Biodiversity information pack

Contents

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Biodiversity

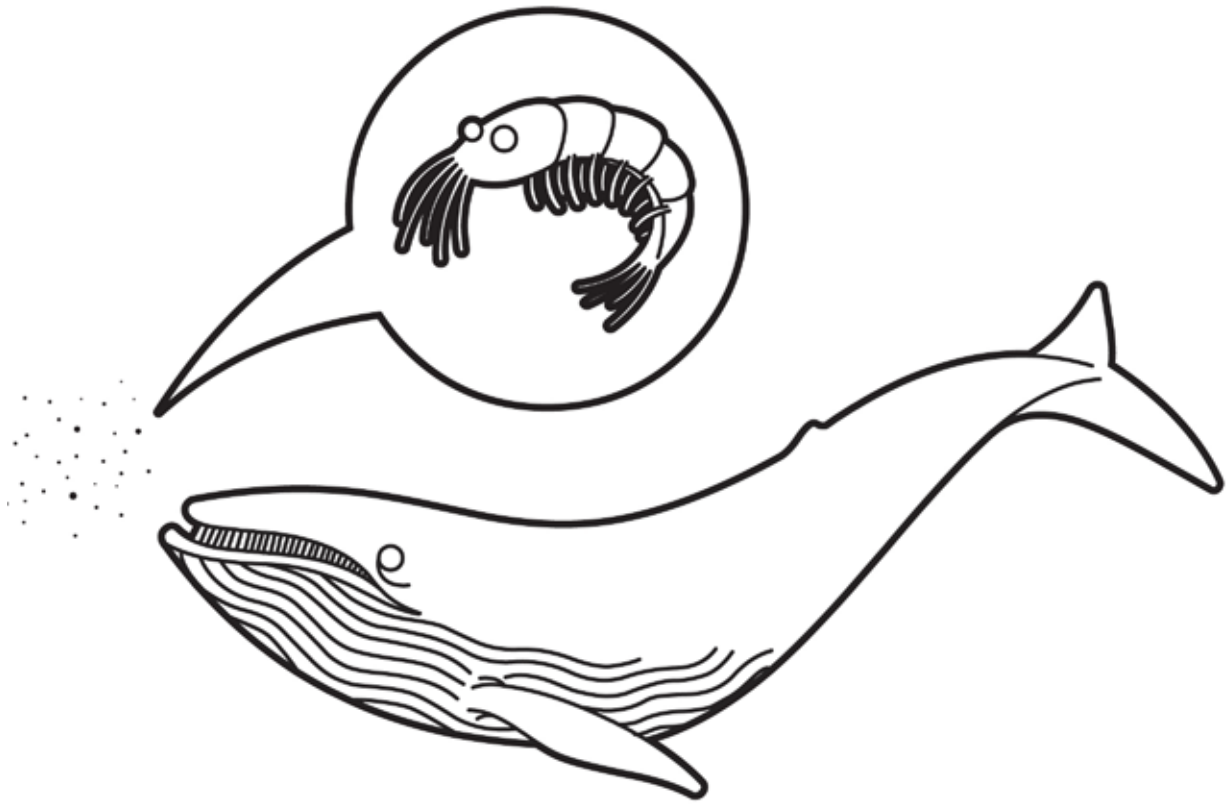
This document provides background information on biodiversity. It outlines the classification of life on Earth, why biodiversity matters, the threats to it and steps being taken to conserve it.

The footnotes provide details of websites or books where further information on these topics can be found.

What is biodiversity?

Biodiversity is the variety of life on Earth.

Biodiversity does not just include plants and animals in wild places. It encompasses all forms of life, from micro-organisms to oak trees to whales, in all places: city centres, wastelands, garden ponds, forests, oceans.



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Classification and identification of the diversity of life

Estimates of the number of species on Earth vary. Even the number of species identified and named is not specifically known, but is in the range of 1.4 to 1.9 million. This is thought to be a small proportion of the total number of species on Earth, which may be around 10 million, although some estimates are up to 100 million[1].

