

Our changing marine environment: Redmap and the contributions of citizen science

Dr Gretta Pecl & Redmap Australia Team

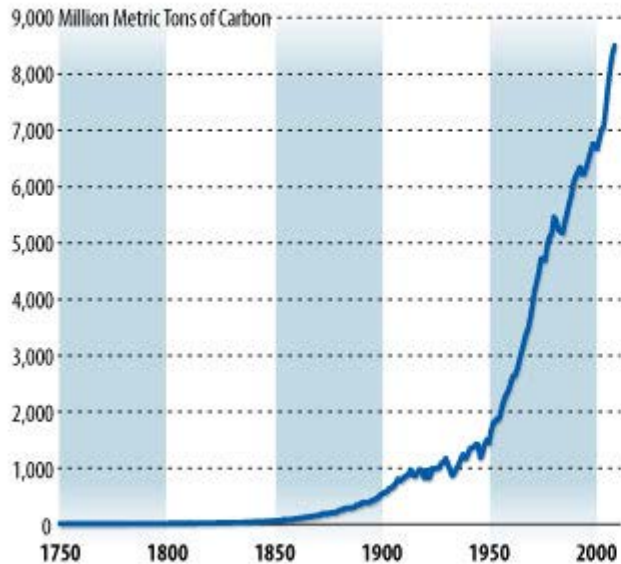
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translatingnatureintoknowledge

Our changing climate

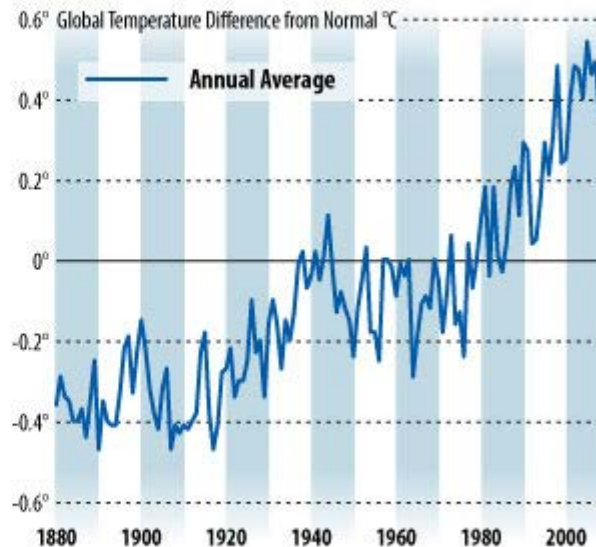
- Climate has always been changing!
- BUT...pace of current changes is more rapid than in the past

Carbon Dioxide Emissions Since 1750



Data: Oak Ridge National Laboratory

Global Temperature Change Since 1880

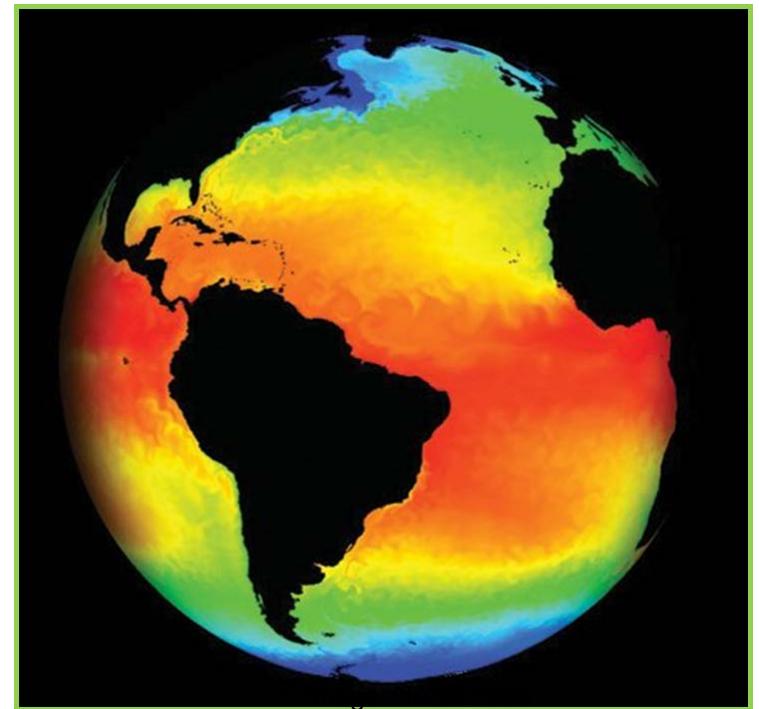


Data: NASA



Global marine changes

- Increased water temperature
 - *80% heat absorbed by ocean*
- Ocean acidification
 - *50% of the atmospheric carbon emitted is absorbed by ocean*
 - *Ocean already 30% more acidic*
- Changes in ocean currents, winds, productivity (nutrients) and rainfall
- Increases in frequency and/or intensity of extreme events
- Sea level rise
- Regional differences in changes & sensitivity to change



