Ecological rewilding

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Rewilding is a term that has become widely used in the UK in recent years, but with little clarity in its meaning. These notes are offered as a perspective on rewilding from the Wildland Research Institute (WRi) and which are provided as an input to the proposed POSTnote on ecological rewilding. An introduction to the origin of the term rewilding is followed by an explanation for the need for ecological restoration in the UK; how it is initiated; how species are identified to restore natural vegetation; what the aim of ecological restoration is, its timescales and extent; and protection of the gains from ecological restoration. Some preliminary, unpublished results from opportunity mapping are given to illustrate certain points.

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WRi came into being at the University of Leeds in October 2009 (1). Its origins go back to "Wilderness Britain?", an Economic and Social Research Council funded seminar series between 1998 and 2000 that was coordinated from the University. While this series opened up the wider debate on wild land in the UK, it became clear that it was not being supported by a research capability or by policy development. Thus WRi was formed to identify the requirements, strategies, and policies for a transition to a greater presence of wild landscapes within the broader land use continuum of Britain.

WRi has been active on a number of fronts, including mapping, policy advice, and participatory approaches. Work by WRi members underpins much of the detailed mapping of wilderness quality being carried out today. Examples include the Scottish national wildness map implemented by Scottish Natural Heritage, the wild land maps for the Scottish national parks, the European Wilderness Quality Index developed for the European Environment Agency in collaboration with Alterra in the Netherlands, and a series of Wilderness Character maps developed for the U.S. National Park Service. Other collaborations include wilderness maps for Iceland, Austria, and for the Carpathian Mountains in Romania. While a draft map has been developed for Wales to complement the SNH map for Scotland, there is no equivalent map for England.

Introduction

The concept of rewilding is most highly developed in North America. It was given definition in a landmark article by Soule and Noss (2) who traced its antecedence through ecosystem recovery and protection from the following: the setting up of the first national parks; the wilderness movement; the concern for biological conservation as well as conserving scenic beauty; the capture of a representative range of ecosystems in a system of protected areas; and the lessons for species integrity that came from island biogeography in which small, isolated populations were vulnerable to accidents of demography and genetics, and to environmental fluctuations and catastrophe.

Rewilding to Soule and Noss is complementary to biological conservation, but with an emphasis on the regulatory roles of large predators in driving landscapes with a natural range of variation. Their premise is the recognition that the structure, resilience, and diversity of ecosystems are maintained by ecological (trophic) interactions that are initiated by top predators (3). These predators require extensive space in which to exhibit their wide-ranging natural behaviour, and thus large core protected areas are needed if they are to be recruited in ecological restoration. Connectivity between these core areas is also an essential element as it compensates for deficiencies in the size of core areas, and ensures the long-term viability of these wide-ranging species by population mixing.

The need for ecological restoration

The WRI takes as a working definition that rewilding is an ecological restoration, a reinstatement of fundamental ecological processes with which our native biota has evolved and to which it is best adapted. The need for ecological restoration arises because our natural resource management has created highly modified landscapes where wild nature is controlled so that they give greater reliability for human use (4). The inevitable result of this holding back of wild nature is a reduction in the range of natural variation of systems in their structure and ecological function. We have thus reduced the unpredictability and contracted the boundaries of ecosystem behaviour; changed species composition to obtain a reliable flow of goods and services; and reduced the undesirable behaviour of those natural systems – at least in terms of their human benefits.

Examples of that control are in the clearance of woodlands for pasture development, and their limited replacement with a monoculture of single-aged plantations of non-native species; our replacing of native species of plants and animals with non-native domesticated varieties; the drainage and reduction of flooding of landscapes, and the control of river flow; and we have eliminated the larger predators, supplanting their role with ourselves. In doing so, we have replaced the natural ecological controls that existed with interventions that require persistent involvement if they are to be maintained.

The consequence of reducing the range of natural variation in a previously self-regulating, self-sustaining natural system is that it loses the scale of dynamic interaction that is characteristic in natural processes, thus reducing ecological resilience to external perturbations, either of a natural (storms, fires, floods) or human-induced (social, institutional or climatic) origin, that could otherwise be absorbed. The fragmentation of native vegetation in our landscapes has also led to a loss of their ecological connectivity, reducing many species to small isolated populations that are under continual pressure (5). Whether plants, animals, or insects, they cannot move easily across farmed landscapes, leading either to local extinctions or a loss of genetic diversity and vigour.

