



Hungry tropical fish, sea urchins marching south as kelp forests disappear

ABC Weather / By Ben Deacon

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Marine biologist Dr Adriana Verges says the Solitary Islands have an extraordinary mixture of tropical and temperate marine species. (*Supplied: John Turnbull/#marineexplorer*)

Like Nemo, tropical fish look out of place in southern waters, thousands of kilometres from their usual homes on the Great Barrier Reef on Queensland's eastern coast or at Ningaloo Reef, off Western Australia's coastline.

Their vivid colours give them away.

These usually northern fishes have been seen as far down the eastern states as Narooma on the New South Wales south coast, according to boat skipper and citizen scientist Georgia Poyner.

"They're the fish that are quite often bright blues and yellows. And they stand out a fair bit from the other local species," Ms Poyner said.

When Ms Poyner is not skippering game-fishing charters, she is often diving in the waters around Narooma.

There, she's noticed the arrival of more and more tropical fish.

Key points:

- Tropical fish numbers are increasing in usually temperate waters due to climate change
- Along with migrating sea urchins, they are eating kelp, leading to a decline in kelp forests
- Western Australia has lost more than 1000 square kilometres of kelp forests while sea urchins on the eastern coast are even cleaning up the turf algae that replaces kelp



Tropical fish — such as this moon wrasse — are being increasingly seen in southern waters. (Supplied: John Turnbull [#marineexplorer](#))

"A lot of tropical fish now over-winter and get larger. Usually, you'd only get juvenile tropical fish. A lot of fish now over-winter and get larger and become resident fish," she said.



Georgia Poyner is a boat skipper, diver and citizen scientist from Narooma on the New South Wales south coast. (ABC: Ben Deacon)

These fish have not escaped from fish tanks. They have been swept south by currents and then thrived in waters warmed by climate change. And they are hungry.



Tropical species such as this Klein's butterflyfish seem to be surviving longer and getting bigger outside the tropics. (Supplied: John Turnbull [#marineexplorer](#))

Double whammy for kelp forests

University of Western Australia marine scientist Dr Thomas Wernberg said, like invasive species on land, tropical fish are now causing huge problems in southern Australia, particularly in Western Australia's kelp forests, which have already been devastated by marine heatwaves.

"Increasing temperatures really are a double whammy for the kelp forests because first you have the acute temperature stress then, at the same time, the warming temperatures bring in all of these tropical fish that like to eat seaweeds," Dr Wernberg said.



Dr Thomas Wernberg is an eyewitness to the destruction of more than 1,000 square kilometres of kelp forest in Western Australia. (Supplied: Thomas Wernberg)

Dr Wernberg was studying southern Western Australia's kelp forests in 2011 when the region was hit by one of the worst marine heatwaves ever recorded on earth.

In a matter of months, vast areas of cool-water kelp forests were killed by warm water.

Soon after, tropical fish started arriving.



This is what a healthy kelp forest looks like, says Dr Thomas Wernberg. (*Supplied: Thomas Wernberg*)

"So, not only did the kelp get stressed by the direct effect of the warm water, [it] subsequently got hammered by these very hungry herbivorous fish that ate the kelp," he said.

Warming seas, tropical fish, sea urchins

Australia's east coast waters have not experienced the same degree of catastrophic marine heatwaves.

However, kelp forests there — from Byron Bay all the way to Tasmania — are in decline as waters become warmer, seaweed-eating tropical fish move south and sea urchin numbers explode.



Dr Adriana Verges is witness to the decline of kelp forests up and down the New South Wales coast. (Supplied: John Turnbull/#marineexplorer)

University of New South Wales marine biologist Dr Adriana Verges has been diving the waters around the Solitary Islands in the mid-north of New South Wales for almost two decades.

Dr Verges said the Solitary Islands was a frontier, where tropical and temperate undersea worlds meet.

"The number of tropical species there has been increasing, massively, over the last 20 years," she said.



These headband humbugs, seen around the Solitary Islands, are often associated with branching corals. (Supplied: John Turnbull #marineexplorer)

"Among the fish that are increasing in abundance, the most are tropical warm water herbivores.

