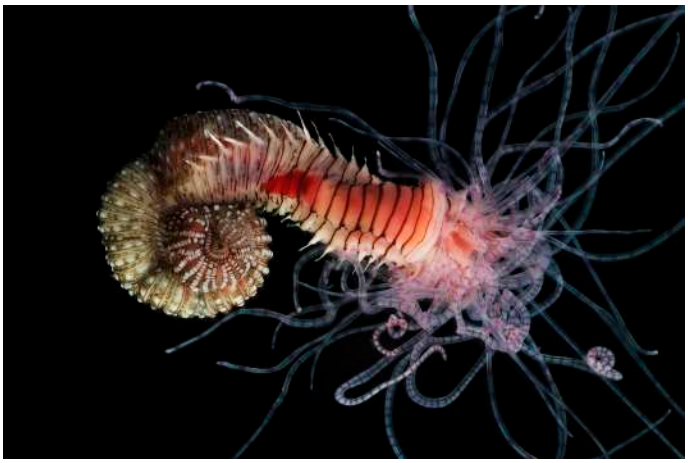
A RESEARCH WORKSHOP AT LIZARD ISLAND - SPONSORED BY LIZARD ISLAND REEF RESEARCH FOUNDATION

In August, 2013, the Australian Museum hosted the 11th International Polychaete Conference. Dr. Pat Hutchings, Senior Principal Research Scientist at the Australian Museum, was Chair of the Organising Committee. The conference was notable in that it was held thirty years after the first such conference which also was held at the Australian Museum and organised by Pat Hutchings. On both occasions, a group of scientists visited Lizard Island Research Station for a workshop to do field research on the polychaetes living in that area. This document portrays stunning images resulting from that workshop.

So…what are polychaetes and why are they interesting and important?

Polychaetes (segmented bristle worms) are the most abundant and diverse group living in all marine and estuarine environments from the intertidal to the deep sea. They show a great variability in their form, structure, feeding and reproductive strategies. They are adapted to a wide range of marine habitats, from sand and mud to rocks and coral reefs. As an important component of marine ecosystems, polychaetes are vital to the structure, production, dynamics, and health of the marine environment as they aid the deposition, breakdown, incorporation and turnover of the organic matters in the seabed that help to recycle nutrients to the water column. They are important as a food source for many other organisms and, due to their high calorific value and rich protein content, both the adults and larvae of polychaetes are the main food supply of many economically important fishes.



This stunning photograph of a polychaete (*Loimia* sp) was taken by Gary Cranitch from the Queensland Museum on a research trip to Lizard Island. In this photo the worm has been extracted from its tube. Normally only the tentacles on the right hand of the photo would be exposed, seeking food from the passing currents.

ipc
international polychaete conference · sydney 2013

Members of the original polychaete workshop held at Lizard Island Research Station in 1983.

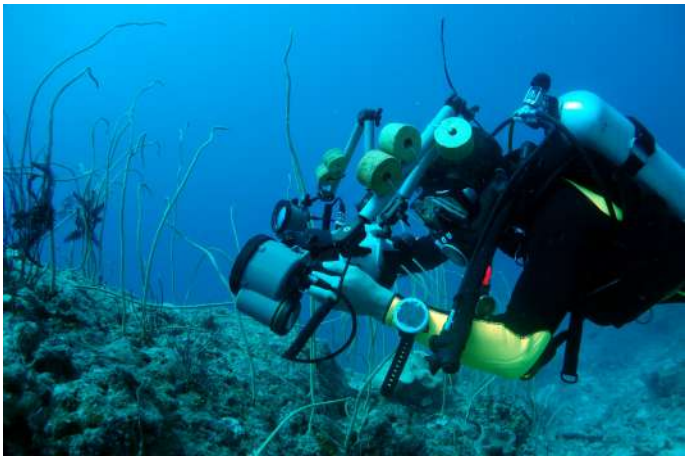
Around 10,000 species of polychaete have been described worldwide so far. Most polychaetes are less than 10 cm long and between 2 mm and 10 mm wide. They are beautifully patterned and coloured with iridescent or bright primary colours. While some polychaete species have been described from Lizard Island and surrounding areas, much remains to be done in order to document the diversity of this ecologically important group of worms. More than 80 families of polychaetes are currently recognised and of these a significant proportion are known or are predicted to occur at Lizard.

