

# Mangroves



**Courtesy of Miss Idalia Machuca  
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# Mangroves

This module<sup>1</sup> is intended for elementary or secondary teachers interested in teaching their classroom about the types of mangroves in Belize, their needs for survival, their importance, the human-induced or natural damage caused to them, and ways in which we can diminish the negative impacts on mangroves

Lessons within this module:

- **Mangroves Overview**
- **Mangroves in Belize: Red Mangrove (*Rhizophora mangle*)**
- **Mangroves in Belize: Black Mangrove (*Avicennia germinans*)**
- **Mangroves in Belize: White Mangrove (*Laguncularia racemosa*)**
- **Mangroves in Belize: Buttonwood Mangrove (*Conocarpus erectus*)**
- **Mangrove Survival Needs**
- **Importance of Mangroves**
- **Damage to Mangroves**
- **Mangroves in Belize**
- **Save the Mangroves!**

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<sup>1</sup> Supplementary items are also provided for this module: Classroom activities, Fact sheets, Class projects, Field activities, Lesson plans, Map, and Worksheets

Related learning goals<sup>2</sup> as specified by the Ministry of Education:<sup>3</sup>

- (Social Studies: M) What is the physical environment of Belize like?
- (Social Studies: M) What are examples of marine resources?
- (Social Studies: U) What is the role of our natural resources in the Social, Political, and Economic development of the country?
- (Social Studies: MU) How do some human activities and industries harm our natural resources?
- (Social Studies: M) What are the disadvantages of any damage caused to the environment by tourism?
- (Science: M) How are animals and plants affected by pollution?
- (Science: L) What are examples of improper waste disposal?
- (Science: M) How do agricultural practices, such as the use of pesticides and herbicides, affect animals and plants?
- (Social Studies: U) How have natural disasters affected Belize physically?

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<sup>2</sup> The Primary school curriculum does not specifically ask for “Mangroves”, but it is greatly recommended for both primary and secondary teachers to include it into their Science or Social Studies classes.

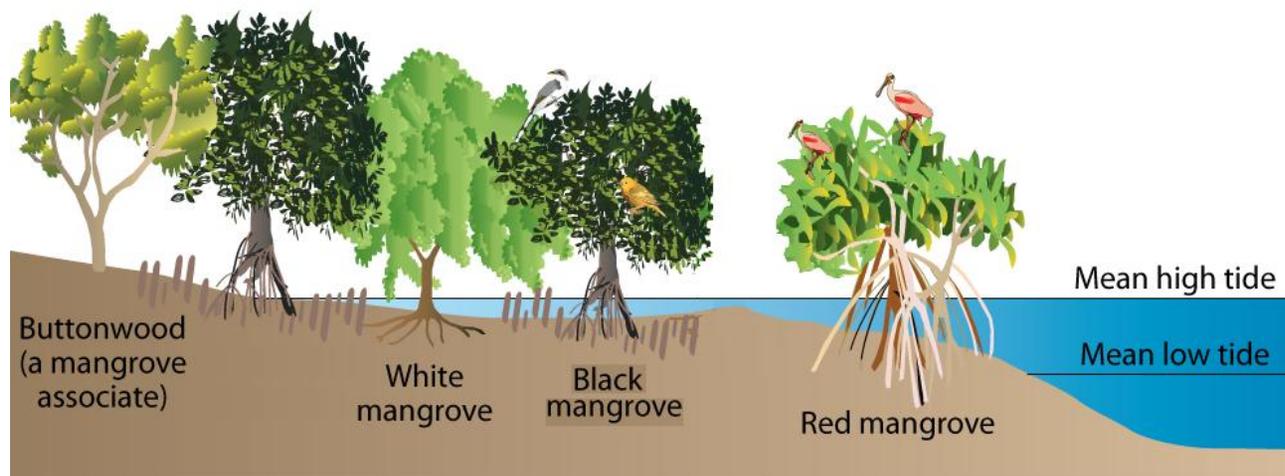
<sup>3</sup> L = Elementary school Lower Division, M = Elementary school Middle Division and U = Elementary school Upper Division

# Mangroves

Mangroves are a tropical species of trees or shrubs that have adapted to live in coastal regions. They grow on loose wet soil that is periodically flooded by salty seawater during high tides. There are about 54 species of mangroves in the world, and we have four of those types in the Caribbean: Red, Black, White, and Buttonwood mangroves.

