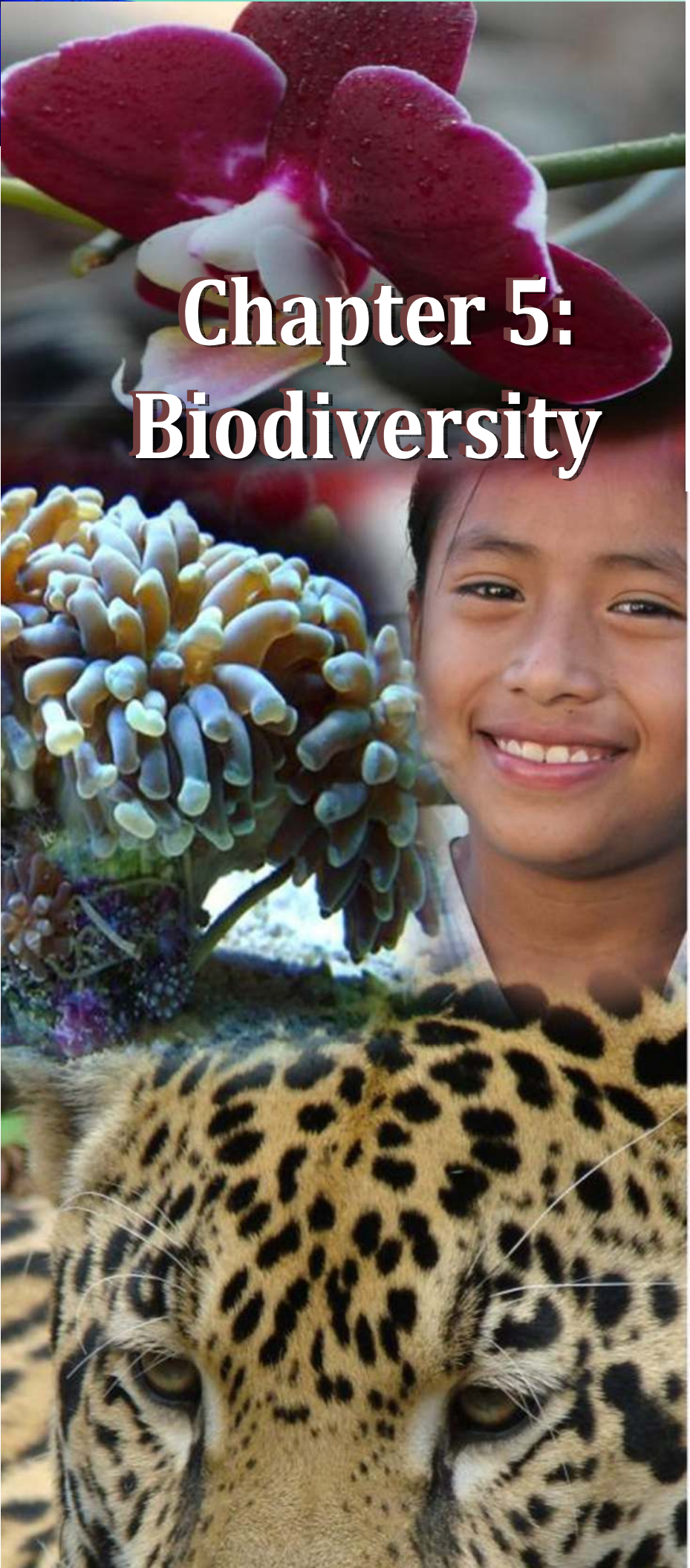
# Chapter 5: Biodiversity



CHAPTER 5

# Biological Diversity

Biodiversity or 'Biological Diversity' simply means **the variety of life** and includes ecosystem diversity, species diversity, and genetic diversity. Our biological diversity is vital for supporting our existence in many ways and forms. So vital is our biodiversity, it provides us with everything from clean air to food production, supporting a large number of goods and services that sustain our lives every day.

From the large mahogany trees, mountain cows, jaguars and huge crocodiles to the tiny insects and micro-organisms, Belize is blessed with a large biodiversity make-up. To date, Belize has profiled some 7,046 biological species of flora and fauna, including more than 1,014 native species of vertebrates and some 3,408 native plant species.

## TOPICS



## BENEFITS OF BIODIVERSITY

Belize's biodiversity importance goes beyond counting and cataloguing how much diverse flora and fauna we have. Our biodiversity has helped to provide us with numerous benefits. Most notable examples are our tourism, agriculture, forestry, and fisheries sectors. But there are countless other uses and importance of our biodiversity that may not be visible to us. Here are a few examples of these benefits:

**ECO-TOURISM**

- It provides direct economic benefits from eco-tourism.
- it provides ecological attractions and services such as natural beauty and materials to showcase Belize's abundant natural treasures.
- Many artistic pieces such as wood carvings, seashell jewelry and other materials purchased by tourists are acquired from biodiversity.


*services such as natural beauty and materials to showcase Belize's abundant natural treasures*

- It provides and supports recreational activities.
- This allows the use of ecological areas for a variety of pursuits: film, photographs or literature, natural habitats, and bird watching.

**FOOD & AGRICULTURE**

- Biodiversity continues to provide economic and ecological benefits for crop production. Crops or livestock were first obtained from plants and animals in the forest. Many farm animals were once wildlife.
- Wildlife help to generate genetic traits that make crops and livestock improve performance, increase production, make them more resistant to pests and diseases and cope with changing environmental conditions. Other benefits include:
    - insects pollinating crops,
    - termites and earthworms aerating the soil,
    - toads/frogs/salamanders eat insects and help to control the insect population,
    - Also, in less than a day a ladybird can eat over 100 aphids, which are harmful to crops.

**FORESTRY PRODUCTS** (*Timber and Non-Timber*)

- Forest wood used for fire and fire-hearths has been one of our basic forms of energy in Belize.
- As a huge income-earner for Belize, forestry continues to provide timber and non-timber produce.
- Forest materials are used for building and construction, furniture making, woodcrafts and paper production.


**MEDICINES**

- Biodiversity has helped to support both modern medicine and traditional healing. Today, almost 2/3 of the medicines used worldwide come from plants, animals, or micro-organisms.
- New medicines being produced and patented are derived from wild plants and animals. The more biodiversity that exist, the better our chances of finding treatments for a wide range of diseases.

- Examples of animal and plant species that are useful for medical purposes are:
    - willow provides an organic molecule for aspirin
    - certain fungus are used for making penicillin
    - bees are used to treat arthritis
    - The venom of certain snakes is the basis for substances which enables blood to clot.
    - Caribbean sponges can be used to combat rejection of organ transplants.

www.medicine.com

**CULTURAL NEEDS**

- Biodiversity supports our cultural needs by providing materials for cultural food, clothing, music, and other utensils.
- It also provides places and spaces that become interwoven with a group's social and spiritual beliefs and practices.

**RESEARCH**

- Scientists have long studied how nature works and are now beginning to understand the dynamics through which species function in their natural environment.
- Research has helped to improve our technology by mimicking special traits of wild plants and animals. Many modern devices are engineered based on animal characteristics, example Velcro, jet engines, helicopters, night vision equipment etc.
- Natural areas provide excellent living laboratories for studies, for comparison with other areas under different systems of use, and for valuable research into ecology and evolution.

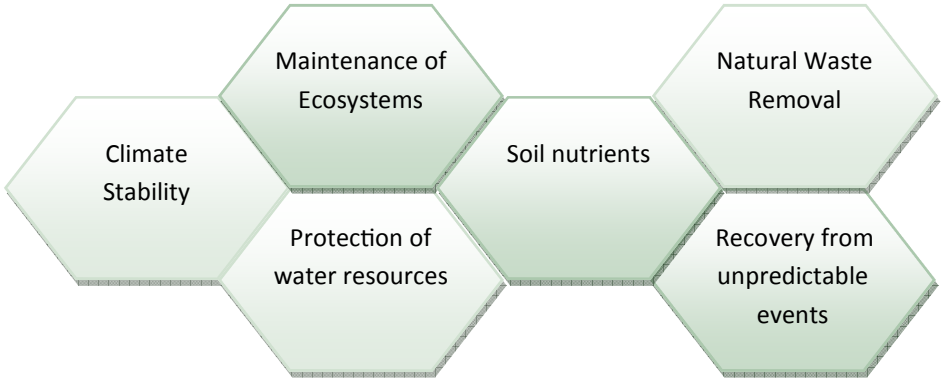
Courtesy Chaa Creek Lodge

**NATURAL BEAUTY**

- Aesthetic values are provided by natural systems. These natural scenic areas stimulate all senses and promote a sense of wellbeing.

