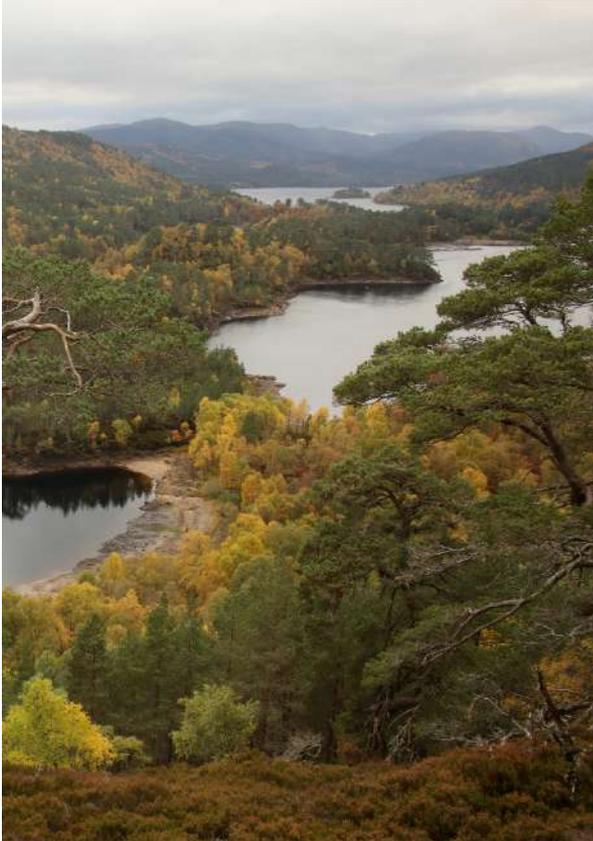


Restoring the Caledonian Forest in the Highlands of Scotland



Alan Watson Featherstone

The Caledonian Forest



- * **The western-most extent of the boreal forest in Europe**
- * **Characterised by Scots pine, the ‘backbone’ of the forest ecosystem**
- * **Supported a range of other tree species, including birch, rowan, aspen, alder and willows, and wildlife such as pine martens, capercaillie, beavers, lynx, wolves etc.**

The Caledonian Forest



- * Covered about 1.5 million hectares in the Highlands, at its maximum extent, about 4,000 years ago
- * Today only about 2% of the original forest survives, and consists mainly of old trees at the end of their lives
- * Takes its name from the Romans, who called Scotland 'Caledonia', meaning 'wooded heights'

The Need for Restoration



The Need for Restoration



What is happening all over the world today is a repeat of the fate of Scotland's forests and wildlife.



Deforestation in southern Venezuela – burned gallery forest on the northern edge of the Amazon Basin.



Deforestation in Scotland – a standing dead Scots pine is the only reminder of the lost forest in this part of Glen Strathfarrar.

Species extinctions in the 21st century

- * Pyrenean ibex or mountain goat (Spain)
Extinct in 2000.
- * Western black rhinoceros (Cameroon).
Extinct by 2006.
- * Baiji or Yangtze river dolphin (China).
Reported as probably extinct in 2006.
- * Rabbs' fringe-limbed tree frog (Panama)
Declared extinct on 26th September 2016.
- * Hawaiian snail (*Achatinella apexfulva*)
Extinct on 1st January 2019.



Baiji



Achatinella apexfulva

Humans are now causing the 6th Mass Extinction event in our planet's history

Species nationally extinct in Scotland

- * Moose or elk (*Alces alces*).
Extinct by 1,500 BC.
- * Eurasian lynx (*Lynx lynx*).
Extinct by 7th century?
- * Brown bear (*Ursus arctos*).
Extinct by 1,000 AD?
- * Wild boar (*Sus scrofa*).
Extinct by 17th century.
- * Wolf (*Canis lupus*).
Extinct by 1743.



The UK, including Scotland, is one of the world's most nature-depleted countries

The Highlands are a deforested, depleted landscape



The Highlands are a deforested, depleted landscape



Peat hags are wounds that scar the land in many places.



Ruins of a croft house and eroded peat stranded beside the Affric River.

Most of the Highlands should be like this



Scots pine and birches in autumn beside Loch Beinn a'Mheadhoin in Glen Affric.