The bark of mangroves is used as a source of dyes, and as durable and water resistant wood. Black and Buttonwood mangroves are used in charcoal production. Mangrove fruits can be eaten, and the leaves can be consumed as tea and medicine.

In this module, we will take a closer look at the types of mangroves, their importance, the damage we are causing them, and how we can solve this problem.



Conceptual diagram illustrating the dominant mangrove species of south Florida. Diagram courtesy of the Integration and Application Network ([ian.umces.edu](http://ian.umces.edu)), University of Maryland Center for Environmental Science. Source: Kruczynski, W.L., and P.J. Fletcher (eds.). 2012. Tropical Connections: South Florida's marine environment. IAN Press, University of Maryland Center for Environmental Science, Cambridge, Maryland. 492 pp.

“Mangrove zonation” describes the order in which the four different types of mangroves are found on land. The red mangrove is closest to the water, while the buttonwood mangrove is found the farthest from the water (deeper inland). Their positions depend on land elevation, water and soil salt levels, and tidal changes.

## Mangroves in Belize: Red Mangrove (*Rhizophora mangle*)



Red Mangroves: [www.envirodiva.wordpress.com](http://www.envirodiva.wordpress.com)



Red Mangrove: [www.fimnhuf.edu](http://www.fimnhuf.edu)

The Red Mangrove, also called the ‘walking tree’, is the tallest of all the mangroves we will be covering. It can be as tall as 80 feet. It is found on shorelines, where conditions are harshest. You can easily recognize a red mangrove by its network of aerial roots, which may extend 3 feet above the surface of the soil.



Red mangrove leaf: [www.naturefoundationsxm.org](http://www.naturefoundationsxm.org)

The leaves are large (1-5 inches), elliptical in shape (like an egg), shiny, smooth-edged, dark green on the top side and light green on the bottom side. The leaves have a waxy layer which helps the tree lose less water (similar to sweat on humans).



Red mangrove propagules: [www.naturefoundationsxm.org](http://www.naturefoundationsxm.org)

The seedling or “propagule” is about 6 inches long and has the shape of a pencil. They germinate and produce a tap root while still attached to the tree. When they fall, they can float away or take root in the shallow shore waters.



Red mangrove flower: [www.duke.edu](http://www.duke.edu)

Flowers bloom in spring and early summer.



Red mangrove prop roots: [www.rhmi.org](http://www.rhmi.org)

Red mangrove drop roots: [www.rhmi.org](http://www.rhmi.org)

Prop and drop roots make the trees look like they are walking. Prop (or stilt) roots grow out of the trunk, and drop roots grow down from the branches. These roots help keep the tree from falling over in the slippery mud below, and they provide extra oxygen to the tree since the roots are exposed to the air. Prop roots also provide a protective nursery habitat for many marine and coastal animals.

## Mangroves in Belize: Black Mangrove (*Avicennia germinans*)



Black Mangroves: [www.fimnh.ufl.edu](http://www.fimnh.ufl.edu)



Black Mangrove: [www.fimnh.ufl.edu](http://www.fimnh.ufl.edu)

The Black Mangrove is found very close to the red mangrove but farther inland. It is the second tallest of the mangroves covered here, reaching a possible height of 65 feet. It is called the “black” mangrove because the colour of the wood is dark brown or black. The wood can be used in construction, charcoal and fuel, or to tan leather.



Black mangrove leaf: [www.bermudaconservation.squarespace.com](http://www.bermudaconservation.squarespace.com)

The leaves are narrow and oval-shaped but with pointy ends. They are 2-5 inches long, dark green on the upper side and light green on the underside with small yellowish-silvery dense hair. The tree excretes salt through the leaves, leaving salt crystals on the leaf's surface.