## ECOLOGICAL FUNCTIONS & SERVICES

There are numerous ecological benefits of biodiversity. Healthy ecosystems diversity contributes to:




## CLIMATE STABILITY

- Growing evidence suggests that undisturbed forests can help to maintain the rainfall in its immediate vicinity by recycling water vapor at a steady rate back into the atmosphere.
- Natural vegetation maintains water and humidity levels and is essential for maintaining the oxygen/carbon dioxide balance in the atmosphere

## MAINTENANCE OF ECOSYSTEMS

- Ecosystem relationships form the web of life, a connection of numerous food chains. Flora and fauna rely on each other for survival, food, shelter, reproduction, movement, growth and so forth.
- Biodiversity maintains natural habitats by helping ecosystems to function properly and allows species survival through a natural cycle. In some instances, human induced activities, such as controlled forest fires, or reforestation help to maintain ecosystem functions. However, maintaining natural habitats is favored over costly artificial controlled or rehabilitation measures.

## PROTECTION OF WATER

- It protects our water resources, maintaining our water cycles, protecting our water quality, and acting as a buffer against extreme events such as flood and drought.

- Our Riparian forest acts as a buffer along rivers and our mangrove forest, also helps to filter waste before it enters the sea. Removing these types of forests could have devastating effects, causing contaminants to enter the water and reduce our water quality.
- Vegetation also helps to regulate underground water resource, preventing mudslides, land degradation and other environmental disasters.

**SOIL NUTRIENTS**

- microorganisms such as bacteria, fungi, algae and many tiny insects come to the rescue by creating, maintaining and providing nutrients for the soil

**WASTE REMOVAL**

- The biodiversity consists of microbes, fungi and other microorganisms that help to decompose organic materials like leaves, logs, twigs and dead animals and insects. This is the natural process by which biodiversity helps to remove waste from the environment.

**RECOVERY FROM UNPREDICTABLE EVENTS**

- Healthy ecosystems are more able to cope with natural disasters or environmental damages. A healthy ecosystem would regenerate healthy plant and animal populations after a natural disaster such as forest fire, flood, and hurricanes or from disasters caused by humans. A weak and unhealthy ecosystem will less likely recover quickly or at all and could result in species extinction.

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*What is biodiversity? It is the variety of life. But it is more than a list of species. It is about their many interactions, their importance to our environment and our lives.*



**Table 4:**

Biodiversity Services & Functions



| | SERVICES | FUNCTIONS | EXAMPLES |
|---|---|---|---|
| 1. | **Aesthetic Value** | pleasing appearances that can influence senses | natural beauty |
| 2. | **Agriculture** | food production, economic benefits, genetic study to enhance crop and livestock resistance to diseases, soil nutrients, water supply, climate stability | wildlife utilised to generate genetic enhancement of crop and livestock resistance to climatic changes. |
| 3. | **Biological control (food webs)** | Trophic-dynamic regulations of populations. | Keystone predator control of prey species, reduction of herbivores by top predators. |
| 4. | **Climate regulation** | Regulation of global temperature, precipitation, and other climatic processes at global or local levels. | Regulate Greenhouse gases and it also affects cloud formation. |
| 5. | **Cultural Purpose** | Providing opportunities for cultural preservation or non-commercial uses. | Aesthetic, artistic, educational, spiritual, and/or scientific values of ecosystems. |
| 6. | **Disturbance regulation** | the integrity of ecosystem response to environmental changes | Storm protection, flood control, drought recovery and other aspects of habitat response to environmental variability mainly controlled by vegetation structure. |
| 7. | **Eco-Tourism** | direct economic benefits from ecological tourism | Natural ecological settings, ecological tours, tourism souvenirs, employment, income generation |
| 8. | **Erosion control** | Retention of soil within an ecosystem. | Prevention of loss of soil by wind, runoff, or other removal processes, storage of stilt in lakes and wetlands. |
| 9. | **Food production** | That portion of primary production extractable as food. | Production of fish, game, crops, nuts, fruits by hunting, gathering, subsistence farming or fishing. |
| 10. | **Gas regulation** | Regulation of gases in the atmosphere. | Carbon Dioxide/Oxygen ($CO_2/O_2$) balance, ozone $O_3$ for UVB protection, and $SO_x$ levels |

| | SERVICES | FUNCTIONS | EXAMPLES |
|---|---|---|---|
| 11. | **Genetic resources** | Sources of unique biological materials and products. | Medicine, products for materials science, genes for resistance to plant pathogens and crop pests, ornamental species (pets and horticultural varieties of plants). |
| 12. | **Habitat and Biological Corridors** | Habitat and corridors for resident and transient populations. | Nurseries, habitat for migratory species, regional habitats for locally harvested species. |
| 13. | **Nutrient cycling** | Waste treatment . Natural recovery of nutrients lost and removed or breakdown of waste nutrients and compounds. | Natural waste treatment, pollution control, natural removal of waste |
| 14. | **Nutrient Storage** | internal cycling, processing and acquisition of nutrients | Store nitrogen and phosphate nutrients and other elements for nutrient cycles. |
| 15. | **Pollination** | Movement of floral gametes. | Provision of pollinators for the reproduction of plant populations. |
| 16. | **Soil formation** | Soil formation processes. | Weathering of rock and the accumulation of organic material. |
| 17. | **Raw materials** | That portion of extractable raw materials for primary productions, energy, income generation, etc. | The production of lumber, petroleum, fuel. |
| 18. | **Recreation** | Providing opportunities for recreational activities. | sport, fishing, and other outdoor recreational activities. |
| 19. | **Research** | Ecological study, genetic studies, inventions, natural living laboratories for studies, | Study of ecology, archaeology, forestry, agronomy, hydrology... Data for sustainable development, protection of resources, maintain healthy environment and people |
| 20. | **Water regulation** | Regulation of hydrological flows. | Provisioning of water for agricultural (such as irrigation) or industrial (such as milling) processes or transportation. |
| 21. | **Water supply** | Storage and retention of water | Provisioning of water by watersheds, reservoirs and aquifers. (groundwater resource) |

## Genetic Diversity Level

This is the combination of different genetic makeup found within a specific species.

These genetic differences are determined by the genes, chromosomes, DNA and so on. It is what makes each species unique.

All organisms contain a different mix of genes or DNA. This is seen in slight differences in the same species of flora or fauna. For instance, in a flock of macaw birds, each bird may have different feathers, eye color, height or built, or a group of mangroves may have different root and leaf structures, color, or height.

These differences can determine how the organisms develop physically, gain and use nutrients, and interacts with their environment. It's special traits within species that allow them to adapt to changes in climate and other environmental conditions.


## Species Diversity Level

There are many different species of plants, animals and microorganisms that exist – it is species diversity. This is what most people refer to when they talk about biodiversity. There are about one and a half million named species on earth, but we know that many unnamed species exist, and the total number is probably between 5 and 15 million. Tropical rainforests cover less than 2% of the earth yet are the home for more than 50% of all species on earth. Species are the building blocks of any natural community. They are members of a specific kind of plant or animal that can breed and produce fertile offspring. Species are the units that scientists generally use to study quantity or their importance. It is also the unit most frequently used to associate people to the realities and impact of development on the natural processes.

## Ecosystem Diversity Level

Ecosystem diversity includes the general differences between the type of ecosystems that exist, and the diversity of habitats and ecological processes within each ecosystem. Simply it is difference between places where life exists, such as coral reefs, forests, wetlands, lakes, rivers, and agricultural landscapes. In each ecosystem, living creatures interact with one another and with the air, water, and soil. It is harder to define ecosystem diversity than species or genetic diversity because the 'boundaries' of communities and ecosystems are not visible. It is generally used to differentiate similar communities or conditions such as temperate rainforests or coral reefs.

*Figure: 15: Levels of Biodiversity*

# SPECIES DIVERSITY

Each year the number of our biological species keeps changing. So far, Belize has discovered approximately 3,411 native species of plants, 1,014 native species of vertebrates and an even greater population of insects, of which over 700 are butterflies. We are still identifying or discovering new and more species of marine life, plants, birds, mammals and insects.

*Humans worldwide rely on at least 40,000 species of plants and animals on a daily basis for food, medicine, clothing and shelter.*

**Mammals:** Approximately 150 mammal species have been recorded for Belize of which more than half are bats.

**Amphibians & Reptiles:** Belize has approximately 151 species of amphibians and reptiles. It includes two crocodile species and five species of sea turtle.

**Marine and Freshwater Fish:** Boasting the 2nd largest barrier reef in the world and rich marine and land ecosystems, Belize is home to a diverse number of marine and aquatic biodiversity, recording well over 600 species of marine and inland fish so far.

**Plants:** Belize has roughly 4,000 species of native flowering plants of which 2,500 are dicots and 1,500 are monocots. About 700 species of native trees are reported for Belize, representing 331 genera in 87 plant families.

**Insects:** The insect population of Belize remains largely unknown. Only some butterflies and moths families and the dragonflies and damselflies have been sampled extensively. Reportedly, there are about 700 butterfly species; dragonflies & damselflies are at 174 species so far.

