The Spice of Life

Module 1 • i2P • Biodiversity

"'Biodiversity' is an attempt to invoke the splendor of the living world with a single word. Just six syllables but they flood the mind with images: fish, bright as petals, dart through a coral reef; herds of caribou stream across frozen lakes; bees thrum, wings beat, buds burst with greenery. This miracle planet teems with living things."

- Candace Savage

All Creatures Great & Small

There are estimated to be between ten and thirty million species of living organisms on the planet Earth (see: catalogue and species number). This includes plants, animals, lichens, algae, fungi and bacteria. The majority of species remain 'undiscovered', and have never been described or named by scientists. Of all locations on the Earth, one of the richest in life forms is the Amazon jungle. The Amazon Jungle, also known as Amazonia, is so dense in plant life that the vegetation produces approximately 20% of the Earth's oxygen, earning the region the nickname "the lungs of the Earth" (see: lungs).

Matching the bountiful plant life are a rich array of animals that call Amazonia home; among them creatures that fly, swim, jump, burrow and bite. Foremost in number are the insects of the jungle, constituting over 90% of all animal species in the Amazon (see: insects). This bounty of insects, although fascinating to some, are considered by many people to be a great nuisance. The annoyance is so great that humankind has a long history of attempting to control or purposefully eliminate various species.

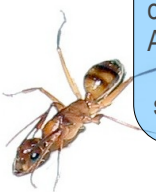
Pestilent Mosquitoes

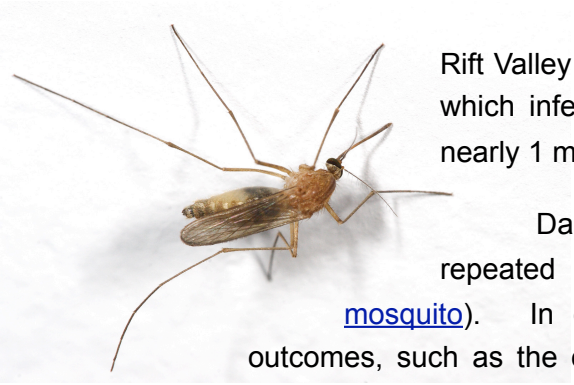
A case in point are mosquitoes, which the i2P team is guaranteed to encounter in large numbers in the Amazon. There are 3,500 named species of mosquitoes in the world, most of which do not bother humans in any way. However, a few hundred species do bite humans, and in doing so can be the vector for a variety of serious illnesses such as Yellow Fever, Dengue Fever, Japanese encephalitis,

Did You Know?

Some scientists estimate that 30% of the animal biomass of the Amazon Basin is made up of ants.

see: ants





Rift Valley fever, Chikungunya Virus, West Nile Virus, and Malaria which infects 247 million people worldwide each year, and kills nearly 1 million (see: malaria).

Dating back almost 100 years humans have made repeated and concerted efforts to eradicate mosquitoes (see: mosquito). In certain cases such efforts have resulted in positive outcomes, such as the elimination of malaria from the United States in 1949. Most campaigns however, have been unsuccessful (see: eradicate).

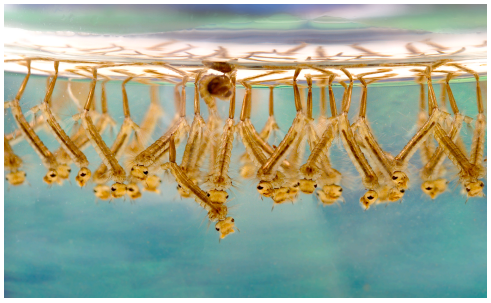


Figure 1: Larvae of *Culex mosquitoes in standing water. Mosquito larvae are an important source of food (source:* James Gathany)

Historically, little thought was given to the implications of eradicating an organism such as the mosquito. However with a growing understanding of the function of ecosystems even the lowly mosquito is now recognized as having merit. Mosquitoes, both in the form of water dwelling larva and as winged insects, form a significant biomass in the world and serve as a rich source of food for many fish and birds, not to mention the function they serve pollinating thousands of plant species. The sudden elimination of mosquitoes could result in many hungry animals and many un-pollinated plants. Although experts are uncertain of the impact the global eradication of mosquitoes would have on ecosystems, it is important to understand that even the mosquito, considered at best a pest, has an important role in a healthy ecosystem (see: helpful mosquito).

