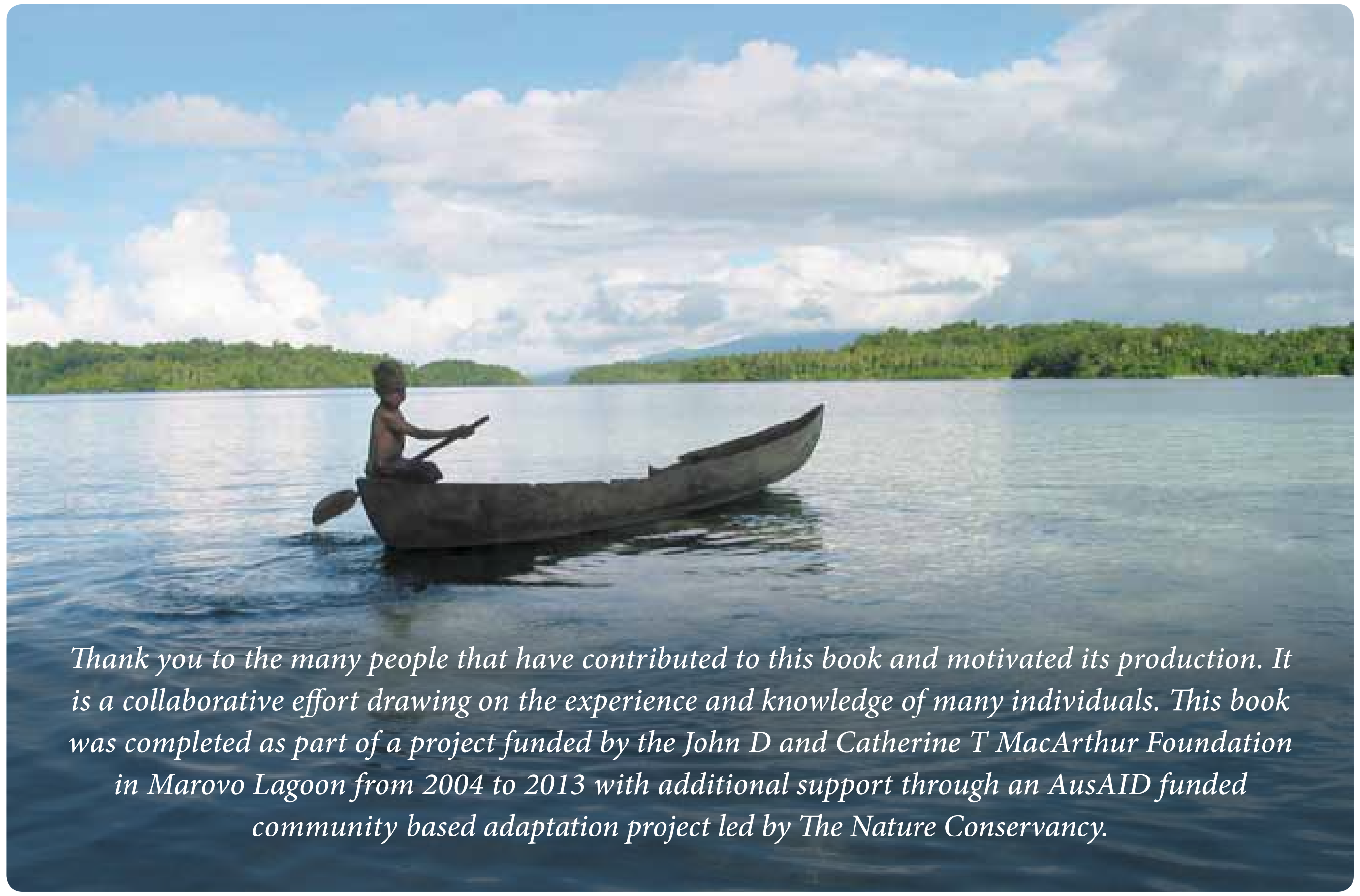
Solomon Islands Marine Life

Information on biology and management of marine resources




Simon Albert

Ian Tibbetts, James Udy



Thank you to the many people that have contributed to this book and motivated its production. It is a collaborative effort drawing on the experience and knowledge of many individuals. This book was completed as part of a project funded by the John D and Catherine T MacArthur Foundation in Marovo Lagoon from 2004 to 2013 with additional support through an AusAID funded community based adaptation project led by The Nature Conservancy.

Photographs: Simon Albert, Fred Olivier, Chris Roelfsema, Anthony Plummer (www.anthonyplummer.com), Grant Kelly, Norm Duke, Corey Howell, Morgan Jimuru, Kate Moore, Joelle Albert, John Read, Katherine Moseby, Lisa Choquette, Simon Foale, Uepi Island Resort and Nate Henry.

Cover art: Steven Daefoni (artist), funded by GEF/IWP

Cover photos: Anthony Plummer (www.anthonyplummer.com) and Fred Olivier (far right).

Text: Simon Albert, Ian Tibbetts, James Udy, Christine Buckius, Joelle Albert, Badin Gibbes, Morgan Jimuru, Graham Baines, Norm Duke, Grant Kelly, Tim Alexander, Eran Brokovich, Robyn James.

Design: Dieter Tracey, Simon Albert, Kate Moore, Emily Smykal and Joelle Albert.

Reference: Albert S, Udy J, Tibbetts IR. 2013. *Solomon Islands marine life: information on biology and management of marine resources*. The University of Queensland. Brisbane.

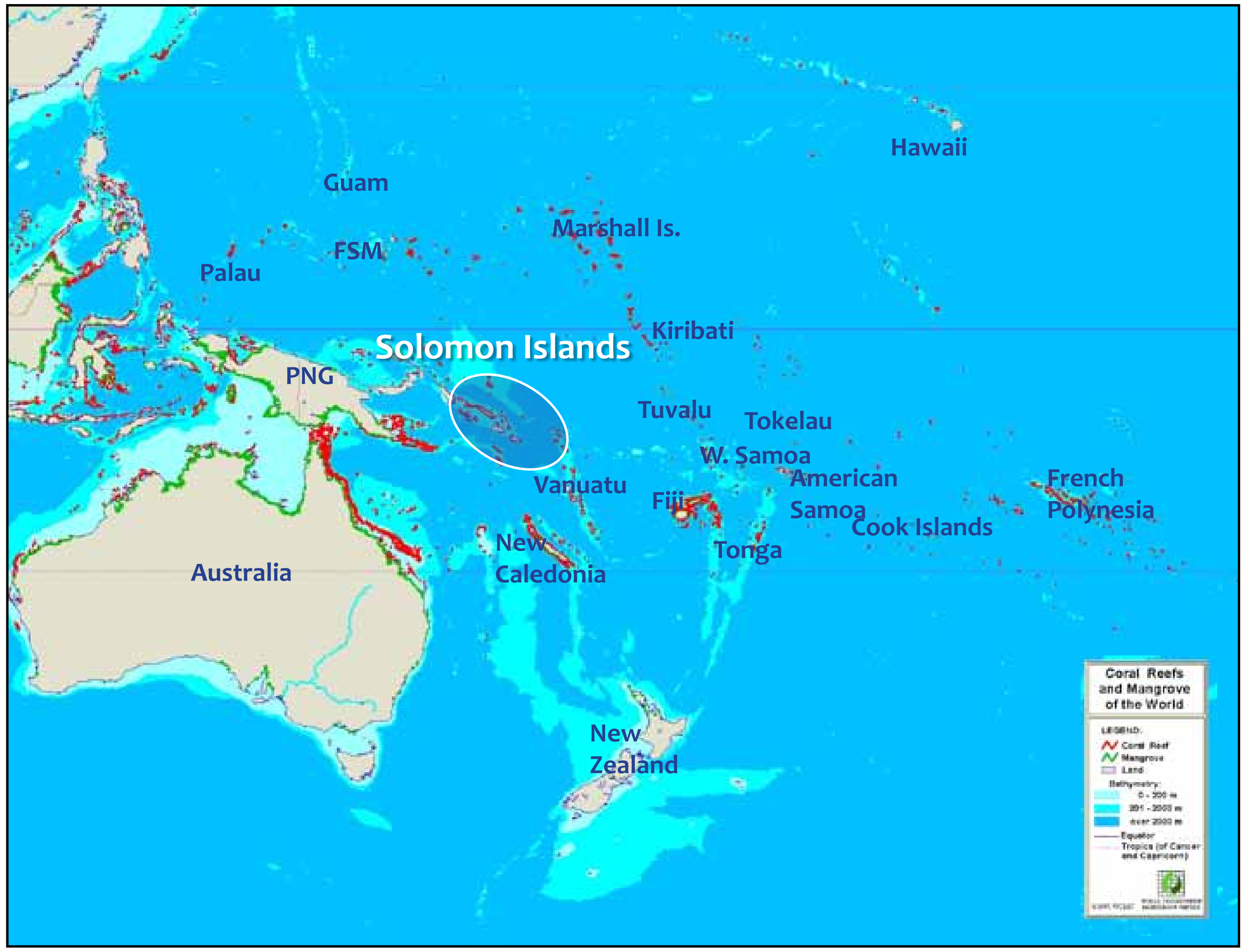
ISBN: 978 1 74272 098 2

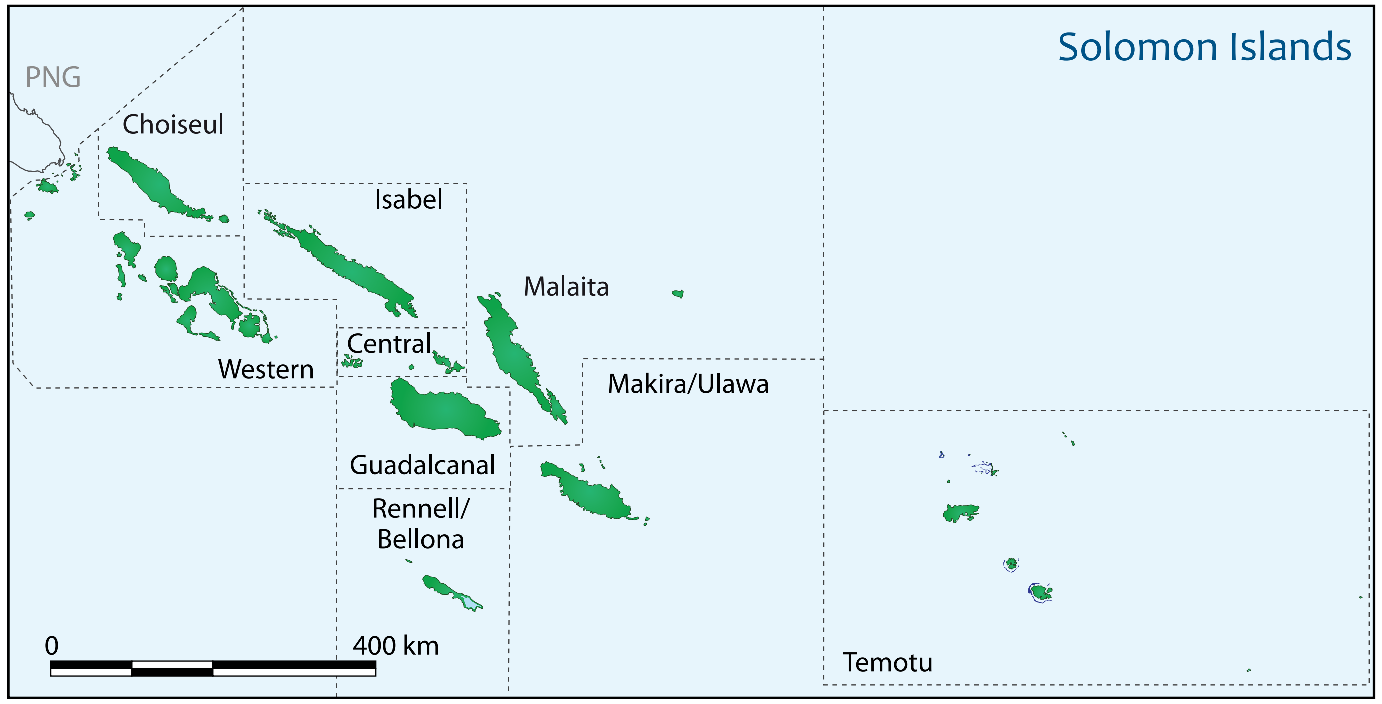
Printed on carbon neutral paper sourced from a mixture of recycled and FSC certified pulp

For further information please contact:
Simon Albert: s.albert@uq.edu.au

The University of Queensland Australia · MacArthur Foundation · The Nature Conservancy · Australian AID

Solomon Islands Marine Life





Introduction

This book provides a brief overview of some of the key aspects of the Solomon Island's marine environments and the threats they face. The Solomon region's marine ecosystems are some of the most diverse and intact on earth. They have been identified as part of the 'Coral Triangle', which is an area of the highest biodiversity of coral and fish species on the planet. It is these rich resources that support the livelihoods of the rural population. Solomon people have been sustainably using these marine and forest resources for thousands of years. The recent change to commercial harvesting of forests and reefs as well as future climate change related impacts has and will continue to place new pressures on these resources.

This book outlines some of the threats to marine ecosystems and suggests some simple ways to reduce their impact. Hopefully this will complement the deep understanding of the environment Solomon people already have and assist with the continued management of this special part of the world.

Coral Triangle

Solomon Islands is within the region known as the Coral Triangle. The Coral Triangle region also includes the countries of Indonesia, Malaysia, Papua New Guinea, Philippines and Timor-Leste. The area includes the highest marine biodiversity in the world with 605 species of corals and 2228 species of reef fish. This high biodiversity has made the region a priority for conservation organisations. The high biodiversity in this region is due to three main factors:

- Area of mixing between Indian and Pacific Ocean species
- The focus of coral reef evolution
- The diversity of landforms and geology at various sea levels

The Coral Triangle Initiative was founded in 2007 by the six countries forming the Coral Triangle to manage the biodiversity whilst ensuring food security for the local people.

Marine biodiversity in Solomon Islands:

- 30 species of mangrove
- 10 species of seagrass
- 494 species of coral
- 1159 species of reef fish
- 10 species of whales and dolphins
- 10 species of sharks
- 5 species of turtles

It is likely there are many more species in each of these groups yet to be discovered. Algae and invertebrates have not been included as they are poorly studied.

Marine life

The marine life in Solomon Islands is rich and varied. This book only covers the most common and useful animals and plants; much remains to be discovered.

Marine plants

Marine plants support the foundation of life in the oceans; without them there would be no animals. The three major marine plants are seagrass, algae and mangroves.

4

Marine invertebrates

Invertebrates are the most common and diverse group of animals in the ocean. Inside the marine invertebrate group are: corals, bêche-de-mer, crabs, starfish, shellfish and many other useful marine resources.

13

Fish

The diverse and healthy fish populations in the Solomons are the most important resource for people's day to day food. This book also covers some of the ways fish help to keep the reef healthy.

26

Turtles

The Solomons has some of the most important nesting areas for turtles in the world.

30

Sharks

Little is known about the sharks of the Solomons. But globally sharks are very important for keeping the food chain in balance.

34

Marine plants

Seagrass, algae and mangroves

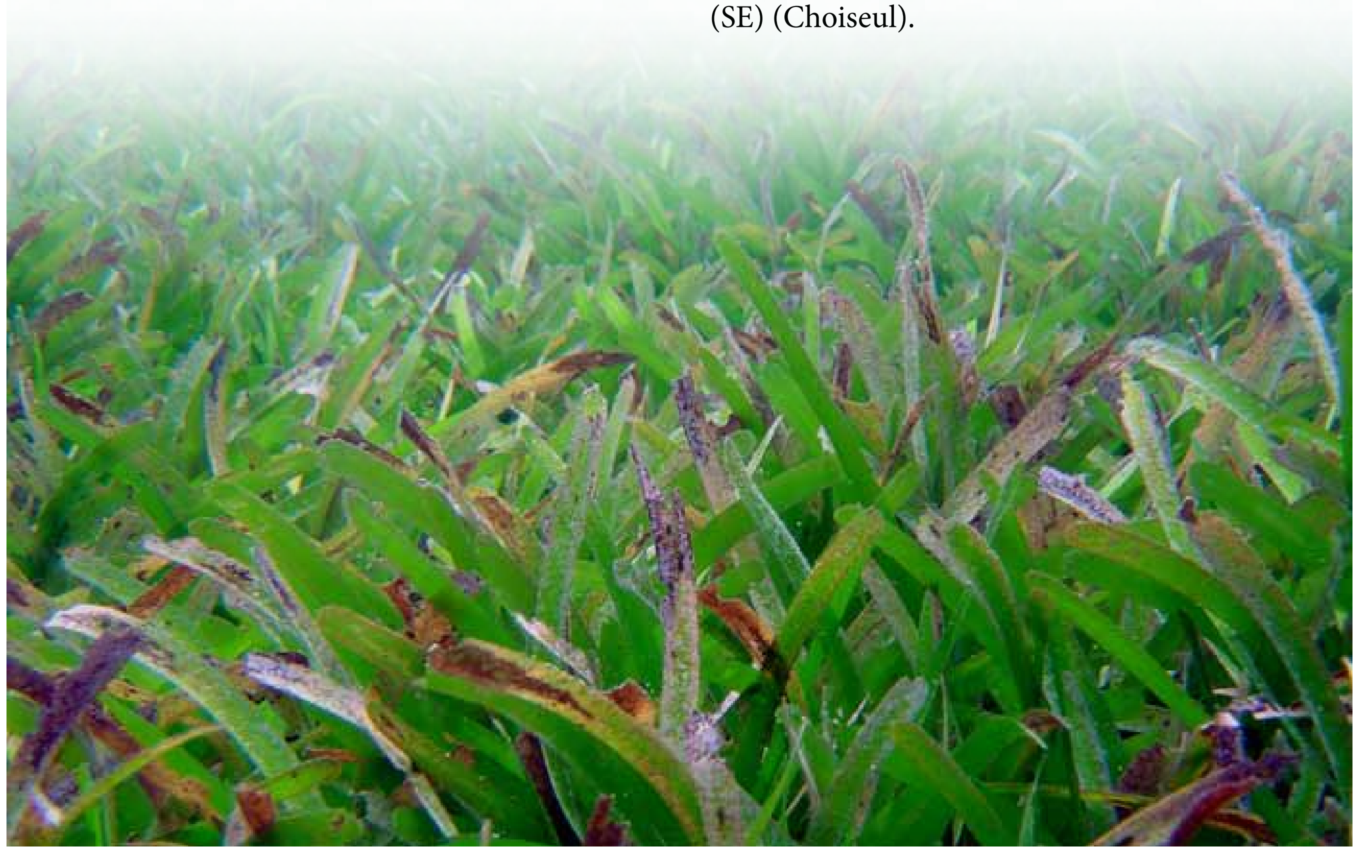
Seagrass

Seagrasses are flowering plants that live in nearshore coastal environments with sandy or muddy bottoms and protections from large waves. They are highly productive and widespread. In the world there are approximately 70 species of seagrass. Seagrass habitats indirectly support various coastal fisheries, largely through provision of a nursery habitat for juvenile animals and providing habitats and food for adult animals such as fish, turtles, shellfish, bêche-de-mer and dugongs. In The Solomons there are ten different types of seagrass, some of which look very similar. Seagrass is the only flowering plant that can survive submerged in salt water. Seagrass can grow in a large range of habitats, from shallow inter-tidal areas to over 40 m in depth.

- *Flowering plant*
- *Important for young fish*

Where are they found?

Generally seagrasses are found in shallow sandy areas close to a source of nutrients (sediments from land or waste from villages). Large areas of Seagrass in the Solomons are found in Roviana Lagoon (Western Province), Lau Lagoon, Maramasike and Greenwich Islands (Malaita Province), Tambatamba (NW) Wagina Island (SE) (Choiseul).



Flowering

Seagrass are the only submerged marine plants that use flowers to reproduce. At certain times of the year (normally summer), seagrass produce separate male and female flowers. Pollen from the male flower is released into the water and carried by currents to another seagrass with a female flower. When this female flower is pollinated, the seed begins to develop. Seeds from some species then float to the surface and drift to a new area to grow, while others settle into the sand close to the parent. *Enhalus* is slightly different, it raises its flowers above the water surface and lets the pollen drift in the wind to another female flower. Sometimes millions of small seagrass seeds can be seen floating on the surface of the water in some lagoons.


Seagrass flowers (*Enhalus*)


Seagrass fruit (*Halophila*)

Seagrass as food

Green turtles and dugongs both rely on seagrass as their main food source. Green turtles bite the top sections of seagrass leaves, preferring *Halodule univervis*. Dugong use their heads to dig up the roots of seagrass and then eat these. Dugong prefer *Halodule* and *Halophila* as these are the tastiest and have the most nutritious roots.

Dugong


Seagrass (*Halophila*)

Green turtle

Marine algae

Algae are a group of plants that live in both freshwater and saltwater. Marine algae are those that live in saltwater and are often called "seaweeds". There are over 500 species of marine algae in Solomon Islands. Algae play a very important role in the marine food chain as they are primary producers. Using sunlight algae convert carbon dioxide into carbon compounds and oxygen through a process called photosynthesis. This provides a food source for the majority of animals in the sea including whales, fish and bêche-de-mer.

Algae can be found in many areas of the Solomon Islands:

- On the sand on the bottom of lagoons
- In the water of lagoons and the open ocean
- On reefs
- Inside corals
- Inside giant clams
- On the bottom of canoes
- Inside marine sponges

Types of algae

Green algae

Green algae are common in many different areas of Solomon Islands. Caulerpa is generally found in inshore reefs with dirtier water or amongst seagrass beds. Caulerpa is a commonly eaten algae in the Solomons. Other types like Chlorodesmis are only found in cleaner waters, growing attached to corals, while some species like Halimeda are found across almost all reefs in both shallow and deep waters and occasionally growing directly on sandy bottoms. Halimeda is different from other green algae as it produces calcium carbonate, which gives it a strong rigid structure and reduces the number of fish which can eat it. The calcium carbonate from Halimeda is an important source of sand on coral reefs. It is also used for cleaning canoes.

→ *Found all over Solomon Islands*

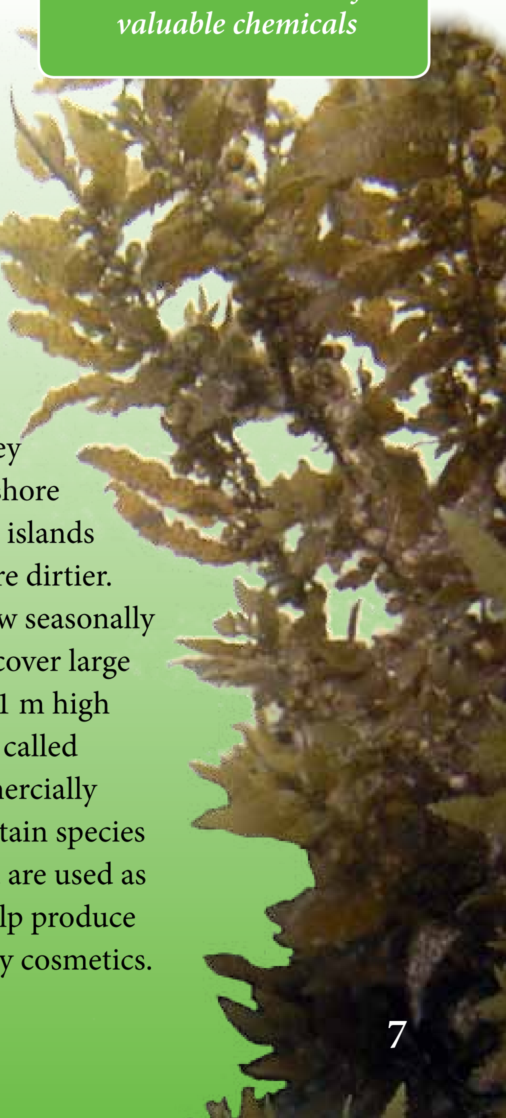
→ *Different types in clean and dirty waters*

Brown algae

→ *Found inshore*

→ *Harvested inshore for valuable chemicals*

Brown algae are more common in colder waters (south Australia, Europe and America), but a few species also grow in the warm water of Solomon Islands. Padina, Turbinaria and Sargassum are the most common. They can be found in inshore areas near volcanic islands where the waters are dirtier. Sargassum can grow seasonally around villages to cover large areas with a dense 1 m high canopy. Chemicals called alginates are commercially harvested from certain species of brown algae and are used as an ingredient to help produce ice cream and many cosmetics.



Red algae

Red algae are the most common form of algae seen on reefs in Solomon Islands. They can be either fleshy and soft or hard and rock like. The hard red algae are called calcareous red algae as, like corals, they produce calcium carbonate. This calcium carbonate gives them a strong 'skeleton' that few fish can eat. These calcareous red algae are important for forming the foundations of coral reefs.

- → *Most common*
- → *Can be soft or hard*

Phytoplankton

Phytoplankton are tiny microscopic plants that live floating in the water, on the bottom or epiphytic on other plants. Although individual phytoplankton cannot be seen with the naked eye, they are the most important algae in the ocean for capturing light and turning carbon dioxide into oxygen and food. Phytoplankton are very fast growing. They can double their population in a few hours. Sometimes there are so many phytoplankton in the waters of Solomon Islands that the water looks a green colour. This is from the green pigments called chlorophyll that phytoplankton use to photosynthesise (capture light).

- → *Microscopic plants*
- → *Turns water green*

Cyanobacteria (blue-green algae)

Cyanobacteria are more closely related to bacteria than algae, but have many similar properties to marine algae. Cyanobacteria photosynthesise to produce carbon but they can also fix nitrogen from the atmosphere. This nitrogen fixation is an important source of nitrogen for other animals and plants in the ocean. Many species of cyanobacteria contain toxins which can make humans sick if they come in contact with the cyanobacteria or eat fish that has eaten it.

- → *Related to bacteria*
- → *Can be toxic*

Issues and threats

Too much algae can harm reefs

Algae are very important for the reef ecosystem as they provide the source of energy and food for the marine food chain. However, too much algae can be harmful to corals. When nutrients increase and/or herbivorous fish (e.g. parrotfish and surgeonfish) populations are decreased, algae can grow fast and cover corals. This can reduce the amount of space available for baby corals to settle and grow.

- → *Overfishing can lead to algal growth*

How can you help?

Don't over-harvest herbivorous fish

Herbivorous fish like parrotfish, surgeonfish and rabbitfish play a very important role on the reef by eating (grazing) large amounts of algae. Fish grazing ensures that algae are reduced, allowing corals to dominate the reef environment. To maintain this fish grazing activity, it is important not to over-harvest herbivorous fish. Some forms of fishing like night spearfishing, gill netting and poison leaf/root can reduce populations of herbivorous fish on some reefs. Without these herbivores, algae begin to grow fast and cover the reef.

- → *Herbivorous fish help keep algae low*

Important fish that eat algae

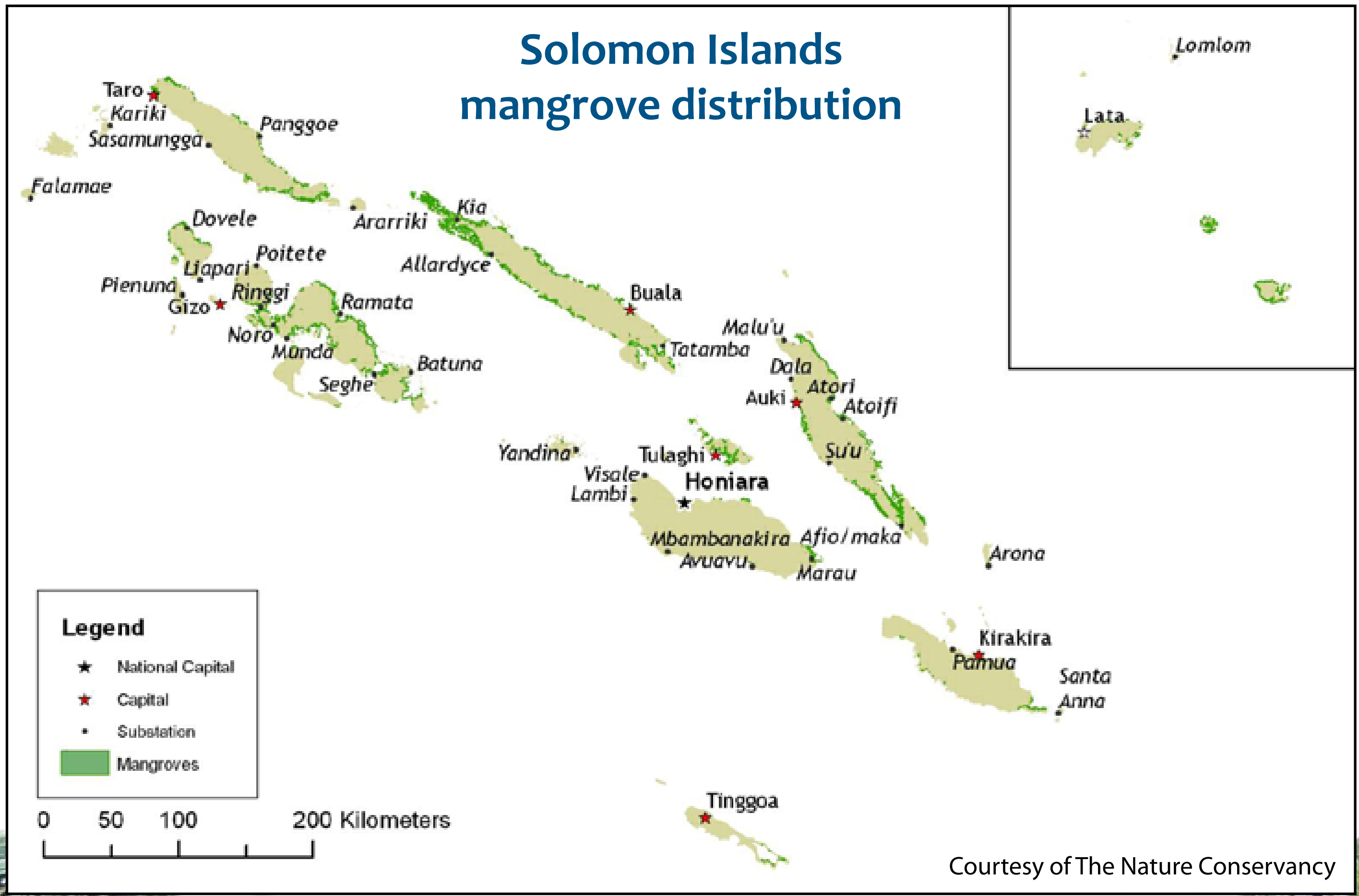
There are four main groups of fish that are important algal grazers on the reef:

Rabbitfish

Parrotfish

Damselfish

Surgeonfish



Courtesy of The Nature Conservancy

Mangroves

Mangroves are trees and shrubs that live in seawater bordering the coast and tidal parts of rivers and creeks. Mangrove habitats form biologically diverse ecosystems. There are 72 different species of mangroves in the world, 30 of these occur in the Solomons. Mangroves are special plants as they can grow in saltwater and freshwater. They have developed many ways to deal with living in salty water, such as:

- Roots and trunks for breathing
- Filters to stop salt entering the roots
- Floating propagules (like a seed from a tree)
- Strong roots to hold in the mud
- Strong timber to resist waves and wind.
- Important for people and the environment

Important for people and the environment

Mangroves are generally important to people in the Solomons. Mangroves are used for all sorts of everyday things. Most mangroves have direct benefits like: carving timber, firewood, tools for digging, spears and hooks for fishing, poles and leaves for houses, timber for canoes, fruits are eaten with coconut milk and fish; and leaves and fruit are used to treat various illnesses.