**Birds:** Belize also has more than 600 species of birds.

*Black Orchid*

*The national flower of Belize is the Black Orchid (Encyclia Cocheeata). There are approximately 250 species of orchids in Belize.*

## EXAMPLES OF BELIZE'S SPECIES DIVERSITY

### Birds

**Roadside Hawk**: Stop and look to see the roadside hawk perching on the side of the road or on high tension lines. Common throughout Belize, this hawk shows that the area is teeming with biodiversity. It hunts rodents and insects.

**Indigo Bunting:** A migratory bird from Canada and the USA, this bird usually comes to nest in our warm tropical climate, away from the winter cold. The deep blue feathers indicate that it is a male and brown and dusty streak colors are females. They often feed on insects

**Rufus-tailed Hummingbird:** the smallest bird and the only bird with the ability to fly backwards, hummingbirds live on insects and use nectars to refuel for flight. They flap their wings up to 200 times per second. Helicopter blades were designed to mimic the unique wing maneuvering abilities of the hummingbird.

**Scarlet Macaw:** The scarlet macaw parrot, apart from being under stress through loss of habitat (nesting trees), is also sought for supplying the local pet trade.

### Marine & Freshwater Species

**Spotted Eagle Ray:** It can grow up to 8ft long, with a well-defined head set off from its pectoral fins. There are 3 species of eagle rays in Belize. One of their most impressive features is the "wings that give the appearance that they are flying. They can be found along the barrier reef, and in shallow or deep, sandy areas. They are bottom feeders, and eat crabs, conch, oysters, small fishes and crustaceans.

**Toad Fish** also known as coral toadfish is name for its toad-like appearance. They usually range from 4 to 6 inches in size and can move in depths of 25 to 60 feet.

**Angel Fish**: Of 74 species worldwide, only 7 species are found in the Caribbean. In Belize, Rock Beauty, Queen Angelfish, Gray Angelfish and the French Angelfish are more common. 95% of their food intake is sponges, which is not the most appetizing meal.

**Viper Moray Eel:** With strong jaws that expose tiny teeth, the viper moray eel can grow up to 3 ft long. The eel smooth, scale-less skin is like snakes. With fanglike-teeth between narrow, muscular jaws, their grasp can be deadly. There is no venom but their teeth carry the decayed food particles of their past travels and meals.

## Amphibians & Reptiles

**Green Iguana**: A reptile, the green iguana can grow 5-6 feet long and live up to 15 years in the wild. There green is a protective measure to blend with their environment. As adults they gradually change from green to a mixture of brown, gray, black and slight green. The green iguana is herbivores that feed mainly on leaves, flowers, and fruits such as figs and BriBri. The female iguana can lay from 20 to 60 eggs.

**Hawksbill Sea Turtle**: It can weigh between 30 and 100 pounds but there are reported cases of it growing up to 280 pounds. All sea turtles in Belizean waters are endangered species. Three species breed in Belize. The breeding of the hawksbill turtle is considered of global importance for the survival of this species. The loggerhead and green turtles and four of the larger freshwater turtles are hunted for food. The largest and most prized species is the Hickatee or Central American river turtle. Their populations have declined considerably.

**Crocodiles:** Presently, Belize has two crocodile species known as the American crocodile (crocodylus acutus) and the Morelet crocodile. The acutus species, which can grow up to 5 meters, are rare and live in coastal regions. The largest population of acutus is found at the Turneffe Atoll. The morlets, more common than the acutus, is the smaller species with a length of 3.5 meters. Belize's crocodile population, after a serious decline caused by over hunting in the 60's and 70's, has recovered well but recent urban expansions in areas inhabited by crocodiles, increase the risk of human encounters.

## Mammals

**Tapir** - The Tapir or 'Mountain cow' is the largest land mammal of Central America and the national animal of Belize.

They feed on grasses, aquatic vegetation, leaves, buds, nuts and fruits. Most Tapir species spend 90% of their waking hours hunting for food. They have an excellent sense of smell and hearing, but poor sight.

Their sizes vary between species, but most are about 2.2 meters long, stand about a meter high at the shoulder, and weigh between 550 - 600lbs. The natural lifespan of a tapir is approximately 30 years.

**Manatee**: or "Sea cows" are large but gentle mammals of water. They live in warm shallow waters and feed on only plants, spending most of their days grazing sea grass like cows on land. Manatees can live for 50-60 years. Although endangered, manatees are still being hunted for their meat and rib bones. Many fall victims to boat collisions and their population are threatened by rapid development of coastal areas. Belize presently has the largest manatee population in Central America and the Caribbean.

## Insects

**Blue Morpho Butterfly**: It is considered to be one of the biggest butterflies seen. Brilliant and blue, their wingspan measures 5″ - 8″ inches in width. Female Blue Morpho butterflies have a dull blue with brown edgings for their wings. They also have white spots in the blue area. An adult Blue Morpho butterfly often lives in shrubs. They do not visit flowers for nectar but feed on the juice of rotting fruits or on the sap of the tree

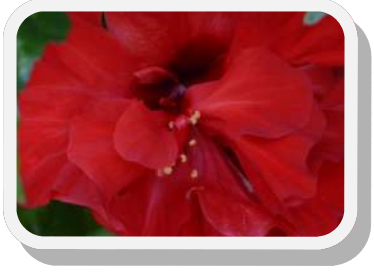
**Leafcutter ant**: A bug, these hard working ants can carry portions of leaves that weight more than 3 times their own weight. They haul leaves to their underground colony where the leaf is used as compost for growing the fungi. This is the main food source for these ants.

**Praying Mantis**: Named after their pray-like posture, the praying mantises are believed to have evolved from cockroaches. The mantises have two grasping, spiked forelegs in which their prey are caught and held securely. The mantis thorax consists of a prothorax, a mesothorax, and a metathorax. Its prothorax is flexible and allows for free movement of the front limbs while the rest of the body remains more or less immobile. The head is also remarkably flexible, permitting nearly 300 degrees of movement in some species and permitting a great range of vision. This vision allows them to fly at night in search of their mate and food but mostly to avoid being caught by birds and bats.

Mantises are exclusively predatory, preying mostly on insects but larger species have been known to prey on small scorpions, lizards, frogs, snakes, birds and rodents. Some prey even on their own, especially during the mating season.

## Plants

**Christmas candle** or Piss-A-Bed (Creole) or Hoja de Barajas (Spanish) is a shrub with green leaves and yellow flowers. It is used as remedy for urinary tract infections, liver spots and illnesses of the kidney. It can be found in yards, farms and forest.



**Hibiscus:** with over 200 species in the world, the hibiscus is a large flower with two or more petals. Their color vary depending on the species but they are mainly white, pink, red, orange, purple or yellow. Dried hibiscus are edible and some species have been used to make food coloring, medicines and tea.

**Savanna Palmetto Palm**: Belizean vegetation is characterized by numerous species of palms including the palmettos of the savanna, silver palmetto: palmetto and the common coconut palm of coastal areas. Other important palms include the cohune palms: cohune and warree cohune, as well as the give and take palm, xate palms, pokenoboy, basket tie-tie and royal palm.

# ENDANGERED SPECIES

Endangered species are any species of plant or animal in immediate danger of becoming extinct. Their numbers are usually low or near extinction and are in need of protection in order to survive. Belize has a wide range of endangered species. Forty-three of the mammal species found in Belize are in some way endangered, rare or are being illegally hunted. Thirteen mammal species were placed on the Convention on International Trade in Endangered Species (CITES) list. Eighty bird species found in Belize are of special conservation concern.

As a party to the Convention on International Trade in Endangered Species (CITES), Belize has been actively protecting wildlife for decades. Thanks to its persistent efforts, many wildlife species populations, such as jaguars, crocodiles, manatees, Jabiru storks, howler monkeys, sea and freshwater turtles, and other forest and marine species are being recovered. This is largely the result of the legislation like the Wildlife Protection Act of 1981 and combined effort of government and wildlife or community groups. However, the efforts to protect wildlife continues to be threatened, largely by the loss of habitat and over hunting.

