Marine life of Belle Mare

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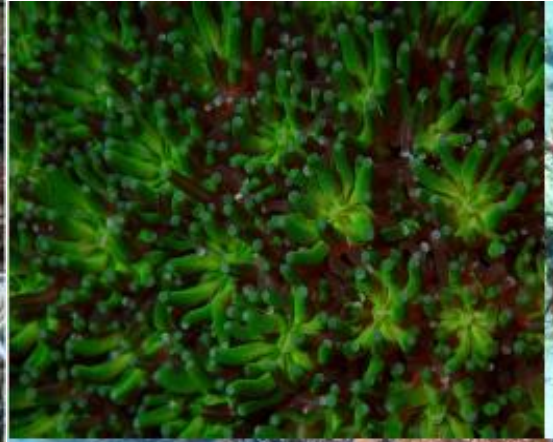
MARINE LIFE OF BELLE MARE







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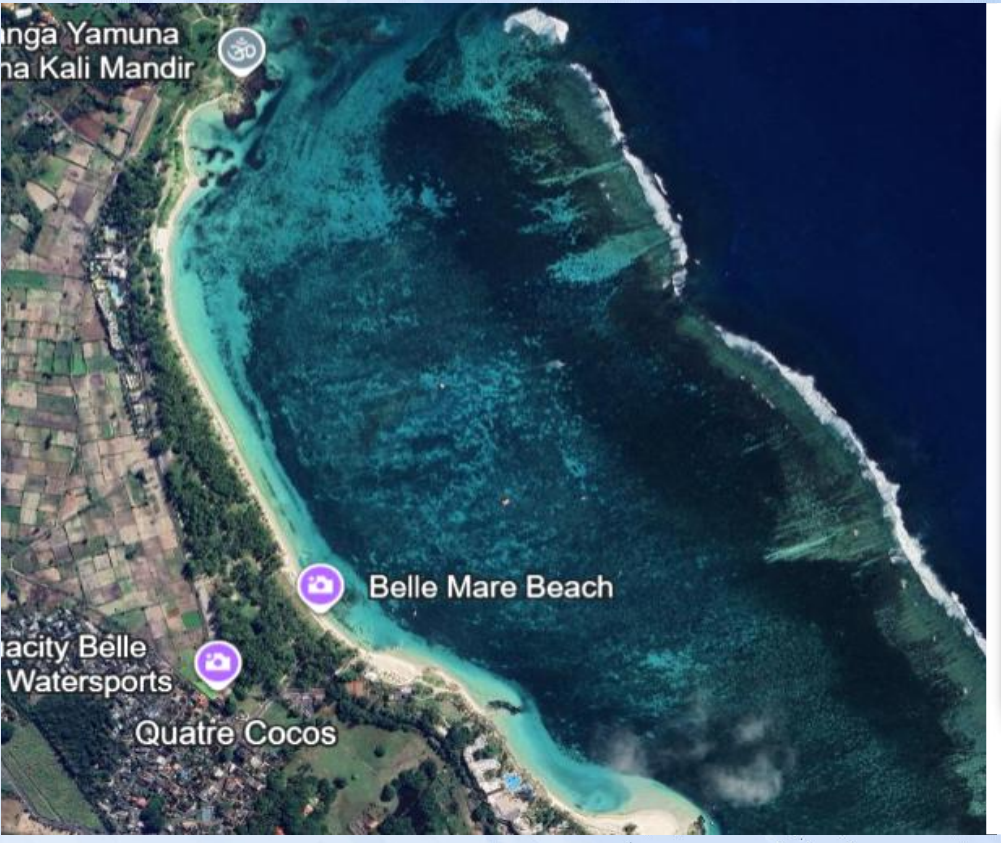
Belle Mare coast

- Belle Mare coast has sandy beach and rocky beach habitats, where plants and animals live.
- Sandy Beach of Belle Mare habours biodiversity of marine life and may include someburrowing molluscs (e.g. clams) and crustaceans (e.g. ghost crabs). These organisms dig into the sand to protect themselves from wave energies and hide away from predators.

- Belle Mare coast is surround by a well-formed coral reef. It is called a fringing coral reef.
- The reef can be seen where the high oceanic waves break and form some kind of foam, whitish in colour.



The coral reef ecosystem present at Belle Mare harbours many corals, reef fishes, seaplants and inverterbrates.

One can go out on the reef and visually check out the reef via snorkelling to experience the beauty and biodiversity of the reef or get a glass bottom boat ride to the reef to observe the reefs from the boat.

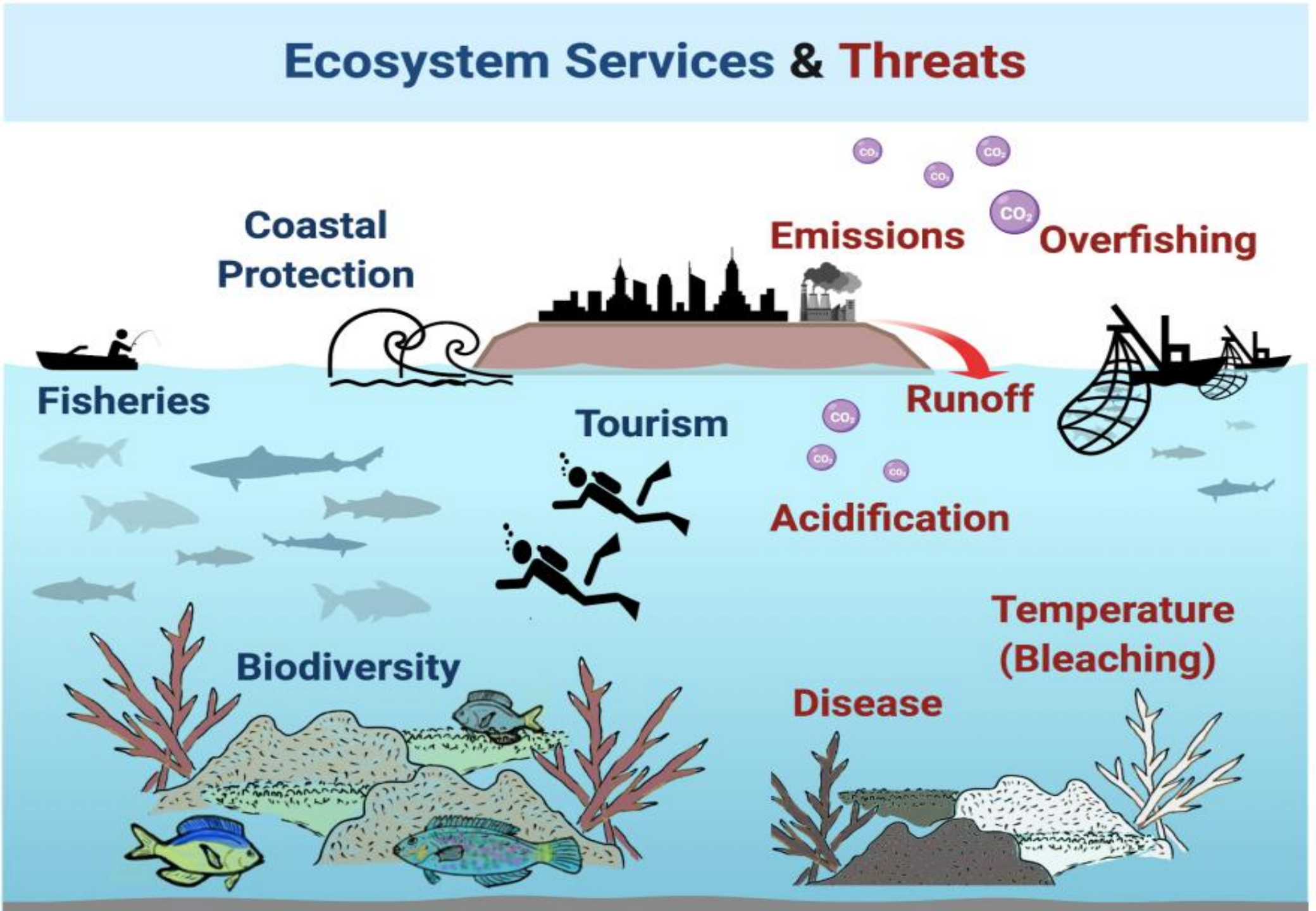
Belle Mare has a huge lagoon, which is the space of about 1 km distance between the reef and coastline.

The lagoon is 2-3 meters deep, depending on tide, with some currents at some times. During calm days, one can snorkel. Diving sites like Sea Fan Valley

Belle Mare Marine Life

This volume is illustrated by **224 taxa (41 macroalgae, 2 seagrasses, 5 cyanobacterial/microbial mats, 3 sponges, 2 anemones, 1 black coral, 50 hard corals, 5 zoanthids, 4 soft corals, 2 hydrozoans, 3 tubeworms, 1 crustacean, 26 molluscs, 12 echinoderms, 6 tunicates, 60 fish, and 1 sea turtle taxa),** highlighting the very rich biodiversity.