A long-term goal of the Lizard Island Research Station is to thoroughly document the fauna and flora of its immediate environs and to make that information freely available online. There is already a substantial knowledge base due to forty years of intensive research in the area and a good start has been made in making that information available through the online Lizard Island Field Guide (available at http://www.gaiaguide.info/lirs). However, there is still much scientific work to be done. The Lizard Island Reef Research Foundation is proud and delighted to have been able to sponsor the field trip to Lizard Island for an intensive two week polychaete workshop. This workshop was modelled on the highly successful amphipod workshop led by Dr Jim Lowry in 2005, when about twenty researchers interested in these small, bottom-dwelling crustaceans, worked at Lizard Island for two weeks. The results were published in 2009 in a single 930 page volume in which the number of amphipod species known from the Great Barrier Reef was increased by more than five times, from fewer than 50 species to 256.

The 2013 polychaete workshop at Lizard Island was led by Dr Pat Hutchings, a world-renowned polychaete expert, and Dr Elena Kupriyanova, also a polychaete taxonomist also at the Australian Museum. Other international polychaete scientists were invited to join the field trip. Material was collected for both morphological and molecular studies as increasingly both tools are needed to distinguish species. To facilitate mentoring and future collaborations, the workshop participants represented polychaete workers at various stages in their careers, including both senior researchers and postgraduate students.

The results of the workshop will be published in a special issue of the taxonomic journal *Zootaxa*, with open access so that all articles are freely available. The publication will include records of species already known from Lizard Island in museum collections as well material housed at the Australian Museum but not yet worked up. An interactive key to the polychaetes of Lizard Island will be developed and will feed into the online Lizard Island Field Guide.

In summary, it is expected that this workshop will significantly increase our knowledge of the polychaetes around Lizard Island.



Most of the beautiful underwater images in this publication were taken by Alex Semenov who was the official photographer for the workshop.

Polychaetes are sediment dwelling so the work involved much digging and scraping at low tide.

Polychaetes also live in the rocks and corals at the bottom of the sea. Here is one of the researchers working at depth on the outer barrier reef.

The following pages contain many beautiful photographs taken from around Lizard Island. They portray graphically the astonishing diversity and beauty of the Great Barrier Reef.

Those animals that are identified already are included in the Lizard Island Field Guide. Others will be included as they are identified and named.

AMAZING ANEMONES

A sea anemone is a polyp attached at the bottom to the surface beneath it by an adhesive foot, called a basal disc, with a column-shaped body ending in an oral disc. They can have anywhere from a few tens to a few hundred tentacles. A few species are not attached to the bottom; instead they float upside down in the sea.

The mouth, also the anus of the sea anemone, is in the middle of the oral disc surrounded by tentacles armed with many cells that function as a defense and as a means to capture prey. The cells hold a toxin that paralyses the small fish and shrimp that are prey for the anemone. An external sensory hair triggers a cell explosion when the hair is touched. This launches a harpoon-like structure that attaches to organisms that trigger it and injects a dose of venom in the flesh of the aggressor or prey.

Anemonefish (clownfish), small banded fish in various colors, are not affected by their host anemone's sting and shelter themselves from predators among its tentacles.

Ten species of anemone are host to small groups of anemonefishes. The fish are not stung by the anemone and in return they protect the anemone from predators and feed it from time to time. Here the Barrier Reef anemonefish lives with anemone *Stichodactyla mertensii*.

Some anemones are specialized for living on narrow cylindrical objects, like the seawhip in this photo. The larger anemone is about 4 cm in diameter.

Spine-cheek anemonefish. Males are smaller and more brilliantly coloured than females - this is a male with its bright red and white colourings.

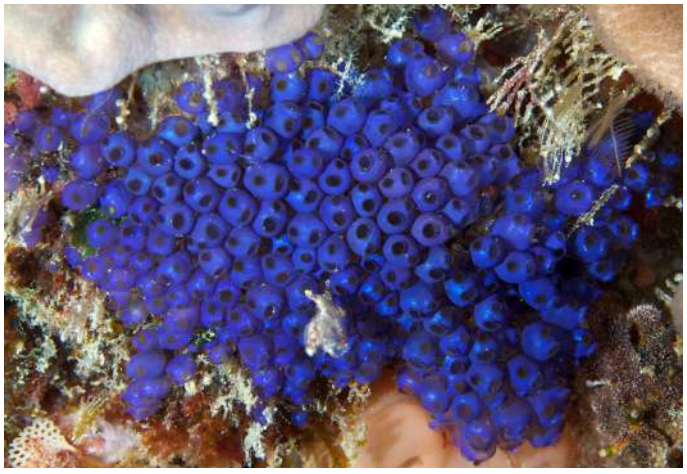
A tiny unidentified anemone with base diameter about 5mm.

