Paradise found

If you were to design a perfect natural research laboratory, you could not do better than One Tree Island

Text and photography by Linda Vergnani

Professor Maria Byrne is standing on a coral shelf in the aquamarine waters of a vast lagoon. In her hands is a glistening, tubular creature the size of a baseball bat.

Around her, striped angelfish, turquoise and pink parrotfish and myriad other reef inhabitants flit. But rather than observing the paradisal parade below, Byrne is intent on the beche-de-mer, or sea cucumber, that she has just caught.

Surprisingly, its skin has the woody texture of tree bark, but the creature can change the stiffness of its body walls at will. Within seconds, the coppery-coloured animal spurts a defensive jet of water and droops over her arm. Now it feels more like a floppy jelly.

"If I keep interfering with this beche-de-mer it will disintegrate altogether. It thinks it is going to die and literally self-destructs," explains Byrne, Professor of Marine and Developmental Biology at the University of Sydney.

Director of One Tree Island Research Station, Byrne is a world expert on echinoderms, the 500 million-year-old family of invertebrates that includes seastars (starfish), sea urchins and sea cucumbers. One Tree Island is what she calls "sea cucumber heaven", with 32 species recorded so far.

Beches-de-mer form the basis of a $6.5 million per annum industry in Queensland. Once caught, they are exported, predominantly to China and other Asian nations, for consumption and use in traditional Chinese medicines. Byrne is trying to find out which species can be harvested sustainably now that the population of one of the most sought after sea cucumbers, the black teatfish, has crashed due to overfishing. All commercial harvesting of this teatfish in Queensland has been stopped.

Some of Byrne's research has been done in the lagoon's "micro atolls", swimming pool-size basins in which she can confine sea cucumbers. "If you designed a perfect natural research laboratory, you could not do better than One Tree Island," she says.

Restricted to scientists and post-graduate students, One Tree Island has "not been impacted by stressors from development and tourism," Byrne says. "You come here to do the kind of research you can't do anywhere else."

But this perfect laboratory is under threat from climate change. The research station complex, with its dormitories, laboratories and aquarium, could disappear under the waves in decades. "If the sea rises a metre here we could be gone," says Byrne.

Located at the southern end of the Great Barrier Reef, just seven kilometres from the coastal shelf and buffeted by cooling winds from the south, it is thought that corals here might have a greater chance of surviving warming oceans than elsewhere.

Through long-term monitoring of the creatures that live here the scientists at One Tree Island are getting an "early warning of change".

About 100 km from the nearest coastal town of Gladstone and 20 km east of Heron Island in the Capricorn Bunker group of islands, One Tree Island was first recorded in 1843 when HMS Fly carried out a survey voyage of the Great Barrier islands and reefs. On board, naturalist J. Beete Jukes wrote in his journal of anchoring near an island on which a "single conspicuous tree" was growing.

Now there are groves of low trees, sheared by the wind. The island, a coral rubble cay, is on one edge of a great ring of reefs that enclose the lagoon.

Founded by the Australian Museum, the station has been run by the University of Sydney since 1974. It attracts researchers from across Australia as well as from institutions including Princeton University and Germany's Max Planck Institute.

Squeezing over the encircling reef is only possible for an hour or two at the highest tides. This time, Byrne has planned a trip to coincide with the annual coral spawning. There is no jetty, so she jumps into knee-deep water and wades ashore to be greeted by a robust crew in wetsuits and sarongs - research students, lecturers and professors from various universities.

The station, with its banks of gleaming solar panels, is set amid low scrub and stunted emerald-green pisonia trees from which comes the constant churring, chattering noise of thousands of grey noddy terns, many of which have eggs in nests of dried leaves. Brilliant white, bridled terns have commandeered crannies in the reception building and laboratories to raise their fluffy chicks.

The station takes a maximum of 28 researchers, who might stay for days or even months. The station is run on an environmentally sustainable basis, using rain water for drinking and showering (one bucket a day) and composting toilets. Kitchen waste is sorted and removed from the island and all laboratory waste is removed. All food has to be ordered and shipped in by individual researchers. On this trip, Byrne arrives with a backpack filled with frozen meat, a new electric drill for the station manager, and her laptop.

Among those currently working at One Tree is Dr Selina Ward, a marine biologist and lecturer at the University of Queensland, doing research on how coral spawning, larval development and reef settlement will be affected by different climate change scenarios.

The live corals she is studying fill most of the plastic tanks in the aquarium room and Ward is assisted by three students.

On the night the cry goes out "the coral is spawning", they use infrared lights, to gather and watch bundles of egg and sperm rising from the coral branches like slow-motion

Opposite: Maria Byrne. Below: Noddy Tern and egg

pink bubbles. As the spawn reaches the surface, it is scooped up for experiments and cross-fertilising programs.

In the following days, the students tend tanks filled with fishy-smelling coral larvae that resemble brick dust. Ward says her previous research at One Tree showed that there were big changes in the larvae's ability to calcify and form coral when exposed to more acid seawater. "It's a very grave outlook," she says.

The work of the coral crew complements Byrne's major research into how a combination of ocean warming and acidification affects the "unbelievably fragile" larval skeletons of abalone and other commercial shellfish. Byrne says they are extremely vulnerable to ocean acidification, which is caused by man-made pollution generating increased carbon dioxide levels in the water. (The carbon dioxide dissolves to create carbonic acid and decreases the availability of carbon ions, which marine animals use to build their shells and skeletons.)

Byrne found that at pH levels of 7.6 (compared to the current pH of 8.1) abalone larvae were unable to make shells. The "naked abalone" would not survive in the wild. Sea urchin larvae could tolerate slightly higher levels of acidification before their shells became "corrupted".

In between overseeing the station, her own research, supervision of postgraduates and administration, Byrne gets updates from other researchers. Among them are three Australian Institute of Marine Science scientists who are setting up sensor stations across the lagoon as part of the Great Barrier Reef Ocean Observing System.

German doctoral student Maxi Eckes is studying how damselfish adjust the level of sunscreen produced in their mucous according to the depth of water they live in. As the recipient of the One Tree Island Scholarship, Eckes is spending a month on the island.

Top: Bridled Tern. Above: Maria Byrne and beche-de-mer

Dr Richard Stump is doing post-doctoral research into a method of ageing crown-of-thorns seastars from pigment bands in their venomous spines. These voracious predators, which are referred to by the acronym COTS, can reach a metre in diameter and grow 23 arms.

Stump, who works at Sydney University's Bosch Institute, trained as a marine biologist and did his doctoral thesis on COTS. He dives down to collect bristly specimens, which he wrestles into a boat.

On board, two assistants weigh and sex each seastar, then insert a tetracycline tablet into an incision in an arm. Stump says the antibiotic will leave a mark in the calcium of the spines which will help determine the creature's age when they are recaptured. Because the size of the animals is not directly related to age, it is currently difficult for researchers to work out how old the adults are at One Tree.

Byrne says the population of COTS at One Tree has remained small and stable for years, whereas, in disturbed areas of reef, plague populations devour huge tracts of coral. She is interested in discovering the factors that keep these predators in check on the island.

The professor believes that studying creatures like COTS within One Tree's healthy, undisturbed ecosystem is vital as a benchmark for determining the effects of global warming. For example, warmer waters might mean the crown-of-thorns population will explode.

Byrne muses: "I think One Tree Island could be a cradle, a refuge for biodiversity. This is the end of the reef and if the corals and fish cannot survive here there is nowhere else for them to go." **SAM**

For further details contact Professor Byrne at mbyrne@anatomy.usyd.edu.au.