Scots pine and heather in flower in the Caledonian Forest in Glen Affric.

The Caledonian Forest is the habitat for a wide range of species, many of them now very rare in Scotland

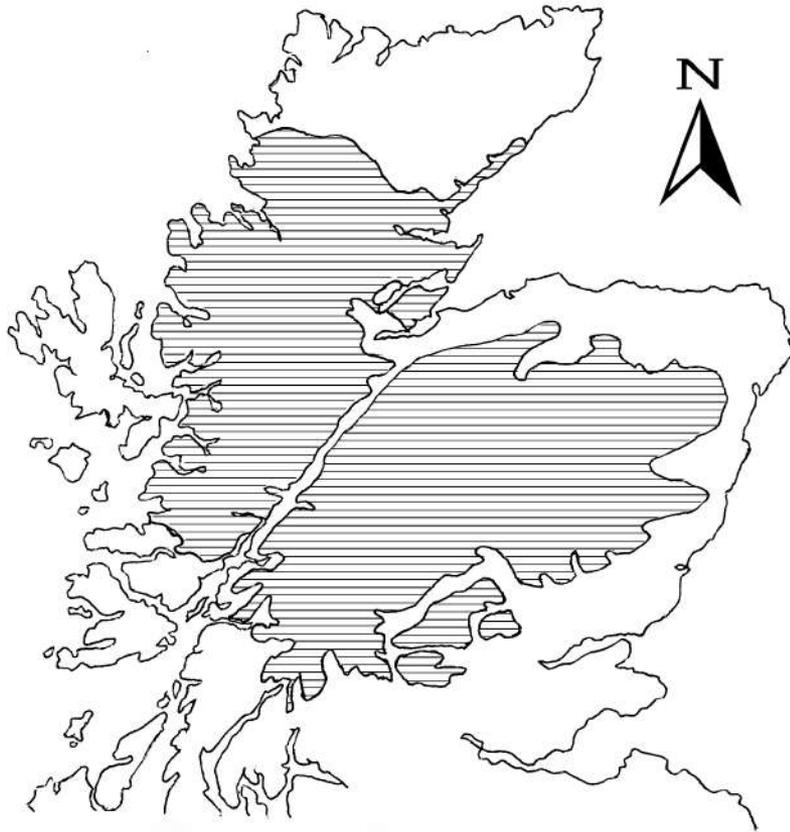


Cock capercaillie in lekking display.