ASTONISHING ASCIDIANS

Ascidians, commonly known as sea squirts, are an evolutionary link between invertebrates and vertebrates. They have a primitive backbone at some stage of their life cycle but in other aspects they resemble invertebrates.

Most ascidians are hermaphrodites (producing both eggs and sperm) and reproduce by external fertilisation (releasing eggs and sperm into the water). The free-swimming larvae they produce are known as ascidian tadpoles. After a few hours, the 'tadpoles' secrete slime, and attach themselves to a rock surface head-first, and then absorb their tail. Adult ascidians are 'sessile' (unable to move around) and filter food particles from the water by pumping water in one siphon and out the other. Their common name of sea squirt arises from their habit of squirting a jet of water when you stand on or near them when they are uncovered at low tide.

The images on this page illustrate the rich diversity of ascidians on the Great Barrier Reef around Lizard Island.



CHRISTMAS TREE WORMS

Christmas Tree Worms are tube-building polychaete worms that are very common and conspicuous around Lizard Island. All Christmas Tree Worms are currently classified as a single species (*Spirobranchus gigantea*), however taxonomists suspect that there are many more species involved. This is one of the areas that the polychaete workshop will help to resolve. These worms build a tube in the coral and withdraw into the tube for security. Because it does not move outside of its tube, the worm has no appendages for movement or swimming.

The two coloured crowns, shaped like christmas trees, are specialised mouth appendages. Each spiral is composed of feather-like tentacles called radioles. They get their name from the bright and beautiful colours of their radioles as you see in these photographs. The worm feeds by trapping prey in its radioles which then cause the prey to be transported to the mouth. The worm also uses its radioles for respiration. A modified radiole is used to secure its hole when withdrawn into its tube.

Christmas Tree Worms have a complete digestive system and an effective closed circulatory system. They have well-developed nervous systems with a central brain and supporting nerve tissue.

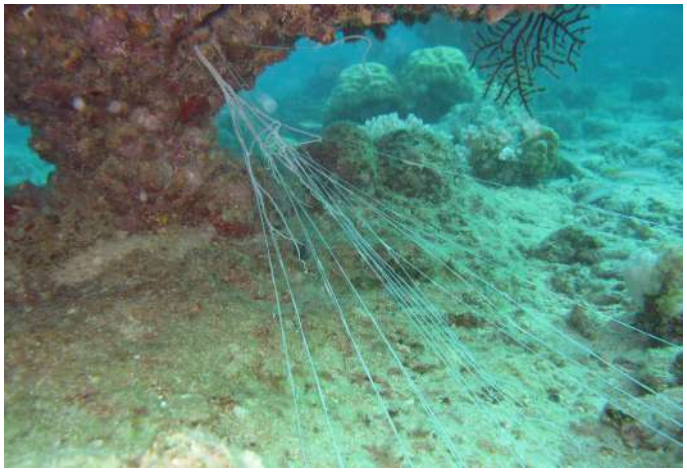
OTHER POLYCHAETES

Polychaetes refer to segmented worms, most of which are marine. They are generally less than 10 cm long and can display a wide range of body forms. Some crawl on the reef, whilst others spend their entire lives buried within the reef (e.g. Christmas Tree Worms).