Natural processes depend on the presence and abundance of organisms with particular functional traits. These traits or trophic functions are the interaction between animals and plants, fungi and bacteria, in a food chain or web. The greatest possible dynamic interaction in natural processes comes when the functional or trophic diversity is greatest, when species are present in all trophic levels of a natural system, including top predators, middle (meso) predators, plant eaters (herbivores), plants, carrion and detritus feeders, and decomposers (6). A trophic cascade occurs when the animals at the top of the food chain - the carnivores - modify the numbers and behaviour not just of their prey, but also of species with which they have no direct connection. Their impacts cascade down the food chain, in some cases radically changing the ecosystem, such as maintaining the vegetation cover of a landscape in the face of herbivore pressure, and even the composition of the soil from decomposing carrion (3).

Initiating ecological restoration

The UK has few if any ecosystems with a natural range of variation, even where a predominantly native but limited range of species persist. It is the consequence of millennia of unrestrained, domesticated herbivory and the associated persecution of both plants and animals that were driven out as an inconvenient threat to that domesticated herbivory. Thus entire landscapes have fallen into a *landscape trap* where they have shifted into a state in which major functional and ecological attributes have become depauperated from the centuries of grazing, burning, and leaching of soil minerals (7) a state from which it would be difficult to return without assistance in reinstating natural vegetation species that have been lost and where there is no local refuge (8).

The priority in the ecological restoration of landscapes now is to break from that past of domesticated herbivory so that the distinctive natural vegetation that develops in reaction to the varying soils, hydrology and climate - and which has been lost from view in our highly modified landscapes - can re-establish itself. This re-establishment of natural vegetation is characterised by a combination of the geographical and altitudinal distribution of plants (phytogeogeography) (9) and the distinctive community associations of the plants (phytosociology) (10) within that distribution. It will encompass the range of climatic and edaphic factors that would produce a tree-line woodland at the true extent of its altitudinal range; the transition in vegetation that is discernible when the underlying geology changes; the large scale wetlands and riparian vegetation; and the coastal cliff assemblages of vegetation that alter as the forces of coastal exposure recede further inland. It then becomes a question of how and where that natural vegetation will establish.

The rewilding project at South House Moor in the Ingleborough NNR set out in 1999 to recreate the natural mixture of upland plant communities by demonstrating the ecological impact of removing farming pressures (sheep grazing) thus allowing and encouraging the upland vegetation communities to re-establish and develop to a more natural state (11,12). In reinstating a wildwood to the Carrifran valley of the Moffat Hills, a community of hefted goats were removed in 2000 after fencing had been erected around the whole valley to exclude any incursion from other goats and sheep (13). This was followed by a phased removal of sheep from internal, temporarily fenced enclosures within the valley, in line with the terms of the purchase agreement.

Identifying the species to restore natural vegetation

While natural recolonisation can play a part after exclusion of domesticated grazing (14) the small potential in relict populations may act as a constraint on the process (8). Moreover, not all of the potential native species may be present within that population, nor may they be provided by recolonisation from sources in the immediate area. A contemporary mapping system of the Natural Vegetation of Europe can be used in the determination of what communities of species can be assisted or expected to return in their reinstatement of natural vegetation in specific locations (15). The mapping system is based on surviving remnants of natural and near-natural ecosystems and their correlation with site-specific conditions (climate, soil, temperature, nutrient and water balance) and the distribution of characteristic and differential plant species. It brings together plant ranges through phytogeography and phytosociology to display the potential distribution of the dominant natural plant communities under the current climatic and edaphic conditions, and across the different zones of vegetation with regard to longitude, latitude and altitude.

WRi have used this mapping system to identity the spatial distribution of the dominant natural plant communities of the UK as an opportunity mapping for restoration of missing natural habitats. The mapping reveals that there are 35 phytosociological plant communities represented, of these 19 are woodland and which are characterised by the dominant tree present as well as the species of the shrub and ground layer. Of the remaining non-woodland types, there are lowland and upland bogs, coastal and mountain heath, coastal sand dune and salt marsh, and sub-alpine dwarf shrub. In quantitative terms, the mapping indicates that 4% of England could, in the absence of land use and modification, be covered along its major water courses by alluvial flood plain forest, a vital natural habitat that is missing and which can help prevent floods (16). In addition, almost 5% of England could be areas of estuarine and low lying inland wet woodland, and 1% could be fen woodland, two wet woodland communities with little presence. Of the five oak woodland communities that combined could cover 45% of England, one at 6% is shown on the montane fringe of the Northern uplands (Pennines and Lake District). Not shown by the mapping is bog woodland, a habitat type that has not previously been well described in the UK, and consequently knowledge of its ecological characteristics is limited. It is however a priority feature that is protected under the EU Habitats Directive, and which currently occupies perhaps 0.02% of its favourable reference range in England (17,18).

