

SCOTLAND'S BIODIVERSITY STRATEGY: A CONSULTATION

Comments from Dr James Fenton, 4 August 2022

I am always happy to discuss these comments, which are based on a lifetime of ecological survey, research, reading and cogitation in the Highlands

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2. THE EVIDENCE OF BIODIVERSITY LOSS

General comments

Note: these comments are directed at the terrestrial environment, not the sea.

There is no 'one size fits all' approach to biodiversity conservation in Scotland: very different approaches are needed in lowland Scotland, where natural habitats are now rare, than upland Scotland where natural habitats are still common. The former needs a prescriptive approach, the latter a more 'let it be' approach.

Definition of biodiversity

The definition given is too imprecise to be of much use. In practice 'biodiversity' means different things to different people so that a tightly prescribed definition is necessary in order to provide a consistent approach to biodiversity conservation. The word 'biodiversity' is often used synonymously with 'species diversity', so people think that an aim of biodiversity conservation is to maximise the species diversity in a given area.

However, taking a global perspective, each area of a planet has a characteristic range of habitats/species; hence conserving global biodiversity means conserving the species/habitats characteristic of each area, whether rainforest in the tropics, tundra in the arctic, boreal forest in the taiga, peat bogs in Scotland ...

Hence a more useful definition of biodiversity is "**the plants and animals native to a given area**", *i.e.* the species complement we have inherited from nature. Some locations may be naturally species-poor and some naturally species-rich, and hence 'biodiversity conservation' is about conserving this variety. Following from this, increasing the number of species in a naturally species-poor region will increase the diversity of species there but reduce the overall biodiversity of the planet. For example, creating ponds where ponds would naturally be absent, or creating woodland where it would naturally be absent will certainly increase the diversity of species in the locality, while reducing its biodiversity (at a global scale). Much of Scotland is naturally species-poor, owing to poor soils, harsh climate and being at the end of an island.

Following-on from this definition, it can be seen the biodiversity of a region is fixed by nature and cannot be increased by us, although humans can reduce the biodiversity: **biodiversity cannot be increased, but can be restored.**

NGO group think

Hence, before biodiversity conservation can take place, there has to be a full understanding of the natural ecological characteristics of a region: it is essential to first understand the ecology and ecological dynamics. There is little demonstration of this understanding in the strategy presented here, particularly with regard to the long-term ecological dynamics of Scotland's upland landscapes. There seems to be no knowledge or understanding of the phases of postglacial succession in NW Europe (cryocratic-mesocratic-oligocratic).

Instead much of the suggested action, at least in relation to upland ecology, is based on what I see as 'NGO group think': everyone is saying the same thing, so it must be true! There is no attempt to understand the ecological history of Scotland over the millennia, which should be the essential precursor to any biodiversity strategy. Hence much of the suggested action here will, instead of

benefitting the biodiversity of Scotland, damage it. Action for biodiversity must be evidence-based, not emotion or wish-fulfilment based!

Question: Using your own knowledge and the evidence presented, to what extent do you agree that there is a nature crisis in Scotland? Why do you think that?

No, I do not think there is a nature crisis in Scotland. Certainly some areas have lost most of their natural biodiversity, in particular intensive areas of lowland farmland and urban areas, and I suppose these areas could be said to be 'in crisis', but I think calling them 'impoverished in their native species' might be a better phrase.

There is certainly no 'biodiversity crisis' in the Highlands, which still (just) retains one of the most natural vegetation patterns in Europe. A few specifics:

a) Woodland, after early postglacial expansion, has been declining naturally for the past 5-7,000 years, and will continue to do so: a natural ecological succession and attempting to reverse it is going against natural ecological processes, and hence reduces the biodiversity value of the region. Woodland might be expected in this, the oligocratic phase of postglacial succession, to naturally occupy 5-10% of the landscape – but its needs currently define the conservation management of the whole landscape. This is a very skewed and unbalanced approach to the conservation of Scotland's upland landscapes. Woodland is probably the least resilient habitat type in the presence of native herbivores and soil podsolisation, so liable to population fluctuations, even to extinction. Obligate woodland species will decline in line with woodland decline, again some to extinction. Hence woodland is not a key biodiversity feature of Scotland. Having said that, although many native woods are naturally species-poor, some are internationally important for bryophytes and lichens, although many of the bryophytes can also be found on boulder fields and north-facing moorland.