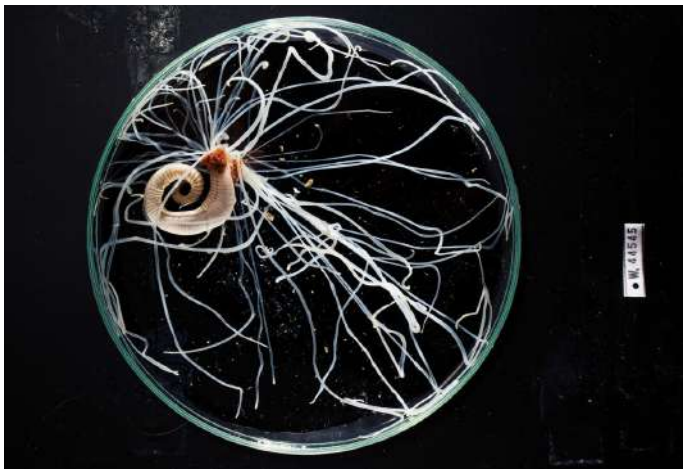
Some polychaetes are specialised to live on other animals. This scaleworm spends its life on a starfish.

This tubeworm has a single whorl of tentacles and is in a different family to the Christmas Tree Worm.

There are many other tubeworms in the same family as Christmas Tree Worms.



The "spaghetti worm" is common at Lizard Island and it is one of the most common "what is that?" queries that the research station gets from non-scientist visitors. The only part of the worm that is seen is its white feeding tentacles that can be more than a metre long.



This photo was taken in the laboratory after the spaghetti worm was extracted from its tube.

CRAFTY CRINOIDS

Crinoids, also referred to as feather stars, are related to starfish. They have a mouth on the top surface, surrounded by feeding arms.

Crinoids are ancient animals and they appear to have been much more abundant in the past. Some thick limestone beds, dating back more than 200 million years, are almost entirely made up of disarticulated crinoid fragments. Crinoids are still abundant in the deep sea and on some coral reefs. Stalked forms, resembling lilies, are found in the deep sea. Unstalked forms are found in shallower water and they are very abundant and diverse at Lizard Island. There are about 60 species at Lizard Island while the whole of the Caribbean has fewer than 10 species.

Crinoids feed by filtering small particles of food from the sea water with their feather-like arms. The tube feet on their arms are covered with a sticky mucus that traps any food floating past. A water vascular system maintains the hydraulic pressure in the tube feet.

STARFISH & BRITTLESTARS

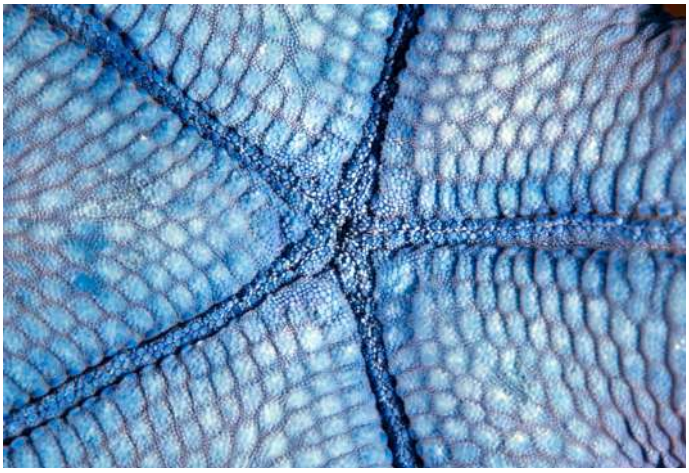
Starfish typically have a central disk and five arms. They have tube feet operated by a hydraulic system and a mouth at the centre of the lower surface. They are opportunistic feeders and mostly prey on inverterbrates living in the sediments.

Most species can shed arms as a means of defence and can regenerate damaged parts and lost arms.

Brittlestars (see 2 photos below) are closely related to starfish. They have five long, slender whip-like arms.

Linckia laevigata, the blue starfish, is common and conspicous at Lizard Island.

This starfish, not uncommon at Lizard Island, appears to be new to science.



The mouth and arm bases of *Linckia laevigata*.

Never seen during the day, the species on the left is occasionally seen at night at Lizard Island. This one is spawning.

HARD CORAL

Hard corals are corals that have a hard calcium carbonate skeleton. They can either be compound colonies of coral polyps or solitary organisms. Compound colonies live primarily in clear, warm water and make up the majority of the world's coral reefs.