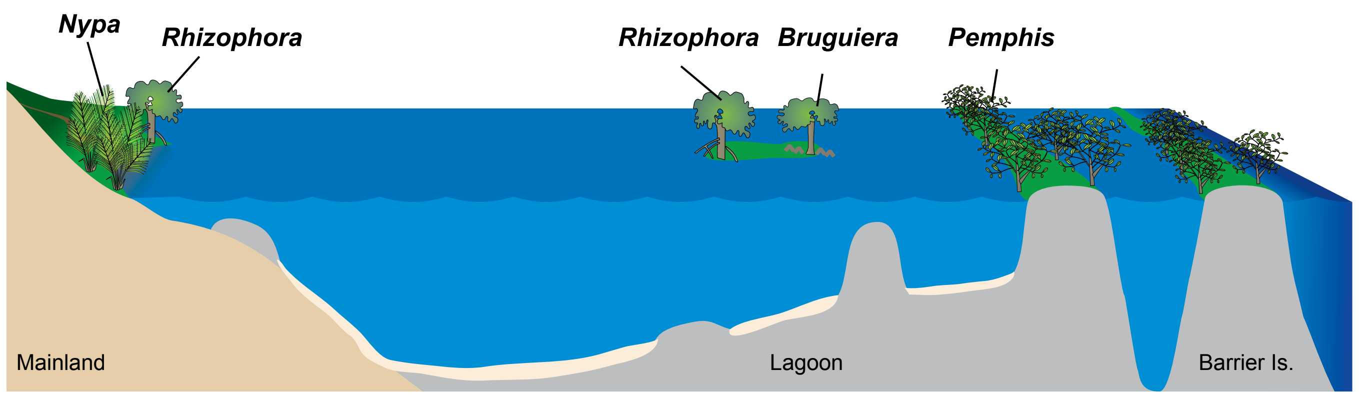
Mangrove habitat is also important because juvenile prawns and fish live amongst their roots, and birds nest in the branches. Their roots also help to


Mangrove forest

strengthen the shoreline to prevent erosion of the land. Some species are unique to this habitat such as mud crabs and mangrove shells. Conservation of mangroves is important to these species and others. Each hectare of mangrove destroyed means 1 tonne less fish per year for the community.

Where are they found?

The 30 species of mangrove found in the Solomons live in different habitats. They can be found on most islands and it is estimated that mangroves here cover an area of about 50 000 hectares. Some mangroves are found inshore within the river and small stream estuaries; others surround the lagoons' coastal fringes and small islands, and others grow around exposed barrier islands. See map on page 10.

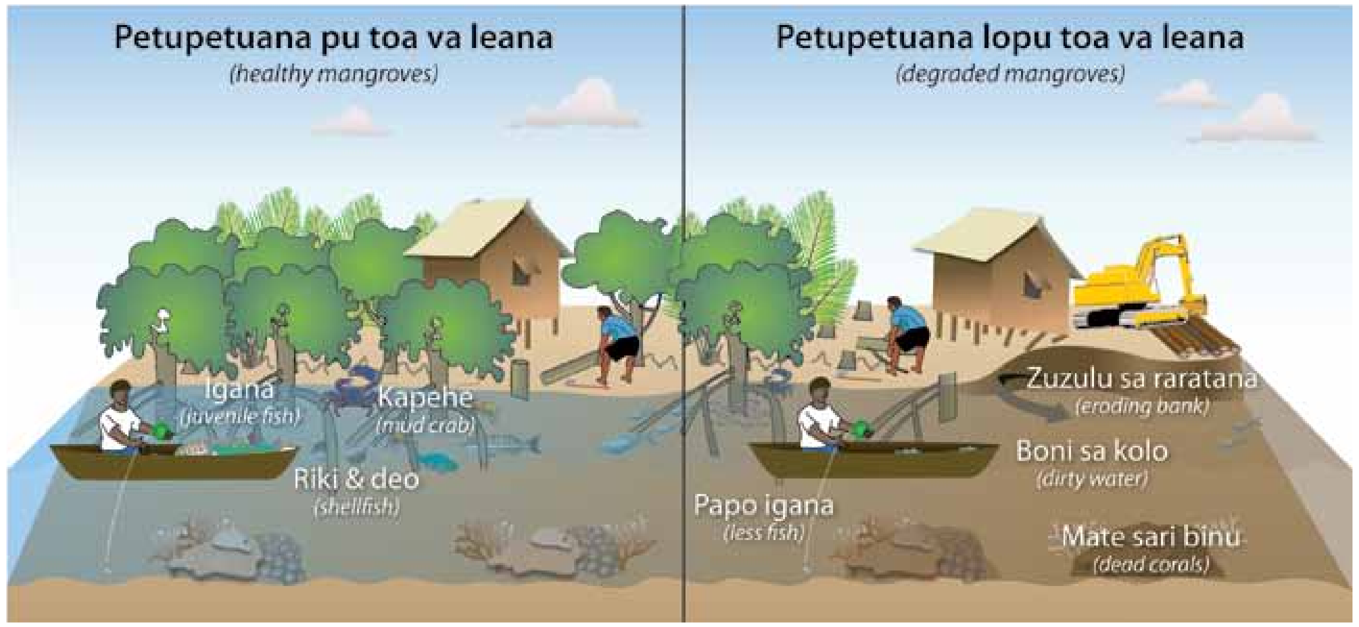


Issues and threats

There are a number of threats to mangroves in the Solomons. If mangroves are damaged their benefits are lost. Logging and land clearing has destroyed mangroves at the log camps and where logging is close to the coast. Removing rainforest and other vegetation behind mangroves also increases the risk of mangroves being uprooted by storms.

Over harvesting of mangroves near villages can also cause beach erosion during big storms and high tides. Mangroves are often cut for firewood and in some places this harvesting is unsustainable so it would help to plant new mangroves to replace those cut and have some mangrove areas tambu or closed to harvest.


Clearing mangroves to load logs



Marine invertebrates

Introduction

Invertebrates are animals that lack a spine and account for 97% of all animal species. There are more than 50 different groups of invertebrates. They are found in every habitat on earth, including the ice caps of the polar regions, deep-sea thermal vents and on land. The marine environment contains the greatest diversity of all invertebrates which take on a variety of forms and body shapes. There are four main groups of marine invertebrates: Molluscs, Arthropods, Echinoderms and Cnidarians. Each of these groups has different features and lives in different places.

Molluscs

Included in this group are snails, sea slugs, nudi-branchs, trochus, clams, mussels, octopus and squid.

- → *Valued for food and shells*
- → *Some species have reduced or no shell*

Soft body

All molluscs have soft fleshy bodies.

Mantle

The mantle acts as a cover for the "guts" and surrounds the soft body parts. The mantle also produces the shell.

Foot

The foot is a muscle that most molluscs use for movement. The foot works by waves of muscular contraction. The siphon that squids and octopuses use for "jet propulsion" is thought to have evolved from the foot.

Gills suspended in mantle cavity

Gills are used to extract oxygen from the water to breathe. In most bivalve (two-shelled) molluscs, the gills are also used for filter feeding.

Types of molluscs

Important mollusc—Trochus

English name: Trochus shell

Scientific name: *Trochus niloticus*

Description: A medium to large sized sea snail (gastropod), can get as large as 13 cm. It has a thick inner layer of nacre, also known as mother of pearl.

Habitat: They live either intertidally or in the shallow subtidal. Trochus in the Solomons are commonly found living in the shallow edge of exposed reefs.

Uses: Since the 19th century, trochus has been the most important commercial shell and is therefore quite scarce today. Traditionally trochus was used as a material for armrings. Tabu areas can allow trochus to recover quickly.

Trochus

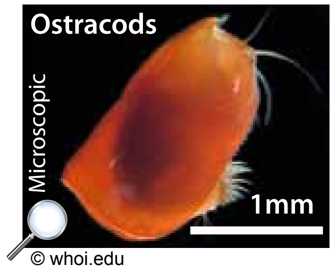
Arthropods

Of all the known animal species on Earth, 75% are arthropods. There are more than 853,000 described species and an estimated 20-50 million species of insects yet to be identified. They are the most successful group of animals in the world, and the only one to live in every type of habitat. Most arthropods are land dwelling insects, which makes them a familiar group to humans.

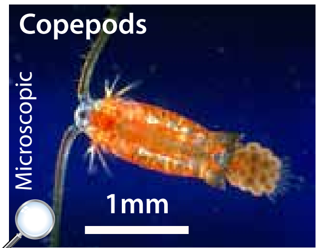
- → *75% of all known species*
- → *Crustaceans most common marine arthropod*

Arthropods have a hard skeleton on the outside of their body called an exoskeleton, which covers their soft vulnerable inside. They have jointed legs that allow mobility from beneath their exoskeleton. Crustaceans are the most common group of arthropods in the oceans with over 40,000 different species. Included in this group are crabs, lobsters, shrimp, barnacles, copepods, isopods, and amphipods.

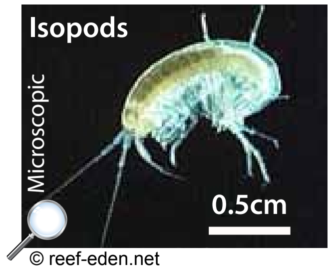
Types of crustaceans



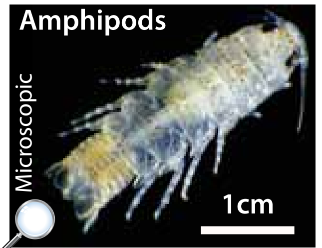
© whoi.edu



© sacsplash.org



© reef-eden.net



© invertebrates.si.edu

© Jared Zimmerman

Jointed appendages

Although not all arthropods have legs, many have some type of moving appendage. The appendages of arthropods are jointed which allow the animals to move.

Segments on body

Arthropods have a body consisting of groups or segments usually with a pair of appendages on each segment. They typically have three segments; head, abdomen and thorax.

External skeleton

The external skeleton (or exoskeleton) is the hard exterior layer that not only supports the body of the arthropod, but also protects internal organs, allows locomotion and reduces moisture loss. The exoskeleton is made of a hard, protective substance called chitin. It works much like the armour used by medieval knights. The exoskeleton does not grow with the animal. Instead, as the animal grows, the old exoskeleton is shed (a process known as moulting), and a new exoskeleton is inflated and quickly hardens, resulting in stepwise growth rather than the continuous growth seen in other animals.

Open circulatory system

Arthropods have an open circulatory system, without veins and arteries that mammals have. Therefore, the organs are suspended in blood. Should the shell of certain arthropods crack deep enough into the body area, it will bleed to death.

Mud crab

Echinoderms

Echinoderms are the spiny-skinned marine invertebrates. There are 7,000 species living in the oceans.

→ *Spiny skinned animals*

→ *Important in reef ecosystem*

Spiny skin

In order to protect themselves, echinoderms use their spiny skin for defence. The spines range in size and form depending on the species. Some echinoderms spines are short and stubby, some are thin and long, and others have soft spines.

Tube feet

Most echinoderms have dozens of little 'noodle like' appendages called tube feet, used for movement. The tube feet are moved by an internal water pressure with 'suction cups' on the tips. This allows them to fasten themselves to rocks. Some echinoderms have developed other uses for tube feet such as burrowing, tasting, and touching. Some sea stars use them to pull open bivalves for feeding. Sea urchins often use their tube feet to attach bottom debris to the tops of their bodies for camouflage and shade.

Regeneration

Echinoderms have the ability to grow back lost body parts.

Urchin

Radial symmetry

Radial symmetry is a body plan arranged or repeated around a central axis. The advantage of radial symmetry is that an animal can encounter its environment from all directions. Echinoderms have pentamerous (radial) symmetry, a body plan consisting of five distinct body parts. This is obvious on the sea stars, as most have five legs. However, the sea cucumbers, brittle stars, sea urchins, and sand dollars also have this five-part body plan.

Water vascular system

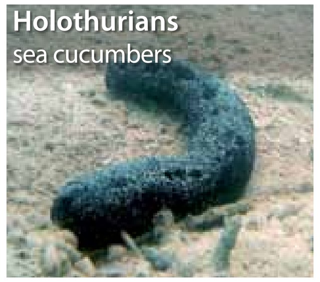
Echinoderms, for the most part, lack blood. Instead, gases and nutrients are exchanged and distributed throughout the body by water. This system is known as a hydro-vascular system. The hydro-vascular system also controls the movement of the tube feet by hydraulic pressure.

Types of echinoderms

Echinoids
sea urchins

Asteroids
sea stars

Crinoids
feather stars



Holothurians
sea cucumbers

Ophiuroids
brittle stars

Cnidarians

Cnidarians represent one of the simplest multi-cellular organisms in the oceans. Most are either sessile (stationary) or planktonic (animals that float and drift). They include jellyfish, corals and hydrozoans.

Rings of tentacles

The mouth of a cnidarian is surrounded by at least one or more rings of tentacles. The tentacles are used not only for feeding, but also for protection.

Body cavity with one opening

The body cavity of a cnidarian has only one opening. Anything that goes into and out of a cnidarian is done through the same opening.

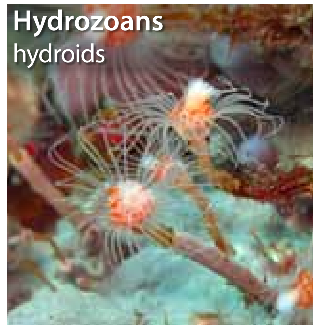
Nematocysts

Nematocysts are the stinging cells of cnidarians, used for both feeding and defence. The nematocysts are located on the surface and in the tentacles. The nematocyst is made up of a capsule containing a trigger and a coiled hollow thread with barbs, similar to a harpoon. When stimulated, either by prey or predator, the nematocyst is triggered and the coiled hollow thread is discharged, similar to the firing of a harpoon. A toxin is then sent via the hollow thread to kill or stun the prey. Once captured, the prey is then drawn in the mouth and digested.

Some are colonial

Many cnidarians live together in colonies, like corals. A colony is a group of polyps living together in a common structure. Different species construct their colonies in different ways. For example, gorgonians construct their colonies with a protein called gorgonin. The more common corals construct their colonies with calcium obtained from water.

Types of cnidarians



Hydrozoans
hydroids

© Richard Ling

Scyphozoans
jellyfish

Anthozoans
corals and anemones

Example cnidarian

English name: Bluebottle (Portugese Man O' War)

Scientific name: *Physalia physalis*

Description: The bluebottle has an air bladder that allows it to float on the surface of the ocean and is pushed by the winds and the current. Below the surface they have long tentacles (~1 m), which they use to sting and kill small fish. These tentacles can also sting humans.

Habitat: They float on the surface of the ocean and can be seen washed up onto beaches after strong winds.

Bluebottle

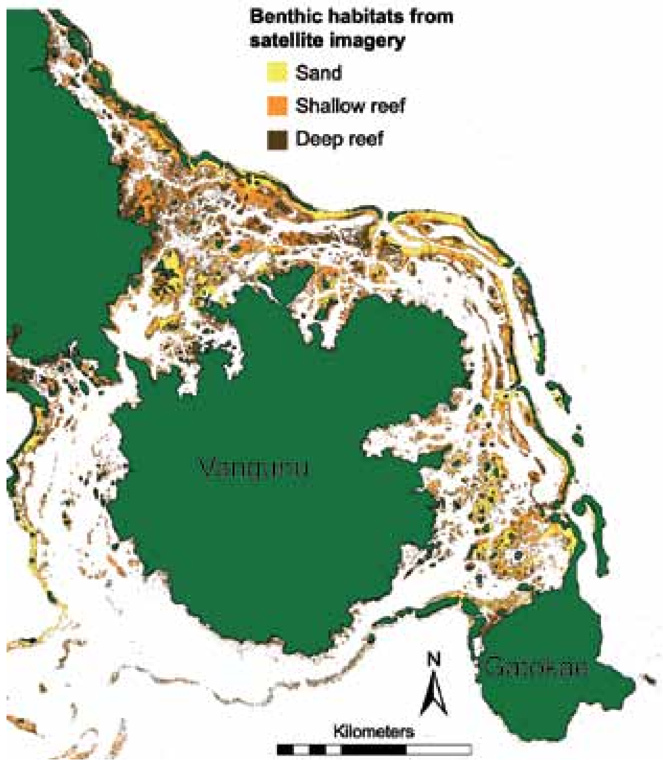
Corals

Corals (a type of cnidarian) are an unusual partnership between a microscopic plant (zooxanthella) and an animal (coral polyp). The zooxanthella provides food (carbon) to the polyp through photosynthesis and the polyp provides essential nutrients to the zooxanthella through filter feeding. This relationship between the zooxanthella and polyp is called symbiosis. Most corals that you see on the reef are made up of millions of zooxanthella and thousands of polyps. As the corals grow they produce a calcium carbonate skeleton. This hard rock-like skeleton enables them to withstand large waves and currents. After large corals die they leave behind these calcium carbonate skeletons, which then form the rock like structure known as a "coral reef". Many of the smaller islands and barrier islands in the Solomons are formed on old coral reefs. The complex structures that corals form on the reef provide critical habitat for fish. Without corals, fish would have nowhere to hide, lay eggs and feed so corals are needed to maintain healthy fish stocks on reefs. i.e. no coral = no reef fish.

Corals come in many different forms. There are over 500 coral species in the Solomons, which is 85% of all known species worldwide. These 500 species can be divided into four major groups: massive corals, branching corals, plate corals and soft corals. Different corals have different physical needs and biological properties, hence they live in different areas.

Where are they found?

Corals are found around most islands in the Solomons and on offshore reefs. This map shows where they are found in Marovo.



Reef distribution based on ground truthing and satellite imagery classification. Courtesy of Chris Roelfsema, The University of Queensland.

The map shows where the coral reefs occur in Marovo Lagoon in the Western Province. The orange colour indicates shallow reefs in less than 3 m of water, while the brown colour shows reefs that are in more than 3 m of water. The yellow colour represents mainly sand with some small patches of coral. The white area is deeper parts of Marovo that may also contain coral reefs but were not included in the survey. All together there are over 130 km^2 of coral reefs in Marovo Lagoon. This large area of healthy coral is what makes Marovo Lagoon such a productive fishery.

Types of corals

Massive corals

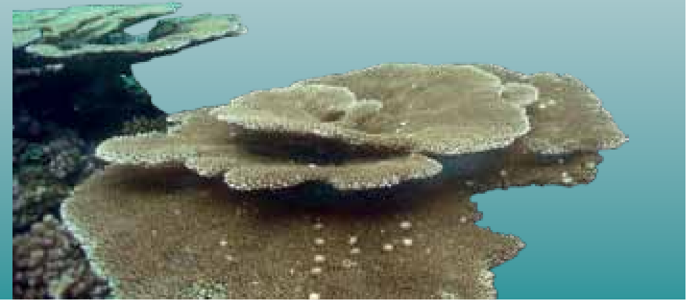
→ *Large rock-like corals*
→ *Can live for over 500 years*

Massive corals are large rounded corals that grow very slowly (1-2 cm per year). They are generally more resistant to fresh water and sediment so are often found closer to river mouths or areas where the water is dirtier. Massive corals are often 50-100 cm high, but can grow to over 8 m in height. These large massive corals provide important habitat for large fish and crayfish.

Plate corals

Plate corals are closely related to branching corals. They also have numerous small branches but they form into flat "plate-like" colonies. These plate corals are often found on the steep walls of the outer reefs, but can also occur within the lagoon. Plate corals are also very fragile with large waves sometimes breaking the entire colony off at its base. Plate corals are typically 50-100 cm in diameter and only 5-10 cm high.

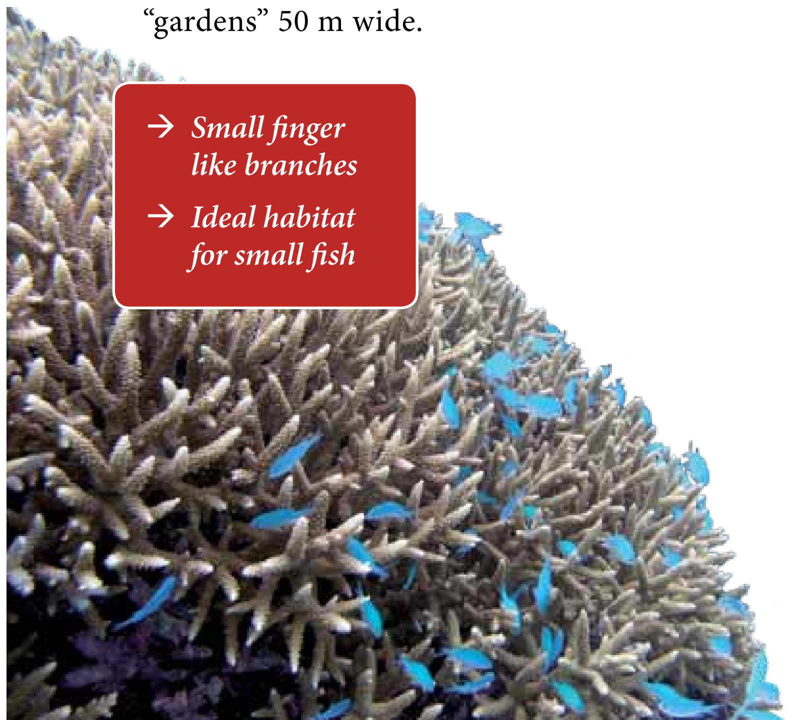
→ *Flat corals that break easily*
→ *Often found on outer reefs*



Branching corals

Branching corals are relatively fast growing (10 cm per year) but are relatively fragile. Branching corals are easily broken by boat anchors or reef walking. The countless small spaces between the branches of these corals make them ideal habitat for small and juvenile fish to hide from predators. Branching corals normally only grow to 50 cm high, although they can join together to form large coral "gardens" 50 m wide.

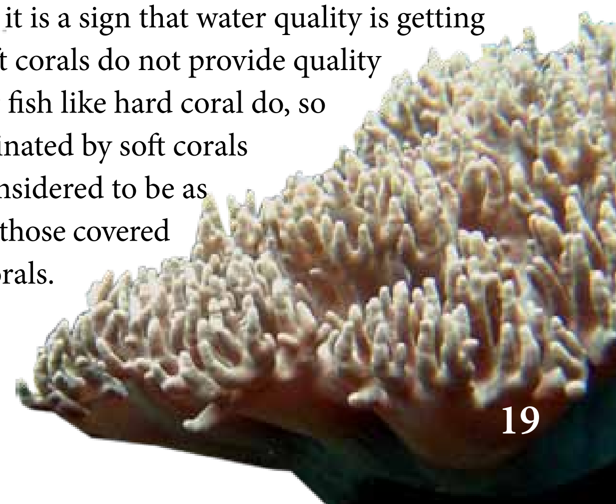
→ *Small finger like branches*
→ *Ideal habitat for small fish*



Soft corals

Soft corals are different from the other corals as most do not secrete a hard calcium carbonate skeleton and often lack symbiotic zooxanthellae. Instead they get most of their food from filtering the water with their polyps. As they do not have a skeleton, soft corals do not normally grow on reefs exposed to waves and strong currents. Most soft corals do not rely on the sun for photosynthesis so they are able to grow in deeper and dirtier waters where they can feed on sediments and nutrients in the water. When reefs become dominated by soft corals it is a sign that water quality is getting worse. Soft corals do not provide quality habitat for fish like hard coral do, so reefs dominated by soft corals are not considered to be as healthy as those covered by hard corals.

→ *Fast growing*
→ *Live in dirty water*



Issues and threats

Bleaching

Corals can "bleach" or turn white from being stressed. Generally this stress comes from very high water temperatures and strong sunlight. During coral bleaching the dinoflagellates (microscopic plants) are expelled from the coral colony leaving only the fluorescent coloured coral polyps. Sometimes new dinoflagellates can colonise the corals and the coral can survive, but generally the polyps die as well leaving a dead coral skeleton, white in colour. Worldwide, coral bleaching has been increasing due to global warming and it is suggested it may cause the death of entire coral reefs in some regions. In the Solomons, coral bleaching occurs every few years in some small areas but does not appear to be a major threat to the Solomon's corals.

- → *High water temperatures turn corals white*
- → *Many corals die after being bleached*

Sedimentation

Corals are very sensitive to changes in water quality from sedimentation. Most corals require sunlight to photosynthesise and grow so live in clear waters. When sediments from rivers flow onto the reef after rain, the sediment prevents sunlight reaching corals. Whilst corals can live in dirty water for short periods, if the sedimentation increases and occurs too frequently the corals will die from lack of light. Also sediment can block the polyps, depriving them of oxygen and food. Corals can clean themselves to a degree. but too much will kill them. Often soft corals (which require less sunlight) will grow to replace them. Sediments and mud can also settle out of the water and smother corals directly. This has occurred at the mouths of some rivers on larger islands where logging has released sediments and buried the corals. Reefs which are covered with mud are not able to recover, as baby corals cannot settle and grow on a muddy surface. They need a hard rock-like surface to settle on and grow.

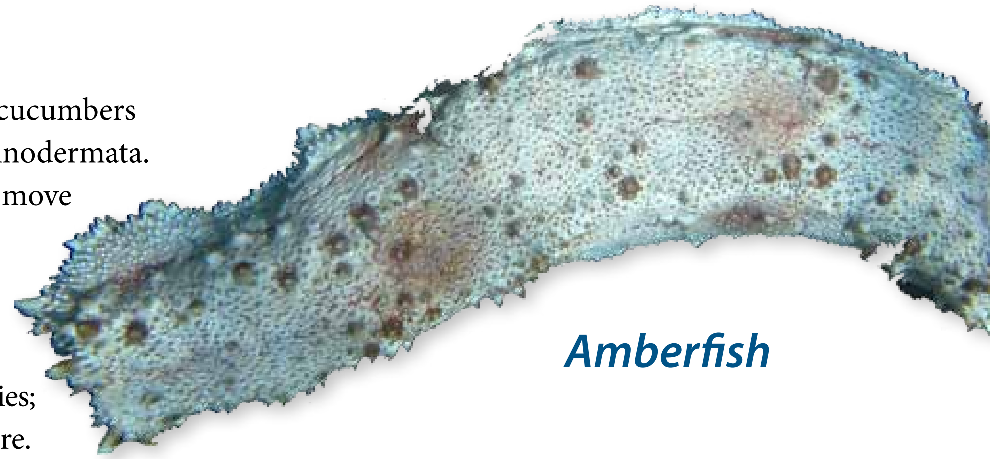
- → *Dirty water makes some corals sick*
- → *Can kill corals*

How you can help

- → *When fishing or walking on the reef, it is important not to walk on or break live corals. 20 years of coral growth can be destroyed with one footstep.*
- → *Reducing sediment and nutrient run-off from logging operations will help the Solomon Islands' corals stay healthy.*
- → *Educate family and friends about the important role corals have in the marine ecosystem. If corals die there will be less fish!*

Bêche-de-mer

Bêche-de-mer, Holothurians or sea cucumbers are invertebrates of the phylum Echinodermata. These animals have soft bodies, and move slowly by moving their tube feet up and down.



Amberfish

Bêche-de-mer are able to take up water to expand or contract their bodies; which makes them difficult to measure. They can be found living from temperate climates to tropical coral reef habitats. In reef habitats, bêche-de-mer inhabit reef slopes, inner lagoons, inner reef flats, outer lagoons, and coastal bays. Bêche-de-mer are deposit feeders, using their oral tube feet to graze and ingest organic matter, detritus, meiofauna, and microalgae that are on or in the marine sediment.

Bêche-de-mer reproduce asexually by splitting into two, or sexually by spawning. Sexual reproduction occurs during mass spawning events where the bêche-de-mer come together in groups and stand up and release their gametes into the water where they mix. The success of these mass spawning in the formation of new bêche-de-mer decreases when bêche-de-mer densities are reduced by overfishing. Bêche-de-mer larvae have a short plankton larval life, and take three days to metamorphose into juveniles. They are slow growing into adults. Some species, such as Holothuria scabra reach adult size in four months.

Tigerfish

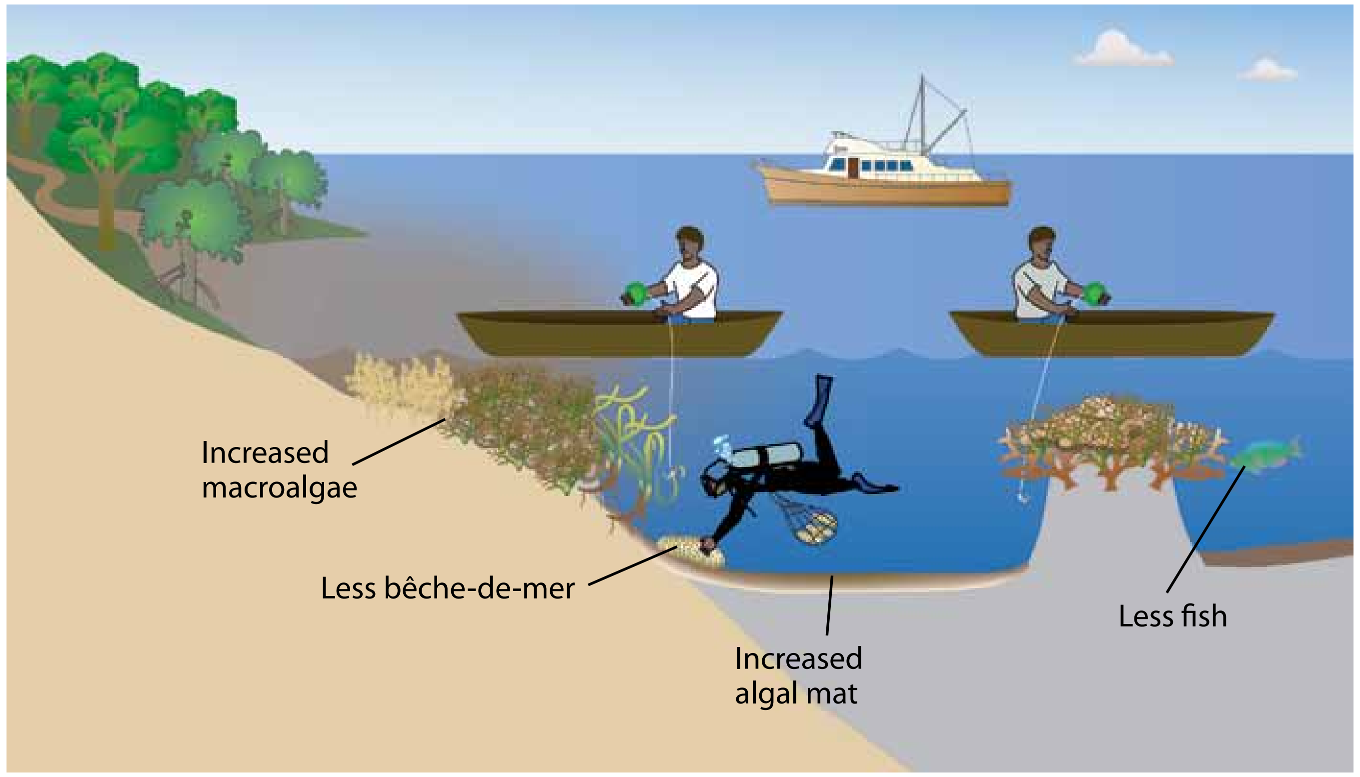
Issues and threats

Over harvesting

Currently, in Solomon Islands, the bêche-de-mer are over-harvested for the bêche-de-mer market. When the bêche-de-mer are over-harvested it lowers the entire bêche-de-mer population and reduces their chance of successful reproduction. When the bêche-de-mer population is decreased the ecosystem in which they live is harmed. The bêche-de-mer feed on algae, dead organic matter and meiofauna. Their feeding and moving behaviours on the sediment keep the nutrients in the sediment balanced. Thus if there are too few bêche-de-mer, there will be a build up of nutrients and cyanobacteria (algae) on the sediment, which will lead to more algae growth on the reefs. There are plenty of areas in the Solomons where the bêche-de-mer have been over-harvested and the sediment is covered in slimy algae.