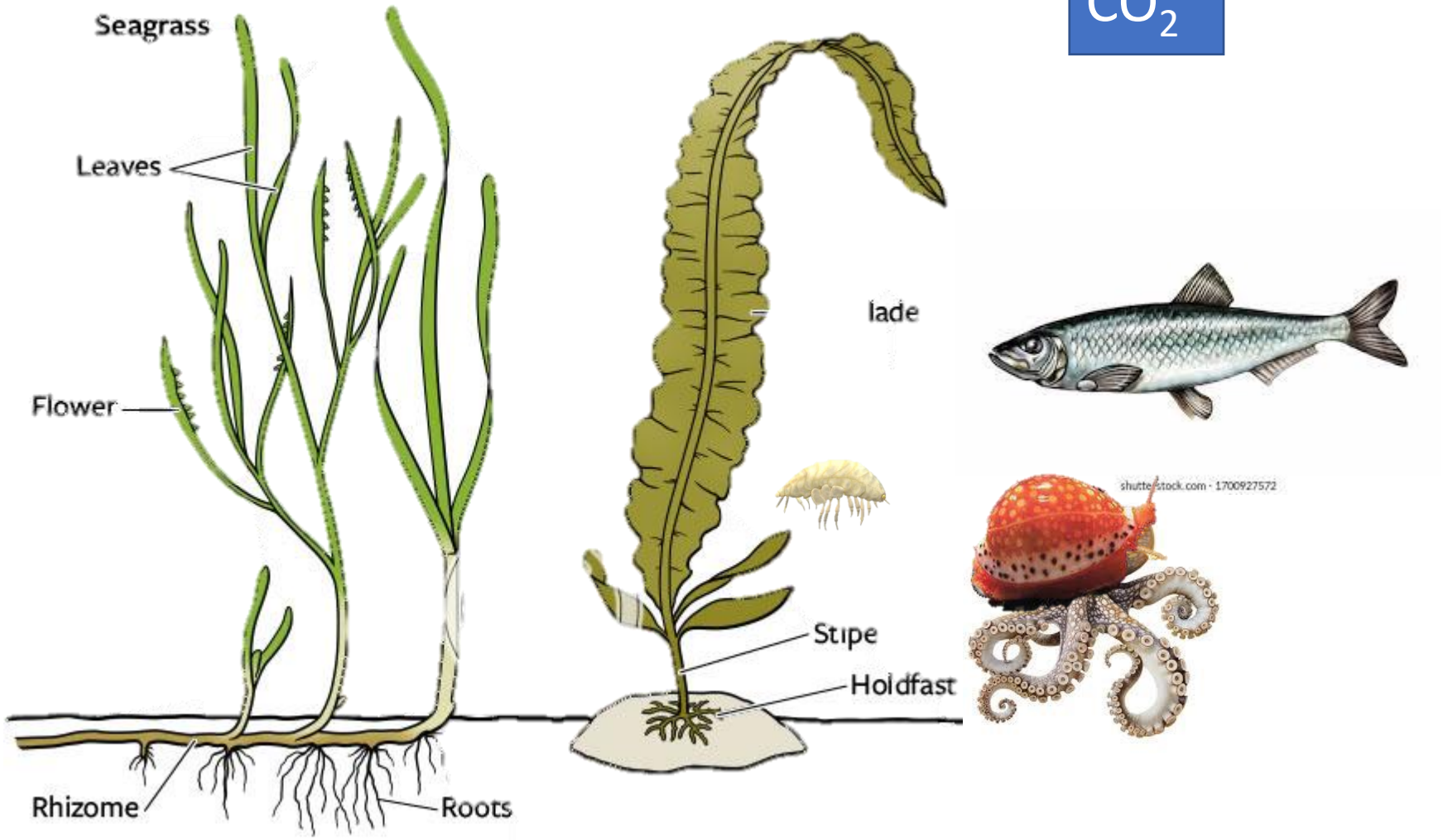
Ecosystem Services & Threats



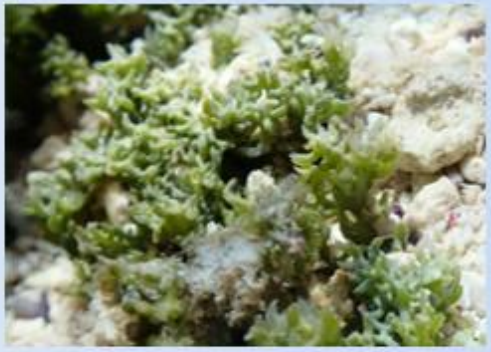
Importance of biodiversity

O_2

CO_2

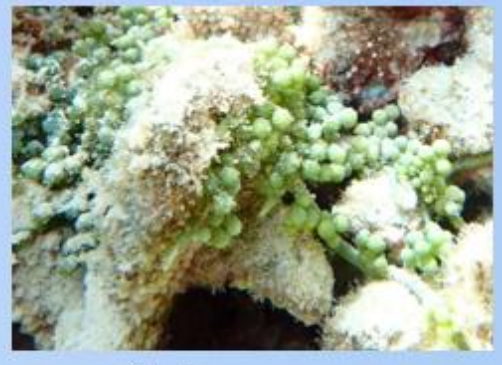


Seaweeds: 41 species

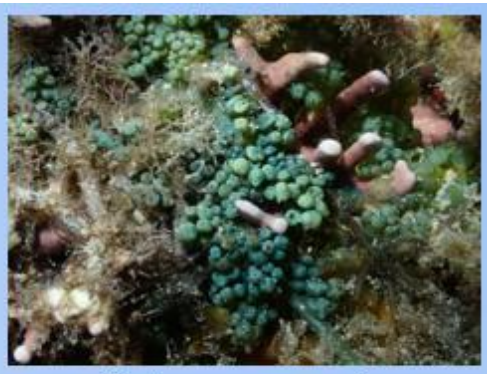


Caulerpa cupressoides

Caulerpa serrulata



Caulerpa racemosa

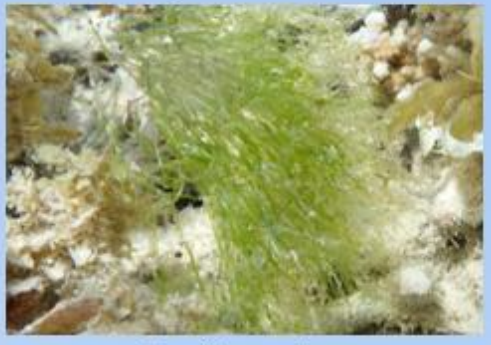


Caulerpa racemose var2

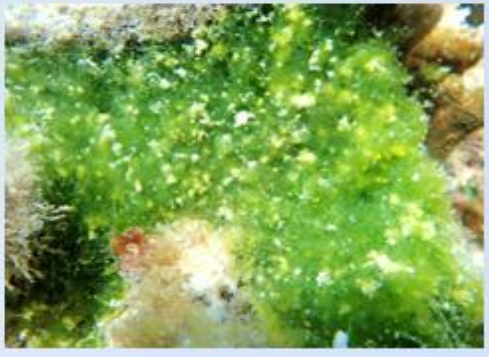
Codium geppiorum

Halimeda discoidea

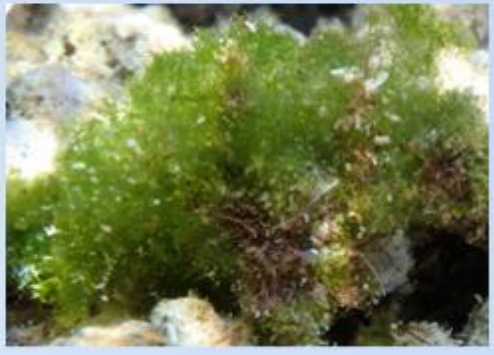
Halimeda opuntia



Boodlea sp.1

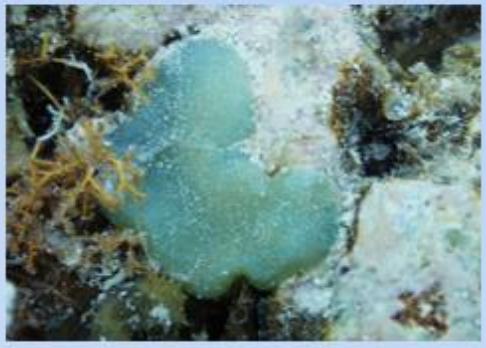


Boodlea sp.2

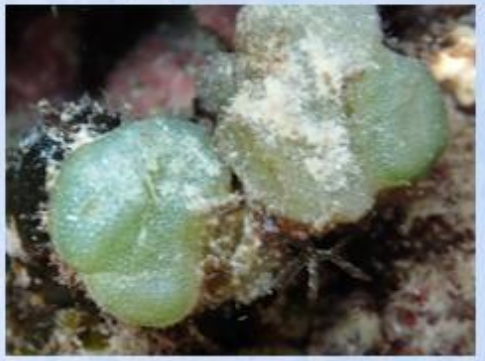


Vanvoorstia sp.

