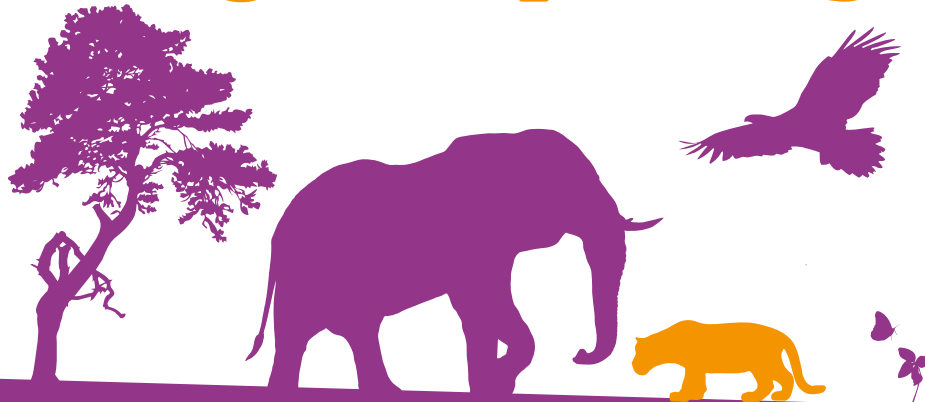




WHAT IS BIODIVERSITY?



DEFINING BIODIVERSITY AND ITS COMPONENTS,
AND WHY THEY ARE CRITICAL FOR HUMANS AND
FOR ALL LIFE ON EARTH

Christine Gibb, CBD and FAO

1

“Bio” means life and “diversity” means variety, so **biodiversity** (or biological diversity) is the incredible variety of living things in nature and how they interact with each other. It’s one of the world’s most precious treasures. Every human being, plant and animal contributes to the diversity, beauty and functioning of the Earth. This chapter introduces the concept and components of biodiversity, and some of the ways that biodiversity enriches our lives. The uses of biodiversity will be explored in later chapters.

When you see text highlighted like this it indicates the word is in the glossary so you can find out more on what it means.



BIODIVERSITY, A THREE-PART CONCEPT

Biodiversity consists of all the many species of animals, plants, fungi, micro-organisms and other life forms and the variety that exists within each species.

It also includes the diversity present in ecosystems – or explained another way – the variation we see in the environment including landscapes, the vegetation and animals present in it, and the various ways in which these components interact with each other. Biodiversity is very complex and is often explained as the variety and variability of genes, species and ecosystems.



GENES

Genes are the units of heredity found in all cells. They contain special codes or instructions that give individuals different characteristics. Let's compare, for example, the genes coding for the necks of two different species: giraffes and humans. Even though both species have the same number of neck vertebrae (seven), the neck lengths of the two species are very different – approximately 2.4 metres for giraffes versus 13 centimetres for humans. This is because a giraffe's genes instruct each vertebra to grow up to 25 centimetres in length, whereas a human's instruct each vertebra to grow to less than two centimetres.

Genetic diversity occurs within a species and even within a variety of a given species. For instance, in a single variety of tomato, the genes of one individual may cause it to flower earlier than others, while the genes of another individual may cause it to produce redder tomatoes than other plants. Genetic diversity makes every individual unique. So in fact no two living things in nature are exactly the same. Chapter 3 delves into genetic diversity in greater detail.

DIATOMS ARE MICROORGANISMS.

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YELLOW STRIPED LYCHNIS MOTH CATERpillARS

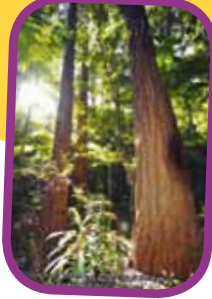
ON THE ROADSIDE IN AVEYRON, FRANCE.

© Clémence Bonnefous (age 8)



SPECIES

In our world you can find a dazzling array of animals, plants, fungi and micro-organisms. The different kinds of these are called 'species'. **A species is a group of similar organisms (individual living creatures such as spiders, walnut trees or humans) that can breed together and produce healthy, fertile offspring.** Although we may not think about it, we see various species as we go about our daily lives, such as humans, goats, trees and mosquitoes. Species diversity is the most obvious type of biodiversity. Our planet supports millions of species, many of which are not yet identified! At present, there are 310 129 known species of plants and 5 487 known species of mammals. There are perhaps millions of tiny organisms or **micro-organisms** that scientists have yet to identify. Chapter 4 explores species diversity, and answers species-related questions such as: why are species important?