Bêche-de-mer drying

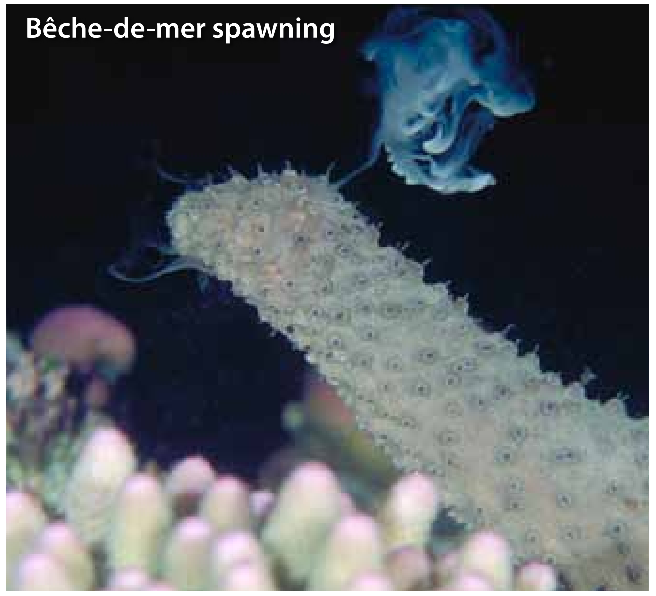

Cyanobacteria on sand



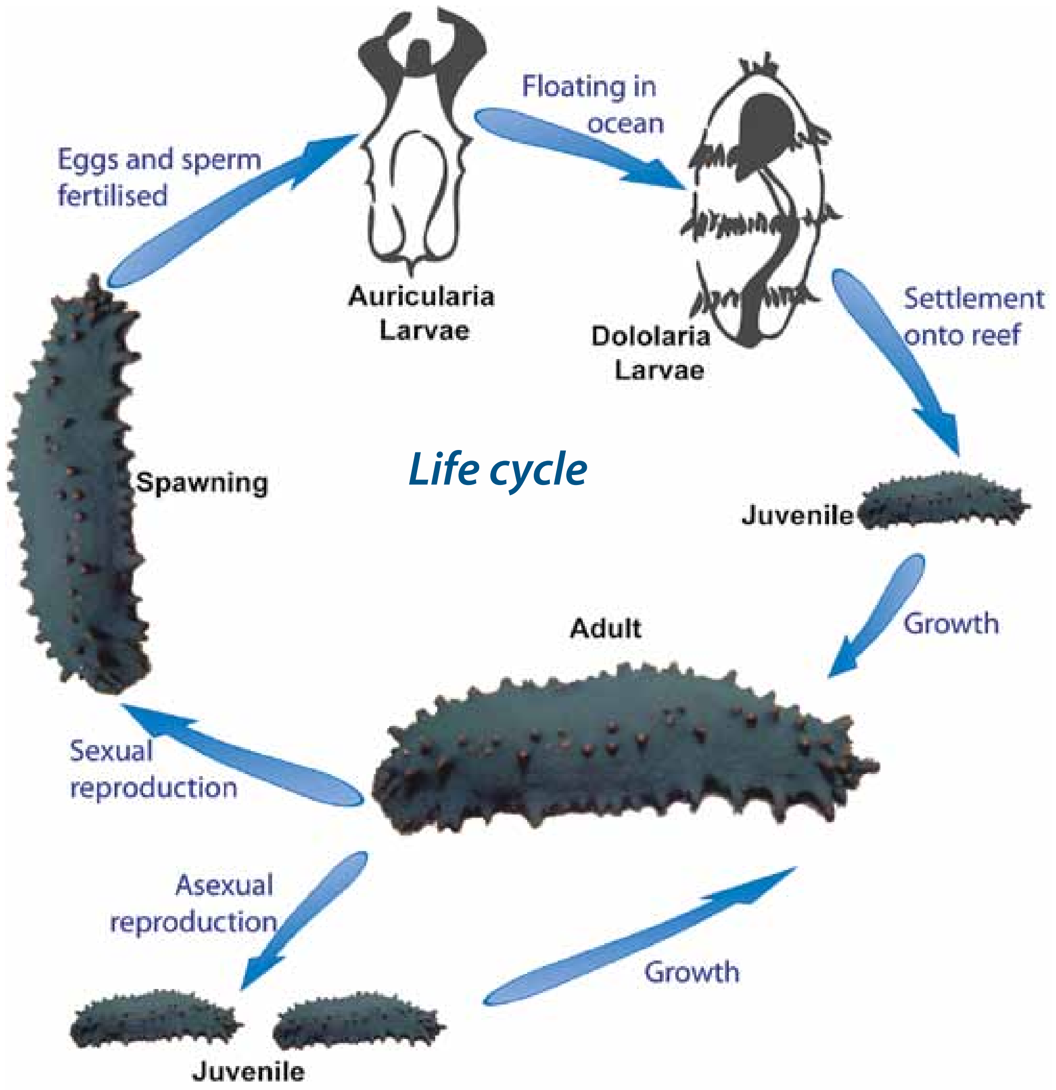
Impacts of over harvesting

How you can help

Recently, the Solomon Island Government has started managing the bêche-de-mer fishery. They have banned export for a short time to allow the population of bêche-de-mer to build up. It is important these restrictions are followed so that in the future Solomon people will be able to harvest bêche-de-mer. Also, by not collecting bêche-de-mer on the full or new moon when they are spawning will help make sure they can reproduce. By taking away the adults during spawning you are lowering the chances of successful spawning, and decreasing the number of baby bêche-de-mer growing into adults.


Bêche-de-mer spawning

→ *This concept of restricting harvest to provide a better harvest in the future is called maximum sustainable yield. See page 48 for details.*



Crown of thorns starfish

Introduction

Crown of Thorns are a type of starfish which feed on corals. Crown of Thorns can grow up to 1 metre across and have between 12 and 21 arms. Crown of Thorns (COT) have many large spines which are venomous if touched. Do not touch the Crown of Thorns starfish when removing them from the reef. Use a spear or knife to move them onto dry land. The only natural predators of Crown of Thorns starfish are the Triton Trumpet shell and large Maori wrasse. It may be that overhavesting of these trumpet shells and wrasse has led to the increase in Crown of Thorns in the Solomons.

Did you know?

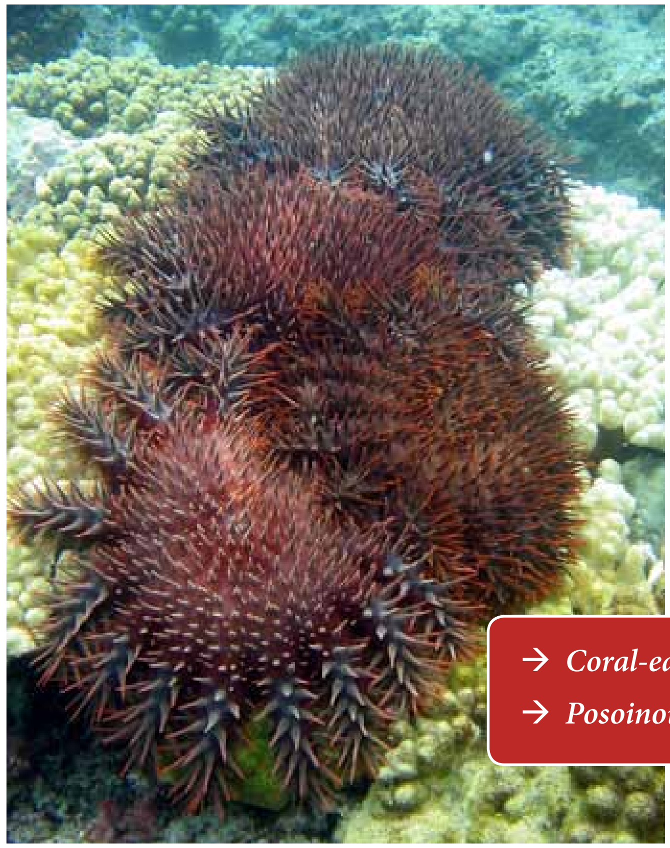
→ *One Crown of Thorns starfish can eat six square metres of coral in a year*

Coral eating

They often hide under corals or rocks during the day and come out to feed at night. Crown of Thorns prefer to feed on branching and plate corals but can also feed on massive corals. They feed by laying over the corals and ingesting the polyps, leaving patches of dead coral skeleton.

Are they natural?

In low numbers, Crown of Thorns are a natural part of coral reefs. In some areas of the Solomons Crown of Thorns are present in unnaturally high densities and are capable of eating large quantities of corals leaving the reefs dead. In Australia it is thought that increases in Crown of Thorns number are related to declining water quality.



→ *Coral-eating starfish*
→ *Posoinous spines*

Reproduction

One Crown Of Thorns (COT) can release up to 60 million eggs per year, these eggs mix with sperm in the water and are fertilised. After these are fertilised, they drift as larvae for 2-4 weeks. Most of these larvae do not survive; the ones that do settle onto the reef and start to grow. After 2 years a baby COT can breed. This high reproductive rate can lead to rapid increases in COT populations.

Regeneration

Like most starfish, if one or more arms is cut off a COT they are able to regrow that arm. So cutting COT up with a knife is not a good method of removal as they can quickly regrow, even multiply.

Toxic

Crown of Thorns Starfish (COT) are covered in spines that can inject poison into humans or fish that come in contact with them. The pain caused by COT is extreme and can last for a few days. Be careful when diving around COT and do not try and pick them up with your hand.

How you can help

→ *In areas where Crown of Thorns are in high density (more than 1 or 2 per km^2) and damaging the reef it is a very good idea to remove them. The most efficient method to remove Crown of Thorns is to collect them with a spear and bury them on land. Because COT are toxic if touched it is best to use a spear to collect them and place into a canoe. When the canoe is filled it can be paddled to shore for burial of the COT.*

Fish

Why are fish important?

Fish are important food for people around the world. They are harvested from the world oceans by a wide range of clever methods for use by families or for sale to earn money for things we need, like kerosene and school fees. The fishes of the Solomons are very special as there are many more different types here than in other parts of the planet. Some types of fish are not caught for food but contribute to the health of the ecosystem, and are valuable because they contribute to global diversity and can attract visitors who will pay money to see them. Other fishes are used as food by local people and some of these also have very important roles on the reef.

Fishes that eat algae are called grazers, and are very important for keeping corals healthy. If we eat too many of these fishes (like parrotfish) then the reef can get sick because algae grow too tall and block light from the corals, which the corals need to live. If corals die then fewer and different fish will live in on Solomon reefs.

Fish also do other important jobs around the reef. Fish that eat other fish and those that eat shells or other animals are called carnivores. They can be important to control the things that might do damage to the reef if there are too many. For example, trigger fish are important predators on the reef and keep the number of sea urchins under control. Also fish like coral trout keep the numbers of little fishes under control. So, you can see that the fishes that provide us food and money have important jobs to do to keep our reef healthy. If we harvest too many fish then the reef can suffer and the number and kinds of fish will decrease. This can upset the balance of the reef and make it unhealthy.

Tourist on the Great Barrier Reef, Australia

Important reef fish

Coral trout

Coral trout change sex from female to male as they grow. The big males need lots of females to make enough eggs. They eat smaller fish so help keep the reef healthy by removing sick and weak fish.

Illustration © R. Swainston

Parrotfish

Parrotfish are very important in reefs all over the world. Their tough parrot-like beaks bite very small algae (and some eat corals) keeping corals healthy. These fish change sex from female to male. Again the big males need lots of females so enough eggs are produced. If we harvest the big males then the bigger females change sex to become males. Then only very small females (who cant make many eggs) will be left. This can be very bad for the reef as not enough young survive the planktonic phase to come back to the reef and harvest the algae.

Surgeon fish

Surgeonfish stay the same sex throughout their life. They eat algae so are important in helping corals keep healthy. But they do taste nice!

How can you help?

Caring for our fish populations is not like caring for pigs or looking after a garden where we can grow baby pigs born to mother sows, baby chickens hatched from the eggs produced by our chickens, or cassava grown from cuttings we have made.

To have healthy supplies of fish we have to know about how they breed, if they change sex as they grow and what habitats their young need in order to come back to the reef (e.g. some need mangroves and others need seagrasses, not just corals). If we know these things then we can set limits on the size of fish we catch and the number of fish we catch to make sure that there are enough fish to give us food, keep the reef healthy and available for sale to pay for family and community costs in the future.

It is important to find ways of keeping some big fish in your area. You might have a meeting to agree on some areas that will not be fished, to regulate some kinds of fishing (e.g. night spearfishing) or sizes of fish that can be taken. You might also stop or set limits on catching some fish when you know they are spawning. Generally with fish the natural mortality rates are much greater in small ones than big ones. If we catch the big ones we will make the average size of the fish smaller and may reduce the supply of young ones to the population. Just as we care for elders in the village community so we should try to safeguard larger fishes (but think about sex change). You can also help by talking with the scientists to help them understand your reef, fish spawning aggregations, and any changes you have noticed in the fishes. If we work together we can keep the resources of the Solomons healthy for our children and their children.

Turtles

Introduction

There are seven species of marine turtle in the world. Of these five occur in the Solomons. The Solomon region is a globally important nesting area for turtles. Some come from the Great Barrier Reef in Australia to nest here.

Turtle diet

Turtles have a wide variety of diets

- ***Green turtles*** are herbivores and eat algae and seagrass.
- ***Leatherback turtles*** are carnivores and eat mainly jelly fish.
- ***Loggerhead turtles*** are carnivores and eat shellfish and crustaceans.
- ***Hawksbill turtles*** are omnivores and eat a mixture of sponges, soft coral and algae.
- ***Ridley turtles*** are omnivorous, eating crabs, shrimp, jellyfish and sometimes algae.

Hawksbill turtle

Reproduction

Mating occurs in the waters close to nesting areas. Several weeks after mating females come to shore to nest. Nesting beaches are carefully selected to ensure eggs will be at the correct temperature, above the high tide mark and free from predators. Each female lays a hundred eggs or more and buries them with sand. After two months the baby turtles hatch and head out to sea. As there is no parental care of young the majority of these baby turtles are eaten by monitor lizards, dogs, sharks, fish and birds.

Sand temperature

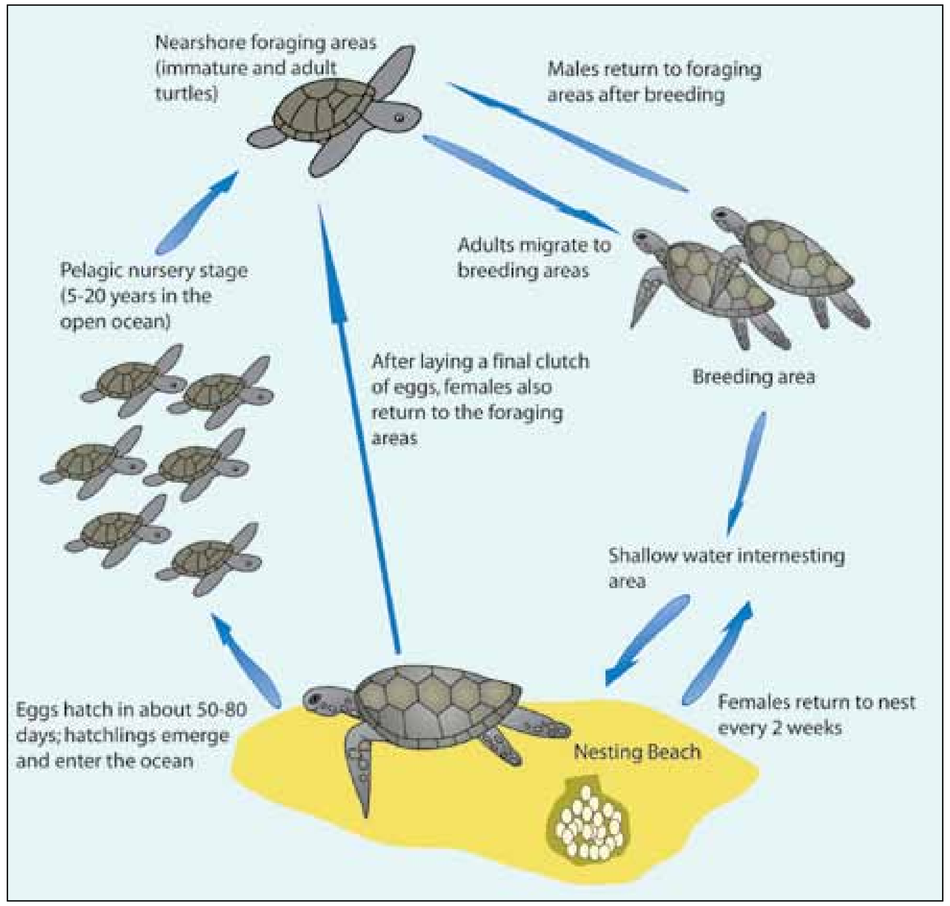
Having the correct sand temperature while turtle eggs are incubating is very important as it determines the sex of the hatchlings. A sand temperature of around 28 °C is considered the best for most species and results in even numbers of females and males. Warmer sand causes more hatchlings to be females. Cooler sand causes more hatchlings to be males. Leatherback turtles prefer to lay eggs on black sand beaches as the black sand stays warm.

Anthony Plummer (www.anthonyplummer.com)

Global traveller

Most species of turtles travel thousands of kilometres between nesting and feeding areas. For example, turtles that nest in the Solomons may travel to Australia and PNG to feed on seagrass and algae. The global nature of these unique animals makes management challenging. Hunting of turtles in other countries can reduce turtle populations in the Solomons. Turtles often return to nest on the same beach they were born on. So the nesting beaches around the Solomons are very important to keep turtle populations healthy in the Asia-Pacific region.

Life cycle



Management

Some species of turtles are more vulnerable to harvesting than others. Leatherback turtles are endangered worldwide from longline and net fishing. The Marovo and Tetepare region is one of the few remaining areas where Leatherback turtles can nest safely. The Marovo and Tetepare people have made a commitment to protect these special animals by banning harvesting. Other turtle species such as Green turtles are in higher numbers and some sustainable harvesting is okay. Some communities stop turtle harvesting for a year or two and then re-open it for a short period of time.

Anthony Plummer (www.anthonyplummer.com)

Leatherback turtle on Tetepare

Sharks

Introduction

There are many species of sharks in the Solomons, ranging from small timid lemon sharks to large tiger sharks. Sharks are found across all marine ecosystems, with smaller white and black tip reef sharks the most common inside lagoons and on reefs. Smaller juvenile tiger and hammerhead sharks can also be found on inshore reefs and lagoons, but adults are typically in the open ocean. The highest density of sharks occurs in passages and on offshore islands where there is plentiful food. Grey reef sharks dominate these areas. Further out to sea larger sharks such as silky, silvertip, hammerhead and tiger sharks hunt pelagic fish such as tuna.

Importance

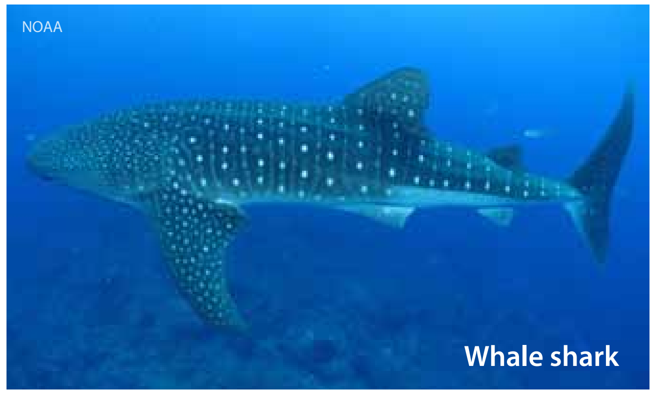
Sharks are the top predator of coral reef ecosystems. Sharks are important to maintain a diverse and productive coral reef ecosystem Without sharks, other fish populations would become unbalanced with a few species dominating. This vital role sharks play in marine ecosystems is often not recognised by marine management groups. Because of the perceived threat to humans, some sharks have been hunted to almost extinction. It is important that the last remaining sharks of the worlds oceans are protected to ensure they continue to maintain productive and diverse marine ecosystems for future generations.

Shark finning

Shark populations worldwide have decreased by 90% due to commercial fishing. Each year 10 million sharks die from shark finning, netting and longlining. Shark finning is the process of killing sharks and removing their fins for sale. The body of the shark is normally dumped at sea and wasted. Fins are then exported to Asia for shark fin soup. Recently the catching of sharks for fins has increased in the Solomons. Many countries have banned shark finning because of its negative impact on marine ecosystems and other commercial fisheries.

Feeding ecology

Different species of sharks have different food and hunting habits. Whitetip reef sharks feed on small fish and squids. These smaller sharks often feed in shallow reef environments that larger sharks cannot access. Larger sharks such as the grey reef shark generally hunt fish in the open ocean and offshore islands. Tiger sharks generally feed at night and have a wide variety of food including: crustaceans, fish, sharks, rays, turtles and mammals. The Whale shark is the largest of all shark species and it feeds on tiny animals and plants in the water such as plankton and crustaceans. The whale shark does not hunt, but instead it just swims slowly filtering huge volumes of water in a similar way to a whale.



Whale shark

Shark reproduction

Sharks reproduce by either live birth or egg laying.

Live bearers

70% of sharks give birth to live young in a similar way to mammals. After a 6-24 month gestation the young sharks are born. Baby sharks do not receive any post-birth care from mothers.

Egg layers

About 30% of shark species lay eggs. These eggs are strong and resistant to predators. Eggs are attached to the reef and when they hatch the baby sharks do not receive any care from mothers.

Did you know?

- *Sharks are fish*
- *Sharks do not have bones*
- *Many sharks must keep moving to allow water to flow over their gills and deliver oxygen*

Are sharks fish?

Yes, sharks are fish but three things make them very different from most fish.

- Sharks can give birth to live young
- Sharks have gill slits that water flows over as they swim (most fish use muscles to pump the water over their gills).
- Sharks do not have bones, instead their skeleton is made of soft cartilage

Save Our Seas Foundation | Peter Verhoog

Finding food

Sharks have an amazing six senses to find their prey: Smell, Sight, Electrical Pulses, Taste, Hearing and Pressure.

Smell: Sharks use smell to find and follow trails of blood in the water that indicate a wounded animal.

Sight: Sharks have very well developed eyes which are able to detect and follow prey in dark and dirty water.

Electrical Pulses: The most unique sense a shark uses is its electro-sensory system. The point of a sharks head contains hundreds of small sensors called ampullae of Lorenzini which are able to detect the weak electrical pulses given off by other animals. Injured animals give off erratic pulses and attract sharks. Once sharks get close to prey they rely primarily on these electrical pulses.

Taste: Sharks have taste receptors in their mouth that they use to identify prey when they take the first bite.

Hearing: Sharks do have ears that are found inside the head. It is not known if they use hearing for finding prey. But like humans, sharks use their ears to maintain balance and orientation.

Pressure: Sharks have a very special set of pressure receptors on their lateral line. These receptors are able to detect changes in water pressure caused by the swimming of other fish. The pattern of this pressure change will indicate if the fish is injured.

Critical issues

The marine environment of Solomon Islands is considered one of the most diverse, intact and productive worldwide. The following chapters explain some of the important reasons for this and some critical issues that will be important in the future to maintain the healthy marine environment that Solomon communities depend on.

Reproduction of fish and corals 36

Fish and corals have many different ways to reproduce, with some species even changing sex as they mature. Some fish spend their life cycle in one habitat (like a coral reef) while others move between reefs, seagrass, mangroves and ocean as they mature. Understanding the way fish and corals reproduce and move between habitats is essential to successfully manage their harvests and keep populations productive.

Water quality and movement 38

All animals and plants that live in the marine environment are sensitive to changes in the quality of the water. As temperature, salinity, sediment and oxygen levels change it can cause some species of animals and plants to be stressed or die. Water quality can be impacted by pollution of the marine environment or changes to land-use like logging that causes sediments to flow into rivers and out to sea. The way that the marine water moves with currents and tide can help bring clean open ocean water into coastal areas and reduce impacts of pollution and sedimentation.

Climate change 44

The earth's climate is closely linked to the marine environment, as one changes so does the other. Recently, human activities have caused rapid changes in the climate and the Solomons is starting to experience changes in sea level, rainfall and temperature. These changes in the climate will impact the marine environment and may affect the corals and fish that are important for subsistence livelihoods.

Marine resource management 56

The marine resources of the Solomons provide essential food, income, firewood, recreation, medicine, tourism and many other services. As populations grow and commercial pressures increase, marine resources are becoming threatened by human activities and harvesting. To face these new challenges many communities are implementing community based marine resource management to control their usage and ensure resources remain for future generations.

Reproduction of fish and corals

Fish spawning

Most young reef fish are produced in very large numbers by large adults releasing eggs and sperm (spawning). Nearly all of the reef fishes have a stage in their life where the young larvae move up into the water column and feed on plankton until they are large enough to settle on the reef. Even though very large numbers of eggs are fertilised when fish spawn, very, very few survive to return to the reef. Because of this we need to make sure that there are enough adult fish to make enough young. Some will eventually come back to the reef to grow and provide us with food and in turn the next generation of young so that our fisheries are maintained.
It also means that we have to be careful if we target particular species during their spawning aggregation (e.g. coral trout). If we take too many then not enough young will return to the reef. Indeed, larval fish can be moved a long way by currents so fish that live on your reef may have come from adults spawning on the next island or even another province.

→ *Some fish form groups when spawning*

→ *Important to not over-harvest spawning fish*

Coral reproduction

Corals use both sexual and asexual reproduction methods.

Asexual methods are:

Budding—As corals grow each small section is capable of "budding" where they divide and create a new polyp.

Fragmentation—When a section of coral is broken by a storm it can start to regrow in a new part of the reef.

Sexual methods are:

Brooding—Egg and sperm are fertilised internally and larvae are released into water.

Broadcast Spawning—Egg and sperm are released into the water and fertilise in the water. To increase chances of egg and sperm joining in the water, broadcast spawners release their eggs and sperm at the same time. This often occurs at night a few days after full moon in October-December. After eggs are fertilised by sperm the coral larvae can drift in the ocean for over a month before finding a suitable reef to settle on and grow. Coral larvae have specific requirements for successful settlement and growth. If too much turf algae is present on the reef, corals cannot settle and grow.

Connectivity

Most marine organisms utilise tidal and ocean currents to send larvae long distances to other reefs. For example coral trout spawn in the passages of Marovo Lagoon around full moon from January - March. This is the time when tidal currents are highest and coral trout larvae will drift out to sea on these currents and perhaps arrive at reefs in Roviana or Isabel.

Likewise coral trout spawning in Roviana may result in baby coral trout arriving on reefs in Marovo. This connectivity between reefs across the Solomon region is important to maintain the high biodiversity and productivity of the region. It is important to understand connectivity between ecosystems when designing management plans. What occurs in one area can impact on a nearby reef. For example, giant trevally caught on an offshore island may have spent part of their life living in the mangroves of the river on the mainland, so cutting of mangroves in rivers can reduce the fish catch on reefs. This concept of connectivity also occurs over global scales. Corals spawning in Papua New Guinea can drift across to Solomon reefs and grow.

Sex changing fish

Reef fish are also very unusual in that many change sex as they grow. For example, many small parrotfish are female when small and only change to males when they get bigger. In other species (eg anemone fishes) the younger ones are males and change to females when they get bigger. This change is partly caused by the fish of the dominant sex stopping the other fish of its species in the area changing sex. If that bigger fish is harvested then the next strongest fish changes sex and takes over the area. If we take all the large fish in a species then this can mean that sex change occurs earlier and earlier in development. This leads to fish being smaller and producing fewer eggs. Fewer eggs mean that survival of the species is threatened. Looking after fish is a very complex business! We have to think carefully about how we care for them.

Water quality

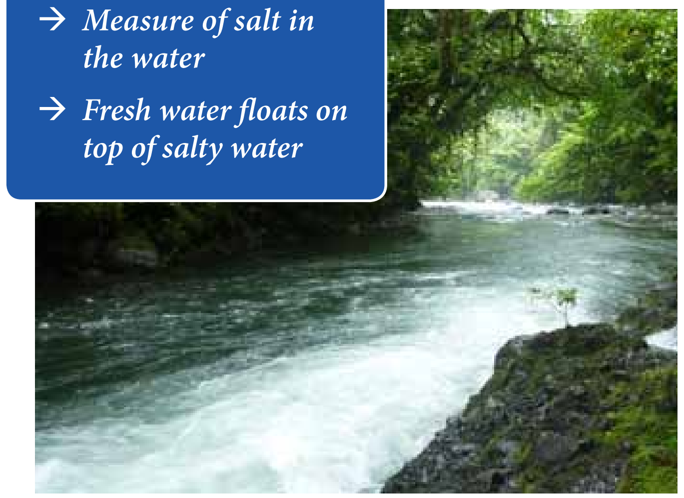
The quality of the seawater determines what can survive and how fast things will grow. Fish, corals, seagrass, algae, bêche-de-mer, turtles and all other living things in the ocean require a certain water quality to survive. If the water becomes too dirty some things will die, while others may need dirty water to grow. Water Quality is a general term that refers to a range of physical, chemical and biological properties of water. These properties include: temperature, dissolved oxygen, salinity, chlorophyll, nutrients, chemicals and sediments.

Water quality properties

Salinity

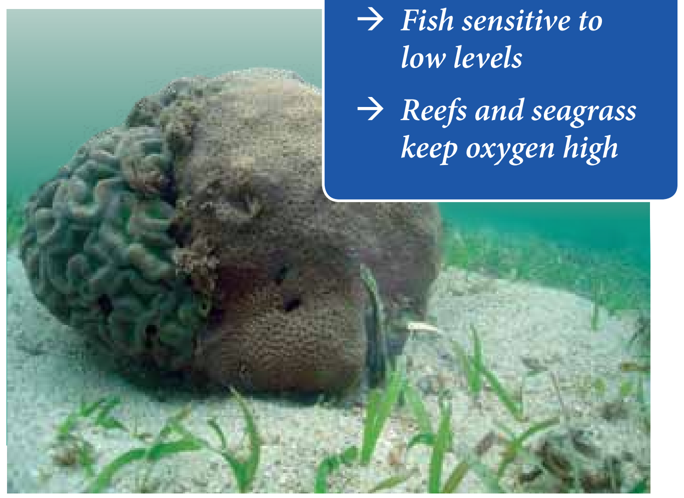
The quality of the seawater determines what can survive and how fast things will grow. Fish, corals, seagrass, algae, bêche-de-mer, turtles and all other living things in the ocean require a certain water quality to survive. If the water becomes too dirty some things will die, while others may need dirty water to grow. Water Quality is a general term that refers to a range of physical, chemical and biological properties of water. These properties include: temperature, dissolved oxygen, salinity, chlorophyll, nutrients, chemicals and sediments.

- → *Measure of salt in the water*
- → *Fresh water floats on top of salty water*



Dissolved oxygen

All animals and plants in Marovo Lagoon require oxygen dissolved in the water to survive. Fish in particular are very sensitive to reductions in oxygen in the water. If it gets too low they die and float to the surface. Corals, seagrass and algae all produce oxygen through photosynthesis so they help maintain dissolved oxygen levels in seawater. Waves and currents also help circulate the water and keep dissolved oxygen levels high. Because of the large areas of healthy coral, seagrass and algae in most areas of the Solomons the dissolved oxygen levels are very high and the fish are healthy.

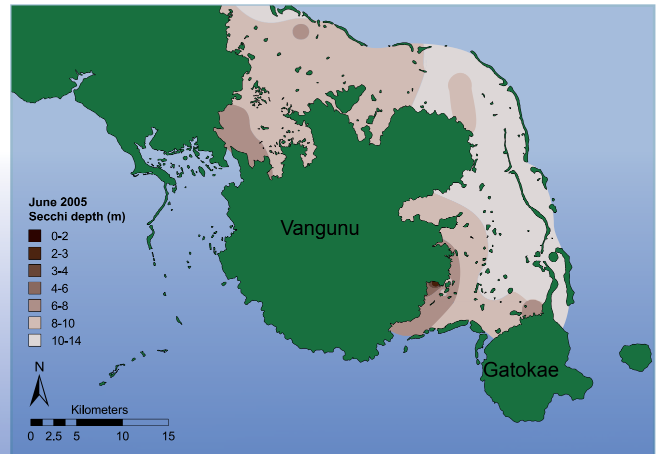


- → *Fish sensitive to low levels*
- → *Reefs and seagrass keep oxygen high*

Sediments

Sediment is a term used for fine particles of soil, sand or mud which can be eroded from the land and transported into rivers and out to sea. When these sediments become suspended in the water they block the sunlight that is critical for the survival of seagrass, corals and algae. These brown or orange plumes of sediment can often be seen at creek mouths entering the ocean following heavy rain. Sediment concentrations in waters around many large islands have increased in recent years due to logging operations in the catchment. As sediment concentrations in the water increase some sensitive marine organisms like corals can die.

Example from Marovo



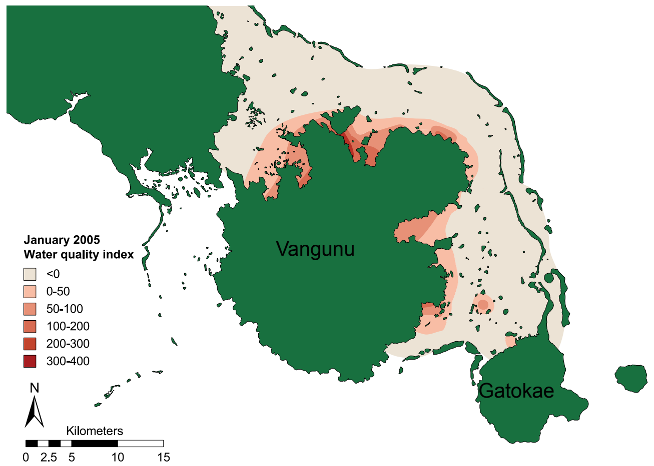
Map showing how clear the water was in Marovo Lagoon in June 2005. The dark colours are high levels of sediments or dirty water.