Phytoplankton

The lesson of the mosquito is that even a creature that mankind considers insignificant has a hand in maintaining the balance of life on Earth. An example is phytoplankton, a tiny water dwelling organism invisible to the naked eye. A recent study published in the journal Nature reveals that world phytoplankton concentrations have declined by as much as 40% in the past sixty years (see: phytoplankton). This is a concern because phytoplankton, which capture the sun's energy through photosynthesis, form the basis of the marine ecosystem. According to lead author

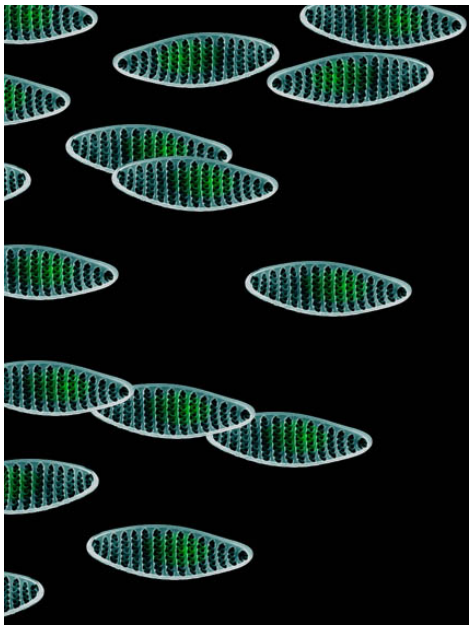


Figure 2: fragilariopsis, which is diatom, one of the most common types of phytoplankton (source:Uwe Kils)

Daniel Boyce,

"Phytoplankton is the fuel on which marine ecosystems run. A decline of phytoplankton affects everything up the food chain, including humans." (see: Boyce)

Did You Know?

A single square mile of rainforest often houses more than 50,000 insect species?

see: insects

The loss of phytoplankton would have grave consequences for marine life forms, as well as terrestrial life that rely upon marine plants and animals as a food source. The continued loss of phytoplankton could result in mass multi-species extinctions.

Figure 3: Forest fruits from the rainforest of Barro Colorado Island, Panama are an example of the wonder of biodiversity (source: Christian Ziegler)

The story of the mosquito and the phytoplankton illustrate that the integrity of world-wide ecosystems are dependent upon the collective health of all life forms, even tiny and seemingly innocuous species. Sustaining biodiversity serves as the foundation of the long-term health of life on Earth.

Year of Biodiversity

Recognizing the crucial importance of preserving biological diversity, the United Nations declared 2010 the International Year of Biodiversity. According to the Secretary General of the United Nations, Ban Ki Moon,

"Biodiversity underpins the functioning of the ecosystems on which we depend for food and fresh water, health and recreation, and protection from natural disasters. Its loss also affects us culturally and spiritually. This may be more difficult to quantify, but is nonetheless integral to our well-being." (see: Moon)

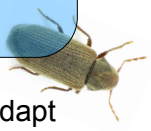
Unraveling the complex nature of the world's ecosystems is a monumental undertaking. The scope of complexity of the Earth's web of life is yet to be fully understood. What has become increasingly evident is that variety helps to protect life forms from threats to their well-being. This is because the planet is not a stable place to live, but keeps changing.

The Changing World

Did You Know?

Around 25% of the world's 2 million described animals species are beetles (Coleoptera).

see: beetle



Alterations in habitat or climate can throw off the delicate balance of resources and conditions that allows a creature or plant to survive. Even subtle changes can stress a species by limiting food sources, increasing the number of predators or consumers and rapidly precipitating extinction before the species can adapt to the new conditions. Species and ecosystems that are blessed with the ability to adapt more rapidly are far more likely to meet the challenge of changes in their environment. This ability to adapt is greater in species with a rich variety of traits, and in ecosystems with a greater variety of life forms. This is the crux of biodiversity, that *a greater diversity of life forms will be better able to adjust to environmental changes that threaten the welfare of life on the planet*.

