

Bibliography

The public library, SPREP's Information Resource Centre, University of the South Pacific (USP) and the Ministry of Natural Resources, Environment and Meteorology (MNREM) have some interesting materials on mangroves.

Some mangrove publications available at SPREP for reference use only:

Coastal Environments in the South Pacific

Produced by SPREP

Coral Reefs and Mangroves. What we need to know

Produced by the International Coral Reef Initiative and SPREP

Life in the Mangroves

By Neil Taylor and Derek Keats

Mangroves of Samoa

Prepared by Malaki Iakopo
Published by UNEP



The UNESCO library at Mata-uta has some interesting titles for reference use only:

Journey Amongst Mangroves

Produced by the International Timber Organization and the International Society for Mangroves Ecosystems

Mangroves of Asia and the Pacific: Status and Management

Prepared by UNDP and UNESCO

Restoration of Mangroves Ecosystems

Produced by The International Timber Organization and the International Society for Mangroves Ecosystems

World Mangrove Atlas

Editors Mark Spalding, Francois Blasco and Colin Field



Getting to know Samoa's mangrove ecosystem

Going into the mangroves

Mangrove field study booklet

Upper primary level
Samoa 2006

Education for Sustainable Development Resource

In memory of
Mr Peter Varghese

Glossary

This **Mangrove Field Study Booklet** is designed for upper primary students and is the first of its kind produced in Samoa. It was created by a team of primary, secondary and tertiary educators, the Curricula Development Unit (CDU) of the Ministry of Education, Sports and Culture and UNESCO. Advice and revisions were provided by the Secretariat of the Pacific Regional Environment Programme (SPREP) and the Ministry of Natural Resources, Environment and Meteorology (MNREM).

It is envisaged that this **Mangrove Field Study Booklet** will provide teachers and students with a better understanding and appreciation of the mangrove ecosystem, and the need to conserve and protect it for present and future generations.

Acknowledgments

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Biodiversity:	The variety of life on earth.
Carnivore:	An animal that eats other animals.
Decay:	To rot or become rotten; decompose.
Ecosystem:	A community of plants, animals and micro-organisms that are linked and that interact with each other and with the physical environment.
Endangered:	Threatened with extinction, as a species of plant or animal; to have put in a dangerous situation.
Environment:	Everything that surrounds a living thing and affects its growth and health.
Erosion:	Wearing away of the earth's surface by wind or water.
Estuary:	The wide part of a river's lower end, where it meets the sea.
Habitat:	The area where an animal, plant or micro-organism, lives and finds the nutrients, water, sunlight, shelter and other essential needs for survival.
Herbivore:	An animal which only eats plants.
Photosynthesis:	The process by which green plants or algae use sunlight to produce carbohydrates (starch). Oxygen is released as a by-product of photosynthesis.
Reclamation:	To fill an area with soil or debris to gain space.
Sediment:	Material which settles out of a liquid to form a layer.
Sewage:	Fluid containing waterborne, domestic and human waste.
Species:	A group of organisms that has a unique set of characteristics that distinguishes them from other organisms.
Sustainability:	Meeting the needs of the present without diminishing the ability of people, other species, or future generations to survive.
Wildlife:	Wild animals that live independent of humans.

In the classroom




Before and after the field trip

Make sure that your students are well prepared for the mangrove visit.

Before the trip, ask them to find out about the area that they will visit, and the mangroves themselves.

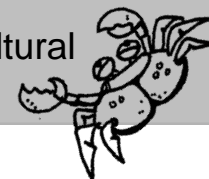
Organize the student working groups and ask them to select a **secretary**, who will record the information, and a **speaker**, who will present the information to the class after the trip.

It is very important that they are well equipped. Remind them about how important it is not to disturb, damage or litter the mangrove area, ask them to bring back anything they take with them, specially plastic bottles or bags.

Group No		<h1>Before</h1>	
			you visit the mangroves
Names		Mangrove area	_____
			water bottle hat pen or pencil rain coat change of clothing lunch proper shoes plastic bag... (...to protect your guide chart. Make sure you bring it back!)
Secretary			
Speaker			

Aims

- To provide opportunities for primary school students to develop an understanding and appreciation of the importance and usefulness of mangrove systems through an organised field study to a mangrove area.
- To appreciate the value of healthy mangroves as sources of food, medicine and other traditional products as well as places of cultural significance.



Objectives

Students will investigate and develop an understanding of:

- a **a mangrove area/environment when they:**
 - identify all the mangrove areas in Samoa – Upolu and Savai'i;
 - take a trail walk in a mangrove area;
 - identify and list different types of plants and animals seen in the area;
 - describe the environment in which the mangroves grow (such as water, soil, plant growth).
- b **the common types of mangrove plants found in a mangrove area when they:**
 - look at selected mangrove plants, their leaves, flowers, seeds, stem and roots;
 - record differences between the two species of mangrove plants (Rhizophora and Bruguiera) commonly found in Samoa;
 - discuss the environmental, economic, social and cultural importance of mangroves.

- c **the special features of the mangrove leaves, seeds, seedlings, flowers, stem and roots that help the mangrove plants to survive in the environment when they:**

- observe the mangrove roots;
- examine flowers/seeds/seedlings on the plants, their shape, toughness, floating characteristics;
- observe a seed falling as it is dropped from a height;
- observe wave action on a growing seedling;
- examine some leaves;
- examine the stem;
- discuss their findings in the assigned groups.

