



Invertebrate Indicator Species of Koh Tao and the Gulf of Thailand



CONSERVATION
DiVER

2022

PHYLUM: Platyhelminthes
CLASS: Turbellaria
ORDER:

Flatworms

Characteristics

Flatworms are indeed flat, and move around using an undulating motion of the body. It is difficult to differentiate the head from the tail end, and they do not have eyes or antennae (although some do have antennae-like folds at the front of the body referred to as 'ceros.') There are over 20,000 species, and most are very small and parasitic, but the ones found

during the EMP are larger (about 2-10cm) and are free swimming carnivores.

Importance

Flatworms found on the reefs can be very sensitive to water quality changes and habitat destruction. Seeing flatworms is a sign of good reef health and diversity, having an absence of flatworms could indicate a larger problem on the reef.

Notes

Flatworms are mostly nocturnal and are cryptic. They will be difficult to spot, and will generally be hidden during the day





PHYLUM: Mollusca
CLASS: Gastropoda
FAMILY: Muricidae
GENUS: Drupella

Drupella Snails

Characteristics

Drupella snails are carnivorous gastropods that feed on coral tissue (called a corallivore). They are generally small (<5 cm) and are cryptic. They are long-lived (up to 45 years) and generally occur in aggregations (groups).

The family has three known coralivorous species: *D. rugosa*, *D. cornus*, *D.*

margariticola

Importance

In small numbers, Drupella help to increase coral reef resilience by introducing small-scale disturbances which improve diversity and open areas for coral settlement. But in high numbers, Drupella snails can consume vast amounts of coral, reducing diversity and abundance, and changing the population structure of the reef. It has also been shown that they are a vector for disease transmission, allowing coral disease to move from one colony to another. For the EMP we want to monitor Drupella numbers to watch for outbreaks or overpopulations.

Notes

Because their shells are usually covered in calcareous algae, it is often very difficult to see the Drupella snails themselves. The best way to spot them is to look for their effects, the white coral of the reef which has recently been killed due to predation. As you conduct the survey, look for any clean, white coral skeleton, next look around the white skeleton to see if the predator is still around, very often you will find Drupella snails or the Crown of Thorns Starfish nearby.

Also, as it is too difficult to count Drupella, you will have to estimate their numbers during the EMP survey. At the end of every segment (before moving on to the next segment) estimate the number of Drupella that were in the survey area and write down a number between 0-3:

- 0 ---> None
- 1 ---> A Few (1-50)
- 2 ---> Fair number (50-150)
- 3 ---> Overabundance (>150)



PHYLUM: Mollusca
CLASS: Gastropoda
FAMILY: Terebridea

Auger Snail

Characteristics

The Auger Snail is a large carnivorous snail. They have a very effective toxin which they use to neutralize their prey, before consuming it with their powerful mouth, and a structure similar to a tongue called a radula.



Importance

The Auger Snail is considered to be a top-predator, and thus important in top-down controls of the reef trophic structure.

Notes

The Auger Snail grows up to about 30 cm long but lives primarily in the sandy areas on the reef edge. You will most likely not see the snail but may see the track they leave as they move just under the sand, resembling a trail like in Bugs Bunny Cartoons.

Some areas of the Indo-Pacific, host the Triton Trumpet Snail (*Charonia tritonis*.) These snails are a top-predator as well, and are one of the predators of the Crown of Thorns Starfish. In such areas, the Auger Snail (*Oxymeris maculate*) should be replaced with the Trumpet Triton on EMP surveys



PHYLUM: Mollusca
CLASS: Gastropoda
FAMILY: Muricidae

Ramose Murex

Characteristics

The Ramose Murex (*Chicoreus ramosus*), or Branched Murex is one of the largest and more ornate carnivorous gastropods in the Indo-Pacific. They tend to be found away from the reef, in sandy areas. You may find a higher abundance of them in areas with many sea urchins and sand dollars, as these are their primary prey sources.



Importance

As large carnivores, they are an important higher order predator that has few natural enemies. They are an economically important species as their large shell is often appealing to the souvenir trade, and numbers are monitored to assess both biodiversity and the threats of over-collection. Due to their shape, they are also prone to being entangled in lost fishing nets lying on the sea bed, one of the reasons why such nets should be removed by divers.

Notes

The shells are generally covered in filamentous algae or other epibionts and fouling organisms (sponges, tunicates, etc.), and so the snails can often be difficult to differentiate from rubble. This becomes much easier with practice. During times of mating (September-October), large aggregations can be found in and around the reefs. In some cases, over 20 individuals can be found in a 100 m² area.