Scientists have arranged the biological diversity of life on Earth into three categories:

- Genetic diversity
- Diversity of species
- Diversity of ecosystems

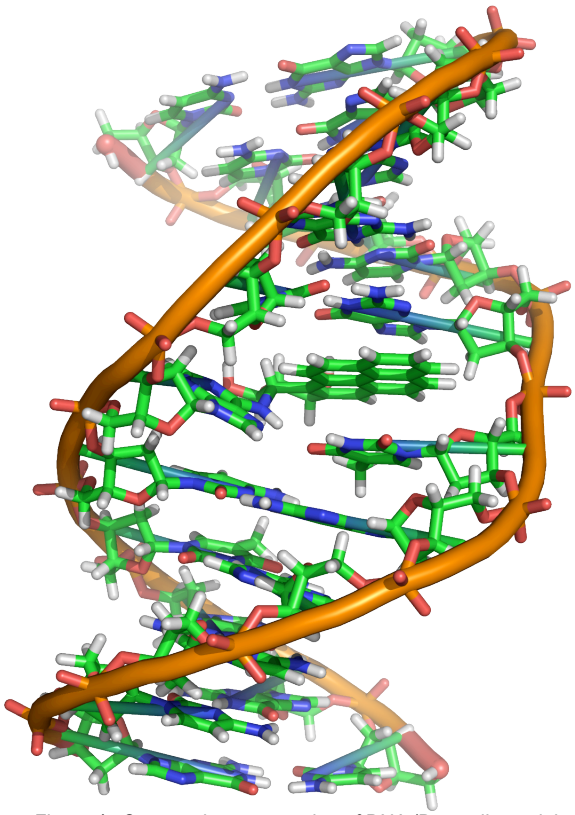


Figure 4: Structural representation of DNA (Deoxyribonucleic Acid). Genes are coded by the structure of DNA (source: Richard Wheeler)

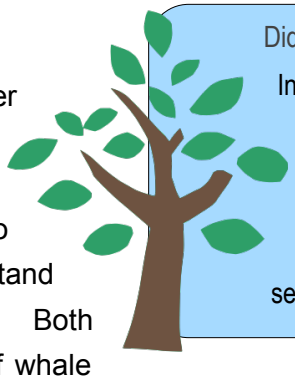
Genes

The basic unit of life is the cell. Each life form is made up of at least one cell. Human beings are thought to be made of between 50 and 75 trillion cells (see: human). Each cell type has unique properties that dictate how that cell will function. The unique properties of different cells in turn dictate the nature of the organism they form, whether a tiny single-celled bacteria, or a large multi-cellular organism like a human being.

Found inside each cell are coils of paired molecules (DNA) that make up genes. Genes contain the code that dictates the traits or properties of each organism. Genes are inherited from generation to generation, and can vary amongst organisms of the same species. A simple example of this in human beings is eye colour, which varies from person to person depending upon the genes inherited from parents.

The sum of all the different genes that a given species has is the genetic diversity of the species. The greater the variety of genes, or the genetic diversity of a species, the more likely the species will be to surviving or adapting to changes in their environment.

Species



Did you know?

In the Amazon rain forest, a single tree can provide a home for up to 2,000 species of birds, insects, fungi, epiphytes and microorganisms?

see: tree

Organisms rich in genetic diversity will be better prepared to adapt to changes in habitat. By the same token, organisms in a world with greater diversity of species will be better prepared to adapt to habitat change (see: species). To understand this concept let us create two artificial worlds. Both worlds are home to the same solitary species of whale that eats any form of plankton as a food source. However the planets differ in the following manner:

- Planet 1 has a solitary type of plankton that photosynthesize the sun's energy to survive, and lives in cool water. The whale eats this plankton as its source of food.
- Planet 2 is home to twenty different varieties of plankton. They live in a variety of different ocean habitats, some preferring cool water, and some warm tropical water.