- d **how plants and animals living in a mangrove area depend on each other when they:**

- observe the different animals and plants living there;
- name some fish and other animals found in the area;
- explain why they are there;
- discuss the benefits to the community of maintaining a healthy mangrove area.

- e **how human activities affect a mangrove area when they:**

- observe and record evidence of activities such as dumping of rubbish, cutting down of mangroves, and reclamation of land and discuss how these activities affect the area and the abundance of life;
- gather, process and report information on the uses of mangroves;
- discuss the benefits of good management practices to the mangrove systems.



Think, feel and act for a sustainable Pacific

Conserving the mangroves' **biodiversity** and finding solutions to the issues that threaten them will mean that we will have to start thinking in different ways.

We need to:

Understand the connection between the mangroves and our way of life and our culture.

Realise the consequences that unsustainable practices have on other species, and the social and economic impact on our traditional ways of life.

Samoans have been using the mangroves for generations. It is important to learn some of the traditional knowledge related to the use of the mangroves as well as their protection. These practises are part of the Fa'a Samoa.

As educators we can actively participate in mangrove protection by providing a rich and productive learning experience, through field visits to the mangroves, clean up days, and awareness campaigns.

think
feel act





● Reforestation

Many mangrove areas have been destroyed. Replanting mangroves can be an interesting and good learning activity that will benefit all of us.

● Mangrove reserves

Creating more mangrove reserves, like Sa'anapu-Sataoa, will benefit the coastal villages, through ensuring food and protection for future generations. Reserves also protect the culture and heritage of Samoa.

● Protection of endangered species

Some animals like the reef heron (matu'u) and Pacific black duck (tolo'a) are **endangered** and need to be protected.

Healthy mangroves provide them with a home.

Preparation for the field trip

Ensure that all the necessary preparation and arrangements (as discussed below) are made before the field trip.

It is important that the SAFETY of the students is ensured at all times.

Below are some suggestions to ensure your trip is safe, successful and enjoyable.

● Setting a date

- Ask permission from the Head Teacher. You should also seek permission from the village to access the mangrove area.
- Consult with MNREM concerning mangrove areas under reserves.
- Check the Tide Chart – it is important that you get there during or just before low tide. Choose a day when the low tide is around 9.00 a.m.
- You will need extra helpers, such as voluntary parents or school committee members, to accompany and supervise the groups during field activities.

● Introduction to the mangroves

- Make sure that the students complete the “before” part of the Mangrove Guide before going into the mangrove area.
- Invite people to speak to your class about the importance and marvels of the mangrove trees and environment.
- Invite people such as fishermen, extension officers from MNREM, Ministry of Agriculture and Fisheries (MAF) and SPREP.

● Teacher's responsibilities

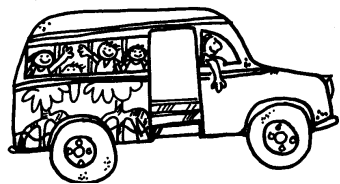
- Seek permission from the Head Teacher.
- Seek permission to access the area for the field trip.
- Book transport if required.
- Organize equipment and any other resources such as notepads, pencils, copies of the activity sheets.
- Prepare a First Aid Kit to be taken on the trip.
- Ensure that the students bring proper clothing and shoes.
- Prepare a list of materials that students will need for the trip.
- Send this list to the parents together with a letter requesting permission for their children to join the field trip.

Field trip planning

- Divide the class into working groups (about five students per group)
- Students (in their assigned groups) should complete the “before” part of the **Student Activity Sheets** before the field trip.
- Emphasize the importance of disturbing as little of the area as possible.
- Check that all equipment and resources listed in the **Student Activity Sheets** are ready.
- Check the weather forecast prior to departure in case new arrangements need to be made.
- Ensure that you have a First Aid Kit.
- Check that all the students have enough water to drink.
- Take the roll and do a headcount before departure.
- Ensure that each group is supervised.
- Clean the area of any litter at the end of the field trip.
- Ensure that no personal belongings are left behind.
- Take the final roll call and do a headcount before leaving the mangrove area.
- Ensure that all students reach home safely.

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HAVE FUN!!



Taking care of mangroves

Creating protected mangrove areas, enforcing environmental protection laws, and raising awareness about the natural, economic and cultural values of mangroves are some initiatives. One of the most important things that we can do to conserve the **biodiversity** of the mangroves is to get involved... **All of us:** teachers, students and our communities can help restore and maintain our mangrove areas.

● Education

Visit the mangrove areas with your students, invite people to speak to your class, give the students awareness projects that involve people in their homes and villages.

● Monitoring

Monitoring means keeping an eye on the mangrove forest and animals that use the mangroves. Check the way people are using it. Observe if the mangrove trees and the other plants, as well as the animals that live in the mangrove area, are healthy or if their numbers have changed.

● Awareness

Community awareness activities can be done in schools, in meetings with different groups and with the local authorities. Also, remember you teach with your actions when you provide a good example by the way you use and respect the mangroves.

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Sustainable mangrove use

Sustainable

means meeting the needs of the present without diminishing the ability of people, other species, or future generations to survive.