Threats to the relict native woodland are invasive plants and management action which reduces their naturalness (e.g. tree planting, grazing reduction). Using the phrase 'Atlantic rainforest' is also a threat because it gives the mindset of large, untrammelled forests as in the Amazon basin, whereas in practice they are naturally highly fragmented woods, confined mostly to optimal coastal sites.

b) Moorland. Scotland is a world centre for temperate moorland, with a wide variety of grassland, heathland and peat bog types. The red grouse/heather ecosystem is not found outwith the British Isles, and *Calluna* is a globally much rarer species than the Scots pine which one of the commonest trees in the eastern palaeartic. Many of the moorland types are not particularly species-rich, but this is a biodiversity characteristic of Scotland. Muirburn certainly affects the pattern of heather moorland, increasing the species diversity, but the heather moorland would be there, burning or not. These are ancient, natural landscapes.

Threats to moorland are tree planting (commercial & native tree plantations), grazing reduction and invasive plants, including self-seeded Sitka spruce; the construction of hill tracks also encourages the spread of invasive plants such as gorse, making use of the disturbed ground along the track.

c) Montane scrub. It has been fashionable in recent years to 'restore' montane scrub and a 'natural' tree line. However there is no evidence that such a habitat type as montane scrub has ever existed in the hills: the few upland shrubs present will be relict sub-arctic scrub, dating from the cryocratic phase, and perhaps also the Little Ice Age, when consistent winter snow cover would have protected the shrubs from grazing. Likewise, in a montane climate where herbivores are naturally present, it is unlikely that there would be a climatically-determined tree-line, particularly as the best grazing is often to be found on the hill slopes. Grazing levels are ultimately

determined by the food availability in winter (productivity and palatability of the vegetation) and there is plenty of plant growth in a montane climate to support a relatively high number of herbivores.

d) Peatlands. Scotland is a world centre for temperate peatlands of blanket and raised bog. Peat has been accumulating for the last 4-10,000 years and many peat bogs have now reached the end of their peat-forming phase. A soft material such as peat cannot go on getting thicker for ever, particularly on hill slopes, and the deeper the peat the greater the probability of erosion setting in; it is possible also that there is a maximum depth for blanket peat, the depth at which capillary action can no longer maintain a perched water table: once this depth is reached, peat accumulation will stop (see my *Illustrated Book of Peat. The life and death of bogs: a new synthesis*, available from NHBS.com). There are erosion features on most upland peats, which is a biodiversity characteristic – and most of these features are natural in origin, with the exception of moor grips (ditches). Blanket peat goes through millennial-scale cycles of growth-erosion-growth: eroding peatland is just as much a biodiversity characteristic as growing peat.

Threats to peatland are ‘restoration’ of natural erosion features under government grant schemes, leading to a loss of naturalness in the world centre of an internationally important and rare global habitat. Tree planting on shallow peats is also a major threat.