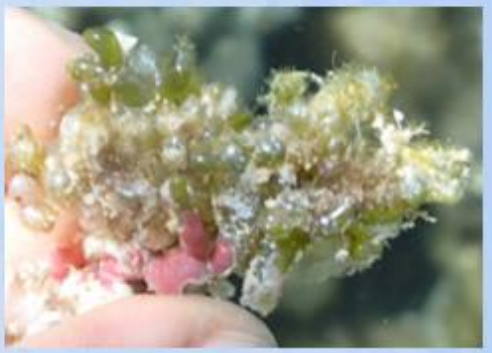
Borgesenia forbesii



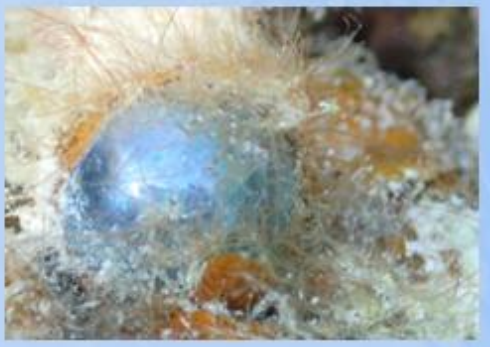
Dictyosphaeria cavernosa



Dictyosphaeria versluysii

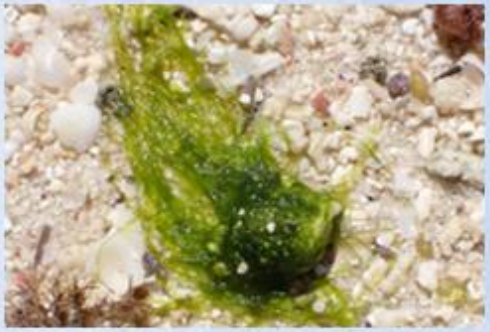


Valonia aegagropila



Valonia ventricosa

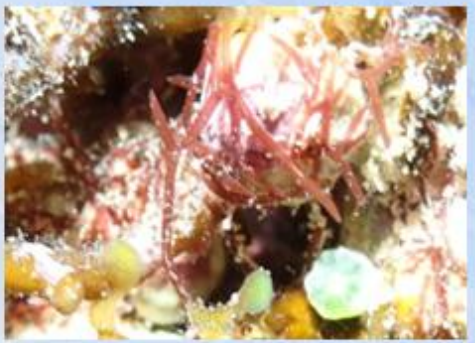
Parvocaulis clavata



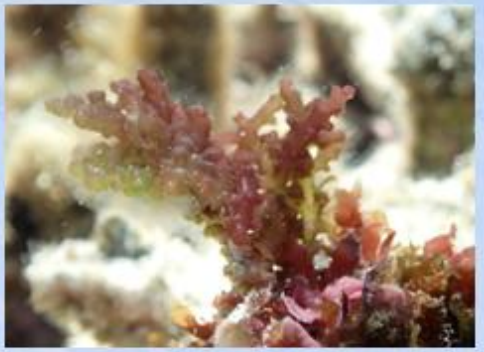
Ulva intestinalis

Red Macroalgae 21 spp.

Amansia rhodanta

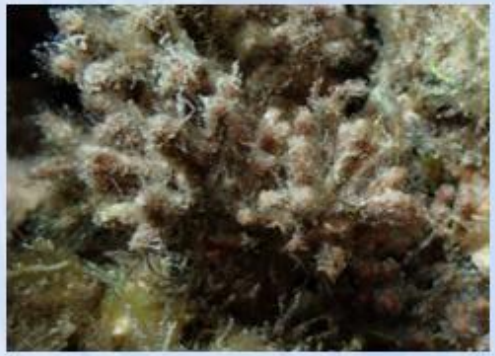


Ceramium sp.



Laurencia sp.

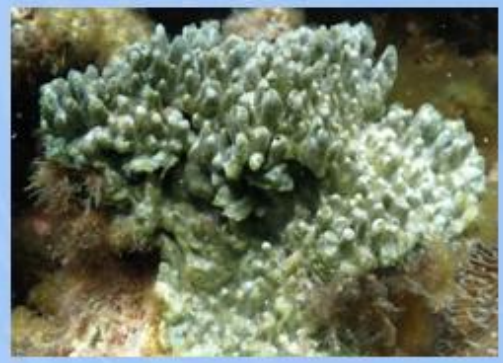
Dacia sp.



Galaxaura rugosa

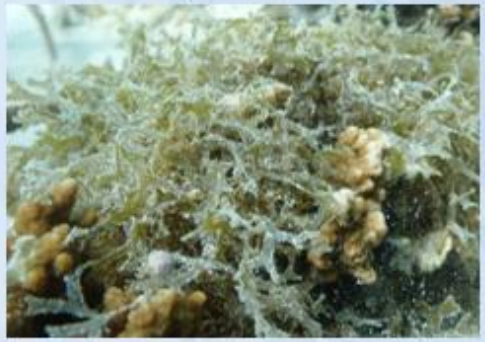
Peyssonelia sp.

Gelidiopsis sp.

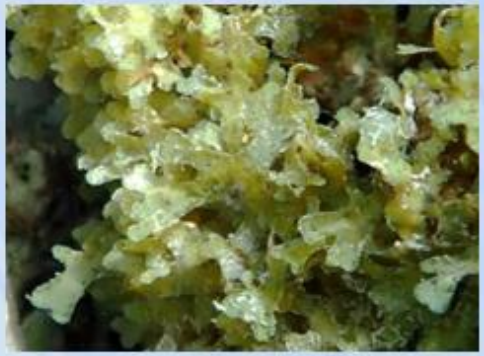


Ceratodictyon sp.

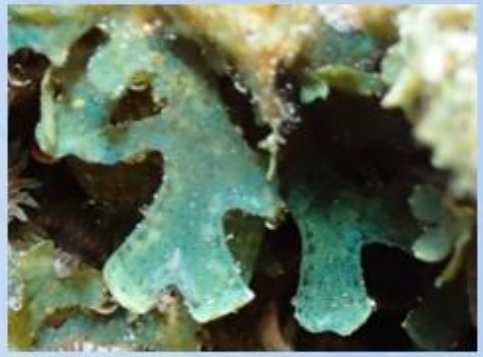
Brown Macroalgae 13 spp.