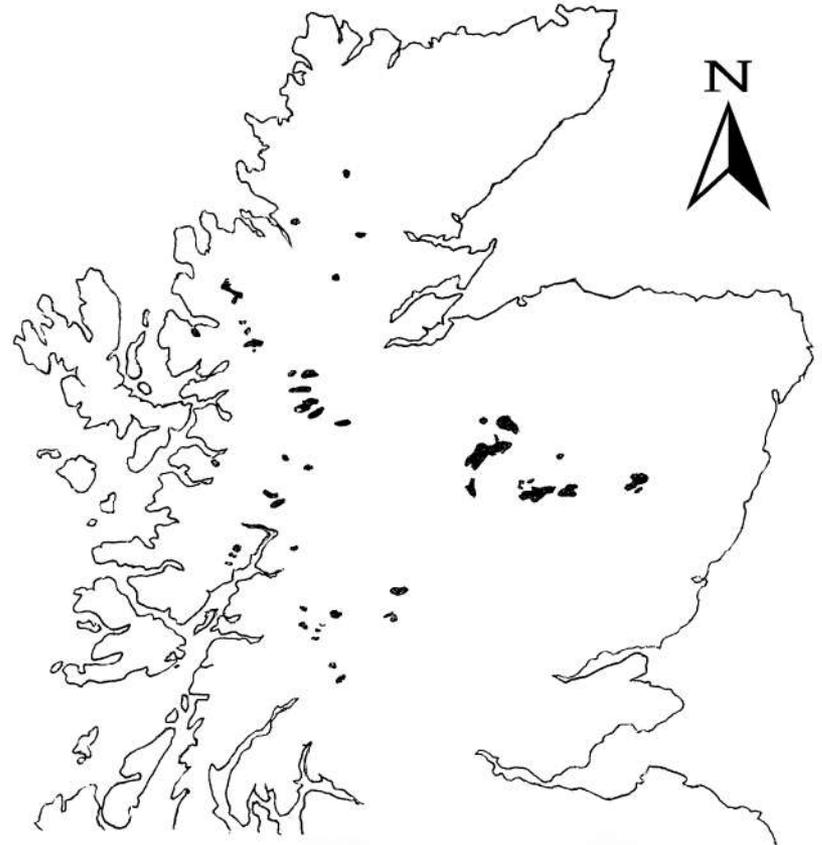


Twinflower.

Scotland has experienced massive deforestation



Maximum extent of the Caledonian Forest,
c. 4,000 years ago



Surviving remnants of the Caledonian Forest,
late 20th Century

98% of the original native pinewoods are gone

Overgrazing by deer & sheep prevents forest recovery



Red deer are out of balance with their forest habitat, and every tree seedling that germinates gets eaten.

As a result, only a few old trees remain, as a 'geriatric forest', with no new ones growing to replace them as they die.

Overgrazing by deer prevents forest recovery



Heavily-overgrazed rowan,
West Affric, October 1992



May 1996



May 1999



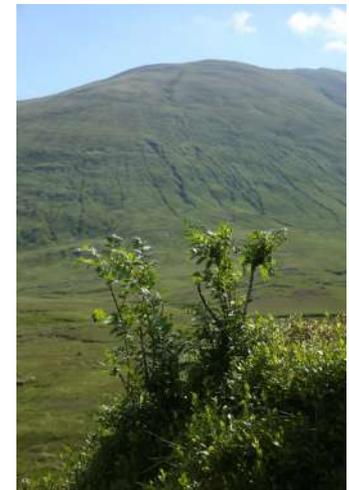
May 2004



July 2008



June 2012



August 2015

In some places sheep grazing prevents forest recovery



Sheep in a native pinewood remnant. Note the absence of any young trees or forest floor plants.



These horizontal ridges are the results of sheep trampling on deforested land for many decades.

The natural regeneration of forests in southwest Norway shows what is possible in Scotland



Seana Mheallan, Ben Damph,
Wester Ross, Scotland

Latitude:

57.49 °N

Annual rainfall:

2,800 mm

**Average annual
temperature:**

8.3 °C

Latitude:

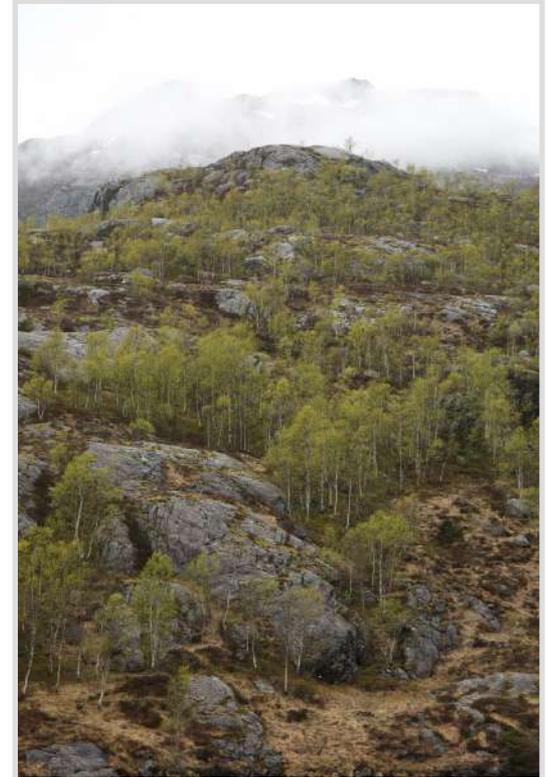
58.50 °N

Annual rainfall:

Over 4,000 mm

**Average annual
temperature:**

4 – 5 °C



Fidjadalen, Rogaland,
Southwest Norway

Islands in Highland lochs have trees on them!



The pressure of overgrazing by deer and sheep keeps the land tree-less, except for islands in lochs, where deer and sheep do not go.

