MOUNTAINS

The Big Picture

REWILDING REACHOUT









SCOTLAND: The Big Picture works to drive the recovery of nature across Scotland through rewilding, in response to the growing climate and biodiversity crises.

We believe that restoring the natural living systems on which all life depends is the responsibility of everyone, and that young people's voices should be heard and valued.

Rewilding Reachout is a series of booklets, films and stories shaped by our #NextGen rewilders, a team of inspirational young people who aim to inform and inspire fresh thinking among young Scots around the potential of a rewilded Scotland.

#SBPNextGen

Thanks to National Lottery players

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"Because in the end, you won't remember the time you spent in the office or mowing the lawn...climb that goddamn mountain!"

Jack Kerouac

Whenever we think of Scotland's wildest landscapes, we tend to think of the mountains and upland bogs that stretch across vast swathes of the country. These places might appear unwelcoming but they have long been home to their own special wildlife communities.

Scotland's last surviving top predator, the golden eagle, has historically found sanctuary amidst these high peaks, while in the glens below, the wolf, bear and lynx disappeared. Hunted to extinction around the rest of the UK, pine martens and wildcats clung on in just a few isolated pockets, hidden around the Highlands.

The golden eagle is symbolic of Scotland's rugged mountains.

Mountain retreats

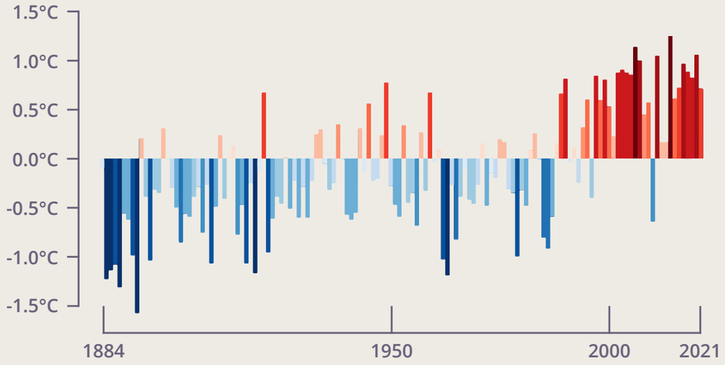
Today, Scotland's high places are susceptible to a new threat – that of climate change.

Every species on Earth has a preferred set of conditions in which it thrives, and when the environment changes, animals that rely on specific types of habitat soon struggle. Move any organism out of its natural environment and it won't do well – like a fish out of water.

As global temperatures rise, driven by human carbon emissions and the resulting greenhouse effect, Scotland's cold-adapted species have just two choices: move north or move to higher ground.

The further you get from the equator, the colder it gets, but it also gets colder with altitude – about 1°C for every 100m. So, as global temperatures have increased, many of Scotland's animals have migrated uphill.

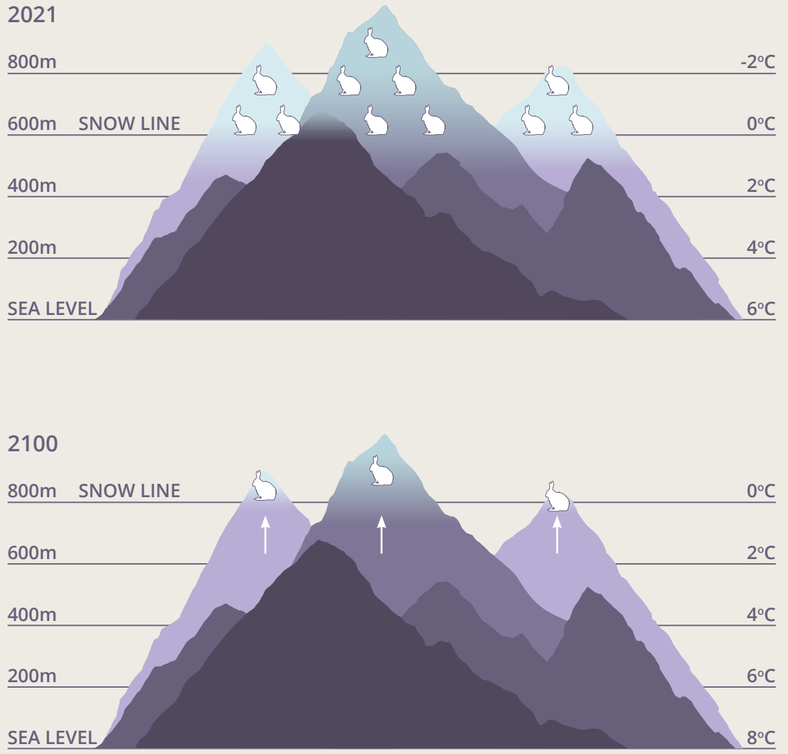
In 2020, the world was already 1.2°C warmer than the average temperature in the 19th century.



