Story by **JEAN-PAUL HOBBS and JUSTIN GILLIGAN** *Photography by* **JUSTIN GILLIGAN**

In the face of increasing concern for the future of coral reefs, a team of young explorer scientists set out to uncover the secrets of Australia's remote outposts in the Indian Ocean.

FAR AWAY ISLANDS

Whispers of a remote tropical

enclave bounded by pristine coral reefs, whose sheer isolation had discouraged scientific exploration stimulated our imaginations.

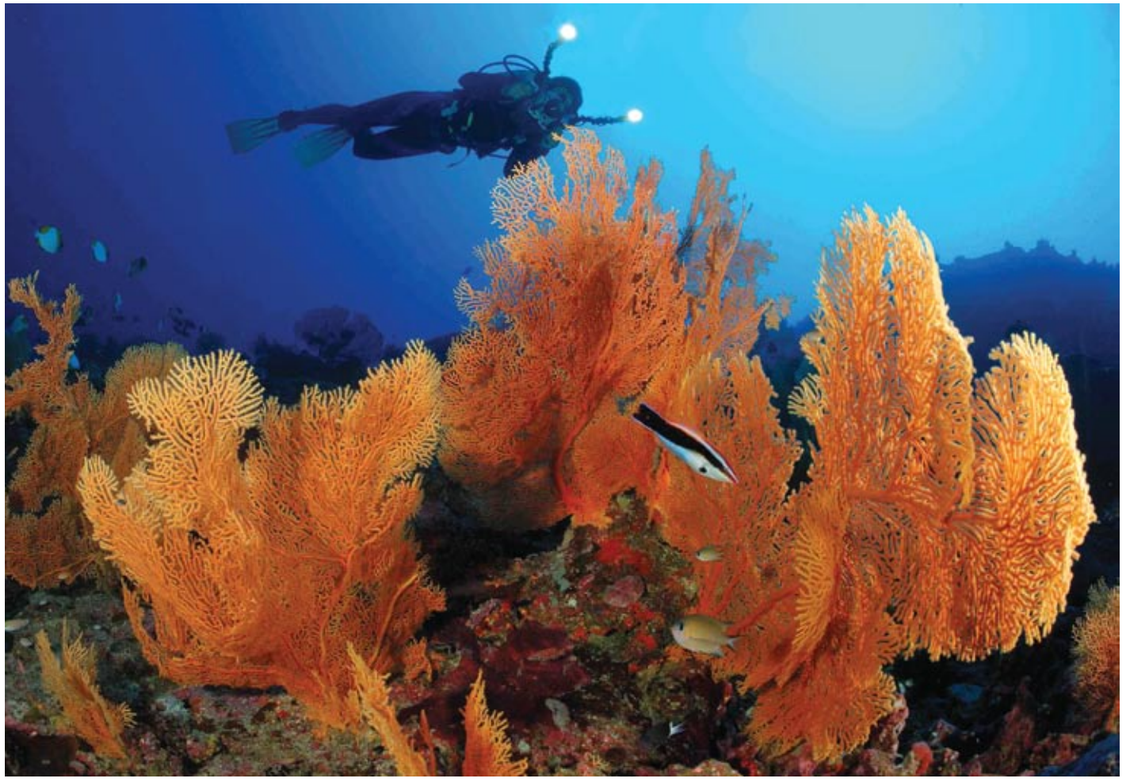
Visibility in the water was a crystal-clear 40 metres with an electric-blue tinge. Already in the early stages of this transect we had recorded encouraging numbers of the endangered humphead Maori wrasse, several rare species of butterflyfish, and an angelfish found nowhere else on Earth. Nearing the end of the transect we observed various sharks shadowing our every move… their first face-to-face meeting with a human. As we wound up our measuring tape, the vibrations excited a grey reef shark to bite and snap at the tape. A look of disappointment, a flick of the tail, and the shark was gone. For a young team of marine scientists it's another exciting day exploring the little known waters of the Cocos (Keeling) Islands.

The Cocos (Keeling) Islands and Christmas Island are Australian external territories located in the tropical eastern Indian Ocean. They are more than 2500km northwest of Perth. The unique terrestrial flora and fauna of the islands are well documented, and the territories are internationally recognised for their diversity of nesting seabirds and abundance of land crabs. Underwater, the marine ecosystem is largely unexplored but every bit as spectacular. Marine scientists have only recently begun to document and monitor the unique marine life of the islands. But unlike most scientific discoveries which are led by experts in their area of studies, we are but an unknown group of young marine biologists on the adventure of our lifetime.