e) Deer. As mentioned above under ‘montane scrub’, natural grazing levels are largely determined by food availability in the limiting season (late winter/early spring in Scotland). Scotland is perhaps the only country in Europe to have retained significant populations of a large indigenous herbivore (red deer) at a landscape scale throughout the postglacial period. This is because that throughout most of history the hill areas of the Highlands suffered from ‘benign neglect’, i.e. were unmanaged and left to be wild; only after the Battle of Culloden did land management become a feature of upland Scotland. However, because deer eat trees, and people want trees, everyone says ‘there are too many deer’, even though they may go to the Serengeti on holiday and marvel at the number of herbivores present! There is no *a priori* ecological reason why grazing levels should be low in the Highlands, or be ‘in balance’ with woodland. If woodland cannot survive grazing, it will die out – which it has: regeneration conditions are poor (plant competition, poor soils), and, unlike much of Europe, the landscape is ecologically unsuited to thorny shrubs which could protect young trees from grazing (the Vera hypothesis), and there is no consistent winter snow cover as in boreal climates. Woodland declined naturally during the 10,000 years when wolves were present, showing that reintroducing wolves is unlikely to affect woodland cover; although bringing back wolves would be restoring biodiversity, as they undoubtedly became extinct through human action (unlike obligate woodland species).

Threats. The presence of large herbivores in the landscape should be seen as a conservation success story. Instead, because deer eat trees, they are almost seen as ‘vermin’ in many quarters and, in ecological terms, are made functionally extinct. Instead they should be seen as keystone species of Highland ecosystems.

f) Invasive plants: The main threats to the biodiversity of upland Scotland come from misguided tree planting (loss of natural open ground habitats) and invasive plants. The list of problem species is ever-increasing and perhaps their expansion could be called ‘a crisis’. Unfortunately most conservation action has been directed to ‘visionary things’ like tree planting (which damages biodiversity) rather than eradication of problem invasive species, which have the long-term potential to transform the landscape, replacing the native species and habitats with new combinations: a major loss of biodiversity (see the definition above). Such plants include self-seeded Sitka spruce (an ever-increasing problem), other self-seeded conifers, rhododendron ponticum, cotoneaster spp, leycesteria, Japanese knotweed, lesser knotweed, Himalayan knotweed, giant knotweed, giant hogweed, Himalayan balsam, buddleia, montbretia, alchemilla, mimulus, gunnera, fuchsia, Leontodon, skunk cabbage ...

g) Rarity. The concept of 'rarity' can itself be a threat to biodiversity conservation. We humans generally ascribe greater value to rare things, which includes plants, animals and habitats. In Scotland, woodland was rare, therefore it is of value and (*a non sequitur*) more must be better. Because something is rare, the default position is the unthinking 'let us make it more common' or 'let us stop it going extinct' – without any rationale being given, or any understanding or why it is rare – or whether any action is sensible. For example, edge of range species are always liable to extinction. Does it make any sense to devote effort to conserving relict arctic-alpine species in the high hills in the light of global warming, particularly as they are common elsewhere in the world? Action on rare species can result in the loss of naturalness (biodiversity) in a locality.

If there is a 'nature crisis' in upland Scotland, this is largely occurring through our current action of planting trees everywhere (destroying the naturalness of our open landscapes), misguided peatland 'restoration' (destroying the naturalness of peatlands), and not doing nearly enough on controlling invasive species. The first two have come about because current action is not based on an understanding of the long-term dynamics of our vegetation.

Question: What do you see as the key challenges and opportunities of tackling both the climate and biodiversity crises at the same time?

Woodlands & tree planting

There is a lot of misunderstanding of the role of terrestrial ecosystems in taking carbon out of the atmosphere (carbon sequestration). A mature woodland, where tree regeneration balances tree mortality, will be in steady state in regards to carbon: the carbon storage potential will have reached its maximum, with carbon storage from photosynthesis being balanced by carbon release from decomposition. If the wood is harvested, and the harvested timber stored (e.g. used in construction), then the wood can continue to sequester carbon if there is replanting. If the harvested wood is instead burnt as biomass, the carbon is released back into the air and, assuming new trees are planted, over long timescales the woodland will be carbon neutral (burning is equivalent to accelerated decomposition).