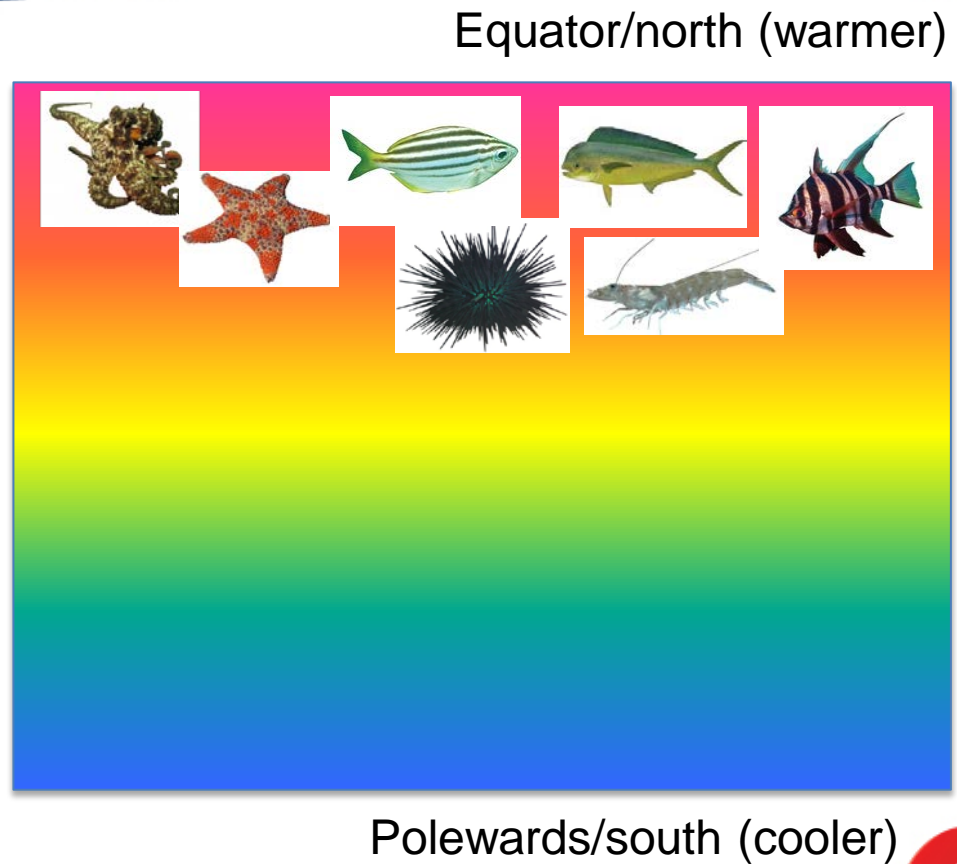
Species on the move

- Rearrangement of what lives where – on land and in the ocean
- Species have a preferred range of temperatures they like to live in
- Species' distributions shifting polewards
- Changes in distribution are, and will continue to be, extensive
- Some of the largest shifts in species ranges have come from the ocean
- 'Range shifts' greatest where climate has warmed the most



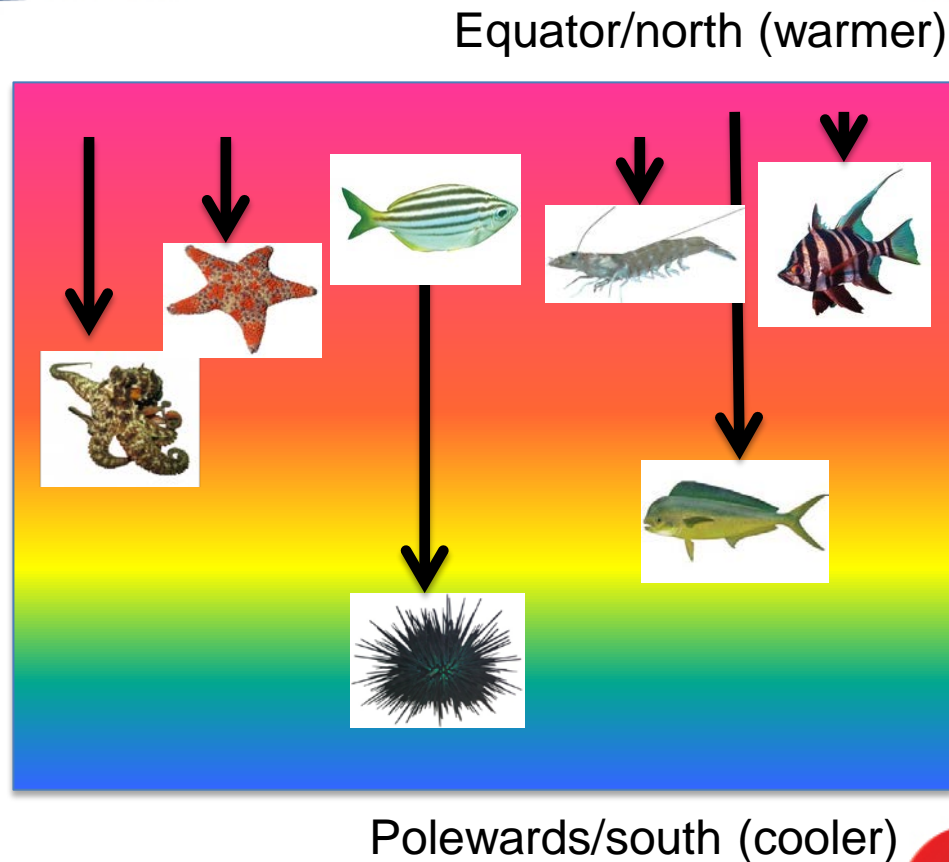
Variation in timing & pace of species shifts

- Not all species can/will shift
- Species will shift at different rates



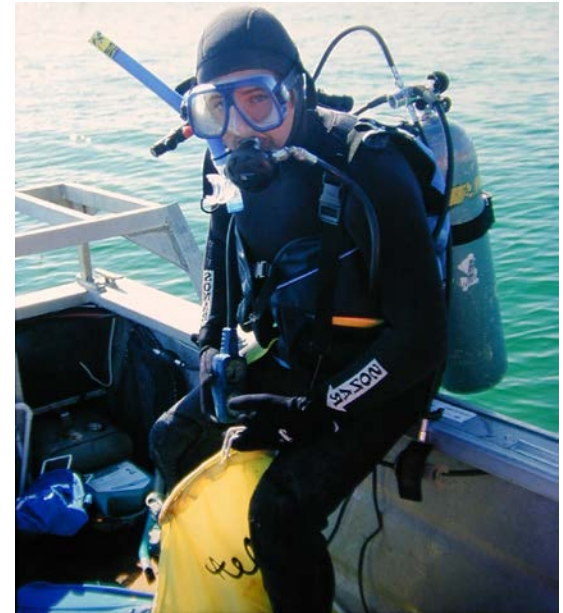
Variation in timing & pace of species shifts

- Not all species can/will shift
- Species will shift at different rates
- General poleward movement - but lots of variation
- Species can also change where they live for many reasons
- Some changes harder to detect than others – species detectability
- Overall – very complicated!!