- → *Block sunlight killing corals*
- → *Heavy rains cause plumes*

Nutrients

Nutrients are chemicals that plants and animals require to survive and grow. Humans get nutrients from the food they eat. For corals, seagrass and algae the most important nutrients are Nitrogen and Phosphorus. These are generally present in low concentrations in seawater and corals have developed ways to survive in these low nutrient waters. Growth of algae is limited in these low nutrient waters, hence corals often dominate the reefs of the Solomons. When nutrients are increased it can upset this sensitive balance between coral and algae on coral reefs and result in algae dominated reefs with only some soft corals surviving. This has occurred in some reefs in Australia, Fiji and the Caribbean. In most areas of the Solomons nutrients are generally still low and hence corals are dominating, but in some areas near villages and creeks there are elevated nutrient concentrations. Nutrients can be increased by human sewage, soaps and run-off from logging.

The highest nutrient level in Marovo Lagoon occurs in the waters close to Vangunu. The high density of villages and logging operations in this area contributes to the elevated levels of nutrients. These nutrients decline quickly 1 km away from Vangunu as they are used by algae and phytoplankton.



Map showing the nutrient levels in Marovo Lagoon in January 2005. The dark red colours indicate high levels of nutrient pollution.

Water quality properties

Chlorophyll

Chlorophyll concentration is a measure of how much phytoplankton (microscopic plants) is in the water. Phytoplankton need high levels of nutrients (nitrogen and phosphorus) to grow so they provide a good indication of the nutrient levels of the water. If chlorophyll levels are too high it shows that there is excess nutrient pollution in the water. In some areas of the Solomons the water appears green in colour, this is the chlorophyll from millions of phytoplankton that have grown fast because of high nutrients in the water.

- → *Measure of microscopic plants*
- → *High levels indicate pollution*

Temperature

Water temperature has a large effect on the growth rate and health of all marine organisms. In the open ocean, water temperature varies during the year, ranging from 28 to 31 degrees in most areas of the Solomons due to ocean currents. Because some lagoons are small shallow bodies of water compared to the open ocean they can have larger temperature changes (from 24-34 degrees).

Most marine organisms can survive these changes in water temperature as they are part of the natural seasonal cycle. However in some years waters around the Solomons become particularly warm due to changes in global ocean currents or calm conditions allowing the sun to heat the surface waters. These unusually high water temperatures have caused some corals in the Solomons to die from 'coral bleaching'.

- → *Vary between 24 and 34 degrees*
- → *Hot water causes coral bleaching*

Issues and threats

Logging

The major impact on the water quality in Solomon Islands is the logging operations. As trees are removed from the land soil becomes exposed and can run-off into creeks and eventually into the lagoon after rainfall. This soil brings with it both sediments and nutrients which can effect the health of marine organisms (as explained above). After logging has stopped it may take the forest 3-5 years to cover the exposed soil areas with small trees and vines. This stabilises soil and reduces the amount of sediment and nutrient entering the ocean. However, the large amounts of sediments and nutrients that have already entered the ocean and settled to the bottom can be re-suspended into the water (stirred up) by wind, waves and currents for many years to come. Clearfelling logging operations (Oil Palm) have a more long term impact on water quality as the forest is not allowed to re-grow and areas of soil remain exposed and continue to enter the ocean after rainfall.

- → *Logging has increased in recent years*
- → *Can lead to nutrient and sediment pollution*

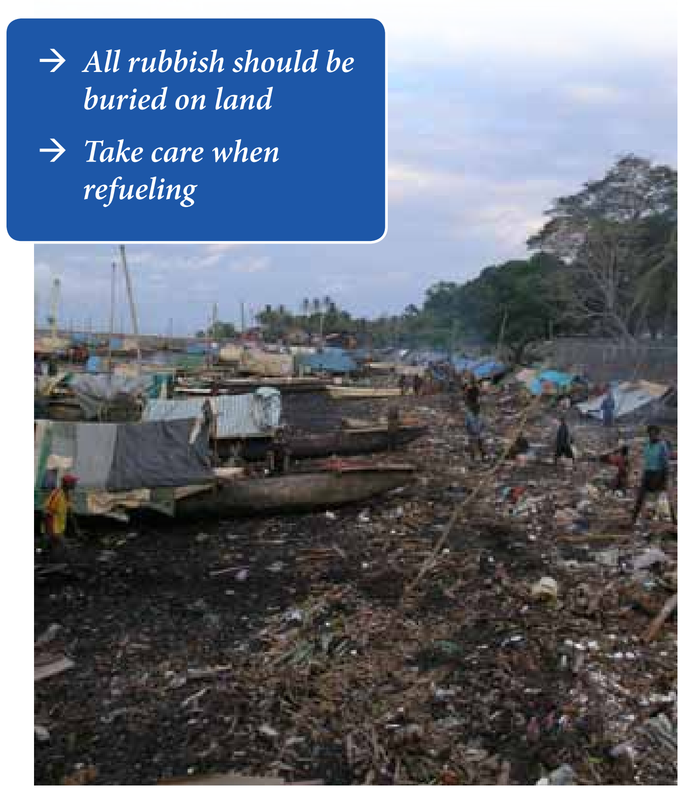
How you can help

Waste management

Many types of rubbish contain chemicals that can impact on the water quality of the Solomons. Old batteries contain dangerous metals and acids that can affect the health of fish, shellfish and humans. It is important that all rubbish is buried on the land and not thrown into the water. Likewise petrol and oil contain chemicals that are dangerous to fish, shellfish and humans. Be careful not to spill petrol into the water when re-fuelling and collect any waste gear oil when conducting an oil change. Plastic bags and wrappers damage marine life when they are thrown into the water or creeks. Some animals like turtles think the plastic is food and eat it, this causing the turtle to die. Worldwide, more than 100,000 marine mammals and turtles as well as over 1 million sea birds die every year from plastic.

It is a good idea to designate a rubbish dump and make sure all rubbish is placed there. When it is full the rubbish can either be buried or burnt.

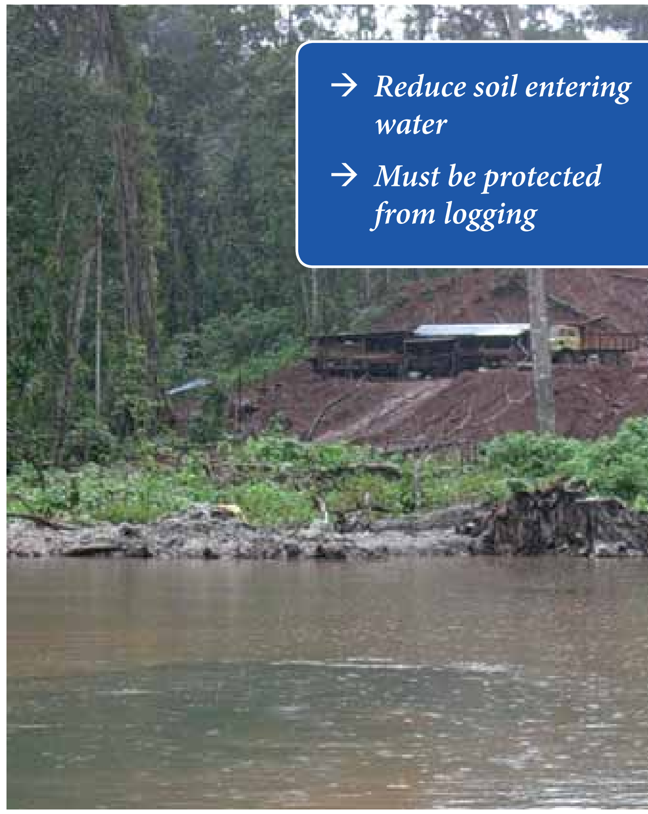
- → *All rubbish should be buried on land*
- → *Take care when refueling*



Riparian forests

Not logging near creeks or rivers will help to reduce the amount of sediments and nutrients entering the ocean. Keeping a strip of forest (approx 400 m wide) along the banks of rivers and creeks ensures that any soil washed off the land during rainfall will be captured by this strip of forest before it enters the creek. This forest along creeks and rivers is called "riparian forest". The forestry department has rules to prevent it being logged, but these are often ignored by companies.

Mangrove and seagrass

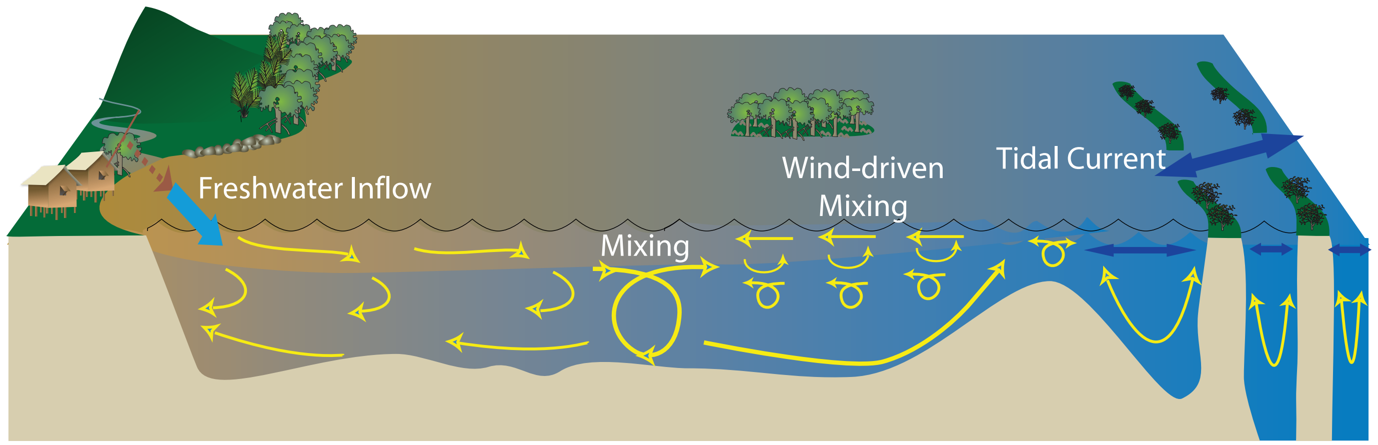


- → *Reduce soil entering water*
- → *Must be protected from logging*

Water movement

As water flows through reefs and lagoons it moves food that corals and fish rely on. Understanding how the different flows or currents work is important as they determine where and when food which supports the marine ecosystem is transported. Areas where there are fast currents such as passages are a rich source of food and many fish gather there to feed. This is why passages are such a good fishing location.

The shape of most lagoons and reefs is very complex with a mixture of very deep and very shallow zones as well as many passages and small islands. This unique shape combined with occasional freshwater inflows from rivers and the regular tidal inflows from the open ocean creates complex current patterns. Scientists are only starting to understand how these currents work and what causes them.



Water movement and currents in a shallow lagoon

What causes current?

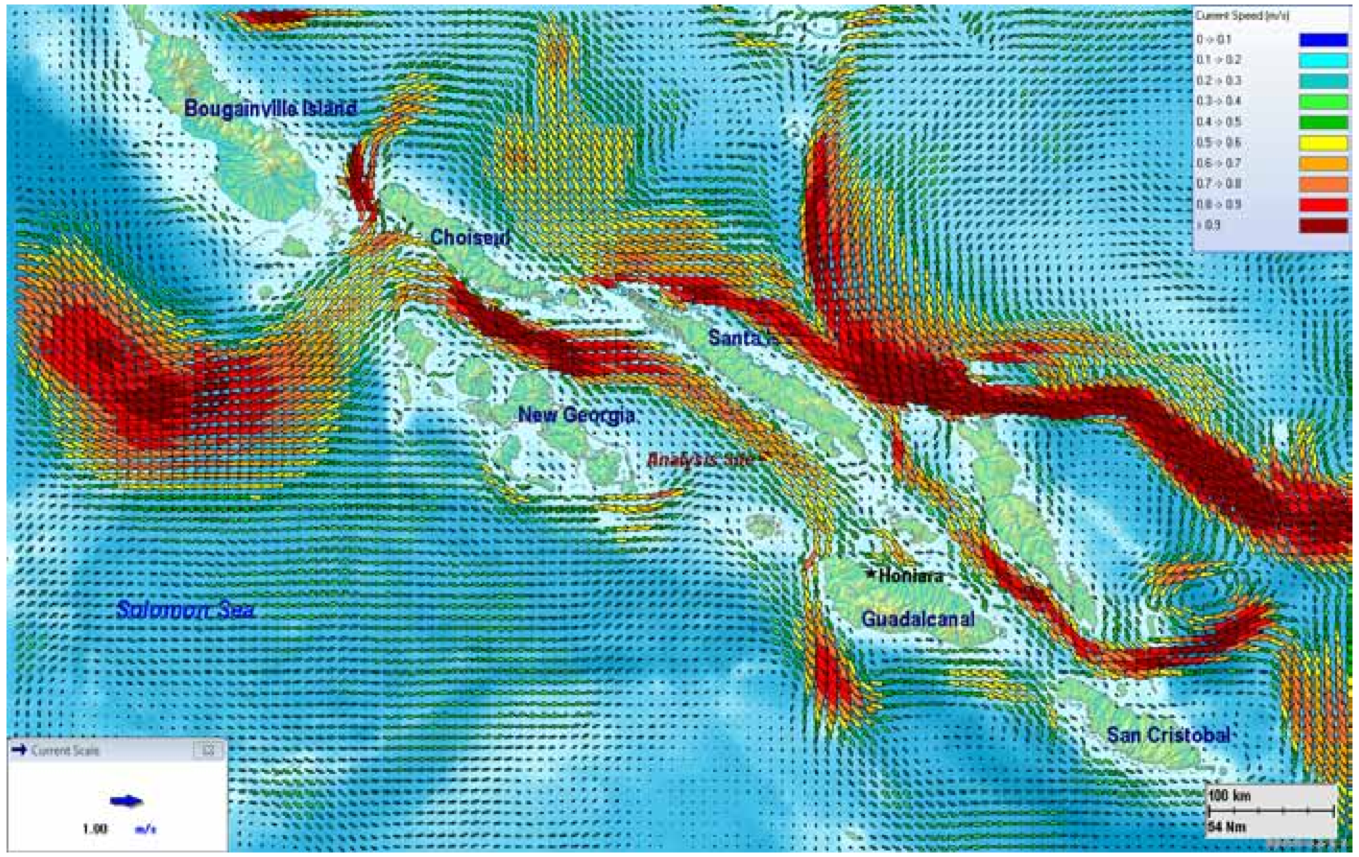
Wind—As the wind blows over the surface of the water it pushes the surface layer along with it. In strong winds this can cause a current along the surface of the water that travels in the same direction as the wind. At deeper depths the water can still be stationary or even moving in the opposite direction.

Tide—Tides have the strongest influence on water movement in shallow lagoons and reefs. As the tide is dropping water drains out of the lagoon or reef via the passages into the open ocean. This can cause very fast currents at the passages. A similar process is repeated as the tide rises and water from the ocean flows through the passages and into the lagoon.

Waves—Waves that have not broken into white water do not have much impact on currents. When waves start to break they can push large volumes of water that can cause localised currents.

Ocean circulation—There are very large currents that move water around the Pacific Ocean. These oceanic currents are caused by temperature differences between different parts of the Pacific, or from large-scale weather systems, such as tropical cyclones. As these oceanic currents move past islands they can push water into shallow lagoons and reefs and cause currents.

Water movement and currents of Solomon Islands



Results from Hycom computer model of surface currents in Solomon Islands during January 2012

How do reefs influence currents?

→ *As water moves from deep areas into shallow areas it usually speeds up. Depending on the shape of the reef, the water can also be forces to flow in a different direction. In passages this change in depth occurs very quickly and causes the water to move fast and in unpredictable directions.*

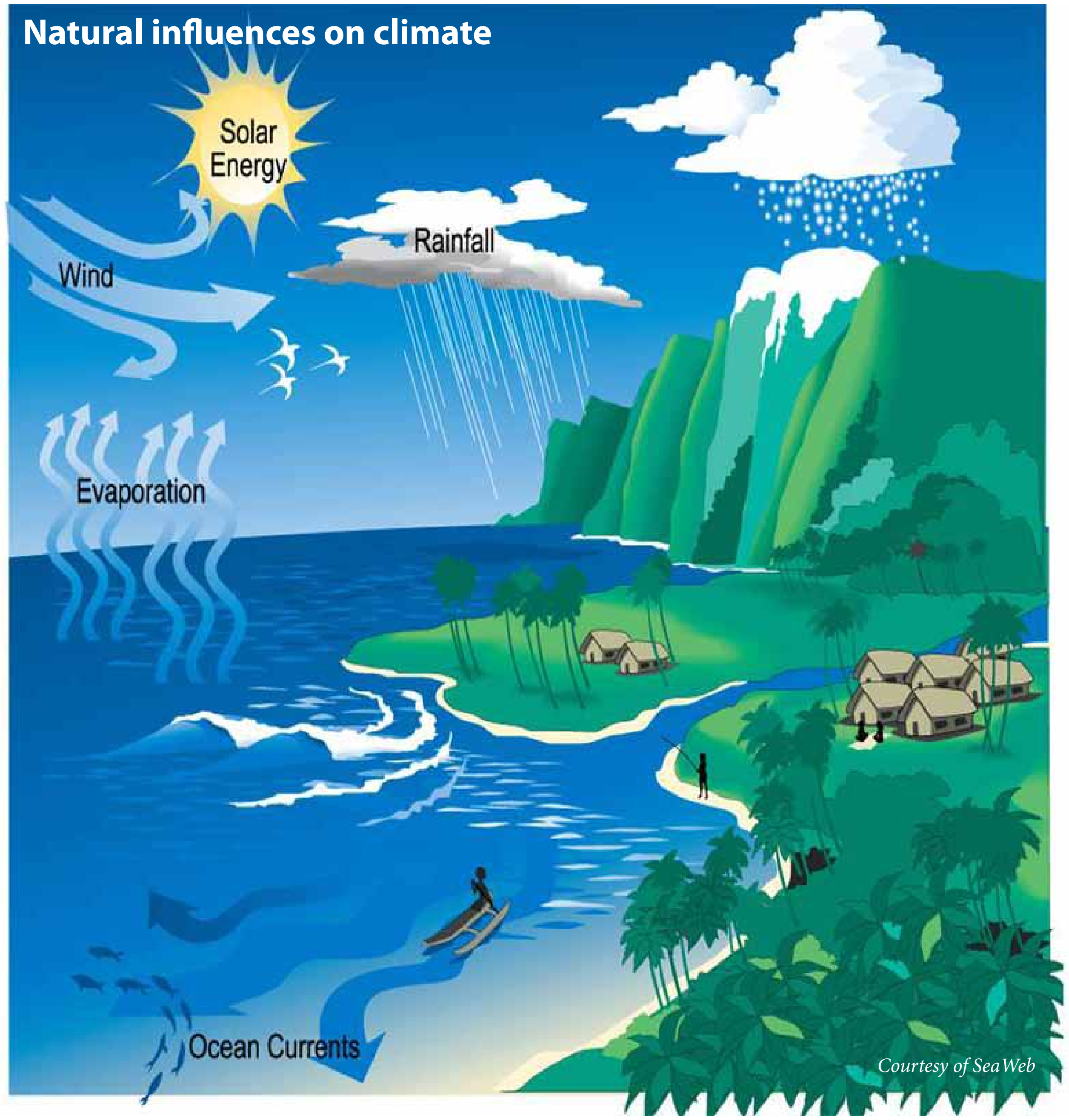
What causes tides?

The tide is caused by the gravitational pull of the moon and sun on the oceans. As the moon orbits around the earth it attracts the seawater towards it, causing high tides. When the sun is close to earth it also attracts the seawater towards it, although the attraction is only half as strong as the moon. When the moon and sun are at 90 degrees to each other the tides are the smallest (neap tides). When the moon and sun line up at full moon and new moon the tides are the largest (spring tides). During January and July each year the tides are even larger (king tides) because the sun and moon are at their closest points to the earth. During these spring and king tides the strength of the currents in the passages is greatest.

Climate change

What is climate change?

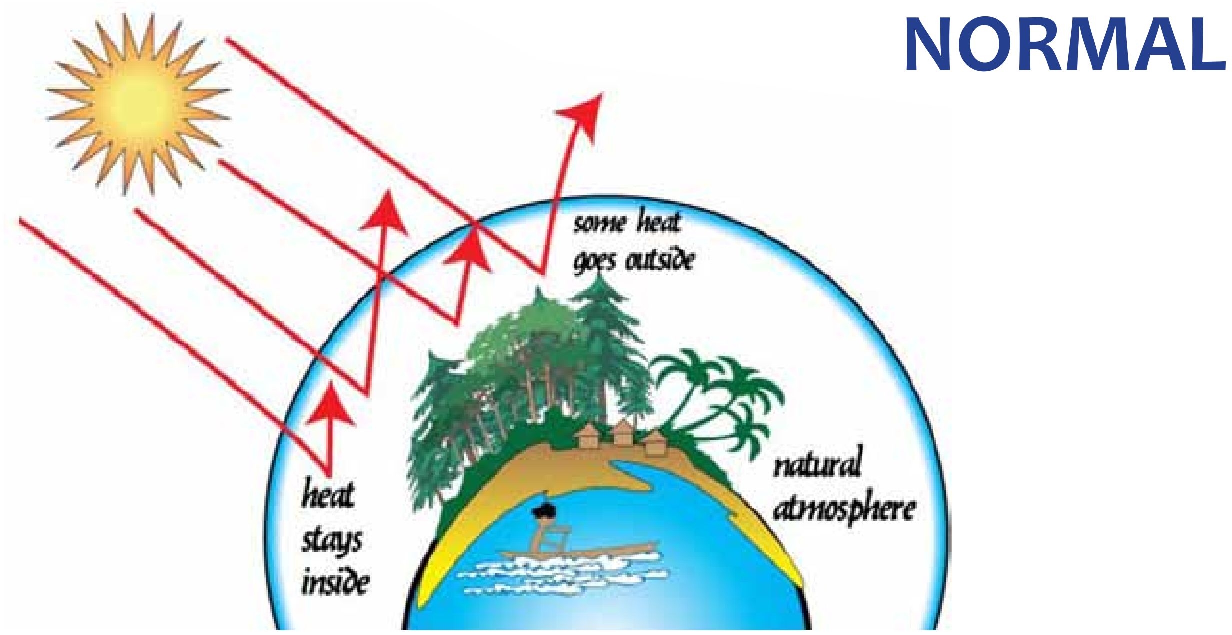
Climate change is a name for the weather and environment changes the earth is currently experiencing. Compared with long term historic trends, climate over the last 50 years has been very different. While the earth's climate is affected by natural things like volcanos and ocean currents, most scientists now agree that the climate changes in recent decades are largely caused by humans. These changes are set to continue, and all countries and regions of the world will be affected in various ways by climate change.

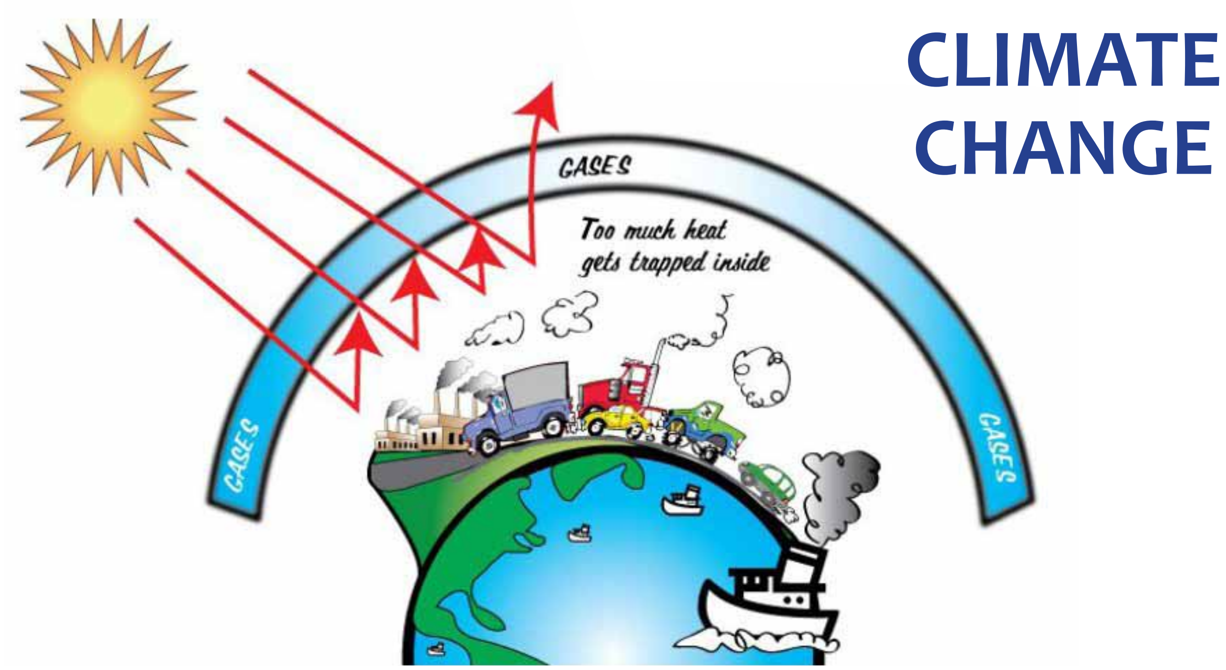


Climate is a word for the long term patterns of weather. Climate is influenced by many things like rain, wind, sunshine and ocean currents.

What causes it?

The main cause of human induced climate change is the large increase of certain gases (called greenhouse gases) like carbon dioxide and methane in the atmosphere. The atmosphere is the blanket of gases that covers the earth and regulates its temperature. Normally when the warmth from the sun shines on the earth some of it is trapped by the atmosphere. This keeps the earth warm. But now there are more gases in the atmosphere, so more heat from the sun is trapped. This means the earth is getting warmer.





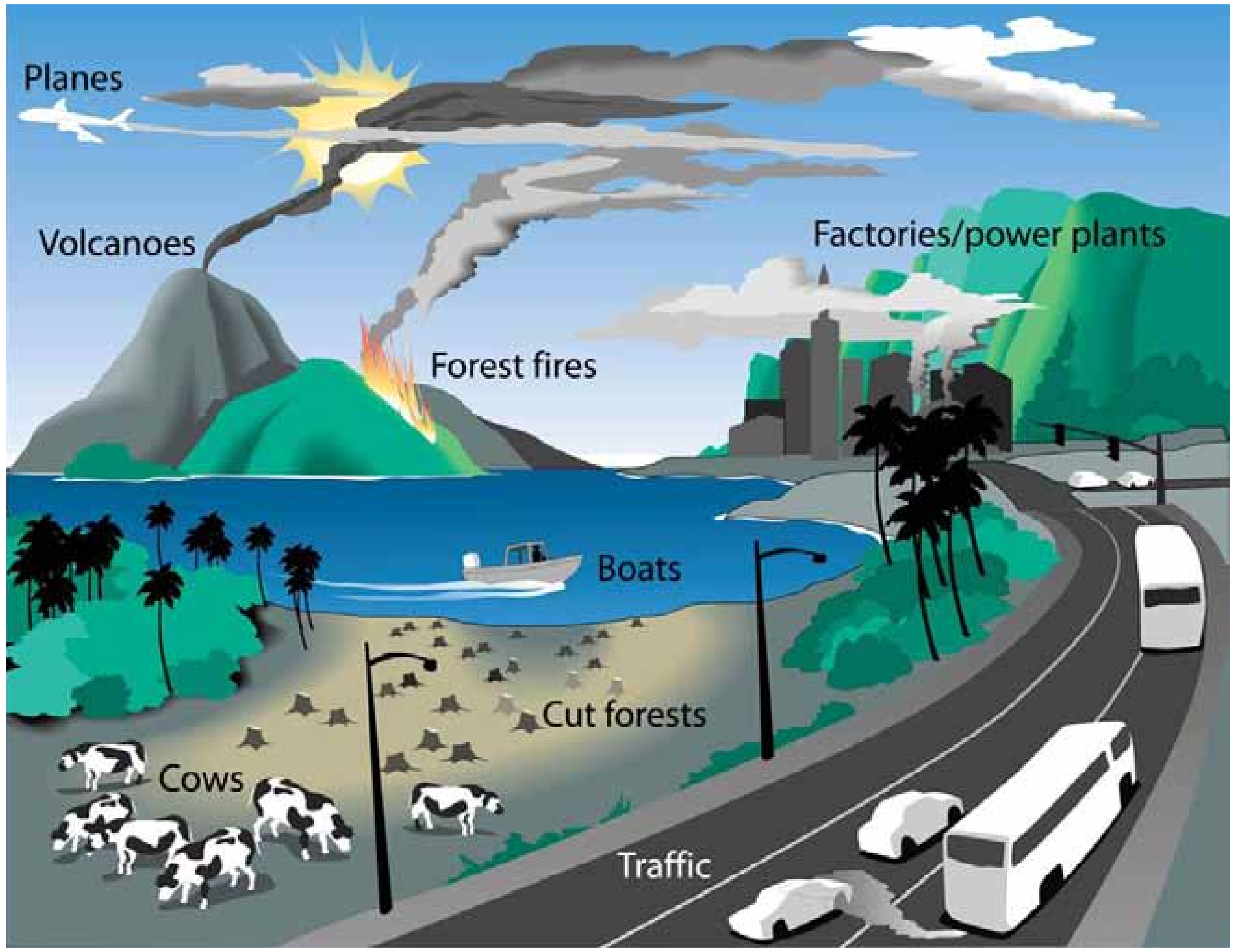
Pictures thanks to Kisey Mae and Live and Learn

Where have these extra gases come from?

Greenhouse gases like carbon dioxide are naturally part of the earth's atmosphere. But over the past 100 years, human activities have started to increase the amount of greenhouse gases that enters the atmosphere. These extra gases come from our use of engines in cars, trucks, planes and boats. More greenhouse gas is also produced from burning coal and diesel in power stations to make electricity. When we burn fuel for our cars and boats or to make electricity certain gases are released as pollution. This pollution increases the blanket of gases covering the earth and trapping heat from the sun. Clearing of land, burning forests and livestock like sheep and cattle also contribute to increased greenhouses gases. Trees naturally have an important role in absorbing some of these gases such as carbon dioxide, but with trees and entire forests being cleared nature's way of removing carbon dioxide is limited.

- Transport (cars, trucks, planes, boats)
- Energy (burning coal/diesel for electricity)
- Land clearing (logging)
- Agriculture

Sources of carbon dioxide in the atmosphere



Courtesy of SeaWeb

How will the climate change?

Climate change will impact different areas in different ways. The weather and the seasons will be more variable. People will experience more hot days. People living along the coast are likely to feel the effects of sea level rise, while people living inland are at a higher risk of floods.

Sea surface temperature

Due to climate change, it is predicted the temperature of the ocean surface in the Solomons will increase by 0.5-1 °C by 2040 and 2 °C by 2080. While these changes may seem small, they can be enough to cause certain marine life to be stressed and die. For example, corals are very vulnerable to high ocean temperatures; they can suffer from coral bleaching and die.

Sea level rise

As water warms it expands and takes up more room. Warmer temperatures are also causing huge amounts of polar ice to melt. The extra room taken by warmer water and the extra water from melting ice causes the overall sea level to rise. It is predicted that the sea level will rise by 0.5-1m over the next 100 years. This is a high level of increase. Already in the Solomons the tide gauge in Honiara has measured an average 8 mm rise in sea level per year over the past 15 years. Whilst this may not seem much it is enough to already cause coastal erosion and salt water intrusion of groundwater in low-lying areas.

Rainfall

Rainfall is affected by changes in sea temperature and different atmospheric circulation patterns. Rainfall patterns in the Solomon Islands have been changing. For example, evidence from weather stations around the Solomons shows that the number of rainy days has been decreasing while the periods of extreme rainfall has been increasing. It is predicted this trend will continue which will mean longer droughts and more intense floods. This is an example where the average may not change but the weather simply becomes more variable and sometimes extreme.

Temperature

It is predicted that in the Western Pacific, which includes the Solomon Islands, average air temperature will increase by 1–2°C by 2050 and by 2–3°C degrees by 2080. This will mean more hot days per year.

Ocean acidification

More carbon dioxide in the atmosphere will cause acid to form in the ocean. Seawater will slowly become slightly more acidic. When acid levels become too high corals cannot build strong skeletons that form the reef. It is predicted that by 2040 acidity may start to become a problem in sea waters of the Solomons (particularly in the south).

Flooding from high sea levels in Nusa Hope village

Impacts of climate change

» Marine resources

As the temperature of the ocean rises from climate change there will be four major impacts on coral reefs:

1. Coral bleaching

Warmer water temperatures will increase the frequency of coral bleaching, which can kill corals and make them more prone to other impacts. Bleaching occurs when corals lose the algae that give them colour (and provide them with food). Bleached corals can recover if stressful conditions stop, but if they are exposed to warmer water for a long time the corals will die and become covered with algae (see below).

