DarwIN Shrewsbury Festival 2021

Extinction:
How Our Museum Collections
Reflect Our Planets Changing Biodiversity

Rhynchosaur Forelimb Fossil (SHYMS: G/1982/133.002)

Shropshire Museums cares for over 45,000 geology specimens, (including fossils, rocks and minerals) and around 80,000 biology specimens (including birds, mammals, insects, fish and plants). Our collections include specimens from all over the world as well as many collected locally. This invaluable resource is stored at our Collections Centre in Ludlow; a purpose-built environmentally controlled, museum store with research and education spaces on site.

Shropshire has some of the most varied geology in the whole of Britain. 11 of the 13 geological time periods are represented in the county's rocks. No other area in Britain of a similar size contains such a diverse range of geology. All over the world there are geological formations named after places in Shropshire such as Ludlow, Wenlock and Caradoc. This shows just how important the geology of Shropshire is, not only locally but worldwide, to our understanding of our planet's deep history and changing environments.

Our biology collection includes many plants and animals still common in Shropshire. However, some are rare and precious survivors of species now found only here or in a handful of other localities.

What is Extinction?

A species is described as 'extinct' when there are no living members left. However, there are different types of extinction event ranging from the loss of one species in a specific geographic location to the loss of numerous species globally.

When Darwin proposed his theory of evolution through natural selection this not only explained how new species evolved, but equally how less well-adapted and ecologically competitive species consequently died out (or became extinct). In recent times, extinction has understandably been regarded as a negative and catastrophic result of the actions of our own species, but extinctions have occurred since the beginning of life on earth.

Mass Extinction

Mass extinction occurs when a major catastrophic global event causes many species all over the world to become extinct at the same time. Such events can be caused by meteorite impact, comet showers, huge levels of volcanic activity or dramatic climate changes to name just a few.

Perhaps the most famous Mass Extinction occurred at the end of the Cretaceous period 65 million years ago when approximately 62% of species became extinct; most famously the dinosaurs and pterosaurs. The event is believed to have been caused by a huge meteorite impact and massive volcanic activity making the environment unsustainable for these creatures. But this impact had far reaching effects beyond the land, causing the extinction of an estimated 70% of marine animal species alone. These extinctions included some enormous and wonderful ancient marine reptiles such as mosasaurs and plesiosaurs and cephalopod molluscs such as ammonites.

The earliest ammonites appeared 409 million years ago during the Devonian and are excellent index fossils; often making it possible to date a rock to a specific geological period by its presence. Ammonites were marine cephalopod molluscs. Their fossilised shell is made up of coils or whorls and the living mollusc would have lived in the outermost part of the shell. As ammonites grew they would lay down a series of chambers that would then contain a mixture of gas and water to control the animal's buoyancy. As predators of smaller marine creatures, they would move through the water by squirting out water- a form of jet propulsion not unlike their modern-day relatives the squid and cuttlefish.

Ammonite, Dactylioceras sp. (SHCMS: G.18514)

Throughout the Earth's history there are believed to have been five mass extinctions (known as the BIG 5) and famous though the 'end of Cretaceous' event was, it was not the largest. This in fact occurred at the end of the Permian period 248 million years ago; long before any dinosaurs roamed the land! Though no consensus has been reached, this was thought to be caused by a combination of low atmospheric oxygen; huge levels of volcanic activity; low sea level and changes in ocean circulation currents due to the formation of the single land mass known as Pangea. Whatever the cause, it resulted in the largest Mass Extinction seen to date with an estimated 70% of early vertebrate genera lost along with an estimated 95% of all marine animal species. Amongst the marine species were the well-known trilobites.

Though finally made extinct 248 million years ago (at the end of the Permian period) trilobites were already in decline. They had their heyday from the Cambrian 545 million years ago through the Ordovician and Silurian periods (the latter ending 417 million years ago). Much of southern Shropshire consists of exposed Silurian and Ordovician rock strata and, as such, we have many fossils from these periods in the collections. Museum specimens such as these are all important pieces in the ongoing evolutionary jigsaw. They not only enable palaeontologists to study the many and varied ways in which animals like trilobites changed over time, but also by their decline and ultimate absence in more recent rock strata, provide evidence of the Permian mass extinction event.

Ordovician trilobite Elrathia kingi (SHCMS: G.05621)

Global Extinction

Global extinction relates to the worldwide loss of all individuals of a single species as opposed to a broad range of species (or indeed higher group of species) as seen in Mass Extinctions. Causes are many and varied ranging from habitat alteration or loss; climate change; alterations in sea level or competition from other species including exploitation by man. One famous example of this is the extinction of the passenger pigeon.

Passenger Pigeon (SHCMS: Z.00264)

The Passenger Pigeon is often used as an example of catastrophic population loss. They were once found across most of North America. These nomadic birds would migrate between the north and south extremes of their distribution area searching for food, shelter and nesting sites. Their huge flocks, numbering millions of individuals, were frequently described as being so dense that they blackened the sky. But by the 1870s, the decrease in bird numbers was already noticeable and by the 1890s there were very few recorded sightings. The last fully authenticated record of a wild passenger pigeon was in 1901.

The passenger pigeon became extinct due to overhunting. In the mid-nineteenth century there were concerns that the huge flocks were a risk to agriculture. Therefore, people were encouraged to shoot and trap them for meat, feathers or just sport. Recent archaeological theories have also suggested that the genocide of Native Americans from the late-eighteenth century onwards, may have previously caused a huge increase of bird numbers due to a decrease in traditional hunting of the birds for food. This boom in numbers may have then caused a subsequent population crash, which was expatiated by human factors.