Soil oxidation: However there is more to carbon budgeting than just the carbon stored in the wood. If planted on organic-rich soils, such as peats and peaty podsoles, then tree roots extract water from the humus/peat, so drying out the soil and causing oxidation of the stored carbon. Even a shallow layer of humus/peat, say 15cm thick, will store more carbon than any woodland planted on it. Hence tree planting on organic-rich soils has the potential of releasing more carbon to the air than is fixed by the trees, contributing to global warming.

Albedo: Another factor, which to date has been largely ignored, is the change in albedo (surface reflectivity) of the landscape when trees are planted on open ground. Two-dimensional moorland vegetation, particularly when dead grasses are present in winter, reflects significantly more solar radiation than three-dimensional woodland, particular if composed of dark trees. Hence trees can result in localised warming, which may negate any benefits from carbon storage. For example, it has been known for years that conifer forests advancing northwards into the arctic tundra are causing a warming feedback loop, in winter the dark trees absorbing heat, whereas the snow they have replaced would have reflected the solar radiation. There has been less research on this effect at the latitude of Scotland, but it is a field in dire need of more research.

Taking into account, therefore, the impact on soil carbon and albedo, it is by no means certain that tree planting in Scotland's upland landscapes will help mitigate climate change: indeed, the opposite might be the case. However, when trees are planted on more mineral-rich lowland soils (mull soils rather than mor soils), then it is probable there will be net benefit to the climate. However, unless any harvested wood is stored long-term, even tree planting on lowland soils will only have a

temporary impact on the climate, with carbon sequestration ceasing once the woods have matured and reached steady-state. Still perhaps a necessary emergency action.

In terms of biodiversity, bearing in mind that most of upland Scotland (and perhaps lowland Scotland as well), would naturally be an open landscape at this phase of postglacial succession (the oligocratic phase), then planting trees will damage Scotland's biodiversity. In summary, therefore, tree planting in upland Scotland can be detrimental to both the climate and biodiversity, although may be of benefit in the lowlands.

Peatlands

Unlike woodlands, which eventually reach a steady-state (a store of carbon with carbon input = carbon output), peatlands can continue to sequester carbon for thousands of years. However temperate blanket peat and raised bogs cannot go on accumulating peat for ever, with erosion eventually setting-in, whether through development of pool systems (pools are erosion features), surface erosion, gully erosion or vertical-edge cutback. There is also probably a maximum depth such bogs can reach owing to capillary action no longer being able to draw water up into the peat to keep the catotelm waterlogged. It is unrealistic to expect many of the upland peatlands to continue to sequester carbon as, after 4-5,000 years of growth, they are now reaching the end of their lives.

It is very difficult in practice to measure the rate of carbon sequestration/release in peat bogs, and there have been few direct measurements of this on Scottish peats. Hence a lot of the supposition about whether a given peat bog is carbon negative or positive is guesswork. Even where erosion features are common on a peatland, there are normally other areas of the bog where peat is still accumulating, so the peatland overall could still be sequestering carbon, or carbon neutral.

There are unrealistic expectations of Scottish peatlands to significantly contribute to climate mitigation. Certainly filling-in ditches cut through the peat (moor grips) is likely to be beneficial, but other peatland 'restoration' efforts are taking place without any quantification of their impact. Additionally, as discussed above, they are destroying the naturalness of an internationally important habitat type.

Deep peat does not start-off ready-formed, but starts as humus-rich podsols, going on to become shallow peat. Hence **such organic-rich soils have the best long-term potential for carbon sequestration** as it will be thousands of years before erosion becomes dominant. However, these are the locations where most tree planting is taking place: and both the tree establishment method (ploughing/mounding) and tree roots will release this soil carbon. **If climate change is to be taken seriously, it is essential that locations with shallow organic soils be left to develop naturally**, allowing deep peat to develop in the long-term. There should be incentives to landowners to conserve such areas – which also contribute to the biodiversity of Scotland.

A secondary point is that upland peats do not contribute to flood mitigation because the water is permanently held in place in the body of the peat: there are not sponges storing and releasing peat depending on the weather.

