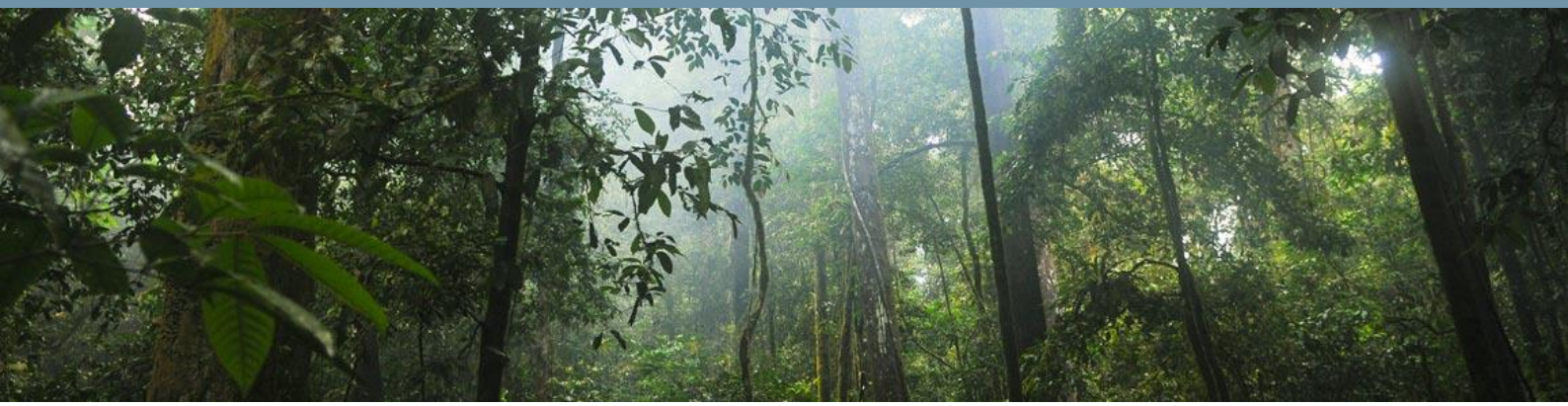

Ecosystems and biodiversity

Biodiversity is a measure of the variety of life on earth. It can be assessed at genetic, species and ecosystem levels.[1, 2, 3]

An **ecosystem** is defined as a community of living organisms, together with the physical environment they occupy at any given time. The diversity of ecosystems is difficult to estimate, as ecosystems grade into one another and large ecosystems may contain diverse smaller ones.

Our planet as a whole is an ecosystem, but it contains many others: forests, deserts and oceans, for instance, which are each made up of smaller ecosystems — for example, coral reefs and shallow seas within the oceans. These, in turn, are made up of many yet smaller ecosystems, such as mangrove swamps, which border on and grade into terrestrial ecosystems.

Change in one ecosystem will impact on the others with which it overlaps, and into which it grades.

Species diversity refers to the number of different species in a certain area. It is, of course, very difficult to count all the species present — some are too small, live in inaccessible places, only use the area at certain times of the day or year, or are very rare. Despite this, the number of species present is probably the most common measure of biodiversity used by conservationists; it is measured in different ways, but most include weighting for numbers of individuals as well as numbers of species. A field with 99 buttercups and one daisy is not as diverse as one with 56 buttercups and 44 daisies!

Genetic diversity refers to the variation between individuals of a single species, between different groups (races, populations or breeds) of the same species, and between versions of the same gene in different individuals in a population. The genetic differences between individuals of the same species are the raw material of evolution. It allows species to adapt over generations to some of the changes in their environment which would otherwise put them at risk of extinction.

Why biodiversity matters

Every individual is dependent on its environment — both the physical environment (rainfall, soil type, temperature, oxygen gradient, light, etc.) and the living environment (other individuals of its own and other species), and how these interact. Change in any aspect of these environments will impact on, and may destroy, whole communities.

A healthy ecosystem can be buffered to some extent, mitigating change. Over time, the composition of species may change, but the ecosystem will still function to sustain life. The change may be caused by new species moving into the environment, by existing species increasing or decreasing, or by evolution over time. Resources are normally recycled within an ecosystem, and small, progressive changes can generally be accommodated without collapse of the system. The greater the biodiversity, the more likely it is that the system is able to adjust to changes. But natural communities are very complex, and it is

impossible to predict accurately what effect changing even one parameter will have on the whole.