PHYLUM: Mollusca
CLASS: Gastropoda
SUBCLASS: Heterobranchia

NUDIBRANCHS AND OTHER SEA SLUGS

Characteristics

Nudibranchs and other sea slugs are a type of Gastropod very similar to snails, except that they do not have a shell (Nudi – Naked, Branch- lung, referring to the exposed gills otherwise under the shell in other gastropods). Other sea slugs may or may not have exposed gills, but have the 'slug' body shape and are not difficult to tell apart from other invertebrates on

the reef. From an evolutionary standpoint, they most likely evolved from snails, but lost the shell overtime. A shell is great for protection from predators, but it is a big energy investment, difficult to carry around, and clumsy. Instead of the shell, Nudibranchs use other tools for protection; they feed on toxic organisms like sponges and hydroids and incorporate these defense mechanisms into their bodies for protection. You will distinguish the Nudibranchs by its slug shaped body, and exposed gills. They range from the almost microscopic, to over 10 cm in length.

Importance

Nudibranchs and sea slugs are incredibly diverse; they are a favorite amongst divers for their very striking colors and often ornamental bodies. The diversity of nudibranchs in an area is a good indicator of overall reef diversity. Furthermore, by monitoring the abundance and range of the animals it may be possible to better understand the effects of climate change on water temperatures and chemistry.

Notes

You must look closely to find the Nudibranchs and other sea slugs, so take your time when doing the survey. Check around any of their typical food sources (i.e. sponges, hydroids, macroalgae, etc.) Remember, 'look but don't touch,' you are not permitted to move or overturn objects on the reef while searching for these or any other organisms. Also, be sure to look for the rose like eggs laid by the sea slugs, and record that in the notes section when observed.



PHYLUM: Mollusca
CLASS: Bivalvia
FAMILY: Tridacna

Giant Clams

Characteristics

The first bivalve discussed here is the Giant Clam. This clam is a filter feeder, which also utilizes a symbiosis with zooxanthellae (the same as in corals) to build a very large and strong shell. You will always see the giant clam exposing its mantle (skin like tissue) up towards the sun, giving adequate light to its zooxanthellae crop. Because it is the

zooxanthellae that give the giant clams their nice colors, no two giant clams are ever the same (like snowflakes).

Importance

The Giant Clams in Indo-Pacific reefs are considered to be a keystone species, or one of the most important species in maintaining ecosystem health. Some of their important traits include:

- Filter feeding – a single large Giant Clam can filter 1,000's of liters of water per day, removing nutrients and maintaining water quality
- Contributing to reef structure – The giant clam shell is very large (up to 1 m) and provides habitat and settlement points for corals and other sessile organisms. Often the shell provides a way for corals to begin growing in sandy areas.
- Hosting Zooxanthellae- By hosting zooxanthellae giant clams contribute to energy production on the reef, and also may help to 'seed' corals with zooxanthellae after a bleaching event

Notes

There are many different types of clams and mussels growing on the reefs, be sure to only count the colorful giant clams and boring clams, both in the Tridacna Family and containing zooxanthellae (distinguished by their brightly colored mantle).





PHYLUM: Mollusca
CLASS: Bivalvia
FAMILY: Tridacna
SPECIES: T. Crocea

Boring Clams

Characteristics

Boring clams are in the same family as the Giant Clams, but they bore into the rock and corals. So, while the Giant Clam is free living, these clams require substrate in which to grow. They contain the same photosynthetic zooxanthellae as the corals and giant clams, which allows them to be very productive. This also means that you will most likely find

them on the top of coral heads where there is strong sunlight.

Importance

See Giant Clams

Notes

In the Conservation Diver 'Giant Clam Nurseries and Population Studies' course you can learn much more about how to identify the various species within the family Tridacna. However, for the EMP we keep it simply as Giant clams (those free living with their shell exposed) and Boring (those without their shell exposed as they have bored down into the substrate).



PHYLUM: Mollusca
CLASS: Cephalopoda

Octopus, Squid, & Cuttlefish

Characteristics

As all of these animals play a similar predatory role on the reefs, they are combined into one group together. If you do see any members of this class while performing the EMP also note the species.

The Reef Octopus is very small, and inhabits the shallow reef areas. They are generally very well hidden and difficult to spot during the EMP. Squid and cuttlefish tend to stay in the deep sea during the day, and follow the zooplankton up at night to feed (called diurnal migration).

Importance

These animals are quite rare, so observing them is a good sign of reef diversity. As a top predator, they require a large supply of food, and allow us to also gain information on the crustacean abundance around the island.

Notes

Although rare in the reef areas surveyed for the EMP, if you see any cephalopods, including Octopus, Squid, and Cuttlefish please also take note on their behavior (hunting, hiding, mating, etc.).