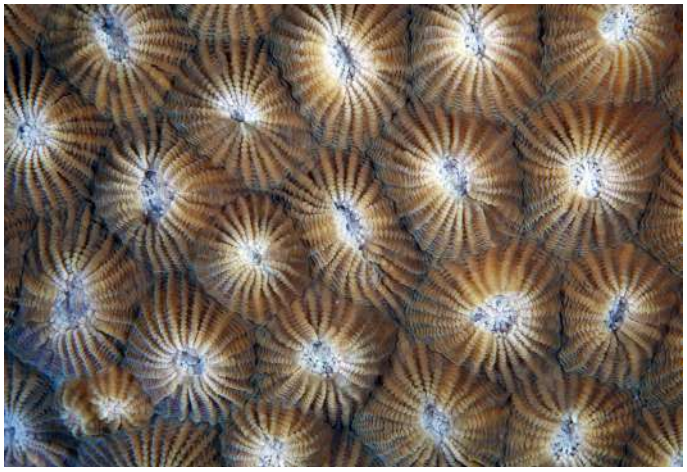
A common misconception is that hard corals are plants. In fact, compound hard corals are made up of many thousands of animals called coral polyps. These animals build a hard exoskeleton from calcium carbonate, which creates the structures we see on the reef.

Most hard corals feed on zooplankton in the water column. Additionally, coral polyps have a symbiotic relationship with a photosynthetic algae called zooxanthellae. These organisms provide the coral with the bright colours seen on the coral reef. Up to 95% of the energy produced by the zooxanthellae is absorbed by the coral polyp.

Under stressful conditions, such as increased temperature or increased water turbidity, zooxanthellae leave the coral polyp. This is a process known as coral 'bleaching' and leaves behind the white exoskeleton of the coral. The coral is then at a much higher risk of dying.

The coral in the above photo is a branching hard coral. Each dot on this coral is a polyp about 2mm in diameter. The four photos in the column on the right show massive hard corals with polyps up to 3 cm across.

Two solitary corals (*Cycloseris (L) and Heteropsammia*) that live on sandy bottoms away from reefs in water more than 12 m deep. Lizard Island is unique in having seven solitary coral species living together. A no-anchoring zone has been established to protect them.



HARD CORAL (cont)

The photo above shows a bubble coral. The hard structure of the coral polyp is inside the bubble. Some species of crab, such as the orang-utan crab, like to hide between the bubbles.

The polyps and corallites are not so distinct in "brain" coral as shown in the two images above.

The photo at the right shows a single polyp that will develop into a massive colony.

Each of the starry structures in the above two images is a "corallite", the hard cup that houses a polyp. The polyps' tentacles are visible in these photos. Polyps of most hard corals are hidden within the corallite during the day.

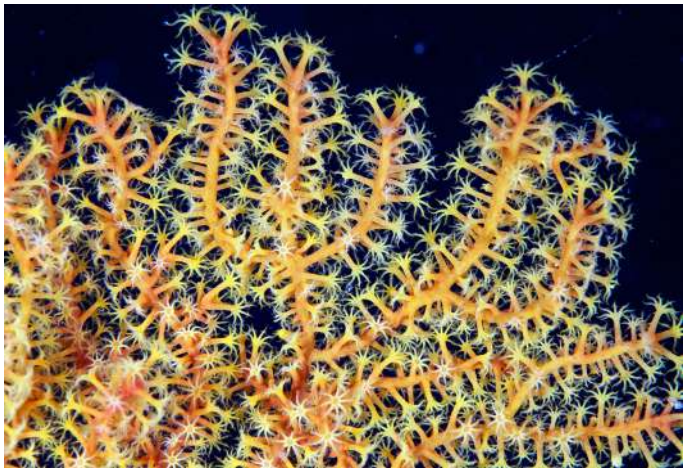
Growing edge of a small colony that will grow very large. The polyps at the front are about 1 cm in diameter.

GORGEOUS GORGONIANS

Gorgonians, also referred to as sea fans, are closely related to hard, reef-building corals. The gorgonian's individual tiny polyps form colonies that are normally erect, flattened, branching and reminiscent of a fan. Instead of making a stony skeleton like hard corals, gorginians make a more pliable skeleton of internal spicules.

Each gorgonian polyp has eight tentacles which catch plankton and particulate matter that is consumed. This filter feeding is facilitated when the fan is oriented across the prevailing current to maximise water flow and therefore food supply.

Some gorgonians contain algae, or zooxanthellae. This symbiotic relationship assists in giving the gorgonian nourishment via photosynthesis. Gorgonians provide important habitat for many other reef creatures including snails, bivalve molluscs and brittlestars.