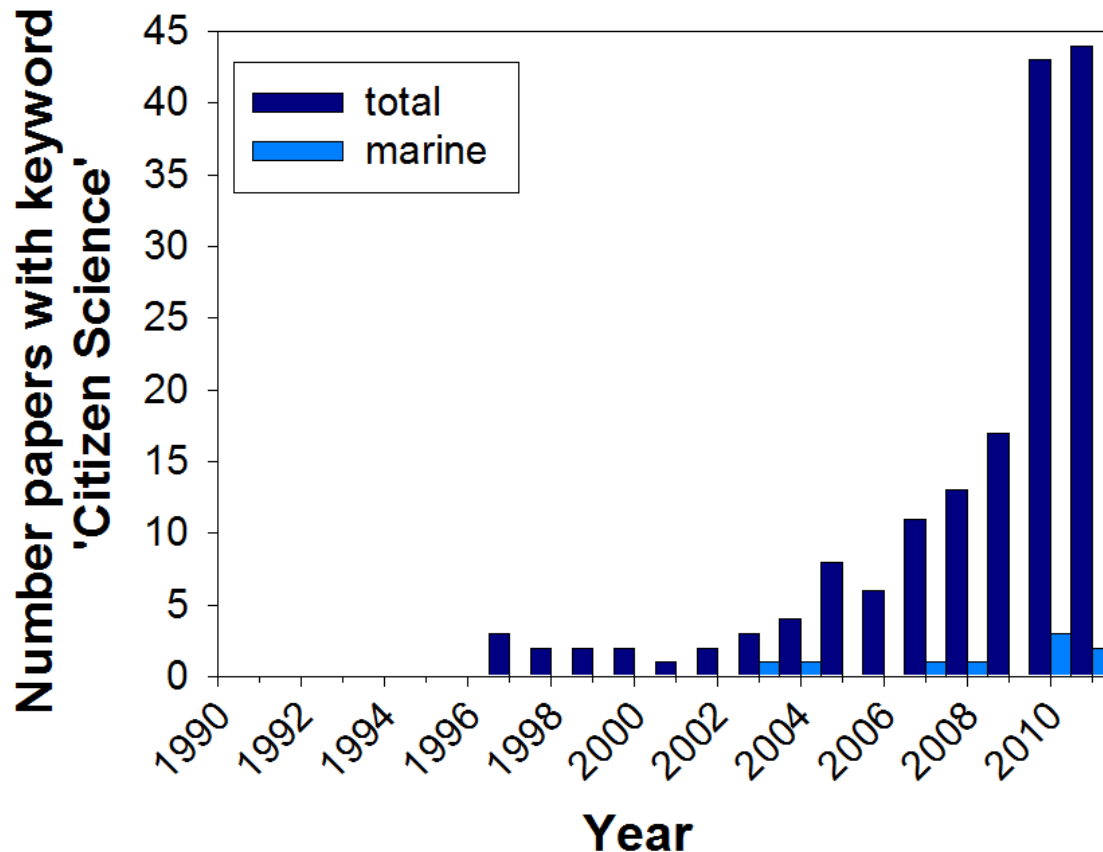


Understanding a changing environment

- Requires many observations over time & space.
- Monitoring is expensive and difficult to sustain over large areas or for prolonged periods.
- Observations made by the countless men and women spending time in their environment are rarely recorded & potential coverage is vast.
- Advances in our technological capacity have also radically improved the precision & accuracy with which many types of community information can now be recorded.



Emergence of citizen science



- Exponential increase
- More momentum in land based systems
- Marine systems lagging



Imagine...

NT

QLD

SA

NSW

ACT

VIC

OCEAN



A school of blue fish, possibly mackerels, swimming in clear blue water. The fish are arranged in a loose formation, moving towards the left. The water is a deep, clear blue, and the fish have a silvery-blue color with a darker stripe along their sides. The text is overlaid on the center of the image.

**Turning observations and pictures
from the community into data.....**

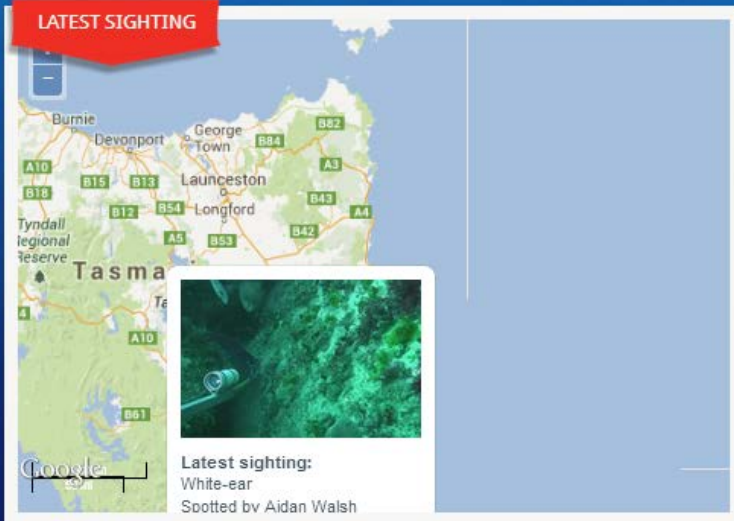
Mick Baron



What's on the move along the TAS coast?

Log a sighting or check out what others have spotted recently!

LATEST SIGHTING



View the regional map



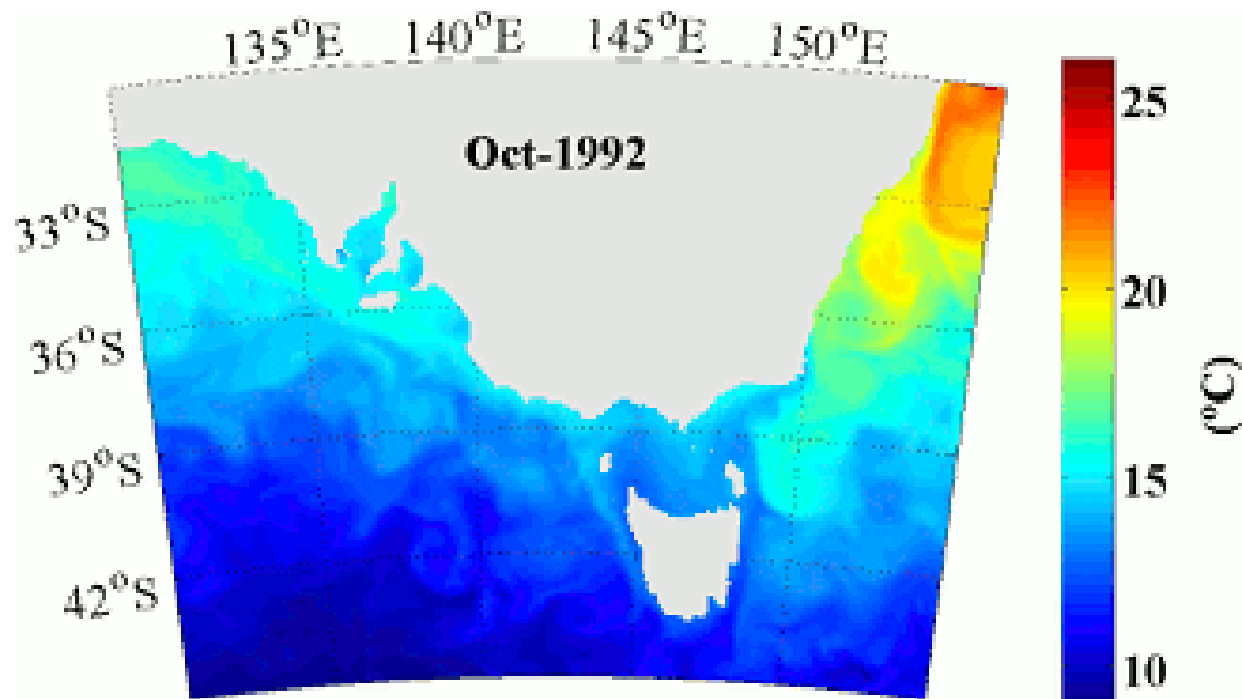
GOT A QUESTION?

