



Darwin, biodiversity and a changing world

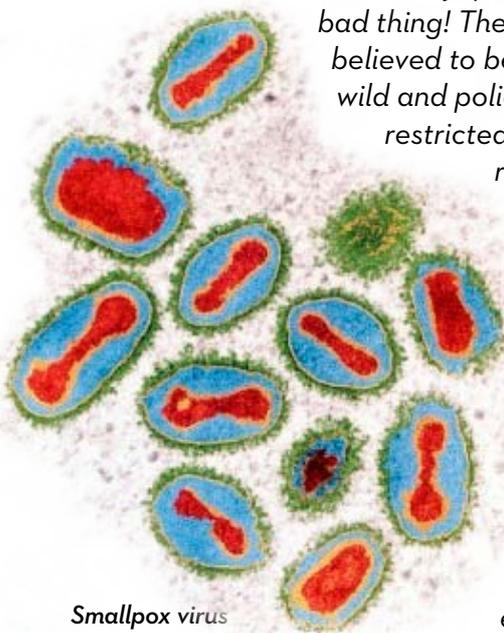
Darwin's theory of evolution by natural selection describes how species emerge, change and become extinct in response to changes in the environment. At several points in Earth's history, rapid environmental change has caused mass extinctions when up to 95% of Earth's species were wiped out. But, these "disasters" have been followed by a blossoming of biodiversity, as a rich variety of new species evolved.

If natural selection is changing species and ecosystems, in response to environmental change, then what should be our attitude to the management and conservation of biodiversity and how important, in the long term, is the extinction of species? Some estimates suggest half of the species alive today will be extinct by 2100; what should we do?

Biodiversity - who needs it?

Human activities such as habitat destruction, pollution and over-harvesting are threatening many species with extinction. Even feeding the birds can put species in danger of extinction. On the Galapagos Islands, two diverging populations of Darwin's finches are collapsing back into one because of the local practice of feeding finches with rice. The abundant supply of one food type has removed the selection for different beak types adapted to different food sources. What should we do about it?

Extinction of species may not be a bad thing! The smallpox virus is believed to be extinct in the wild and polio virus is now restricted to a few small regions. The serious cattle disease, Rinderpest, was almost certainly wiped out in 2000; making it the first virus of non-human animals to be eradicated.



Smallpox virus

It has been suggested that the planned extinction of 30 species of mosquito, which spread diseases that kill one million people annually, would be morally and economically justified.

But what of the majority of species that contribute to the planet's biodiversity? We have poor estimates of how many species are going extinct and little idea of how quickly new species are appearing; almost certainly the overall diversity of the Earth's ecosystems is being reduced. We know that less diverse ecosystems are less productive and less stable, so loss of biodiversity may weaken ecosystems and make them more fragile.

Biodiversity loss certainly reduces the natural resources available to us. Fourteen animal species account for 90% of the livestock we raise and around 30 crop species supply 90% of the calories in our diet. This is a tiny slice of the 1.5 million known plant and animal species. In a constantly, changing world, dependence on so few plants and animals makes us very vulnerable to crop and livestock diseases and the effects of climate change. Natural selection allows species to adapt to changing environments, whether in the wild or on farms, and understanding how pests and pathogens evolve in different environments is increasingly important in the fight to protect our livestock and crops.



While sudden changes can be catastrophic, as seen with mass extinctions, we know they can also be extremely effective in selecting for individuals that can survive under new conditions. Natural systems can respond very quickly to changes in their environment. A recent example is the effect of a deadly bacterial disease on populations of Blue Moon butterflies on South Pacific islands. The arrival of the disease was a sudden and harsh selection pressure that killed off nearly all male Blue Moon butterflies. A few males carried a particular gene mutation that enabled them to fight off the bacterial infection; as only these males lived to reproduce, the resistance gene spread rapidly through the butterfly population; the population evolved in response to the new selection pressure.



Climate change is changing evolution

The reality of climate change is no longer seriously questioned. What is debated is how quickly changes will occur, how extreme they might be and what their impact will be on wild and farmed ecosystems and human activity. We can expect that species that cannot adapt will go extinct, while new species may evolve to fill niches in changed ecosystems. There will be winners and losers.



Soay sheep

Recent studies, on Soay sheep and migratory birds, have demonstrated how sensitive some species can be to small changes and that species respond to change in different ways.

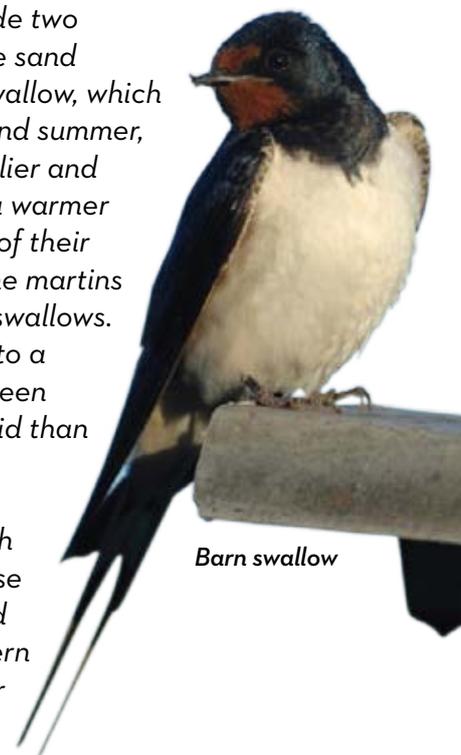
In years with long, cold winters the Soay sheep population of the Outer Hebrides grows fastest when the flocks include many large individuals. A greater proportion of big sheep in the population increases the population growth rate. Big sheep are better adapted for harsh winters and their survival rates are higher, so hard winters select for larger sheep and this increases the population growth rate. If climate change results in milder winters, the selective advantage of large animals will decrease and this could have a significant effect on the number of sheep that are born.

In the last decade two migratory birds, the sand martin and the barn swallow, which visit the UK in spring and summer, have been arriving earlier and earlier in response to a warmer climate. But the order of their arrival has reversed; the martins now arrive before the swallows. The martins' response to a warming climate has been stronger and more rapid than that of the swallows.

Bluetongue virus, which causes a serious disease in livestock, has spread from Africa into southern Europe because milder weather has allowed the African midge that spreads the virus to survive the winters of southern Europe.

As we learn more about natural selection, genetic variation and the importance of biodiversity, Darwin's theory is informing the steps we are taking to prepare for, and respond to, the effects of climate change.

Read more at <http://www.darwin.rcuk.ac.uk>



Barn swallow

Darwin Today is raising awareness of the importance of Darwin's theory of evolution by natural selection, in current research and innovation across many disciplines. Darwin Today is targeting general audiences around the UK. It is led by the Biotechnology and Biological Sciences Research Council on behalf of the UK Research Councils.

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