How you can help scientists track how marine life reacts to climate change

October 7 2015, by Gretta Pecl Jemina Stuart-Smith, Jennifer Sunday, And Natalie Moltschaniwskyj

This common lionfish (Pterois volitans) was sighted more than 200km further south than expected down the NSW coast by 14-year-old scuba diver Georgia Poyner. It's one of almost 40 verified observations she has submitted to Redmap. Credit: Redmap/Georgia Poyner, Author provided

There are many factors that determine where a marine species will find a place to call home, such as wave exposure, salinity, depth, habitat and where other friend or foe species live.

But sea temperature plays a critical role in how far north or south an animal can live. This is due to the strong effect temperature has on almost every system and process in the body.

As our climate warms, we know some marine animals are already on the move, such as king crabs marching into Antarctica and tropical fish turning up in new regions of South Africa, New South Wales and as far south as Tasmania.

These changes in distribution are seen as a key fingerprint of climate change. But as with many large-scale patterns and processes in ecology, the devil is in the detail, and overall it's a pretty smudgy fingerprint.

There is substantial variation between species in the speed and magnitude of their responses to climate change. Species with geographically limited ranges, endemic species, or those with specific habitat requirements are possibly at greatest risk.

Marine animals that are widely distributed or are highly mobile as adults seem to have the greatest capacity to shift where they live. Yet this does not explain or encompass all the variation in species' responses.

Where to call home?

A large part of the problem is that we have a poor understanding of where many species live in the first place.

Complicating matters are mobile species of fish, lobsters or squid that can have different distributions across their larval, juvenile and adult stages, or with different seasons – summer vs winter. They might also occupy different habitats or areas when they are breeding or feeding.

So which one of these distributions do we monitor or assess to determine

if a species has shifted its range?

Ideally, we would like to know where a species range boundaries have existed in the past, for all life stages, and how these are shifting in response to a changing climate.

But Australia has 60,000km of coastline and thousands of species, of which we have very limited data for most, making access to this baseline information extremely difficult.

Often caught in northern Tasmania, the yellowtail kingfish (Seriola lalandi) is thought to be getting more common further south over recent years. Credit: Redmap/Daniel Paull, Author provided

Even where we do have a reliable estimate of the range of a species, defining and establishing exactly when a change has occurred still requires substantial information. Changes in distribution take place over time and through a series of stages.

At the range edge that is extending into new areas there may just be a few new arrivals at first. However, numbers may increase over time until there is a persistent population.

At the range edge that is getting too warm, individuals may start to struggle and decline in performance before the population decreases and then local extinction occurs.

Without intensive survey data available, it is much easier to detect a change at the extending edge of a species' distribution than it is to detect a change at the contracting edge. It is easier to report, and be more confident about, the first observation of something new in an area than it is the last to be seen in an area.

Additionally, it is not uncommon for vagrant marine animals to sometimes venture far from home (particularly as juveniles), but then be unable to survive for longer periods of time. Even if they do survive, they may not reproduce and set up a new home turf there.

Who's new to the neighbourhood?

Given range shifts progress in stages over time, starting with an arrival stage, how do we determine when a few individuals stop being vagrant visitors and start being the beginning of a new population?

Changes in the distribution of larger and more charismatic species are

going to be easier to detect than in more cryptic species. A large manta ray swimming around Tasmania's east coast would be (and indeed was – see image above) easily recognised. If they start turning up in larger numbers we will be sure to hear about it.

In contrast, a small intertidal or cryptic snail would be not so easy to identify or even spot. We may well be underestimating shifts occurring in rare or inconspicuous species, and this could be complicating our understanding of the overall pattern.

So it's not easy to pinpoint the finer details of exactly how warming waters are changing the distribution of our species. The fact that strong global and regional patterns of pole-ward movements are being seen, despite these differences in responses and detectability, is evidence of the large and inescapable nature of the effect.

Manta birostris spotted off north-east Tasmania on Australia Day 2014. Credit: Redmap/Leo Miller

The most effective way to detect changes in distribution are repeated, structured scientific surveys, such as those undertaken by Reef Life Survey.

Let the public help

Unfortunately, surveys and data from our intertidal zones, sandy sea floors or in the open ocean are sparse. But Australia does have more than

four million recreational fishers, divers, boaters and beachcombers who can help give scientists a heads-up on where we might need to look in more detail.

Participants in Redmap, the Range Extension Database and Mapping project, have already recorded observations of many out-of-range species, some in abundance.

Photos sent in to Redmap are verified by one of a team of more than 80 scientists around the country. These photos provide an early indication of which species might be shifting, highlighting where additional research could be targeted.

This gloomy octopus (Octopus tetricus) was spotted in the waters near Hobart, well out of its usual home range of NSW. Credit: Redmap/Peter Hirst, Author provided

The gloomy octopus (above) for example was one of the first species reported to Redmap. Subsequent research confirmed this species had indeed made a new home in Tasmania and is successfully breeding there.

Each Redmap sighting is like a piece of a puzzle that over time will help reveal a picture of which species might be on the move in Australian seas.

There remains much we do not know about why some species shift and others do not, or what the impacts of changing distributions might be on the structure and function of our natural seascapes, biodiversity and fisheries.

While fishers may welcome hooking new species and divers in temperate waters will love to see Nemo in their marine backyard, other less desirable changes are also anticipated.

In 2016, several hundred scientists from around the world will meet in Hobart, Tasmania, for the Species on the Move conference to discuss this global redistribution of species, how these changes in distribution may be better predicted, and how to assess the magnitude of their ecological, social and cultural impacts.

Source: The Conversation