Grouping living things is called **classification** or **taxonomy**. Characteristics/criteria for groupings can include morphology, DNA analysis and common ancestry.

A Swedish biologist, Carl Linnaeus (1707-78), adopted a system of binomial classification to give consistency to the naming of organisms[2]. In this system, organisms have two names: for example, humans are *Homo sapiens*. The convention is for the first name, the genus, to start with a capital letter, whilst the species (the second name) is lower case. The name is written in italics or underlined. Sometimes the name reflects a characteristic of the organism or recognises the discoverer. There are further levels of classification: Kingdom, Phylum, Class, Order, Family, Genus and Species[3].

[1]http://www.grida.no/geo/geo3/english/pdfs/chapter2-4_biodiversity.pdf
http://www.reuters.com/article/2011/08/24/us-science-species-idUSTRE77N20O20110824
http://www.nhm.ac.uk/nature-online/science-of-natural-history/taxonomy-systematics/what-is-taxonomy/
[2]http://www.linnean.org/Education+Resources/who_was_linnaeus
[3]Tudge C. 2000. The Variety of Life. Oxford University Press.

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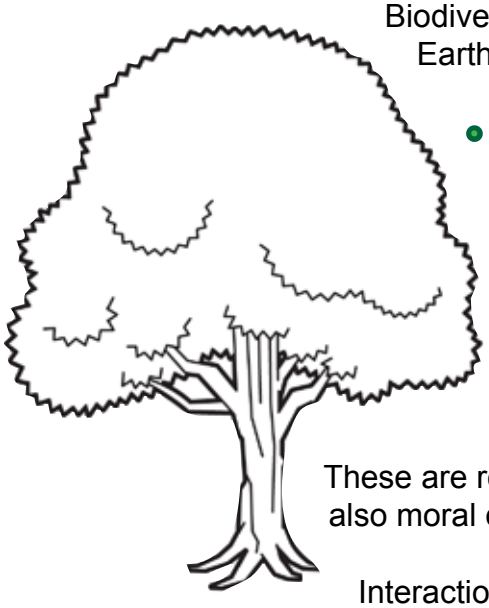
Why does biodiversity matter?



Biodiversity is life on Earth and has a vital role in the continuation of life on Earth. It matters because:

- It provides us with food, fuel, fibres and medicines.
- It contributes to regulating the climate, soil and water systems of the planet.
- It is a key element of green and marine spaces we enjoy using for recreation and relaxation. These activities can help our physical and mental well-being.

These are reasons why biodiversity matters to our survival as humans. There are also moral questions about whether all species have a right to exist.

Interactions between organisms and with the non-living environment form units termed '**ecosystems**'. Examples of ecosystems include tropical rainforests, coral reefs and rock pools. The benefits provided to us are sometimes called '**ecosystem services**'. These services have been categorised[4] as:

- **Provisioning** - providing us with things we use in everyday life, such as food, water, timber, fibres. Plant extracts are used in some medicines. For example extracts from willow trees are used in aspirin. Yew trees are used in anti-cancer drugs and an extract from star anise (a spice) is used in the anti-flu drug Tamiflu[5].

- **Regulating** - biodiversity plays a huge part in controlling how the planet works. It contributes to climate; water quality; the regulation of diseases and wastes; and pollination. An example is the use of reed beds to filter pollution and sewage from water.

[4] Categories from the Millennium Ecosystem Assessment - http://www.greenfacts.org/en/ecosystems/toolboxes/box2-1-services.htm
[5] Tamiflu:http://news.bbc.co.uk/1/hi/sci/tech/4978634.stm
Anti-Cancer: http://news.bbc.co.uk/1/hi/wales/north_east/7568403.stm

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- **Supporting** - biodiversity has a role in nutrient cycling (e.g. carbon and nitrogen) and soil development and is vital for photosynthesis.

- **Cultural** - we use biodiversity for recreation, inspiration, relaxation.

