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# The Wolf at the Door

Module 5 • i2P • Biodiversity

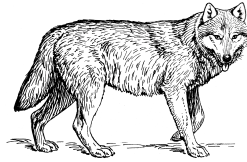
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“Ultimately, our behavior is the result of a fundamental failure to recognize that human beings are an inseparable part of Nature and that we cannot damage it severely without severely damaging ourselves”.

- Eric Chivian, M.D.



## EASTER ISLAND

From the Amazon Rainforest one must travel west, high over the Andes Mountains to the coast of South America, then sail 3,500 kilometers out into the Pacific Ocean to find one of the most isolated spots on the planet. Easter Island, best known for the great stone Monoliths that grace its coastline, is a triangle of volcanic rock 164 square kilometers in area. Radiometric dating indicates that humans colonized Easter Island about 800 years ago (see: [Easter](#)). With its closest inhabited neighbor, Pitcairn Island, more than 2,000 kilometers away, Easter Island is a world unto itself.

More recently Easter Island has become infamous as a metaphor for overpopulation and environmental collapse. Archeological records indicate that the island was once richly carpeted with a broad range of trees, shrubs, ferns and grasses. After colonization the island's forests were gradually cut back by the growing population. Eventually the needs of the population outstripped local resources and the island was virtually cleared of trees. Archeological records indicate that a variety of trees, birds and animals were driven into extinction. In the 19th century the population of Easter Island collapsed. The exhaustion of the island's natural resources is thought by some to have lead to the collapse of the human population (see: [collapse](#)).



Figure 1: A panorama of Easter Island. Note that the island is almost completely barren (source: [Rivi](#))

## NEWFOUNDLAND COD

The cautionary tale of Easter Island is borne out in modern times by similar environmental collapse from the over-exploitation of resources. One of the most compelling examples in recent memory is the northern cod fishery off Canada's East Coast. Until recently the Grand Banks off the coast of Newfoundland were home to one of the richest fisheries in the world. After visiting the region in 1497, the explorer John Cabot returned to England to report that "the sea there is full of fish that can be taken not only with nets but with fishing-baskets (see: [Cabot](#)).

For more than 500 years, this fishery sustained Newfoundland's economy and provided the main food protein source. Yet in 1992 the fishery suddenly collapsed. Caught by surprise the Canadian government was forced to interrupt all fishing (see: [Northern Cod](#)

## Did You Know?

There are more species of fish than all the species of amphibians, reptiles, birds and mammals combined.

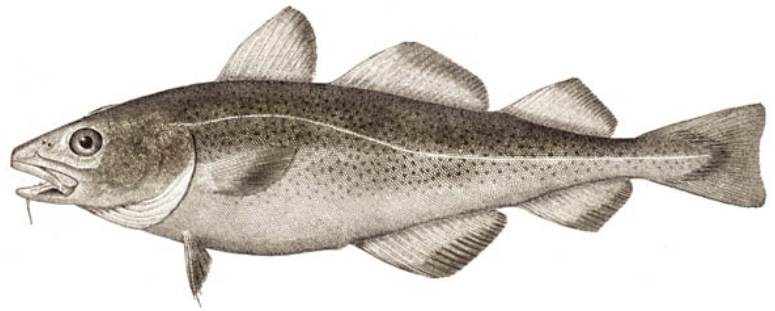


Figure 2: Atlantic Cod (source: [NOAA](#))