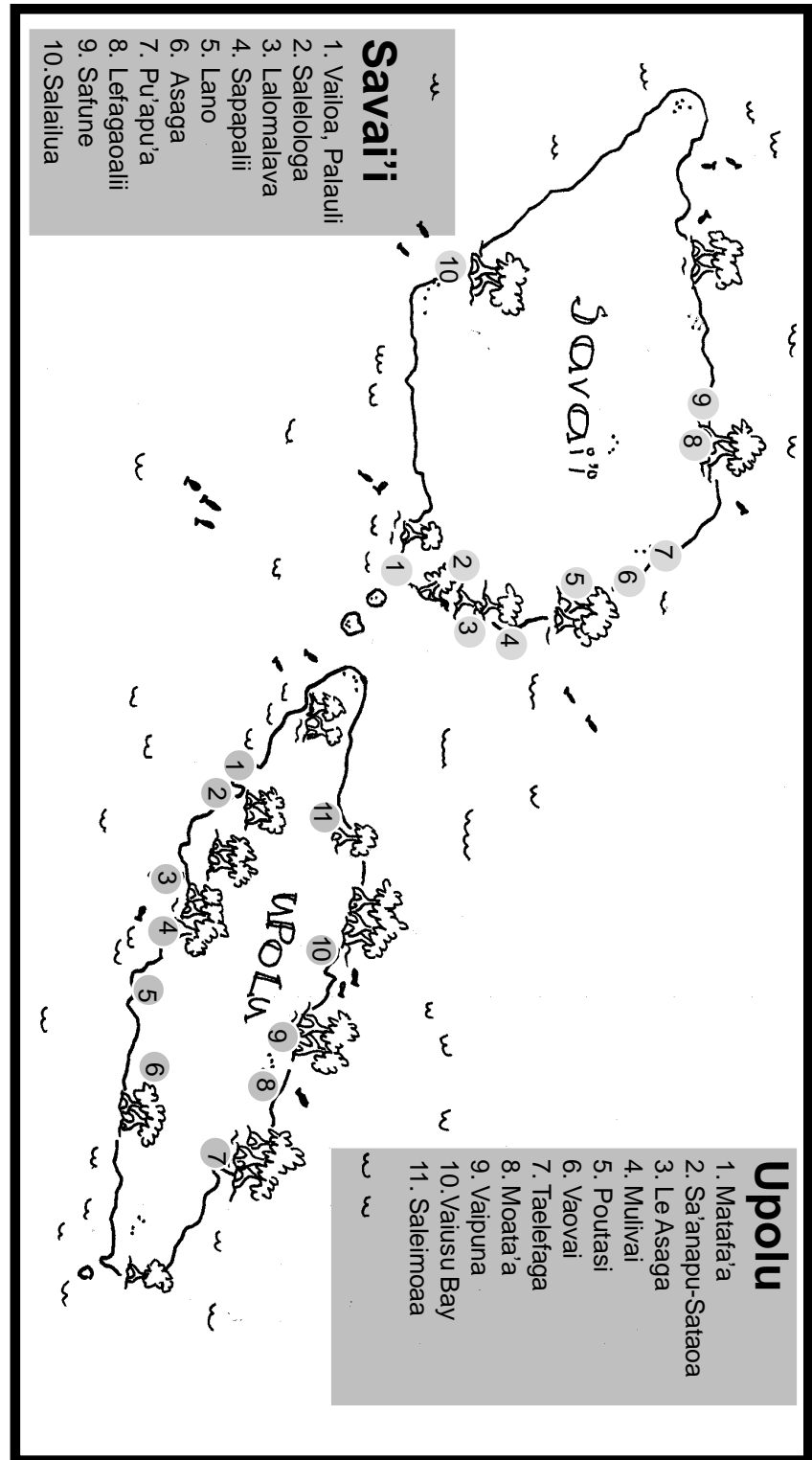
One of the greatest challenges we face in protecting mangroves' **biodiversity** is how to balance the needs of the people that use it, and the future of the mangroves' creatures and environment.

There are many reasons why the mangroves are endangered, so it is necessary to address all of them to protect and ensure their future.

It is important to remember that protecting the mangroves not only protects the natural environment, but also the human, economic and cultural values of the mangroves.



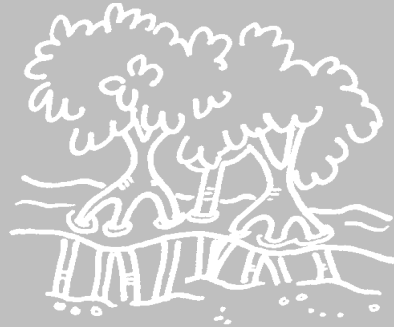
We need to focus on long term sustainability strategies, but also develop and carry out short term projects to address the immediate needs of the mangrove ecosystem.



Mangroves are unique!

Mangroves are amazing trees that live halfway between land and sea. They are “specialized coastal trees” which means that they can live under unique conditions.

For most plants, salt water is deadly. Mangroves are among the few trees that can grow in sea water as well as in places where the sea water mixes with the fresh water from the land.



In Samoa, most of the mangroves grow in areas protected by a coral reef. The mangroves and the coral reefs have a very special relationship: the coral breaks and reduces the force of the waves providing the mangroves with calm waters, while the mangrove roots act like a sieve filtering soil and dirt, that can harm the coral reefs.