However, this is a plan with a limited lifespan. You can only move uphill so many times before you run out of mountain. And of course, you can only move so far north before you end up in the sea. As animals have moved to more habitable areas, the land available to them has shrunk. Where whole mountain ranges were once covered in snow, now only the mountain tops remain white; cold islands receding before a rising sea of warm air.

EXTINCTION ESCALATOR

Rising temperatures result in a rising snow line, forcing wildlife into ever-higher and smaller parts of their former range.



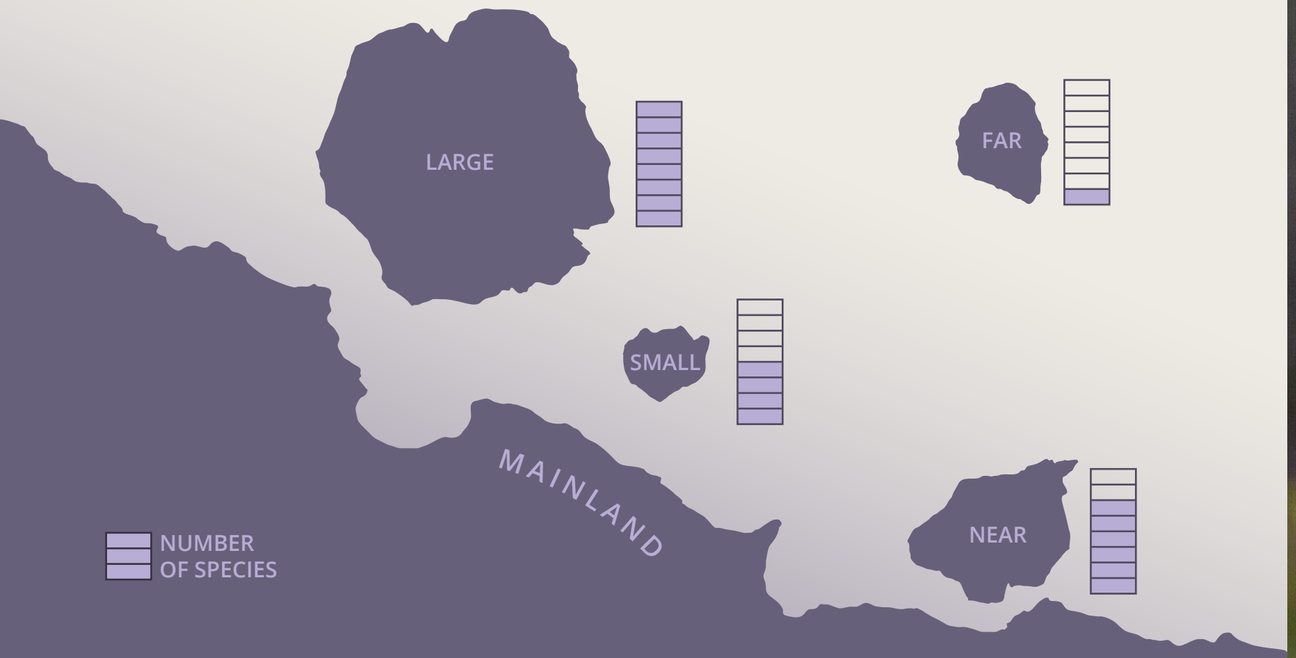
Island life

The theory of **island biogeography** emerged in the 1960s after ecologists noticed that islands supported different ecosystems to their nearest mainland neighbours. Life on islands was clearly different. For one thing, islands supported unique life forms – such as Darwin's finches on the Galapagos – but islands also supported different amounts of life.

Ecologists concluded that the number of species an island could support was largely influenced by how big any given island was, and how remote.

These two things determined how often new species were able to colonise an island, and the likelihood of their survival once they arrived. Larger islands, with a wider range of habitats, or islands closer to the mainland, gathered more arrivals and supported more life. Smaller islands, and more remote ones, supported less.