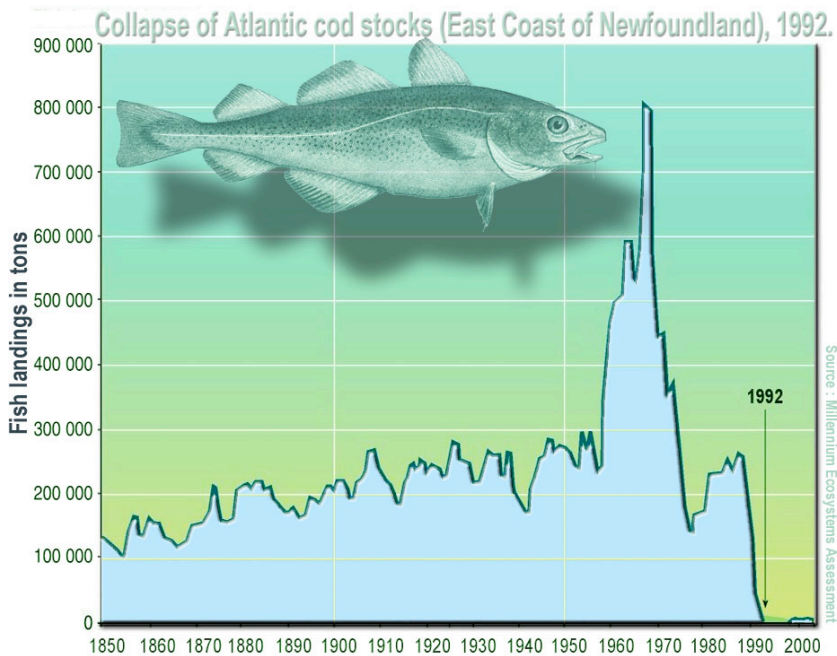


Figure 3: Collapse of Atlantic cod stocks in 1992. From the late 1950s, offshore bottom trawlers began exploiting the deeper part of the stock, leading to a large catch increase and a strong decline in the underlying biomass (source: [Lamiot](#)).

[Fishery](#)). It was predicted at the time that it would only be a couple of years before the cod stocks rejuvenated and the fishing ban could be lifted. It's been 18 years and the fish have not recovered. It appears the ecosystem has been destroyed.

Researchers point out that the use of modern dragger technology also contributed to the destruction of this ecosystem. Dragners pull massive nets, as long as football fields, across the ocean floor, scooping up entire schools of the target fish as well as any other species that happen to

Student Exercise:

Researchers are finding physical changes to the cod in the North Atlantic - a rapid evolutionary response to new environmental conditions caused by the practices of overfishing and bottom trawling. Think of some of the ways in which the physical appearance of cod may change to adapt to these new challenges. Compare these to what researchers are finding in their own studies:

see [The Downturn of the Atlantic Cod](#) and [Angling for Evolutionary Answers](#).

be in the way. These nets were a boon to the fishing industry and caught more cod than ever before, but they also destroyed much of the supporting ecosystem.

## BIODIVERSITY LOSS

The demise of the Newfoundland cod fishery is one of many sad stories of ecosystem collapse. Worldwide there are five principal causes of biodiversity loss:

- Habitat transformation
- Climate Change
- The introduction of exotic species
- Over-exploitation
- Pollution

These categories are all linked, and all ultimately contribute to the most important direct driver of biodiversity loss: habitat transformation.

### HABITAT TRANSFORMATION

Habitat transformation is defined as the “change in the local environmental conditions in which a particular organism lives” (see: [habitat transformation](#)). This can occur naturally or as byproduct of human activity. Volcanoes, earthquakes, and hurricanes are examples of natural phenomenon that can cause habitat transformation. Today the principal driver of habitat transformation is human activity, and foremost among these activities is the transformation of ecosystems into agricultural land.



Figure 4: Jungle burned to make way for agriculture in Mexico (source: [Jami Dwyer](#))





Figure 5: Soybeans are an important crop in Brazil (source [US Gov](#)).

Agriculture did not exist until about 10,000 years ago. Now, according to the World Bank over 25% of the world's terrestrial surface is used for agricultural purposes. It's predicted that a further 10 to 20% of forest and grassland will be converted to agricultural use by 2050.

A prime example of this habitat change is the deforestation of the Amazon Rainforest to create land to grow soy beans, or raise cattle. This process displaces the indigenous forest species of plants and animals with farmed species. Other human activities that result in habitat transformation are:

- The creation of towns and cities permanently displaces ecosystems.
- Energy production, such as hydroelectric dams, oil and gas production, pipelines, and the harvesting of wood all disrupt ecosystems.
- The creation of recreation facilities such as ski slopes and parkland alter the natural habitat.
- Means of transportation such as planes, trains and automobiles create noise, and interrupt the migration routes of indigenous species.

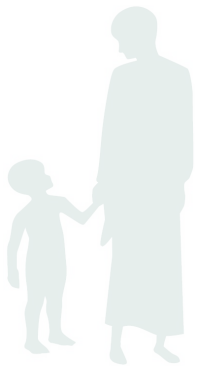


Figure 6: Human activities that result in habitat transformation include oil exploration (Brazil) and dam construction (Australia) (sources: [Divulgação Petrobras](#) & [Noodle Snacks](#))

## CLIMATE CHANGE

Climate change refers to the documented process of global warming that is occurring as a function of natural and human activity. According to the Intergovernmental Panel on Climate Change (see: [IPCC](#)) the average global temperature has increased steadily over the past 150 years, and a further rise of 1.4 to 5.8 degrees in average global temperature is expected by the year 2100.