Mangroves form a very productive **ecosystem** with other types of plants and trees.

Other plants are usually found closer inland while mangrove trees are normally nearer to the sea.

● Water pollution and rubbish

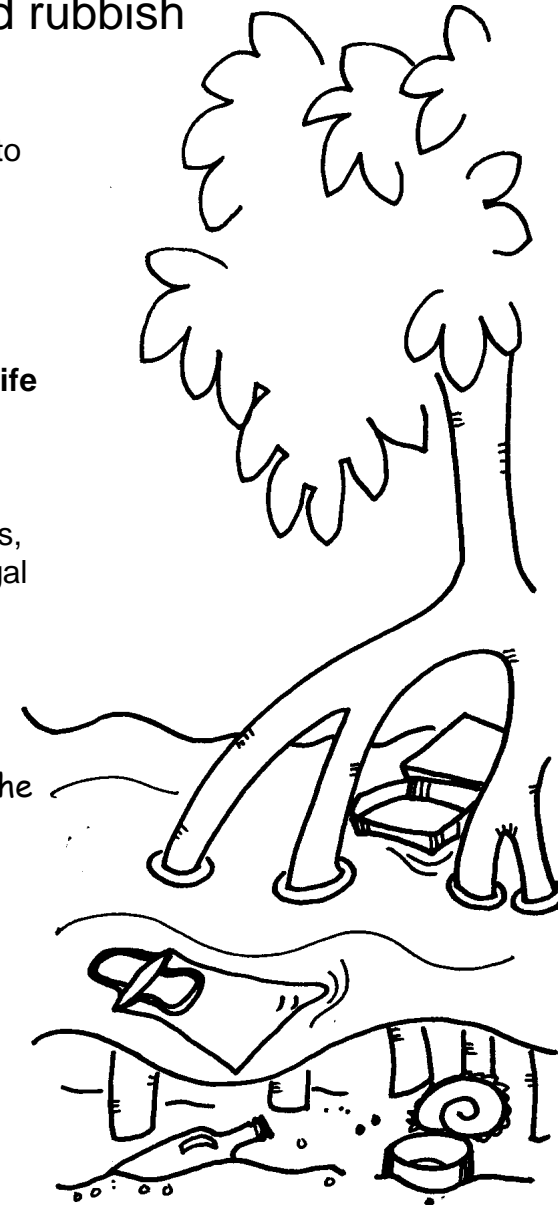
Oil and gasoline from faulty outboard motors and spills create a thin film that sticks to the mangrove roots.

Household rubbish like plastic bags and containers contaminate the mangrove areas endangering the **wildlife** that live there.

In some areas **sewage** is disposed in the mangroves, which results in excessive algal growth which kills the other marine life.



“Don't throw rubbish into the mangroves!”



Mangrove threats

Mangroves are an important part of our island environment. Many plants and animals live in and depend on them. Sadly many people consider the mangroves to be dirty, useless and mosquito ridden places, without understanding that the destruction of these areas endangers our way of life.

● Poor land management

When land is cleared for construction or agricultural purposes the soil is easily washed away during heavy rains. This dirt and sediment is carried downstream to the mangrove forest where it can cover the roots and kill the trees and affect the animals that live in the water.

● Cutting the mangrove forest

Cutting some trees will not destroy the mangrove forest if it is done in a **sustainable** way. It is important to remember that mangroves are not fast growing trees.

● Construction and reclamation of land

Large areas of mangroves are being cleared and filled. These reclaimed areas alter or totally stop the amount of fresh water entering the mangrove areas. Mangroves need a mixture of fresh and salt water to grow, any changes in this mixture will affect the growth and health of the trees.

Key concepts

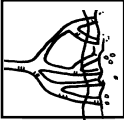
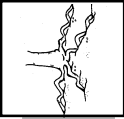
- Mangrove trees are found in coastal areas, especially in river **estuaries**. They are able to grow well in areas with a mixture of fresh and sea water.
- The two common types of mangrove trees found in Samoa are Rhizophora and Bruguiera.
- Mangrove areas are under constant threat, and are often used as places for dumping rubbish.
- Mangroves are also being cleared and filled to construct roads, houses and hotels, leading to coastal erosion and causing damage to the ecosystem.
- An example of a well managed mangrove site is the Sa'anapu-Sataoa **Conservation Area**.



Mangrove areas are important because:

- **Mangrove** areas have murky muddy water that give young fish a place to hide, making it difficult for **predators**, like birds and big fish, to catch young animals.
- **Mangrove** root systems anchor the soil and prevent erosion in the coastal zones.
- **Mangrove** trees act as wave breakers and thus protect the coasts and the communities from strong wind and high waves, even tsunamis.
- **Mangrove** tree root systems trap and reduce the amount of sediment entering the lagoon and smothering the coral (silt sedimentation).
- **Mangrove** areas are good breeding, feeding and nursery grounds for many fish and other animals like crabs, shrimps and shellfish.
- **Mangrove** areas provide a good sources of food and income for the community.
- **Mangrove** tree parts have many traditional uses.

