites fishers and divers to submit photographic observations specifically of out-of-range species with the explicit aim of identifying potential range extending species (Pecl et al 2019). Each photograph submitted to Redmap is verified by one of 80 scientists around the country. https://www.redmap.org.au/

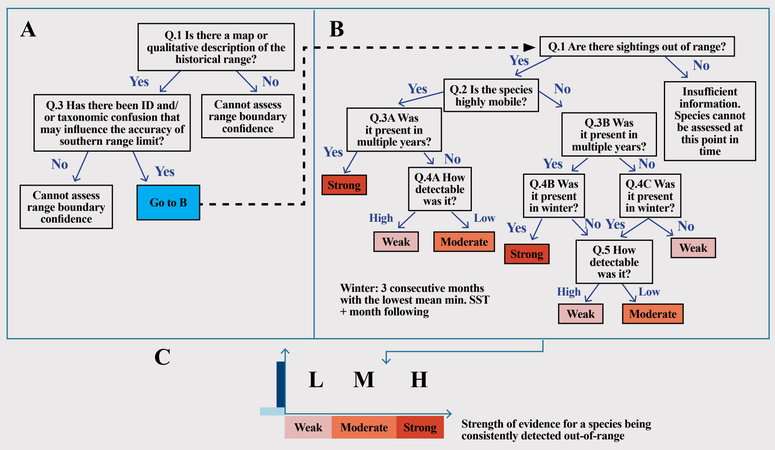
iNaturalist Australasian Fishes Project

The iNaturalist Australasian Fishes project that invites marine users to send in photographs of any marine species, regardless of location. https://inaturalist.ala.org.au/projects/australasian-fishes

RLS REEF LIFE SURVEY

The Reef Life Survey project which undertakes structured systematic surveys of inshore reefs with trained volunteer SCUBA divers, providing a rich database of species occurrences through time. https://reeflifesurvey.com

We considered historical distribution limits (as of 2012), along with species traits (e.g., migratory behaviour, detectability) and evidence provided by citizen scientists' data (e.g., possible overwintering and/or multi-year observations) to assess confidence in redistributions occurring via a decision tree process modified from Robinson et al 2015

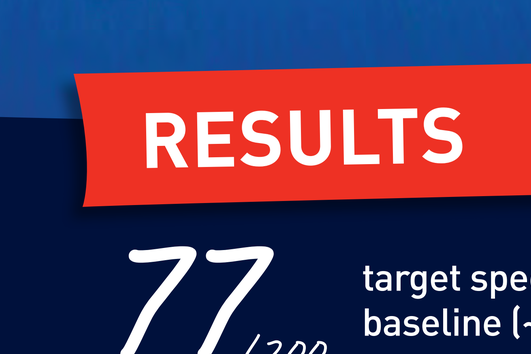


RESULTS

77/200 target species were observed beyond established baseline (~2012) poleward range limits.

	Redmap	RLS	iNaturalist	TOTAL
Target species represented	151	156	175	197
Target spp observations	1069	68854	28570	76118
Out-of-range target spp	69	22*	45	77
Out-of-range observations	229	320	371	914

*Only including species with photo evidence available e.g. present in the other data sources



The **target list of species assessed** included a wide range of taxonomic groups, including anemones, corals, crabs, lobsters, seastars, urchins, sharks, rays, dolphins, morays, octopus and many different teleost fish.

In total, confidence that a species' range is shifting was classified as follows:

31	8	43
HIGH	MEDIUM	LOW

The **mean extent of range extensions assessed**, calculated as latitudinal distance, from historical distribution limit to the maximum extent of recent citizen science observations was 316 km, with a maximum of 1474 km.

316 kilometres

The eight extensions with the greatest poleward extent all occurred from the **Leeuwin current-influenced west.**

CONCLUSION

Among a list of 200 species tracked by Redmap over the past decade, we identified dozens of previously undocumented shifts, identifying priority species and regions where further targeted scientific research may be appropriate.

97% of people surveyed say they trust the information they get from Redmap (Nursey-Bray et al 2018)

Results of the assessment have been incorporated into detailed regional state-based report cards, and an A1 poster summarizing the results across the whole Australian marine estate. Citizen scientists provided extensive feedback on design of products & help us disseminate them through the marine community.

The report cards provide communication tools for dissemination to demonstrate the scientific value of citizen science and engage with the broader public on climate change, using their own observations.

SCAN THE CODE FOR MORE INFO ON METHODOLOGY, RESULTS & PDF LINKS
redmap.org.au/article/report-card/

THIS PROJECT WAS MADE POSSIBLE WITH THE EFFORTS OF:

100s of Australia's divers, fishers, beachcombers and other citizen scientists that contributed out-of-range species observations; nearly 100 scientists across 30 institutions that have verified observations; many managers, science communicators and scientists that have contributed to development of the assessment methodology and the report cards; citizen scientists that volunteered thoughtful feedback on drafts of the report cards.

Marine and Coastal National Environmental Science Program
UNIVERSITY of TASMANIA IMAS Institute for Marine and Antarctic Studies
NSW GOVERNMENT
CMS CENTRE FOR MARINE SOCIOECOLOGY
Tasmanian Government
fishwise Your licence fees at work
Department of Primary Industries and Regional Development
JAMES COOK UNIVERSITY AUSTRALIA
MUSEUM OF TROPICAL QUEENSLAND

Pecl, G.T., et al (2019). 'Redmap Australia: challenges and successes with a large-scale citizen science-based approach to ecological monitoring and community engagement on climate change'. Frontiers in Marine Science
Nursey-Bray, M, Palmer, R, Pecl, G (2018). 'Spot, log, map: Assessing a marine virtual citizen science program against Reed's best practice for stakeholder participation in environmental management'. Ocean and Coastal Management.
Robinson, L.M. et al (2015). Rapid assessment of an ocean warming hotspot reveals "high" confidence in potential species' range extensions, Global Environmental Change