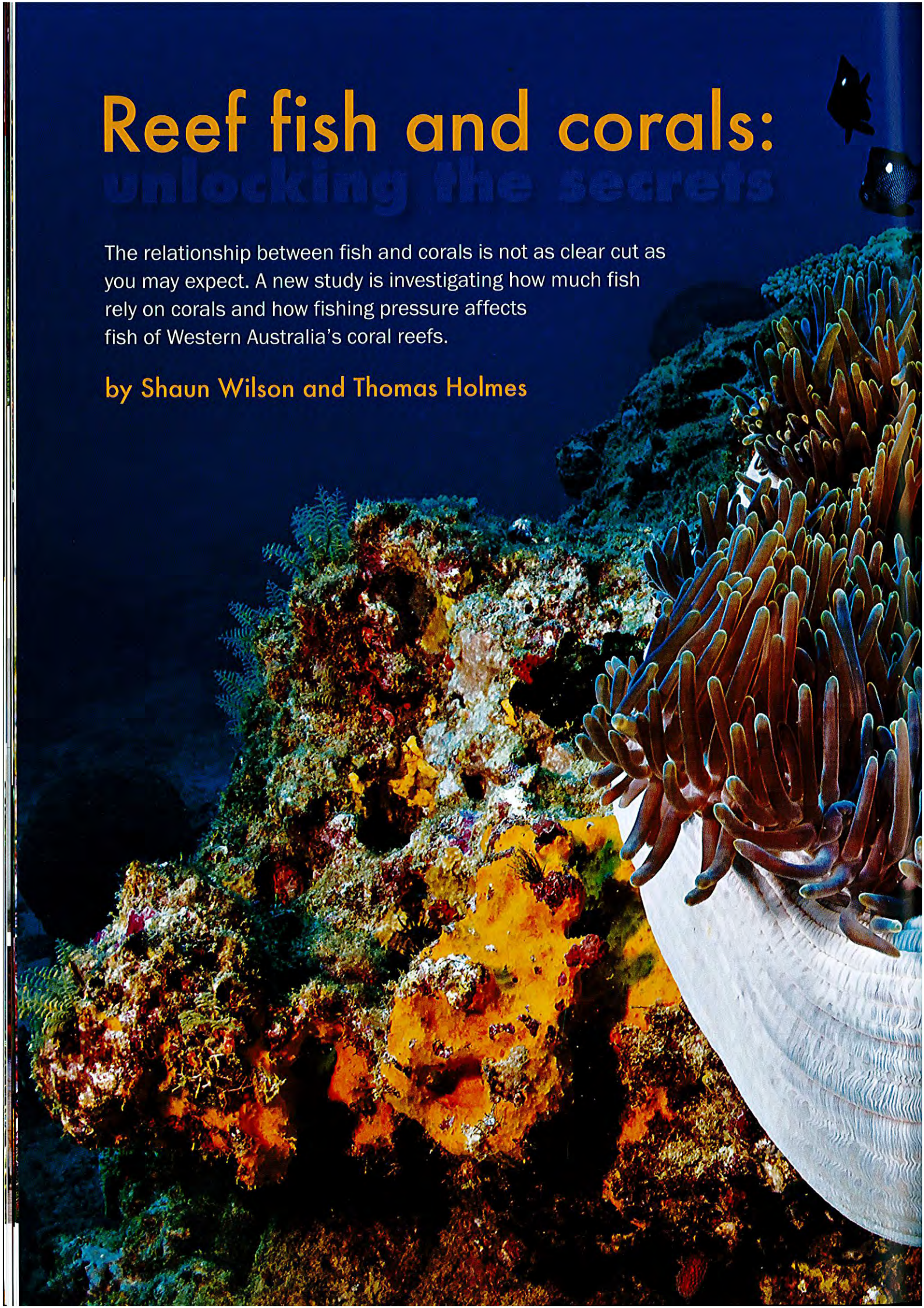
Reef fish and corals: unlocking the secrets

The relationship between fish and corals is not as clear cut as you may expect. A new study is investigating how much fish rely on corals and how fishing pressure affects fish of Western Australia's coral reefs.

by Shaun Wilson and Thomas Holmes



Coral reefs, which line extensive areas of the state's tropical and island coastlines, are an integral component of Western Australia's natural environment. While most of us are aware of the famous fringing reefs at Ningaloo, corals reefs are also a prominent feature of the Kimberley coast, the remote Rowley Shoals and the Montebello Islands. Many of these areas are either existing or proposed marine parks, managed by the Department of Environment and Conservation (DEC). Warm waters, pushed down the coast by the Leeuwin Current, also enable coral reefs to thrive in southern waters around the Abrolhos Islands, creating a unique combination of warm and cool-water habitats (see 'Slaughter, seabirds and ocean life at the Abrolhos', *LANDSCOPE*, Winter 2010). These reefs and many others are among the most diverse of all ecosystems, providing homes for thousands of species of fish, plants and invertebrates.