Crucially, the theory also established that when islands shrink, they become less able to support the diversity and abundance of life they once did, often losing large predators first, in a gradual re-balancing known as **ecosystem decay**.



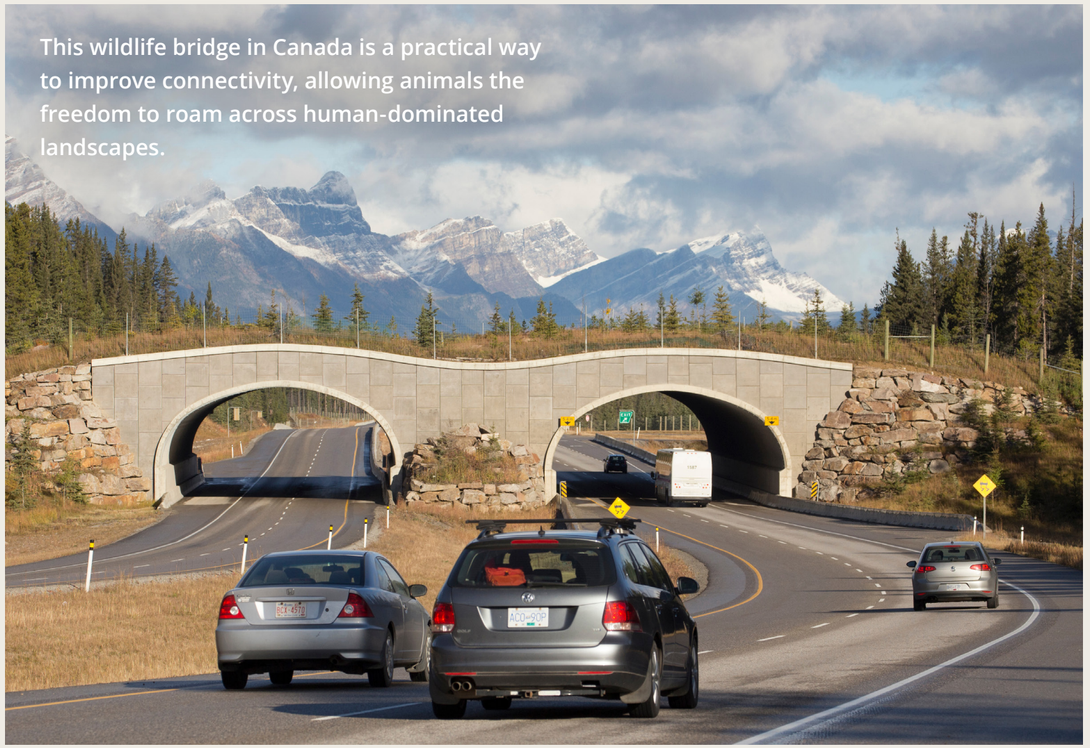
It's almost impossible to imagine a Scotland with brown bears and yet, not so long ago, creatures such as bears, lynx and wild boar would have been a familiar sight here.

Natural habitats that are criss-crossed by roads and other infrastructure prevent animals from moving freely.

Today, the theory of island biogeography applies to more than just islands, with our remaining wild places increasingly isolated in a sea of human activity.

Where uninterrupted forests once grew, roads have been cut and clearings have been burned. Where animals roamed free, fences and barriers now stand in their way. As natural habitats have been broken up and fragmented, whole continents have been reduced to a series of ecological islands.

Aware of the threat posed by this fragmenting effect, and the risk to species stranded in small, isolated patches, rewilding seeks to conserve large areas of wild land wherever possible. When that isn't possible, there is a move to establish natural bridges that connect isolated islands; wildlife corridors that can turn two small islands of natural habitat into one larger one.



This wildlife bridge in Canada is a practical way to improve connectivity, allowing animals the freedom to roam across human-dominated landscapes.

Standing out

Scotland supports a hardy collection of cold-adapted species: the secretive ptarmigan (a type of mountain grouse), mountain hares, and even a few Arctic snow buntings that breed on the highest parts of the Nevis range and the Cairngorms.

Many of these cold-adapted species are mountain specialists that live above the snow line in winter and as the landscape turns white, so do they. Mountain hares moult into white winter coats in time to match seasonal snowfall, and ptarmigan grow white feathers as winter camouflage. This is a useful trick, but the really difficult bit is matching these colour changes to the arrival and disappearance of the snow.

"When we try to pick out anything by itself, we find it hitched to everything else in the Universe."