SCHOOL OF FAIRY BASSLETS BETWEEN GIANT SEA FAN IN CORAL REEF.

© Korallenriff_139905

THE TEMPERATE RAINFOREST ON FRASER ISLAND, GREAT SANDY NATIONAL PARK, QUEENSLAND, AUSTRALIA IS A UNESCO WORLD NATURAL HERITAGE SITE.

© Michael Weber

KING PENGUINS IN THE SUBANTARCTIC REGION.

© Michael Weber

In the same way that humans live in communities, so too do animals, plants and even micro-organisms. **Where communities of plants and animals live together, and share their space, their land and their climate, they form an ecosystem.** Ecosystems are what many people call "the environment" or "nature". Chapter 5 provides an overview of ecosystems, and Chapters 6, 7, 8 and 9 take a closer look at biodiversity in several ecosystems. There are many kinds of ecosystems on Earth. Ecosystems can be small like puddles, or large like deserts, forests, wetlands, mountains, oceans, lakes and rivers.

ECOSYSTEMS



BRINGING BIODIVERSITY TO THE WORLD STAGE

In 1992, an Earth Summit was held in Rio de Janeiro, Brazil, where governments, indigenous groups, women's groups, environmental groups, activists and other non-governmental organisations met to discuss the environment.

It was the largest international environmental meeting ever. In Rio, world leaders agreed that it was important to protect

the environment for all people, including future generations. To reach this goal, the leaders decided to adopt three conventions (or agreements): the Convention on Biological Diversity (CBD), the United Nations Framework Convention on Climate Change (UNFCCC) and the United Nations Convention to Combat Desertification (UNCCD).

At the summit, participants agreed on the following definition of biodiversity:

“the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.”

This is the official definition used by the Convention on Biological Diversity.



© Mariño Moreno Ruiz (age 16)



Convention on
Biological Diversity



UNCCD



UNFCCC

IT'S ALL ABOUT THE INTERACTIONS

Perhaps the most important characteristic of biodiversity is that all of the components are linked to each other.

For example, if a mouse eats a chemically-contaminated seed, it may survive, but if a hawk eats many mice that have eaten such seeds, the hawk may die from a lethal dose of the chemical. Because of their position in the food chain, top predators such as hawks are susceptible to such **biomagnification**, the accumulation of substances that increase in concentration up the **food chain**. Biodiversity linkages can also be beneficial: the restoration of coastal mangrove forest ecosystems provides an important nursery **habitat** for fish and other marine species, improves fisheries along the coastline, and protects human settlements from extreme weather events.

Similarly, the re-naturalisation of upstream rivers allows the recreation of a natural food chain, decreases the amount of mosquito larvae (thereby decreasing the incidence of malaria or similar mosquito-borne diseases), improves fisheries, and purifies water. If one level of biodiversity is interrupted, the other parts experience a ripple effect, which can be harmful or helpful to biodiversity.

The box: "Smaller Habitats Lead to Smaller Gene Pools" shows how the deterioration of an ecosystem negatively affects both species diversity and genetic diversity.

The box: "The Black Bear and the Salmon: Mighty Ecosystem Engineers" illustrates one positive example where two species play vital roles in engineering an ecosystem.



IMPROVING ONE ASPECT OF AN ECOSYSTEM BENEFITS THE WIDER ECOSYSTEM. A FORESTRY PROGRAMME TO REHABILITATE HILLSIDES IN NEPAL IMPROVED THE FLOW OF WATER FROM SPRINGS, WHICH, IN TURN IMPROVED CROP PRODUCTION.

© FAO/Giampiero Diana





SMALLER HABITATS LEAD TO SMALLER GENE POOLS



The Florida Everglades in the USA is a unique ecosystem that was once home to many wading birds, mammals, reptiles, insects, grasses, trees and other species. It used to cover an area as large as England (over 9 300 square kilometres), but has shrunk over the years as more and more people moved there. The people also changed the ecosystem by building water management areas and canals, and filling in swampy areas for agriculture.