PHYLUM: Arthropoda
SUBPHYLUM: Crustacea
CLASS: Malacostraca

Hermit Crabs

Characteristics

Hermit crabs are specially adapted to fit inside the discarded shells of many marine gastropods. They use their specially adapted soft abdomens to grasp the inside of the shell, and thus utilize the shells for protection. The hard front legs of the hermit crab protrude from the shell, allowing it to walk around and feed.



Importance

Hermit crabs are important 'reef cleaners', much in the same way as ants in a rainforest. Hermit crabs feed on detritus or algae, acting as a major controlling factor on the abundance of macro-algae in the coral reef environment.

Notes

You will have to look closely at the gastropod shells that you see during the EMP survey to see if it is occupied by the snail or by a hermit crab. If you cannot tell, take your best guess – DO NOT pick up or overturn the shell to check. Some snail species are poisonous, and a sting can be fatal in only minutes. If you cannot tell, skip it or take your best guess.





PHYLUM: Echinodermata
CLASS: Asteroidea
GENUS: Acanthaster

Crown of Thorns

Characteristics

The Crown of Thorns Sea Star (COTs) is a large, corallivorous starfish with up to 19 legs. This very well protected sea star is covered in sharp, venomous spines, which only a few powerful predators such as the Triggerfish and Triton Trumpet are able to overcome.

Importance

As a large corallivore, in high abundances they can consume and destroy vast areas of coral, leading to decreased diversity and abundance of the reef. In low numbers (less than 2-3 per dive) they help to open clean coral skeleton for settlement of juvenile corals and other organisms, and strengthen the reef resilience. They can sense chemicals released by stressed corals, and thus remove less fit corals from the reef, much like a lion helps to keep zebra populations healthy by removing the weak or sick.

Notes

Like Drupella snails, COTs can be found by looking for feeding scars, or freshly killed corals.

COTs are on the rise in many areas due to overfishing and nutrient input. With less fish predation, and more nutrients in the water, more of the pelagic COTs larvae survive to adulthood, causing outbreak conditions in the worst cases. Throughout much of the Indo-Pacific, they have reached outbreak proportions, and are regularly poisoned or removed by teams from the diving community.

Do not try to touch or remove COTs while diving unless you are trained and equipped to do so, their spines are very sharp. In certain instances, harming or disturbing the COTs will cause it to release its eggs or sperm in to the water (spawn) which can lead to increased population levels.





PHYLUM: Echinodermata
CLASS: Asteroidea
FAMILY: Oreasteridae
GENUS: Culcita

Cusion Star

Characteristics

The Cushion Star has short arms which give it the appearance of a pentagonal pillow. Although it does not really look like other sea stars in its adult form, as juveniles they do resemble more typical sea stars. Its mouth and tube feet are all located on the underside of the body.

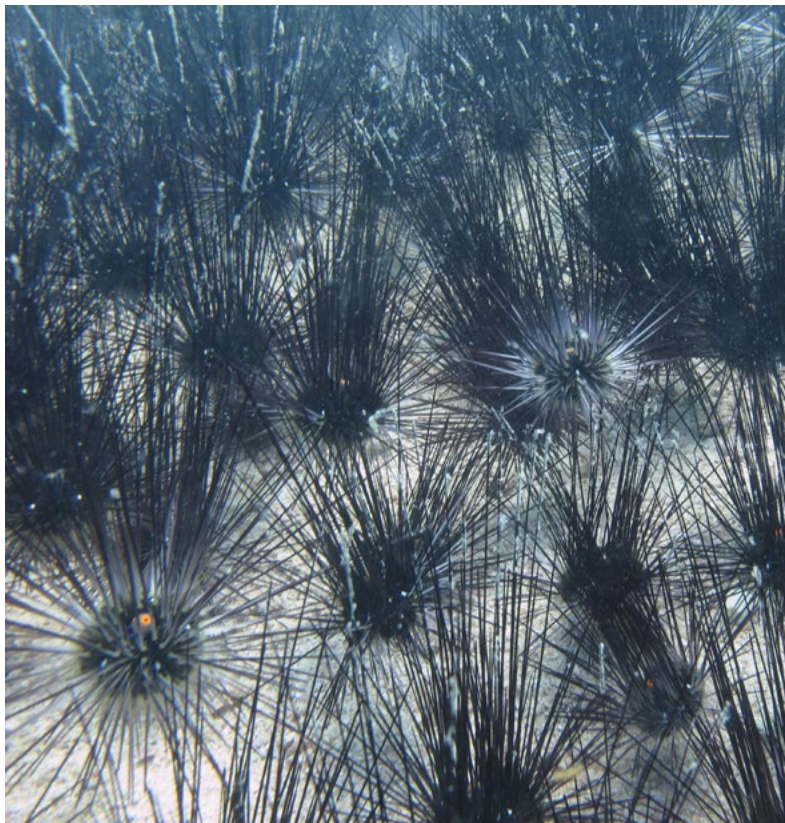
Importance

The Cushion star feeds on detritus, small invertebrates, and also hard corals (Primarily fragments that are already under stress). It is monitored for its role in nutrient cycling on the reef, and also its potential to alter coral population dynamics.