If given a reprieve from overgrazing, forests will recover

3 main elements of ecological restoration



- * Restoration of healthy vegetation communities
- * Re-instatement of key ecological processes (eg succession, nutrient cycling, natural disturbance, predator-prey dynamics etc)
- * Reintroduction of missing species, including large mammals and apex predators

Together, these will re-create healthy, self-sustaining ecosystems

Reducing herbivore numbers enables tree regeneration



Natural regeneration of Scots pines in Glenfeshie, as a result of a substantial reduction in deer numbers.



Natural regeneration of birch woodland in Creag Meagaidh National Nature Reserve, as a result of greatly reducing the population of red deer.

Restoration of healthy vegetation communities



1992



2002



2021

Excluding deer and sheep enables natural regeneration to take place

Restoration of healthy vegetation communities



Dead Scots pines in a dying forest in 1989, before the area was fenced for regeneration in 1990.



The same area in September 2021, with naturally-regenerated Scots pines, after 31 years of protection.

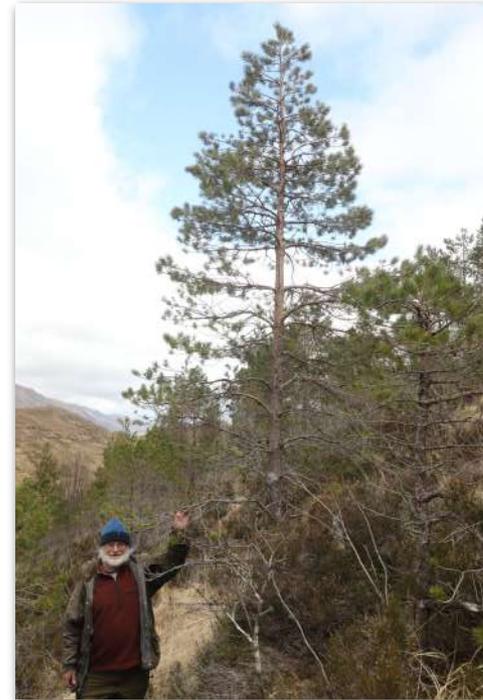
Restoring healthy natural habitats



Left: Planting a pine in Glen Affric in April 1991.

Bottom left: The same scene in 2002.

Below: May 2022, after 31 years of no grazing.



Rewilding entails the recovery of the whole ecosystem



Photo taken 23 years after fencing and planting.

Rewilding entails the recovery of the whole ecosystem



Planted pines, regenerating birch and recovering ground vegetation inside the fence – only stumps and grass outside.



Bluebells flowering inside a small fence put up to protect an eared willow in the upper Affric watershed.

Rewilding enables the crucial process of ecological succession to occur



Removal of grazing pressure by fencing allows succession from grassland to heath (left) and then from heath to pioneer birch woodland (right) to take place.

Restoration facilitates the re-establishment of ecological relationships – the linkages that form the web of life



Mycorrhizal fungus (*Russula emetica*) growing at the base of a Scots pine planted 26 years previously as part of the restoration of the Caledonian Forest.



Insect larvae, like these of a sawfly (*Nematus melanaspis*) feeding on an aspen leaf, attract insectivorous birds, which also transport the seeds of plants.

Wildlife returns when the vegetation is restored



With protection from overgrazing even the peat hags recover, and return to life



Peat hags like this are open wounds or running sores on the land, that are unable to heal because of the grazing pressure.



When the grazing pressure is removed, for example by a fence, sphagnum mosses, cross-leaved heath and other plants successfully colonise the area.

Rewilding – the return of the missing mammals



Photo © Laurie Campbell



European beavers and wild boar are now re-established in the wild in Scotland.

Re-establishing ecological relationships & processes



Aphids being tended by wood ants on a young aspen tree protected from overgrazing.



Robin waiting to find food in snow-covered ground that is being disturbed by wild boar.

Removal of invasive non-native species



Invasive non-native rhododendrons (*Rhododendron ponticum*) growing under Scots pines at Roshven, Lochaber.



Volunteers removing non-native rhododendrons from a native pinewood area at Ben Damph, Wester Ross.