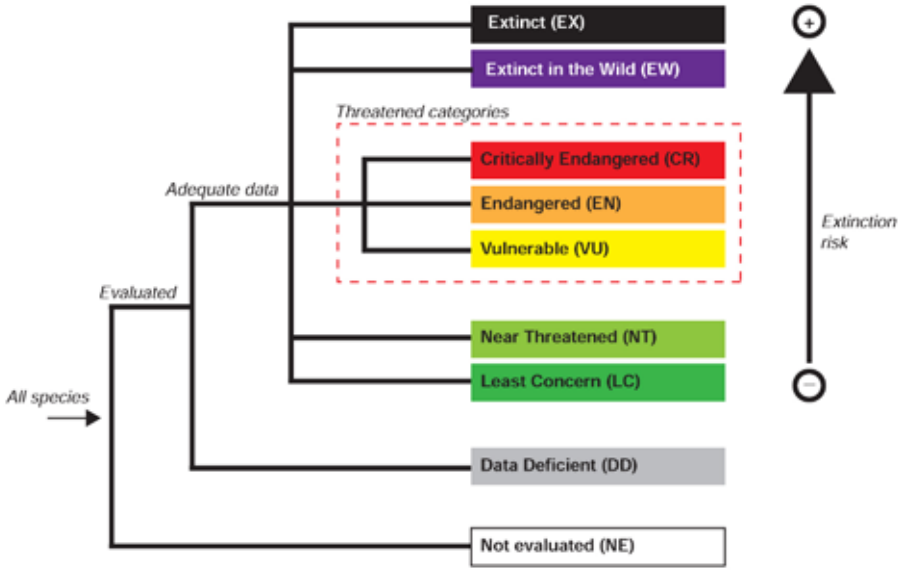
If we lose biodiversity, we risk disrupting or even losing these ecosystem services. We are still in the process of discovering new species and learning about the ones that have already been identified, so we may not even know what we are losing before it is too late.

The great range of biodiversity is an asset in our changing world. For example, by conserving plant seeds we keep genetic resources that may enable us to breed plants adapted to different climates.

The International Union for Conservation of Nature (IUCN) produces a Red List of Threatened species[6], based on an evaluation of the risk of extinction of plants and animals. The list highlights conservation needs.

EDEN FACTS

Few of the plants at Eden are rare. Most are crop plants cultivated around the world and have been chosen for our global garden because they provide food, fuels, medicines or materials.



The IUCN taxonomy for relative risk of extinction

[6] http://www.iucnredlist.org/about/red-list-overview

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What are the threats to biodiversity?

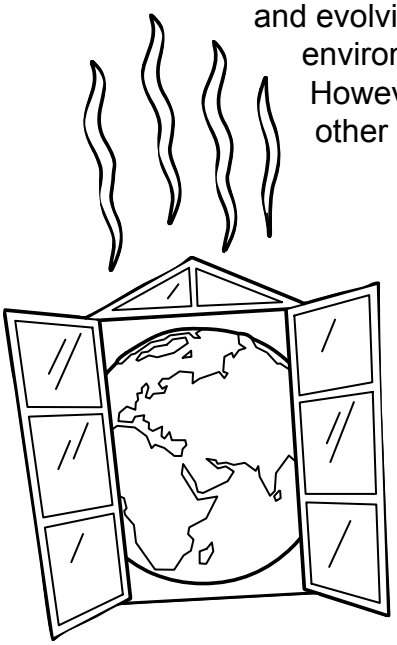
Climate Change

Climate change is the long-term alteration of our climate, including changes in temperature, precipitation and wind. (See the Climate Science information pack for more information about the greenhouse effect and climate change).

Some of the changes that are projected to occur include temperature increases, sea level rise and changed patterns of precipitation[7]. These conditions could have dramatic impacts on biodiversity, altering lifecycles, migratory events, lengths of growing seasons and species distributions[8].

According to the Intergovernmental Panel on Climate Change (IPCC): 'Substantial changes in structure and functioning of terrestrial and marine ecosystems are very likely to occur with a global warming of 2°C to 3°C above pre-industrial levels and associated increased atmospheric CO^{2}'[9].