"And, as these herbivores or vegetarian fish increase in abundance, we have seen the complete disappearance of kelp from some reefs," she said.

Further south, University of Technology Sydney's Professor David Booth has been charting the arrival of tropical fish in his local waters.

"Back in 2001, we started this study," he said.



Professor David Booth has been tracking the increase in tropical fish around Sydney.

(ABC: Ben Deacon)

"Since then, we've seen a ramping-up of ocean temperature, but we've also seen a strengthening of the East Australian Current.

"In the last few years, we've seen a massive increase in certain groups of tropical fishes, like the surgeonfishes."

Professor Booth explained that tropical fish were swept south in ocean currents when they were very small.

"Fish may get off the bus, so to speak, in a place like Sydney. They're not coming to Sydney on purpose," he said.



Professor David Booth surveys fish at Shelly Beach, Sydney. (ABC: Ben Deacon)

"Tropicals do pretty well through most of the summer into April, May and June.

"But, around about June or so, the water temperature can drop below 18-degrees-C.

"And that seems to be roughly the magic number when we don't see many fish surviving."

Professor Booth said Sydney's winter sea temperatures were right on the cusp of survival for tropical fish.

"Some years, it's 18 degrees, some years, it's 16," he said.

And those years when it's 18, it seems these fish can survive that one winter, and then get a foothold in Sydney."



Tropical fish such as this brightly coloured Barrier Reef chromis stick out in the waters around Sydney. (Supplied: John Turnbull #marineexplorer)

Coral off Sydney

And it's not only tropical fish establishing a foothold. Incredibly, a reef-forming coral [has very recently established itself](#) just a stone's throw from Sydney's Manly beach.



Reef-forming coral, *Pocillopora aliciae*, was only discovered off Sydney in 2015. Since then it has multiplied in size. (*Supplied: John Turnbull #marineexploror*)

"The species of coral is quite prolific up in Port Stephens (about 140 kilometres away), but it's appeared in Sydney in the last few years and is now expanding quite rapidly in certain areas of Manly for instance," Professor Booth said.

"And we're finding this is attracting these tropicals and even some species of fish and invertebrates that we had not seen in Sydney in all our 20 years.



Off Sydney, plate corals grow on rocks stripped bare by sea urchins. (*Supplied: John Turnbull #marineexplorer*)

"This is probably the furthest south you'll find fairly large expanses of this coral. But we're probably at the southern limit of what we call hard coral distribution in Australia at least.

"What we think is happening in the next decade, for instance, I think there'll be a rapid increase in the corals, the fish, the breeding."

Professor Booth explained that a region of Japan — about the same latitude above the equator as Sydney is below it — has recently seen rapid growth of plating corals in habitats formerly dominated by kelp.

"We think we may well be on a threshold of great change around Sydney in the next decade or so," he predicted.



As waters warm, Professor David Booth suspects temperate marine environments may be on the threshold of great change. (ABC: Ben Deacon)

Coral reefs forming in southern waters may be a nice idea, but Professor Booth says Sydney's new coral may be an exception rather than a rule.

"I don't think we're seeing a huge barrier reef shifting south. In our case, there's just one species, this is a subtropical coral," he said.

"Certainly not like the hundreds and hundreds of species that proliferate on the Barrier Reef."

In-between undersea world

A decade on from Western Australia's catastrophic marine heatwave, Dr Wernberg has witnessed a new environment emerge in the ruins of the region's once-magnificent kelp forests, and it is not one dominated by coral.

"After the marine heatwave, we saw massive schools of rabbitfish. It's normally found at warmer latitudes, around coral reefs," Dr Wernberg said.



Rabbitfish numbers have exploded in Western Australia since the marine heatwave of 2011.

(Supplied: John Turnbull/#marineexplorer)

Like rabbits on land, rabbitfish are vegetarian, they breed like rabbits and can explode in numbers, forming huge schools.

Following the heatwave, rabbitfish devoured the already stressed and dying kelp, and also grazed away emerging young kelp.