OTHER CORALS

Like gorgonians, these soft corals have polyps with eight tentacles and a skeleton of internal spicules. They form more bushy or amorphous colonies than the gorgonians. These photos all show the polyps extended but they can be, and often are, retracted into the leathery skeleton.

SHRIMPS

Shrimps are highly diverse and abundant at Lizard Island but inconspicuous because they are small and often at least partly transparent. Some live in association with gobies: the shrimp digs a burrow in the sand that the gobie guards. Both animals live in the burrow together. Others live with specific animals such as starfish, crinoids and anemones or in the branches of corals.

Some shrimps have specialised to feed on ectoparasites (parasites found on the skin and scales of animals). These shrimp form 'cleaning stations' where fish can have their parasites removed by the shrimp.

NUDIBRANCHS

Nudibranchs are a type of slug and include some of the most colourful creatures on earth. They have a variety of defence mechanisms as they have lost their shell in the course of evolution.

Some species have colours and textures that blend in with their surroundings whilst others have such bright contrasting colours that they appear to be warning potential predators that they are distasteful or poisonous.

CUTTLEFISH

Cuttlefish are related to squid, octopuses and nautiluses. “Cuttle” refers to their unique internal shell, the cuttlebone. which is often used to supply calcium to caged birds. They are the chameleons of the sea as they can change their skin colour seemingly at will. Their ability to change colour is facilitated by specialised pigment cells, with up to 200 of these cells per square millimetre.

They have large highly specialised eyes, eight arms and two tentacles with which they capture prey. Their preferred diet is fish, crabs and shrimp. They swim at the bottom where the crabs and shrimp are found and shoot out a jet of water to uncover the prey buried in the sand. When the prey are trying to get away, the cuttlefish open their eight arms and shoot out their tentacles to capture the prey.

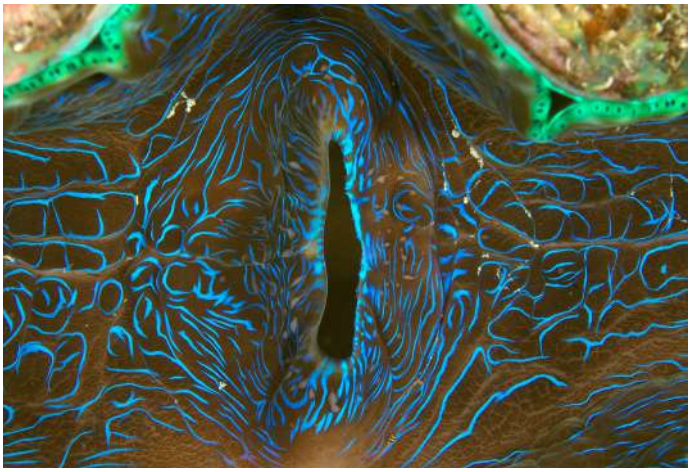
The blood of a cuttlefish is an unusual shade of blue-green as they use the copper-containing protein hemocyanin to carry oxygen instead of the red iron-containing protein hemoglobin. The blood is pumped by three hearts!

There are four or five (even up to ten) males per female so male cuttlefish challenge one another for dominance during the mating season. Smaller cuttlefish sometimes disguise themselves as females to get past a dominant male.

CLAMS

Giant clams are not all giants! *Tridacna gigas* is the real giant, growing to more than a metre across and it lives up to about 75 years. Four smaller species in the same group are also common at Lizard Island. They look similar to the giant but are smaller. Particularly common is *Tridacna crocea*, the burrowing clam, which look a bit like "lips" pouting out of coral rock. These clams create holes for themselves by secreting an acid that dissolves the coral rock to accommodate them as they grow. Many other bivalve molluscs also burrow into corals.

Bivalve molluscs pass water through themselves, filtering the water for food particles and to take in oxygen and remove wastes. Giant clams are different to most other bivalves in that they have a symbiotic association with algal cells. These provide some of the bright colours in the clam mantle, others are due to pools of fat that act as lenses to get light deeper into the tissue. After their algal "farm" is established, giant clams can live in clean food-free seawater as long as they have access to light.



One of the "siphons" of a giant clam, used for passing water through the body.

Light-sensitve areas line the edge of a giant clam's mantle.

The above three images are *Tridacta crocea*.