***Red-footed Booby*** *(Sula sula) is a large seabird of the booby family, Sulidae. Like the name, they have red feet, but the colour of their feathers varies. Though powerful fliers, they are clumsy in takeoffs and landings. Yet, they are spectacular divers, plunging into the sea at high speeds to catch their prey of small fish or squids. They breed colonies in coastal regions, especially on cayes such as the Halmoon Caye. These birds were the first protected animals in Belize and were the reason for Belize establishing the first protected area in the Central American region in 1928.*

***JAGUARS (Panthera onca goldmani)***

*There are five cat species in Belize: the puma, ocelot, margay and the jaguarondi, but the largest and most revered is the jaguar. It is the third-largest feline after the tiger and the lion, and the largest in the Western Hemisphere.*

*The jaguar's present range extends from southern North America, most of Central America and parts of South America. Its preferred habitat is dense rainforest but it will range across a variety of forested and open terrain. A unique part of its habit is its profound need to stay close to water bodies, where it enjoys swimming.*

*With its golden brown fur that's covered with black spots, the jaguar resembles the leopard but is larger and more sturdy. There are rare variations in colour due to a melanism. These jaguars are called the black panthers but they still have their spots. Extremely rare albino jaguars, sometimes called white panthers, also occur among jaguars. Their normal weight range from 124 to211 pounds but larger males have been recorded at as much as 350 lbs.*

*A predator and a keystone species, the jaguar is largely a solitary, opportunistic animal at the top of the food chain. It feeds mostly on meat, preying mainly on armadillo, pacas, deer, tapir and peccary. In hunting its prey, the jaguar has an exceptionally powerful bite, even relative to the other big cats. This allows it to pierce the shells of armoured reptiles like the armadillo or biting directly through the skull of its prey to deliver a fatal bite to the brain. As a keystone species, it plays an important role in stabilizing ecosystems and regulating the populations of the animals it hunts.*

*Although jaguars are endangered species, they are still frequently killed by humans, particularly ranchers and farmers, whose livestock are threatened by jaguars. Currently, Belize's Cockscomb Basin Wildlife Sanctuary is the only designated jaguar preserve in the world.*



## Ecosystems

*Ecosystems are functional units consisting of living things and non-living things. These functional units are linked together through nutrient cycle and energy flow. They are also affected by chemical and physical factors of their environment.*

**Examples of Ecosystems of the World**

* Agro-ecosystem
* Aquatic ecosystem
* Coral reef
* Desert
* Forest
* Farm
* Human ecosystem
* Marine ecosystem
* Littoral zone
* Lotic
* Pond ecosystem
* Prairie
* Rainforest
* Riparian zone
* Savanna
* Taiga
* Tundra
* Urban ecosystem

# ECOSYSTEM DIVERSITY

An ecosystem is a naturally occurring group of organisms (plant, animal and other living organisms) living together in their environment. The word "eco-system" means so much more than just a mere place or thing. Eco- means environment and "system" is a network. If you combine the meanings, ecosystem would mean an "environment-network". Therefore, an eco-system is not just the biodiversity within a community but takes into account the relationship or interaction between plants and animals that exist in that given area.

Let us consider, for example, the people living in our own cities, towns and villages. These people are teachers, students, doctors, nurses, lawyers, police officers, shopkeepers, bankers, farmers, and so on. In our communities we have our homes, roads, transportation, stores, hospital, library, markets and our schools or place of work. These are all important parts of our community and we need all these places for our community to function smoothly. The same is true for our natural ecosystems, where a number of different organisms live and interact with each other. These organisms are so closely linked that they form a network, depending on each other to make the system work. Completely removing just one keystone species of plant or animal can throw the ecosystem into a tailspin.

There are several similar characteristics of ecosystems and several factors that make them different.

**ECOSYSTEMS SIMILARITIES**- basic characteristics of any ecosystem are:

- There are populations of plants and animals living and interacting with each other.
- The plant and animal populations are dependent on each other.
- Plants produce food and the energy from the food flows through ecosystems.
- The flow of energy is necessary to the survival of the ecosystem.
- Different organisms get their energy in different ways.
- Important physical and chemical factors are present.

- Each plant or animal species plays a different role in an ecosystem.
- Each plant and animal species has a tolerance limit for various things in its environment.

*"Forest ecosystems are the combination of species, geology, topography, and climate tied together by physical and biotic processes specific to any one site, and most importantly occupied by trees as the dominant vegetation." Peter Kolb, University of Montana*

**ECOSYSTEMS DIFFERENCES:** A variety of factors that can make ecosystems differ are:

- **CLIMATE**: Where climate varies, so does the vegetation and wildlife. Warmer climate promotes tropical rain forests and deciduous forest ecosystems but colder climate promotes more tundra forest.
- **LOCATION**: Some animals and plants, depending on their physical features, are equipped to live in special locations, such as areas close to water, while others are more drawn to dryer areas.
- **ALTITUDE** : Altitude plays a major role in determining the type of vegetation that you may find in a given area and the animals living within an area.
- **RAINFALL** : Rainfall is one of the most important elements for Belize's flora and fauna. Areas where rainfall is above or below average helps determine the type of vegetation and wildlife in that zone.
- **SOIL TYPE–** This plays a crucial role in determining the flora and fauna diversity in different areas. The types of plants that would grow in one type of soil may not be able to survive in another type of soil.
- **HUMAN ACTIVITIES:** Our activities can change natural habitats, shrinking habitats or threaten the existence of biodiversity in an area, forcing native animals and plants to seek new places to live.

*A typical ecosystem usually forms a number of food webs, where plants and other photosynthetic organisms are the producers.*

## Belize's Forest Ecosystems

***Forest ecosystems*** *are highly complex and are made up of a variety of living things (wildlife, trees, shrubs, wildflowers, ferns, mosses, lichens, fungi and microscopic soil organisms) and non-living things (water, nutrients, rocks, sunlight and air). Trees are the biggest part forest ecosystems; but they depend on living and non-living things in this ecosystem to survive.*

## Belize's Marine Ecosystems

*Marine ecosystems are among the largest and most diverse ecosystems. They consist of estuaries, lagoons, mangroves, marshes, coral reefs, sea grass, sea floor, and are teeming with plant and animal life. Unlike freshwater ecosystems, coastal and marine ecosystems have a high salt content.*

# EXAMPLES OF ECOSYSTEMS

Belize has numerous ecosystems of broadleaf forests, pine forests, savannah, mangroves, littoral forests, wetlands, shrub lands, coral reefs, seagrass, agricultural areas and urban areas. However, we have placed them under two main categories: forest and marine ecosystems.

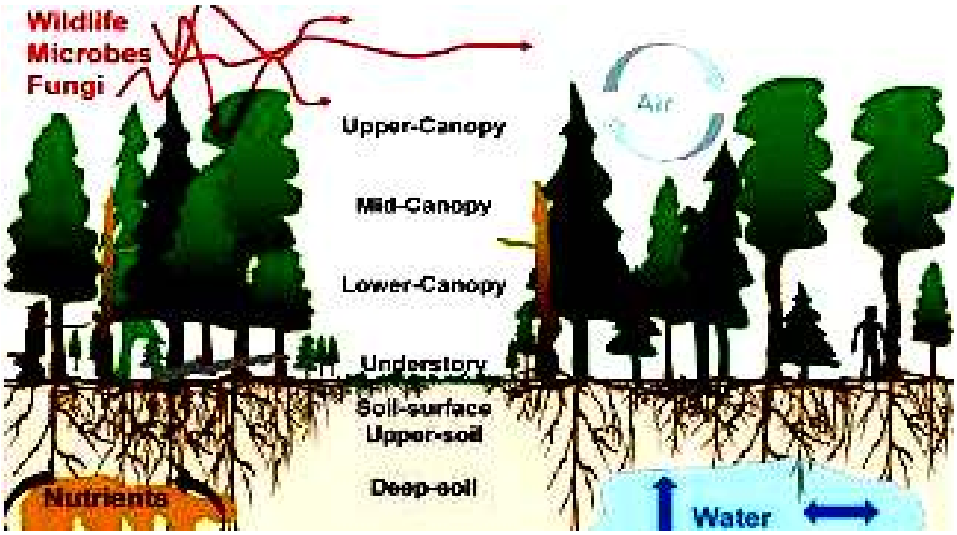



Figure 15: Forest Ecosystem Components

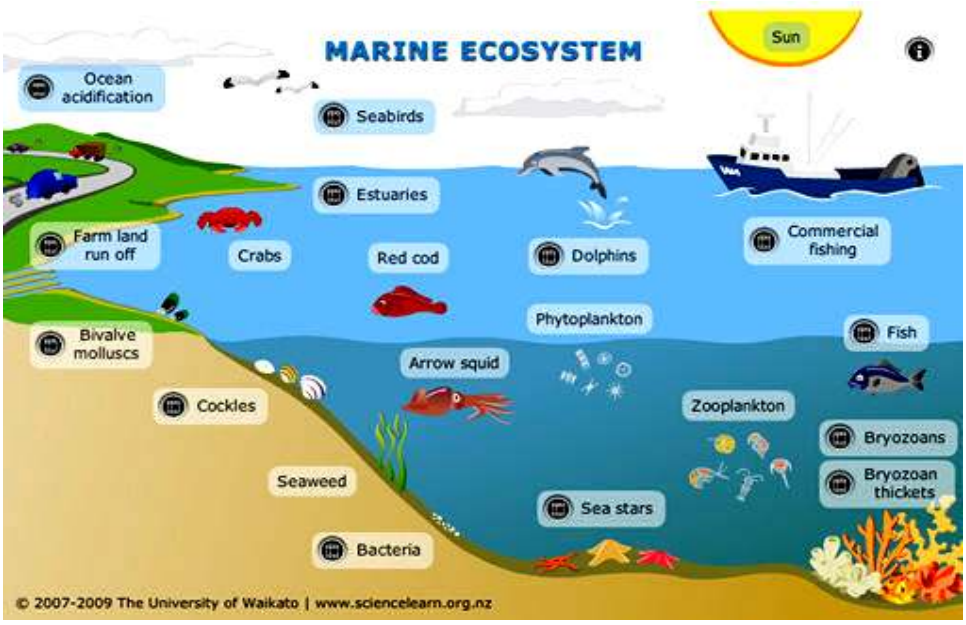



Figure 16: Marine Ecosystem Components

# FOREST ECOSYSTEMS

## Pine Forests

Pine forests of different types constitute 10% of the forests of Belize. Large areas along major highways are still under some type of presence of pine forest, “Pine Forest” or “Pine Ridge broadleaf species. The Caribbean pine is usually dominant in pine forests that are managed for timber extraction.