Notes

The Cushion Star is primarily nocturnal and will often be hiding under coral heads or rocks during the day time.





PHYLUM: Echinodermata
CLASS: Echinoidea
FAMILY: Diadematidae
GENUS: Diadema

Long Spine Black Sea Urchin

Characteristics

Internally, urchins are quite similar to starfish, but instead their arms are fused into a round body. Long Spine Black Sea Urchins are very effective herbivores, able to eat much of the macro-algae on the reef which is unpalatable to fish. In areas such as Jamaica, where disease has reduced urchin numbers, algae becomes the dominate form of life in the

area.

Importance

Sea Urchins are important in regulating macro-algae levels and contributing to the uptake of nutrients from the reef. They are a prey species for large fish and some other invertebrates (like the Horned Helmet). In high numbers they can also indicate an imbalance in either the nutrient levels (too much food availability) or decreased predator abundance (overfishing).

Notes

You will notice many different species of urchins on the reef but be sure to only count the ones with the long, thin spines and black body.





PHYLUM: Echinodermata
CLASS: Holothuroidea
GENUS: Pearsonothuria
SPECIES: P. graeffei

Marbled Sea Cucumber

Characteristics

The Marbled Sea Cucumber has modified tube feet surrounding its mouth, which are used as feeding appendages to scrape algae and organic matter from the rocks and corals. They have a black and white marbled body color, and have many small spines along the body.

Importance

Marbled sea cucumbers are important in regulating nutrient levels on the reef. They clean rocks and corals, removing microalgae and improving substrate availability for coral larvae and other organisms

Notes

In some areas of the world sea cucumbers, are considered a delicacy, or are used to supplement diets when food is scarce. This practice is incredibly destructive, as sea cucumbers are obvious, slow moving, and easy to collect. The populations of sea cucumbers of an entire reef can be decimated in a single day by an efficient team of collectors in dive gear.

The juvenile form of the marbled sea cucumber closely mimics the shape and color of wart slugs to avoid predation.



PHYLUM: Echinodermata
CLASS: Holothuroidea
GENUS: Holothuria
SPECIES: H. atra

Black Sea Cucumber

Characteristics

The Black Sea Cucumber is smaller and less robust than the Marbled Sea Cucumber. They can be found mostly in sandy areas, or in the reef flat and back reef zones. They consume sand, and remove the organic matter or tiny invertebrates from it as it passes through their bodies.



Importance

Black sea cucumbers are an important regulator of nutrients and organic matter flowing from land to the reefs. Their numbers reflect the available food supply, and thus are an indicator of water quality.

Notes

To defend themselves, sea cucumbers can release their inner tissues, which are sticky and often toxic. This can protect them from predators, but comes at a large cost, as it may take over a month for the tissues to regrow.





PHYLUM: Echinodermata
CLASS: Holothuroidea
GENUS: Holothuria
SPECIES: H. edulis

Pinkfish Sea Cucumber

Characteristics

The Pinkfish Sea Cucumber (also known as the edible sea cucumber) is very similar to the Black Sea Cucumber, but has a pink strip down the belly. They can be found mostly in sandy areas, or in the reef flat and back reef zones. They consume sand, and remove the organic matter from it as it passes through their bodies.

Importance

Much like Black Sea Cucumbers, it is responsible for removing organic matter and biofilm from the sand to prevent algal overgrowth. Furthermore, as it feeds it aerates the sand, improving the conditions for burrowing invertebrates and allowing for aerobic conditions in which bacteria grow.

Notes

The Pink Fish Sea Cucumber is differentiated from the Black Sea Cucumber as it is much more likely to be collected as food, especially in China or Indonesia.





PHYLUM: Echinodermata
CLASS: Holothuroidea
GENUS: Stichopus
SPECIES: S. chloronotus

Orange Spiked Sea Cucumber

Characteristics

The Orange Spiked Sea Cucumber is more robust, larger, and stronger looking than the Black Sea Cucumber. They inhabit sandy to rubble covered areas. Like the other sea cucumbers, they are detritivores who eat and filter through the sands.

Importance

Much like the other sea cucumbers, they remove organic matter, biofilms, and small organisms from the sand as it is processed by their digestive system. They also help to aerate the upper layer of sand to prevent it from becoming anoxic.

Notes

Sea cucumbers are important hosts for many parasitic or commensal fishes, shrimps, crabs, and worms. Sea cucumbers are also some of the fastest healers of the animal kingdom. This species can actually reproduce asexually when it is separated longitudinally due to its ability to heal and regenerate.