Biodiversity has some mechanisms to cope with this environmental change. By adapting and evolving to suit changing conditions or moving to new areas where suitable environments exist, species can change their range and distribution on the planet. However, other factors such as fragmentation of habitats and competition with other species (see below) can make this more challenging.



[7] http://ukclimateprojections.defra.gov.uk/media.jsp?mediaid=87851&filetype=pdf
[8] http://www.millenniumassessment.org/documents/document.356.aspx.pdf
[9] http://www.ipcc.ch/publications_and_data/ar4/wg2/en/tssts-4-1-2-ecosystems.html

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While climate change has an impact on biodiversity, biodiversity is itself important in reducing the impact of climate change. For example:

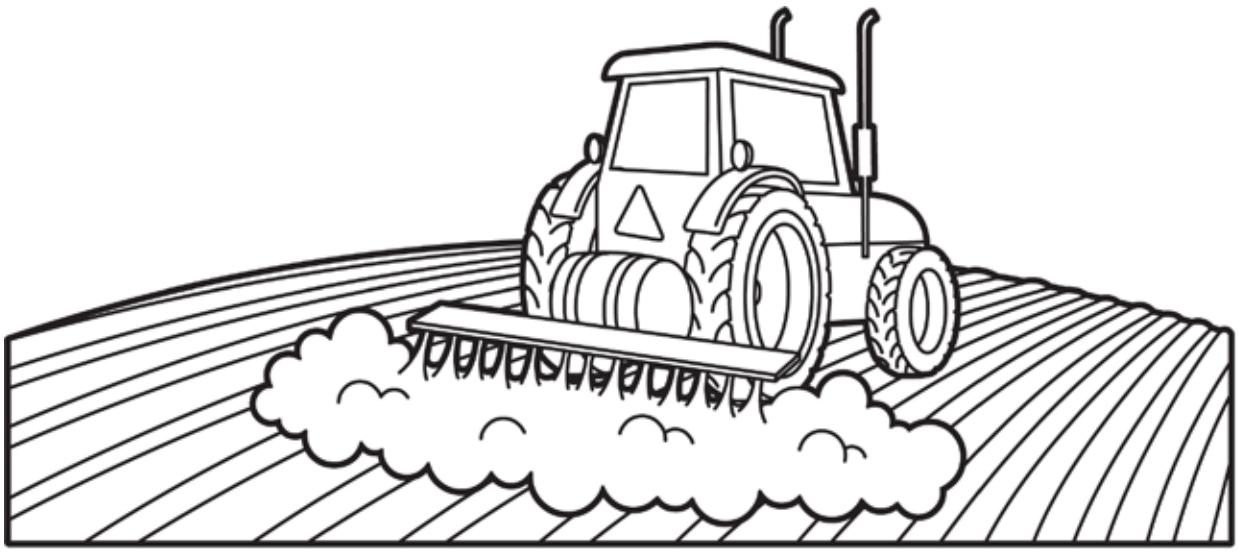
- Biodiversity can reduce vulnerability to natural disasters such as flooding. For example, mangrove swamps can protect coastal areas from the damage of tropical storms.
- Plants and soil can store CO^2, reducing how much is released into the atmosphere (CO^2 is a greenhouse gas which contributes to climate change). Deforestation has the opposite effect, as it releases CO^2 to the atmosphere.

Land use change and land management

Construction or industry – such as road-building, mining or new housing developments – can result in habitats being lost or broken up into small areas (fragmentation).

Habitat fragmentation can change the conditions of an area, perhaps letting more light in or leaving bare earth which can heat up more quickly in the sun. These altered conditions may change what is able to live there. Also, if habitats become smaller and more isolated, the plants and animals can become more vulnerable to environmental change or to pests and diseases.

Conversion of grasslands and forests to agricultural land is also a threat to biodiversity through habitat loss. Some modern agricultural methods can be damaging. Fertilizers, pesticides and irrigation can all contribute to the damage of biodiversity.



