Explorers find hundreds of undescribed corals, other species on familiar Australian reefs

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Species of sea urchin found during the CReefs expedition, Australia, 2008
Credit: CReefs

Hundreds of new kinds of animal species surprised international researchers systematically exploring waters off two islands on the Great Barrier Reef and a reef off northwestern Australia -- waters long familiar to divers.

The expeditions, affiliated with the global Census of Marine Life, help mark the International Year of the Reef and included the first systematic scientific inventory of spectacular soft corals, named octocorals for the eight tentacles that fringe each polyp.

The explorers today released some initial results and stunning images from their landmark four-year effort to record the diversity of life in and around Australia's renowned reefs.

Discoveries at Lizard and Heron Islands (part of the Great Barrier Reef), and Ningaloo Reef in northwestern Australia, included:

-- About 300 soft coral species, up to half of them thought to be new to science;

-- Dozens of small crustacean species -- and potentially one or more families of species – likewise thought unknown to science;

-- A rarely sampled amphipod of the Maxillipiidae family, featuring a bizarre whip-like back leg about three times the size of its body. Only a few species are recorded worldwide;

-- New species of tanaid crustaceans, shrimp-like animals, some with claws longer than their bodies;

-- The beautiful, rare Cassiopeia jellyfish, photographed upside down on the ocean floor, tentacles waving in the water column -- a posture that enables symbiotic algae living in its tentacles to capture sunlight for photosynthesis;

-- Scores of tiny amphipod crustaceans – insects of the marine world – of which an estimated 40 to 60% will be formally described for the first time.

As well, the researchers deployed new methods designed to help standardize measurement of the health, diversity and biological makeup of coral reefs worldwide and enhance comparisons.

Preparing for future discoveries, the divers pegged several layered plastic structures – likened to empty doll houses – for marine life to colonize on the ocean floor at Lizard and Heron Islands. Creatures that move into these Autonomous Reef Monitoring Structures (ARMS), which provide shelter designed to appeal to a variety of sea life, will be collected over the next one to three years.

"Corals face threats ranging from ocean acidification, pollution, and warming to overfishing and starfish outbreaks," says Dr. Ian Poiner, Chief Executive Officer of the Australian Institute of Marine Science (AIMS), which led the research. "Only by establishing a baseline of biodiversity and following through with later censuses can people know the impact of those threats and find clues to mitigate them."

Dr. Poiner also chairs the Scientific Steering Committee of the CoML which, after a decade of research, will release its first global census in October 2010.

Dr Julian Caley, Principal Research Scientist at AIMS and co-leader of CoML's CReefs project, says the three explored coral reef sites are located in two ocean basins with different levels of biodiversity.

"These site characteristics offer clues to predict patterns of biodiversity on reefs that are well known and those that aren't."

Previous studies have uncovered large differences in the biodiversity at the Great Barrier Reef's Lizard Island and, further south, Heron Island – 30% more hard corals, 40% more fishes, for example. The cause of such gradients in species diversity is poorly understood, but species richness

in the region tends to decrease with distance from the equator.

Ningaloo Island appears to be the least biodiverse of the three sites studied, which may be related to its comparative isolation from other reef systems.

Understanding these biodiversity gradients and the influence of connectivity will help scientists predict reef biodiversity worldwide.

Expeditions to the same three sites will be repeated annually over the next three years to continue their inventory and measure impacts of climate change and other processes over time.

The number of species living on reefs is roughly in reverse proportion to body size, with microbes most numerous and larger animals such as corals and fishes smallest in number.

Says Dr. Caley: "We were all surprised and excited to find such a large variety of marine life never before described – most notably soft coral, isopods, tanaid crustaceans and worms – and in waters that divers access easily and regularly."

"Compared to what we don't know, our knowledge of marine life is a proverbial drop in the ocean. Inventorying the vast diversity and abundance of life across all ocean realms challenges both science and the imagination."

First systematic inventory of soft corals on Barrier Reef

The expedition marks the first census of soft corals, named octocorals for the eight tentacles that fringe each polyp.