Two common types of mangroves found in Samoa

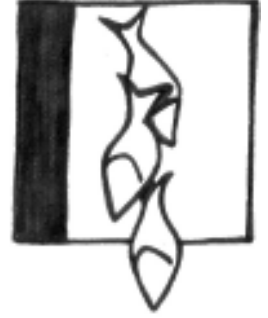
Features	 Rhizophora	 Bruguiera
Tree trunk size and height	Not as big as Bruguiera	Tall and big
Shape of the whole tree	Oval	Not oval
Leaves	Tips of the leaves are blunt	Tips of the leaves are pointed
Flowers	Whitish yellow	Pink
Seeds	Usually longer and thinner	Short and fat
Stems	Thin and short	Tall, thick and strong
Roots	Prop roots Mostly above the ground (Arched roots growing from the stem)	Knee roots Mostly underground (Knee-like roots in the mud)
Where it's found	Towards the water/sea	In the mud or towards the land

Traditional mangrove uses

● Building materials

Traditionally, mangrove trees have been used to build houses, fences, walls, furniture and also for carving. Some other plants like fau, niutuma, talie and tavai that grow in the mangrove forests are used for building purposes.

Economy



● Food and income

Fish, crabs, shimps, eels, wild ducks and plants like ifi and talie, traditionally harvested for food and selling, all live in the mangrove forest.

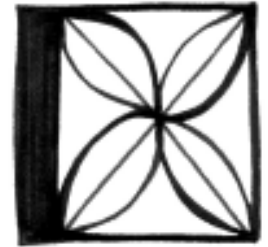
● Firewood

Some people collect mangrove wood for fuel. This happens mainly when there is easy access to the mangrove forest.

● Handicraft

Other uses of the mangrove include dyes for tapa (siapo) and materials to make handicraft. Mangrove flower parts are used to make garlands.

Cultural



● Traditional medicine

The roots, bark and leaves are used for traditional medicine.

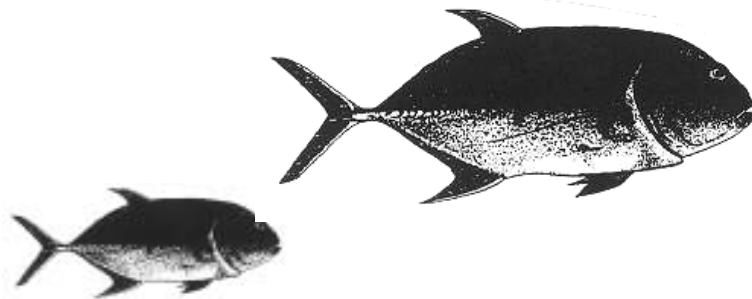


Nurseries

Young fish find mangrove roots a very safe place to grow. They live in the mangroves until they are big enough to live on reefs or deeper waters.

Feeding areas

During high tide larger fish like mullet, snapper and trevally come there to feed on smaller fish, crabs and other animals.



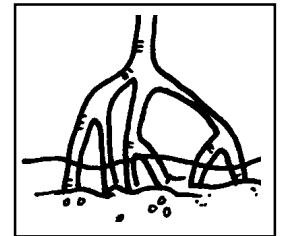
Mangrove roots

You can easily recognize the two most common mangroves growing in Samoa by their roots.

The Rhizophora has “**prop roots**” and the Bruguiera mangrove has “**knee roots**”.

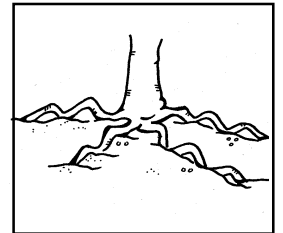
Prop roots

These roots can sprout from very high in the tree. The older the tree the higher the roots are located.



Knee roots

These roots come in and out of the soil.



Mangrove roots have different functions:

- The roots: Anchor the plant
- Absorb minerals
- Exchange gases (O₂ and CO₂)

Roots can only absorb water from the surroundings and excludes most of the salt.

The extensive root systems slow down waves and water flowing through them. This reduces erosion by holding the earth together so it does not wash away from the land into the lagoon and reef, killing the coral.

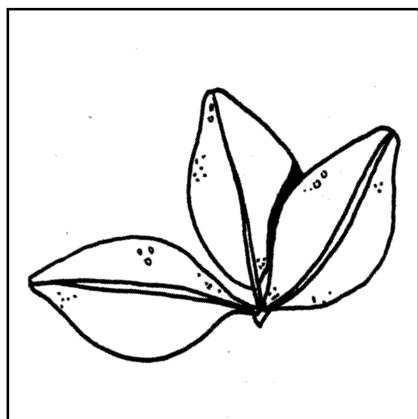
As a result, mangrove shores continue to grow towards the sea.

Mangrove leaves

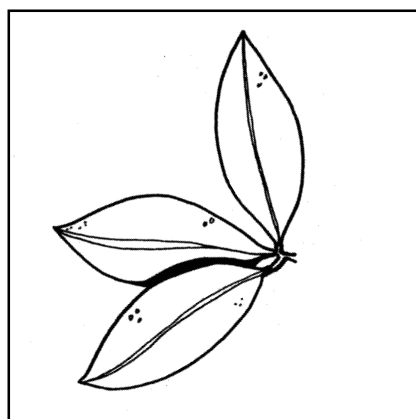
Mangroves have a medium-sized, thick waxy leaf that helps prevent excessive water loss. Like other plants, the green leaves of the mangrove use the light of the sun to make food; this process is called **photosynthesis**.