Dictyota ceylanica

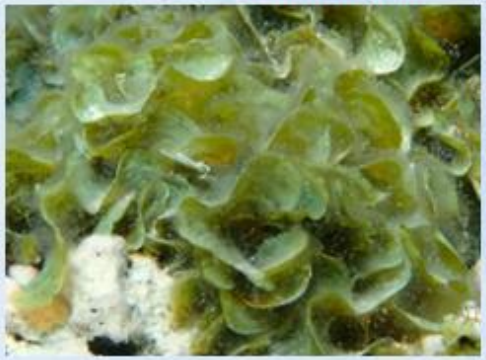


Dictyota friabilis

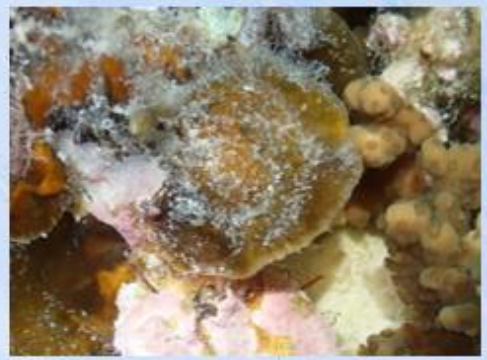


Dictyota humifusa

Padina gymnospora



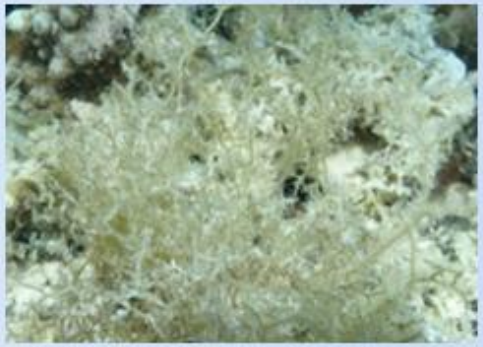
Distromium skottsbergii



Lobophora variegata

Colpomenia simuosa

Hydroclathrus clathratus

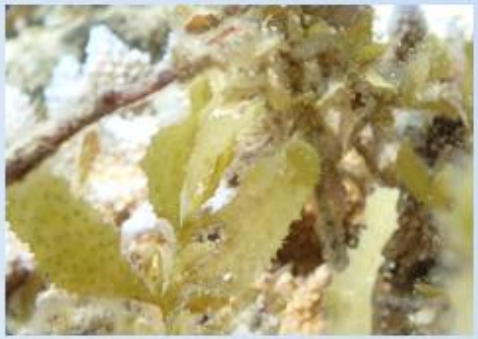


Chnoospora implexa

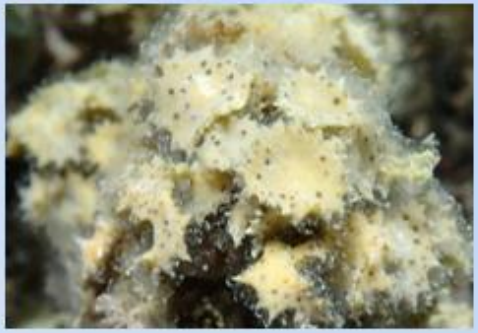
Ectocarpus sp.

Sargassum pfeifferae

Sargassum polycystum



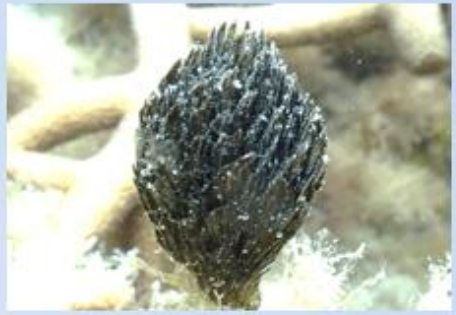
Sargassum obovatum



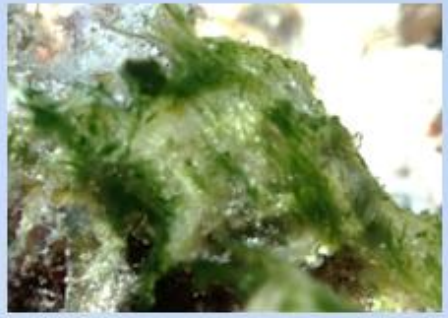
Turbinaria ornata

Cyanobacterial mats

Cyanobaterial mat, majorly Leptolyngbya sp.



Cyanobaterial mat, majorly Lyngbya sp.



Cyanobaterial mat, majorly nodularia sp.

Cyanobaterial mat, majorly Symploca sp.

Vertebrates Fish

Acanthurus triostegus
Convict tang

Abudefduf sparoides
False-eye surgeant

Chrysyptera brownriggii

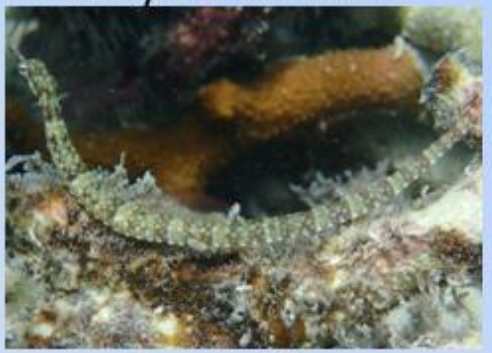
Anampses twistii
Yellow-breasted wrasse

Arothron nigropunctatus
Blackspotted puffer

Chrysitera glauca
Grey Demoiselle

Canthigaster valentini
Valentini Puffer

Ostracion cubicus
Yellow boxfish



Syngnathus sp.
Lesser piperfish

- *Chaetodon vagabundus*

Chaetodon guttatissimus
Peppered butterflyfish

Chaetodon lunulatus
Oval butterflyfish

Chaetodon xanthocephalus

Chaetodon guttatissimus
Racooon butterflyfish

Chaetodon zanzibarensis
Zanzibar butterflyfish

Chaetodon melannotus
Blackback butterflyfish

Zanclus cornutus
Moorish idol

Epibulus insidiator

Stegastes nigricans
Dusky farmerfish

Halichoeres scapularis
zigzag wrasse adult

Halichoeres scapularis
zigzag wrasse juvenile

Myripristis murdjan
Crimson soldierfish

Epinephellus Merra
Honeycomb grouper

Mulloidichthys flavolienatus
Yellowstripe goatfish

Mulloidichthys vanicolensis
Yellowfin goatfish

Neoniphon samara
Sammara squirrelfish

Halichoeres hortulanus
Checkerboard wrasse

Lethrinus harak
Emperor thumbfish

Sargocentron diadema
Crown squirrelfish

Naso unicornis bluefin
unicornfish

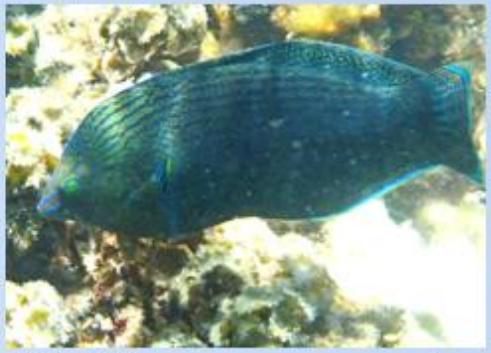
Zebrasomas scopas
Brown tang

Zebrasoma desjardinii
sailfin tang

Thalassoma Hardwicke
Sixbar wrasse

Acanthurus nigricauda
Epaulette surgeonfish

Parrotfish

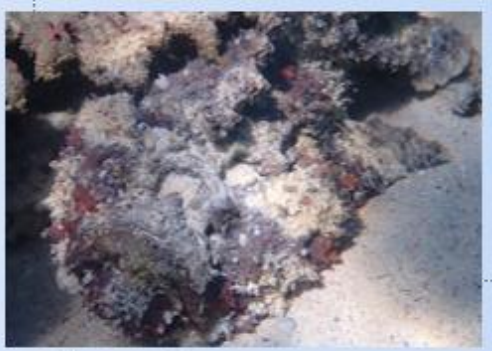


Halichoeres marginatus
Dusky wrasse

Leptoscarus vaigiensis
Marbled parrotfish

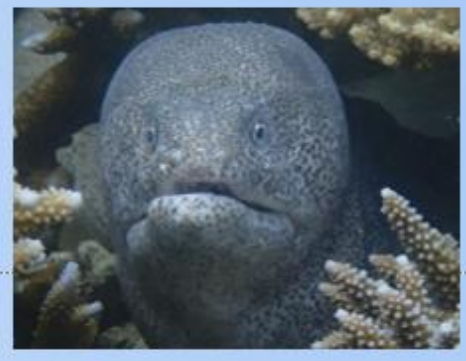
Cheilinus tribolatus
Tripletail wrasse

Abudefduf vaigiensis
Indo-Pacific sergeabt



Synanceia verrucosa
stonefish

Pterois sp.
lionfish



Siderea picta
Peppered moray

Sepioteuthis lessoniana
Mourgate

Marine Reptile

Eretmochelys imbricata
Hawksbill Sea turtle
critically endangered

Toxopneusteus pileolus

Echinometra mathaei

Nardoa variolata

Trippineuteus gratilla

Heterocentrotus mamillatus

Fromia mireporella

Holothuria sp.1

Holothuria sp.2

Synapta maculata

Sponges

Haliclona sp.

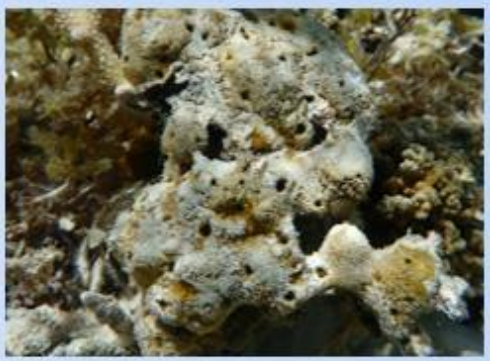
Haliclona sp 2.

Aptos sp.

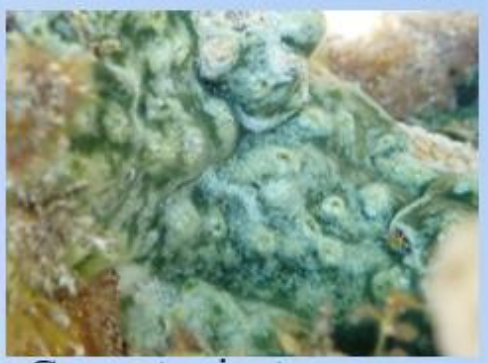
Neopetrosia chaliniformis

Tunicate

Haliclona sp3.