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Some habitats may appear to need little management. They might be seen as 'natural', but they actually require management to maintain them. For example, heathlands can appear 'wild' and 'natural' but they rely heavily on grazing or controlled burning to maintain them. Without this form of management, the diversity of plants and animals found in heathlands can decrease, turning the area into a scrubland.

Pollution

A significant threat to biodiversity – particularly in freshwater or coastal areas – is nutrient enrichment. In a process called 'eutrophication', ecosystems accumulate mineral nutrients. This can result in excessive growth of plants and algae[10]. Excessive growth may change the way the ecosystem functions and which species live there.

Eutrophication can occur through natural processes, for example if light levels increase. However, human activities such as agriculture and sewage treatment are increasingly the cause. Phosphorous and nitrogen compounds are particularly significant in this process. Nitrogenous fertilizers can improve crop yields, but only up to a point, and high levels of synthetically-produced nitrogen fertilizer entering water courses contribute to eutrophication.

EDEN FACTS

To help look after the plant collections, 33 different types of biological control (bugs that eat bugs) are used.

Invasive species

Introduced species are those which are not usually found in an ecosystem. With globalisation, trade and tourism, it has become easier to transfer plants, animals and micro-organisms around the world. Transfers can be intentional introductions - for example species of commercial importance for agriculture or horticulture - as well as accidental. Not all introduced species pose a problem, but some can become invasive, posing a threat to biodiversity. Usually this threat arises because the invasive species is highly competitive or a strong predator to other species in the ecosystem[11].

Japanese knotweed, an invasive species in Europe

[10] Find out more at http://www.wri.org/project/water-quality
[11] http://www.cbd.int/invasive/WhatareIAS.shtml, http://www.wri.org/publication/content/7956

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How can biodiversity be protected?

The Convention on Biological Diversity

The Convention on Biological Diversity (CBD) has been in force since the end of 1993[12]. It was agreed at the Rio 'Earth Summit' (UN Conference on Environment and Development) in 1992. Most of the world's governments are signed up to this. The objectives of the Convention are:

- To conserve biological diversity
- To use biological diversity in a sustainable manner
- To share benefits of biological diversity fairly and equitably.

The UK response to the CBD is the UK Biodiversity Action Plan[13] in which species and habitat priorities for conservation are listed.

2010

In 2002, those signed up to the Convention committed to targets: 'to achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on Earth'[14]. Unfortunately, the targets were, largely, not met by members, with some experts becoming increasingly worried about the number of species at risk of extinction as a result[15]. At the 2010 Convention on Biodiversity conference in Japan, the Nagoya Protocol was adopted which set out a framework for the 'fair and equitable sharing of benefits arising out of the utilisation of genetic resources'[16]. In addition, the United Nations declared 2010 the International Year of Biodiversity[17] in a bid to raise awareness of the Convention's targets and the issues facing biodiversity in the world. There is also an annual International Day for Biological Diversity (May 22nd)[18].

[12] http://www.cbd.int/
[13] http://jncc.defra.gov.uk/page-5155
[14] http://www.cbd.int/2010-target/
[15] http://www.globalpolicyjournal.com/blog/26/08/2010/convention-biological-diversity-ten-year-failure
http://thepimmgroup.org/977/international-year-of-biodiversity-2010-heading-towards-failure/
[16] http://www.cbd.int/abs/about/
[17] http://www.cbd.int/2010/welcome/
[18] http://www.cbd.int/idb/

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Conservation

Methods of conserving biodiversity can be classified as *in situ* or *ex situ*.

In-situ conservation preserves species on the site of their habitat. In this type of conservation an area is usually protected, preserving the links between the organisms and their environment. National parks and nature reserves preserve biodiversity in situ.

Ex-situ methods involve preserving the species outside their habitats - for example in botanic gardens, zoos or seed banks. Animals may be taken into captivity to protect them from extinction and to carry out breeding programmes to produce a population for re-introduction to their wild habitats[19].