EXPLORATION ON A SHOESTRING

We arrived at the Cocos (Keeling) Islands, straight out of university, with only the clothes on our backs and a small amount of research equipment. The research team consisted of JP Hobbs, Justin Gilligan, Jay Hender, Christian McDonald and Joseph Neilson. During the final year of our marine biology degrees, we decided to design and fund our own research expedition. Whispers of a remote tropical enclave bounded by pristine coral reefs, whose sheer isolation had discouraged scientific exploration, stimulated our imagination. We scraped together enough money for flights, filled our empty pockets with snacks and supplies and boarded a plane with no idea of what we were diving into.

The sign at the airport read, *'Welcome to the Cocos (Keeling) Islands. Altitude 10 feet. Coconuts fall regularly, Please take care.'* Keeping an eye out for free-falling fruit, we made the islands our home for the next 10 months. Barefooted people sauntered about with broad smiles spanning their tanned faces, taking care to dodge the crabs and wild chickens. The stresses of the mainland are irrelevant, and wristwatches a literal waste of time. We took off our shoes, and set out on an ambitious program of monitoring fishes, corals, and invertebrates.



Top: **AS DEPTH INCREASES ALONG THE OUTER REEF DROP-OFF at Christmas and the Cocos (Keeling) Islands, hard reef building corals give away to flexible seawhips and fan corals. Unlike hard corals these species don't rely on photosynthetic zooxanthellae and sunlight to survive. As a result, they thrive in deeper waters where there is less competition for space.**

Right: **ONE FISH, TWO FISH… marine biologists Christian McDonald (at left) and JP Hobbs (at right) identify and count species of fish that are targeted by anglers or indicate the health of the reef. They will then swim back along the transect and count corals and benthic invertebrates such as sea cucumbers, clams and crown of thorns starfish. The results of this technique provide an indication of stock sizes and reef health.**

Front page: **FRESH OFF THE PLANE AT THE COCOS (KEELING) Islands in 2001, we were greeted by blue skies, low-lying palm fringed islands and inviting tropical seas. At this point we were unaware of the adventures and discoveries that would unfold over the following years in the waters surrounding this Indian Ocean paradise.**

The lagoon of the Cocos Keeling Islands is a complex maze of shallow sandbanks, coral reefs and deep "blue holes". These marine potholes, 5 to 50 metres wide and 10 to 30 metres deep are the result of weathering thousands of years ago when sea levels were lower and the atoll was high and dry. These largely unexplored, mysterious waters became the focus of our research. These blue holes were an exhilarating mixture of discovery and survival. We recorded some of the greatest densities of reef sharks and sea cucumbers on Earth, and found that the blue holes were used as a nursery by the endangered humphead Maori wrasse. Sharks, humphead Maori wrasse and sea cucumbers have been depleted throughout the world by overfishing and there is serious concern about the viability of these species. The Cocos (Keeling) Islands still support natural levels of these species, and is therefore one of their last remaining strongholds in the world.

At night, from the jetty on West Island we watched the darker side of the marine world come alive. The streetlights on the jetty would attract a smorgasbord of unsuspecting plankton and baitfish like moths to a flame, which in turn attracted giant trevallies, manta rays, and, of course, sharks, all searching for a meal. The surface of the water boiled with the activity below, and the violent splashes of baitfish being chased by trevallies resonated into the tropical night. Mild-mannered green turtles, oblivious to the carnage, fed gently on seagrass and algae, temporarily surfacing to take a breath and glimpse at onlookers. The jetty was our platform to capture, measure, ascertain gender and tag sharks, then release them. On the northern edge of the lagoon, we stumbled on a new addition to the marine community: a lone, male dugong. Where the dugong originated is unknown; the nearest known population is in Indonesia, more than 1000 kilometres away.

A critical point of our study was the acceptance of our research team by the local community. Their interest led to support from the local administration in the form of a research vessel and other logistical aid. When Wilson Tuckey, then Federal Government Minister for Forestry and Conservation, visited the islands, we presented our preliminary findings. His subsequent approval led to funding support through the Fisheries Resource Research Fund to extend the research to the outer reef. The aspirations were becoming a reality.