When dead leaves fall into the water, they **decay** providing **nutrients** for the soil and food for animals like crabs, prawns and some fish.

The two most common mangroves growing in Samoa have different leaves. The Rhizophora leaves have blunt tips while Bruguiera have pointed tips.



Rhizophora leaves



Bruguiera leaves

● Provide rich habitat

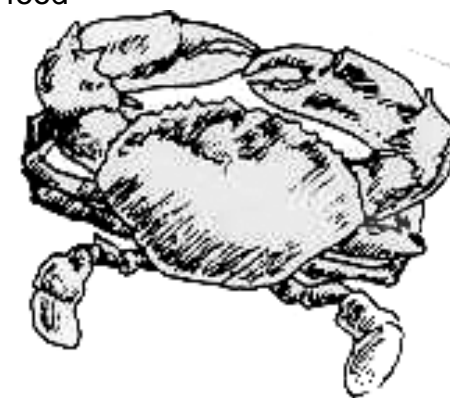
Mangrove trees produce large amounts of organic matter that provides a constant supply of food for crabs, shrimps and other **herbivores** which then become food for meat eating animals, the **carnivores**. Other animals come to the mangrove areas to feed on the animals that live there.

Mangroves provide three different types of habitats:

Permanent homes

Oysters grow on the mangrove roots; mud crabs live permanently in the mangrove forest.

A lot of shellfish live in areas near mangroves. A great variety of insects also live in the mangroves providing a permanent source of food for birds, which live in the mangrove **canopy** (top of the tree), and can sometimes be seen flying around dusk. Sea birds like heron (matu'u) and sooty tern (gogo'uli) can be seen in the mangrove forest.



Importance of mangroves



● Food and income

Marine resources such as oysters, mud crabs and prawns and various species of fish are part of the Samoan diet.

Some of these animals are collected and sold at the local fish market or along the roads.

● Protection from high waves

When high waves and strong winds, including cyclones, hit the shores where mangroves grow, the trees protect the shore and houses from the wind and waves.

● Protection of coastal areas

Mangroves protect the shoreline from **erosion**.

● Keeping the lagoon clean and clear

The roots of the mangrove trap soil, debris and sediment washed down by floods, rivers or streams, cleaning the water before it enters the lagoon and reefs. Without the mangroves, these particles of soil and sediment would damage the corals that make up the reef.

Healthy coral can only live in areas with clean, clear sea water.

Mangrove seeds

Mangroves usually grow in flat, soft muddy ground. When the long, thin and pointed mangrove seeds fall vertically to the ground, they are able to stick upright in the soft mud.

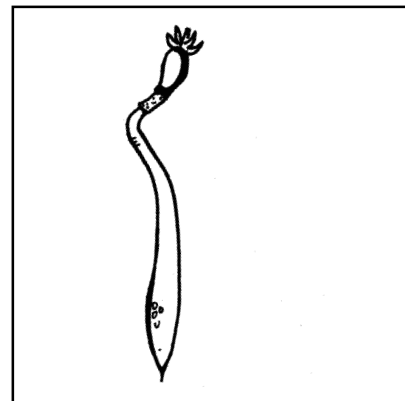
Some mangrove trees have seeds that start to grow while they are still on the tree. When the young plant is big enough to survive it falls into the water or mud. These young plants float around until they find a muddy area to grow.

The seeds can float which helps them disperse and grow in new areas.

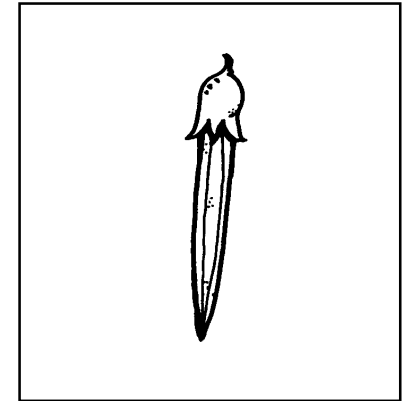
Mangrove trees are constantly exposed to strong wind and waves. The new plants, when established in the soil, are able to withstand wave action.

It is easy to distinguish between the seeds of Rhizophora and Bruguiera. The Rhizophora seed curves on the top, while the Bruguiera seed is straight.

Rhizophora seed



Bruguiera seed

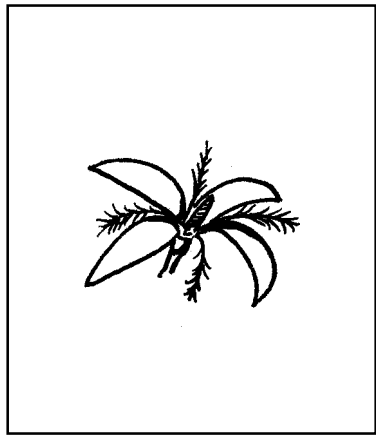


Mangrove flowers

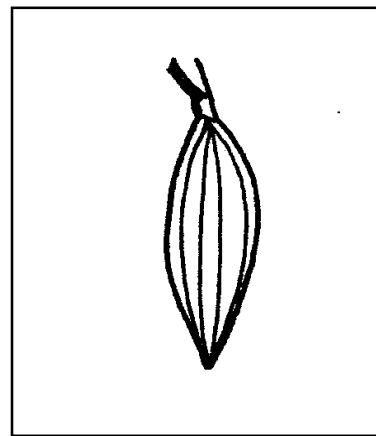
The two most common mangroves found in Samoa have different flowers.