2. Coral disease

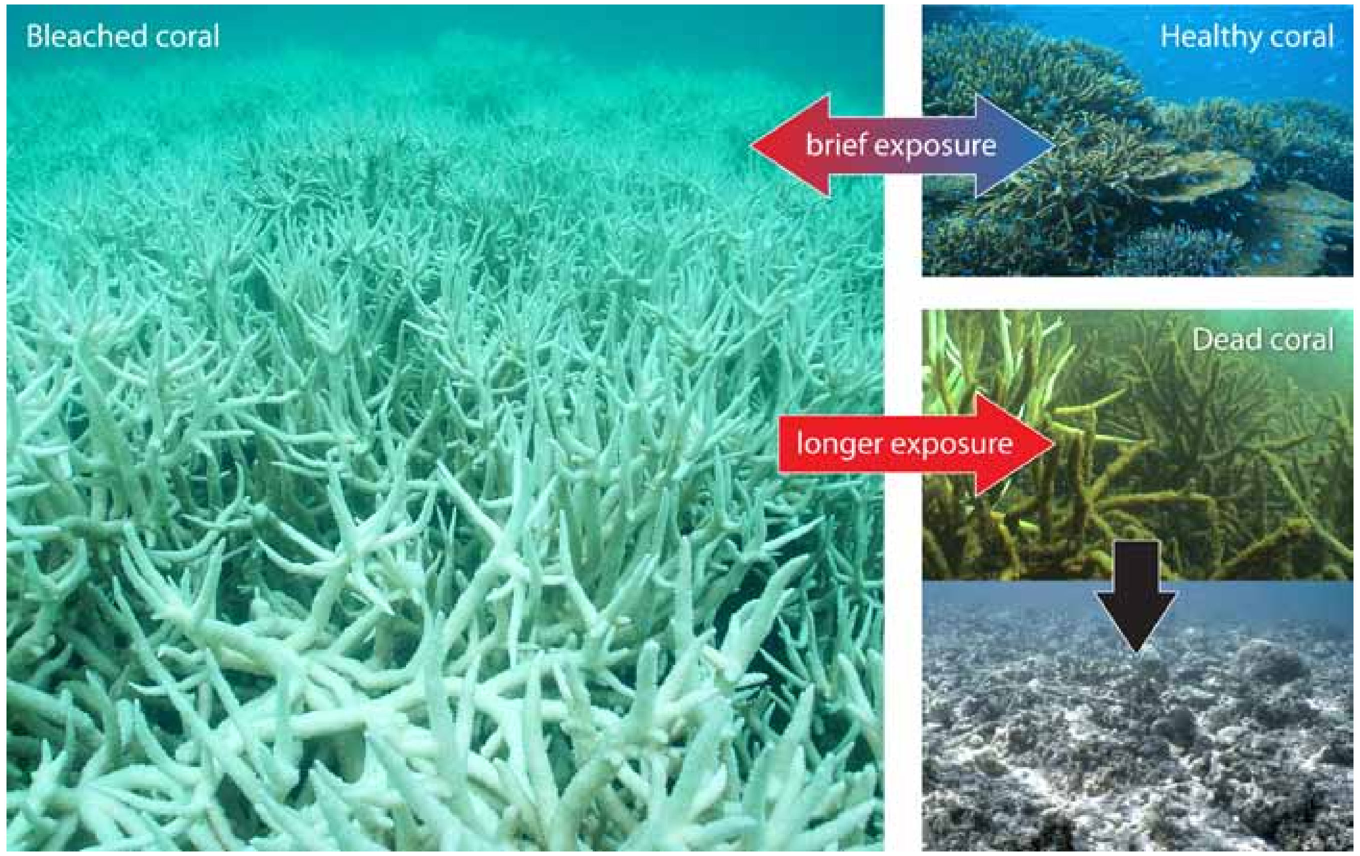
Warmer water temperature will lead to more corals being infected with some types of disease. Warm water will also increase the types of disease and the number of corals they infect. Coral disease can rapidly kill coral.

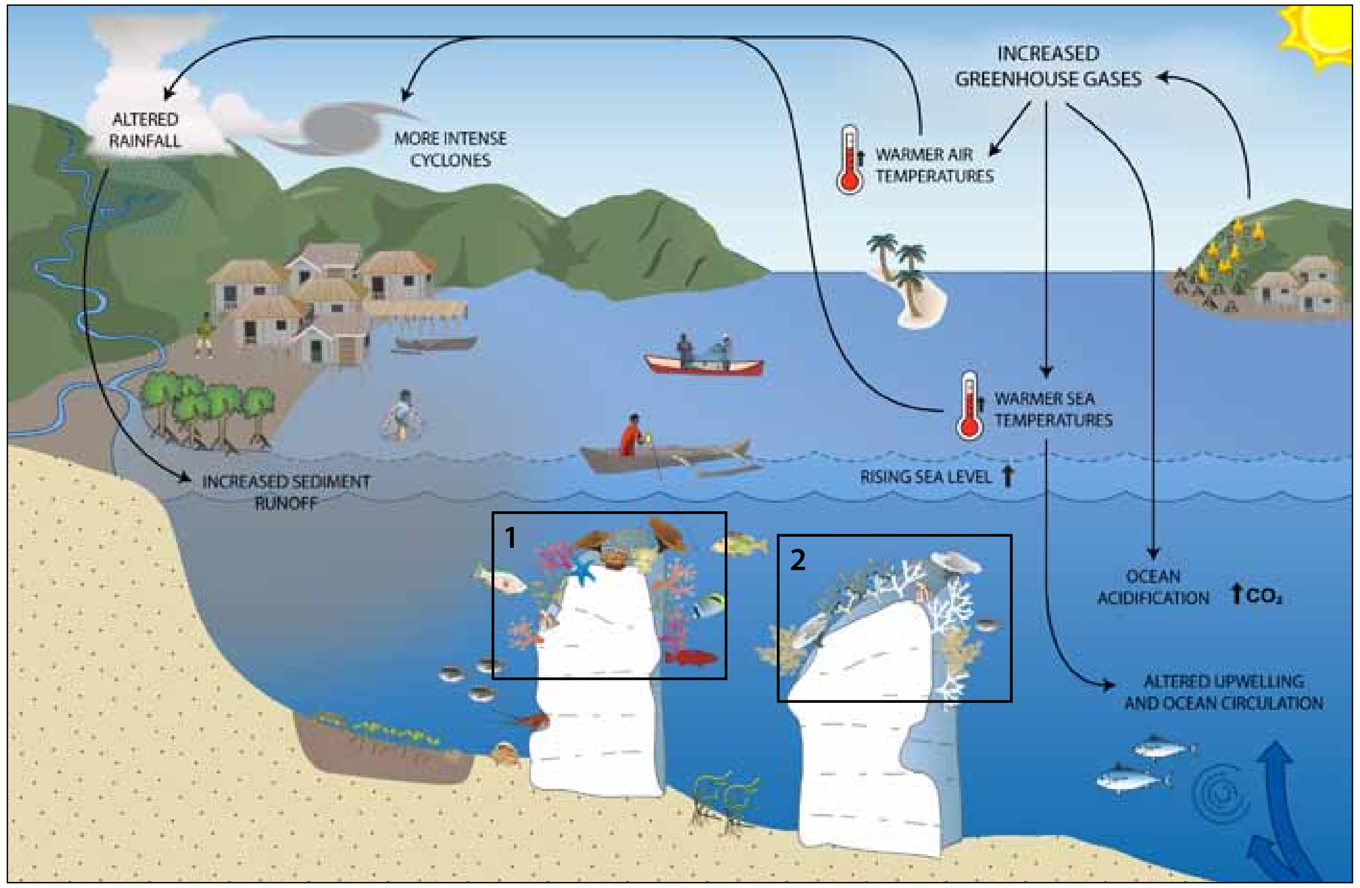
3. Ocean acidification

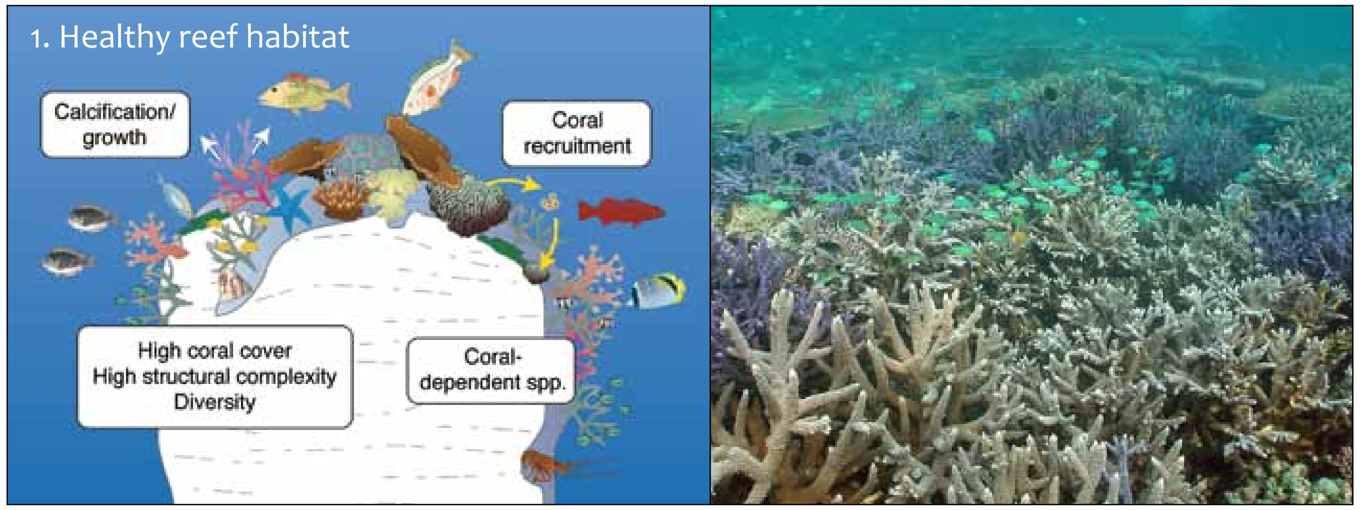
The acidity levels of the ocean are very important for the growth of corals and shellfish. Fish and humans will not be impacted by acidic seawater but the skeletons of coral will become more fragile. Eventually the water will be too acidic for corals to form skeletons and the reef will be easily broken by storms.

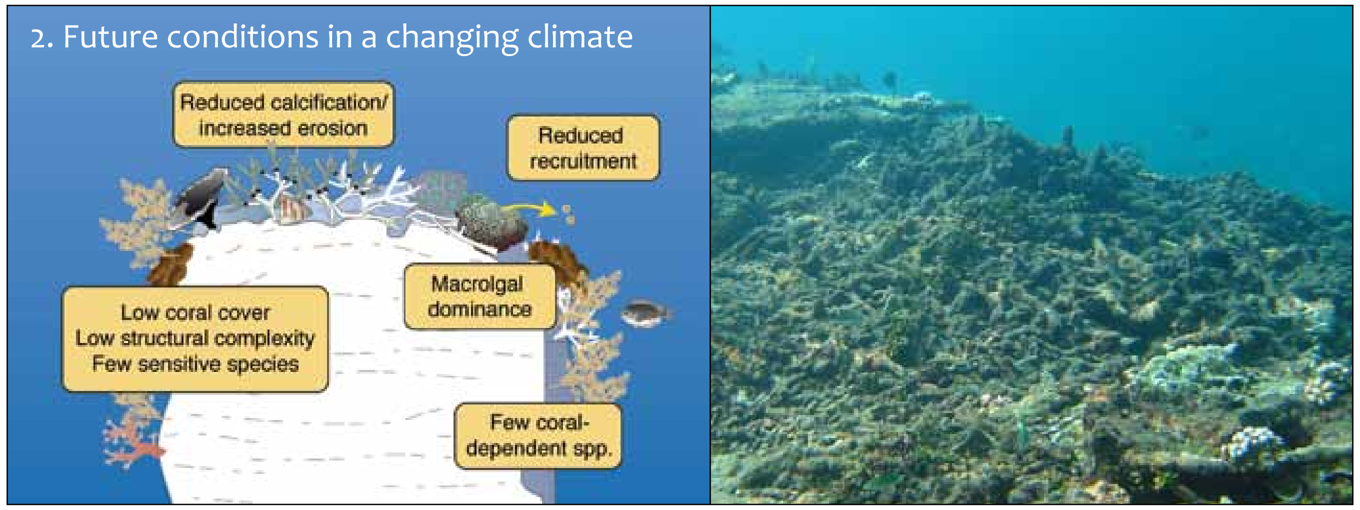
4. Direct impact of warmer waters

Some fish species will have lower reproductive rates and be less healthy as the waters warm. There may also be benefits of climate change for some species with faster growth rates and new geographic distributions.









» Coastal erosion

As sea levels rise the coastline will change and move. Much of the coastline is made up of soft sands and gravel held together by the roots of trees. As the sea level rises these soft sands and gravels will be washed away into the ocean and in some cases houses and villages will be flooded.

In the coming years, climate change will be an increasing threat to coastal communities in the Solomon Islands. More intense storms and cyclones will bring more heavy rainfall and storm surges. This will increase the risk of flooding. Flooding will be worse in areas where coastal plants have been cleared or coral reefs damaged. These coral reefs and trees work like coastal barriers and protect the coastline during storms.

A small increase in average sea level can lead to a greatly increased risk of damaging storm surges. Rising sea levels will also change many island habitats and gradually flood the coastal lands where people live and flood the fresh water springs which coastal depend on.

Topographic survey results from Nusa Hope showing high tide mark, 0.5 m and 1 m contours Sea level is likely to rise by 0.5-1m over the next 100 years.

High sea levels in Roviana

» Garden resources

Food crops are also expeceted to be impacted by climate change (unpredictable seasons, hotter weather):

- Unpredictable seasons are causing staple food crops to rot during very wet periods or die during very dry periods
- Pests and diseases are becoming more common, which is having significant impact on garden productivity
- Salt intrusion into coastal gardens is increasing

Increasing the impacts of climate change (less resilience):

- Diversity of garden crops is decreasing
- Young people no longer value garden knowledge
- Repeated use of garden areas and agricultural practices such as slash-and-burn are increasing soil erosion and reducing soil fertility.
- Reliance and preference for processed foods (e.g. tinned tuna, noodles, biscuits) is increasing

- Bushfoods are an important food source during disasters or shortages
- Fertile garden land is being used for commercial agriculture such as forestry and oil palm plantations
- Growing populations mean land is also being used for new homes, and infrastructure such as schools and hospitals

» Drinking water

Access to clean drinking water is an essential requirement for healthy communities.

Traditionally in the Solomon Islands people have used water from both streams and groundwater. Recently rainwater tanks have also been relied on. Protection of clean drinking water supplies should be the top priority of any community.

- Climate predictions indicate rainfall will become more variable
- The sea level rise will also cause salt water to come into low-lying groundwater wells making them unsuitable for drinking.
- Community water supply from streams with a forested catchment, and from wells located away from the coastline, will be very important in the future.

Drinking clean water from stream in a healthy, forested catchment.

How can we respond to climate change?

There are two ways:

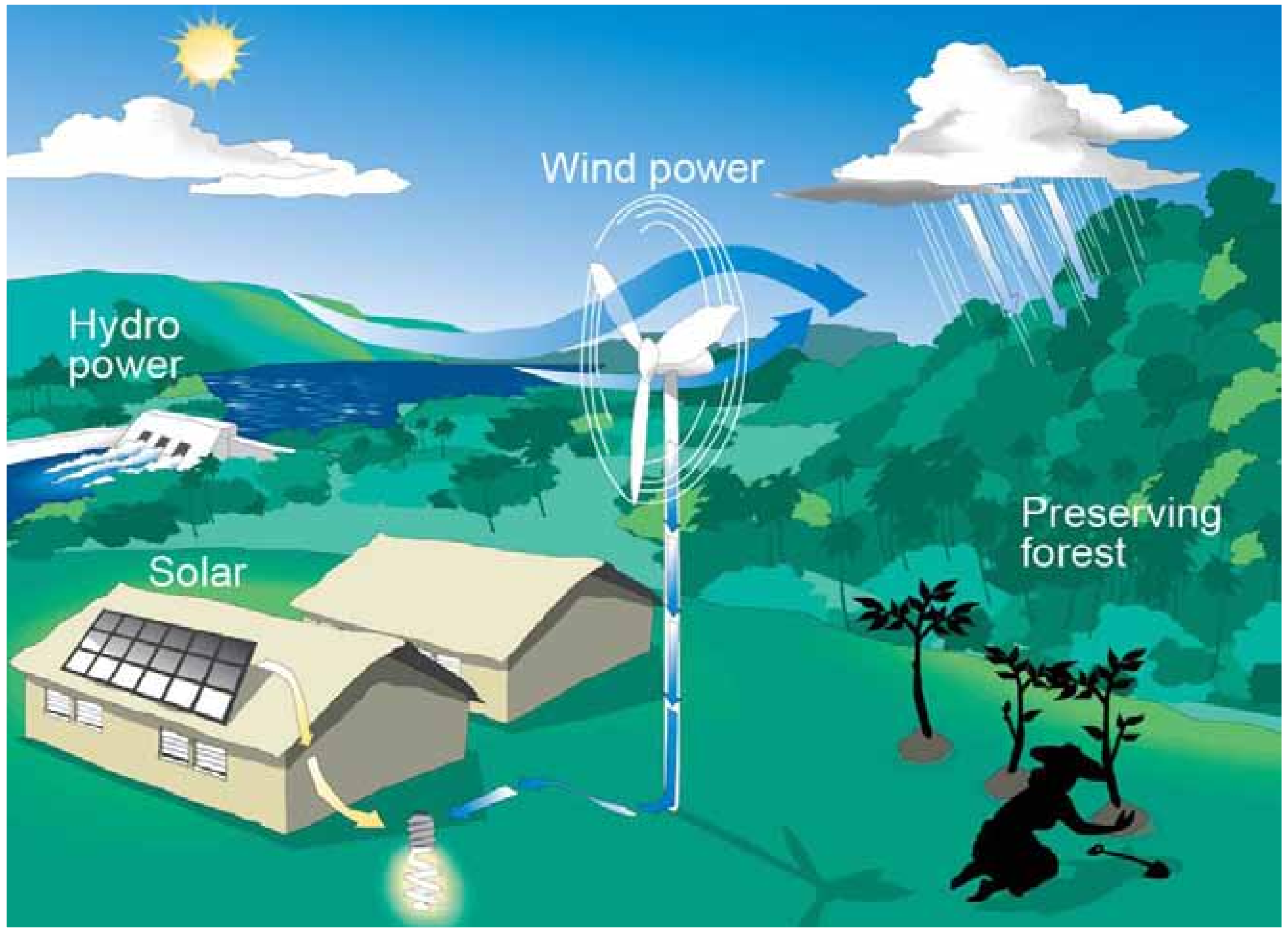
1. **by reducing the amount of carbon dioxide produced—this is called *mitigation***
2. **by changing the ways we manage our environment so we are better prepared—this is called *adaptation***

» Mitigation

Future climate change can be reduced if less carbon dioxide is released into the atmosphere from things such as cars, boats and coal from electricity. The amount that sea levels rise, and that ecosystems like coral reefs are damaged by rising temperatures, will depend on how quickly carbon dioxide emissions can be reduced. Governments worldwide are working to reduce the amount of carbon dioxide produced by decreasing the use of fossil fuels such as coal and oil, and by stopping damaging land use practices, such as deforestation, that all increase carbon dioxide levels.

The benefits of mitigation come from a global effort. The Solomon Islands, like all countries, will need to balance social and economic development objectives with efforts to reduce emissions of carbon dioxide. Opportunities for the Solomon Islands to reduce carbon dioxide emissions will include the protection and sustainable management of forests and the transfer of renewable energy technologies from development partners.

Ways we can reduce carbon dioxide in the atmosphere



Courtesy of SeaWeb

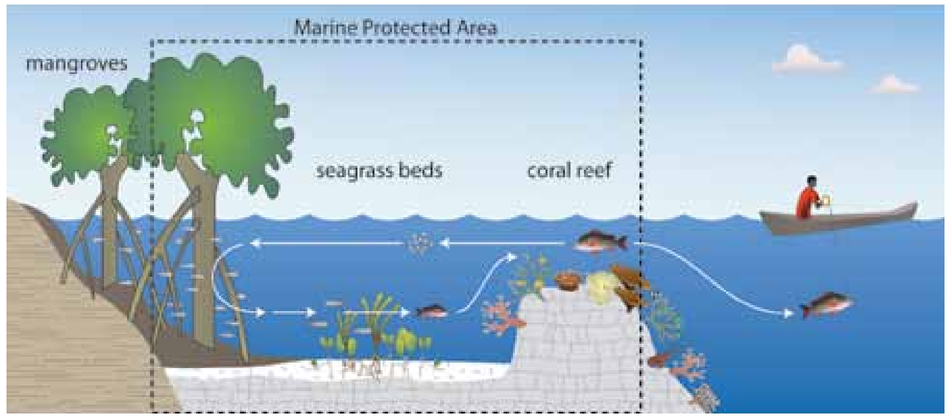
» Adaptation

Marine resources

Climate change is affecting marine ecosystems such as coral reefs that are already under stress due to other human impacts, such as poor water quality and overfishing. Changing the ways we manage marine resources to reduce these other stresses gives ecosystems the best chance of coping with climate change. Things we can do to protect marine resources include:

- Protect fish like parrotfish that eat algae and keep coral reefs healthy
- New marine protected areas, especially which connect coral reef, seagrass and mangrove ecosystems should be encouraged to increase resilience and productivity of marine resources
- Protect lagoon passages, as corals there are resistant to temperature fluctuations, they are important as spawning grounds, and have high connectivity and productivity

Parrotfish grazing



Agriculture

- Improve transfer of traditional knowledge between generations
- Access new climate proof crops from Kastom Gaden Association
- Trial composting and mulching to improve soil fertility
- Limit commercial activities on fertile garden lands

Children in Biche village harvesting ngali nuts and learning traditional skills.

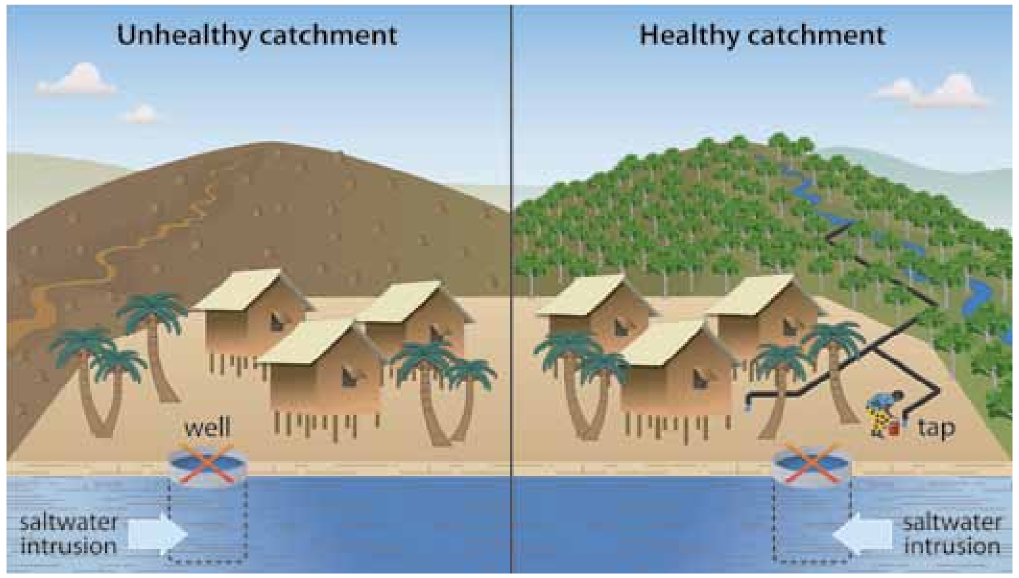
Coastal erosion

- Map areas of the village likely to experience sea level rise
- Limit construction in coastal areas
- Protect and replant mangroves
- Construct seawalls to protect trees and houses

Drinking water

To help ensure a healthy and reliable future water supply, communities should:

- Keep healthy forests in water catchment areas
- Not allow logging within 200m of streams or anywhere in water catchment areas. Cutting forests near streams causes drinking water to be filled with sediment and unhealthy for drinking.
- Maintain a diversity of water sources (rainwater, wells, stream supply)



→ *A community with a drinking water supply from a healthy catchment (right) will be better off than one in an unhealthy catchment (left) that is forced to use groundwater contaminated by salt water.*

Images this page: Design and content by Meghan Gombos, Scott Atkinson, and Supin Wongbusarakum. Illustrated by Sevuloni Tora. Funding/Facility Agency—Micronesia Conservation Trust and The Nature Conservancy

Marine resource management

Why manage resources?

The fish, invertebrate, plant and coral resources in the Solomons are vital to support the life of the Solomon people. Marine resources provide food, medicine, building materials, firewood and income. As the population increases and there is more commercial harvesting, these resources can run out if they are not correctly managed. If resources are managed well they can continue to provide for future generations. This is called sustainable resource management. Sustainable resource management provides a way to balance all the pressures on a resource, such as: harvesting for food, commercial harvest, conservation, tourism appeal.


Installing MPA markers

Managing marine resources is complex

There are many social and environmental factors to balance in order to achieve sustainable management of resources. These include:

Social

Subsistence harvest—Ensuring local people are able to harvest enough food to support healthy diets needs to be a priority of any management.

Artisinal harvest—Local people harvesting and selling resources.

Commercial harvest—Outside companies harvesting and selling resources.

Tenure—Who owns the land and sea resources you want to manage?

Tourism—Some areas might attract more tourists if they are looked after.

Biological

Spawning success—Some fish come together on certain reefs to spawn and reproduce, it is important these areas are looked after.

Habitat—It is important to look after seagrass, mangrove and reef habitats. They all support the health of marine resources in different ways.

Age-sex change-structure—Some fish change sex as they get older so it is important that a combination of big and small fish are on the reef.

Marine management options

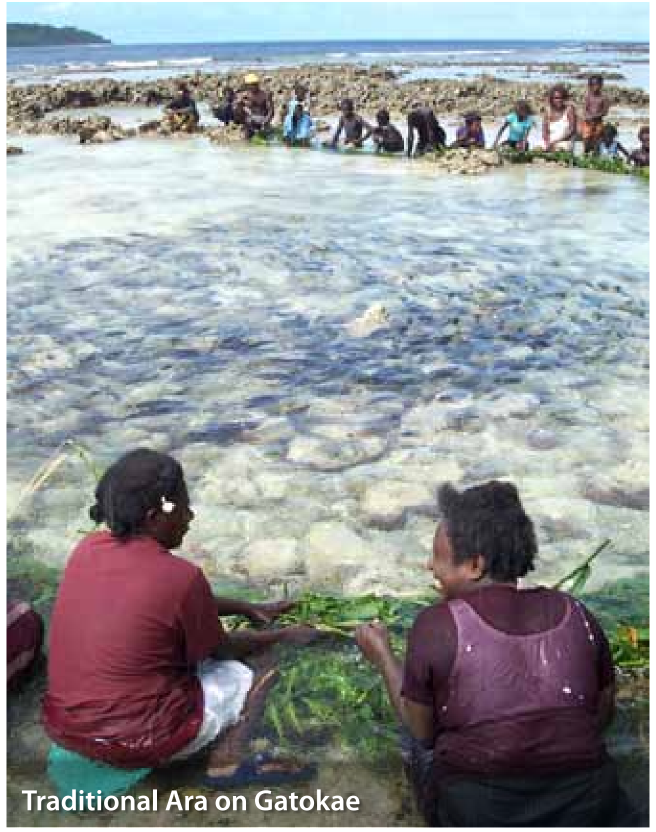
There are many options for the sustainable management of marine resources. Many of these have been used by the Solomons' people for centuries. Due to increasing pressures on the marine resources in the Solomons from new technologies, outside companies, cash economy and population growth, many people have requested information on how to reinstate some of the traditional management methods or introduce some new ideas.

→ *There is no simple answer for what the best way to manage marine resources is. It depends on a number of factors that are specific to your community.*

A Tabu area or MPA is not the only way to manage fisheries

Placing a tabu (or marine protected area (MPA)) over a small area of reef, while over-harvesting other areas is not a good example of resource management. Likewise, if fishing pressure is being managed well but poor land management is causing sediments to kill reefs, the reef resources can still become depleted.

It is important to consider all of the issues in your fishing area (e.g. water quality, spawning areas, over-harvesting, commercial fishing, tourism, habitat condition, tenure etc.). Sitting down and discussing these problems and some solutions is an important first step in creating a management plan for your communities fishing areas.


Traditional Ara on Gatokae

Only you know the answers to these questions:

- → *Why do you want to manage your resources?*
- → *Who will be affected by a management plan?*
- → *How will the management plan be enforced?*
- → *Are mangroves, seagrass and reef all important?*
- → *How often should we review our management plan?*

Some methods that have worked in different parts of the world are:

Gear restrictions

- Small mesh size nets are often banned as they indiscriminately catch baby fish.
- Poison leaf/root fishing also impacts on baby fish and can harm corals.
- Night spearfishing often targets herbivorous fish which sleep on the reef at night. These fish are important to keep the reef clean from excess algae.

These restrictions are generally applied over the entire area to make enforcement simple. However they could be specific to different areas, times or if the fishing is for food or market.

→ *See www.lmmanetwork.org for some good examples of marine management in other parts of the Pacific.*

Catch limits

Quota (bag limit)

Many countries have a system where each fisherman has a quota of how many fish of each type they can take each day. The numbers vary depending on the type of fish. This helps by reducing the total take by the community, but provides enough fish for everyone to eat.

Size limit

Many countries also have minimum size limits of fish to ensure the young fish have the chance to grow to maturity and reproduce before they are caught. In some cases fish have a minimum and maximum size limit to protect the larger fish that are able to reproduce e.g. parrotfish and those fishes that change sex as they grow to ensure that there are enough females and males.

Night spearfishing harvest

Closed areas

Full closure

An area of reef is closed to all forms of fishing to allow fish within that reef to grow to maturity and reproduce. In many cases the reefs surrounding this full closure will become popular fishing areas with more fish that have moved from within the closed area.

Temporal closure (Periodic closure)

An area of reef is closed to all forms of fishing for a certain length of time. The local community can then decide to open the reef to fishing for a specific event (fundraising/feast) or for subsistence harvest. This 'temporal closure' is similar to many traditional forms of management in the Pacific, where a chief would have the power to open and close reefs to fishing.

Spawning closure

This is used in Australia to protect large reef fish which spawn in the months of October and November. The entire reef is closed to recreational fishing. In the Solomons this might be the closure of a certain area for a period when fish are known to aggregate to spawn.

Combination

In Roviana lagoon communities have included both full and temporal closures in their management plan for an area. This can be useful so that one section of reef remains closed while another section may be opened periodically to reap the rewards.

Specific uses

Only for subsistence use

Fishing within a certain area is only for consumption by the village or for exchange. The fish caught cannot be sold or sent to market.

Reserved for traditional fishing practices

Fishing within a certain area can only be done using traditional forms of fishing.

Traditional Ara on Gatokae

Marine management examples

Specific uses

- One section of the reef may be designated at "subsistence harvest only". Fishing inside that area is for consumption in the village, and not for sale at markets or for eskies.
- Another reef may be closed to all forms of fishing except for designated community-wide fishing events.

Gear restrictions

- Night spearfishing for subsistence harvest is permitted but night spearfishing for the esky trade is not allowed.
- Poison leaf/root fishing during organised traditional fishing events by the community is allowed but poison fishing by individuals is not allowed.

Catch limits

Quota (bag limit) examples

- one person may only harvest twenty mullet per day
- one person may only harvest five parrotfish per week.

Size limit examples

- In Queensland, Australia some size limits are:
- *Coral trout*—38 cm minimum size
- *Maori wrasse*—45 cm minimum size
- *Flowery cod*—50 cm minimum and 70 cm maximum

Closed areas

In Fiji, some communities have divided their reef areas up so that certain areas are open to fishing all year round and other areas are closed to fishing for 2-3 years. During this time nobody is allowed to enter the closed area to collect fish or shellfish. This area is often close to the village so they can see that no poachers enter the area. If people are caught poaching they sometimes have a fine, which may be money or community service. The chief and elders have the power to open the closed area for fishing for a short period for a feast.

Marine management issues

Marine habitats in Solomon Islands are of critical importance to the life of all Solomon Islanders. They provide food, money, tourism, coastal protection, building materials, firewood, medicine and many other services.