Contact the Redmap team in TAS

- Range Extension Database & Mapping Project
- Record 'out-of-range' species
- Hosted by IMAS in collaboration with many institutes
- Winner of multiple awards
- Launched Australia-wide 6 months ago
- Pilot project in Tasmania, started Dec 2009

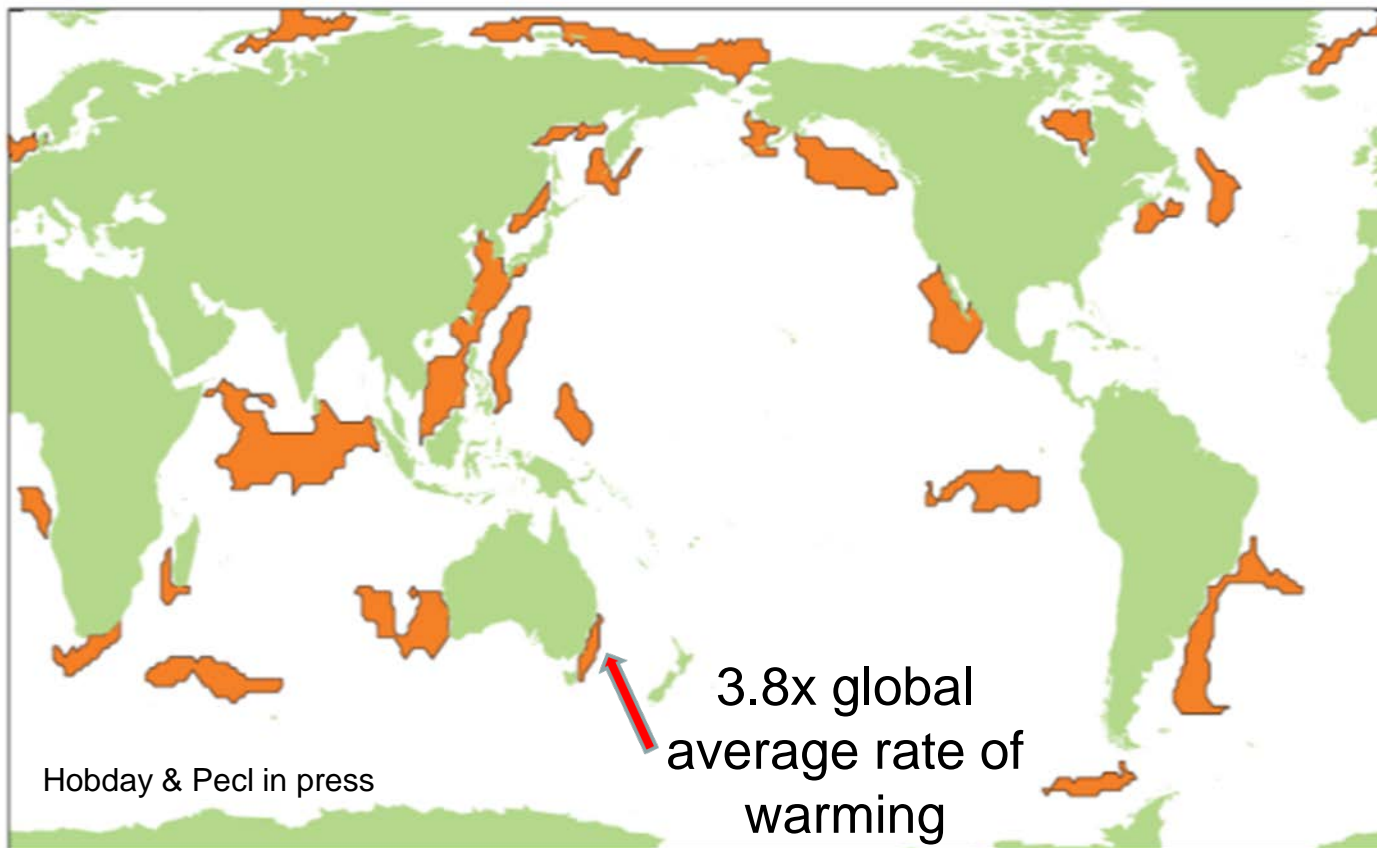


East Australian Current pushing further south & persisting for longer



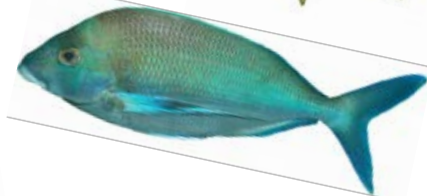
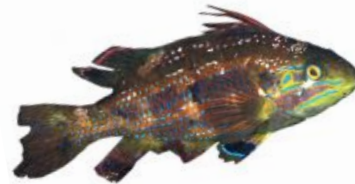
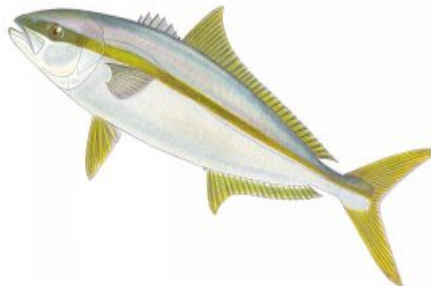
Animation courtesy of CSIRO