The flower of Rhizophora is small and yellow, while the Bruguiera flower is bigger and pink.

Many people confuse the flowers and the seeds of Bruguiera seedlings, thinking the tops of the seeds are flowers.



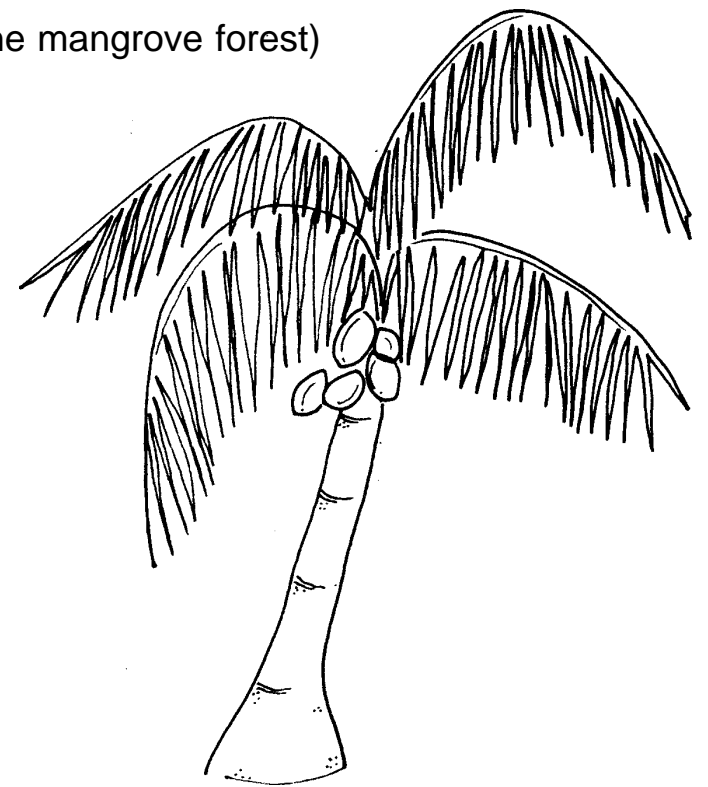
Rhizophora flower



Bruguiera flower

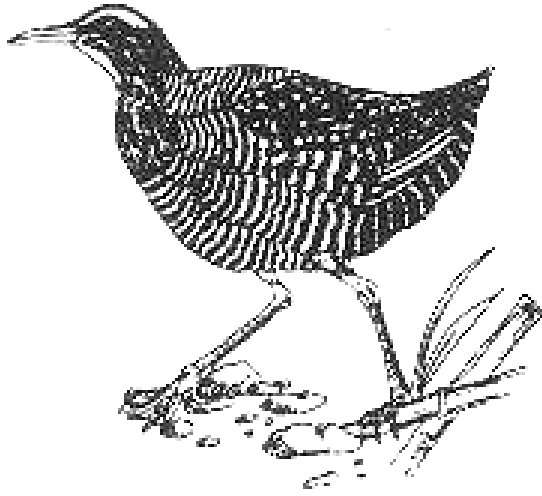
Plants

(Found in the mangrove forest)



Scientific	English	Samoaan
<i>Inocarpus fagifer</i>	Tahitian chestnut	Ifi
<i>Hibiscus tiliaceus</i>	Beach hibiscus	Fau
<i>Cocos nucifera</i>	Coconut	Niu
<i>Morinda citrifolia</i>	Indian mulberry	Nonu
<i>Alpinia purpurata</i>	Red ginger	Teuila mumu
<i>Asplenium nidus</i>	Bird nest fern	Laugapapa
<i>Dendrobium sp.</i>	Epiphytic orchids	Oketi
<i>Citrus reticulata</i>	Chinese orange	Molisaina