## Did You Know?

Coral Reefs are called the "rainforests of the sea," and are the most biodiverse ecosystem on Earth with 30 of 34 known animal phyla present.

see: [coral](#)

An increase in air, land and water temperature has an effect on all organisms. Evidence is mounting that even subtle changes can have a significant impact on wildlife and ecosystems. The decrease in plankton levels in the world's oceans (discussed in module 1) is thought to be a byproduct of the warming of sea-surface temperatures (see: [plankton](#)). According to the World Bank Millennium Ecosystem Assessment, climate change is likely to become one of the most significant drivers of biodiversity loss by the end of the century. Furthermore the rate of global warming is increased by the destruction of natural habitats because:

- CO<sub>2</sub> (a greenhouse gas) is released when plant matter is destroyed.
- A decrease in the Earth's plant biomass results in a decreased capacity for the world to absorb CO<sub>2</sub> (greenhouse gas), and counteract global warming.

## EXOTIC SPECIES

The introduction of foreign species to a new habitat can trigger profound ecosystem change. The foreign species that become established in a new environment are called *exotic species*. When these species prove to be very successful and displace native plants and animals they are called *invasive species*.



Figure 7: Habitat destruction. An estimated 25% of the world's coral reefs have already disappeared and an estimated two-thirds of all coral reefs are at risk today (source: [Mikhail Rogov](#)).

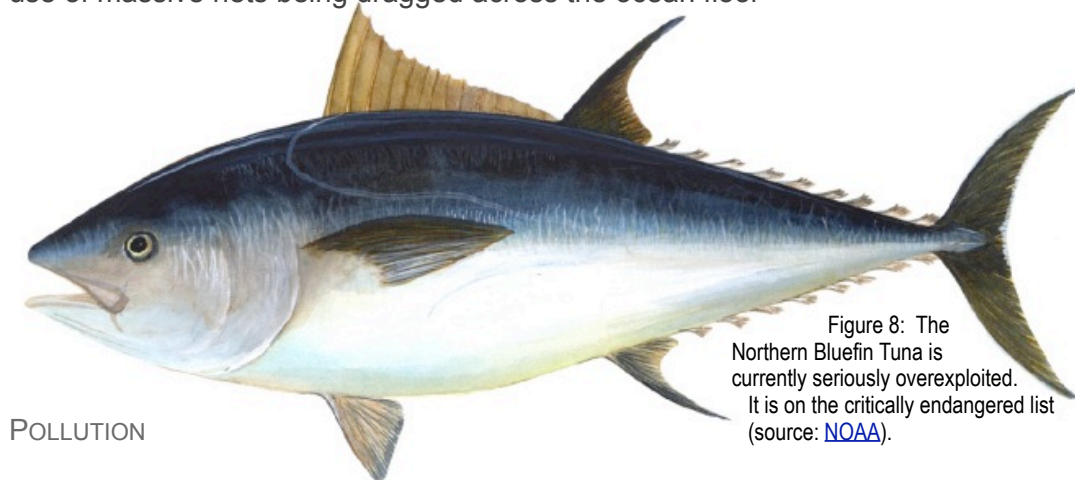


Exotic species play a prominent role in precipitating extinction. Estimates are that 40% of all animal extinctions (for which the cause of extinction is known) since the 17th century have been caused by exotic species (see: [exotic](#)). Module 6 examines this topic in detail.

#### OVER-EXPLOITATION

The over-exploitation of a natural resource can lead to its destruction, or the collateral destruction of its supporting ecosystem. The tale of Easter Island and the story of the Newfoundland Cod Fishery are resonant examples of the outcome of over-exploitation.

Over-exploitation is a dominant driver of change in marine ecosystems. A significant proportion of the burgeoning human population is dependent upon fish as a source of food. This has led to widespread overfishing across the globe. The World Bank states that overfishing has reduced fish biomass by as much as 90% relative to levels prior to the onset of industrial fishing. About three quarters of the world's fisheries are either fully exploited or over-exploited. As we learned earlier, the damage is compounded by the use of massive nets being dragged across the ocean floor



#### POLLUTION

The act of polluting is defined as, “the contamination of soil, water, or the atmosphere by the discharge of harmful substances. (see: [pollution](#)). There are countless examples of ecological degradation caused by pollution, from the effect of the pesticide DDT on bird populations, to the impact on whole ecosystems of large oil-spills such as the recent Gulf of Mexico disaster.

The pollutants that are causing the most harm to worldwide ecosystems, however are not the classic pollutants such as pesticides, urban waste (soap, hormones) or industrial byproducts (chemicals, heavy metals, mine tailings). Nitrogen, Phosphorous and Sulfur based fertilizers are the biggest enemy through a process called *Nutrient Loading*.