Invasive non-native species are a serious threat to the old pinewoods in many Caledonian Forest remnants

Next steps for restoration: Translocations and reintroductions



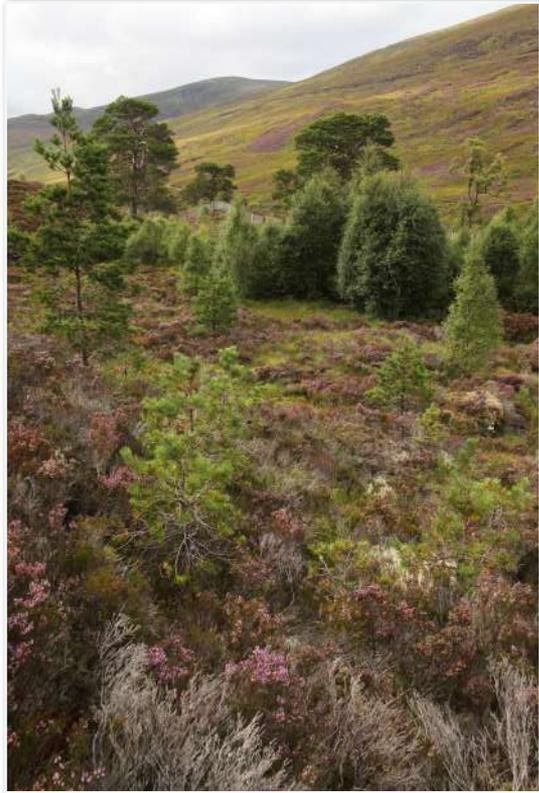
Trees for Life has been translocating red squirrels to isolated forest remnants in the NW Highlands where they are missing.



Photo © Peter Cairns

The Eurasian lynx is the carnivore most likely to be reintroduced to Scotland in the near future.

Some Principles of Restoration



Scots pines regenerating near mature trees in Glen Affric.

1. Work from areas of strength - the areas where the ecosystem is closest to its natural condition.
2. Pay particular attention to 'keystone' species - those on which many others depend.
3. Utilise ecological processes such as beginning with pioneer species and natural succession etc to facilitate the rewilding process.

Some Principles of Restoration



Red ant (*Myrmica ruginodis*) tending aphids (*Aphis farinosa*) on an eared willow regenerating in a fenced exclosure.

4. Mimic Nature wherever possible.
5. Re-create ecological niches where they have been lost.
6. Re-establish ecological linkages - reconnect the threads in the web of life.
7. Control and/or remove invasive introduced non-native species.

Some Principles of Restoration



Eurasian lynx

Photo © Peter Cairns

8. Remove or mitigate the limiting factors which prevent rewilding from taking place naturally.
9. Pay special attention to species with limited ability to disperse – eg aspen, wood ants, twinflower.
10. Reintroduce species that are unlikely or impossible to return by themselves.

Some Principles of Restoration



Volunteer planting a birch tree as part of restoring the Caledonian Forest

11. Re-establish essential ecological processes, such as predator-prey dynamics, nutrient cycling and natural disturbance, which are absent.
12. Let Nature do most of the work.
13. Human interventions should be the minimum necessary & designed to be inconspicuous as soon as possible.
14. The ‘green thumb’ principle - love has a tangible, positive effect on all living things to which it is directed.

Rewilding, or ecological restoration...

*“This we know.
All things are connected
like the blood which unites one family.
All things are connected.*

*Whatever befalls the Earth
befalls the sons of the Earth.
Man did not weave the web of life
he is merely a strand in it.
Whatever he does to the web
he does to himself.”*

Attributed to Chief Seattle



... is the Work which Reconnects

Restoration is the Work which Reconnects

Participating in restoration projects can reconnect people with some of the most important things in life

- * with the rest of Nature
- * with place
- * with life
- * with each other



- * with their own power
- * with healing
- * with hope
- * with spirit

Volunteers from Madagascar
planting trees in Scotland

Restoration provides an opportunity for each of us to make a positive difference in the world



We can draw inspiration from our connection with Nature, and bring the care of our hearts to a 'labour of love' that can accelerate the healing of the land and the restoration of healthy ecosystems.



The need for ecological restoration is global



The first shared task of all humanity must surely be to restore and rewild our depleted planet.