Ocean warming hotspots (■) areas in the top 10% for measured rate of warming



Several dozen new and range-extending species in Tasmania (since 1970)

Last et al. 2010



Importance of marine environment to Tasmania



- Highest value of seafood nationally
- Seafood contributes 1/3 value of agricultural production
- High participation rate (29.3%) in recreational fishing
- Most diverse communities of temperate marine life
- Considered a region of potential biodiversity decline

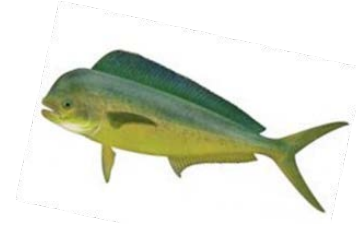


Redmap: Capturing & maximising local knowledge

Two broad aims:

1. Monitoring for ecological change (we have a long coastline & large-scale/long-term monitoring programs are under-funded)!
2. Engage, informs and educate our marine communities (using their *own* data)

Two-way knowledge exchange:
gaps in knowledge being addressed *in partnership*



Ecological aims of Redmap

- What 'new' or 'uncommon' species, usually observed only in warmer waters, are fishers and divers seeing?
- Observed over cooler months/years, or only warmer months/years?
 - Over winter or in large numbers?
- Is there evidence of a shift in distribution?
 - EARLY INDICATION of 'new' species - qualitative report card
 - Impact of shift, e.g. qualitative modelling
 - Evaluate shift, e.g. presence only SDM's
 - Manage new species proactively to maximise benefits/minimise impacts





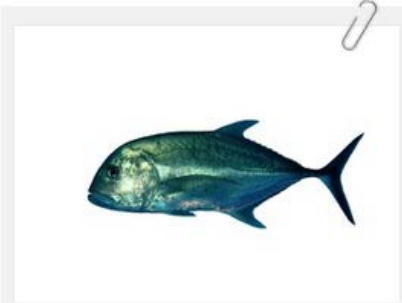
What's on the move in Tasmania?

Home > Tasmania > Marine species

Marine Species

Jump to a region ▾

Jump to species ▾



Bony Fishes



Invertebrates



Shark & Rays



Reptiles



Algae & Plants



Mammals

Quality photos submitted to verify sightings



Up to 475 km further polewards than expected

Photos are ID'ed by many scientists – thanks to Rick Stuart-Smith, Graham Edgar, Neville Barrett, Peter Last & Daniel Gledhill in particular



For the scientist: validating species ID & verification of sighting details is simple

A Web Page

http://

Sighting verification wizard

Verify photo and characteristics | Verify location | Assessment & response


Photo and characteristics checklist

- Photo clarity sufficient to correctly identify species
- Photo is of nominated species
- Reported characteristics match photo
- Reported characteristics match species

[Next, Verify location >](#)

Sighting details


Uploaded photo



Reported characteristics

Species	Ludrick
Gender	Male
Length	22 cm
Weight	500g
Type of sighting	In a small school (5 - 10 fish)
When	22 Feb 2011 at 2pm
Location	Tasmania, Fishing Block E16 1km accuracy
Activity	Diving
Comment	Was really surprised to see this little guy and his mates. There were about 30.

Reported location




Tasmania, Fishing Block E16
1km accuracy

Providing feedback to the observer (fisher or diver) is easy - sent an automatic acknowledgement

Message

Reply Forward Delete Print Move Follow Up

From: REDMAP Australia <no-reply@redmap.org.au>
To: Emma Flukes
CC:
Subject: Pagrus Auratus sighting



Hi Emma,

We're pleased to report that your sighting has been reviewed by our Expert Panel who agree that it is indeed a Pagrus Auratus.

Now that the sighting has been verified we've added sighting, including your photo, to the REDMAP website so others can see and comment on it.

[You can view your sighting online here](#)

Thanks again for logging your sighting on REDMAP.

kind regards,
REDMAP Australia





Sightings from
Emma Flukes



Sighting activity: 49.8% divers, 42.7% fishers



Very few 'dodgy' sightings submitted....



Information generated: Old wife (*Enoplosus armatus*)



- Found in shallow reefs Sth QLD to WA
- Common on north coast of Tasmania
- Poisonous spines & makes a 'grating' sound when stressed
- Redmappers are spotting it in south Tasmania



Have you spotted one?