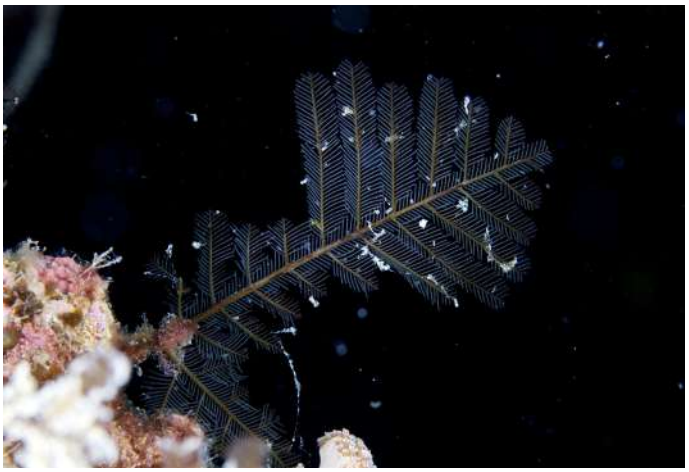
This scallop also burrows into corals.

VERMETIDS

Vermetids are sea snails that have irregular elongated tubular shells that are cemented to the surface where they live. They catch prey with mucus “nets” that are visible in several of these photos.

OTHER BEAUTIFUL CREATURES

This page contains other species that again demonstrate the astonishing beauty and diversity of life around Lizard Island.



Fern-like stinging hydroids are not plants but animals, related to corals and anemones. They pack a punch too! On contact, specialised cells called nematocysts release microscopic toxin-laden harpoons that cause a painful sting like that of a bluebottle.

Flatworms are common and diverse at Lizard Island and can be extraordinarily beautiful. Some have evolved to resemble toxic nudibranchs to avoid predation.

Urchins are spiny creatures that live in hollows in the reef or under coral structures. They commonly graze on algae at night, sheltering themselves from predators during the day. Their spines often contain toxins and so are best avoided.

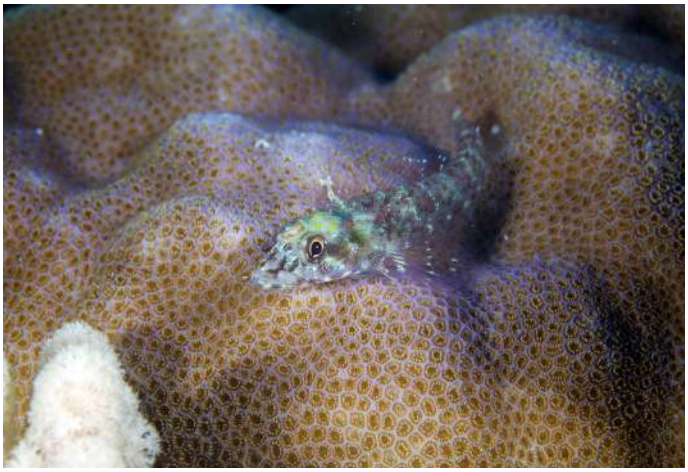
Although not always as attractive as other creatures on the reef, sea cucumbers provide a vital role to the ecosystem as they help to recycle nutrients. They are considered a delicacy in some parts of the world.

This drifting gelatinous cylinder about 2 metres long is the egg mass of an open-ocean squid.

FASCINATING FISHES

There are a great variety of fish found on coral reefs. In these photos, you can see some unusual examples - small fish that spend their lives flitting across corals; pipefish that look so delicate and yet are very well camouflaged with the background, providing protection from predation; and the moray eel. Interestingly, the moray eel has recently been shown to be a hunting ally with the iconic coral trout, *Plectropomus leopardus*, aiding the trout by flushing out otherwise inaccessible prey.

The above two images are pipefish - closely related to the seahorse. They look like straight-bodied seahorses. Like the seahorses, they also leave most of the parenting to the male. Females can often produce more eggs than the male can carry so the male is regarded as the limiting sex.



Close-up of a moray eel. Moray eels are carnivorous with a wide jaws framing a protruding snout. They have large teeth to tear flesh or grasp slippery items of prey.

Morays are the only animals that use a second set of jaws in their throat to actively capture and restrain prey. They launch these jaws into their mouth to grasp prey and transport it into the throat and digestive system. The moray cannot release its grip, even in death, and must be pried off.