If managed correctly these resources can continue to provide these essential services into the future. These services from natural resources provide the people of the Solomons with independence and security that most developed countries could only dream of. Unfortunately, often these services from natural resources are undervalued and the demand for cash drives people to mis-manage these resources.

By mis-managing and over-harvesting natural resources now you are placing the security and health of future generations at risk. If managed correctly marine resources can be a source of food and cash for many years to come.

Some of the activities that are placing the future of these resources and their services at risk are:

Night spearfishing

Spearing reef fish at night is a very effective way to kill large numbers of fish in a short period of time. If enough people are doing it, it is possible to kill all mature and juvenile fish of a species from that area of reef so they will be unable to reproduce in the future. Night spearfishing also targets algae eating fish which are important to keep the reef healthy. In most communities that are involved in sustainable management of their reefs night spearfishing is an activity that they stop or restrict.

Small net sizes

Using a small size (2 inch) gill net to harvest fish catches a lot of under-size or juvenile fish. These under-size fish should be left on the reef to grow and breed so that the fish on that reef will continue to provide food and cash for future generations.

Commercial harvest

Over thousands of years there has been enough marine resources to provide food to people in the Solomons. Now marine resources are providing both food and cash. In some areas the over-harvesting of marine resources for cash (commercial) has reduced the amount of food available for families. In the future if commercial harvests continue to increase (eg Esky trade) it is likely that many people will struggle to find marine resources for food. So it is important to limit or control the commercial harvest of marine resources so that future generations will have enough marine resources for a healthy diet.

Illegal harvest

The national and provincial governments and your community have the power to place rules on the harvesting of marine resources. These rules are designed to make sure that there are enough resources to provide for future generations. If you break these rules, you will benefit in the short term but your community and children will suffer in the future. Currently (2011) the National Fisheries Laws are:

- No harvesting of Trochus less than 8cm and greater than 12cm
- No harvesting of Crayfish less than 8cm, no crayfish with eggs
- No harvesting or possession of Coconut Crab less than 9cm or with eggs
- No harvest of Leatherback Turtle or nests
- No harvest of Coral (live or dead) (except for traditional use or to make a passage)
- No harvest of Bêche-de-mer
- No machine collection of Coral sand/gravel
- No selling of Turtle products, no disturbing turtle nests/hatchlings
- No selling of Giant Clams
- No export of Pearl Oyster shell
- No export of Crocodile

Anthony Plummer (www.anthonyplummer.com)

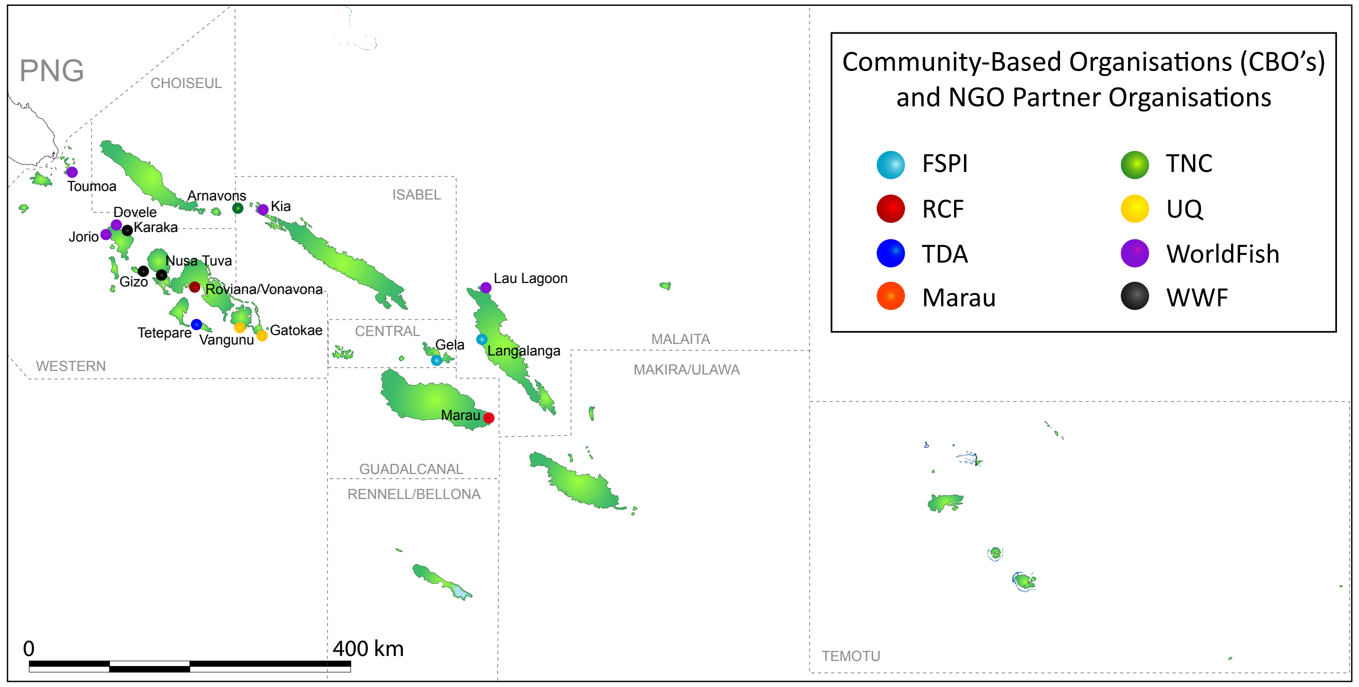
Solomon Islands Locally Managed Marine Areas Network—SILMMA

"Our Vision is to be a well resourced network for information sharing to ensure well-informed decision making by SILMMA members on sustainable resource management and conservation of biological diversity"

Who we are

The SILMMA network is a group of projects and practitioners including NGOs, Government and communities in Solomon Islands who have joined together and are working to improve the success of their conservation and fisheries management efforts through information sharing and networking.

Our SILMMA communities



What we do

SILMMA helps Solomon Island communities to manage and conserve marine resources to maximize benefits and ensure food security. This is achieved by sourcing funds, facilitating, coordinating and providing information, building capacity and empowering partners through traditional and scientific approaches.

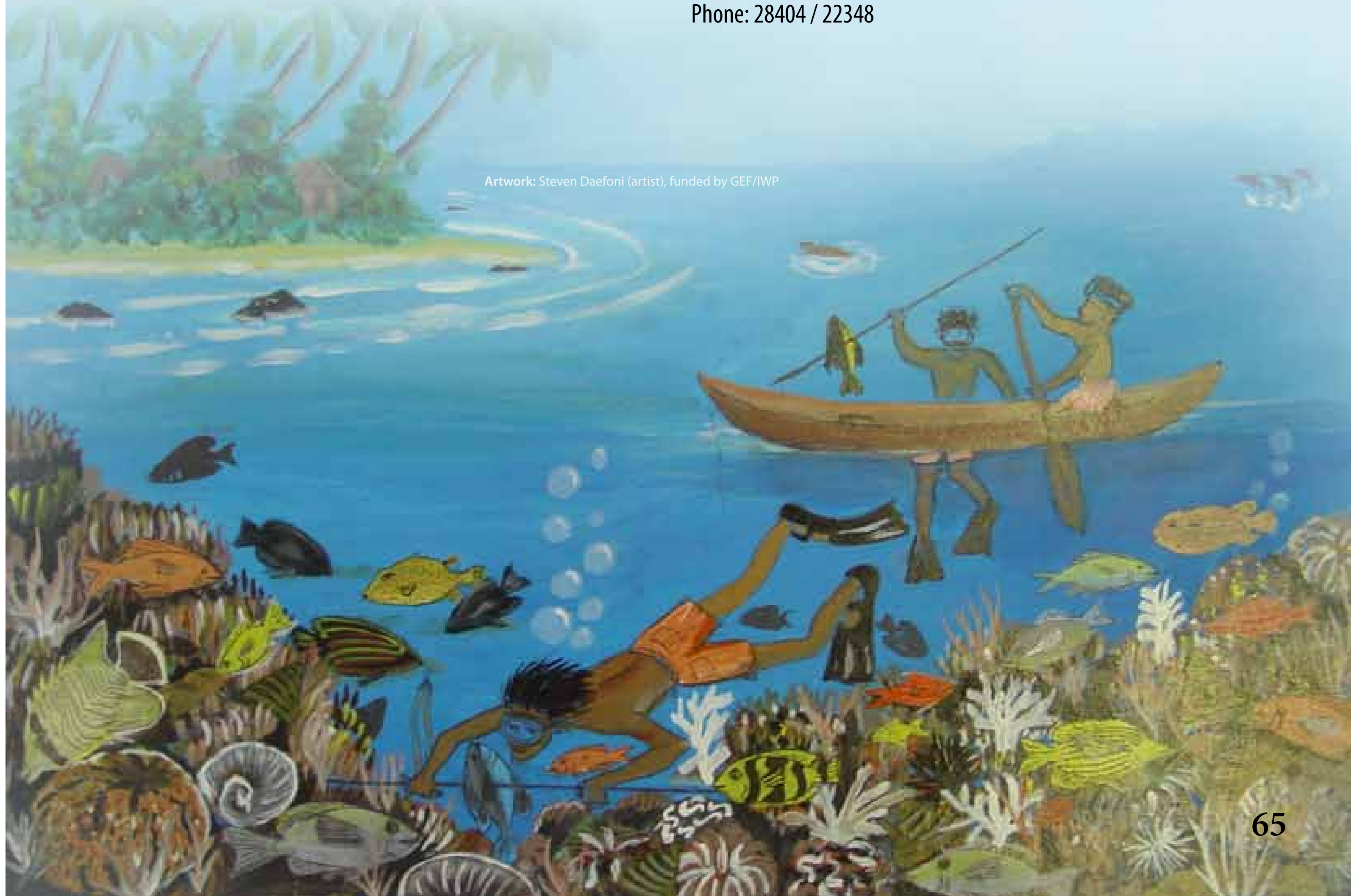
Can I be a SILMMA member?

SILMMA members may consist of individuals, communities, landowning groups, traditional leaders, government representatives, conservation organization staff, elected decision-makers, and university scientists who are working to achieve specific goals related to the conservation or sustainable management of marine resources and biodiversity in Solomon Islands. To become a member, contact Ministry of Fisheries—Phone: 30564

Who else can help?

If your community is interested in improving natural resource management in your land and sea areas, there are a number of groups in the Solomons that can help you or provide you with more information.

- **The Nature Conservancy** (TNC) Phone: 20940 Website: www.nature.org
- **WorldFish** Phone: 25090 Website: www.worldfishcenter.org
- **Foundation of the Peoples of the South Pacific International** (FSPI) Phone: 25389 Website: www.fspi.org.fj
- **WWF** Phone: 28023 Website: www.wwf.panda.org
- **Live and Learn** Phone: 23697 Website: www.livelearn.org
- **Solomon Islands Community Conservation Partnership** (SICCP) Phone: 23297 Website: www.siccp.org
- **Ministry of Environment, Conservation, Disaster and Meteorology** (MECDM) Phone: 23031
- **Landowners Advocacy and Legal Support Unit** (LALSU) Phone: 28404 / 22348



Artwork: Steven Daefoni (artist), funded by GEF/IWP

A guide for mangrove rehabilitation in Solomon Islands

The importance of mangroves

Mangroves are important ecosystems for the people of the Solomon Islands both for their value and many uses. Mangrove timber is used for building material, firewood, and making tools. The fruit of some mangroves is a valuable traditional food source. Mangroves also provide a home and nursery habitat for fish, shellfish and crabs. Mangrove trees help stabilise and protect the coastline from wind, waves and rough sea.

However there is not an endless supply.

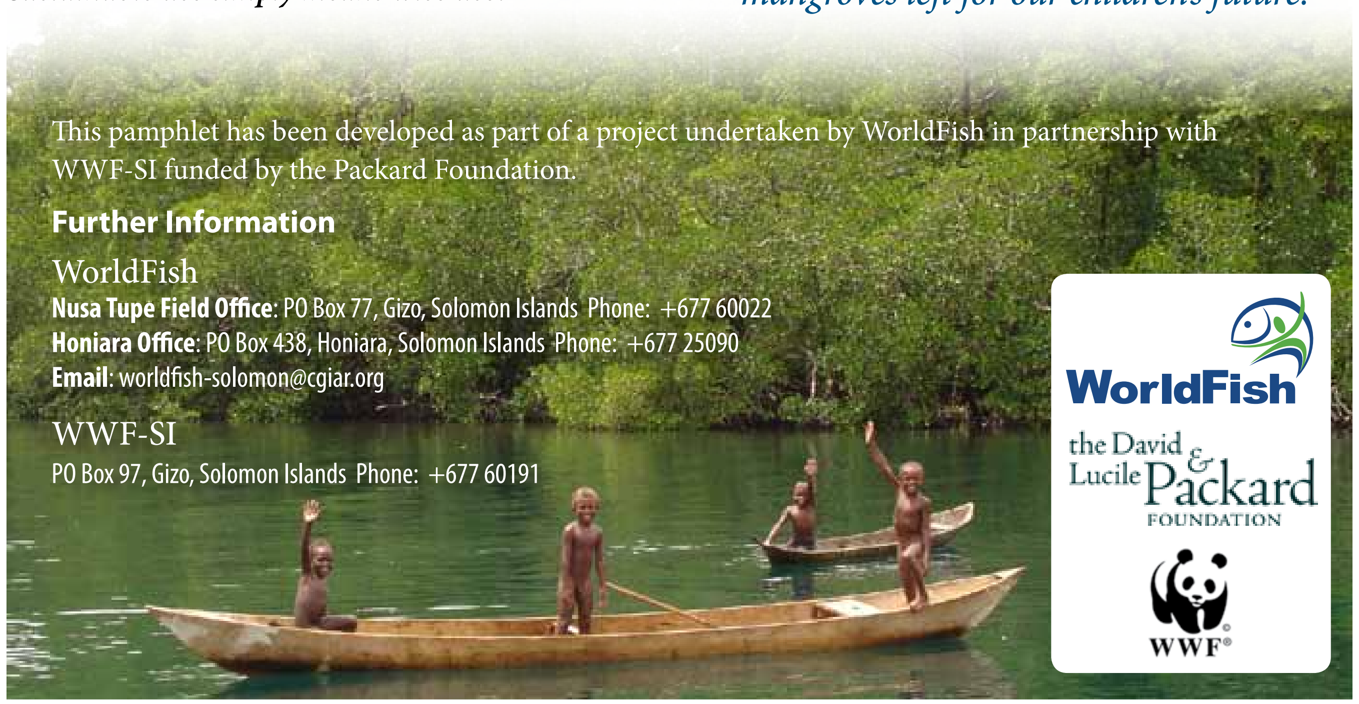
In some areas of the Solomon Islands there has been recent decline in mangrove forests due to overharvesting of mangroves (because of population increase), and in some places mangroves have been lost/destroyed by natural events such as earthquakes and tsunami.

Communities need to plan now to think about developing ways to help conserve and protect mangroves for future generations. This may include developing a management plan with rules for cutting down mangroves or re-invigorating traditional management methods.

Sustainable use simply means wise use.

→ *Only take what is really needed and do not destroy mangroves when it is not required.*

→ *All Solomon Islanders need to work together to help save mangroves to ensure there are mangroves left for our children's future.*



This pamphlet has been developed as part of a project undertaken by WorldFish in partnership with WWF-SI funded by the Packard Foundation.

Further Information

WorldFish

Nusa Tupe Field Office: PO Box 77, Gizo, Solomon Islands Phone: +677 60022

Honiara Office: PO Box 438, Honiara, Solomon Islands Phone: +677 25090

Email: worldfish-solomon@cgiar.org

WWF-SI

PO Box 97, Gizo, Solomon Islands Phone: +677 60191

WorldFish

the David & Lucile Packard FOUNDATION

WWF

Rehabilitation—why replant?

In most situations, mangrove forests are able to naturally grow and replace themselves through the distribution of seedlings from the mature mangrove trees within the local area. The fruit/seeds can float and are transported by water and start to grow in an area where they will survive. In some cases however, nature may need a helping hand. This is where mangrove rehabilitation projects can be of assistance.

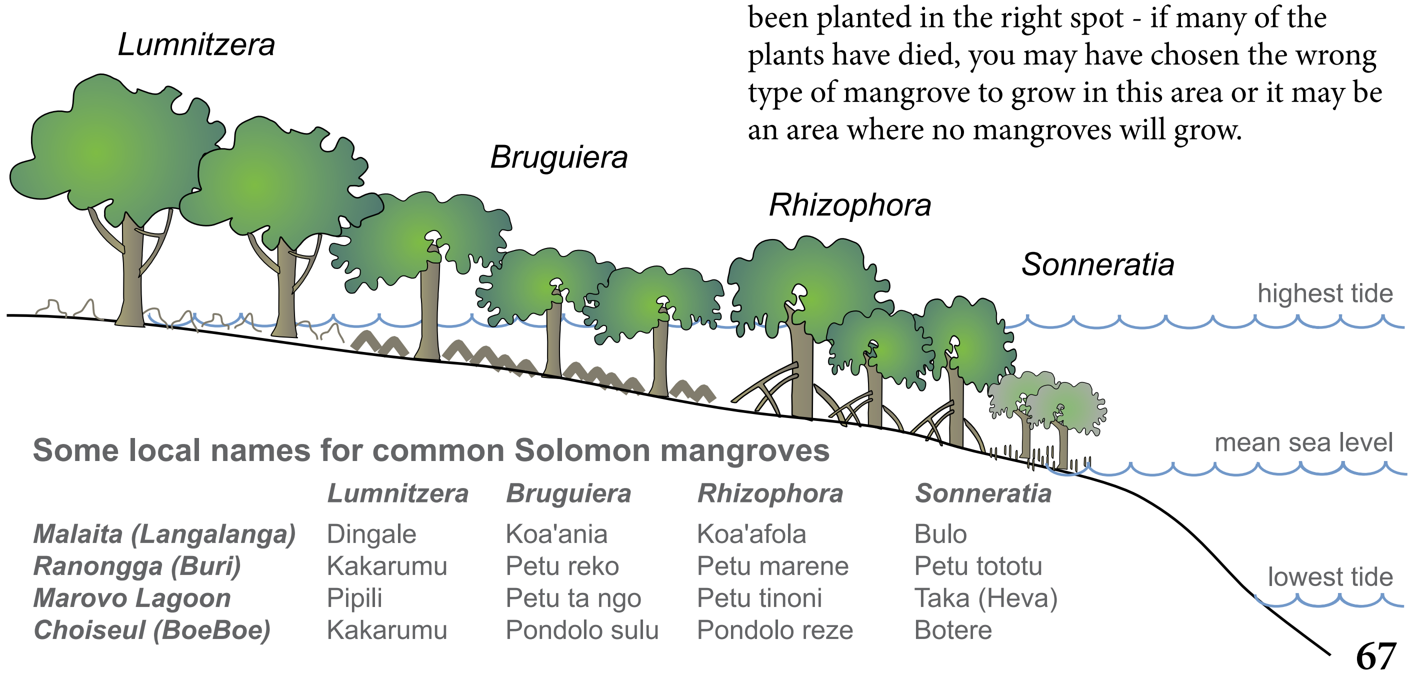
These cases may include:

1. Areas where mangroves have been dramatically overharvested in the past and there are few mangroves left to produce seedlings.
2. Areas where extensive areas of mangrove have been removed or severely damaged by external factors such as tsunami's, earthquakes, logging, building roads etc.

How to replant mangroves

1. What mangroves to plant where ?

Mangroves grow in coastal areas near the sea, but they do not grow anywhere. They grow best in between the highest tide and mean sea level in places sheltered from big waves. Within this zone, some mangroves grow better in different areas than others. The figure below shows the best place for four common mangroves. You should re-plant what mangroves were growing there before. If there are no plants left in the area - ask an elder what mangroves used to grow there before. If mangroves have never grown in a certain area - it is unlikely that they will never grow there.



Some local names for common Solomon mangroves

	Lumnitzera	Bruguiera	Rhizophora	Sonneratia
Malaita (Langalanga)	Dingale	Koa'ania	Koa'afola	Bulo
Ranongga (Buri)	Kakarumu	Petu reko	Petu marene	Petu tototu
Marovo Lagoon	Pipili	Petu ta ngo	Petu tinoni	Taka (Heva)
Choiseul (BoeBoe)	Kakarumu	Pondolo sulu	Pondolo reze	Botere

	Lumnitzera	Bruguiera	Rhizophora
Seedling type			
Planting depth	⅓ length	⅓ length	⅓ length
Between plants	1.5 - 2 m	1 - 1.5 m	1 - 1.5 m

2. Plan your planting

You need to sit down and plan the area that you want to re-plant. Make a map that shows where you will plant, where there are walking and canoe pathways etc. Make sure you discuss the plan with your family and community.

3. How to collect seedlings

Mangroves have seedlings that mature on the tree before falling to the ground. Mature seedlings can be collected from the ground (check there is no insect damage) or shake the tree and collect what falls down. The collected seedlings should be planted within a few days.

4. How to plant mangrove seedlings

Be careful not to damage seedlings when planting (use a stick to create a hole first). It is best to plant in clumps with 2-3 plants per clump (about 15 cm apart). Not all will survive, but the ones that die will provide food for the others. If your mangroves are being eaten by crabs, try cutting a piece of bamboo and place over the seedlings.

5. Monitor the mangroves growth and survival

Watch your planted mangroves grow. Mangroves that are growing leaves and looking healthy have been planted in the right spot - if many of the plants have died, you may have chosen the wrong type of mangrove to grow in this area or it may be an area where no mangroves will grow.

Sustainably farmed aquarium products from the Western Province, Solomon Islands

Culturing animals for the aquarium market has become an important source of income for some rural villages in the Western Province of the Solomon Islands. In many parts of the world overfishing, increases in human population, changes in land use and destructive fishing methods have reduced the health of reefs that serve as places for capture of marine ornamental species. The Solomon Islands is home to some of the most unspoilt coral reefs in the world. These reefs also provide the subsistence fishing needs for local communities. Sustainable farming and culture of animals for the aquarium market thus provides a way for a modest income for local people in a way that does not harm the reefs that they depend on. This sustainable farming uses the best possible practices to ensure that farmed aquarium products have minimal impact on the surrounding coral reef communities.

Clam farming

Giant clams are internationally protected by CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) meaning that globally, only hatchery-grown clams or clams from managed fisheries can be sold. In the Solomon Islands, giant clams are cultured by WorldFish with a hatchery located on Nusa Tupe, near Gizo. Broodstock (parent) clams, primarily *Tridacna derasa* (at this stage), are spawned and then nurtured in the small island hatchery for about 10 days. They are then transferred to land based tanks for about 8 months until they are big enough to be distributed to village 'farmers'. Village farmers grow out the clams in cages to ensure that they are safe from predators. Clams are kept clean and are periodically thinned to provide ideal conditions for healthy growth. After less than a year the clams are ready for export to the international aquarium market.

Coral farming

Coral farming is being developed as a village-based sustainable industry. Hard and soft corals are cultured from cuttings using sustainable techniques. Initially brightly coloured broodstock corals are selected from the reef and kept on steel trestles. Once these broodstock are established, they provide future cuttings that are grown onto to small cement discs. After a few months, the cuttings attach to the cement disc and the base of the coral begins to grow out and start to cover the disc creating an attractive product ready for export. Once the broodstock is grown and established, there is no need for further corals to be removed from the reef. This also means that the right coral stock is easily accessible. At this stage mostly soft and hard corals are cultured, however over time this will expand to include sponges and other reef animals that can be sold as part of the aquarium market.

Shrimp and lobster farming

Techniques for the farming of shrimp and lobster are based on the capture and culture of postlarval animals. Postlarval animals are in their final stage before becoming a juvenile and they have spent the last weeks drifting in the open sea. These postlarval animals come back to the reef to find a new home to live in. During this time many of the animals naturally die or are eaten anyway as part of the process of returning to the reef, so it is sustainable to catch some of these animals during this time. The village farmer catches the postlarval shrimp and lobster when they are returning to the reef. These animals are then kept in a grow-out area for a few weeks until they grow to export size. Exporters find that these farmed animals are better for the aquarium industry as they are used to being handled and artificially fed.

The future of sustainably cultured products

The best possible practices are used to ensure that farmed aquarium products produced by farmers in the Western Province of the Solomon Islands are ecologically sustainable. In this way there is minimal impact on coral reef communities, and at the same time providing an income to some of the poorest people in the Pacific.

There are however, extra costs associated with culturing corals and clams rather than just extracting them from a natural reef. So, the future lies with the consumers, those that buy these products. Only if people choose to buy sustainably cultured products will the economic viability of village-based sustainable farming be assured.

This work has been funded originally through the ACIAR and more recently through an NZAID funded project "Creating Rural Livelihoods in Solomon Islands through Environmentally-Friendly Aquaculture and Trade of Marine Ornamentals".

◇◇◇

For further information about this project, please contact:

WorldFish
Nusa Tupe
PO Box 77, Gizo
Western Province, Solomon Islands

Phone: 60022 Email: worldfish-solomon@cgiar.org

or contact the WWF-SI Office, Gizo. Phone: 60191.

Solomon Sea Sustainables

WWW.SOLOMONSEASUSTAINABLES.COM


Reef monitoring training in Marovo


Anthony Plummer (www.anthonyplummer.com)

Reef monitoring on Tetepare

Coral reef monitoring

Introduction

Coral reefs are always changing due to natural and human disturbances. The amount of coral, algae, invertebrates and fish can change over time and between different locations. When snorkelling on coral reefs we can observe these differences between reefs. Reef monitoring is a formalised way to document these changes and get an estimate of the condition of fish, coral, invertebrates and algae on the reef.

Around the world there are global networks of scientists monitoring coral reefs. See website:

→ *www.gcrmn.org*

There is also a network of community members monitoring coral reefs. See website:

→ *www.reefcheck.org*

Why monitor?

Accurately monitoring coral reefs provides important information about:

- How the reef condition has changed over time
- If management actions are working
- How biodiverse or productive a reef is
- How the reef condition compares to other reefs around the world

This information can be useful to help reef owners and managers decide whether they should place management restrictions on their reef or if existing management restrictions are working. For example if a community has decided to stop night spearfishing on their reefs they could monitor fish and coral populations to determine if the management is leading to an increase in fish size or number.

Just swimming over the reef and looking at the water quality, corals and fish is also useful. Without any training you can still look at the reef and see if your management plan is working.

Monitoring methods — Reef

How to do the reef survey

1. Select location where water depth is about 2m and fill in the top of the sheet. Repeat transects should be more than 20m apart from each other. Fill in top of datasheet.

name: Simon Albert habitat: Reef crest

date: 13/6/10 time: 10:20am tide: low transect length: 50m

location: reef on south of Totolave island

management (closed/open): tabu area-closed for 9 months

2. Place weight on bottom and unwind transect tape in a straight line over the reef, try to stay in 2m of water.
3. Swim back to beginning of tape.
4. Identify what is directly under each metre mark. If tape stretches over a hole, try to see what is at the bottom. Make a mark on the datasheet next to what you see. It should be one of these:

massive coral
branching coral
soft coral
algae

dead coral
bleached coral
rock/rubble/sand

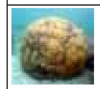
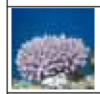
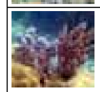
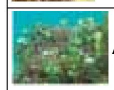
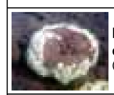
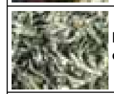
5. Swim slowly along the whole 50m transect tape and write down what is under each metre mark. Start at 1m, finish at 50m.
6. When you have finished, wind up the transect tape onto the reel.
7. Try and do three transects at each location. Repeat transects should be more than 20m apart from each other. Your completed sheet should look something like this one to the right.
8. When completed copy the data into the Data Record Book.

name: Simon Albert habitat: Reef crest

date: 13/6/10 time: 10:20am tide: Low transect length: 50m

location: reef on south of Totolave island

management (closed/open): tabu area-closed for 9 months

	Transect 1	Transect 2	Transect 3
 Massive Coral	IIIIIII III	IIIIIII IIIIII	IIIIII
 Branching Coral	IIIIIII	IIII	IIIIIII IIIIII
 Soft Coral	IIIIIII	IIII	IIIIIII
 Algae	IIIIIIII	IIIIII	IIIIIII
 Bleached Coral (massive or branching)	III		
 Recently dead coral (massive or branching)	IIIIIIII I	IIIIIII III	IIIIIII IIIIII
 Rock, Rubble or Sand	IIIIIII III	IIIIIIII IIIIII	IIIII
Other			

Monitoring methods — Reef

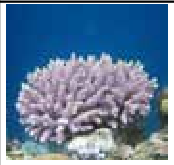
Datasheet—Reef

name: ______ habitat: ______

date: ______ time: ______ tide: ______ transect length: ______

location: ______

management (closed/open): ______

	Transect 1	Transect 2	Transect 3
 **Massive Coral**			
 **Branching Coral**			
 **Soft Coral**			
 **Algae**			
 **Bleached Coral** (massive or branching)			
 **Recently dead coral** (massive or branching)			
 **Rock, Rubble or Sand**			
Other			

Monitoring methods — Invertebrates

How to do the invertebrate survey

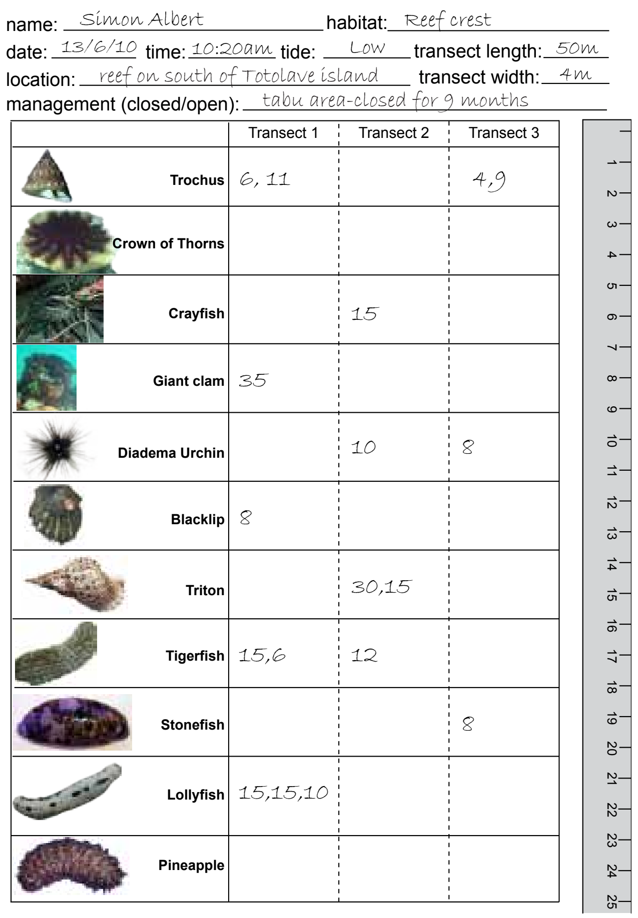
1. Select location where water depth is about 2m and fill in the top of the sheet. Repeat transects should be more than 20m apart from each other.

name: Simon Albert habitat: Reef crest
date: 13/6/10 time: 10:20am tide: low transect length: 50m
location: reef on south of Totolave island transect width: 4m
management (closed/open): tabu area-closed for 9 months

2. Place weight on bottom and unwind transect tape in a straight line over the reef, try to stay in 2m of water.
3. Swim back to beginning of tape.
4. Slowly swim along the transect tape looking out for any invertebrates. When you find one estimate its size and write it in the box on the datasheet. Invertebrates to look for are:

trochus
crown of thorns
crayfish
giant clam
diadema urchin
blacklip
triton
tigerfish
stonefish
lollyfish
pineapple

5. When you have finished, wind up the transect tape onto the reel.
6. Try and do three transects at each location. Repeat transects should be more than 20m apart from each other. Your completed sheet should look something like this one to the right.
7. When completed copy the data into the Data Record Book.