Background Extinction

We think of extinction as a signal that something is wrong, but extinctions are a normal part of evolution. Background extinction is the ongoing loss of individual species due to environmental or ecological factors such as climate change, disease, loss of habitat, or competitive disadvantage in relation to other species. Background extinction occurs at a steady rate over geological time and is the result of normal evolutionary processes, with only a limited number of species in an ecosystem being affected at any one time. This can result in localised extinction when a population of a species in an area dies out, but still exists elsewhere.

One example of background extinction is the loss of tundra steppe megafauna from Britain, such as mammoths, at the end of the last Ice Age. This was due to natural climate change. As the climate warmed, mammoths were restricted further north to Northern Siberia and Alaska.

Adult mammoth left jawbone (SHCMS: G.15002)

In 1986, the remains of one adult male and several juvenile mammoths were found at Condover Quarry near Shrewsbury. These individuals are thought to have met their end having fallen into a kettle hole formed as the ice retreated at the end of the last Ice Age. This steep-sided natural hollow would have been full of sticky mud and water and the animals were most likely unable to escape. The Condover Mammoths, dying around 12,800 years ago, were some of the last surviving examples in northern Europe.

The exact reason for the decline of mammoths in general however is less precise and most likely a combination of factors chiefly a warming climate making life hard for these enormous woolly beasts and the ever-increasing presence of 'hunting' humans and Neanderthals. The last mammoths lived in the far north on Wrangel Island in the Arctic Ocean and finally died out some 4,000 years ago. Extinction events can be a complex mix of factors. Mammoths populations were under pressure from climate change but were further impacted by increasing hominid hunting. Isolation on Wrangel Island would have protected this isolated population from human predation.

In summary, we can see that really there is a continuous spectrum of extinction. These range in severity from background rates, where species such as mammoths slowly and inexorably disappear, to huge and devastating mass extinction events, where huge numbers of species are lost as illustrated by the demise of dinosaurs and ammonites.

Extinction Today

In modern times it seems human factors are the key trigger of extinction events. Currently, we are experiencing a biodiversity crisis so dramatic it has been referred to as the 6th mass extinction. Extinction rates are escalating thousands of times faster than background rates illustrated in the fossil record. In 2019, an Australian entomologist, Francisco Sanchez-Bayo, reviewed all existing evidence for insect declines. He estimated that insects are declining by 2.5% each year, with 41% of insect species threatened with extinction. He concluded: "we are witnessing the largest extinction event on Earth since the Late Permian".

The impact of habitat loss, pesticide use, and climate change fuelled by human activity is now becoming very real and visible on our doorstep in our gardens and the wider countryside of Shropshire. For example, regular recorders of dragon and damselfly species frequently report a lack of abundance when visiting well-known sites. At such locations, clouds of these insects in the summer skies were the norm in living memory. Even if we do not know one species of insect from another, many of us well remember that not too long-ago car windscreens and headlights were coated in the remains of unfortunate insects after a long journey. It is a sad fact that all too easily we get used to a 'new norm' and forget how things really were and cannot therefore see how much they have changed.

Biological records and museum specimens provide an essential record and important reminder of what species used to thrive here in Shropshire. Local species loss is illustrated by our butterfly collection including the Large Blue, the Black-veined White and the Large Tortoiseshell - all recorded historically in Shropshire, but now locally extinct.

Large Blue Butterfly (SHCMS: Z.15199)

Butterflies are nationally a well recorded species with numerous Butterfly Monitoring Scheme volunteers monitoring transects at more than 2,500 locations in the UK. In a recent report published in 2018 the Joint Nature Conservation Committee analysed these data and concluded numbers of butterflies had decreased by an estimated 46% between 1976 and 2017, with habitat specialist species falling by an estimated 77% over the same time scale.

One rare British dragonfly species still in north Shropshire, living in and around the bog pools of Whixall Moss, is the White-faced Darter. We are very fortunate to have this species as it has been lost from 50% of its sites in England in the last 50 years. Whixall Moss is one of a small handful of breeding locations left in England with the main strongholds being in north-west Scotland. The species remains threatened by peat extraction, land drainage, habitat succession and climate change. As our climate warms, this species can only survive in more northerly locations and there is every likelihood that at some point in the future museum specimens like this will be the only ones left in Shropshire.

Conclusion

Our museum collections have the capacity to shine a light on past extinction events. One key question is "Can humans be the solution to this problem rather than the cause?" Whilst we have little control over causes such as meteorite impact, we can change the devastating impact we, as a species, are currently having on background extinction rates. It is certainly shocking to think we are contributing to what has been termed the '6th Mass Extinction and we should take heed that a mass extinction event will result in a snowballing loss of numerous species. If we continue as we are, that would most likely include our own species.

This may seem overwhelming. Even though largescale changes need to be embraced globally, we as individuals can make a real difference too. One example is by creating and maintaining habitats for insects. Many of us are lucky enough to have gardens which if managed with wildlife in mind have the potential to form a 'species saving' network of good habitat. Simple actions like planting species rich in nectar and pollen can help insects. As can leaving log piles and wild corners; digging a pond; building a bee hotel or simply stopping mowing all the grass. Perhaps most importantly we can stop using pesticides and use companion planting to attract natural predators of pests into our gardens. Even with no garden you could add to this recovery network by installing window boxes with great plants for pollinators.

SHROPSHIRE MUSEUMS

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