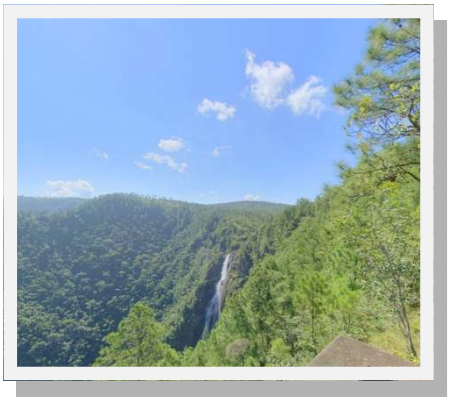
**Pine forests of the plains**

Pine forests of the plains are located along major highways where their presence is very high. Typical broadleaf species occurring naturally in lowland pine forests are palmetto, mylady, craboo, caimito, oak and polewood. Frequently affected by fire, this vegetation type slowly reverts to an open “pine savannah” where the Caribbean pine is present in varying densities but is not always dominant.

**Pine Hill forest**

Pine Hill forest is a slightly different type of forest found in the Mountain Pine Ridge area of the Cayo District, and in small patches along the eastern slopes of the Maya Mountains. Soil type and elevation differ from those in the lowland pine forests. At higher altitudes of the Mountain Pine Ridge a second species of pine can be found. Several Melastomaceae, mata palo, oaks, craboo, mountain palmetto and tree-ferns, add to the vegetation. Although this vegetation type is mostly fire resistant, frequent fires create grass-land vegetation as can be seen on the “Bald Hills” around Baldy Beacon.

Pine Forest



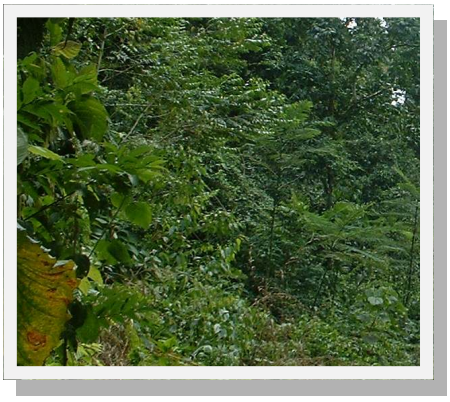
Pine Hill Forest

## Broadleaf Forests

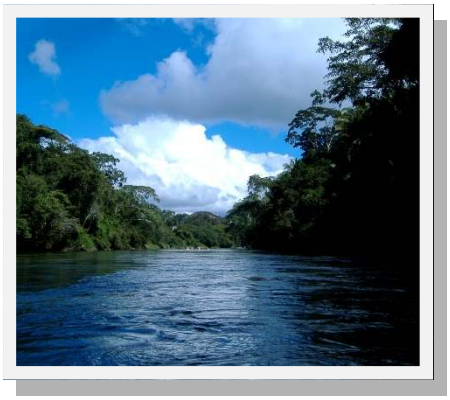
Broadleaf forests (or hardwood forests) of Belize are often popularly referred to as rain forests. There are 6 main types of broadleaf forests:

**Swamp Forests**

Swamp forests occupy 14% of all forests in Belize. They are usually short trees that are usually covered with water at least part of the year. In northern Belize, on limestone derived soils, swamp forests typically include pokenoboy, bullet tree, Santa Maria, wild grape, madre de cacao, logwood, sapodilla, black poisonwood and bayleaf. Swamp forests in southern Belize usually occur on poorer soils than those of the



Broadleaf forest



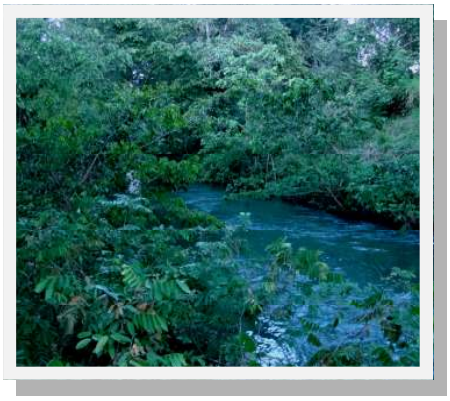
*Riparian forests are teeming with biodiversity. They provide important habitats for flora and fauna.*

north. Characteristic trees in these forests are mylady, rosewood, nargusta, yemeri and polewood. Certain swamp forests in the Toledo District occur on clays or loams. Its tree species include pokenoboy, bastard mahogany, bombo wood, provision tree, kaway and waika chewstick.

**Riparian Forests** (riparian buffer zone, or riparian strip or riparian area)

Derived from Latin word 'ripa', meaning river bank, Riparian forest is one of the fifteen terrestrial biomes of the earth. This area is the boundary between land and a river or stream, naturally engineered for soil stabilization. It acts as a filtering system between land and river. Riparian forests also fall within swamp forest and occur along most of major rivers. Typical species include cohune, pokenoboy, bullet tree, bokut, tubroos, figs, bribri, swamp dogwood, provision tree, kaway and royal palm. Its vegetation along the river banks protects a diverse collection of flora and fauna, including aquatic species.

Presently, riparian forests are endangered, as zones are being cleared or destroyed for development purposes. When riparian zones are damaged, biological restoration can take place but they are costly human interventions of controlling soil erosion and re-vegetation.

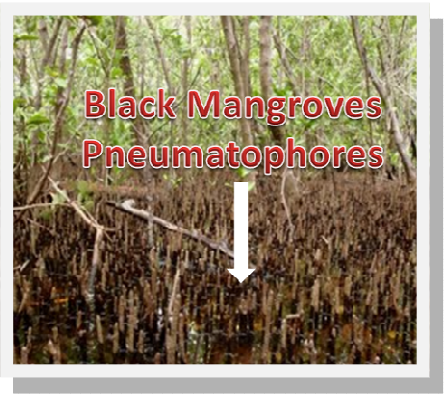


*Riparian forests form along river banks. Its root systems prevent soil erosion and act as a filter against land pollutants*

**Importance**

- Helps to reduce soil erosions
- Acts as an important natural bio-filter, protecting aquatic environments from land pollution and sediments from erosion.
- helps to reduce flood damage
- Supply shelter and food for many aquatic animals
- Provide shade and regulate river/stream temperatures
- Helps to protect and even improve water quality for both surface or groundwater flow.
- decreases nitrate levels often introduced from fertilizer, lowering nitrate contamination in surface runoff from agricultural fields,
- provides wildlife habitat and increase biodiversity
- provide biological corridors for wildlife, providing protective forage for them to move, feed and reproduce.
- provides native landscape irrigation by extending seasonal or perennial flows of water.

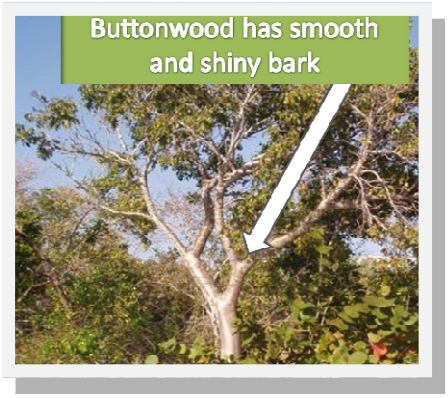
- Provide nutrients to aquatic species from vegetation (e.g. plant and insect drops)
- contribute to aesthetic value




**Mangrove Forests**

Mangroves are a group of woody, salt-tolerant trees that can adapt and grow in coastal zones. In Belize, mangroves accounts for 3.4% of the country's land area. There are four species: black, buttonwood, red and white mangroves.

For decades we used mangrove areas as dumping grounds, waste drainage sites or just cleared them for development because we were unaware of its significance. Today, more of us are becoming increasingly knowledgeable and appreciative of their importance.




**Economic benefits:**

- When sustainably manage, Red mangroves bark, leaves and shoots yield various tannins for dyes and medicinal purposes.
- Red mangrove leaves have been used for cattle feed and contain high amounts of protein
- The flowers of most mangroves yield high grade honey
- The Buttonwood barks are durable woods used for building and charcoal production.
- Natural Protection – it forms a natural protective shield against storms and hurricanes.


**Ecological benefits:**

- Acting as nurseries for many marine species, e.g. fish, shrimp and lobster.
- Decaying leaves and twigs in the water under mangroves provide a rich source of nutrients for other nearby marine ecosystems such as seagrass and coral reefs
- Being the principal source of food for coastal marine species.