Haliclona sp4.



Green tunicate

Eudistoma sp, green bubblegum tunicate

Spirobranchus giganteus

Spirobranchus sp.

Spirobranchus sp.

Acanthaster planci

Monetaria annulus

Connus sp.

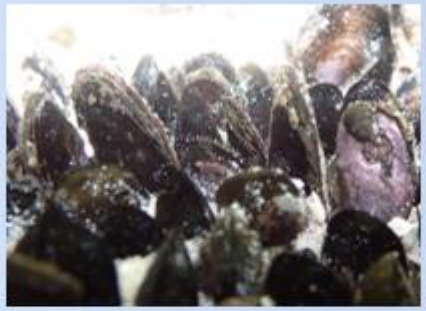
connus ebraeus

Drupella sp

Trochus sp

Tridacna sp

Tridacna sp



Mytillus sp. mussel

Sea hare

Littorina sp.

Anemones 2 spp.

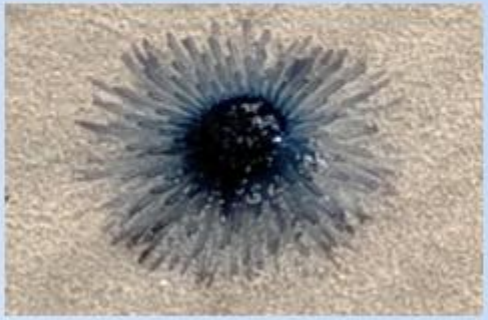
Siphonoriidae Limpet

Anemonia sp. Anemone

Antacmaea sp.
Bubble anemone

Jellyfish 2spp.

Physalia sp. blue bottle



Porpita sp. Blue button

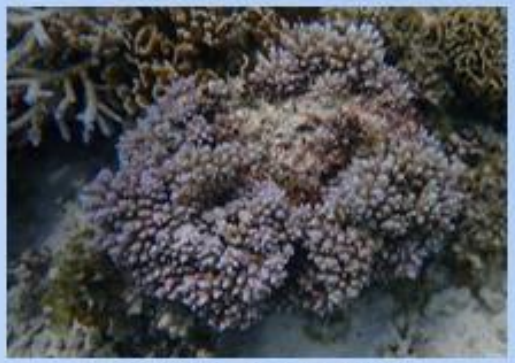
Porites lutea

Porites furcata
branched finger coral

Acropora tenuis

Acropora cytherea

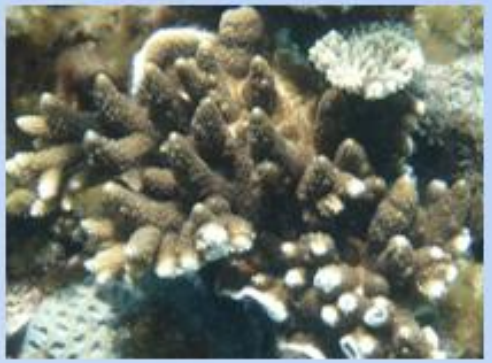
Acropora hyacinthus



Acropora aculeus

Acropora abrotanoides

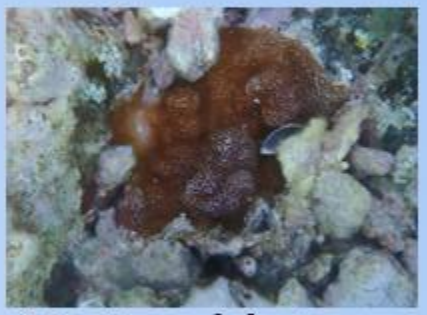
Acropora muricata



Acropora robusta

Montipora sp.

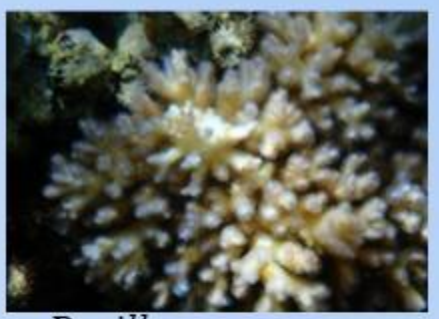
Montipora aequituberculata



Montipora lobuta

Pocillopora verrucosa

Pocillopora eydouxi

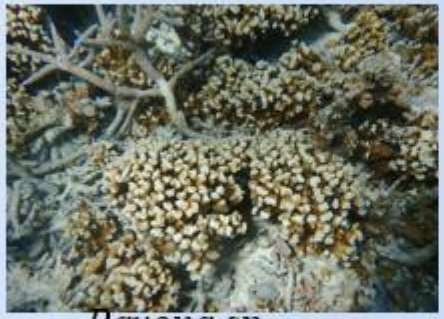


Pocillopora sp.

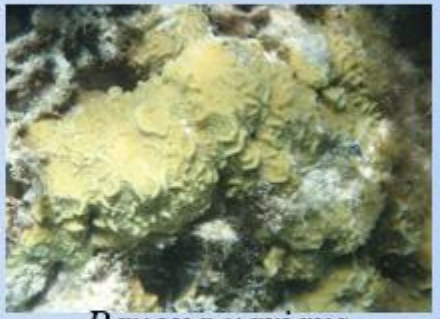
Astreopora sp.

Astreopora myriophthalma

Echinopora hirsutissima



Pavona sp.



Pavona varians

Pavona venosa

Favites sp.

Favites flexuosa

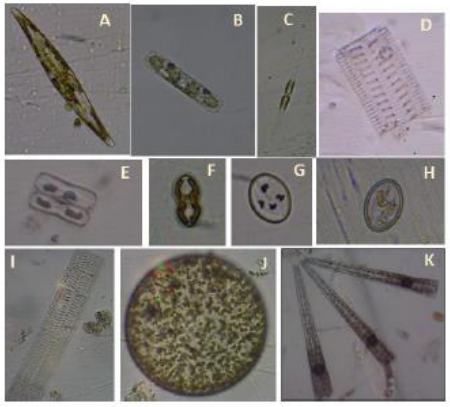
Goniopora djiboutiensis

Galaxea fascicularis

Highlights

Phytoplankton

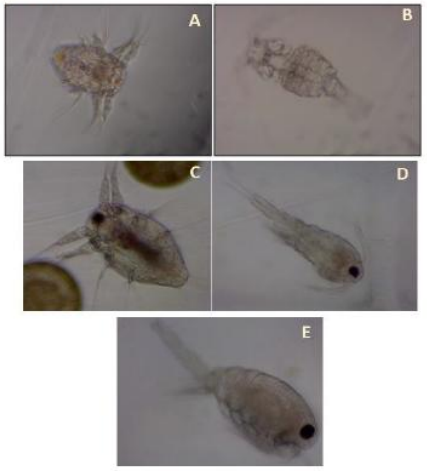
Phytoplankton are microscopic, photosynthetic organisms that inhabit the euphotic zone. They convert sunlight, carbon dioxide, and nutrients into organic matter through photosynthesis, producing oxygen as a by-product. They are incredibly important to marine ecosystems, forming the base of the ocean food web and producing nearly half of the world's oxygen (Sournia, 1982).



Some common phytoplankton species observed under light microscopy
A - *Pleurosigma* sp., B - *Navicula* sp. C - *Nitzschia* sp.D - *Grammatophora* sp. E - *Diploneis* sp. F - *Achnanthes* sp. G - *Cocconeis* sp. H - *Surirella* sp. I - *Thalassionema* sp. J - *Coscinodiscus* sp. K – *Licmorpha* sp.

Zooplankton

Zooplankton are small animals, including larval fish, krill, and even baby jellyfish, which feed on phytoplankton. These drifting creatures move within the ocean's currents and are found throughout the water column, from surface waters to the deep sea. Zooplankton play a major role in marine food chains, serving as a link between primary producers and larger marine animals such as fish, whales, and seabirds (Irigoien, Huisman & Harris, 2004).



Some common zooplankton species observed under light.
A & B - Copepod Nauplius
C- Copepod nauplius (late stage) D- Copepod E- Adult copepod

2. Mass Coral Spawning at Belle Mare?

Did you know?
Mass coral spawning usually occurs 3-7 days after full moon during every October and November!

Corals spawn, that is they release male (sperms) and female (eggs) gametes in the seawater column where fertilisation (fusion of sperms and eggs) takes place to produce larvae, and then planulae settle on a suitable substratum to metamorphose into a coral recruit. This type of coral reproduction produces genetically diverse coral individuals and increases the chance of these individuals to have an adequate variety of genes to help survive adverse environmental conditions, such as ocean warming. Some corals undergo mass spawning whereby several species release their eggs and sperms in large quantities at the same time and form a pinkish/orange slick in the seawater, while others spawn at different times of the year.