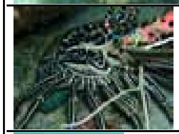
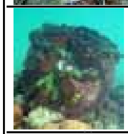
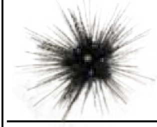
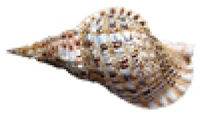
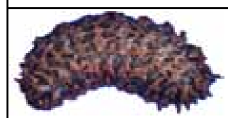

name: Simon Albert habitat: Reef crest
date: 13/6/10 time: 10:20am tide: Low transect length: 50m
location: reef on south of Totolave island transect width: 4m
management (closed/open): tabu area-closed for 9 months

	Transect 1	Transect 2	Transect 3
Trochus	6, 11		4,9
Crown of Thorns			
Crayfish		15	
Giant clam	35		
Diadema Urchin		10	8
Blacklip	8		
Triton		30,15	
Tigerfish	15,6	12	
Stonefish			8
Lollyfish	15,15,10		
Pineapple			

Monitoring methods — Invertebrates

Datasheet—Invertebrates

name: ______________________ habitat: ______________________
date: ________ time: ________ tide: ________ transect length: ________
location: ______________________ transect width: ________
management (closed/open): ______________________

	Transect 1	Transect 2	Transect 3
 Trochus			
 Crown of Thorns			
 Crayfish			
 Giant clam			
 Diadema Urchin			
 Blacklip			
 Triton			
 Tigerfish			
 Stonefish			
 Lollyfish			
 Pineapple			

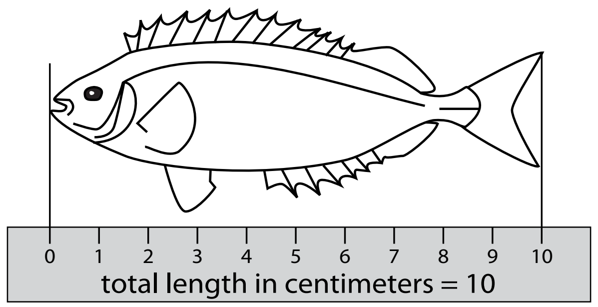
Monitoring methods — Fish

How to do the fish survey

1. Choose the fish species you want to monitor and write them in blank sections of datasheet. Some possible indicator fish can be found in the back of this book.
2. Select location where water depth is about 2m and fill in the top of the sheet. Repeat transects should be more than 20m apart from each other.

name: Simon Albert habitat: Reef crest
date: 13/6/10 time: 10:20am tide: low transect length: 50m
location: reef on south of Totolave island transect width: 4m
management (closed/open): tabu area-closed for 9 months

3. Place weight on bottom and unwind transect tape in a straight line over the reef, try to stay in 2m of water.
4. Swim back to beginning of tape and wait quietly for 5 minutes for fish to return.
5. Look for fish that are up to 2m from the tape.
6. If you see any fish that are on the list, estimate its total length in centimetres, from its mouth to tip of its tail. Don't include any fish under 4cm.



7. Swim slowly along the whole 50m transect tape looking for fish that are 2m or closer to the tape and estimating their length.
8. Add the length of each fish you see in the box next to its picture and name.
9. When you have finished, wind up the transect tape onto the reel.
10. Try and do three transects at each location. Repeat transects should be more than 20m apart from each other. Your completed sheet should look something like this one to the right.
11. When completed copy the data into the Data Record Book.

name: Simon Albert habitat: Reef crest
date: 13/6/10 time: 10:20am tide: Low transect length: 50m
location: reef on south of Totolave island transect width: 4m
management (closed/open): tabu area-closed for 9 months

Fish size estimate (only if bigger than 4cm)

Fish		Transect 1	Transect 2	Transect 3
Parrotfish	Bumphead Parrotfish	40	25	
	Longnose	25		
Groupers	Coral Trout	15,25,10		35
	Barramundi cod			
Emperor	Thumb-print Emperor	17	23	
	Big eye			
	Longface			
	Thumbprint		28	
Sweetlip	Spotted sweetlip			
	Giant		35	
Wrasse	Maori Wrasse (adult)			
	Tusk	13		9
Rabbitfish	Goldspot rabbitfish			
	Barred	3x15	8	
Snapper	Paddle-tail snapper		8x10	15,20
	Blubberlip	28	20	
	Mangrove		25	
	Red bass			
Surgeonfish	Striped surgeonfish	6x10	10,5	
	Ringtail	3x8		20
Butterflyfish	Vagabond butterflyfish	7		
	Eclipse	7		9
Triggerfish	Orange-lined triggerfish			
	Titan			
Other species draw	name			

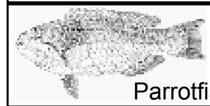
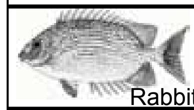
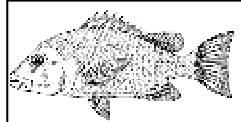
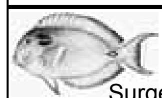
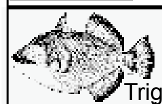
centimeters

Monitoring methods — Fish

Datasheet—Fish

name: ______________ habitat: ______________
date: ________ time: ________ tide: ________ transect length: ________
location: ______________ transect width: ________
management (closed/open): ______________

Fish size estimate (only if bigger than 4cm)

Fish		Transect 1	Transect 2	Transect 3
 Parrotfish	Bumphead Parrotfish			
 Groupers	Coral Trout			
	Barramundi cod			
 Emperor	Thumb-print Emperor			
 Sweetlip	Spotted sweetlip			
 Wrasse	Maori Wrasse (adult)			
 Rabbitfish	Goldspot rabbitfish			
 Snapper	Paddle-tail snapper			
 Surgeonfish	Striped surgeonfish			
 Butterflyfish	Vagabond butterflyfish			
 Triggerfish	Orange-lined triggerfish			
Other species draw	name			

centimeters


Hawksbill turtle

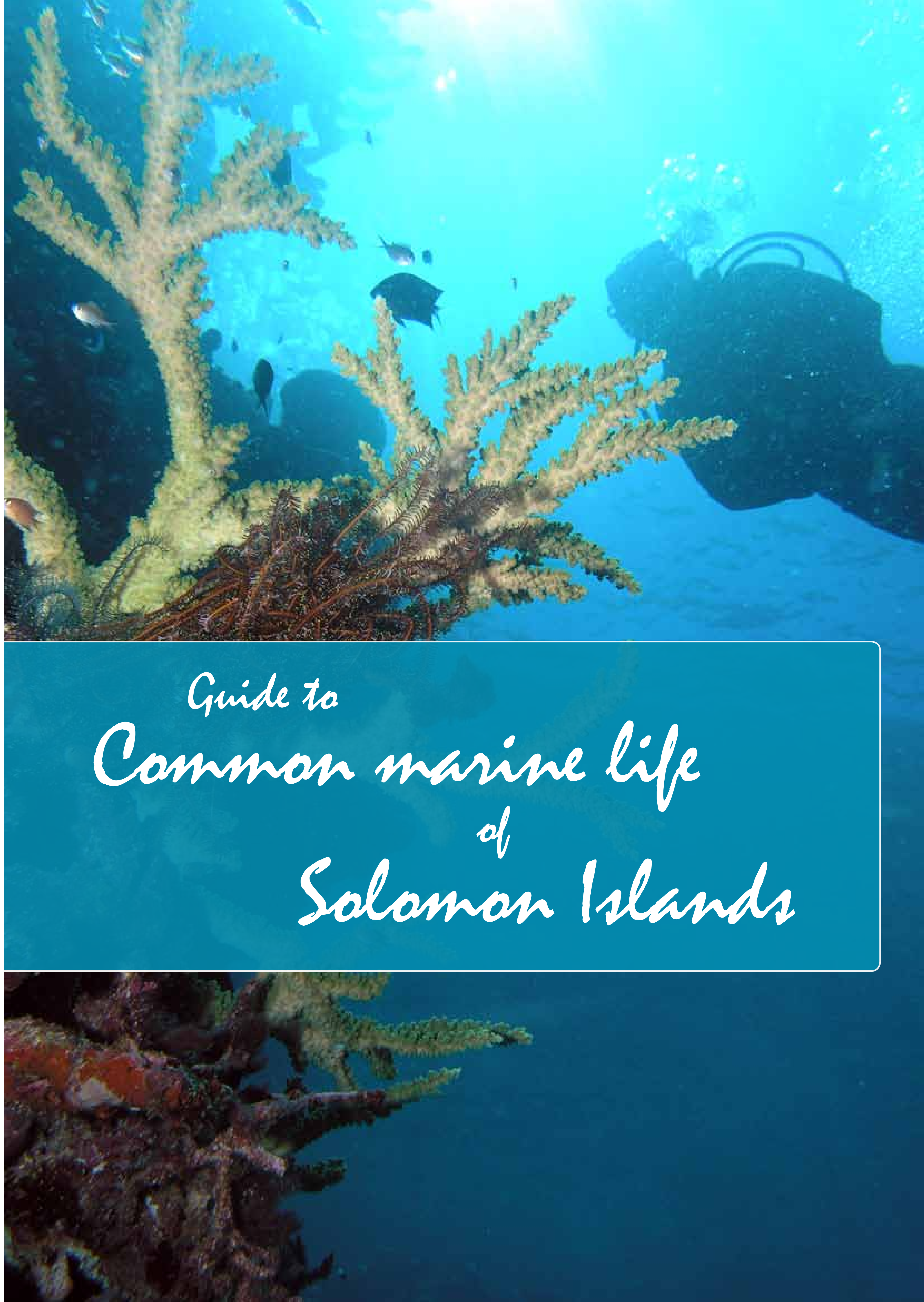

Cleaner wrasse (right)


Manta ray


Nautilus


Blue sea-star


Blue trevally



Guide to Common marine life of Solomon Islands

Seagrass

Language name: ____________________

Scientific name: *Enhalus acroides*

Description: Tall (50-150cm) seagrass with curled edges on leaves.

Habitat: Grows in shallow (0.5-2 m) water, normally next to mangroves.

Uses: The seeds are used as food by people in south east asia, the pacific and Australia. The seeds can be dried and ground into flour.

Language name: ____________________

Scientific name: *Thalassia hemprichii*

Description: Wide, flat leaf 2cm wide and 10-20cm high. Leaves often curved. Small dark specks in leaves. Dark hairy roots.

Habitat: Shallow reefs and creek mouths.

Language name: ____________________

Scientific name: *Halodule uninervis*

Description: Straight leaves <1 cm wide and 5-15 cm high. Leaf tip pointed.

Habitat: Found in shallow water mixed with *Halophila ovalis* or *Enhalus acroides*

Uses: Energy rich shoots favoured by dugongs.

Language name: ____________________

Scientific name: *Halophila ovalis*

Description: Small oval shaped leaves 2 cm wide and 2-4 cm high.

Habitat: Widespread in shallow and deep areas.

Uses: Energy rich shoots favoured by dugongs.

Language name: ____________________

Scientific name: *Halophila decipians*

Description: Small oval shaped leaves 2 cm wide and 2-4 cm high. Small spines surround edge of leaf.

Habitat: Widespread in shallow and deep areas

Uses: Energy rich shoots favoured by dugongs.

Language name: ____________________

Scientific name: *Cymodocea serrulata*

Description: Wide, flat leaf <2cm wide and 10-20cm high. Leaves often curved. Leaf tip with small spines.

Habitat: Common in shallow reefs close to islands.

Language name: ____________________

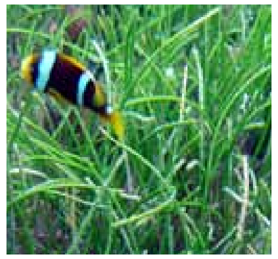
Scientific name: *Cymodocea rotundata*

Description: Wide, flat leaf 1cm wide and 10-20cm high. Leaves often curved. Leaf tip rounded and smooth.

Habitat: Common in shallow reefs close to islands.

Language name: ____________________

Scientific name: *Syringodium isoetifolium*



Description: Leaves are round thin cylinders, normally 10-50cm high. Leaves float when broken. Habitat: Syringodium generally grows in dense mono-specific meadows in 2-5 m of water.

Uses: *Syringodium* is soaked in vinegar and eaten as a salad vegetable in some parts of Asia.

Algae

Language name: ____________________

Scientific name: *Sargassum*

Description: *Sargassum* is a large brown algae that can grow to over a metre long. It connects to hard rocky surfaces with a 'holdfast'. It produces numerous small gas filled 'vesicles' that enable it to float up to the surface of the water and be exposed to sunlight for photosynthesis. Often large clumps of *Sargassum* break off the bottom and float around the water surface.

Habitat: In some areas, *Sargassum* grows on rocks close to villages.

Uses: In Southern Japan (Okinawa) *Sargassum* is mixed with vinegar and eaten. In many areas around the world Sargassum is used as a fertiliser for gardens (leave it in the rain first to rinse the salt off).

Language name: ____________________

Scientific name: *Halimeda*

Description: *Halimeda* is a green algae that grows in small clumps attached to coral reefs or sandy areas. *Halimeda* is hard and crunchy because of the calcium carbonate it produces. *Halimeda* is made up of several small segments that are joined together to form large (up to 50cm) clumps.

Habitat: There are many species of *Halimeda* in the Solomons, some grow amongst corals on the outer reefs, others can be found growing in deep sandy areas on the bottom of lagoons and reefs and some grow amongst seagrass in shallow areas.

Uses: *Halimeda* has been traditionally used in some parts of the Solomons to smooth down wooden canoes when they are being made. More recently it has also been used to clean algae off the hulls of modern fibreglass boats.

Language name: ____________________

Scientific name: *Caulerpa racemosa*

Description: *Caulerpa* is a fleshy green algae with a series of small 'grapes' growing along its length.

Habitat: Generally found on reefs or seagrass beds close to large islands where the water is dirtier.

Uses: Can be eaten raw or cooked as a vegetable.

Language name: ____________________

Scientific name: *Caulerpa*

Description: A rough green type of *Caulerpa* growing in a spiral shape

Habitat: Generally found on reefs or seagrass beds close to large islands where the water is dirtier.

Uses: Can be eaten raw or cooked as a vegetable.

Language name: ____________________

English name: Turf algae

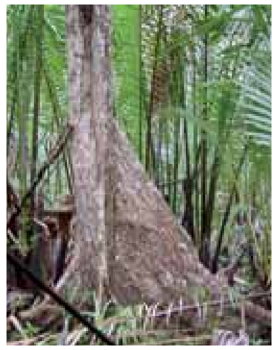
Description: Turf algae is a general term for small growths of algae that form dense patches or turfs. There are numerous algal species from the green, brown and cyanobacteria groups that can form these turfs.

Habitat: Generally found growing on hard substrates like dead coral or on the bottom of canoes.

Mangroves

Language name: ____________________

English name: Keeled-pod mangrove



Scientific name: *Heritiera littoralis*

Uses: The timber used in construction and decorative wood carving. The wood is very strong when dry, and is used also for planks, spear shafts, and the reinforced stern pieces that hold outboard motors of large dugout canoes.

Language name: ____________________

English name: Large-leafed orange mangrove

Scientific name: *Bruguiera gymnorhiza*

Uses: Fruit is prepared, grated and washed (to remove tannins), cooked with coconut and served with tuna as a stew or pudding.

Language name: ____________________

English name: Mangrove palm

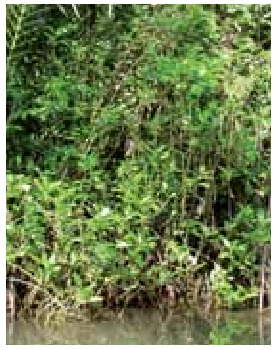
Scientific name: *Nypa fruticans*

Habitat: Upstream river estuaries

Uses: The foliage is used for walls of leaf houses.

Language name: ____________________

English name: Holly mangrove



Scientific name: *Acanthus ilicifolius*

Description: Purple flowers and shiny dark leaves with sharp pointed edges. Crocodiles often rest under the Holly mangrove waiting for food to come in.

Language name: ____________________

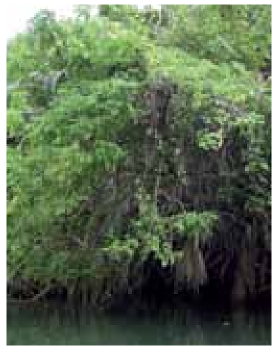
English name: Mangrove fern

Scientific name: *Acrostichum speciosum*

Habitat: Upstream river estuaries

Language name: ____________________

English name: Trumpet mangrove



Scientific name: *Dolichandrone spathacea*

Habitat: Upstream river estuaries

Uses: The wood is used for various canoe parts and sometimes for carving. The timber grows back quickly after being cut.

Language name: ____________________

English name: Red-flowered black mangrove

Scientific name: *Lumnitzera littorea*

Uses: The timber is used in construction. It is favoured as central support poles in leaf houses in the tidal zone. It is also used as jetty posts. It is known locally as a hardy and resistant timber. The trunks are straight growing and the wood is resistant to saltwater. The wood is also good for spear shafts, canoe masts, sawn planks and other house materials.

Mangroves

Language name: ____________________

English name: White-flowered holly mangrove

Scientific name: *A.ebracteatus* subsp. *ebracteatus*

Language name: ____________________

English name: Reflexed orange mangrove

Scientific name: *Bruguiera cylindrica*

Uses: The timber is used for house poles because the stems are slender, very straight and strong.

Language name: ____________________

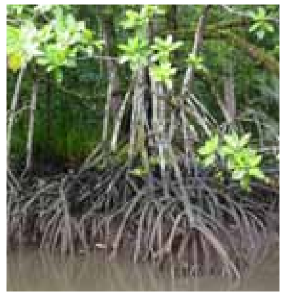
English name: Cannonball mangrove

Scientific name: *Xylocarpus granatum*

Uses: It has beautiful timber for decorative wood carving. The wood also provides special firewood for burning coral lime. At Bughotu, they use it to make dugout canoes.

Language name: ____________________

English name: Upriver stilt mangrove



Scientific name: *Rhizophora mucronata*

Language name: ____________________

English name: Rib-fruited yellow mangrove

Scientific name: *Ceriops tagal*

Uses: The timber is popular because it is hard and burns hot and long in cooking fires. It also makes good poles for house materials. It is particularly good for the hard sharpened sticks that are used for husking coconuts. The fruits are edible. Birds nest and sleep in the branches and eat the fruits.

Language name: ____________________

English name: Milky mangrove

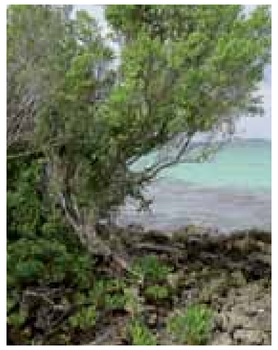
Scientific name: *Excoecaria agallocha*

Habitat: The name means 'of much sap' and this is harmful to people's eyes. Even smoke from burning wood may cause sore eyes.

Uses: Dead wood without sap is very good for slow-burning fire-sticks that are carried around, and for fuel for cooking fires. Leaves and foliage are used as a medicinal for stonefish stings. The puncture wound is held over the smoke of burning/smoldering leaves. The milky sap may also be pushed into the wound to speed up recovery.

Language name: ____________________

English name: Reef barrier mangrove



Scientific name: *Pemphis acidula*

Uses: This plant has very hard, heavy and tough wood. It is used for a great number of special tools including mortar pestles, sharpened sticks for husking coconuts and weapons.

Coral

Language name: ____________________

English name: Mushroom Coral

Scientific name: *Fungiidae*

Description: Small solitary corals up to 50cm wide.

Habitat: Live in sandy areas amongst coral reefs or seagrass.

Uses: Used for grating local 'putty nuts' when making canoes.

Language name: ____________________

English name: Brain Coral

Scientific name: *Platygyra*

Description: A rounded massive coral with a maze like pattern on its surface.

Habitat: Generally found on outer reefs in clean water.

Language name: ____________________

English name: Branching Coral

Scientific name: *Acropora* and *Pocillopora*

Description: Sharp pointy coral with numerous small branches.

Habitat: Widespread across all reefs in Marovo.

Uses: Important habitat for small fish. Harvested to produce binu for betel nut chewing.

Language name: ____________________

English name: Soft Coral

Scientific name: *Sarcophyton*, *Xenia*

Description: Soft fleshy corals normally yellow or brown in colour. Small polyps can often be seen covering soft corals, although these retract when the corals are disturbed.

Habitat: Occur throughout the Solomons, but are more common on reefs with dirtier water.

Uses: Soft corals can be used to scrub algae from the bottom of canoes.

Language name: ____________________

English name: Sub-massive coral

Scientific name: *Heliopora*

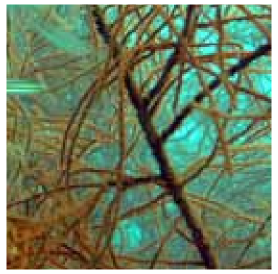
Description: Dark coloured hard coral forming dense colonies to 4 m.

Habitat: Occasionally found in sheltered areas of lagoons and inshore reefs.

Language name: ____________________

English name: Black Coral

Scientific name: *Cirrhipathes*



Description: A large branching black coloured coral.

Habitat: Black coral grows on coral reefs to depths of over 50 metres but can also be found in shallower areas.

Uses: Used to make jewellery although over-harvesting is making black coral endangered in some reefs around the world.

Language name: ____________________

English name: Cauliflower Coral

Scientific name: *Pocillopora*

Description: Short stumpy branched coral with rounded ends. Grows in small isolated colonies.

Habitat: Generally found in the cleaner waters of the outer reefs.

Coral

Language name: ____________________

English name: Plate Coral

Scientific name: *Acropora*

Description: Flat colonies of corals with small branches, generally 50-100 cm in diameter.

Habitat: Normally found growing in clear waters of the outer reefs, although some large plate corals occur on inshore reefs.

Uses: Traditionally used for building shrines associated with headhunting.

Language name: ____________________

English name: Cabbage coral

Scientific name: *Montipora* sp.

Description: Hard plate like coral growing in stacked layers.

Habitat: Found throughout the Solomons, dominates on steep coral walls with high current.

Language name: ____________________

English name: Massive coral

Scientific name: *Porites*

Description: Large rounded coral that can grow over 5 metres in height. Often brown, yellow or purple in colour.

Habitat: Found throughout the Solomons on inshore and outer reefs.

Uses: Often harvested to build jetties and wharves, also an important habitat for crayfish and bêche-de-mer.

Invertebrates

Language name: ____________________

English name: Trochus

Scientific name: *Trochus niloticus*

Description: A medium to large sized sea snail (gastropod), can get as large as 13cm. It has a thick inner layer of nacre, also known as mother of pearl.

Habitat: They live either intertidally or in the shallow subtidal. Trochus in the Solomons are commonly found living in the shallow outer areas of the barrier reefs.

Uses: Since the 19th century, Trochus has been the most important commercial shell and is therefore quite scarce today. Trochus was traditionally used as a material for armrings.

Language name: ____________________

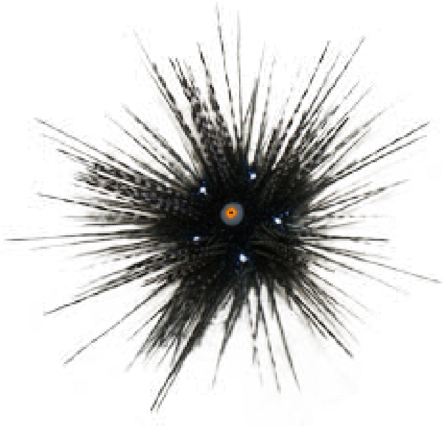
English name: Sea urchin

Scientific name: *Diadema savignyi*

Description: It is a small ball shaped invertebrate with large black spines covering it. It has hundreds of tube feet around its 'test', also known as their shell. They are detritivores and like to eat algae and sponges.

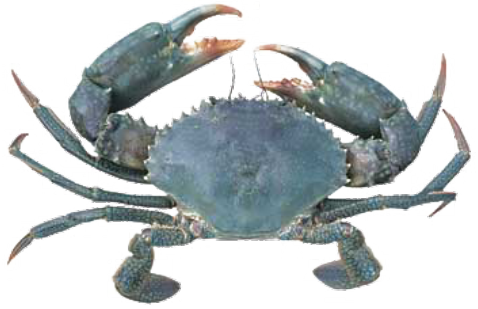
Habitat: These sea urchins can be found up to 70 m deep. They live on the sandy bottom, sea grass beds and on damaged parts of coral reefs.

Uses: In some Asian countries they eat sea urchin, Japanese consider the gametes to be a delicacy.



Language name: ____________________

English name: Mud crab



Scientific name: *Scylla serratea*

Description: A large crab with very large claws and a dark green to brown shell. They can grow up to 3.5 kg in size and 24 cm wide. The females can lay up to 5 million eggs.

Habitat: The mud crab is commonly found in mangroves and estuaries.

Uses: Mud crab is a popular food to eat in the Solomons and many other countries.

Language name: ____________________

English name: Crown of Thorns Starfish

Scientific name: *Acanthaster planci*

Description: Large green and red coloured starfish up to 100 cms across. Can have 12-21 arms that are covered in numerous large toxic spines. Usually observed at night feeding on coral.

Habitat: Crown of thorns live in coral reefs, hiding under rocks during the day before coming out to feed on corals curing the night. They are often found in high numbers on outer reefs or passages.

Language name: ____________________

English name: Fire Coral

Scientific name: *Millepora*

Description: Not actually a "coral" , it is a Hydrozoan. Orange coloured branching Hydrozoan with smooth edges. Can cause a hot burning feeling on the skin when touched.

Habitat: Generally found on shallow reef flats in areas which have been disturbed from canoes or people walking.

Invertebrates

Language name: ____________________

English name: Mangrove cockle

Scientific name: *Polymesoda erosa*

Description: A large bivalve shell found within mangrove habitats.
Important food source for many rural communities.

Habitat: Found in sheltered mangrove habitats around the Solomon Islands. They can be submerged in soft mangrove sediments to a depth of 1m.

Reproduction: They are either male or female and they reproduce (breed) by sending their eggs and sperm into the water where they meet and start to grow into juvenile shells. After approximately two weeks, these juveniles settle into the mud to start their new life. They are able to reproduce when they are bigger than 35 millimetres wide.

Language name: ____________________

English name: Giant clam

Scientific name: *Tridacna gigas*

Description: Giant clams can grow to over 1 m long, making it the largest bivalve on earth. They can live for over 100 years. Giant clams feed by filtering phytoplankton from large amounts of seawater, these acts as a filter to keep the water clean. They have symbiotic algae that live in their tissue and provide carbon from photosynthesis (similar to the algae living in corals).

Habitat: Giant clams are found on shallow reefs and near passages.

Language name: ____________________

English name: Blue sea star

Scientific name: *Linckia laevigata*

Description: A blue sea star that can grow up to 30 cm in diameter. Some individuals have light or dark spots on their arms.

Habitat: This sea star is commonly found in the shallow reefs of the Indo-Pacific. They live subtidally or intertidally on the fine sand or hard substrate.

Uses: In some parts of the Indo-Pacific this sea star has been a part of the shell trade. Some areas where this sea star are commonly found have seen a population decline due to the harvesting industry and tourists.

Language name: ____________________

English name: Painted Crayfish

Scientific name: *Panulirus versicolor*

Description: Large crustacean up to 50 cm in length. Its brightly coloured red, green, white and blue body give it the name painted crayfish.

Habitat: Found in rocky or coral reefs down to 15m in depth. Common both on inshore reefs and exposed weather coasts. Often hides under large corals during the day and come out at night to feed.

Bêche-de-mer

Language name: ____________________

English name: Prickly redfish

Scientific name: *Thelenota ananas*

Habitat: Reef slopes near passages, hard bottoms with large rubble and coral patches, at depths of 0-25 m.

Average size: 45 cm and 2.5 kg

Language name: ____________________

English name: Elephant trunkfish

Scientific name: *Holothuria fuscopunctata*

Habitat: Reef slopes and shallow seagrass beds, found 0-25 m deep.

Average size: 36 cm and 1.5 kg

Language name: ____________________

English name: Brown curryfish

Scientific name: *Stichopus hermanni*

Habitat: Reef slopes and flats, sandy/ muddy seagrass habitats with some coral patches. They are found between 0-30 m deep.

Average size: 35 cm and 1 kg

Language name: ____________________

English name: Blackfish

Scientific name: *Actinopyga miliaris*

Habitat: Reef flats of fringing and lagoon reefs at depths of 0 -10 m.

Average size: 25 cm and 0.4 kg

Language name: ____________________

English name: Brown sandfish

Scientific name: *Bohadschia vitiensis*

Habitat: Coastal lagoons and inner reef flats. They like to burrow in the sediment, especially the muddy sediment. Found from 0–20 m deep.

Average size: 32 cm and 1.2 kg

Language name: ____________________

English name: Stonefish

Scientific name: *Actinopyga lecanor*

Habitat: Hard substrates at depths of 0-25 m. They are nocturnal; during the day they are under stones or gaps in the reef.

Average size: 25 cm and 0.4 kg

Bêche-de-mer

Language name: ____________________

English name: Surf redfish

Scientific name: *Actinopyga mauritiana*

Habitat: Outer reef flats and fringing reefs at depths of 0-10 m.

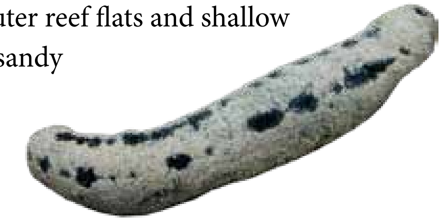
Average size: 20 cm and 0.3 kg

Language name: ____________________

English name: Lollyfish

Scientific name: *Holothuria atra*

Habitat: Inner and outer reef flats and shallow lagoons. Plentiful on sandy and muddy substrate with coral rubble and some times found in sea grass beds. Found from 0–20 m.



Average size: 20 cm and 0.2 kg

Language name: ____________________

English name: White teatfish

Scientific name: *Holothuria fuscogilva*

Habitat: Outer barrier reef, passages, sometimes found in shallow seagrass beds. Found at 0-40 m deep.

Average size: 42 cm and 2.4 kg

Language name: ____________________

English name: Snakefish

Scientific name: *Holothuria coluber*

Habitat: Reef slopes and flats, hard substrates. They are found between 0-6 m deep.

Average size: 100 cm and 0.5 kg

Language name: ____________________

English name: Black teatfish

Scientific name: *Holothuria nobilis*

Habitat: Reef flats, slopes, and shallow seagrass beds. Found in depths of 0-20 m.

Average size: 37 cm and 1.7 kg

Holuthuria nobilis

Bêche-de-mer

Language name: ____________________

English name: Peanutfish

Scientific name: *Stichopus horrens*

Habitat: Reef flats and rubble slopes. They are found between 0-15 m deep.

Average size: 20 cm and 0.2 kg

Language name: ____________________

English name: Sandfish

Scientific name: *Holothuria scabra*

Habitat: Inner reef flats or fringing reefs, lagoon islet reefs, coastal areas affected by sediment and mangroves. Found from 0–10 m deep.

Average size: 22 cm and 0.3 kg

Language name: ____________________

English name: Repo

Scientific name: *Bohadschia graeffei*

Habitat: Reef slopes and flats, hard substrates encrusted with coralline algae. They are found between 0-20 m deep.

Average size: 35 cm and 0.7 kg

Language name: ____________________

English name: Green fish

Scientific name: *Stichopus chloronotus*

Habitat: Reef flats and upper slopes; on hard substrates. Found from 0–15 m deep.

Average size: 18 cm and 0.1 kg

Dried bêche-de-mer for sale in Hong Kong

Information and pictures courtesy of www.fishbase.org

Fish

English name: Bumphead parrotfish

Language name: ____________________

Scientific name: *Bolbometopan muricatum*

Habitat: Adults in clear outer lagoon and seaward reefs up to a depths of at least 30 m (Ref. 9710). Usually in small groups. Sleeps in caves and often in shipwrecks at night (Ref. 48636). The largest and wariest of the parrotfishes.

Food: Feeds on benthic algae, live corals and shellfishes. May ram its head against corals to facilitate feeding.

Population growth: Population doubling time 4.5 - 14 years

Maximum size: 130 cm

Vulnerability to overfishing: High to very high (67/100)

English name: Longnose parrotfish

Language name: ____________________

Scientific name: *Scarus longiceps*

Habitat: Occurs in clear lagoon and seaward reefs. Juveniles usually solitary; adults form harems; males are territorial. Small juveniles usually in dense coral and algae habitats

Food: Benthic grazer of algae.

Population growth: Minimum population doubling time 1.4 - 4.4 years

Reproduction: Goes to several changes during growth and very large females change sex to the brightly colored male.

Maximum size: 70 cm

Vulnerability to overfishing: Low to moderate vulnerability (34 of 100)

Fish

English name: Parrotfish—coloured

Language name: ________________

Scientific name: *Scarus oviceps* / sp.

Habitat: Occurs in clear lagoon and seaward reefs. Juveniles usually solitary; adults form harems; males are territorial. Small juveniles usually in dense coral and algae habitats

Food: Benthic grazer of algae.

Population growth: High, minimum population doubling time less than 15 months

Reproduction: Goes through several changes during growth and very large females change sex to the brightly coloured male.