Black mangrove seeds: [www.naturefoundationsxm.org](http://www.naturefoundationsxm.org)

The seeds are small and oval-shaped. They are encased in a fruit and germinate while still attached to the tree. They are carried further inland by the tide than red mangrove seeds.



Black mangrove flower: [www.eol.org](http://www.eol.org)

They flower during the summer.



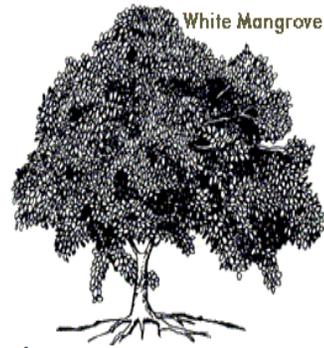
Black mangrove pneumatophores: [www.britannica.com](http://www.britannica.com)

Pneumatophores are born from underground cable roots surrounding the tree. Pneumatophores look like fingers and are about 8 inches tall. They poke out of the surrounding water in order to get oxygen for the tree.

## Mangroves in Belize: White Mangrove (*Laguncularia racemosa*)



White Mangroves: [www.blog.travelmarx.com](http://www.blog.travelmarx.com)



White Mangrove: [www.fmmh.ufl.edu](http://www.fmmh.ufl.edu)

The White Mangrove is relatively short but may grow up to about 50 feet in height. It lives even farther inland than the red or black mangrove and is found on more stable soils and around ponds and lagoons.



White mangrove leaf: <http://www.naturefoundationsxm.org>



White mangrove fruit: [www.naturefoundationsxm.org](http://www.naturefoundationsxm.org)



White mangrove flower: [www.floridasnature.com](http://www.floridasnature.com)



White mangrove peg roots: [www.naturefoundationsxm.org](http://www.naturefoundationsxm.org)

The leaf is about 3 inches long, light yellow-green, broad and oval-shaped with a rounded end. There are two glands called “nectaries” at the base of the leaf. It is believed that nectaries are either a source of sugar for ants that protect the trees from harmful insects or an outlet for salt. The leaves also have pores that excrete salty water. When the water evaporates, salt crystals remain on the surface.

The fruit is very small, green, wider at the tip, slightly flattened, and with ridges along its length. The skin is leathery. These fruits can float as long as it takes for the seed to take root.

They flower from spring to late summer.

White mangroves do not have aerial roots like others. If the water around them has low levels of oxygen, however, they will develop “peg roots”. These are shorter and stouter than pneumatophores.

## Mangroves in Belize: Buttonwood Mangrove (*Conocarpus erectus*)



Buttonwood Mangroves: [www.backyardnature.net](http://www.backyardnature.net)

There is the silver and the green buttonwood mangrove. It is only about 15 feet in height. The name "buttonwood" is derived from the button-like appearance of their flowers heads. Some scientists do not consider this a true mangrove because it is found far inland away from water. Others insist that it is a mangrove because it is adapted to harsh conditions and are very salt resistant.



Green buttonwood mangrove leaf:  
[www.landscapeinvocation.com](http://www.landscapeinvocation.com)



Silver buttonwood mangrove leaf:  
[www.floridahikes.com](http://www.floridahikes.com)



Buttonwood mangrove salt glands: [www.nhmi.org](http://www.nhmi.org)



Epiphytes on buttonwood mangrove:  
[www.nhmi.org](http://www.nhmi.org)

Green buttonwood leaves are long and elliptic with pointed ends and smooth edges. They are shiny and dark green on the upper side, and lighter green. They may have thin hairs on the underside.

Silver buttonwood leaves have a similar shape to the green buttonwood leaves, but they have more of a silver colour. They are densely hairy, which makes their surface feel like velvet.

The underside of the leaves have salt glands alternating along the midrib. The base also has two salt glands.

Unlike the others, buttonwood mangroves produce button-like seed cases that grow in bunches like grapes.

Epiphytes are parasitic plants that live on the bark of older trees, consuming their nutrients.