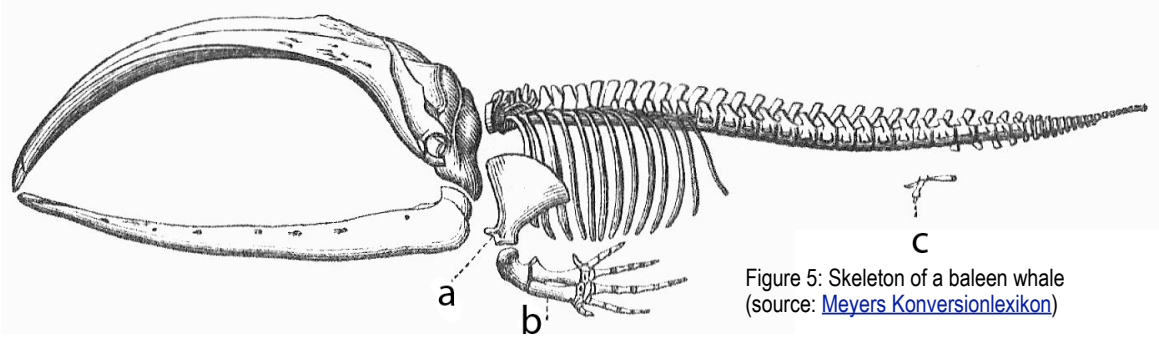


Figure 5: Skeleton of a baleen whale (source: Meyers Konversionlexikon)

Assume for arguments purpose, that there is a similar increase in temperature in the water on both planets. This temperature change results in the extinction of plankton not adapted to warm water including the plankton on Planet 1. With all the plankton gone on Planet 1, this results in the death of the whales.

On Planet 2 those plankton that require cool water also perish, but species of plankton adapted to warm water survive. The survival of some species of plankton on Planet 2, assures the whale population will survive because they have a source of food (see: survival).

This simple illustration demonstrates how diversity of species protects the life on a planet from the threat of habitat change. The whales, although not personally threatened by the temperature change in the water, will only survive on the planet with greater diversity of plankton species.

The sum of the variety of species on the Earth is the species diversity of the planet.

Ecosystems

The final category of biological diversity is that found in ecosystems. An ecosystem is the sum of all the living organisms that interact with a given physical environment (see: ecosystem). Ecosystems are highly complex and are constantly changing. The increases or decreases in population of one species of organism in an ecosystem can have a ripple effect on all the other species. The variety of species, and the manner in which they interact in different habitats is the sum total of the ecosystem diversity of the Earth.

Did You Know?

A single square mile of rainforest often houses more than 50,000 insect species?

see: insects

Figure 6: A male beetle of the family Oxysternon conspicillatum. There are over 30,000 species of beetles worldwide (source: Richard Bartz)

The principles we have learned with respect to genetic and species variation also apply to ecosystem variation. If the Earth was just one uniform habitat and that habitat suddenly changed, the likelihood of wholesale loss of life would be far greater than if there were many different habitats and countless different ecosystems.

Why Worry?

Figure 7: A amphipod, an ocean going crustacean. The oceans are at risk because of the steady decrease in phytoplankton (source: Uwe Kils)

Current estimates indicate that the biological diversity of our planet is vanishing faster in the past fifty years then ever before in human history (see: vanishing). The loss of biodiversity has been tied to shortages of food, vulnerability to natural disasters, decreasing energy resources, loss of clean water and other raw materials, and poor human health (see: loss). The economic and social welfare of humanity is bound to the biological diversity of the planet (see: welfare). As Walter Reid of the World Resources Institute has stated, "biodiversity is inseparable from humanity".

From the Amazon to Japan

In October 2010, while i2P will be in the Amazon on a United Nations partnered expedition to highlight the International year of Biodiversity, the nations of the world will be meeting in Nagayo, Japan to discuss the UN Convention on Biological Diversity (see: Nagayo), The intent of this conference will be to set international goals for the preservation of global biodiversity.

After all - as the old saying goes - variety is the spice of life.