Unlike upland peats, valley bogs (bogs in hollows or valleys constrained by topography) can continue to store peat for longer because topography keeps the bogs waterlogged and prevents erosion: these have the best long-term potential to sequester carbon

In summary, in upland Scotland the current action of tree planting and peatland 'restoration' both damages the area's biodiversity and has dubious benefits to climate mitigation. However, tree planting on lowland humus-poor soils is likely to benefit climate mitigation, although whether they benefit biodiversity (*sensu* the natural characteristics of the area) is a moot point

The only sure way to tackle climate change is to stop releasing fossil carbon into the air – without unrealistic expectations of terrestrial ecosystems having a big role in carbon offsetting. Nature-based solutions have limited effectiveness.

3. OUR STRATEGIC VISION: FRAMING & CONTEXT

Questions: Is the draft vision clear enough? Is the draft vision ambitious enough? Do you have any suggestions for a short strategic vision which would form the title for the strategy?

“By 2045 we will have substantially restored and regenerated biodiversity across our land, freshwater and seas.”

From the above comments, you will see that I do not think that much of upland Scotland is in need of ‘restoration’: instead, current action to ‘restore’ it (such as the phrase ‘reforesting Scotland’, or ‘restoring peatlands’), is in fact damaging the area’s biodiversity.

How about instead:

“By 2045 the value of Scotland’s natural ecosystems will be internationally recognised and conserved: the uplands will be managed as wild landscapes where nature directs ecological change, with restoration concentrated in lowland Scotland where biodiversity loss has been greatest. The surrounding seas will have significant areas where conservation takes precedence over economic exploitation.”

“Our natural environment of plants, animals, insects, aquatic life and other species will be richly diverse, thriving, resilient and adapting to climate change.”

Many areas of Scotland would not naturally be ‘richly diverse’, with such species-poor areas contributing to global biodiversity. Some habitats, particularly woodland, are not particularly resilient in our climate and ecology (which is why woodland is rare), and it is impossible to make it so without unbalancing the whole landscape ecology (making herbivores functionally extinct). Climate change is not a threat to many of our ecosystems because the acid conditions mean that it is a specialist environment with few plants able to colonise, and many of the constituent species having a range well south of us (i.e. able to withstand warming): our moorland ecosystems are resilient, which is why they dominate. High altitude habitats have been vulnerable throughout the postglacial period, and does it matter if they disappear, particularly as the species rare in Scotland are common elsewhere? Peatlands do not need a particularly wet climate, and are more robust to climate variability than most people realise.

The second statement perhaps is not necessary, as it is covered by my suggested revision to the first?

The third statement is fine.

A short strategic title vision:

A landscape for nature (& people [?])

4. HOW WILL WE KNOW WHEN WE HAVE SUCCEEDED?

Questions: Do the 2045 outcome statements adequately capture the change we need to see? Are the 2030 milestones ambitious enough? Are we missing any key elements? What are the key drivers of biodiversity loss in this outcome area? What are the key opportunities for this outcome area? What are the key challenges for this outcome area?

1. RURAL ENVIRONMENT

Statements such as “woodland cover well below the European average” as justification for woodland expansion to me indicate the complete lack of understanding of Scotland’s ecological history and the reasons for the ecosystems we have now. As long ago as 1866, the eminent Scots geologist James Geikie concluded that Scotland’s woodlands had declined naturally. From a European perspective, just because France has less peat bogs than Scotland, it does not follow that France should have more! The natural low cover of woodland in Scotland compared to many other European countries is in fact a biodiversity characteristic of the country, and increasing the woodland cover results in the increasing homogenisation of landscapes (something the European Landscape Convention, of which Scotland is a signatory, aims to tackle).

Woodlands in the uplands would naturally be a minor and declining component of the landscape in this, the oligocratic phase, and, from a biodiversity perspective concentrating on this component is not seeing the wood for the trees (!). But it is good to see the emphasis on introduced species, although these are not just invading woodlands; for example, rhododendron, cotoneaster, self-seed Sitka spruce are colonising moorland with equal rapidity.