These ecosystem changes were bad for many species, including wood storks and Everglade kites.

The changes even affected the genes of some species such as the Florida panther! As suitable habitats were broken up into smaller and smaller pieces (scientists call this process “fragmentation”), only a few Florida panthers could survive.

With fewer breeding partners around, the variety in the **gene pool** (the total variety of genes available) declined. So the changes to the ecosystem negatively affected both species diversity and genetic diversity.

A KITTEN (TOP) AND ADULT (BOTTOM) FLORIDA PANTHER. THE KITTEN WAS MARKED WITH A TRANSPONDER CHIP, THE SAME KIND OF CHIP THAT IS USED TO IDENTIFY HOUSEHOLD PETS. THE ADULT WAS TAGGED WITH A RADIO COLLAR, WHICH HELPS BIOLOGISTS TRACK THE ANIMAL AND COLLECT DATA USED IN PANTHER CONSERVATION.

© Mark Lotz/Florida Fish and Wildlife Conservation Commission.

Sources: www.biodiversity911.org/biodiversity_basics/learnMore/BigPicture.html and www.nrdc.org/water/conservation/qever.asp

THE BLACK BEAR AND THE SALMON: MIGHTY ECOSYSTEM ENGINEERS

Nutrients such as carbon, nitrogen and phosphorus generally flow downstream - from land to rivers then out to sea. But not always. In riparian forests (forests next to a body of water like a river, lake or marsh) in British Columbia, Canada, black bears help to transfer nutrients from the ocean back to the forest!

To understand how this nutrient transfer works, we need to know a little about the lifecycle of Pacific salmon. Pacific salmon are born in freshwater streams, where they feed and grow for several weeks. Once they're ready, they swim downstream and undergo physiological changes that allow them to survive in marine conditions.

The salmon spend up to several years in the ocean eating lots of crustaceans, fish and other marine animals (i.e. acquiring lots of nutrients from the ocean). Once they reach sexual maturity, the salmon leave the ocean and swim back to the exact freshwater stream where they were born. There, they spawn and die.

During the annual salmon run, black bears catch spawning salmon and carry them into the woods to eat. The nutrient transfer is significant. Each salmon offers two to 20 kg (sometimes even 50 kg) of essential nutrients and energy. One study in Gwaii Haanas, Canada found that each bear took 1 600 kg of

salmon into the forest, eating about half. Scavengers and insects dined on the remains. The decaying salmon also released nutrients into the soil, feeding forest plants, trees and soil organisms.

In this way, vital nutrients are transferred from one ecosystem to another first by the salmon, then by the black bear.



THIS BLACK BEAR DINED ON A CHUM SALMON IT CAUGHT IN THE GEORGE BAY CREEK IN SKINCUTTLE INLET, HAIDA GWAII. LOOK CAREFULLY TO SPOT THE SALMON.
© Stef Olcen

Sources: ring.uvic.ca/99jan22/bears.html and www.sciencecases.org/salmon_forest/case.asp



FIBRE AND CLOTHING

HARVESTING COTTON IN INDIA.

© Ray Wittin/World Bank



FOOD

SELLING VEGETABLES IN A MARKET IN KOREA.

© Curt Carnemark/World Bank



MEDICATION

MEDICINE FOR THE PRE-NATAL AND POST-NATAL CARE UNITS AT THE MAWANNALLA HOSPITAL IN SRI LANKA.

© Simone D. McCourtie/World Bank



THE BENEFITS OF

Biodiversity doesn't simply exist, it also has a function or purpose. **Ecosystems** provide things that humans benefit from and depend on. These things are called ecosystem **goods and services** and include the natural resources and processes that maintain the conditions for life on Earth. These ecosystem goods and services

provide direct and indirect benefits, including the ones shown above. All life on Earth provides us with the food we eat, cleans the air we breathe, filters the water we drink, supplies the raw materials we use to construct our homes and businesses, is part of countless medicines and natural remedies, and many other

things. Biodiversity helps to regulate water levels and helps to prevent flooding. It breaks down waste and recycles nutrients, which is very important for growing food. It protects us with "natural insurance" against future unknown conditions brought about by climate change or other events.