## Mangrove survival needs

- **Oxygen and nutrients**

- Mangrove roots are designed to collect oxygen and nutrients from the mud and water around them.
- If sediments, waste, chemicals, or oil cover the breathing cells on their roots, the tree may suffocate.
- They prefer fine grained soil over mud since mud does not have much space for air.

- **Reproduction**

- Mangroves reproduce by dropping their seedlings or propagules into the water for the tide to disperse them.
- The seedlings or propagules only take root once they have found water that is not too salty or too fresh.
- They also need ground that is not too unstable for them to take root.

- **Temperature**

- Mangroves prefer tropical or subtropical regions.
- The lowest temperature they can tolerate is 5°C.

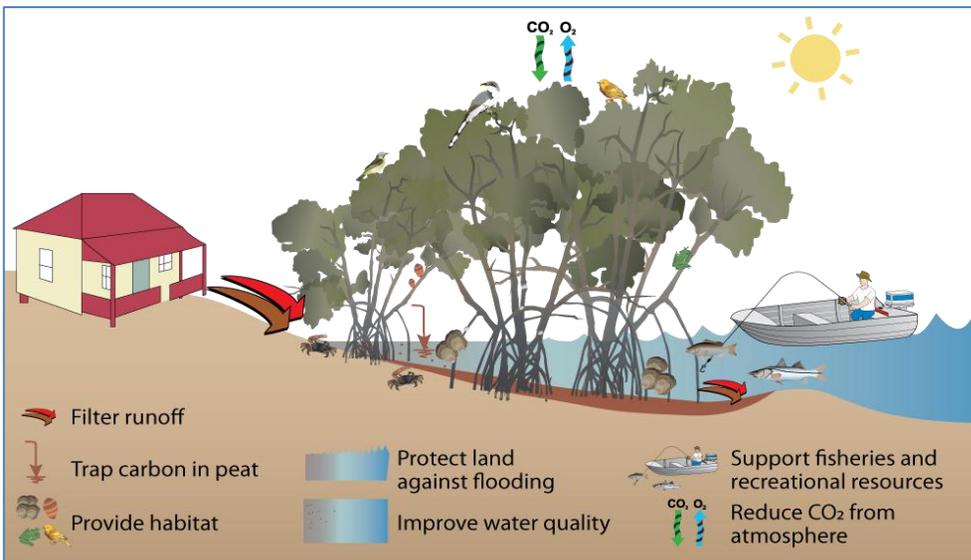
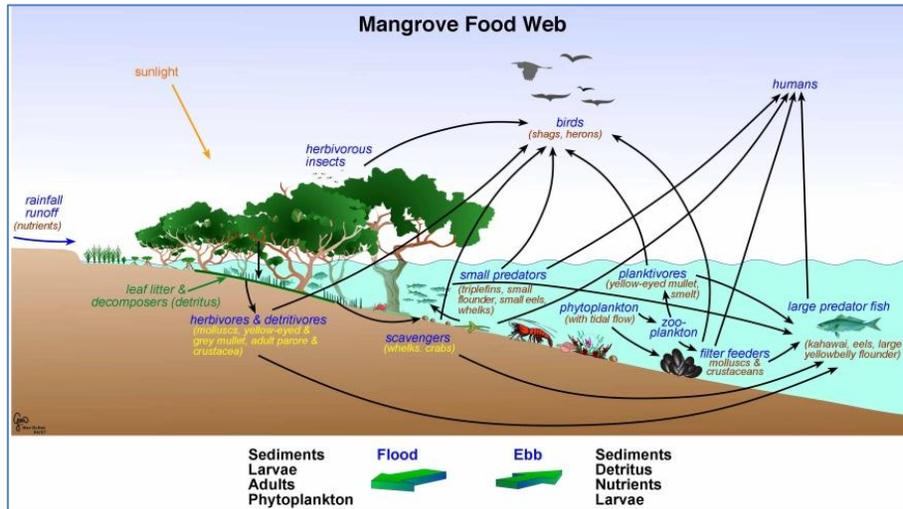
- **Moisture**

- Mangroves have adapted to keep freshwater in their system. They close the pores in their leaves and turn their leaves away from the sun to keep the moisture in.