In June 2005 another research trip beckoned on the back of positive results from our first exploratory trip. By now we had gained support from James Cook University and Parks Australia to extend our research to include Christmas Island. Despite being neighbours, Christmas Island and the Cocos (Keeling) Islands are worlds apart. The former has an inhospitable coastline of jagged limestone cliffs, contrasting sharply with the sandy low-lying topography that typifies the Cocos (Keeling) Islands.

Diving at Christmas Island was breath-taking with exceptional visibility to 80m. The reef around Christmas Island is a near-vertical wall coated with colourful coral wallpaper. Beyond the wall, the deep blue clear water induced a bizarre underwater vertigo sensation. On one particular dive we hovered in awe as a 12 foot tiger shark glided past us.

A BLACK-TIP REEF SHARK cruises the shallow sunlit waters of the Cocos (Keeling) Island lagoon in search of easy prey such as small fish and squid. While shark populations are being decimated world wide, the Cocos (Keeling) Islands represent a stronghold for reef sharks. The islands are now emerging as an important baseline to determine the level of exploitation that occurs on coral reefs where sharks are hunted.

We recorded some of the greatest densities of reef sharks and sea cucumbers on earth, and found that the blue holes were used as a nursery for the endangered humphead Maori wrasse.

Ocean Geographic's honorary editor, also a world-renowned fish taxonomist, Dr. Gerry Allen, had produced the book *Fishes of Christmas Island*, which lists more than 550 fish species from Christmas Island, and some of these species are found nowhere else in Australia. According to Dr Allen, "the fish communities at Christmas Island are distinct from the rest of Australia and contain a unique mix of Indian and Pacific Ocean species". We were delighted to find an additional 20 previously unrecorded fish species, ranging from large silky sharks to small cryptic angelfish. Christmas Island is the meeting place for Indian and Pacific Ocean sister species, and some of them had interbred to produce unique hybrids found nowhere else in the world.

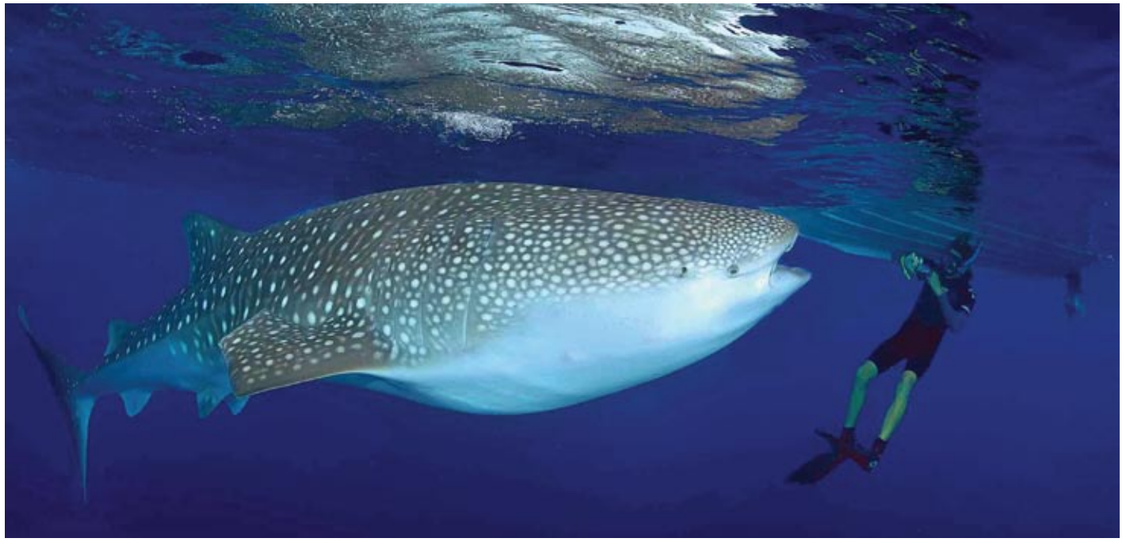
Despite our extensive surveys, one habitat remained unexplored - the inhospitable south side, accessible only between storms during the doldrums or wet season (November to March). In January 2008, in the middle of a tropical cyclone and two weeks of torrential rain, we ventured to survey this inhospitable south side. With adrenalin pumping we made it to our first survey site midway along the southern coast. It was unlike anything we had seen; the coral reef resembled a moonscape, the result of constant pounding from oceanic swells. We also noticed that everything seemed atypically large. Our data later confirmed the southern coastline had a greater proportion of large predatory fish compared to other areas, perhaps due to a lack of fishing pressure on this exposed coast.