NOTE

During mass coral spawning events, activities at coral reefs sites and adjacent areas should be kept to minimal to allow for undisturbed spawning, fertilisation and recruitment to take place appropriately. Mass spawning usually takes place for few days after full moon. The larvae float for several days to weeks and recruitment may take place in few days. Thus, for few weeks following full moon in October and November, seagoing activities need to be mindfully conducted.

3. Sea Fans at Belle Mare?

Did you know?
Sea fans occur at 25-35 m deep at the Belle Mare Sea Fan Valley dive site!

Sea fans are octocorals and are commonly known as gorgonians. They are classified under the phylum Cnidaria. They are sedentary, colonial, and can be distinguished by their polyps which consist of eight pinnate tentacles, that is, their tentacles occur in numbers that can be divided by eight. Sea fans form tree-like branching structures, consisting of many individuals, on the reef and hard substratum. They have a variety of forms but can be distinguished by their unique flattened and branching fan-like, whip-like and feathery forms. They are colourful, ranging from shades of yellow, orange and red. Sea fans inhabit tropical and subtropical waters and are found in coastal waters ranging from depths of 15 m to 300 m. They are filter feeders as they feed on the plankton and thus, thrive in areas with moderate to high water flow. Sea fans act as habitats/shelter for a multitude of organisms. For instance, brittle stars, a type of echinoderm, crawl along the branches or wrap around the octocoral, using it as a substrate and refuge.

NOTE

While sea fans are resilient organisms, they are also very fragile. Therefore, it is essential for divers to practice responsible and environmentally-conscious behaviour to minimize impacts. For instance, practicing good buoyancy control to avoid accidental physical contact with the sea fans and touching or leaning on them as its surface protective mucus layer are sensitive to oils and chemicals from human skin.

11. Bluebottle 'Jellyfish' at Belle Mare?

Did you know?
The bluebottle 'jellyfish' is not a true jellyfish and occur seasonally at Belle Mare!

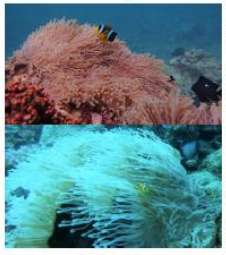
Jellyfish are tactile, non-visual, and gelatinous organisms whose biomass is composed of 96% water (Gibbons *et al.* 2022). They mainly belong to the phylum Cnidaria and Ctenophora. Cnidarians possess stinging cells to capture their prey, while ctenophores secrete glue (colloblast) to entangle their prey. Some juvenile fish species take refuge by living on or near jellies to escape predators, and in turn, jellyfish benefit from the interlopers that feed on their potential prey and parasites (Richardson *et al.*, 2009). Following seasonal changes and heavy rainfall, and depending on wind direction, the Portuguese man-of-war also known as bluebottle 'jellyfish' (*Physalia utriculus*), blue-button 'jellyfish' (*Porpita porpita*), and ctenophores (comb jellies) are commonly found in the lagoons of Belle Mare and washed ashore along its beaches.

NOTE

Jellyfish-like organism blooms can be dangerous as their stings are painful. Thus, stay informed of alerts by the National Coast Guard about their sightings in Belle Mare lagoon and beach. Moreover, do not swim or dive into waters where they are present. Protective clothing, such as stinger suits, should be worn, which can provide a physical barrier against their tentacles. Bluebottle 'jellyfish' are washed ashore on Belle Mare beach. Thus, avoid touching them and report immediately. Ctenophores do not sting but rather secrete a glue, but still be cautious of not touching them.

4. Endemic Species at Belle Mare?

Did you know?
Two regionally endemic fish species, Mauritian anemonefish and Mauritian gregory are found at Belle Mare reefs!



Marine endemic species include marine animals and plants that are only found in a specific geographic location, for instance a region, island or coral reef and nowhere else on the planet. This is often due to isolation and unique local conditions. The restricted range may include a single defined area or region spanning from a small reef to a specific part of the world. Endemism is considered to arise due to long periods of isolation which allow species to evolve specific traits with respect to the exposed prevailing environment. Since endemic organisms may not thrive elsewhere, they tend to be highly vulnerable and at a higher risk of extinction especially due to drastic habitat loss in the wake of anthropogenic and climate change-driven ocean warming impacts.

NOTE

Endemic species are crucial indicators of ecosystem health and biodiversity, highlighting unique evolutionary processes and the importance of protecting specific marine environments from threats like pollution and climate change. The Mauritian anemone fish inhabits the anemone which barbours thermally sensitive symbiotic microalgae and may bleach and die due to ocean warming-induced bleaching. Mass anemone bleaching/ mortality events may threaten the survival of the anemone fish.

12. Coral Bleaching at Belle Mare?

Did you know?
Severe bleaching events have hit Belle Mare in summer of 2009, 2016, 2019, and 2025!

When the water temperature stays too warm for a long period of time, corals are stressed and the delicate relationship between reef corals and their symbiotic microalgae, known as zooxanthellae, is disrupted. They lose/ expel these microalgae, leaving a white skeleton behind. This process is known as 'coral bleaching'. Some corals can recover after bleaching. Corals may recover their microalgae, return to their vibrant colours, and live if circumstances return to normal. However, persistent rising temperatures and other stresses, such as low water quality, can harm the live corals. They struggle to regenerate, reproduce, and combat diseases, making them highly prone to coral diseases and mortality. When water temperatures remain high for eight weeks or more, corals are unable to recover and start to die.

NOTE

Since coral reefs support thousands of marine organisms, providing refuge, spawning sites and shelter from predators, the collapse of this ecosystem might cause the extinction of already threatened species. Belle Mare reef being on the east of Mauritius Island is exposed to South East Trade Winds and having a large lagoon with the reef about a kilometer away along with good sea water flushing tends to recover from bleaching events. These conditions at Belle Mare are helpful in keeping its reefs resilient to ocean warming events.

13. Coral experiment at Belle Mare?

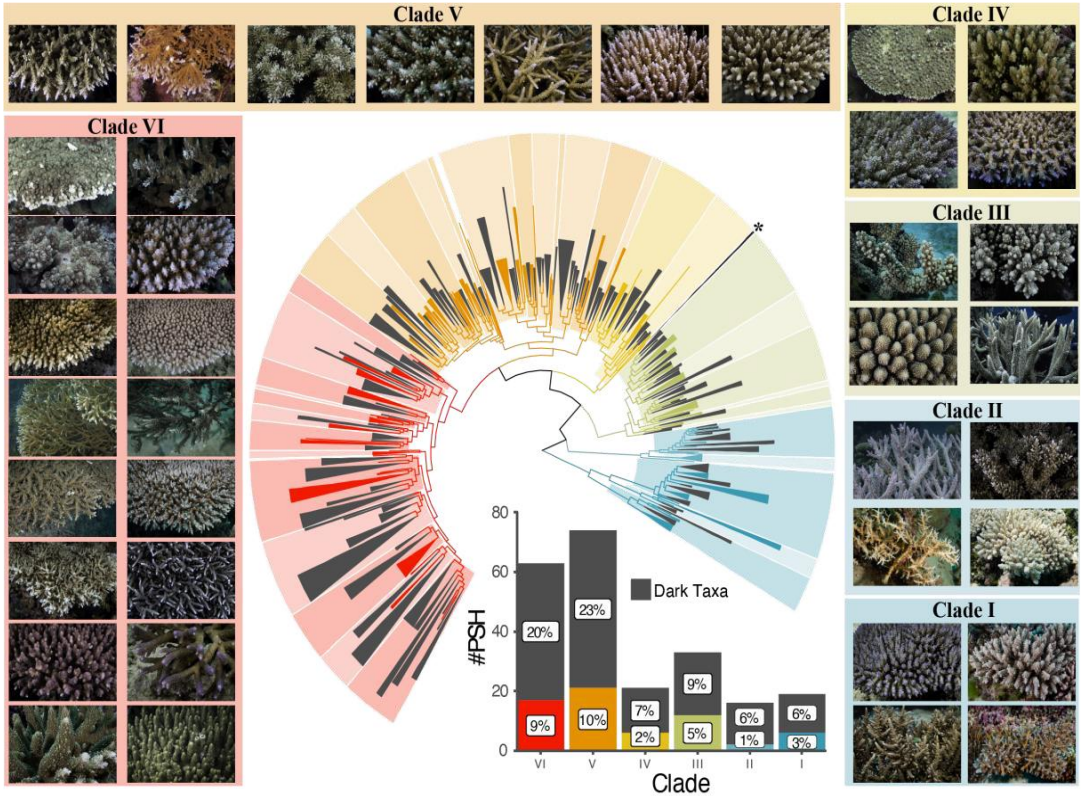
Did you know?
Branching Acropora transplanted to the near-shore site at Belle Mare did not bleach in 2016 and exhibited expected growth!