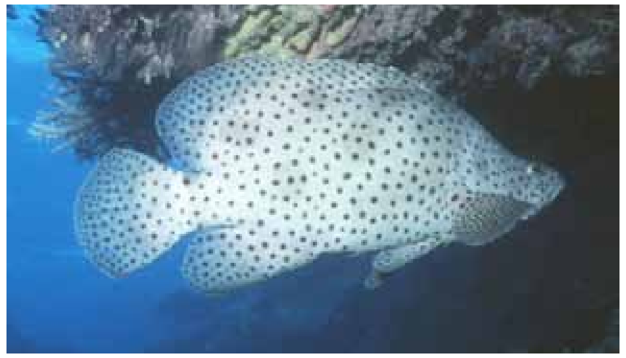
Maximum size: 70 cm

Vulnerability to overfishing: Low to moderate vulnerability (27 of 100)

English name: Barramundi cod

Language name: ________________

Scientific name: *Cromileptes altivelis*



Habitat: Reef-associated; Generally inhabits lagoon and seaward reefs and are typically found in dead or silty areas. Also found around coral reefs and in tide pools. Growth is very slow depth range 2 - 40 m.

Food: small fishes and crustaceans

Population growth: minimum population doubling time 4.5 - 14 years

Reproduction: Spawning where eggs are buoyant, 0.80-0.83 mm in diameter with a single oil droplet; larvae died after 7 days.

Maximum size: 70 cm

Vulnerability to overfishing:

Moderate to high vulnerability (54 of 100)

Fish

English name: Coral trout

Language name: ________________

Scientific name: *Plectropomus*

Habitat: Adults inhabit lagoon and seaward reefs, in areas with rich coral growth. Most frequently encountered in channels along the reef front. Often a shy fish. found in 1-20m.

Food: Fish

Population growth: minimum population doubling time 4.5 - 14 years;

Reproduction: Before actual spawning around full moon, the species aggregates along channels and are responsive to baited hooks, making them vulnerable to fishermen; upward movements of some to take baited hooks presumably mistaken for courtship or spawning behaviour.

Maximum size: 73 cm

Vulnerability to overfishing: High vulnerability (56 of 100)

English name: Ornate emperor

Language name: ________________

Scientific name: *Lethrinus ornatus*

Habitat: Inhabits sandy and soft bottoms and seagrass beds in inshore bays, lagoons and areas adjacent to reefs. Usually in small groups.

Food: Feeds on crustaceans, mollusks, echinoderms, polychaetes and small fishes. Juveniles commonly visit the tidal reef flats to feed when the water is high.

Population growth: minimum population doubling time less than 15 months

Maximum size: 45cm

Vulnerability to overfishing: Low to moderate vulnerability (26 of 100)

English name: Thumbprint emperor

Language name: ________________

Scientific name: *Lethrinus harak*

Habitat: Found solitary or in small schools over shallow sandy, coral rubble, mangroves, lagoons, channel and seagrass areas inshore and adjacent to coral reefs.

Food: Feeds on polychaetes, crustaceans, mollusks, echinoderms and small fish.

Population growth: minimum population doubling time 1.4 - 4.4 years

Maximum size: 50cm

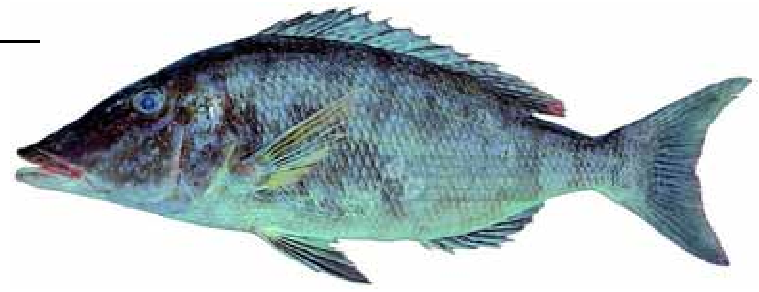
Vulnerability to overfishing: Low to moderate vulnerability (29 of 100)

Fish

English name: Longface emperor

Language name: ________________

Scientific name: *Lethrinus olivaceus*



Habitat: Largest and the longest-snouted lethrinid. Found in sandy coastal areas, lagoons, and reef slopes. Often occurs in large schools. Adults deep along coastal slopes and drop-offs, usually solitary.

Food: Feeds mainly on fish, crustaceans, and cephalopods.

Population growth: minimum population doubling time 4.5 - 14 years

Maximum size: 100 cm

Vulnerability to overfishing: Moderate to high vulnerability (50 of 100)

English name: Orange striped emperor

Language name: ________________

Scientific name: *Lethrinus obsoletus*

Habitat: Found over seagrass beds, sand and rubble areas of lagoons and reefs. Found singly or in groups. Juveniles on weedy reefs.

Food: Feed on mollusks, crustaceans, and echinoderms

Population growth: minimum population doubling time 4.5 - 14 years

Maximum size: 60cm

Vulnerability to overfishing: Low to moderate vulnerability (33 of 100)

English name: Big eye bream

Language name: ___________________

Scientific name: *Monotaxis grandoculis*

Habitat: Found in sand and rubble areas near coral reefs. Solitary fish are often encountered, but large adults usually form aggregations of up to about 50 individuals

Food: Nocturnal feeders. Feed mainly on gastropods, ophiuroids, and echinoids. Pagurids and brachyuran crabs, polychaetes, tunicates, and holothurians are consumed in lesser quantities.

Population growth: minimum population doubling time 1.4 - 4.4 years

Maximum size: 60 cm

Vulnerability to overfishing: Moderate vulnerability (42 of 100)

English name: Spotted sweetlip

Language name: ___________________

Scientific name: *Plectorhinchus* sp.

Habitat: Inhabits coral-rich areas of clear lagoon and seaward reefs. Adults are solitary, near and under ledges or caves by day. Juveniles are found among corals .

Food: Feeds on crustaceans, mollusks, and fishes at night.

Population growth: minimum population doubling time 4.5 - 14 years

Reproduction:

Maximum size: 72 cm

Vulnerability to overfishing: Moderate to high vulnerability (54 of 100)

English name: Giant sweetlip

Language name: ___________________

Scientific name: *Plectorhinchus gibbosus*

Habitat: Found in coastal reefs, sandbanks, and near estuaries. Enter freshwater. Small juveniles occur along sheltered sandy shorelines where they mimic a dead leaf by drifting on their sides. Adults mainly in protected inshore reefs to deep offshore, sometimes swims in small groups.

Food:

Population growth: Minimum population doubling time 1.4 - 4.4 years

Reproduction:

Maximum size: 75cm

Vulnerability to overfishing: Moderate to high vulnerability (45 of 100)

English name: Yellow-banded sweetlip

Language name: ___________________

Scientific name: *Plectorhinchus lineatus*

Habitat: Found in deep inner to outer reef habitats. Occurs singly or in aggregations along coral slopes of clear lagoon and seaward reefs. Juveniles solitary on shallow protected reefs

Food: Feeds on benthic invertebrates in open sand flats and seagrass beds at night

Population growth: minimum population doubling time 1.4 - 4.4 years

Reproduction: At Palau, it aggregates to spawn around new moon

Maximum size: 72 cm

Vulnerability to overfishing: Moderate vulnerability (37 of 100)

English name: Maori/humphead wrasse (adult)

Language name: ___________________

Scientific name: *Cheilinus undulatus*

Habitat: Inhabit steep outer reef slopes, channel slopes, and lagoon reefs. Benthopelagic at 2-60 m. Usually solitary but may occur in pairs. Adults rove across the reefs by day and rest in reef caves and under coral ledges at night.

Food: Primary food are mollusks, fishes, sea urchins, crustaceans, and other invertebrates. One of the few predators of toxic animals such as sea hares, boxfishes and crown-of-thorns starfish.

Population growth: minimum population doubling time 4.5 - 14 years

Reproduction:

Maximum size: 2m (32 years)

Vulnerability to overfishing: High to very high vulnerability (73 of 100)

English name: Maori/humphead wrasse (juvenile)

Language name: ___________________

Scientific name: *Cheilinus undulatus*

Habitat: Juveniles are encountered in coral-rich areas of lagoon reefs, where staghorn Acropora corals abound; also in algae reefs or seagrasses.

Food: Primary food are mollusks, fishes, sea urchins, crustaceans, and other invertebrates. One of the few predators of toxic animals such as sea hares, boxfishes and crown-of-thorns starfish.

Population growth: minimum population doubling time 4.5 - 14 years

Reproduction:

Maximum size: 1m

Vulnerability to overfishing: High to very high vulnerability (73 of 100)

English name: Tuskfish

Language name: ___________________

Scientific name: *Choerodon anchorago*

Habitat: Inhabits seaward reefs.

Food: Feeds on mollusks, crustaceans, various worms, and echinoderms.

Population growth: Medium, minimum population doubling time 1.4 - 4.4 years

Reproduction: Open water/substratum egg scatterers

Maximum size: 40cm

Vulnerability to overfishing: Moderate vulnerability (35 of 100)

English name: Goldspot rabbitfish

Language name: ___________________

Scientific name: *Siganus punctatus*

Habitat: Occurs in lagoons and seaward reefs 1-40m. Juveniles live in schools of up to about 50 fish with pairing commencing as small as 15 cm, but fish may still be schooling at 22 cm SL; older fish live in pairs.

Food: Feeds on benthic algae.

Population growth: Population doubling time less than 15 months

Reproduction: Spawn in pairs. Spawning occurs around either new or full moons or both.

Maximum size: 40cm

Vulnerability to overfishing: Low to moderate vulnerability (26 of 100)

English name: Goldline rabbitfish

Language name: ___________________

Scientific name: *Siganus lineatus*

Habitat: Juveniles found in mangrove areas and seagrass flats; adults in protected waters such as lagoons and bays in the vicinity of rocky substrata or reefs. Forms schools that diminish with age, down to 10-25 fish by adult stage, although congregations may consist of several thousand fish during spawning period.

Food: Feeds by scraping encrusting algae from beach rock or pavement areas of coral reefs or by browsing on larger coarse algae.

Population growth: Population doubling time less than 15 months

Reproduction: Smallest female to spawn was 23 cm. Spawning apparently occurs not until the fish is 2 years old

Maximum size: 43cm

Vulnerability to overfishing: Moderate vulnerability (41 of 100)

English name: Barred rabbitfish

Language name: ___________________

Scientific name: *Siganus doliatus*

Habitat: Inhabits coral-rich areas of lagoons and seaward reefs. Juveniles form schools. Pairs form at 7 cm; but these pairs continue to form loose schools, sometimes with juvenile scarids, to feed in areas being flooded by the tide. At 20 cm, isolated pairs in deep water lagoons or on drop-offs at reef-edges feed on benthic seaweeds

Food: Feeds on algae attached to the substrate and on floating algal fragments.

Population growth: Population doubling time less than 15 months

Maximum size: 25cm

Vulnerability to overfishing: Low vulnerability (23 of 100)

English name: Humpback red snapper

Language name: ___________________

Scientific name: *Lutjanus gibbus*

Habitat: Mainly inhabit coral reefs, sometimes forming large aggregations, which are mostly stationary during the day. Juveniles occur in seagrass beds, also in mixed sand and coral habitats of shallow sheltered reefs. Sub-adults commonly form very large schools that are stationary or drift slowly along slopes during the day. Large individuals along coastal slopes at moderate depths.

Food: Feed on fishes, and a variety of invertebrates including shrimps, crabs, lobsters, stomatopods, cephalopods and echinoderms.

Population growth: Medium, minimum population doubling time 1.4 - 4.4 years

Reproduction:

Maximum size: 50cm

Vulnerability to overfishing: Moderate vulnerability (36 of 100)

English name: Yellow margin sea perch

Language name: ___________________

Scientific name: *Lutjanus fulvus*

Habitat: Inhabit lagoon and semi-protected seaward reefs. Prefer sheltered areas with deep holes or large boulders. Benthopelagic. Juveniles sometimes found in shallow mangrove swamps and the lower parts of freshwater streams.

Food: Feed at night on fishes, shrimps, crabs, holothurians and cephalopods.

Population growth: minimum population doubling time 1.4 - 4.4 years

Maximum size: 40cm

Vulnerability to overfishing: Low vulnerability (23 of 100)

English name: Yellow banded snapper

Language name: __________________

Scientific name: *Lutjanus adetii*

Habitat: Mainly inhabits coral reefs. Sometimes forming large aggregations around rocky outcrops during daylight hours. Disperses to feed at night.

Food: Fish, crustaceans

Population growth: minimum population doubling time 1.4 - 4.4 years

Reproduction: open water/substratum egg scatterers

Maximum size: 50cm

Vulnerability to overfishing: Moderate vulnerability (39 of 100)

English name: Red bass

Language name: __________________

Scientific name: *Lutjanus bohar*

Habitat: Inhabits coral reefs, including sheltered lagoons and outer reefs. Usually found singly, often adjacent to steep outer reef slopes, but occasionally found in groups.

Food: Feeds mainly on fishes, but also takes shrimps, crabs, amphipods, stomatopods, gastropods and urochordates.

Population growth: minimum population doubling time 1.4 - 4.4 years

Maximum size: 90cm

Vulnerability to overfishing: Moderate vulnerability (39 of 100)

English name: Black spot snapper

Language name: __________________

Scientific name: *Lutjanus fulviflamma / russelli*

Habitat: Inhabit coral reefs. Often in large aggregations with Lutjanus kasmira and Lutjanus lutjanus. Juveniles are sometimes found in mangrove estuaries or in the lower reaches of freshwater streams. Adults usually school on coastal reefs and in deep lagoons.

Food: Feed mainly on fishes, shrimps, crabs and other crustaceans.

Population growth: minimum population doubling time 1.4 - 4.4 years

Maximum size: 35cm

Vulnerability to overfishing: Moderate vulnerability (39 of 100)

English name: Mangrove jack

Language name: __________________

Scientific name: *Lutjanus argentimaculatus*

Habitat: Juveniles and young adults occur in mangrove estuaries, the lower reaches of freshwater streams and tidal creeks. Adults are often found in groups around coral reefs. Eventually migrate offshore to deeper reef areas, sometimes penetrating to depths in excess of 100 m.

Food: Mainly nocturnal, this species feeds mostly on fishes and crustaceans.

Population growth: minimum population doubling time 1.4 - 4.4 years

Maximum size: 150cm

Vulnerability to overfishing: High vulnerability (59 of 100)

English name: Black banded snapper

Language name: __________________

Scientific name: *Lutjanus semicinctus*

Habitat: Inhabits coral reefs where it usually occurs singly or in small groups. A shy species that moves around quickly through coral channels in hunt for small fishes

Food: Fish

Population growth: minimum population doubling time 1.4 - 4.4 years

Maximum size: 35.0 cm

Vulnerability to overfishing: Low vulnerability (19 of 100)

English name: Blubberlip snapper

Language name: __________________

Scientific name: *Lutjanus rivulatus*

Habitat: Occasionally encountered in coral reefs or shallow inshore flats. Found singly or in small groups (up to 15 to 20 individuals). Adults on deep coastal slopes; juveniles on shallow algae-reef flats, often near freshwater run-offs

Food: Feeds on fishes, cephalopods and benthic crustaceans

Population growth: minimum population doubling time 1.4 - 4.4 years

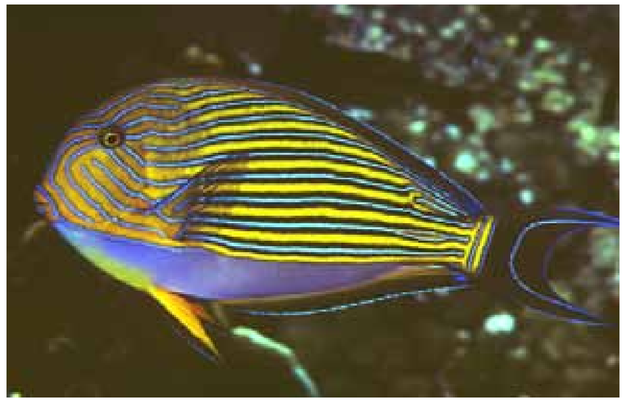
Maximum size: 80 cm

Vulnerability to overfishing: Moderate vulnerability (42 of 100)

English name: Striped surgeonfish

Language name: __________________

Scientific name: *Acanthurus lineatus*



Habitat: A territorial species which is common in surge zones of exposed seaward reefs. The large male controls well-defined feeding territories and harems of females. Benthopelagic usually forms schools and commonly found in shallow gutters. Juvenile solitary and secretive on shallow rubble habitats. The species is almost continually in motion.

Food: Herbivorous but also feeds on crustaceans. The venomous caudal spine can cause painful wounds.

Population growth: Minimum population doubling time 1.4 - 4.4 years

Reproduction: Form spawning aggregations, but spawn in pairs

Size: Maximum 38cm

Vulnerability to overfishing: Low vulnerability (23 of 100)

English name: Unicorn fish

Language name: __________________

Scientific name: *Naso* sp.

Habitat: Found in areas of coral, rock, or rubble of lagoon and seaward reefs 0 - 90 m. Adults usually in small groups. Juveniles in shallow rocky reefs, sometimes in small aggregations mixed with other acanthurids of similar size

Food: Feed mainly on leafy brown algae (*Sargassum* and *Dictyota*)

Population growth: Population doubling time 1 - 4 years.

Reproduction: Spawns in pairs.

Maximum size: 60cm

Vulnerability to overfishing: Moderate vulnerability (38 of 100)

English name: Line bristletooth

Language name: ________________

Scientific name: *Ctenochaetus striatus*

Habitat: Inhabits reef flats and lagoon and seaward reefs to a depth of over 30 m. Occurs over coral, rock, pavement, or rubble substrates. May occur singly or in small to very large, often mixed-species groups.

Food: Feeds on surface film of blue-green algae and diatoms as well as on various small invertebrates.

Population growth: Population can double in 15 months.

Reproduction: Aggregate around full moon to spawn. Eggs and sperm mix in the water.

Size: Maximum length 26 cm

Vulnerability to overfishing: Low vulnerability (17 of 100)

English name: Ringtail surgeon

Language name: ________________

Scientific name: *Acanthurus blochii*

Habitat: Occurs in outer lagoon and seaward reefs 1 - 12 m usually seen in small. Groups and school in some oceanic locations.

Food: Feeds primarily on the algal film covering compacted sand, ingesting the usual component of sand which probably aids in the digestion of the algal food in the thick-walled stomach, also feeds on diatoms and detritus.

Population growth: Population doubling time 4.5 - 14 years

Size: Maximum 45cm

Vulnerability to overfishing: Moderate vulnerability (37 of 100)

English name: Vagabond butterflyfish

Language name: ________________

Scientific name: *Chaetodon vagabundus*

Habitat: Found in reef flats, lagoon and seaward reefs and sometimes in turbid waters subject to freshwater runoff. Swim in pairs

Food: Omnivorous, feed on algae, coral polyps, crustaceans and worms

Population growth: Minimum population doubling time less than 15 months

Reproduction: Oviparous, monogamous. Stable monogamous pairs with both pair members jointly defending a feeding territory against other pairs, but often accompanies other species without being aggressive.

Maximum size: 23cm

Vulnerability to overfishing: Low vulnerability (17 of 100)

English name: Stripey

Language name: ________________

Scientific name: *Microcanthus strigatus*

Habitat: Inhabits coastal and lagoon reefs. Found in dense aggregations under ledges and in caves during the day

Food: Small crustaceans and algae

Population growth: minimum population doubling time less than 15 months

Maximum size: 16cm

Vulnerability to overfishing: Low vulnerability (25 of 100)

English name: Kleins butterflyfish

Language name: ____________________

Scientific name: *Chaetodon kleinii*

Habitat: Occur in deeper lagoons and channels, and seaward reefs (Ref. 1602). Benthopelagic . Occur singly or in pairs

Food: mainly on soft coral polyps, algae and zooplankton

Population growth: minimum population doubling time less than 15 months

Reproduction: Oviparous (Ref. 205). Form pairs during breeding

Maximum size: 15

Vulnerability to overfishing: Low vulnerability (12 of 100)

English name: Eclipse butterflyfish

Language name: ____________________

Scientific name: *Chaetodon bennetti*

Habitat: Occur in lagoon and seaward reefs in areas with rich coral growth. Juveniles may be found in shallow Acropora thickets. Adults occur in pairs

Food: Omnivorous. Feed on coral polyps

Population growth: minimum population doubling time less than 15 months

Reproduction: Oviparous. Form pairs during breeding

Size: Max length : 20.0 cm

Vulnerability to overfishing:

Low vulnerability (15 of 100)

English name: Orange lined triggerfish

Language name: ____________________

Scientific name: *Balistapus undulatus*

Habitat: Occurs in coral-rich areas of deep lagoon and seaward reefs from the lower surge zone to at least 50 meters,

Food: Feeds on a variety of benthic organisms such as algae, echinoderms, fishes, mollusks, tunicates, sponges, and hydrozoans

Population growth: minimum population doubling time 1.4 - 4.4 years

Reproduction: Has a territorial nature. Eggs laid as one cluster in a shallow excavation on sand or rubble along channels.

Maximum size: 30

Vulnerability to overfishing:

Low to moderate vulnerability (30 of 100)

English name: Picasson triggerfish

Language name: ____________________

Scientific name: *Rhinecanthus aculeatus*

Habitat: Commonly found in subtidal reef flats and shallow protected lagoons. Benthopelagic. Juveniles secretive with rubble patches, adults swim about openly but are usually shy. Territorial.

Food: Feed on algae, detritus, mollusks, crustaceans, worms, sea urchins, fishes, corals, tunicates, forams, and eggs

Population growth: minimum population doubling time less than 15 months

Reproduction: Oviparous

Maximum size: 30

Vulnerability to overfishing: Low to moderate vulnerability (30 of 100)

Fish

English name: Titan triggerfish

Language name: ___________________

Scientific name: *Balistoides viridescens*

Habitat: Occur in lagoon, seaward reefs and sheltered inner reef slopes. Juveniles often associated with isolated patches of branching coral or rubble of shallow sandy protected areas. Adults occur singly or in pairs on the slopes of deep lagoon or seaward reefs. Often hostile towards divers and may attack unprovoked when caring for eggs

Food: Feed on sea urchins, coral, crabs and other crustaceans, mollusks and tube worms

Population growth: minimum population doubling time 4.5 - 14 years

Reproduction: Oviparous. Largest triggerfish; females are reported to have attacked divers when guarding their nest

Maximum size: 75.0 cm

Vulnerability to overfishing: Moderate to high vulnerability (53 of 100)

Sharks and Rays

Language name: ___________________

English name: Whitetip Reef Shark

Scientific name: *Triaenodon obesus*

Habitat: Very common in shallow reef areas

Language name: ___________________

English name: Silky Shark

Scientific name: *Carcharinus falciformis*

Habitat: Open ocean

Language name: ___________________

English name: Blacktip Reef Shark

Scientific name: *Carcharhinus melanopterus*

Habitat: Very common in shallow reef areas

Language name: ___________________

English name: Scalloped Hammerhead

Scientific name: *Sphyma lewini*

Habitat: Open ocean

Language name: ___________________

English name: Grey Reef Shark

Scientific name: *Carcharhinus amblyrhyncos*

Habitat: Common in passages and outer islands

Language name: ___________________

English name: Silvertip Shark

Scientific name: *Carcharhinus albimarginatus*

Habitat: Open ocean

Sharks and Rays

Language name: ____________________

English name: Tawny Nurse Shark

Scientific name: *Nebrius ferrugineus*

Habitat: Bottom dwelling shark, often sleeping in caves or under large rocks during the day.

Language name: ____________________

English name: Cowtail Ray

Scientific name: *Pastinachus sephen*

Habitat: Shallow sand areas

Language name: ____________________

English name: Giant Manta Ray

Scientific name: *Manta birostris*

Habitat: Often found feeding inside lagoons and passages.

Language name: ____________________

English name: Spotted eagle ray

Scientific name: *Aetobatus narinari*

Habitat: Often observed in shallow reefs inside lagoons or close to passages

Reptiles

Language name: ____________________

English name: Leatherback Turtle

Scientific name: *Dermochelys coriacea*

Habitat: Nests on black sand beaches on Tetepare, Vangunu, Rendova and Isabel.

Food: Jellyfish

Language name: ____________________

English name: Green Turtle

Scientific name: *Chelonia mydas*

Habitat: Common across the Solomons

Food: Algae and seagrass

Language name: ____________________

English name: Hawksbill Turtle

Scientific name: *Eretmochelys imbricata*

Habitat: Occurs throughout the Solomons.

Food: Sponges and algae

Language name: ____________________

English name: Loggerhead Turtle

Scientific name: *Caretta caretta*

Habitat: Relatively rare in the Solomons

Food: Shellfish and crustaceans

Language name: ____________________

English name: Saltwater Crocodile

Scientific name: *Crocodylus porosus*

Habitat: Increasingly common in many areas of the Solomons

Food: Fish and small terrestrial mammals.

Language name: ____________________

English name: Dugong

Scientific name: *Dugong dugon*

Habitat: Rare in the Solomons. Generally found near shallow areas of lagoons with seagrass present.

Food: Seagrass

Language name: ____________________

English name: Indo-Pacific Bottlenose Dolphin

Scientific name: *Tursiops aduncus*

Habitat: Common across the Solomons

Food: Fish

Language name: ____________________

English name: Spinner Dolphin

Scientific name: *Stenella longirostris*

Habitat: Common in the Solomons.

Food: Fish

Language name: ____________________

English name: Humpback Whale

Scientific name: *Megaptera novaeangliae*

Habitat: Open Ocean

Food: Plankton

Mammals

Language name: ____________________

English name: Sperm Whale

Scientific name: *Physeter macrocephalus*

Habitat: Open Ocean

Food: Squid, Octopus, Rays, Fish

Language name: ____________________

English name: False Killer Whale

Scientific name: *Pseudorca crassidens*

Habitat: Open Ocean

Food: Squid, Fish

Spinner dolphins

Glossary

Adult Mature, sexually active organism able to contribute to future generations.

Algae Plant found in marine and freshwater environments e.g. Halimeda

Alginates Chemical found in brown algae, used to produce ice cream and cosmetics.

Appendage Limb of an animal such as arm, leg, fin or wing.

Benthic The bottom of the lagoon or ocean, like the “ground” on land.

Biodiversity The different types (species) of living things in an area.

Biological Something that is alive or related to the study of living things.

Biomass The weight of something that is living.

Calcareous Containing calcium (hard white material).

Calcium carbonate A chemical that coral and algae use to form skeletons.

Carbon An important element that all living things need for energy and structure. Photosynthetic organisms get carbon from carbon dioxide gas, animals get carbon from food.

Carbon dioxide A gas that plants use in photosynthesis to make food. It is in the air and dissolved in water.

Carnivores An animal that eats other animals.

Caulerpa A type of green algae of which some species are edible.

Chlorodesmis A type of green algae, looks like bright green tufts of hair.

Chlorophyll A green pigment that plants use to absorb sunlight during photosynthesis.

Colony Group of animals living together (e.g. coral).

Coral bleaching When coral lose the small plants inside them. This results in them turning white and often dying. Often as a result of stress from warm water temperatures.

Current The movement of water, often strong in passages caused by tidal movements.

Cyanobacteria Photosynthetic bacteria that can grow in large clumps in marine and freshwater. Looks and functions similarly to algae.

Dinoflagellate A single celled algae that lives in the water or on the bottom. It is so small you need a microscope to see it.

Ecology The interactions between living things and the environment.

Ecosystems A general term to describe the living things and processes occurring in an area.

Estuaries The area near the mouth of a river or creek where fresh and salt water mix. The water in an estuary is partly salty because the high tides bring in sea water.

Expansion When something gets bigger in size.

Fecundity The capacity to reproduce can be measured by how many eggs are produced by females.

Fertilised When a male and female gamete join. e.g. egg and sperm joining.

Filamentous Fine hair-like, usually referring to algae.

Filter feeding The action of taking small particles out of the seawater for food (some corals and clams do this).

Fluorescent Bright colours that are present in some corals and algae (often blue or purple). A substance that absorbs light at one wavelength and emits it at a shorter wavelength.

Food web or chain A diagram showing the eating relationships between organisms in an ecosystem. An organism is connected to another by a line if they consume it.

Fragile Something that can break easily.

Gestation The time a baby spends inside its mother before it is born.

Global warming The warming of planet earth’s air and water, which is currently occurring. It is caused by the increased carbon dioxide in the atmosphere as a result of pollution from humans.

Grazing The process by which animals eat small plants. Grazing fish are those that scrape rocks to remove very small plants like turf algae.

Habitat An area where an animal lives.

Halimeda	A type of green algae that has a hard calcium carbonate structure.
Herbivorous	An animal that eats plants. Herbivorous fish are those that eat plants.
Holdfast	The base of some large algae that is used to attach to the bottom.
Hydrodynamics	The movement of water.
Hypothesised	An idea or theory that has not been proven or accepted.
Ingesting	The process of eating food.
Inshore	An area of the ocean/lagoon that is close to the shore or coast.
Intertidal	An area of the ocean/lagoon that is between the low tide and high tide marks.
Invertebrates	Animals that do not have a back bone (e.g. corals, shells, crabs, bêche-de-mer)
Juvenile	A young animal before it reaches maturity.
Macroalgae	Large forms of algae such as Sargassum or Halimeda.
Meiofauna	Tiny animals found in sand or algae. e.g. nematodes, polychaetes.
Microscopic	Something that cannot be seen with the human eye and needs a microscope before it is visible.
Mobilised	Something that is being moved.
Mortality rate	The rate or amount of death in a population.
Moulting	When an invertebrate (e.g. crab) removes its old shell and produces a bigger one so it can grow.
Nacre	Shiny substance on Trochus shells.
Nearshore	An area of the ocean/lagoon that is close to the shore or coast.
Nitrogen	An important nutrient for coral, algal and seagrass growth.
Nitrogen fixation	The ability of some cyanobacteria to turn nitrogen gas from the air into forms of nitrogen that plants and animals can use.
Nutrients	Chemicals that plants and animals need to grow. The two most important nutrients for marine life are nitrogen and phosphorus.

Nutritious	Food that contains high amounts of nutrients.
Offshore	An area of the ocean/lagoon that is far away from the shore or coast.
Organism	Something that is alive.
Padina	A type of brown algae.
Phosphorus	An important nutrient for coral, seagrass and algal growth.
Photosynthesis	A process plants use to convert sunlight and carbon dioxide into food (carbohydrates).
Phytoplankton	Microscopic algae that occur in seawater, dams, lakes and rivers.
Plankton	Microscopic algae (phytoplankton) or animals (zooplankton) that live in water.
Pollen	Fine particles that flowering plants produce to sexually reproduce.
Polyp	The animal part of a coral, which looks like an anenome.
Predator	An animal that hunts and eats another animal.
Productive	An area that produces large amounts of something. For example a productive fishery can produce a lot of fish.
Propagules	The seeds of mangroves that drop from the trees and float to new areas. They are different from normal seeds because they have already germinated and started growing before leaving parent tree.
Sargassum	A type of brown algae.
Sediment	A term used for sand, dirt or soil that is in the water or on the bottom of a water body.
Sedimentation	When sediment comes from the water (e.g. river) and covers something (e.g. reef).
Solitary	Something that lives on its own.
Spawning	The release of eggs or sperm into the water to reproduce.
Spawning aggregation	A group of the same species of fish or invertebrate that come together at certain times of the year or moon to spawn. Being close to each other increases the chance of successful reproduction.

Species Separate types of animals or plants that have been identified as different from another type.

Substrates The bottom type of the ocean/lagoon. For example sand, rock, mud.

Subtidal The area below the low tide mark.

Sustainably Using something (e.g. resource) in a way that it doesn't finish.

Submerged Under the surface of water.

Symbiosis The relationship between two organisms that live closely together and help each other survive.

Temporal A pattern or cycle over time.

Tentacles Long thin appendages on octopus, coral polyps and squid. They are used for catching prey and filtering food.

Thermal vents A hole in the bottom of the ocean that hot water from the earths core is released. They are often rich in minerals and occur near volcanically active areas.

Transect A line of a certain length that can be used to measure organisms in the environment.

Turbinaria A type of spikey brown algae.

Turfs The growth form of numerous small algae that can cover dead coral, rocks or sand.

Unsustainable Using a resource in a way that it finishes (overharvesting).

Venomous An animal that can inject a painful chemical when it bites or stings (e.g. jellyfish).

Vesicles Small gas filled balls that some algae use to float (e.g. Sargassum).

Vulnerable Something that can easily be effected by an action. E.g. Fish that form spawning aggregations are vulnerable to overharvesting.

Water column The water between the bottom of the sea/lagoon and the surface.

Zooplankton Microscopic animals that occur in the water.

Zooxanthellae Microscopic algae that live inside coral. They photosynthesise to give corals energy.

The University Of Queensland Australia

MacArthur Foundation

The Nature Conservancy

Australian AID