- **Salt**

- Mangroves do not need salty water. They have evolved to be capable of growing in salty water. Since other plants cannot live in this kind of water, mangroves have taken coastal areas for themselves. That way, they do not have to compete with other plants for nutrients or space.
- Mangroves filter salt out at the roots. If any salt enters the plant's system, the tree excretes it from the pores on its leaves.
- Mangroves may also store salt on dead leaves or bark, which they will later shed.

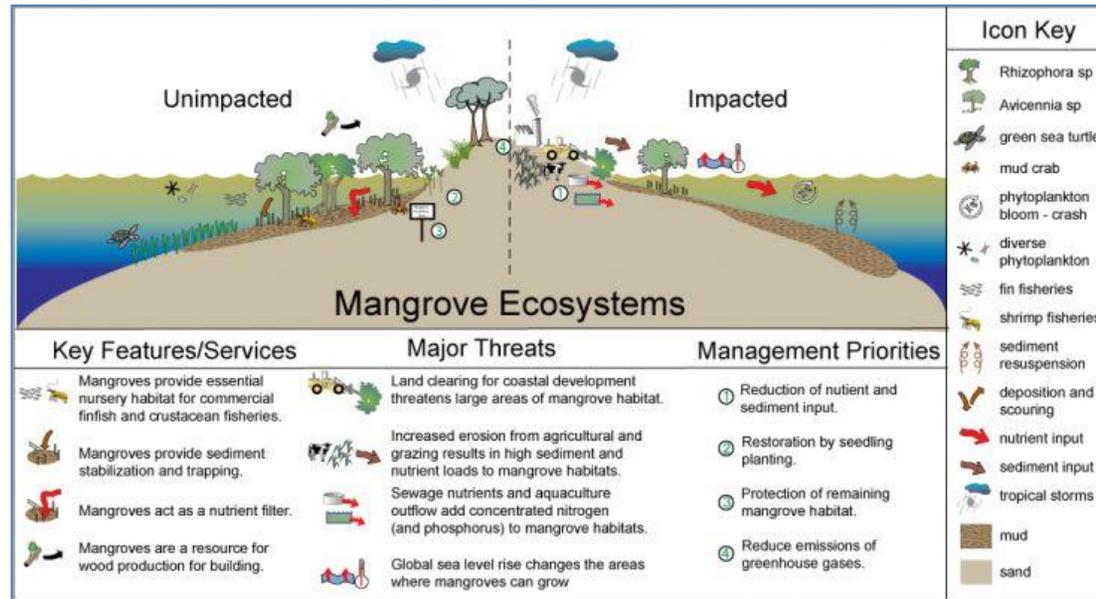
# Importance of Mangroves



Conceptual diagram illustrating the important ecological functions that mangroves provide to the marine environment. Diagram courtesy of the Integration and Application Network (ian.umces.edu), University of Maryland Center for Environmental Science. Source: Kruczynski, W.L., and P.J. Fletcher (eds.). 2012. Tropical Connections: South Florida's marine environment. IAN Press, University of Maryland Center for Environmental Science, Cambridge, Maryland. 492 pp.

- **Provide a physical habitat and nursery grounds for marine organisms**
  - These organisms have important recreational and commercial value
  - Mangroves are nurseries for shrimp, crabs, and fish
  - The roots protect organisms from predators
- **Serve as buffers for storms (and hurricanes)**
  - Mangroves reduce the damaging effects of storm winds and waves.
- **Protect shorelines from erosion**
  - Mangrove roots hold sediments and loose soil together. They stabilize the land
- **Provide roosting and nesting sites for many birds**
- **Improve water clarity and quality**
  - The tangled root systems filter runoff that may include pollutants. They trap sediments and debris from the land
- **Provide food for many marine organisms**
  - Fish like the snook, gray snapper, and the tarpon find food here
- **Trap and cycle organic materials, chemicals, and nutrients that sustain ecosystems**
- **Support endangered species**
  - The hawksbill and green sea turtle, for example
- **Used as a renewable resource**
  - As mentioned in the introduction