CULTURAL AND LEISURE BENEFITS

A CROSS-COUNTRY SKIER ENJOYS THE SPECTACULAR VIEWS IN THE ROCKY MOUNTAINS OF ALBERTA, CANADA.

© Christine Gibb



NUTRIENT CYCLING

RED WRIGGLER WORMS BREAK DOWN FRUIT, VEGETABLE AND PLANT SCRAPS, RETURNING NUTRIENTS TO THE SOIL.

© Christine Gibb



CLEAN AIR AND CLIMATE REGULATION

SMOKESTACKS FILL THE SKYLINE IN ESTONIA. TREES AND OTHER VEGETATION HELP FILTER OUT AIR-BORNE AND SOIL POLLUTANTS.

© Curt Carnemark/World Bank



LIVELIHOODS

FARMER WORKS ON THE TAMIL NADU IRRIGATION PROJECT IN INDIA.

© Michael Foley/World Bank



B I O D I V E R S I T Y

Many people also depend on biodiversity for their **livelihoods** and in many cultures natural landscapes are closely linked to spiritual values, religious beliefs and traditional teachings. **Recreational activities** are also enhanced by biodiversity. Think about when you go for a walk in the woods

or along a river. Would it be as nice as if there was nothing but concrete buildings all around? Biodiversity is what enables ecosystems to continue to provide these benefits to people. As biodiversity is lost, we lose the benefits that ecosystems provide to people. This is why sustaining biodiversity is very

intimately related to sustainable human development. Ecosystem services are further explained in Chapter 5 and Chapters 10 to 13 will further investigate the relationship between humans, biodiversity and **sustainable development**, and what different groups are doing to protect biodiversity.



BIODIVERSITY IS ALL AROUND US



1 A LIVESTOCK HERDER PROTECTS HIS SHEEP IN INDIA.

© World Bank/Curt Carnemark

2 PLACES OF WORSHIP ARE OFTEN NESTLED IN BEAUTIFUL NATURAL AREAS THAT LEND THEMSELVES TO CONTEMPLATION AND PRAYER, SUCH AS THIS MONASTERY IN CHINA.

© Curt Carnemark/World Bank

3 TRADITIONAL SONGS AND DANCES TELL STORIES ABOUT THE LIFE HISTORIES AND CHARACTERS OF PLANTS AND ANIMALS, ESPECIALLY IN INDIGENOUS CULTURES. IN THIS PHOTO, DANCERS PERFORM AT A LOCAL CEREMONY IN BHUTAN.

© Curt Carnemark/World Bank

4 AN ECOTOURIST GUIDE INTRODUCES VISITORS TO NATURAL AND CULTURAL SITES IN UGANDA.

© FAO/Roberto Faidutti

5 BUTTERFLY HIKE IN BONN, GERMANY.

© Christine Gibb

6 TRADITIONAL FISHING IN MEXICO.

© Curt Carnemark/World Bank

7 BIOLOGIST PAULA KHAN WEIGHS A DESERT TORTOISE BEFORE RELEASING IT SOUTHEAST OF FORT IRWIN, CALIFORNIA, USA.

© Neal Snyder

8 CANOE TRIP IN FISH CREEK, USA.

© Christine Gibb



CONCLUSION

Biodiversity, the variety of life on Earth, is a vital ingredient of human survival and welfare. The importance of biodiversity goes beyond its value to human beings: all components of biodiversity have the right to exist. Unfortunately, all is not well for the planet's biodiversity. There are real threats to biodiversity, which will be explored in the next chapter.

LEARN MORE

- :: Chapman. 2009. Number of Living Species in Australia and the World. Australian Government, Department of the Environment, Water, Heritage and the Arts: Canberra. www.environment.gov.au/biodiversity/abrs/publications/other/species-numbers/2009/pubs/nlsaw-2nd-complete.pdf
- :: Resources on the Florida Everglades: www.biodiversity911.org/biodiversity_basics/learnMore/BigPicture.html and www.nrdc.org/water/conservation/qever.asp
- :: Resources on ecosystem engineers: ring.uvic.ca/99jan22/bears.html and www.sciencecases.org/salmon_forest/case.asp