- *Biodiversity*
- *Species*
- *Endangered Species*
- *Ecosystems*
- *Web of Life*
- *Cayes*
- *Coral*
- *Coral Reef*
- *Mangrove*
- *Riparian forest*
- *Searass*

Northern lowland forest

Mangroves extensive root systems tend to trap nutrients for marine species.

- Providing vital habitats for birds and other wildlife, e.g. hummingbirds, pigeons, herons and iguanas. They nest, rest or feed in mangroves over water to be safe from predators
- Protecting coast lines from soil erosion
- Helping to filter land and water pollutants and prevent them from reaching the sea.
- They are found along most of Belize's coastline and can be found inland along rivers where salt water mixes with inland waters.

**Lowland Wet Forests**

Lowland wet forests are lush, tall forests. They occur where rainfall is high, are confined to Southern Belize. They constitute 7% of Belize's forests. This forest type is the closest Belizean equivalent to what is popularly called "Rain Forest".

Tree species composition depends greatly on soil type. Where soils are derived from limestone, characteristic species include: billy webb, cohune, pokenoboy, breadnut, santa maria, wild rubber, ceiba, monkey apple, chicle macho, balsa, barba jolote mammee apple, bayleaf, quamwood, negrito, mahogany, nargusta and yemeri. Where this forest type occurs on poor soils, characteristic species include billy webb, cohune, mylady, negrito, waika chewstick, nargusta, banak, can't-be-helped tree, yemeri and polewood.

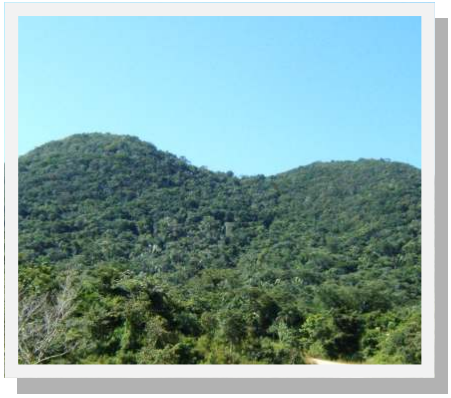
**Lowland Moist Evergreen Seasonal Forest**

Lowland moist evergreen seasonal forests cover about 29% of broadleaf forest areas, and are the second most extensive forest type in Belize. These forests receive a medium amount of rainfall and are virtually restricted to Northern and Central Belize. Usually, there is a substantial amount of deciduous tree species. In some of the more extreme examples, forest canopy height is low (7-8 m) but usually, heights of 20m are achieved.

Again, vegetation species composition depends on soil types. On the limestone soils, characteristic species are wild mammee, cohune, cowfoot, breadnut, gombolimbo, give-and-take tree, wild grape, glassy wood, black cabbage bark, sapodilla, black poisonwood, allspice, copal, bayleaf, mahogany, cojotón, fiddle wood and prickly yellow. On poorer soils nargusta, banak and polewood can be found. The driest and most distinct section of this forest type occurs in the Shipstern Nature Reserve area and in the Bacalar Chico National Park.

## Hill Forest

Hill forests are distinguished by landscape and occur generally in hilly areas of the country. They contribute to about 36% of all Belizean forest types and basically occupy the Maya Mountains massif including the Vaca Plateau. Common trees on limestone derived soils include wild tamarind, wild Mammee, cohune, cedar, ceiba, chicle, allspice, copal bayleaf, white poisonwood, hogplum, and wild lime. In areas where the soil contains rocks without calcium or limestone, tree ferns, cohune, mylady, iron wood, timber sweet, cherry, cypress, nargusta, banak, can't be helped tree, yemeri and polewood are found. Fire through lightning or (more frequently) human caused fires, destroy these types of forest and are replaced by a fern.



Young Gial Area, Cayo District

Montane forests and scrub forests occur in Belize in restricted areas where the altitudes of some of the Maya Mountain peaks reach above

## Montane & Scub Forests

500m. They represent 1% of all forest types in Belize. They are usually characterized by abundant tree ferns, bamboo, santa maria, mountain cabbage, Magnolia and oak. Where fire damage occurs, this forest is replaced by dogwood, parrot plum, hormiga, pine and oak.

There are several types of scrub and herbaceous communities. Scrub communities are dominated by woody species which are generally multi -trunk. Scrub communities technically also include shrub land or pine savannah. In areas of where there is salt, mainly along coastal lagoons or coastal creeks, dwarf red mangrove scrub are found. The herbaceous communities of Belize are being researched, but marsh (often associated with dwarf mangrove scrub) are among the best known. In total, these herbaceous communities cover 2% of Belize's natural vegetation.

**Lowland savanna**. This is an important vegetation type in northern Belize, in which scattered trees occur in "short grass" (actually mainly sedges). Savanna is maintained as open vegetation by a combination of wet-season flooding, dry-season drought and fire. Typical trees include: *Acoelorraphe wrightii*, *Quercus oleoides* and madre de cacao *Gliricidia sepium*.

Savannah lands are prone to forest fires during the dry season



# COASTAL & MARINE ECOSYSTEMS

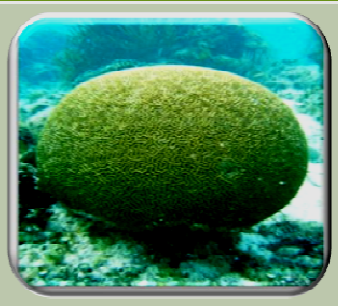
***CORALS:*** *These are colourful and exquisite living invertebrates (animals without backbones), made-up of a soft polyp with tentacles and a protective limestone skeleton. The green, browns and pinks are the result of a unique symbiotic relationship between zooxanthellae algae and the polyp tissues. You see, the zooxanthellae algae produces oxygen through photosynthesis and process waste materials produced by the polyp. In turn, the corals use the oxygen and compounds for food and growth. There are two main types of corals: hard and soft corals.*

Our coastal and marine ecosystems are in a class by themselves. Few countries possess the extent and diversity of our coastal and marine ecosystems. What makes them unique, however, also makes them vulnerable. These ecosystems are heavily affected by land ecosystems. For example, water from our mountains, hills, valleys and sprawling countryside eventually drains to the sea, taking along soils and nutrients.

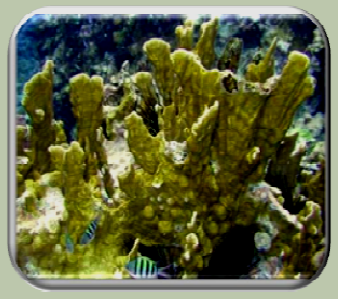
### *HARD CORALS*

*Called reef builders, **hard corals** are made up of stony, firm and hard protective skeletons. They are the only corals that can build reefs in tropical and sub-tropical areas. There are 74 species of hard corals in Belize but the main reef building corals are brain corals, finger corals, elkhorn corals, plate corals, staghorn corals and star corals.*

***Brain Corals** surface resembles ridges on a brain. The colonies often form a half of a hemisphere.*



***Leaf and Plate shaped corals** are fragile and thin, leaf-like colonies, which can dominate shallow water reefs.*

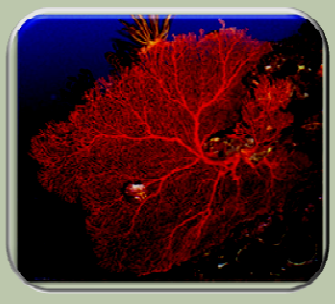


### *SOFT CORALS*

***Soft corals** have skeletons that are not as hard and stony as the hard corals. There are 36 known species of soft corals in Belize, which includes the octocorals, feather plumes, sea fans and sea whips.*

***Feather Plumes** are soft corals that resemble a large feather, with its long main stalk with its feathery branches. They can grow over six feet tall.*

***Sea Fans** are fan-shaped with delicate lace-like patterns that grow vertically.*



## Coral Reefs

An immensely important ecosystem of Belize is the coral reef. Its natural beauty, rich species diversity and many biological interactions make it an important component of the tourism and fisheries sectors.

Coral reefs are formed from a unique system and array of diverse corals built-up over many years. Like the diverse species of corals, there are also different coral reefs ecosystems in Belize. Can you give an example of a coral reef? Here are our examples:

- **Barrier Reef:** Belize has the largest barrier reef in the western hemisphere and the second largest in the world, Belize barrier reef is a continuous reef extending some 220 kilometres from northern Belize to the southern Sapodilla Cayes.

- **Atolls:** These are ring-shaped reefs surrounding a central lagoon. Belize has three atolls: Glover's Reef, Turneffe Islands and Lighthouse Reef. Glover Reef has been recognized as the largest atoll formation in the Caribbean. Turneffe is home to the healthiest mangrove stands and Lighthouse is the home of the famous Bluehole, a natural sinkhole 144 meters deep, with huge stalactites and stalagmites.

- **Fringing:** Coal reef formation that often form close to mainland, islands or close proximity to river mouths, these reefs are more tolerant to sedimentation and freshwater. E.g. Fringing reef occurs between Placencia and Punta Yacos in the south.