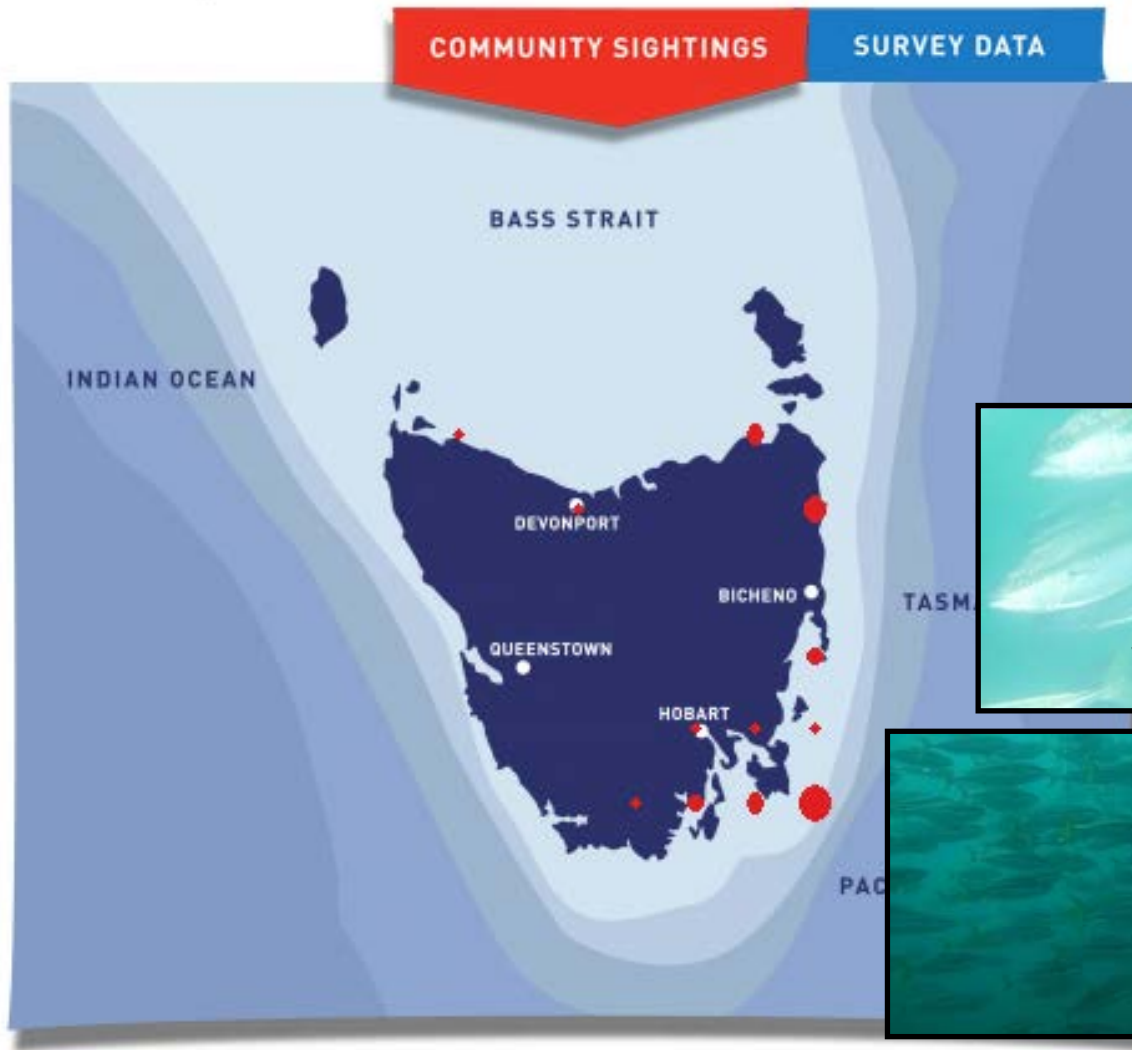
LOG IT NOW →

LATEST SIGHTINGS

WHO	WHERE	WHEN	HOW
Tassie Diver	Fishing Block 7H1	06/05/2012	Diving



Information generated, e.g. Yellowtail Kingfish



- Previously only recorded occasionally along north of Tasmania
- Redmap - multiple sightings of large schools, down south, in cool winter months



Qualitative report card

- Led by Lucy Robinson
- Decision tree approach
- Assesses strength of evidence of a potential shift in distribution (strong, moderate, weak)
 - Detectability (fishers vs divers)
 - Migratory?
 - Observations in winter?
 - Seen in multiple years?
- Also assesses confidence in baseline range estimate (high, medium, low)
- Available on line with supporting info on methods

The graphic is a report card for Redmap Tasmania. At the top left, the 'redmap' logo is written in red and blue lowercase letters, with a red fish icon to the right. Below it, the text 'SPOT. LOG. MAP.' is written in a smaller, black, sans-serif font. To the right of the logo is a map of Tasmania with a red fish icon on it. Below the logo and map, the title 'REDMAP TASMANIA REPORT CARD' is written in large, bold, white, sans-serif capital letters. Below the title, there is a red banner with the question 'Are marine species moving further south?' in white, cursive-style text. Below the banner, there is a text box with a paragraph of text and a list of three numbered items. To the right of the text box is a 'LOG YOUR SIGHTING' sign with a red fish icon. Below the sign are three numbered photographs of fish: 1. King George whiting, 2. Blue morwong, and 3. Yellowtail kingfish. Below the photographs is another red banner with the question 'WHY DO WE CARE ABOUT SPECIES RANGE SHIFTS?' in white, bold, sans-serif capital letters. Below the banner, there is a text box with a paragraph of text and two numbered photographs: 1. Snapper and 2. Red algae. At the bottom right of the graphic is a red fish icon with a white outline of Tasmania inside it.

redmap
SPOT. LOG. MAP.

REDMAP TASMANIA REPORT CARD

Are marine species moving further south?

Waters off the east coast of Tasmania are warming 3.8 times faster than the global average. Redmap Tasmania is gathering and assessing information on a number of species that could be shifting (or to be more specific, extending) their southern range boundaries further south in response to warming seas.

Since 2009 the Tasmania community has been logging sightings on Redmap and sharing stories such as:

- 1 King George whiting (*Sillaginodes punctata*) is usually a popular catch on the mainland but Tasmanian fishers like Bill Smedley are telling us they are finding them further south.
- 2 "During the summer you often see the odd thing that's uncommon like blue morwong (*Nemadactylus valenciennesi*). This is one that we rarely saw 20 years ago and now we see a healthy population every summer," says Phil Malkin, a diveinstructor and avid fisherman on Tasmania's east coast.
- 3 Yellowtail kingfish (*Seriola lalandi*) are being caught further south of their usual range. This one was caught and logged (on Redmap) by Scott Johnston off the Tasman Peninsula.

LOG YOUR SIGHTING

1
King George whiting
Photo: B. Smedley

2
Blue morwong
Photo: P. Malkin

3
Yellowtail kingfish
Photo: S. Johnston

WHY DO WE CARE ABOUT SPECIES RANGE SHIFTS?

Shifts in species ranges delivers both challenges and opportunities. For example, an unwelcome red algae (*Wodiluca scintillans*) species has been extending its range down the eastern coast of Tasmania resulting in closures and significant profit loss for farmed and wild fisheries. It also prevents swimmers from taking a dip when it is in bloom. On the other hand, the extension of snapper, yellowtail kingfish (*Seriola lalandi*) and striped marlin (*Tetrapturus audeax*) provide welcome opportunities for recreational anglers.