What followed was the collapse of an ecosystem.

"Kelps are large, brown seaweeds essentially. And they do underwater pretty much the same job as trees do in a forest," Dr Wernberg said.

"And, when the kelp disappeared, it wasn't replaced by coral reefs that also have some three-dimensional structure that provides habitat.

"Instead, you get intermediate communities dominated by carpets of what we call turf algae — small seaweeds that get tied tightly, packed with sediments," he said.



Turf algae habitats such as this lack the structure that gives shelter to marine creatures.

(Supplied: Thomas Wernberg)

If kelp habitats are like a forest, turf algae habitats are like a lawn packed with sand.

"And, with the turf algae goes a lot of the biodiversity that's associated with the three-dimensional structure with the habitat that the kelps provide," Dr Wernberg said.

Following the 2011 marine heatwave, more than 1,000 square kilometres of Western Australia's kelp forests died and were replaced by turf algae.



In Western Australia, turf algae (in front) is winning the war against kelp (behind).

(Supplied: Thomas Wernberg)

"It's getting stuck in an in-between world, where you're losing a bit of both worlds, neither coral nor kelp," Dr Wernberg said.

Since the marine biologist documented the disaster off the coast of Western Australia, similar in-between worlds dominated by turf algae have started appearing around the world.

"We seem to be at the forefront of change," he said. A lot of the changes we're seeing in our reef systems in Australia are also happening elsewhere."

In waters off Norway, Japan, Canada, Spain, Russia, Denmark and Brazil, kelp is dying and turf algae is emerging in its place.

Urchin barrens

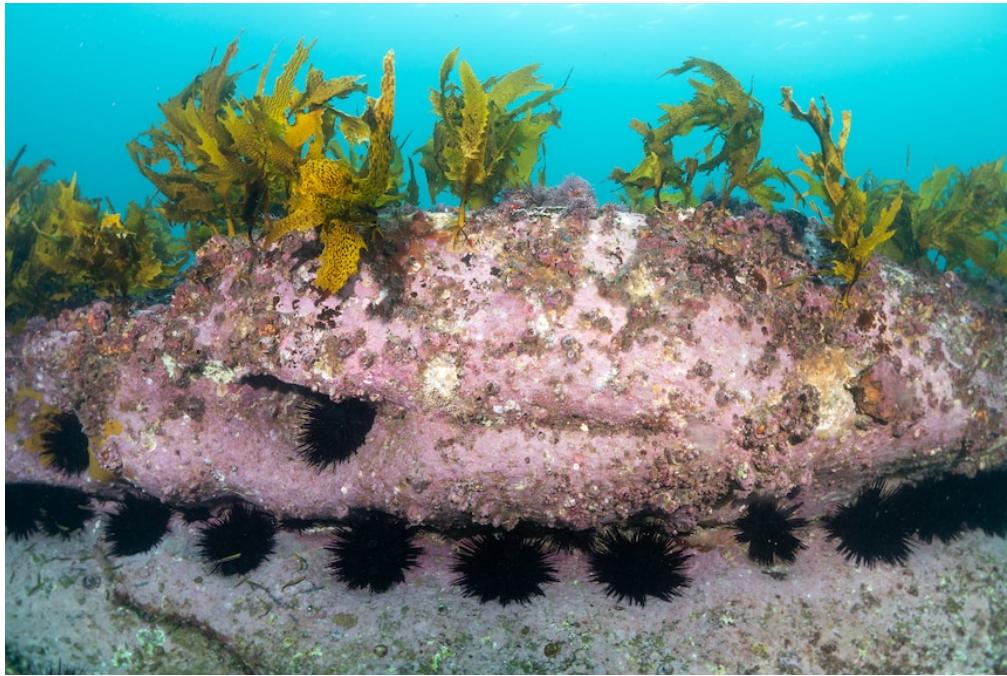
It's a slightly different story on Australia's east coast. There, sea urchins have moved south and multiplied, devastating kelp forests, particularly in Tasmania.