It is mentioned that deer numbers need to be reduced to allow ‘peatland restoration’, but, perhaps counter-intuitively, an SNH Commissioned Report on peatland erosion (no. 410) shows, interestingly, no correlation between herbivore density and peatland erosion. Deer and peatland have always coexisted, and, although deer do cause localised damage, they are unlikely to be a major cause of peatland erosion.

Towards a nature-rich landscape in the lowlands

Because there are few natural habitats left in the Lowlands, then there is little existing biodiversity to damage. Hence there are less constraints on what can be done, and the recommendations seem fine. They will certainly add to the diversity of habitats and species in the Lowlands, although whether many of these would represent the original habitats and species before human land management is a moot point.

Towards a nature-rich landscape in the uplands

The approach suggested here will completely destroy any remaining biodiversity in the uplands (see all my points above), and bears no relation to any Scotland in the past. This vision demonstrates a complete disconnect between the proposed action and any understanding of Scotland’s long-term ecological history.

2. MARINE ENVIRONMENT

Little can be achieved without a network of no-take zones around the coast.

3. FRESHWATER ENVIRONMENT

There are unrealistic expectations of using nature-based solutions to reduce flooding. Flood damage is mostly caused by extreme rainfall events, &/or combined with snowmelt, and increased tree cover will make little difference in these extreme conditions. Landslides can be observed after heavy rain even in forested catchments. As discussed above, upland peats, restored or otherwise, have little impact on water run-off. Having said that, flood plain management, rather than whole catchment management, can mitigate the worst floods.

Most upland rivers would naturally have few trees in their upper reaches, so ‘restoring’ them through encouragement of trees is damaging the biodiversity of the landscape (see my definition of biodiversity on page 1).

Action to remove INNS is to be welcomed, although there needs to be allowance of the use of chemicals adjacent to watercourses.

4. COASTAL ENVIRONMENT

Fine!

5. URBAN ENVIRONMENT

Great to see urban areas made more nature-rich.

6. ACROSS OUR LAND AND AT SEA

Creating nature networks in the lowlands is to be welcomed. However, they are not needed in the uplands for Scotland already has perhaps the best-connected network of open ground habitats in Europe. However this network is being fragment by the increasing network of woodlands. You cannot have it both ways: increasing woodland connectivity reduces moorland connectivity & *vice versa*. The existing moorland network is the more authentic for upland Scotland and should be safeguarded.

Additionally, joining existing woodland through creating networks also creates corridors for invasion by invasive species such as Sika deer, and could, long-term, result in ecological homogeneity of the existing, varied disjunct native woods.

Questions:

To what extent will these outcomes deliver the Vision? What might be missing?

Committing to the vision for the uplands, particularly increasing woodland cover and keeping deer numbers low, will result in 'a painting the Forth Bridge' type situation. The action will have to be carried out forever because there will always be grazing available for considerably more deer than that commensurate with allowing woodland expansion. In the past, up until the landownership changes which took place after the Battle of Culloden, the hills of the Highlands were unmanaged and left to themselves – resulting the biodiversity we have today. No-one worried whether there were too many or too few deer (except where the deer invaded agricultural land). There were certainly wolves present, but woodland still declined naturally in their presence – so even restoring wolves is unlikely to reduce grazing levels enough to allow woodland expansion.

Is it sensible to base a whole strategy on action which has to be continued into perpetuity? It is like pushing a barrel uphill: once you stop, you are back to square one! But this is the approach the strategy is taking in relation to the terrestrial environment because the action is going against natural successional processes. Surely the whole approach needs a rethink to make it more sustainable? Are your priorities (woodland, peatland restoration) not out of touch with ecological reality?

High level strategic leadership is needed: but it needs to be led by someone who is an evidence-based ecologist, not beholden to any sectoral interest!