- **Patch**: From small clusters of coral heads to reef structures of 80 meters wide, patch reef systems are found mainly in central lagoons, e.g. Glover's Reef and Lighthouse Reef lagoons.

- **Faroes or "Shelf Atolls"** or "Ringed Reefs", resemble miniature atolls and are formed in lagoons rather than outside the reef. They are very unique reef types in the Caribbean.

Blue Hole, World Heritage Site

Glover's Reef

Halfmoon Caye



# CAYES

Belize has more than approximately 1000 islands ranging from small barren patches to the large liveable cayes, like St. George's Caye, Caye Chapel, Caye Caulker and the largest – the Ambergris Caye. The majority are lush patches of mangrove that lie within the protection of the Belize Barrier Reef. Without the protection of the barrier reef these cayes would be washed away. Three of the Caribbean's only four **atolls:** Glover's Reef, Turneffe Islands, and Lighthouse Reef, lie just beyond the reef. There are 11 different types of caye ecosystems found in Belize. The table below lists these types of cayes and their ecosystems.

| *TYPES OF CAYES* | | |
|---|---|---|
| **TYPES** | **DESCRIPTION** | **EXAMPLES** |
| **Unvegetated sand caye** | Small, ephemeral islands often forming and re-forming following hurricanes | Paunch & Curlew Cayes |
| **Vegetated sand caye** | Larger islands with strand scrub and woodland vegetation | Nicolas & Tobacco Cayes |
| **Unvegetated shingle caye** | Small ephemeral cayes located in exposed situations | - |
| **Vegetated shingle caye** | Small cayes located in exposed conditions, often on small patch reef | North Spot & Raggard Cayes |
| **Sand and shingle caye** | Small, stable islands in exposed conditions; vegetation with a windward shingle ridge and leeward sand area | Northeast Sapodilla Cayes |
| **Mangrove cayes** | Cayes in a lagoon and colonized by Rhizophora mangle | Jacks Caye |
| **Shelf island** | Island formed through sediment accretion on sub-merged topographic features in northern part of a lagoon | Caye Chapel and Caye Corker (Caulker) |
| **Mangrove caye with dry sand range** | Mangrove islands with sand flats on the windward side; usually in protected areas | Wildcane & French Man's Cayes |
| **Mangrove range** | Extensive and complex array of mangrove islands separated by partially enclosed bays and lagoons | Tobacco Range and Drowned Cayes |
| **Moat island** | Association of leeward sand area, interior mangrove swamp, lagoon and windward shingle ridge | Snake Cayes |
| **Coastal barrier island** | Barrier beaches or separated headlands | Harvest Caye |

Table 5:Types of Cayes in Belize

## Sea Grass Beds

Seagrass beds or "sea pastures'

Seagrass beds or 'sea pastures' are literally sea grass with extensive root systems. This root system helps to provide stable structure for the sea floor and marine soil. Sea grass also provides food and shelter for marine species like the conch, manatees, grass eating fish, sea turtles and micro-organisms. There are five species of sea grass in Belize, namely:

- Turtle grass (Thalassia testudinum),
- duckweed (Halodule wrightii),
- manatee seagrass (Syringodium filiforme),
- Halophila englemani and,
- Halodule filiforme.

## THREATS & IMPACTS

Clearly, we rely on our biodiversity for basic needs of food, shelter and health, as well as for national income generation and development. This dependency places significant pressures on our biodiversity resources and could lead to biodiversity loss. Although many of us struggle to promote sustainable use, many more are unaware of how their actions impact on the survival of our diverse flora and fauna. Below are a list of main threats to our biodiversity resources, which can lead to reduction of food supply, health problems, and environmental damage.

**RESOURCES**

- GENETICS
- SPECIES
- ECOSYSTEMS

**MAIN THREATS**

- Illegal Harvesting
- Over-harvesting
- Rapid Human Population Growth
- Deforestation
- Habitat Loss/Shrink Habitat
- Invasion of Non-Native Species
- Sea-level Rise
- Climate Change

**IMPACTS**

- reduce food quality and quantity
- threat to public health
- Damage of ecological systems
- Limited access to clean water
- salt water intrusion
- loss of watersheds
- Loss of biodiversity
- Habitat Loss
- soil erosion
- increase of droughts
- Economic loss
  - Tourism
  - Agriculture
  - Fisheries
  - Forestry
- Land degradation



# BALANCING USE & PROTECTION

We cannot "lock-away" our resources, or our people would not be able to survive. This dependency on biodiversity places some unique challenges ahead of us. How can we benefit without destroying our environment? How is a balance between use and protection created? It requires all of us doing our part.

**Individual Response**

- no not over use or over harvest
- Appreciate our rich biodiversity
- Protect habitats
- Prevent forest fires
- Be aware of biodiversity in your community
- educate others
- Discourage anyone from the illegal trade of endangered species
- Do not pollute our environment
- conserve water
- Encourage proper land use
- avoid using harmful chemicals pollutes water, land, air

**Community Response**

- communities become more active in protecting their local biodiversity
- The Forest Department developed the co-management system, which now allows local users and government to share responsibility for protecting Belize's rich biodiversity. Today, a co -management system is responsible for the protection of some 24 protected areas and their vast ecosystems.
- Community-based-groups assist in managing, monitoring and educating
- Schools educate students and families about pollution, deforestation and other threats to biodiversity.

**National Response**

**LEGISLATION**: We have both international and national laws which serve to protect our biodiversity from overhunting, overharvesting, illegal extractions and other pressures. The primary laws that protect our biodiversity are the Wildlife Protection Act, the Forest Act, the Fisheries Act and CITES. The United Nations Convention on Biological Diversity has also been a baseline for improving local legislations that create balance of use and protection. These legal framework either protect endangered species or give these agencies the authority to enforce seasonal harvesting and other activities for management. Permits for harvesting are issued and constant monitoring of our forest, coastal and marine ecosystems are conducted to ensure wildlife stocks are replenished naturally.

**MANAGEMENT**: The Forest and Fisheries departments, key agencies responsible for wildlife protection and management, are constantly monitoring but have recognized that laws alone cannot protect our rich biodiversity. Public awareness is also key. The departments work with many other government agencies like the Lands and Surveys Department, Department of Environment and the Police Department to enforce laws and protect our resources.

# LEAD AGENCIES

## FOREST DEPARTMENT

The Forest Department (FD) is charged with the responsibility of ensuring that Belize practices sustainable use or wise use of its forest resources and all that it contains for the benefit of Belizeans.

The Forest Department also works along with the Fisheries Department, which manages marine resources.

The Forest Department operates under several pieces of legislations:

- Forest Act
- Private Forests (Conservation) Act
- Measurers of Wood Act
- Forest Fires Protection Act
- Chicle Protection Act
- Wildlife Protection Act
- National Parks System Act

Also, to better manage biodiversity and protected areas, the Department also encourages the support of community-based organizations, such as Belize Audubon Society, the Toledo Institute of Environment and Development, the Yaxache Conservation Trust, Friends of Nature, Programme for Belize, Friends of Gra Gra Lagoon, and many other organizations.

*Forestry is the management of our forest. It embraces the science of managing, using, conserving, and protecting our forest in a sustainable manner. It is one of the oldest forms of agricultural practice used to meet basic human needs such as food, shelter, clothing, and heat. Forests can be sustainably managed successfully by:*

*Maintaining systems that allow forests to continue sustainable environmental and human services.*

### Forest Department Programs

***Protected Areas Management*** -The Forest Department is the management authority of 38 forest protected areas. To improve management of these areas, it encourages community involvement and participation through a co-management system of protected areas.

**Forest Resource Exploitation Control** - It screens logging activities and assess royalty payments due to the Government by logging companies and individual loggers. In doing so, the department monitors and control Belize's forest harvest, enforcing strict logging conditions and promote sustainable harvesting. This programme also monitors and manages mangroves along our coastlines.

**Law Enforcement** - To protect our forest and biodiversity, the Law Enforcement Program addresses illegal activities under the law. Illegal activities such as killing wildlife, hunting or trading endangered species, cutting of trees and extracting forest flora and fauna without permission are some of the issues that this program deals with on a day to day

*As part of sustainable management, the Forest Department issues permits for the seasonal harvesting of timber*

All logwood must be of mature sized before it can be harvested

basis.

**Forest Resource Planning** - The Forest Resource and Planning Management Program promote sustainable forest management by working closely with the forest sector. It seeks to improve the forest management through updating the forest laws.

**Wildlife Management** – It ensures the protection of Belize's biodiversity and wildlife. This unit manages wildlife on land and marine mammals namely dolphins, whales and manatees. Personnel are specially trained to capture and relocate problem animals such as jaguars and crocodiles. It also provides some services such as issuing hunting permits; and all other wildlife issues.

**The National and International Partnership** - It aims to strengthen the country's efforts to fulfill obligations under the Convention on Biological Diversity (CBD), the Ramsar Convention on Wetlands, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and other environmental agreements relevant to the Forest Department. They do so by lending technical support to the National Focal Points of these Conventions. The programme also acquires resources for Belize to manage its activities, fosters networking at the national and international levels, and build the institutional and technical skills of the Forest Department.