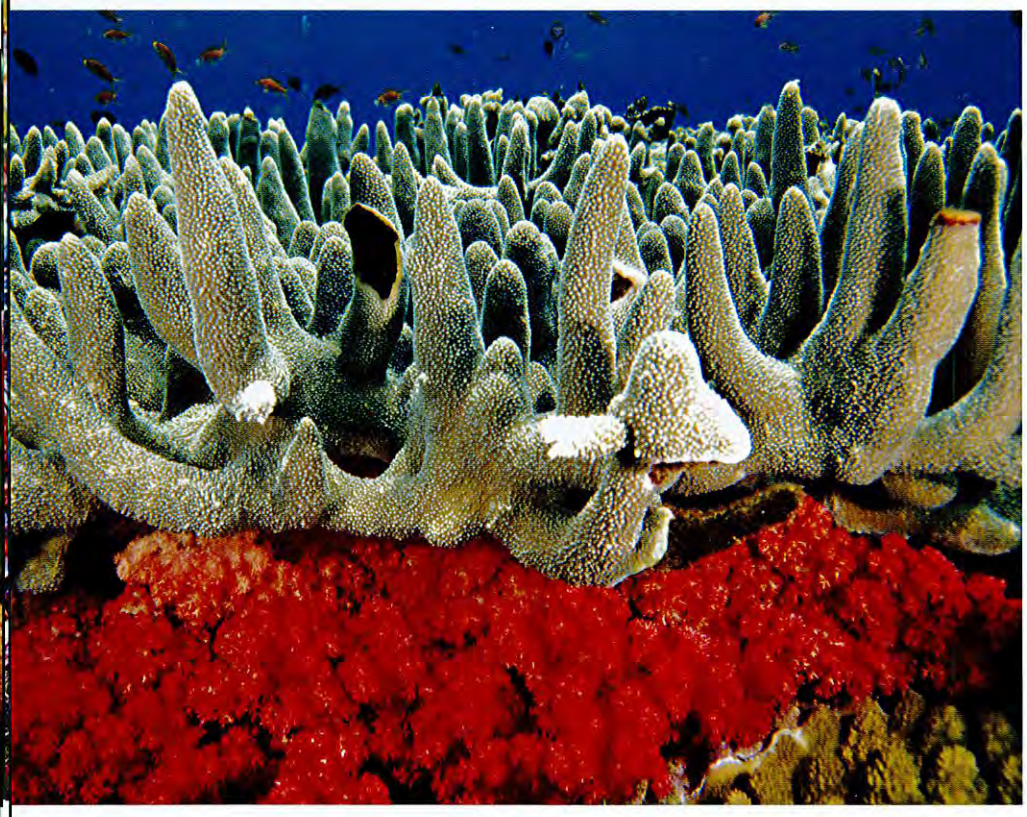
Coral homes

Hard corals, also known as scleractinian corals, create the foundation of most reefs. These corals can form massive colonies, in many cases living up to hundreds of years old, and come in a multitude of shapes and sizes, creating a network of nooks and crannies for animals to feed and shelter on the reef surface. Unfortunately for these animals, corals are coming under growing levels of stress from climate change pressures such as increasing sea temperatures, severe tropical storms, disease, rising sea levels and ocean acidification. The influence of such pressures could lead to changes in the type of corals that we see on tropical reefs and, in some locations, the possible loss of corals.

Fish are one group of animals that benefit greatly from the presence of corals. Many fish species are recognised as playing critical roles in the functioning of reef ecosystems, increasing these systems' ability to recover from disturbances. In addition, through fisheries and tourism, fish on reefs provide food and livelihoods for millions of people living on tropical coastlines around the world. Consequently, fish are among the most well-studied group of species on reefs and, in comparison to other reef inhabitants, we have a relatively good idea of how they respond to changes in coral abundance.

