

### Sustainable management

In the past, our manipulation of natural resources was minimal, causing very little damage to the external environment, but now that technologies increase and the human population seems to be rising exponentially, we use more intensive methods of exploiting the environmental resources available to us, which is causing greater harm to our ecosystem.

Sustainable management concerns finding a balance between *our needs* for natural resources and *conservation*. To develop **sustainably** simply means to do so in a way which does not harm the environment or future generations. A classic problem is that of wood and timber production: sustainable management methods would be concerned with finding techniques to harvest these materials whilst conserving the natural ecosystem.

### Managing small-scale timber production

Sustainable management has meant that exploitation of woods and forests for timber has become possible, maintaining biodiversity whilst providing us with the goods and resources we want. When the approach is on a smaller scale, **coppicing** may be used, which is a traditional approach to obtaining a sustainable supply of wood. It involves harvesting wood whilst keeping the trees alive. Coppicing requires cutting the trunk of a **deciduous** tree (one that loses its leaves in the winter) close to the ground. Once cut, narrow shoots begin to grow from the cut surface which grow into small stems which can be used for fencing, firewood or furniture. After cutting these, new shoots grow, and so on. You can learn how shoots like these grow after coppicing in [8.6 Plant responses](#).

Similarly, **pollarding** is a bit like coppicing, but it involves cutting the trunk higher up. This is useful when the population size of species like deer is high, as it prevents them from eating the shoots which grow from coppicing, as they cannot reach when it has been cut higher up.



Whether woodland managers choose to use coppicing or pollarding, in order to ensure a continuous supply of wood, these managers will divide the woodlands up into sections, so that a new section can be cut at each year, until each section in the area has been cut. By the time all trees have been cut once, the section that were first cut will then be ready to be cut again (as they will have grown back) – this is known as **rotational coppicing**. Some trees in each section will usually be left alone (not coppiced), and they are called **standards**, and are left so either for an emergency supply or to be eventually harvested to supply the larger pieces of timber. Rotational coppicing is very good for biodiversity.

### Managing large-scale timber production

Large-scale production usually involves **clear-felling** all of the trees in an area. This destroys many habitats on a large scale and is rarely practiced in controlled environments such as the UK and many other developed countries. Clear-felling of trees can reduce soil mineral levels and leave them susceptible to soil erosion. Soil may run off into waterways and pollute our water, too (because prior to the deforestation, the trees would have removed water from the soil and therefore stopped the soil from being washed away).

Leaving each section of woodland to mature for between 50 and 100 years will allow for biodiversity to increase, but this is not cost-effective. Modern sustainable forestry on a large scale like this works on a number of principles:

- any tree which is harvested is replaced by another tree (either grown naturally or artificially planted)
- even with extraction of timber, the forest as a whole must maintain its ecological function regarding biodiversity, climate and the **global cycles** (the water cycle, the nitrogen cycle, the carbon cycle and the phosphorous cycle)
- local people should derive benefit from the forest

Selective cutting involves removing only the largest, most valuable trees, and leaving the smaller, less valuable ones. This means that the ecosystem is broadly unaffected.

## Conservation and preservation

Most **conservation** programmes tend to focus on maintaining a 'healthy' level of **biodiversity**. However, this does not mean that an ecosystem which is being conserved is in its '*natural*' form, in fact this can be far from it. The process of conservation must be distinguished from **preservation**, which aims to protect areas of land which are currently untouched by humans, therefore keeping them *preserved* in their natural forms. Conservation is a dynamic process involving management and *reclamation* of land.

There are a number of reasons why humans would want to run conservation programmes of certain ecosystems. Our species threatens biodiversity in natural ecosystems by over-exploiting natural resources and disrupting habitats with our industrial and commercial activities. Also, whenever we introduce new species to an ecosystem, this may actually damage the ecosystem if that new species outcompetes an existing species, causing it to become **extinct**.

### **Ethical reasons to conserve ecosystems**

Many people would simply argue that we have no more a right to exist than other species of animal, or organism for that matter, which is why we should have the obligation to conserve environments (especially when it is our actions which pose a threat to their natural order)

### **Economic reasons to conserve ecosystems**

Many species have a direct value when harvested, and others may have a high value which is not yet recognised, and may provide a benefit in the future, and many species might have an indirect value, such as some wild insect species which are responsible for pollinating crop plants, and without them, harvests would fail

### **Social reasons to conserve ecosystems**

Ecotourism and recreation in the countryside also have a significant social and financial value, which derives from the aesthetic value of living things. Ecotourism depends on the maintenance of biodiversity, and this of course links into the economic reasons, as there is a sizeable commercial side to ecotourism

Effective conservation requires consideration of the social and economic costs to the local community, as well as effective education and liaison with the community. It can involve establishing protected areas, such as **SSSIs** (sites of special scientific interest) or **National Parks**, and can provide legal protection for endangered animals or plants. Conservation can also take place **ex-situ** in places such as zoos or botanical gardens.