Forest Officer monitors forest to prevent overharvesting of xate palms

## FISHERIES DEPARTMENT

The Fisheries Department is responsible for the sustainable management of fisheries resources and marine protected areas. It does so under specific laws, such as the High Seas Fishing Act, Cap. 210: 10, 2003 and, The Fisheries Act, Cap. 210, 2000. The management of our marine resources, are further supported by four units of this department: Capture Fisheries unit, Aquaculture and Inland Fisheries, Ecosystem Management, and Administration and Support units.

Fisheries officer confiscates undersized conch at market in San Ignacio

The Capture unit and the Aquaculture and Inland Fisheries unit work can be challenging. It is not an easy task to promote a sustainable fisheries sector (both inland and sea fishing) and still protect our fragile marine ecosystems. However, they continue to improve their management systems to support economic and social growth of many local communities, while maintaining healthy marine ecosystems. One such system has been the enforcement of seasonal harvesting of specific marine species. Another has been the protection of critical spawning and feeding habitats of juvenile species, especially those with

critical lifecycles. By protecting these and other marine ecosystems, the department ensures sustainable growth of the fisheries sector and the protection of marine habitats for the natural renewal and reproduction of species. It also enables the natural recovery of these species and their habitats both from natural and manmade events.

The Ecosystems Management Unit (EMU) manages the marine reserves, conduct marine environmental assessments, and handle all CITES marine related matters. Through ecosystems management, the focus shifts from specific species and site protection to the protection of entire ecosystems. This entails the regulation of the activities within all marine protected areas.

With sustainable use at the core of its operation, the department supports and guides the fisheries and aquaculture industry on best practices and long-term sustainable opportunities. It is supported by research and projects that help to constantly monitor the state of our marine resources.

*As part of sustainable management, many local fishermen are permitted to harvest only mature marine produce seasonally*

### *Coastal Zone Management Authority and Institute*

*The coastal zone of Belize is home to the second largest barrier reef in the world, three of the only four atolls in the Caribbean, hundreds of patch reefs, extensive seagrass beds, mangrove forests, over 1,000 cayes, and is teeming with plant and animal life. These coastal areas are of significant ecological importance and the a primary source of economic development of our country, particularly for the fisheries and tourism sectors.*

*However, development pressures occurring along the coast and cayes over the years has resulted in degraded coastal resources and loss of critical habitat. To address this issue, the Coastal Zone Management (CZM) unit was formed under the Fisheries Department in 1990. Funding from government and non-governmental agencies facilitated the work of the CZMAI over the years.*

*Today, CZMAI is responsible for ensuring that there is better management, sustainable use and protection of Belize's coastal areas. It continues to work on several activities to bridge the gaps in management of our coastal areas, strengthen partnerships with various groups, conduct research, monitor the state of Belize's coastal areas, and help to educate and encourage more eco-friendly development in coastal areas. (source: coastalzonebelize.com)*



# CHAPTER SUMMARY

Biodiversity is the variety of life. There are three levels of biodiversity: genetic diversity, species diversity and ecosystem diversity. Genetic diversity is the different genetic make of a particular species. Species diversity are different species of plants and animals and even micro-organisms. Ecosystem diversity is a variety of different ecosystems in a particular area. These levels of biodiversity supports our existence in many ways and forms.

The importance of biodiversity are many. It includes economic and social benefits such as eco-tourism, food, agriculture, forestry, cultural preservation, research, medicines, and natural beauty. The ecological importance is also great, ranging from providing environmental balance to waste removal and soil nutrients.

*The importance of biodiversity are many. It includes economic and social benefits such as eco -tourism, food, agriculture, forestry, cultural preservation, research, medicines, and natural beauty.*

Belize has diverse species of mammals, amphibians marine and freshwater aquatic species, numerous insects, a large quantity of birds and vast species of plants. Some of these species are endangered or at risk of becoming extinct.

An ecosystem is a functional unit of living and non-living things linked together through nutrient cycles and energy flow. There are several characteristics of ecosystems, e.g. plant and animals interact, there is an energy flow, each plant and animal play different roles and so forth. However, ecosystems are not the same and certain factors make ecosystems differ. These factors are climate, location, rainfall, altitude, soil type and human activities.

Our ecosystems are grouped mainly by forest and marine ecosystems. Forest ecosystems are highly complex and are made up of a variety of living things (wildlife, trees, shrubs, wildflowers, ferns, mosses, lichens, fungi and microscopic soil organisms) and non -living things (water, nutrients, rocks, sunlight and air). Trees are the biggest part forest ecosystems; but they depend on living and non-living things in this ecosystem to survive.

Marine ecosystems are among the largest and most diverse ecosystems. They consist of estuaries, lagoons, mangroves, marshes, coral reefs, sea grass, sea floor, and are teeming with plant and animal life. Unlike freshwater ecosystems, coastal and marine ecosystems have a high salt content.

Biodiversity is often threatened by illegal harvesting, overharvesting, deforestation, pollution, climate change and other pressures. These activities can result in loss of biodiversity, habitat, food, economic and environmental problems. However, we can sustainably manage and protect our biodiversity. Lead agencies like the Forest and Fisheries departments need the help of all of us.

**Activity 1:** *Multiple Choice. This section fuses different aspects of the chapter to test your general knowledge.*

***Self Test***

*Think you learnt something? Test your knowledge . Each question is worth about 5 points.*

- *If you answered more than 80% of the problems correctly you mastered the information and did some reflecting along the way. You are a natural!*
- *If you answered 60% of the problems correctly you are trying and may need to re-read again to grasp those concepts you may have missed. Don't stop now; you don't want to miss out.*
- *If you got below 40% of the problems correct, don't be discouraged. You might be having some difficulty understanding the material and may need some help. Just ask someone for help and work on the problems together.*

| | | | |
|---|---|---|---|
| 1. **What is biodiversity?** | | | |
| A) forest ecosystems | B) variety of life | C) anything that gives us economic benefits | D) different species |
| 2. **Which is an example of a species?** | | | |
| A) river | B) forest | C) sea | D) red-footed booby |
| 3. **What is an ecosystem** | | | |
| A) the variety of life | B) a community | C) a network of living and non-living things | D) a tourism system |
| 4. **What is the largest but not the only part of a forest ecosystem?** | | | |
| A) trees | B) mammals | C) birds | D) water |
| 5. **What are the levels of "Biodiversity?** | | | |
| A) species, ecosystems | B) genetic, species, ecosystems | C) altitude, rainfall, climate | D) forest, marine |
| 6. **Which is not a factor that influence different ecosystems?** | | | |
| A) climate | B) soil | C) thunder | D) rainfall |
| 7. **What type of activities directly threaten biodiversity?** | | | |
| A) cultural activities | B) pollution, land clearing | C) land policies | D) biking |
| 8. **Which is a component of forest ecosystems that we can find in Belize?** | | | |
| A) plant vegetation | B) seagrass | C) shrimps | D) corals |
| 9. **Which law specifically regulates the protection of fauna in Belize?** | | | |
| A) National Protect Areas Act | B) Wildlife Protection Act | C) Pollution Regulations | D) Forest Act |
| 10. **Which is species is considered a keystone species?** | | | |
| A) blue morph butterfly | B) jaguar | C) mahogany tree | D) none |



**Activity 2:** Word search

1. Biodiversity
2. ecosystem
3. River
4. Riverine
5. Ecologist
6. Aquatic
7. Habitat
8. Herbivore
9. Carnivore
10. Producer
11. Consumer
12. Coastal plain
13. Watershed
14. Hydrologist
15. Mammal

*Can you find the words?*

| | | | | | | | | | | | | | | | | | | | | | | | | | |
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| L | E | S | P | L | A | N | T | A | T | I | O | N | P | O | L | P | N | M | E | D | H | S | D | T | H | G | S |
| O | P | P | L | K | L | J | M | N | T | I | O | S | L | D | S | W | O | P | R | K | Y | T | I | U | E | M | T |
| G | N | H | E | Y | U | I | O | P | L | A | Q | U | A | T | I | C | F | D | I | W | D | E | V | R | R | T | A |
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| J | R | K | O | G | B | K | N | M | K | I | O | P | L | P | T | R | M | W | S | D | G | H | T | J | L | N | I |
| M | O | N | Y | R | E | W | A | R | F | H | N | Y | O | P | L | M | M | E | D | R | I | P | Y | C | O | E | N |
| V | D | D | S | N | W | A | T | E | R | S | H | E | D | E | S | D | A | S | D | F | S | T | G | H | G | U | J |
| F | U | H | T | Y | G | T | J | T | R | E | W | O | P | R | E | P | L | I | C | A | T | E | C | D | I | R | F |
| R | C | S | W | D | F | E | T | U | H | J | K | I | O | P | L | C | O | N | M | W | S | D | E | R | S | D | A |
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