Different responses to coral loss

So what exactly do changes in the reef environment mean for the thousands of fish species that call coral reefs home? Fish that rely on live coral as a source of food are among the most vulnerable to disturbances that reduce the overall cover of hard corals. This includes many members of the brightly coloured butterflyfish family (Chaetodontidae), which snorkellers often spy nibbling on coral branches. Not surprisingly, the abundance of many of these types of fish declines after significant coral loss. However, this is only a general pattern, with the response of butterflyfish to coral loss varying considerably among different species. Some, such as the chevron butterflyfish (*Chaetodon trifascialis*), feed on only a few types of coral and these fish are the most likely to suffer when coral death occurs. Others, such as the melon butterflyfish (*C. trifasciatus*), may feed from more than 50 different



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Main Ningaloo Reef.
Photo – Ross Gudgeon

Above The chevron butterflyfish is a highly specialised coral feeder.
Photo – Shaun Wilson/DEC

Left Hard and soft coral.
Photo – Clay Bryce/Lochman Transparencies

species of coral and an overall loss of live coral cover often has little impact on their abundance.

The differing responses between fish species to coral loss occurs because disturbances to the reef tend to have their greatest effect on a handful of coral types. Unfortunately, these are often the corals that highly specialised species such as the chevron butterflyfish feed upon. Melon butterflyfish also feed on these corals but, as they are able to shift the focus of their feeding to other less affected corals, they tend to be more resilient to disturbances on coral reefs.

Coral settlers suffer

Habitat disturbance and a loss of coral can also have a detrimental effect on many of the small-bodied fish that live on reefs, such as the damselfish (family Pomacentridae) and some of the gobies (family Gobiidae) that shelter among the branches of coral colonies. Some of these fish are closely associated with corals for their entire lives, but some live in close proximity to corals only early in their life, sheltering among corals when they are just a few millimetres long. For these 'coral settlers', reliance on corals may not be apparent when they are adults, but it is still critical to their long-term survival on reefs. A recent study on Ningaloo Reef found that about 40 per cent of fish species rely on live corals for food and shelter when they are juveniles, much more than the 10 per cent of species that closely associate with corals as adults. As a result, any effect of coral loss is expected to be particularly pronounced during the early stages of a fish's life.