People everywhere need to engage in rewilding and restoration.



The wellbeing and diversity of our planet, and all its species, is in our hands.

The need for ecological restoration is global

Percentage of original forest remaining

Caledonian Forest (Scotland)	2%
Coast redwoods (California, USA)	4%
Atlantic Forest (Brazil)	7%
Tropical rainforest (Philippines)	4.4%
Cedar forest (Lebanon)	2%
Dry tropical forest (Central America)	2%
Kauri forest (New Zealand)	0.3%

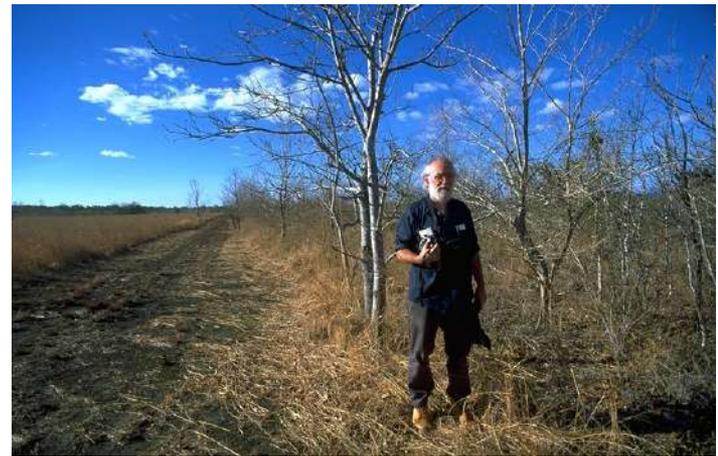


Deforestation in Tierra del Fuego, Argentina

Forest loss around the world

Examples of existing ecological restoration projects

- * **Restoration of the Atlantic Forest in Brazil**
- * **Reintroduction of the Arabian oryx in Oman**
- * **Restoration of mangroves in India and Viet Nam**
- * **Removal of dams in the USA & Europe**



Dan Janzen and dry tropical forest being restored in the Guanacaste Conservation Area in northwestern Costa Rica

Numerous rewilding projects are underway all over the world, usually initiated by local people concerned about their environment

Examples of existing ecological restoration projects

- * **Restoration of Round Island (Mauritius)**
- * **Reintroduction of wolves to Yellowstone National Park in the USA**
- * **Removal of invasive non-native rats from South Georgia in the south Atlantic Ocean**
- * **Restoration of the Loess Plateau in China**



Planting a Critically-Endangered tree (*Hildegardia populifolia*) as part of the restoration of Tropical Dry Evergreen Forest in Tamil Nadu, India

Numerous rewilding projects are underway all over the world, usually initiated by local people concerned about their environment

‘World must rewild on massive scale to heal nature and climate, says UN’

Guardian
led by readers
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World must rewild on massive scale to heal nature and climate, says UN

The 'decade on ecosystem restoration' launches with a call for 'imagination' and action on never-before-seen scale



▲ Mangrove tree seeds are planted in Bali, Indonesia. Mangroves store carbon and protect against flooding, but many forests are severely degraded. Photograph: Made Nag/EPA

The world must rewild and restore an area the size of China to meet commitments on nature and the climate, says the UN, and the revival of ecosystems must be met with all the ambition of the space race.