Examples of ex situ plant conservation include Kew's Millennium Seed Bank, which contains seeds from 10% of the world's wild plant species and has a target of collecting 25% by 2020[20].

EDEN FACTS

Some plants at Eden are wind-pollinated, some insect-pollinated, other times we might use a paintbrush to pollinate the plants.

The Svalbard Global Seed Vault established in 2008 contains 420,000 samples and focuses on seeds of crop plants[21]. These resources may be used by farmers or plant breeders or, in the case of wild plants, contribute to the restoration of ecosystems that have been damaged.

Land management techniques can be used to create new habitats or restore damaged ones. Brownfield sites (previously developed or used for human activity) can sometimes make good sites for wildlife as they have a mosaic of different conditions that encourage a wide range of life forms. For example, extraction sites, such as quarries, can become biodiversity-rich areas of wetlands and ponds. The low level of nutrients and regular disturbance of sites can provide good conditions for wildflower meadows and invertebrates[22].

[19] http://www.durrell.org/Conservation/.
[20] http://www.kew.org/science-conservation/conservation-climate-change/millennium-seed-bank/index.htm
[21] http://www.regjeringen.no/en/dep/lmd/campain/svalbard-global-seed-vault.html?id=462220
[22] http://www.buglife.org.uk/conservation/currentprojects/Habitats+Action/Brownfields/
http://www.rspb.org.uk/Images/natureaftermineralsreport2_tcm9-135675.pdf

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How can I get involved?

Biodiversity at school

There are many areas in and around your school where biodiversity can be observed and recorded. These include:

- Nature spaces
- Hedgerows
- Playing fields
- Walls, tree bark (mosses and lichens)

Why not draw up your own action plan for biodiversity?

Taking part in national surveys

There are a number of national biodiversity surveys that students can participate in. These include:

Open Air Laboratories (OPAL):
www.opalexplorenature.org/?q=surveys
Royal Society for the Protection of Birds (RSPB) Big Garden Birdwatch: **www.rspb.org.uk/birdwatch**

Actions for individuals

There are individual steps that people can take to help preserve and maintain biodiversity:

Conservation International: Simple Steps to Live Green
www.conservation.org/act/simplesteps/Pages/simplesteps.aspx

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Research

Learn about nature, find out about where things come from and think about the impact of the choices you make.

To learn more about nature, there are many organisations which provide information on their websites about specific aspects of biodiversity, such as butterfly conservation, birds, woodlands or marine environments. There are also a whole range of online guides and guidebooks to help you find out about the wildlife you see.

When buying products, you can look into what they contain, where the components or ingredients have come from and how the item was produced. You can also research certification schemes which label products to certify that the way a product has been produced meets a set of standards. For example, the 'FSC logo' is a label which the Forest Stewardship Council awards to products to certify that their production is not contributing to the destruction of the world's forests. You can find out more here: **http://www.fsc.org/about-fsc.html,** or look up other certifications, such as those provided by Rainforest Alliance: **http://www.rainforest-alliance.org/certification.cfm?id=main**.

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Rainforest, Argentina

In Misiones, Argentina, logging and intensive agriculture has resulted in the loss of substantial areas of the Atlantic subtropical rainforest. The area is a 'biodiversity hotspot' and is critical for the local Guaraní people. Eden, funded by the Darwin Initiative **(http://darwin.defra.gov.uk/, http://darwin.defra.gov.uk/project/14034/)** helped to develop a sustainable management plan for the Yabotí Biosphere Reserve.