Nitrogen is produced naturally and is an essential nutrient for plant growth. Humans are now manufacturing nitrogen, and using more and more of it in fertilizers. This helps crops grow bigger, faster and more frequently. In fact, the use of nitrogen fertilizer is responsible for much of the increase in world-wide food production seen in the past century. According to the World Bank, humans now produce more reactive nitrogen than is produced by all natural pathways.

The unfortunate byproduct of the use of fertilizers is the leaching of nitrogen into the world's atmosphere, soil and water systems. Nitrogen favors rapidly growing organisms at the expense of slower growing counterparts. This differential in growth destabilizes ecosystems and leads to the degradation and extinction of organisms not favored by nitrogen. On land this leads to lower levels of plant diversity. In the aquatic domain the classic example of nitrogen driven ecological degradation is the overgrowth of algae (algal bloom). The algae consumes all the water's oxygen, which kills off other oxygen-dependent organisms such as fish.

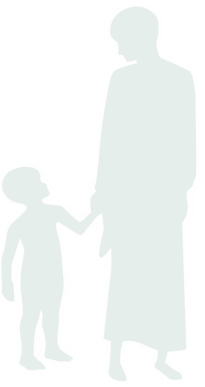


Figure 9: An algal bloom caused by an excess of nitrogen fertilizer in a pond in France (source: [E. Jamiot](#))

#### LOOKING FORWARD

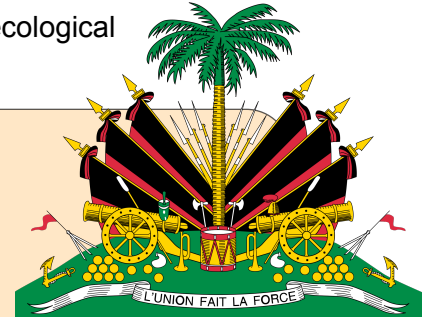
The United Nations states in Global Outlook 3 (a report released for the 2010 International Year of Biodiversity) that global indicators demonstrate the ongoing decline of the world's biodiversity (see: [United Nations](#)). This decline in biodiversity, driven by the





five principle processes described in this module, is of grave concern and threatens the sustainability of life on Earth.

Biodiversity provides humans with the air we breathe, the food we eat, the water we drink, and the supplies we need for shelter and warmth. We would not exist without biodiversity. If the degradation of our natural environment continues at its current pace, our entire planet will become like Easter Island; a world shorn of the natural resources we need to live and prosper. Understanding the manner in which biodiversity is being degraded is the first step in reversing the trend to further ecological destruction.



#### Haiti: A Disaster of Declining Biodiversity

Haiti was once a marvel of biodiversity. A Polish officer serving in the French expeditionary force commented in 1803:

"If the country were at peace, it would surpass nearly all Europe in the beauty of its crops and forests... [The officers] could not contain their admiration at the sight of the diverse and innumerable plants so different from those of Europe." (see [Biodiversity and Haiti](#))."

Unfortunately, the lauded biodiversity that once existed in Haiti has been nearly wiped out; 97% of the forest cover has been destroyed, and a 1985 report from USAID cautioned:

"Few countries in the world face a more serious threat to their own survival from environmental catastrophe than Haiti. Overpopulated, its resources overexploited and with trends towards further environmental deterioration everywhere, the country should brace itself for widespread famine, social upheaval and the potential breakdown of its socioeconomic and political structures."

The "further environmental deterioration" continues to this day, with staggering effects. The vast majority of springs, streams and rivers in Haiti have become horribly contaminated. 15,000 acres of arable land are destroyed each year by unsustainable farming practices, and many of the species that once inhabited the island have become extinct. The lack of forests and root systems means the soil is susceptible to large-scale erosion. Disastrous, and sometimes fatal, landslides are common.

The effects on the men, women and children living in Haiti have been disastrous as well. Haiti is the poorest country in the Western hemisphere with 65% of its population living on less than \$1 per day. General health is atrocious. 90% of children are chronically infected with intestinal parasites most commonly caused by contaminated drinking water and malnutrition, and Haiti has the highest rates of infant (under-five years old) and maternal mortality in the Western hemisphere. The biodiversity of forests in Haiti once provided clean water and limited the spread of disease. Today, Haiti's continued destruction of forest and indigenous wildlife only exacerbates the vicious cycle of poverty and disease.

#### Student Exercise:

Can you think of some of the ways in which Haiti could begin to protect or even recover its vast forests and biodiversity? The Haitian government has put together a plan to do just this. Compare your ideas against theirs:

[Haiti National Biodiversity Strategy and Action Plan](#)