Advertisement



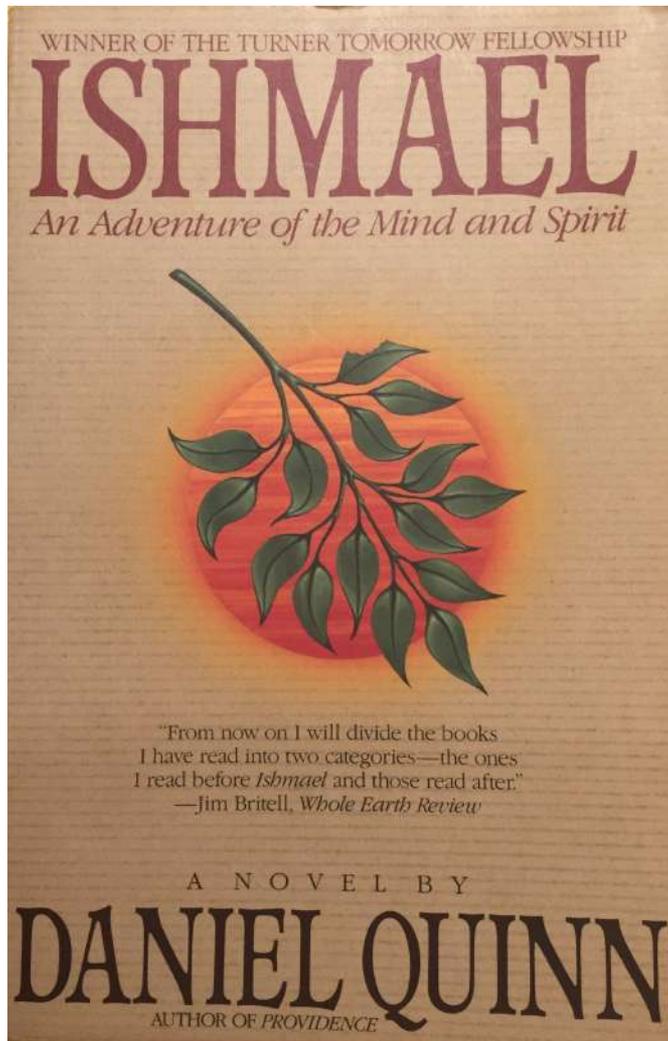
WYSS

Article on The Guardian website, 4th June 2021

Restoration is now a global priority for the next 10 years



The UN Decade on Ecosystem Restoration launched on 5th June 2021



The Leavers:

The hunter-gatherer peoples, who essentially left the Earth as they found it.

The Takers:

The people who have lived since the development of settled agriculture, who have taken more from the Earth than it can sustain.

The Givers:

We have to learn to give back to the Earth more than we take. Our task in the 21st Century is to make this the **Century of Restoring the Earth.**

We have to transform our culture into something new

What we can give to other species & the planet



Young couple hugging a 1,000 year old tree
in southern Chile

Space:

We need to reduce our demands on the Earth to free up space for the estimated 5 million other species to continue to live on the planet.

Life:

We need to transform our culture into one which nourishes life, not destroys it.

Love:

We need to give the same love that we give to children & pets to all other life.

We have to transform our culture into something new

Present day culture

- * The planet is a resource
- * Nature is a machine
- * Reductionist
- * People separate from place
- * No knowledge of local environment
- * Short term thinking
- * No responsibility for the future
- * Endless economic growth
- * Happiness determined by goods
- * The Earth belongs to people
- * Humans superior to all other species
- * Education for 'business as usual'
- * Power over others

'New' indigenous culture

- Earth is alive & sacred
- 'Mother Earth'
- Oneness of all life
- Rooted-ness in place
- Deep knowledge of local environment
- 7th generation perspective
- Caretakers of the future
- Restoring the Earth, nurturing all life
- Happiness gained by love & creativity
- Belonging to the Earth
- All beings have equal rights
- Drawing forth inner potential
- Liberating the power from within

We have to transform our culture into something new

Just imagine ... a century of Restoring the Earth

- 2009** European beavers reintroduced to Scotland
- 2012** Iceland gets all of its electricity from renewable sources - hydro & geothermal
- 2025** Eurasian lynx reintroduced to Scotland
- 2028** The world is declared free of land mines
- 2032** The use of trees for making paper is completely phased out
- 2039** Renewable energy supplies most of the world's electricity
- 2043** The Ganges River in India is clean enough to drink at the holy city of Benares
- 2065** Tiger numbers reach 25,000 in the wild
- 2074** The ecological conversion of the world's major cities is completed
- 2086** Half of the Earth is protected for Nature & other species
- 2095** Blue whales have recovered to their pre-exploitation levels

Rewilding the world & ourselves will create this future

Restoration is how we can pass on a better world to our children than we have inherited from previous generations



Healthy young native woodland of Scots pines, planted by volunteers, flourishing in a formerly-deforested part of Glen Affric in Scotland.



The wellbeing and diversity of our planet, and all its species, is in our hands.