Birds



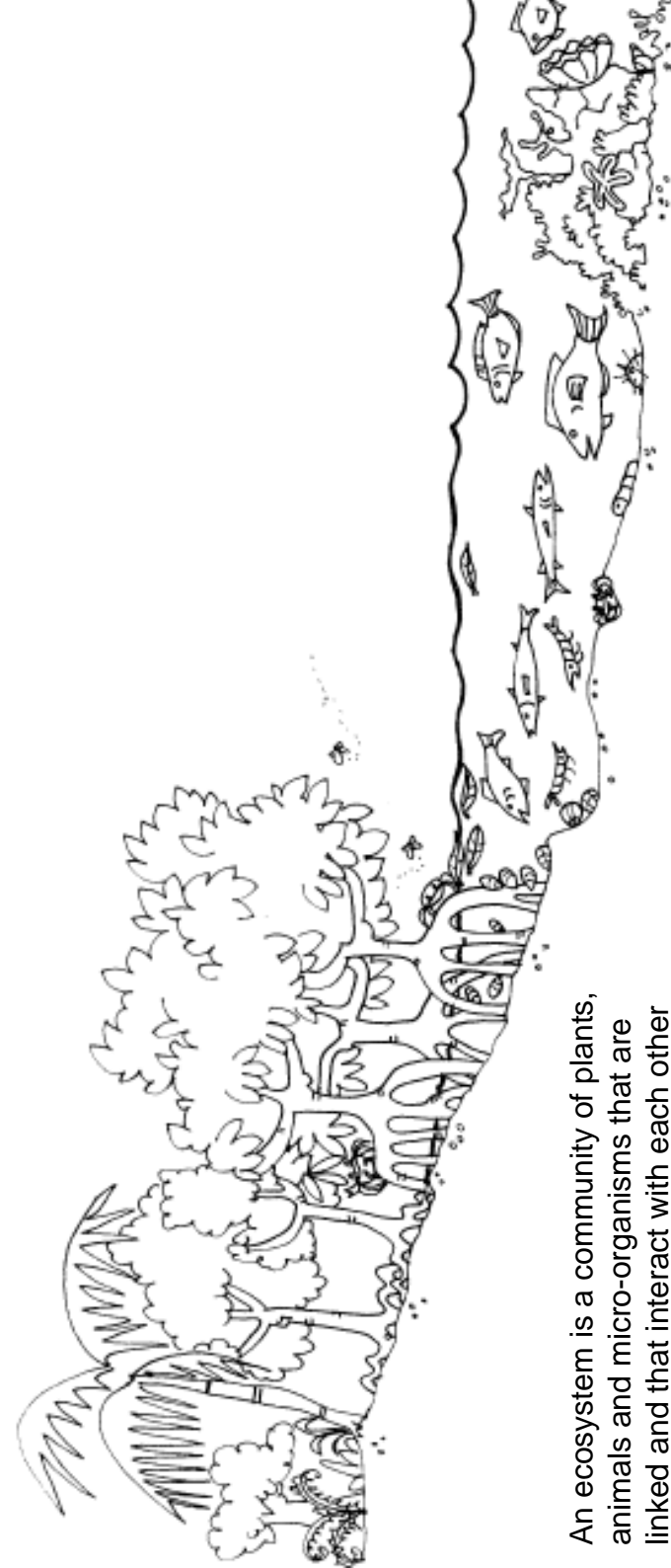
Banded rail (Ve'a)



Wild duck (Toloa)

Scientific	English	Samoan
<i>Foulehaio carunculata</i>	Wattle honey-eater	Iao
<i>Gallirallus philippensis</i>	Banded rail	Ve'a
<i>Halcyon recurvirostris</i>	Flat-billed kingfisher	Tiotala
<i>Aplonis atrifusca</i>	Samoan starling	Fuaia
<i>Pachycephala flavifrons</i>	Samoan whistler	Vasavasa
<i>Myzomela cardinalis</i>	Cardinal honeyeater	Segasegamaau

The mangrove ecosystem

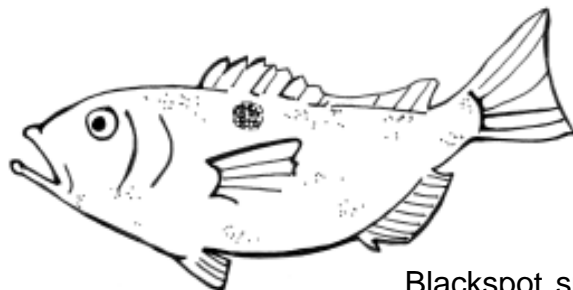
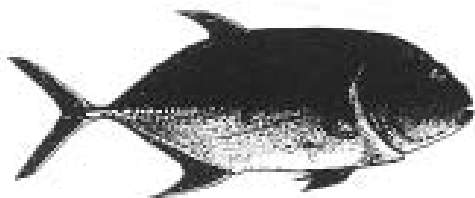


An ecosystem is a community of plants, animals and micro-organisms that are linked and that interact with each other and with physical environments.

Mangrove animals

Fish

Bluefin trevally
(Malauli)



Blackspot snapper (Tamala)

Scientific	English	Samoan
<i>Lutjanus fulvus</i>	Blackspot snapper	Tamala
<i>Kuhlia</i> sp.	Flagtail	Sesele
<i>Terapon jarbua</i>	Perch/Jarbua terapon	Avaava
<i>Caranx melampygus</i>	Bluefin trevally	Malauli
<i>Periophthalmus</i> sp.	Mudskipper	Manoo
<i>Hemiramphus</i> sp.	Halfbeak	Ise
<i>Eleotris</i> sp.	Sleeper	Apofu
<i>Crenimugil</i> sp.	Mullet	Aua
<i>Platax orbicularis</i>	Orbicular batfish	Koko
<i>Trachinotus blochii</i>	Snubnose dart	Lalafutu
<i>Anguilla</i> sp.	Fresh-water eel	Tuna
<i>Sphyræna</i> sp.	Barracuda	Sapatu
<i>Megalops cyprinoides</i>	Indo-Pacific tarpon	A'analagi

Crustaceans



Mangrove crab
(Pa'alimago)



Freshwater prawn (Ula vai)

Scientific	English	Samoan
<i>Cardisoma carnifex</i>	Land crab	Tupa
<i>Sesarma</i> sp.	Redclaw	U'a
<i>Scylla serrata</i>	Mangrove crab	Pa'alimago
<i>Macrobrachium lar</i>	Freshwater prawn	Ula vai