On Australia's east coast, sea urchins have stripped vast areas of kelp forest, leaving what are known as urchin barrens. (Supplied: John Turnbull #marineexplorer)

But the urchins also eat turf algae, so instead of turf algae habitats, the east coast has largely seen the emergence of vast urchin barrens, stripped of all vegetation.

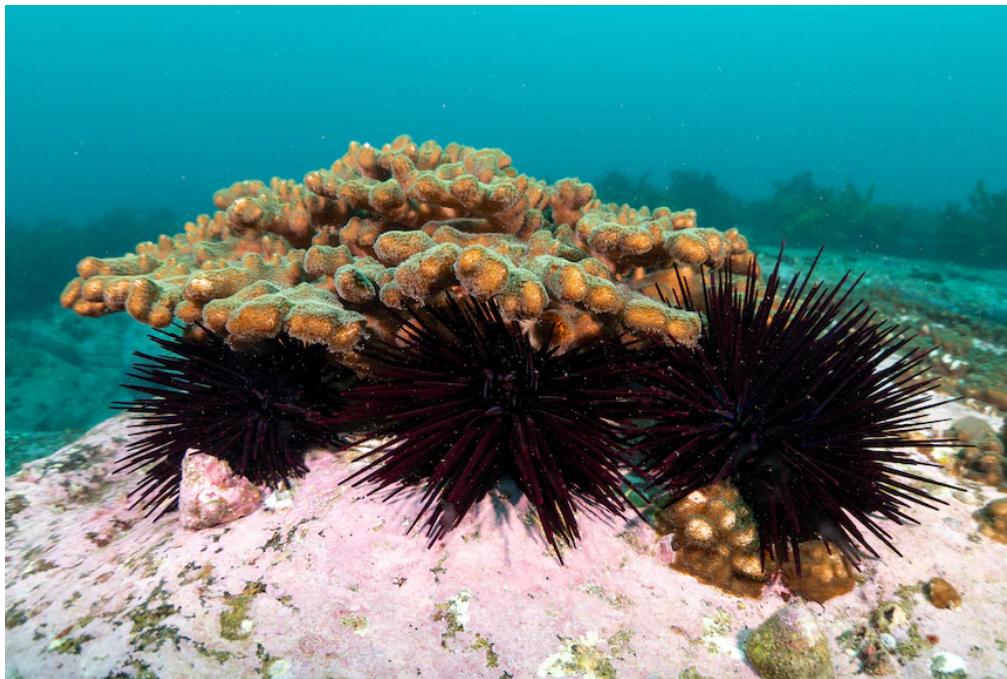
"If you do any snorkelling around Sydney, you will see that there's all these barren grounds, right?" Dr Verges said.



Some kelp survives where it is just beyond the reach of sea urchins. (Supplied: John Turnbull #marineexplorer)

"And, if you look, there's all these urchins in between the rocks.

"Urchins are kind of like bulldozers. We know their action makes the reefs less turfy. And more barren."



In warming waters around Sydney, urchins take shelter in subtropical plate corals, a win-win for barrens and tropicalisation, but a lose for kelp forests." (Supplied: John Turnbull #marineexplorer)

In Narooma, Ms Poyner has put her own unique set of skills to work helping restore balance in her local waters.

"I'm doing a lot of work at the moment with the commercial diving guys with sea urchins," Ms Poyner said.



Skipper and citizen scientist Georgia Poyner is documenting and harvesting sea urchins with commercial divers off Narooma. (ABC: Ben Deacon)

"We're filming and documenting the sea urchins and how many are there and we're harvesting the urchins.

"So, we're trying to build back reefs so that you can harvest the urchins and then I guess you get that balance back," she said.

On the west coast, Dr Wernberg said southern kelp forests deserved to be recognised as a national treasure, just like the Great Barrier Reef.

"We have focused a lot on our unique and amazing tropical environments," Dr Wernberg said.

"But we haven't really spent the same time and effort trying to understand our temperate marine environments.

"The time is now because we are running out of time."



One last strand of kelp survives amid an urchin barren. (Supplied: John Turnbull
#marineexplorer)