John Muir

As our climate warms, Scotland's winter snows have been falling later and melting earlier, leaving snowy white ptarmigan and mountain hares standing out against the dark, snowless slopes. Instead of helping them blend in, their white winter camouflage now makes them stand out, attracting the dangerous gaze of hungry predators.

A barely visible hare is a safe hare.

When the snow melts early however...

Survival of the fittest

It was Charles Darwin who first identified how organisms evolve. Darwin observed that far more individuals are born in any generation than can possibly all survive. He saw that this created competition and that, typically, better adapted individuals – animals with characteristics that increased their chances of surviving – would have more offspring.

If characteristics – or adaptations – that gave an individual such an advantage could be inherited, they would become more common in future generations. A mountain hare that was just a little bit paler, or a ptarmigan that was just a bit better camouflaged, might have gained enough advantage to be passed over by hungry predators in favour of their more obvious neighbours. This is how natural selection works.

We now know that a slight change in genetics that gives an individual even a slight advantage will likely result in that individual producing more offspring. Over time, the power of natural selection can mean that a hare can turn as white as snow, or a caterpillar can become a perfect copy of a twig. Something as complex as an eye can evolve from a thousand minor improvements. The mechanism might be subtle and simple and yet, the results are a kind of miracle.

Playing for time

Evolution has shaped all of our planet's living marvels, but as a process it has its limits. For a start, most evolutionary changes take time – **lots** of time. Given enough time, species can adapt to environmental changes; they can evolve. But the current rate of climate change is happening too fast to allow birds such as ptarmigan and mammals such as mountain hares the time they need to evolve.

Without this time, the only option is to move. But as we know, animals are running out of places to move to, and a tree cannot uproot itself to march north or climb uphill. Plants can only shift their range as far as they can disperse their seeds, perhaps moving a few hundred metres with each generation. When changes occur faster than species can move or adapt, extinctions follow. For many species, climate change is happening too fast.

Out of step

Billy Connolly joked that Scotland only has two seasons: June and winter. However, in truth, we still enjoy four distinct seasons. These changing seasons play a central role in coordinating the behaviours of many plants and animals, influencing when they migrate, nest, or produce flowers. All these behaviours occur in response to subtle environmental cues like temperature or day length, but as is true for so many things, climate change is disrupting the familiar pattern of these events.

Crucially, many plants use temperature as a cue to produce flowers, while many birds use day length to coordinate nesting or migrating. Either way, timing is crucial. As an example, birds need to time their nesting to match the period of maximum caterpillar abundance – ensuring they have enough food to feed their chicks, while caterpillars must time their emergence to match the appearance of new leaves in spring.

In recent years, spring has been arriving earlier. It has been getting warmer while the days are still short. Trees have responded to this temperature shift by budding up sooner, and caterpillars now also emerge earlier, but some birds are struggling to readjust, still tied to the old day length cues when deciding when to nest. The resulting mismatch has left birds such as blue tits trying to feed their young **after** the peak abundance of caterpillars has passed, while migrants such as pied flycatchers are arriving too late to make the most of the caterpillar bonanza.

There is evidence that migrant species are leaving earlier in apparent response to this shift, and nesting dates are advancing – by as much as ten days compared to the past. Given more time, birds would likely evolve to successfully realign their behaviours with these seasonal changes but at the moment, many changes are simply happening too fast.

Too little, too late?

Climate change presents us all with an unprecedented threat. It isn't just that the world will be subject to more extreme weather, with floods and droughts, storms and fires, all more common. The difficulty many species now face in finding the time or space to adapt to climatic changes also threatens to cause a mass extinction event, such as our planet has only witnessed a handful of times.

A few species will undoubtedly survive. Some life forms have persisted after each of the five mass extinction events we know about, in the 3.5 billion years of life on Earth. But we, as a species, only appeared around 300,000 years ago. Humans have never witnessed, much less survived, such a cataclysmic event. Dinosaurs dominated the Earth for around 165 million years before an asteroid wiped most of them out. This time, it isn't an asteroid that is threatening to cause a mass extinction event. It is us, and the changes we have caused.

We depend on other living things for our own survival. We are bound up in an intricate web of life that ties us to every other living creature. If climate change wipes out too many of the species that feed and support us, it will threaten our own ability to survive. Long before that, our planet will have become a much less interesting, much less wonder-full place.