Impatiens in the Seychelles

Eden has worked with conservation organisations in the Seychelles and Reading University to propagate and conserve *Impatiens gordonii*, a rare plant found on only two islands in the Seychelles. Loss of habitat and competition from introduced species threaten this plant. Profits from sales of another *Impatiens*, 'Ray of Hope', at the Eden Project plant shop go towards helping protect the endangered relative in the wild. This project received funding from the Darwin Initiative.
http://darwin.defra.gov.uk/ http://www.edenproject.com/sites/default/files/documents/eden-project-and-the-seychelles.pdf http://www.edenproject.com/whats-it-all-about/places-regeneration/conservation-in-the-seychelles

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EDEN CASE STUDY

FORRU

The Forest Restoration Research Unit works to restore forest ecosystems in north-west Thailand. Initiated by Chiang Mai University, the project brings scientists and local communities together to develop tree nurseries, carry out tree planting and training programmes. The Eden Project has supported FORRU through staff exchanges, training and exhibit development. See **www.forru.org**

EDEN CASE STUDY

Atlantic Coast and Valleys, North Cornwall

The Eden Project has had a long association with the Atlantic Coast and Valleys Project in North Cornwall. Changes in land management along the coastline have resulted in subtle alterations to the landscape and decline in biodiversity over the last 50-70 years. As part of ongoing habitat restoration works in the area, the Eden Project nursery propagates cuttings of wild thyme plants, provided by the National Trust. Several thousand plug plants have been raised this way and have been planted out in the area. The re-establishment of thyme is critical for the re-introduction of the Large Blue butterfly which lays its eggs on the thyme plants.

To find out more about Large Blue butterflies see the National Trust website:
http://www.nationaltrust.org.uk/article-1356399697316/

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Glossary

Biodiversity
'The variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part.'
http://archive.defra.gov.uk/environment/biodiversity/about/

Biodiversity hotspots
These are biodiversity-rich and threatened areas suffering significant habitat loss.
http://www.biodiversityhotspots.org/xp/Hotspots/hotspotsScience/pages/hotspots_defined.aspx
http://www.conservation.org/where/priority_areas/Pages/default.aspx

Classification (biological)
The grouping of organisms into categories on the basis of their common features.

Climate Change
Variation in the Earth's climate (average long-term weather), which can be caused by natural and human factors. The following definition is from the Intergovernmental Panel on Climate Change:

'Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use'.

http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_appendix.pdf

Conservation (nature)
Preservation of nature and the natural environment:
In-situ: 'on-site' conservation, preserving nature in its natural habitat.
Ex-situ: 'off-site' conservation, preserving nature outside of its natural habitat (e.g. in zoos, seed banks).

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Ecosystem

'An ecosystem is a dynamic complex of plant, animal, and microorganism communities and the nonliving environment, interacting as a functional unit. Humans are an integral part of ecosystems.'
http://www.millenniumassessment.org/documents/document.300.aspx.pdf

Ecosystem services

'Ecosystem services are the benefits people obtain from ecosystems.' Examples are food, fuel, climate regulation and aesthetic benefits.
http://www.millenniumassessment.org/documents/document.48.aspx.pdf

Habitat

The home of an organism, its natural environment.

Invasive species

Species whose establishment and spread upset the balance of the ecosystem. Invasive alien species are species introduced into a new environment where they are not normally found and where they pose a threat to biodiversity. Not all alien/non-native species are invasive. An invasive species may have certain characteristics which give it an advantage over what already exists in that environment e.g. it may be fast-growing or produce lots of seeds allowing it to spread rapidly, or it may have few predators.

Pollution

The introduction into the environment of substances liable to have an adverse effect on life and ecological systems.

UK Biodiversity Action Plan (UKBAP)

This is the national strategy for conservation of biodiversity. It is a response to the Convention on Biological Diversity. Priority species and habitats for conservation have been listed under the BAP. Local biodiversity action plans contribute to the national targets by addressing local priorities.
http://jncc.defra.gov.uk/page-5155

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Related websites

Natural England
http://www.naturalengland.org.uk/

Wildlife Trusts
http://www.wildlifetrusts.org/

Growing Schools
www.growingschools.org.uk

Big Wildlife Garden
http://www.bigwildlifegarden.org.uk

Landlife
http://www.wildflower.co.uk/

Learning Through Landscapes
www.ltl.org.uk

Learning Outside the Classroom
www.lotc.org.uk

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