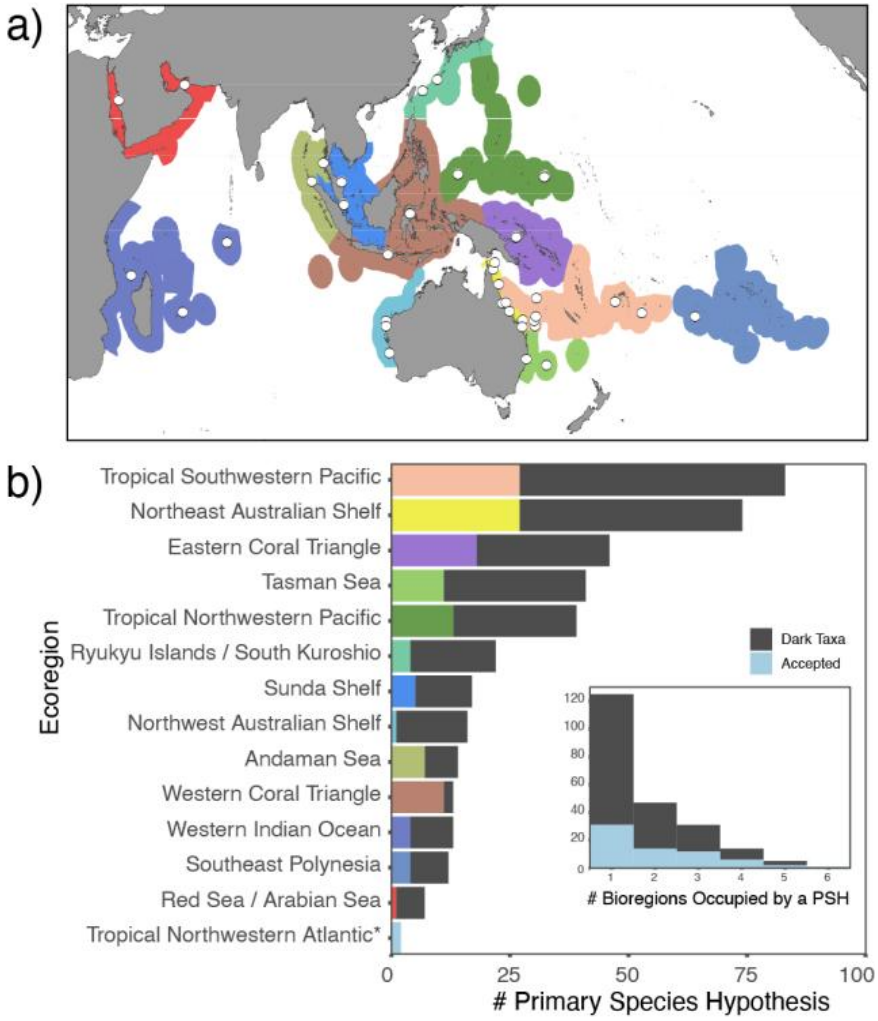
Corals are declining worldwide and human-assisted intervention is becoming a quite common approach to aid in active coral rehabilitation efforts. A small-scale experimental trial conducted at Belle Mare had good success of *Acropora* coral rehabilitation. However, this *Acropora* species is one of the first corals to bleach and die due to global ocean warming phenomenon. These transplanted corals at the near-coast site did not succumb to severe bleaching during the global 2016 mass bleaching event possibly due to acclimatization (Louis *et al.* 2016, 2020).

NOTE

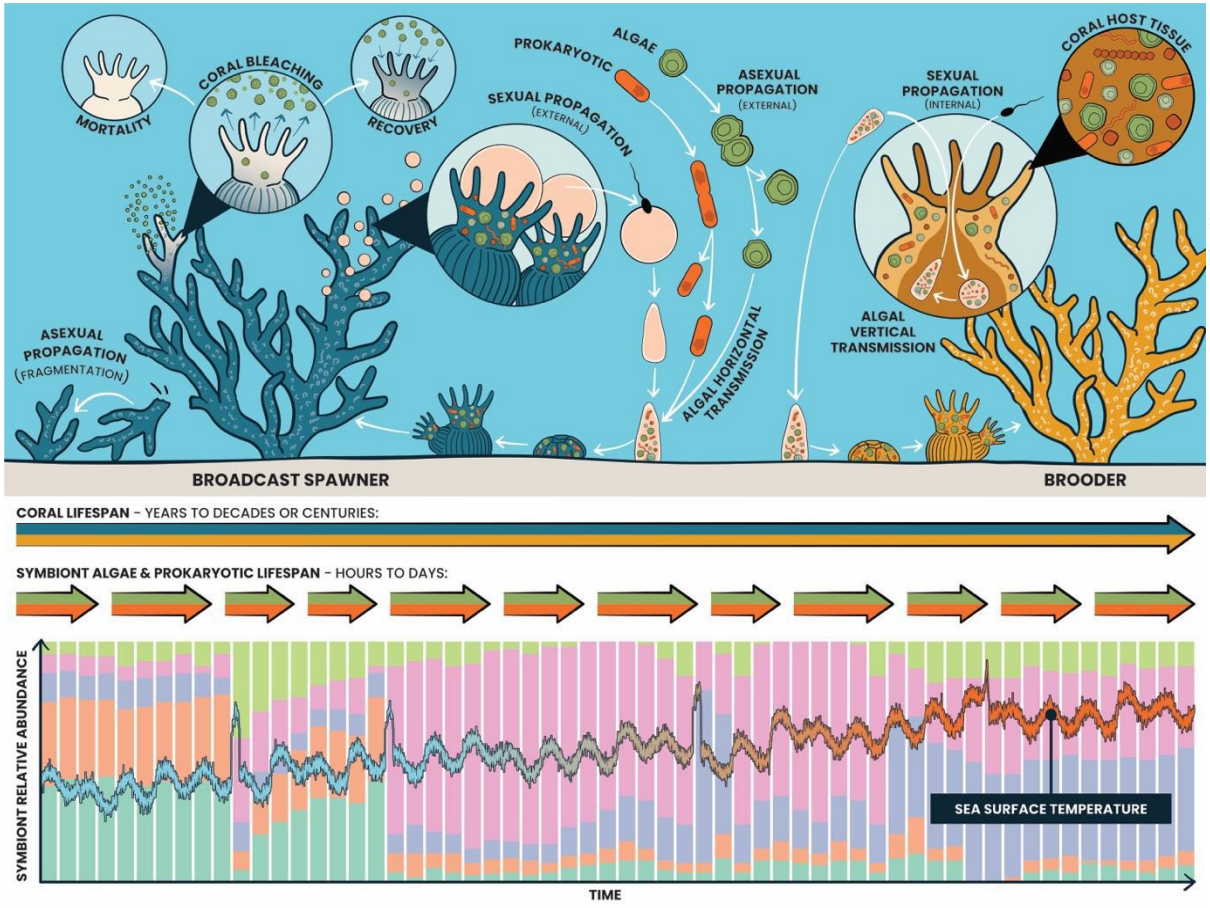
Do not try to transplant corals on your own unless one is well-trained by qualified experts and all necessary permits/clearances from relevant authorities have been obtained. Corals, though have existed for at least 250 million years, are very fragile and delicate animals living in symbiosis with microscopic photosynthetic microalgae. They are very sensitive to slight changes in environmental features and hand-manipulations. Appropriate precautions and methods are required to transplant corals in the wild.