Researchers believe between one-third to half of the hundreds of soft corals found are species new to science.

While the colorful animals are not reef builders, they dominate some areas studied, covering up to 25 per cent of the ocean floor. They also provide important habitat for other species.

The addition of perhaps as many as 150 new species to the global inventory of soft corals is a major addition to the knowledge of this group which, despite its high distribution worldwide, remains one of the most poorly understood groups.

Despite the large number of new species already discovered, Dr. Caley believes as many new species again may be found on future expeditions. DNA barcoding will dramatically expedite the identification of these species in future, he adds.

Vultures of the sea

Researchers were intrigued as well by discoveries of various isopods, often referred to as vultures of the sea, because some feed on dead fish.

Of the many isopod species collected during the first two expeditions, approximately 100 are not yet described in the scientific literature.

Some isopods are parasitic and burrow into the flesh of live fish. Most infamous of the parasitic isopod are cymothoids – the "tongue biter" – so called because they invade a fish and eat its tongue off, essentially replacing the tongue by attaching to the host's mouth.

Still more discoveries

Other major finds included many potentially new polychaetes, a class of marine animals known as "bristle worms," a relative of leeches and earth worms. Up to two-thirds of species found at Lizard Island alone are thought to be undescribed.

The scientists' studies also included seaweeds, urchins, and lace corals. More formally known as Bryozoans, lace coral colonies consist of asexually budded (and therefore genetically identical) individuals. Colonies form large intricate structures which bear no resemblance to the structure of the individual.

"Amazingly colorful corals and fishes on reefs have long dazzled divers, but our eyes are just opening to the astonishing richness of other life forms in these habitats," says CoML Chief Scientist Ron O'Dor. "Hundreds of thousands of forms of life remain to be discovered. Knowledge of this ocean diversity matters on many levels, including possibly human health – one of these creatures may have properties of enormous value to humanity."

Says Dr. Nancy Knowlton of the Smithsonian Institution, Washington, another principal investigator with CReefs: "The new Australian expeditions reveal how far we are from knowing how many species live in coral reefs around the globe. Estimates span the huge range from1 to 9 million."

CReefs has embarked on a mission to create a more precise estimate of reef species by the time of the first CoML synthesis report in 2010.

Adds Dr. O'Dor: "Even at the low end of this range, we must wonder why nature has evolved such prolific diversity on coral reefs. While they are icons of diversity, the processes that have generated and maintained coral reef biodiversity are still unknown.

Expeditions

Each of the three expeditions (Lizard Island, April 2 - 22, Ningaloo June 5 - 25 and Heron, Aug 25 - Sept 14) was three weeks in duration and included about 25 members.

Researchers adapted sampling methods and applied these in a wide range of habitats, including sampling diversity in dead coral heads -- the skeleton of a coral emptied of the fleshy animal that once lived inside. Samples were obtained by enveloping small dead coral heads in a bag and carefully chiseling off the base to capture all of the animals inside. A single dead coral head can yield more than 150 individual crustaceans, molluscs, and echinoderms. Worldwide, these dead coral heads host many thousands of species and their use is emerging as an important tool for assessing coral reef biodiversity.

As with the ARMS devices, the collection and analysis of biodiversity in dead coral heads is being standardized to promote the comparability of research worldwide.

Funding for the work was provided from several sources: BHP Billiton (the giant multinational resources company), the Great Barrier Reef Foundation, the Census of Marine Life, and AIMS, which leads the Australian node of the international CReefs project. As well, the Australian Biological Resources Study is funding follow-up taxonomic work, including DNA barcoding of organisms in support of the Barcode of Life initiative.

Generous support has also been provided by the many consortium partners.

Led by AIMS, the distinguished group of institutions in the consortium includes the Australian Museum, the Museum and Art Gallery of the

Northern Territory, Museum Victoria, the Queensland Museum, the South Australian Museum, the Western Australian Museum, the University of Adelaide, Murdoch University, the South Australian Herbarium, and the Smithsonian Institution.

Source: Census of Marine Life