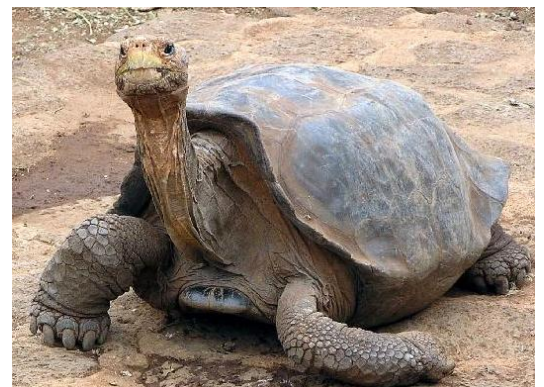
Some management strategies are outlined below, but which strategies are adopted depends upon the specific characteristics of the ecosystem and the species involved:

- raise **carrying capacity** (see 7.5 Populations) by providing extra resources, mainly food
- move individuals to enlarge populations, encourage natural dispersion of individuals between fragmented habitats
- restrict dispersion of individuals by fencing
- control predators and poachers
- vaccinate individuals against disease
- preservation of habitats by protecting against pollution or disruption

## Human activities and the Galapagos Islands

As part of the syllabus, you are required to know about biodiversity in the Galapagos Islands and explain the effects of human activities on the populations of both plant and animals species on the Islands.

It is on the **Galapagos Islands** that Darwin drew up his theory of **natural selection**. The islands' isolation and small population sizes make them perfect for rapid evolutionary change. They have such a high biodiversity and there are many unique and native species on the islands, but unfortunately 50% of the animal species and 25% of the plant species there are **endangered**. The human population has increased significantly in recent years due to the attractions and tourism there, and with increasing demand for marine products such as sea cucumbers and lobster, human activities have only worsened the situation.



This is **Lonesome George**, the last known surviving member of one of the fifteen Galapagos species of tortoise, and described as the rarest creature in the world, he is a worldwide symbol for conservation

### *Habitat disturbance in the Galapagos*

The human population size on the Islands has increased sixfold over the past 25 years, from 5000 to the now 30000 individuals on the Islands. This dramatic increase in population size has placed huge demands on water, energy and sanitation services, which the authorities are struggling to meet. More waste and pollution is also being produced, and there is more demand for oil. The Galapagos 2001 oil spill did not help matters, damaging a significant region of coastal ecosystems on the Islands.

Increased consumption of land for building and agriculture have caused destruction and **fragmentation of habitats**. One of the worse affected places is **Santa Cruz**, an island where complete forests of trees and shrubs have now been eradicated, and where **Lonesome George** lives, who is the last known surviving individuals of one of the species of giant tortoise in the world. George is considered to be the rarest known animal in existence.

### *Over-exploitation of resources in the Galapagos*

150 years ago, whaling boats and fur traders took up residence on the islands and poached whales and seals to trade internationally. These sorts of species were being harvested much quicker than they could be replenished. The same goes for giant tortoises, who were taken on board hunting ships, because they could survive a long time without much food, and then would be killed and eaten by the crew. This had devastating effects on tortoise numbers: over 200,000 tortoises were taken for this reason within half a century. This includes the Pinta tortoise species, of which George belongs.

The same has occurred with species of sea cucumbers, and the removal of such organisms on such a large scale has serious and harmful effects on the ecosystem, as this change has a knock-on effect at each level on the food chain. Similarly, shark fins are a delicacy and are traded internationally, with over 150,000 sharks being hunted from the Islands' oceans annually (included members of around fifteen endangered species). The authorities on the Islands have tried to stop this, as much of this hunting and poaching is illegally-done, but it happens on such a large scale it is hard to control.

### *Introduction of species to the Galapagos*

Humans brought many species which were not native to the island with them, deliberately. These include cats, dogs, goats, vegetables and wild fruit plants, and these new species can have an impact on the existing communities. There are other species, such as many wild insects, which have been transferred accidentally. As well as simply outcompeting existing and native species, these **alien species** can destroy their habitats, bring diseases over with them, or simply eat the native species as prey.

The goat, in particular, has been one of the most damaging introductions to the Galapagos ecosystems. It eats the Galapagos rock purslane, a plant species exclusive to the Islands, and it outcompetes species, mainly the giant tortoise, for grazing and feeding. Goats are also found to change the habitats on the island, reducing the nesting sites of the tortoises. With so many endangered species (especially of giant tortoise) on the island, pests like these are serious.

There was a large scale goat *eradication project*, which aimed to rid the Islands of the pests. On the *Isabela* island, there were nearly 100,000 wild goats a few years ago, but this wide-scale eradication project involved culling the goats over the 400 hectare area, and now there are none on that island, so they no longer pose a threat to the tortoises.