While the wet season is a difficult time for humans, the rain brings the island to life. The first rain in December marks the start of the famous red crab migration. Adult crabs emerge from their burrows and journey to the coastline in a spectacular mass breeding migration. Billions of eggs are released into the sea and hatch into free-swimming larvae that drift in the ocean currents around the island shoreline for about four weeks. Then early one day in February along with tourists who flock to this island at this time of the year, we watched in amazement as the transparent crab larvae gathered at the shoreline emerging from the sea where they had metamorphosed into tiny red crabs to begin a life on land. We were not the only visitors. Waiting with mouths wide-open were manta rays and Christmas Island's best-kept secret – whale sharks, which use their fine gills to filter feed on the abundant red crab larvae. Through discussions with the local community and our underwater observations we found that Christmas Island is an important seasonal nursery area for juveniles of these gentle giants of the sea.

We had collected data on all four coasts of the islands on all manner of marine life including sea cucumbers, crown-of-thorns starfish, corals, Indian and Pacific Ocean fish species, endemic fishes, hybrid fishes and super-abundant species that are rare elsewhere. This included more than 50 species not previously known to be at the Islands and some species previously unknown in Australian waters. "It's an extraordinary place,"

Right:
A CORAL COD takes advantage of a shrimp's offer to act as a toothbrush to clean its teeth and body. The coral reef is a delicate ecosystem, where all animals play a specific role. At this location on the Christmas Island reef, several predatory fish would line up to be cleaned by the shrimp, which would in return obtain sustenance from the dead skin and parasites it would remove.

Opp. page:
THE FIRST RAINS OF THE WET SEASON initiate the world-renowned red crab migration on Christmas Island. Millions of crabs migrate from the middle of the island to the coast where they breed and release their eggs. Red crabs are being killed by the introduced yellow crazy ant and it is unknown what effect the estimated 30-40% reduction in crab numbers will have on the marine species.



says Max Orchard, chief park ranger and long-time resident of Christmas Island and our research echoed this.

At the Cocos Keeling Islands some species of fish could no longer be found during our monitoring study in 2008. The highly prized coral trout and white-lined cod were missing and overfishing appears to have caused the decline of these popular fishes. And in 2008 there was an outbreak of coral disease on the north coast of Christmas Island. These corals are an important habitat and food source for many species of fish, particularly the Chevron butterflyfish, which feeds exclusively on these large corals. Another coral feeder, the longnose or harlequin filefish, has also suffered as a result of the loss of coral and appears to have become extinct at Christmas Island.

The intricate link between the terrestrial and marine life on Christmas Island has also been affected. The introduced yellow crazy ant has caused an estimated 30-40 per cent decline in red crab numbers, whose eggs and larvae are an important food source for marine organisms such as whale sharks and manta rays. The challenge now is, managing these unique habitats. The data and information collated during our research trips is being used in the development of management strategies aimed at preservation of the marine biodiversity of these islands. Western Australia Department of Fisheries is working to protect sensitive species and prevent overfishing, while Parks Australia has established marine parks that limit fishing and protect valuable habitats. Both agencies have developed monitoring programs in addition to our ongoing studies. A Reef Check monitoring program has also been established which enables the local community to monitor the health of their reefs. As global environmental threats rise, marine research will continue to unravel the secrets of these islands in an effort to protect Australia's unique underwater Eden. ○

Top: **CHRISTIAN MCDONALD IS TAKEN ABACK by the size of a cruising whale shark in the waters off Christmas Island. Whale sharks are seasonal visitors to Christmas Island between November and April when they converge on the island to feed on the red crab spawn.**

Opp. page: **A LONE MALE DUGONG arrived at the Cocos (Keeling) Islands in June 2002. The next closest dugong population is in Indonesia, approximately 1000 km away. This male dugong risked starvation and predation to swim a huge distance over water as deep as 5000 m. This dugong now holds the record for the longest known single swim by a dugong and is the only individual to occur at the Islands.**

Acknowledgements

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