1
Snapper
(*Pagrus auratus*)
Photo: P. Johnston

2
Red algae
(*Wodiluca scintillans*)
Photo: P. Johnston













1

Spotted South of Bass Strait

	SPECIES	MOSTLY SEEN BY	REFERENCE POINT CONFIDENCE	EVIDENCE OF RANGE SHIFT	OVERALL CONFIDENCE
1	 Gloomy octopus (<i>Octopus tetricus</i>)	1	Blue	Red	1 fish icon
1	 Crimsonband wrasse (<i>Notolabrus gymnogenis</i>)	1	Blue	Red	1 fish icon
6	 Rock cale (<i>Aplodactylus lophodon</i>)	6	Blue	Red	1 fish icon
2	 Southern Maori wrasse (<i>Ophthalmolepis lineolatus</i>)	2	Blue	Red	1 fish icon
2	 Onespot puller (<i>Chromis hypsilepis</i>)	2	Blue	Red	1 fish icon
3	 Eastern rock lobster (<i>Sagmariasus verreauxi</i>)	3	Blue	Red	1 fish icon
4	 Grey morwong (<i>Nemadactylus douglasii</i>)	4	Blue	Red	1 fish icon
5	 Frigate mackerel (<i>Auxis thazard</i>)	5	Blue	Orange	1 fish icon
7	 Eastern blue groper (<i>Achoerodus viridis</i>)	7	Blue	White	1 fish icon
6	 Snakeskin wrasse (<i>Eupetrichthys angustipes</i>)	6	Blue	White	1 fish icon

The Redmap Top Ten for Tassie

1		Eastern rock lobster (<i>Jasus verreauxi</i>)	6		White-ear (<i>Parma microlepis</i>)
2		Yellowtail kingfish (<i>Seriola lalandi</i>)	7		Herring cale (<i>Odax cyanomelas</i>)
3		Luderick (<i>Girella tricuspidata</i>)	8		Tailor (<i>Pomatomus saltatrix</i>)
4		Maori wrasse (<i>Ophthalmolepis lineolatus</i>)	9		Halfbanded seaperch (<i>Hypoplectrodes maccullochi</i>)
5		Zebra fish (<i>Girella zebra</i>)	10		Gloomy octopus (<i>Octopus tetricus</i>)



Early days – but getting good participation!



Success so far....

- ≈700 sightings (some are large schools, so thousands of individuals), of 198 species from 200+ people
- Identify new research projects
- Over 100,000 discrete visits (hits) on the site
- 220,000 website page downloads
- Visits from 174 countries
- >1000 newsletter subscribers
- Radio, tv, print media
- Many emails requesting more stuff!
- Invitations to present at industry forums
- *Climate change & marine species* – 3rd most visited section of site
- Data used in 3 journal publications so far

DiveH



Diver79





RESEARCH
PAPER

Long-term shifts in abundance and distribution of a temperate fish fauna: a response to climate change and fishing practices

Peter R. Last^{1,2*}, William T. White^{1,2}, Daniel C. Gledhill^{1,2},
Alistair J. Hobday^{1,2}, Rebecca Brown³, Graham J. Edgar³ and Gretta Pecl³

Documentation of range shifts

Contents lists available at ScienceDirect

Journal of Experimental Marine Biology and Ecology

journal homepage: www.elsevier.com/locate/jembe



Climate change cascades: Shifts in oceanography, species ranges and subtidal marine community dynamics in eastern Tasmania

Craig R. Johnson^{a,*}, Sam C. Banks^b, Neville S. Barrett^c, Fabienne Cazassus^d, Piers K. Dunstan^d,
Graham J. Edgar^c, Stewart D. Frusher^c, Caleb Gardner^e, Malcolm Haddon^e, Fay Helidoniotis^{a,e}, Katy L. Hill^e,
Neil J. Holbrook^f, Graham W. Hosie^g, Peter R. Last^e, Scott D. Ling^a, Jessica Melbourne-Thomas^a,
Karen Miller^a, Gretta T. Pecl^c, Anthony J. Richardson^h, Ken R. Ridgway^e, Stephen R. Rintoul^e, David A. Ritz^d,
D. Jeff Ross^c, J. Craig Sanderson^a, Scoresby A. Shepherdⁱ, Anita Slotwinski^c, Kerrie M. Swadling^c, Nyan Taw^d

Synthesis to understand marine ecosystem changes



ELSEVIER

Contents lists available at SciVerse ScienceDirect

Global Environmental Change

journal homepage: www.elsevier.com/locate/gloenvcha



Socio-economic and management implications of range-shifting species in marine systems

Elizabeth M.P. Madin^{a,*}, Natalie C. Ban^b, Zoë A. Doubleday^{c,d}, Thomas H. Holmes^e,
Gretta T. Pecl^{c,f}, Franz Smith^g



Management/Policy responses



Range Extension Database and Mapping project

redmap
SPOT. LOG. MAP.

HOME REGIONS SIGHTINGS LOG RESOURCES NEWS ABOUT

June 2012

What's new at Redmap?


AN UPDATE FROM **The Redmap Team**

Redmap is leaping from Tasmania onto the national stage: a national Redmap will launch in October 2012! Soon all Australians will be able to spot and log marine species that are not usually found along their own stretch of coastline.

[READ MORE](#)

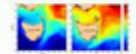
What's been spotted by Redmappers lately?

Some weird and wonderful photos of marine critters spotted by Redmap members! ... [Read more](#)




Fish soup? Tassie seas are getting warmer

Tasmania's coastal waters are warming at over three times the global average...[Read more](#)



Redmap exposed! (on ABC's 7.30 Report)

ABC television's 7.30 Report did a great job of unveiling what Redmap is all about. Watch the five-minute video...[Read more](#)






IN THIS ISSUE

- What's been spotted by Redmappers lately?
- Fish soup? Tassie seas are getting warmer
- Redmap exposed! (on ABC's 7.30 Report)
- Leaving home in a huff: some range shifts in Australian seas
- Who cares if a fish peeks up and shifts house? Strike a pose
- Who do you think you are? The who's who of Redmap

LOG YOUR SIGHTING

Have you seen or caught a marine critter that's not commonly found at your favourite fishing, diving or swimming spot? Then visit the Redmap website and log your sighting (and upload any photos and anecdotes of your unusual fish or catch!).

Newsletter communication

- Light hearted tone
- Mix of science & people
- Released quarterly
- Very well received!

Email from Redmap member "G", a commercial cray fisher:

"Really interesting articles about the science that's going on. Been wanting to know more and finally someone made sense of it to me."



Why does Redmap work?