Of course, extinctions are not new, and it is estimated that the number of species living at the present time constitute only about one per cent of all the species that have ever lived.[4, 5] There have been both gradual and sudden changes to ecosystems, in terms of both number and composition, over geological time.

Our early human ancestors have been part of the earth's ecosystem for at least the last two million years.[6] The biodiversity of the planet has provided for all our needs: fuels, raw materials for food, clothes and medicines and ways of dealing with our waste. The requirements of our species are not going to change — to survive successfully we will always need clean water, good food, clean air and biological waste-disposal services.

Biodiversity and us

Agricultural diversity refers to the biodiversity of the plants and animals that feed us. But, even where cultivated, all our food plants and animals are derived from wild populations. Intensive selection to maximise useful traits reduces the variation within these basic genetic stocks; the resultant uniformity of species type works well until external factors change — we then need access to variation to find individuals that can cope with the new environmental factors.

The Irish potato famine in the 1840s occurred partly because farmers in Ireland found a couple of varieties of potato that did very well on their land. They grew these at the expense of most other crops and all other potato varieties; the human population grew until blight (to which the selected varieties were not resistant) decimated the potato crop.[7] As a result, about a million people in Ireland starved to death and a further million were forced to emigrate, reducing Ireland's population by between 20 and 25 per cent.

We have already lost many natural resources over the last two hundred years. Freshwater fish numbers and variety continue to decline, and the rate of deforestation across the world is unsustainable. These are only two examples; virtually all natural ecosystems are being diminished at an increasing rate.[8, 9, 10]

Soil is a critical resource for agriculture, and we are losing it much faster than it is being formed. Forests are being felled and soils exposed. Land is cleared and planted with monocultures that do not hold the soil together. Water and wind loosen the soil so that it is washed or blown away.[11, 12]

A healthy forest acts like a sponge and holds rainwater, releasing it slowly.[13, 14] By contrast, for instance, the 2015 floods across Europe were exacerbated by the loss of forests.[15] This is being recognised by politicians — for example the Albanian prime minister linked recent floods with deforestation and consequent soil erosion.[16]

Humans have not been good at living sustainably within their local environments — but until recently we have had a whole world to expand into and exploit; when one geographic area became unliveable in, populations moved, locally died out or brought resources in from neighbouring areas.

Humans have always been very good at inventing new technologies. These have brought us many benefits (from early agriculture to air travel and the internet). On the other hand, such advances in technology have always consumed more natural resources and energy than a basic hunter-gatherer would have needed.

These progressive technological developments have allowed our species to generate increasing amounts of material wealth and, since prehistoric times, these developments have supported a gradual accompanying increase in human numbers. However,

since the Industrial Revolution, and the technological "leverage" provided by the use of fossil fuels, there has been a step change, both in the amounts of natural resources consumed and in the size of the human population that these resources have gone on to support.

All over the earth our need for natural resources to support people and their technologies has pushed other species towards extinction. We take their food, destroy their habitat, and pollute and change the chemical and physical balance of their environments. A prime example is climate change caused, or at least exacerbated, by human activity — one of the greatest threats to ecosystems around the world.

In fact, so many species have now vanished forever that many scientists are referring to the present epoch as "the sixth mass extinction", on a par with the one that eradicated the dinosaurs.[17, 18]

We do not know how many species we can afford to lose, nor do we know which endangered species are key to our own survival — but we do now know of many examples of habitats which have been made uninhabitable.[19, 20]

> "Individual species and ecosystems have evolved over millions of years into a complex interdependence. This can be viewed as being akin to a vast jigsaw puzzle of interlocking pieces. If you remove enough of the key pieces on which the framework is based, then the whole picture may be in danger of collapsing. We have no idea how many key 'pieces' we can afford to lose before this might happen — nor even, in many cases, which are the key pieces. The ecological arguments for conserving biodiversity are therefore based on the premise that we need to preserve biodiversity in order to maintain our own life support systems."
>
> *— Dr Barbara Corker (www.countrysideinfo.co.uk/biodvy.htm)*

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