# Damage to the Mangroves



Icon Key	
	Rhizophora sp
	Avicennia sp
	green sea turtle
	mud crab
	phytoplankton bloom - crash
	diverse phytoplankton
	fin fisheries
	shrimp fisheries
	sediment resuspension
	deposition and scouring
	nutrient input
	sediment input
	tropical storms
	mud
	sand

- **Climate change**
  - Mangroves require a stable sea level to survive
  - Climate change causes sea levels to rise
- **Floods and Hurricanes**
  - Strong waves and currents prevents seedlings from taking root in the sediment and washes nutrients away
- **Wildlife, pests, and weeds**
  - Wildlife damage seedlings, leaves, flowers, roots, and propagules
  - Pests eat mangrove foliage and damage the wood
  - Weeds restrict the growth of mangroves

- **Tourism**
  - Visitors bring garbage, sewage, noise, fumes, lights, and other disturbances that put a stress on mangrove ecosystems
- **Coastal development**
  - Building of ports, docks, hotels, marinas, and human settlements pollute the water and mangrove forests
  - People involved in the construction bring traffic, garbage, and noise which put a stress on mangroves and their habitats
  - Deforestation increases erosion and the amount of sediments in the water, which affects mangroves' filtering ability
- **Agriculture**
  - Mangrove forests are being cleared to make way for rice paddies, rubber trees, palm oil plantations
  - Fertilizers, pesticides, waste, and other agricultural products block pneumatophores, choking the mangroves
  - Natural flow of water to mangroves is disrupted by paving roads over waterways or diverting waterways for irrigation
- **Lumber industries**
  - Mangrove wood is harvested for building material, fencing, fuel, firewood, construction wood, and charcoal production
  - The problem is that the harvesting of wood is no longer sustainable
- **Shrimp farming**
  - Mangrove forests are being replaced by artificial shrimp farming ponds
  - Farmers divert water to their ponds, which reduces the amount of freshwater supplied to mangroves and makes it difficult for mangrove seeds to be dispersed

# Mangroves in Belize

## What is the importance of mangroves in Belize?

- Provide fish nursery areas
- Protects coastal regions from erosion and storm surge
- Keep coastal soil together
- Maintain healthy tropical marine ecosystems
- Provide a nesting and feeding area for birds
- Provide construction material, firewood, and fuel
- Absorb carbon dioxide from the atmosphere

## What is the status of our mangrove population?

- The value of products and services provided by mangroves is estimated to be between US\$200,000 and US\$900,000 per hectare per year according to a 2006 UNEP report
- Between 1990 and 2006, there was a decline of 11,939 hectares
- Of this decrease, half was human caused and half was caused by storms
- An average of 344 acres of mangrove is lost every year due to human activities

- Mangroves affected by Hurricanes Keith (1999) and Iris (2001) have not yet recovered

## What are the factors affecting our mangroves?

- Land clearing
- Illegal logging
- Illegal encroachment of reserves
- Coastal development for tourism and housing: resorts, upscale residences, docks
- Bush fires
- Improper agricultural activities and chemical pollution of water resources
- Climate change and changes in weather patterns, such as rainfall and temperature
- Increase in frequency and severity of storms and hurricanes
- Increase in sea level
- Pumping of dredge spoil into mangrove swamps
- Illegal squatting in mangrove and swamp lands in rural areas

