Biodiversity

The word biodiversity was only invented in 1986. It is an abbreviation of 'biological diversity' and encompasses the diversity of ecosystems on Earth, the diversity of species within them, and the genetic diversity of each species.

REASONS FOR THE CONSERVATION OF BIODIVERSITY

Economic reasons

- New commodities, for example medicines or materials may be found in organisms growing in the wild.
- New crop plants or farm animals could be developed from wild species or existing varieties could be improved using genes from wild species.
- Ecotourism could provide considerable income.

Ecological reasons

- Native species are adapted to local conditions, whereas alien species that might replace them are unlikely to be so well adapted.
- Species in natural communities are interdependent, so if one species becomes extinct the rest of the community is threatened.
- Damage to ecosystems can have widespread effects including soil erosion, silting up of rivers, flooding and even changes to weather patterns.

Ethical reasons

- Every species has a right to life, regardless of whether it is useful to humans or not.
- The wildlife of each area has cultural importance to the local human population and it is therefore wrong to destroy it.
- It would be wrong to deprive humans in the future of the rich experiences that the Earth's biodiversity provide to us.

Esthetic reasons

- Natural ecosystems and species in the wild are beautiful and give us great enjoyment.
- Painters, writers and composers have been inspired by nature around them.

EXTINCTION OF SPECIES

When the last members of a species die, the species becomes extinct. The rate of species extinctions is probably at an all-time high at the moment, as a result of human activities. There are unfortunately many extinct species from which to select examples for study, including the passenger pigeon and the dodo. Two less famous examples are described here.

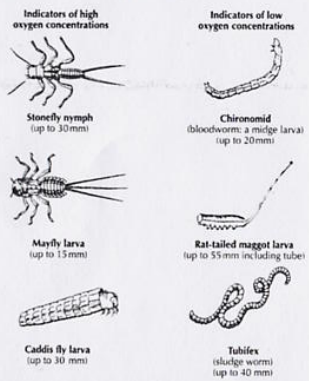
1. Conuropsis carolinensis – the Carolina Parakeet

These brightly coloured parrots were once common in forests to the east of the Mississippi, from New York to Florida, feeding on seeds of trees and herbs. Clearance of forests reduced their habitat and they started to feed on crops. Farmers killed many of them. Others were caught to obtain feathers, which were used to make fashionable women's clothing. They were also trapped and kept as pets. By 1900 there were no Carolina Parakeets in the wild and the last specimen died in Cincinnati Zoo in 1918.

MONITORING ENVIRONMENTAL CHANGE

Problems in natural ecosystems can be detected quickly if there is frequent environmental monitoring. Abiotic factors can be measured directly, but another technique is the use of living organisms to detect changes. Indicator species are very useful, as they need particular environmental conditions and therefore show what the conditions in an ecosystem are. Lichens are valuable indicator species because their tolerance of sulphur dioxide varies considerably from the most tolerant to the least tolerant species. Indicator species are also often used to assess pollution levels in aquatic ecosystems. Stonefly, mayfly and caddis fly larvae (below) require unpolluted, well-oxygenated water. Other aquatic species, including chironomid midge larvae, rat tailed maggot larvae and tubifex worms indicate low oxygen levels and excessive levels of suspended organic matter, from untreated sewage for example. The indicator species found in the River Enningdalselva (page 157) show how unpolluted it was.

Indicator species is aquatic ecosystems



To obtain an overall environmental assessment of a river or other ecosystems, a biotic index can be calculated. There are various methods, which usually involve multiplying the number of individuals of each indicator species by its pollution tolerance rating. An abundance of tolerant species gives a low overall score and an abundance of intolerant species gives a high score.

2. Calochortus indecorus – the Sexton Mountain mariposa lily

Calochortus indecorus was discovered growing over a small area on Sexton Mountain in Oregon. The building of an interstate highway destroyed the habitat and with it this rare plant disappeared. No other sites are known where *Calochortus indecorus* grows, so it is almost certainly extinct

HL Ozone depletion and acid rain

OZONE AND ULTRA-VIOLET RADIATION

At low altitudes in the atmosphere, the concentration of ozone is usually about 0.01 ppm, but at 20 – 50 km above the Earth's surface, in the stratosphere, ozone is much more concentrated – about 1–10 ppm. This is called the ozone layer. Ozone absorbs short wave radiation, especially ultra-violet. The amount of ultra violet radiation reaching the Earth's surface is greatly reduced by the ozone layer. Ultra-violet radiation has very damaging effects on living organisms.

- It increases mutation rates, by causing damage to DNA.
- It can cause cancers, especially of the skin.
- It causes severe sunburn and cataracts of the eye.
- It reduces photosynthesis rates in plants and algae and so affects food chains.

OZONE DEPLETION

Measurements of ozone concentrations in the stratosphere have shown that there has been depletion throughout the world. Since the 1980s an ozone 'hole' has appeared over the Antarctic every year between September and October, which persists for several months.

CHLORINE AND OZONE DEPLETION

CFCs are the main cause of ozone depletion. They are chemical compounds manufactured by humans and released into the atmosphere. Ultra-violet light causes CFCs to dissociate and release atoms of chlorine. These chlorine atoms are highly reactive and cause complex reactions in which ozone is converted to oxygen. The reactions form a cycle, with the chlorine atoms being released again, so that they can go on to cause the destruction of more ozone. One chlorine atom can potentially cause the destruction of hundreds of thousands of ozone molecules.

FIGHTING OZONE DEPLETION

CFCs were used very widely in the 1970s and 1980s:

- in refrigerators as the refrigerant
- in aerosol cans as the propellant
- in gas-blown plastics used for fast-food packaging.

In 1987, after research had shown that CFCs damage the ozone layer, an international treaty called the Montreal Protocol was signed. This treaty set targets for the replacement of CFCs with other chemicals that do not damage the ozone layer. Another measure that has been introduced widely is the collection of CFCs from obsolete refrigerators, to prevent them escaping into the atmosphere. Although levels of CFCs are continuing to rise, they should start to fall by 2010. CFCs are stable chemicals and so levels will only fall slowly, but forecasts made using computers suggest that by 2050 ozone holes over the poles will no longer form.

ACID PRECIPITATION

Carbon dioxide dissolves in droplets of water in clouds and makes the precipitation that falls from the clouds slightly acidic. Sulfur dioxide and nitrogen oxides have the same effect, but can make the precipitation much more acidic – as low as pH3. Although there are some natural sources of these gases, human activities are the main source. The figure below shows the origins of these acid pollutants and the processes involved in the formation of acid precipitation.

Sulfur dioxide emissions have been reduced in many countries, but acidification continues to be a problem where levels of nitrogen oxides are still increasing.

THE BIOLOGICAL CONSEQUENCES OF ACID PRECIPITATION

1. Aluminium becomes water soluble in acidified soils and leaches into streams and lakes. Aluminium ions are toxic to fish and in many acidified lakes and rivers all fish have been killed.
2. When soils become acidified, potassium (K^+), magnesium (Mg^{2+}) and calcium ions (Ca^{2+}) leach out, making the soil less fertile and reducing plant growth.
3. Trees affected by acid precipitation show premature leaf fall and dieback of branches. Conifers seem to be particularly vulnerable, perhaps because acid mist condenses on their needles in winter.