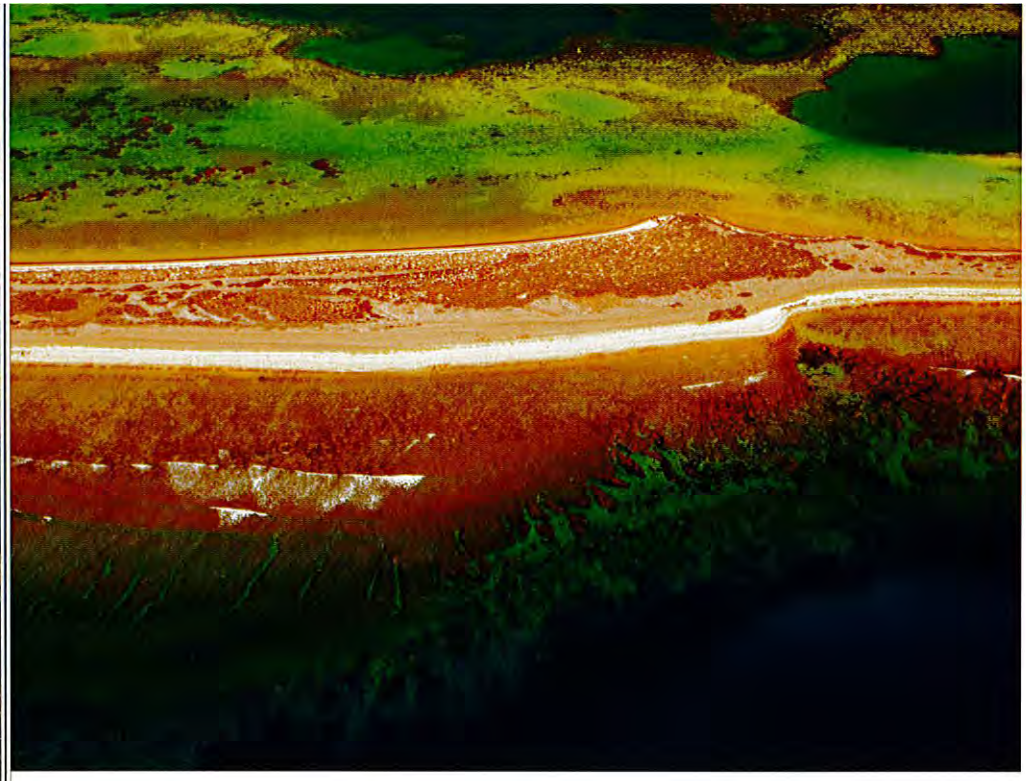
Coral as shelter—dead or alive

For some fish the colour present in coral tissues provides an ideal backdrop, allowing them to blend into their surroundings and help them avoid detection by predators. But for most reef fish it is the myriad of small holes and passages created by coral branches that is essential for their survival. For these fish, extensive coral mortality will have no immediate effect, as coral skeletons will continue to provide the shelter they require, even after the coral has died. Indeed, studies on the Great Barrier Reef have shown the number of fish species present on a reef may be unchanged after extensive coral loss, providing the structural framework of the reef remains intact. And that is the critical factor. If the coral skeletons remain upright, then highly specialised, coral-dependent species will be gradually replaced by fish that feed on algae or invertebrates and the overall diversity of the fish community will be unchanged. In fact, an influx of algal-feeding fish is critical to the recovery process of the reef, as their feeding prevents algae overgrowth and maintains space for corals to grow.

However, if the reef structure breaks down, then diversity of the fish community will decline. This will be particularly important for the small-bodied fish that rely heavily on

Top Abrolhos Islands corals.
Photo – Gunther Schmida/Lochman Transparencies

Above Damselfish and basslets on a coral reef.
Photo – Ann Storrie



Left Aerial view of the Abrolhos Islands.
Photo – Cliff Winfield

Below left Coral trout are prized by fishers on coral reefs.
Photo – Thomas Holmes/DEC

coral shelters to avoid predators. These small-bodied fish are an important component of diversity; species with maximum body lengths less than 10 centimetres typically account for 30 to 50 per cent of all fish species on reefs. Loss of these fish may therefore have a serious impact on overall diversity.

Fishing pressure

Climate change effects are not the only significant pressures affecting coral reef fish communities. One of the most prominent threats on a global scale comes from commercial and recreational fishing. Fishing is a favourite pastime of many Western Australians, contributing $570 million dollars to the state's economy annually and providing a livelihood for thousands of people. Fishing is permitted within designated areas of the state's marine parks and is a popular recreational activity for many visitors.

However, the types of fish targeted by WA fishers represent only a small fraction of the thousands of species found on coral reefs. Fishers typically target large-bodied predatory species that feed on other fish or invertebrates. Reduced presence of live coral is unlikely to directly affect these fish. However, it may affect the availability of their prey, especially if they target coral-dependent species. A breakdown of coral skeletons may also affect juveniles of target species that shelter within the protective reef matrix, which may have long-term consequences for the abundance of adults. Alternatively, removal of fisheries-targeted species may reduce predation pressure or result in an increase in the abundance of small-bodied predators.

Providing answers

Clearly the effects of habitat disturbance and changes in coral cover frequently occur in areas subjected to fishing pressure. It is therefore essential to understand how the effects of habitat disturbances interact with changes instigated by fishing pressure. To date, WA's tropical reef ecosystems remain relatively unaffected by severe climate change impacts. However, given global climate predictions, this may change in the future.

In addition, fishing pressure is likely to continue increasing as population growth continues along WA's tropical and sub-tropical coast. Will excluding fishing effectively reduce stress on the environment and help maintain a healthy reef and diverse fish community in WA's tropical reefs? Or is some level of fishing required to reduce predation pressure and encourage survival of smaller-bodied coral-dependent fish?

These questions and others are the focus of a research program being undertaken by DEC's Marine Science Program. Together with researchers from the Department of Fisheries, Australian Institute of Marine Science and CSIRO, the program will investigate which fish require live coral and at what stage in their life coral is an important habitat requirement. The program will also look at which fish are the major predators of reef-associated fish and what may happen to fish communities and the reef environment if these predators are removed by fishing.

Climate change and fishing are undoubtedly the two greatest threats to reef fish. This research, combined with ongoing monitoring from DEC's West Australian Marine Monitoring Program, will improve our understanding of how both these factors influence reef communities, thereby improving our management of coral reefs.

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