- Engaging website with clear project branding
- Immediate display of most community & fisher reported data
- Individual feedback provided for sightings with photos
- Recognition of contributions on website & in project newsletters
- Clear acknowledgement & valuing of industry & community knowledge
- Involving people in *discovery*...something NEW to report all the time
- Fishers love talking about what they caught & divers love taking photos

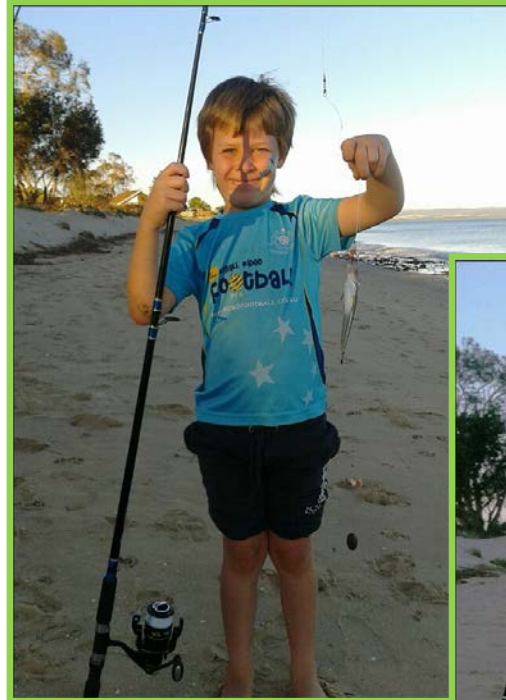


Redmappers: Peter, Sam, Lawfish, Diver263



Long-term benefits of Redmap

- Ecological monitoring - species ranges
- Effective way to identify where research could be targeted
- Promoting awareness within the general community
- Involving & engaging industry - acknowledge & values contribution
- Gives industry and community ownership of some of the knowledge



red map

SPOT. LOG. MAP.

60,000 km coastline

3-4 million fishers

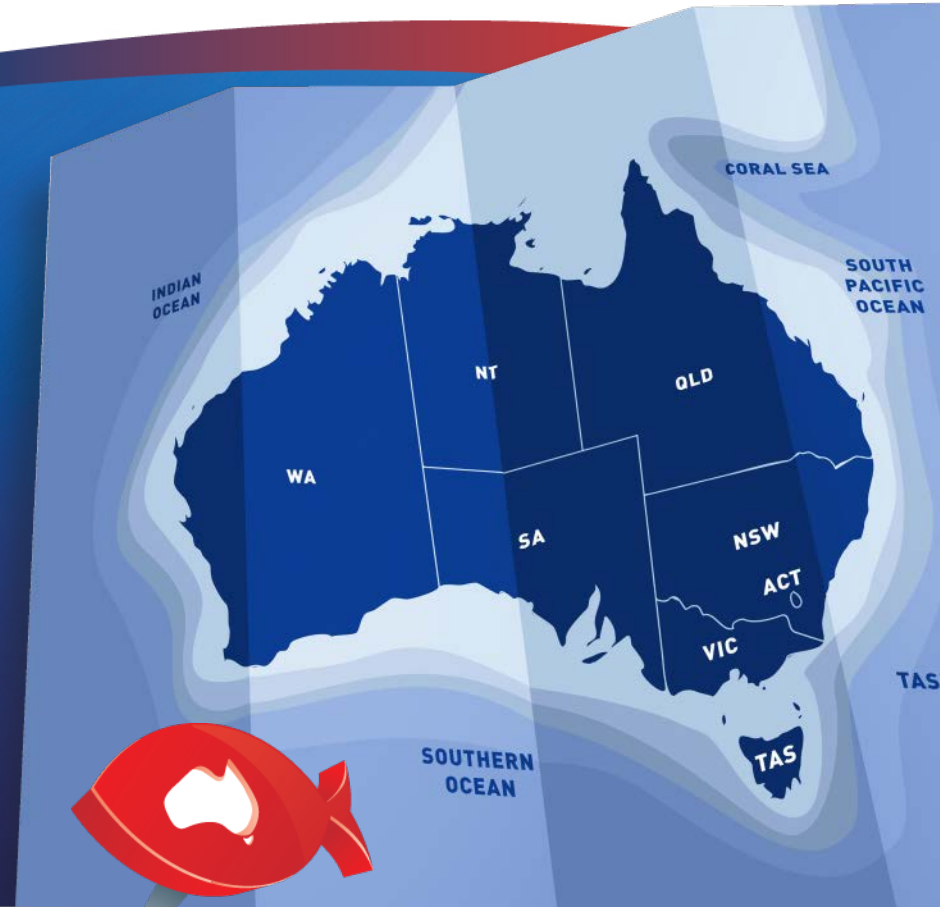
2 million dives per year

1000's of naturalists / beach combers

200+ species being monitored

60+ scientists

10+ institutes



8.6 million

smartphone users
in Australia



11.7 million

Facebook users
in Australia

Out of range
Pacific glass squid
Rob de Little
Submitted 30/8/2012






Synthesising observations from the community.....and showing how one person can make a difference, contributing as a citizen scientist & helping the scientific community unravel the mysteries of how our ecosystems are changing

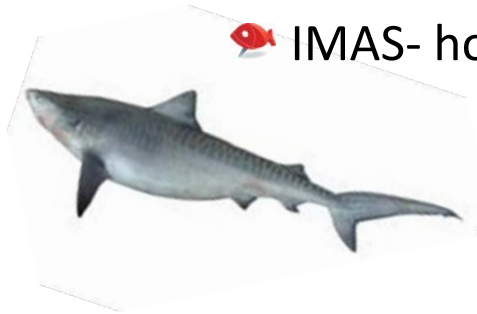
Keep up to date with what's
on the move around
Australia via our quarterly
electronic newsletter: sign
up at www.redmap.org.au



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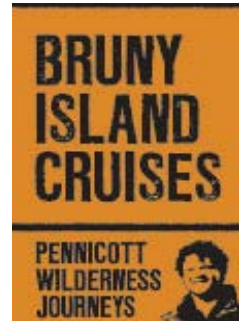
Many thanks to:

-  Fishers & SCUBA divers
-  Scientific validation panel
-  Contributing author scientists
-  Community & industry groups
that support Redmap
-  Our funders!!
-  Regional lead institutes
-  IMAS- host of Redmap Australia



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THANKS to the many supporters



Peter Johnston
Ship Chandlers



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INSTITUTE FOR MARINE AND
ANTARCTIC STUDIES



ands
AUSTRALIAN NATIONAL DATA SERVICE



Australian Government
Department of Agriculture,
Fisheries and Forestry



An Australian Government Initiative

Inspiring
AUSTRALIA

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Range Extension Database and Mapping project