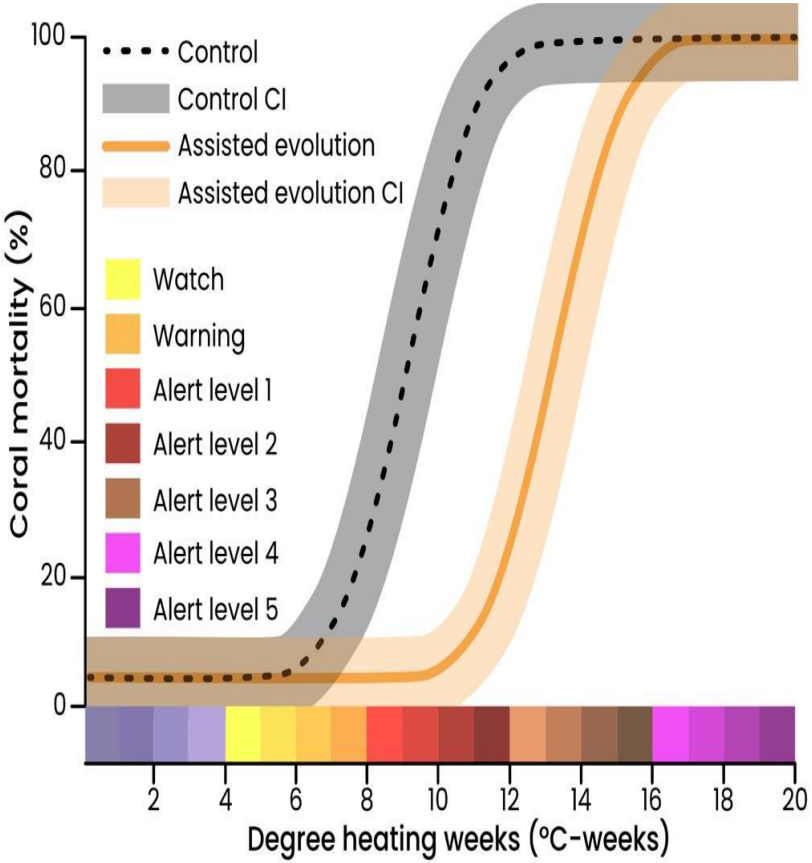
Caution 1: Dark Diversity of corals? – 70% of Acropora unidentified and high endemism potential – Cowman et al. under review (30 authors)



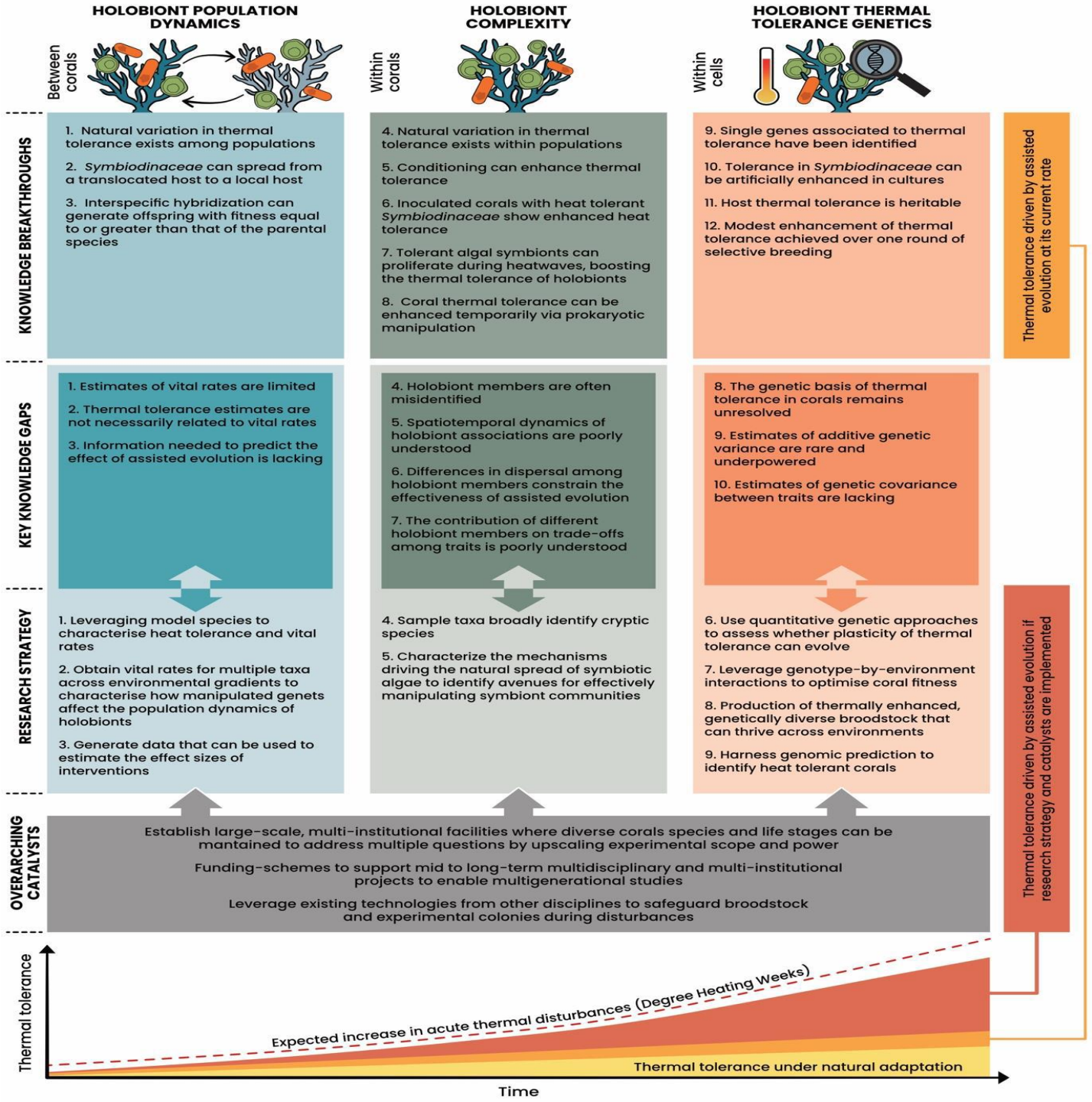


Caution 2: Accelerating coral assisted evolution to keep pace with climate change? – Humanes et al accepted *Nature Biodiversity Reviews* (28 co-authors)



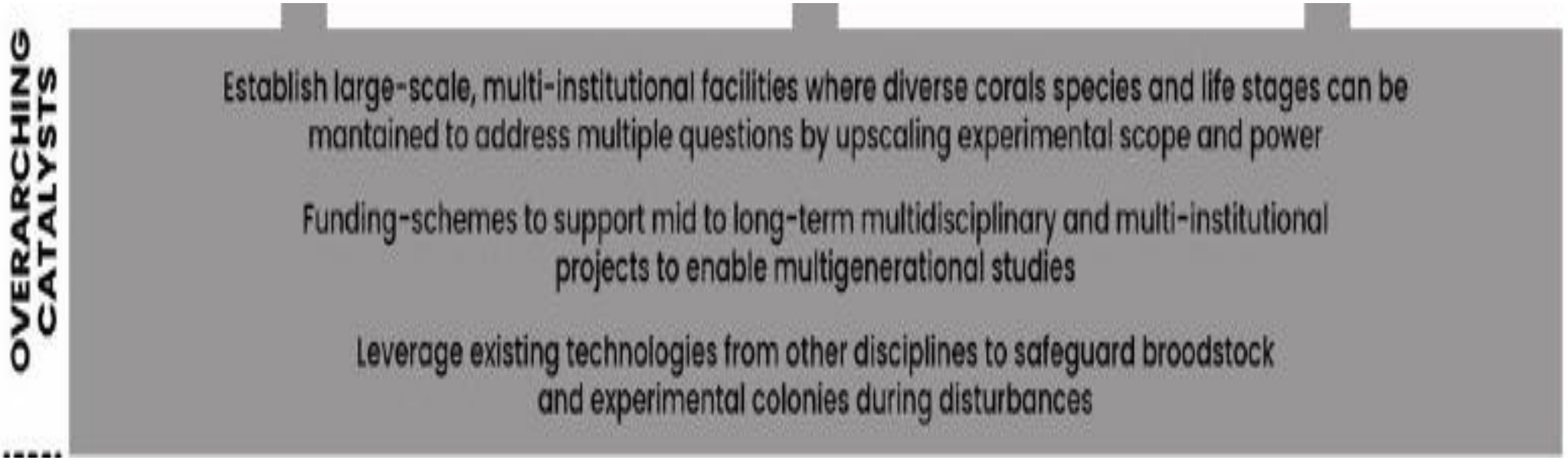


Caution 2: Experimental Assisted Evolution Needed!



What can UoM and Odysseo Marine Station Do to save corals in the wake of global ocean warming?

A regional hub for Mauritius and the Western Indian Ocean for catalysing experimental assisted coral evolution and adaptation to climate change-driven ocean warming!



Conclusions

- Belle Mare hosts a high diversity of marine organisms
- A non-exhaustive Compilation indlude the following: 224 taxa (41 macroalgae, 2 seagrasses, 5 cyanobacterial/microbial mats, 3 sponges, 2 anemones, 1 black coral, 50 hard corals, 5 zoanthids, 4 soft corals, 2 hydrozoans, 3 tubeworms, 1 crustacean, 26 molluscs, 12 echinoderms, 6 tunicates, 60 fish, and 1 sea turtle taxa)
- Need for further species characterization and Implications for Biodiversity and Conservation, Protection and Adaptive Management of corals and reef of Belle Mare and the Republic of Mauritius sea.

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- All local and international collaborators
- All experts who helped verify and caution the identifications
- All MPhil/PhD and research students who have been part of this endeavour

Thank you!

Questions?