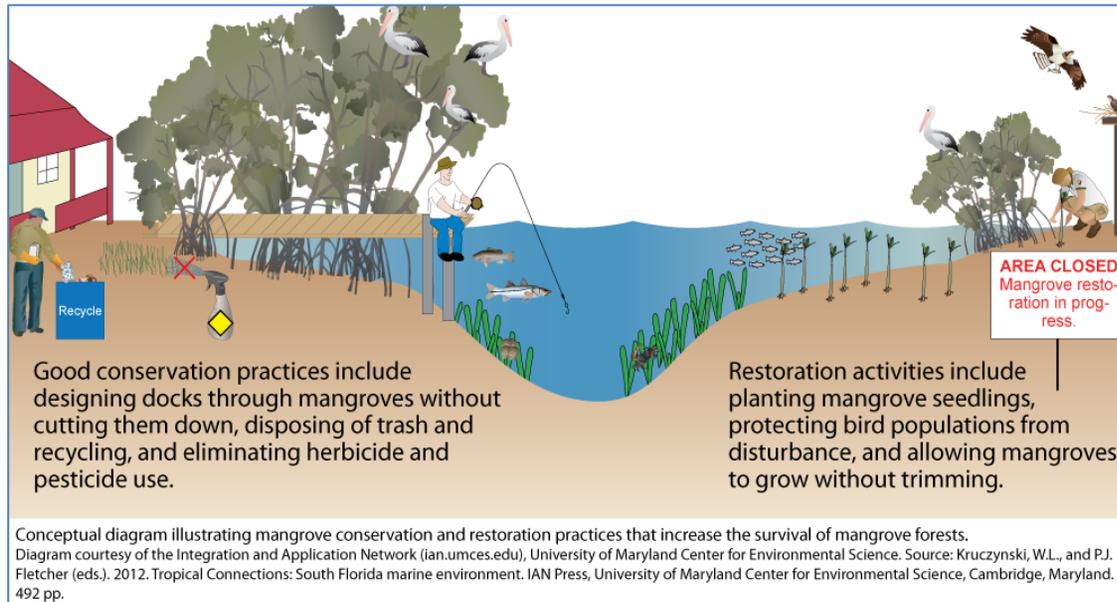
**Table 1** Belize City Development & Mangrove Forest Area

Year	Total Area (mls <sup>2</sup> )	Development		Mangrove	
		Area (mls <sup>2</sup> )	%	Area (mls <sup>2</sup> )	%
1969	9.5	2.01	0.21	7.49	0.79
1988	9.5	4.4	0.46	5.1	0.54
2005	9.5	6.4	0.67	3.1	0.33
2009	9.5	6.48	0.682	2.3	0.24

Percentage of Belize City covered by urban development vs mangrove over a period of 40 years.

Source: Issue Paper 07 by the Inter-American Development Bank

# Save the Mangroves!



## What can Belize do to protect mangroves?

- Regulate coastal development
- Monitor mangrove populations
- Do more research to better understand mangrove ecosystems
- Implement the national mangrove management plan
- Start a program for planting mangroves in critical areas
- Require an assessment of the area and a permit before cutting down mangroves
- Encourage fellow Belizeans to become aware of the situation and to take action
- Commit to the cause of saving the mangroves!

## Related Links

<http://www.naturefoundationsxm.org/education/mangroves/mangroves.htm>

<http://www.tarleton.edu/Faculty/dekeith/mangroves.html>

<http://www.dcbiodata.net/explorer/info/habitats>

<http://www.flmnh.ufl.edu/fish/southflorida/mangrove/profiles.html>

<http://envirodiva.wordpress.com/2011/08/05/what-i-cant-trim-my-mangroves/>

<http://www.backyardnature.net/yucatan/buttwood.htm>

<http://blog.travelmarx.com/2012/01/binomen-art-mangrove.html>

<http://www.nhmi.org/mangroves/id.htm>

<http://www.naturefoundationsxm.org/education/mangroves/>

<http://floridasnature.com/florida%20trees1.htm>

<http://www.nhmi.org/mangroves/rep.htm>

<http://www.amnh.org/explore/science-bulletins/bio/documentaries/mangroves-the-roots-of-the-sea/mangrove-threats-and-solutions>

[http://envis.maharashtra.gov.in/envis\\_data/files/Mthreats.html](http://envis.maharashtra.gov.in/envis_data/files/Mthreats.html)

<http://www.oceanicresearch.org/education/wonders/mangroves.htm>