We have been slow to react to this threat. We remain addicted to fossil fuels and over-consumption of material goods. Our politicians remain reluctant to enact the changes required to tackle the scale of the problem. But it's not just down to politicians. In the end, we all share responsibility for sticking our heads in the sand and pretending this is a problem that either isn't real, or that can be solved tomorrow.

A wild promise

Rewilding can help species cope with the challenges of climate change by creating corridors, or stepping stones, between "islands" of natural habitat, allowing species to move more easily across our human-dominated landscapes, and giving organisms more time to adapt in response to climate change. And, rewilding can help create more space for nature, reducing the vulnerability of small, isolated populations that might otherwise be at risk of extinction.

Rewilding also offers way to future-proof our own prosperity and happiness, sustaining the biodiversity that forms our life support system, improving our mental health, reducing the risk from environmental disasters, making vital ecosystems more resilient and actively slowing climate change, as restored forests and rewetted peatlands lock up climate-warming carbon.

For now, even if you've never ventured into Scotland's mountains (you should by the way), you can enjoy knowing that ptarmigan and mountain hares persist. But for how long?

It isn't yet too late. We have a small remaining window of opportunity to secure a more sustainable future and we all have a part to play – insulating our homes, reducing our consumption of stuff, cutting our fossil fuels and pressurising our politicians. But it needn't be all about personal sacrifice. Rewilding is a really valuable tool that can slow the pace of climate change and at the same time, enrich our own lives.

These young Scots pines emerging from the heather in Deeside are a sign that if we give nature time and space, it can heal.

What can you do for Scotland's mountains?

- **We all need to consume less** and make lifestyle choices that take climate breakdown into account. But we also need to get together, get organised, and make our voices heard, so consider joining a climate campaign group to encourage our Governments to act.

- **Create a wildlife corridor** or stepping stone. Help climate change refugees find new homes by making space for nature near you. Create a wildlife-friendly garden or help plant trees along a local watercourse to soak up carbon and cast vital shade.

- **Start recording.** We know surprisingly little about the ecology and habitat requirements of many upland species. Recording when and where you spot rare species can help inform conservation plans for these threatened species. Check out https://butterfly-conservation.org/butterflies/recording-and-monitoring or https://www.bto.org/our-science/projects/volunteer-mountain-hare-survey to get started.

- **A lot of wildlife is sensitive to disturbance.** Delicate plants are easily crushed underfoot, while loose dogs can flush nesting or feeding birds, so keep to paths as much as you can and keep your dog on a lead!

Glossary

Carbon emissions – greenhouse gases originating from the burning of fossil fuels, decomposition (e.g. of landfill) or other metabolic processes (e.g. from livestock) that trap heat within the Earth's atmosphere.

DNA – The molecule of inheritance (deoxyribonucleic acid). It is a deceptively simple molecule with just four different sub-units, but different combinations of these units create a code for all the complexity of life.

Ecologists – scientists who study relationships between living organisms and their physical environment.

Ecosystem – a community of interacting organisms together with their physical environment.

Ecosystem decay – a gradual loss of species, leaving a less diverse collection of surviving organisms. This loss is often associated with fragmentation of habitats into isolated patches and contrasts with the more usual historical pattern of species radiation, where evolution creates new species faster than old species die out.

Fossil fuels – natural materials formed underground from the ancient remains of dead organisms that humans extract and burn as fuel, releasing carbon into the atmosphere.

Greenhouse effect – the process by which the sun's energy is trapped within Earth's atmosphere by so-called greenhouse gases (e.g. CO_2), warming the planet and changing the climate.

Habitat – the place where an organism naturally lives.

Mass extinction – the disappearance of large numbers of species. Mass extinctions have occurred five times in Earth's history, most famously when an asteroid ended the age of the dinosaurs. Today, humans are believed to be causing a sixth mass extinction – the first caused by a living organism.

Metabolism – the chemical reactions within living organisms that release the energy needed to sustain the processes vital for life.

Moult – the process of shedding an organism's outer layer (e.g. fur or feathers) and replacing this layer with a new one.

Mutations – randomly occurring errors in DNA that change the embedded code, occasionally leading to a selective advantage and new forms of life, but often leading to problems.

Natural selection – a mechanism driving the evolution of species, whereby individuals better suited to their environments enjoy a selective advantage resulting in higher survival rates and more offspring, such that the advantageous characteristic becomes more common in each new generation.

Range – the span of geographic space where an organism naturally occurs.

Wildlife corridor – a strip of land that connects otherwise separated areas of wildlife habitat, allowing the movement of organisms between areas.



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