Ecological restoration through native woodland establishment in the Carrifran valley of the Moffat Hills has been based on a finer scale analysis by the use of the Ecological Site Classification (ESC) system developed by the Forestry Commission for matching tree species to appropriate site conditions (13). ESC is a decision support system for species choice based on an assessment of climate (elevation, windiness and temperature) soil moisture and soil nutrient content (19). At its simplest, ESC is software that uses algorithms and a database to determine appropriate species within a woodland community that is ecologically suited to the location, based on the phytosociological communities of the National Vegetation Classification (NVC) (10). The project brief for the rewilding of South House Moor was also based on identifying the existing phytosociological communities of the moorland (NVC) and then forecasting how those would change into new NVC communities after removal of sheep grazing and the planting of copses of trees as seed parents so that natural regeneration can take over in the long term (11). Ultimately, the distribution of native type woodland will then be determined by the local conditions of soil and climate.

The aim and timescale of ecological restoration

The aim of ecological restoration is to achieve a state of spontaneous perpetuation, a self-replicating population of reinstated species in a natural community. After substantial progress to that state for the natural vegetation of a location, the restoration of herbivory (and what type of herbivory) can be considered, and what natural mechanisms of restraint there must be on that herbivory. There will, in any case, be a likely early resurgence in small herbivorous mammals (such as field voles) as has been observed in the spontaneous regeneration of moorland vegetation of South House Moor freed from grazing, and which has attracted predatory birds (such as the short-eared owl) so that trophic processes have reinstated (12).

It is important to consider the relative timescales involved in reaching spontaneous, self-replicating populations where taller structural elements of natural vegetation are to be reinstated, often with a view to supporting redistribution of existing medium-sized mammalian species or reinstatement of larger, former native mammalian species. The planting of groups of trees on South House Moor and in the Carrifran valley are examples. Thus a mammal may reach sexual maturity within two years, and live for 15 years, whereas an oak tree does not produce acorns until it is 20-40 years old, with the optimum seed bearing years being 80-120+ years, and could live for 700 years. It is this much longer timescale for tree establishment that confirms the need for the removal of domestic herbivory in ecological restoration, and which initially may also need further measures of protection from small herbivorous mammals, such as vole guards at Carrifran (13) and for a longer term the exclusion of larger native herbivores such as deer (20,21). Where there is not the opportunity to exclude deer by fencing, then lethal control of their population is used (22).

The scale and extent of ecological restoration

The scale and extent of ecological restoration should be large enough to permit as full a range of natural processes as possible to function. In effect, this scale can be predicated on the species that would naturally mediate herbivorous pressures. Rodents may have home ranges of less than a hectare (5) whereas the pine marten, a predator of voles, has a home range of 90-126 ha of mainly woodland that has areas mature enough for cavities as den sites in large, standing dead trees (23). In larger scale, roe deer have a home range of 150 ha (5) whereas lynx, the predator of roe deer, has home ranges of between 150-1,500 km2, depending on prey density (24). As woodland based ambush hunters, lynx also show high selectivity for microhabitat in woodland, such as its structural diversity, good availability of cover for stalking prey and dense thickets or undergrowth for resting (25).

A recent Europe wide spatial study identified potential core habitat areas for large forest-based mammals, and analysed the connectivity between them based on landscape resistance i.e. the permeability to migration of the mammals (26). The modelling used the lynx as the focal species, setting a requirement for core areas of forest densities of 50 % or more, and a size that would accommodate a minimum viable population of 20 lynx. Because of the much greater forest cover in continental Europe, it is unsurprising that 134 potential core areas were revealed by the mapping, as well as 209 opportunities for linkages between these core areas The study picked out two areas in Britain, but which were predominantly plantation woodland of non-native conifers, and thus where the microhabitat requirements of lynx are unlikely to be met.

As a preliminary GIS study, the WRi has instead used the Broadleaved Woodland inventory at 25m resolution of the CEH Land Cover data (27) to identify significantly large areas of higher woodland cover in England as potential core areas. A threshold of 50% was unrealistic, given the low woodland cover in England (28) as was even a threshold of 30% at which landscapes are expected to function ecologically as woodland (29). Thus a threshold of 20% was used, about three times the national coverage of deciduous woodland in England (28). This boundary picked out a large and densely populated area of SE England, including parts of E and W Sussex, Surrey and W Kent (about 4,500km2) and the New Forest (600km2) as well as a few smaller areas around England. The implications of these findings may be problematic for reinstatement of lynx in the short term, less so for pine marten, but argue for the need for identification of large core areas within England where ecological restoration could take place for reinstatement of natural vegetation.

Protection of core areas and connectivity between them

The gains from ecological restoration in such as large core areas from the reinstatement of assemblages of native species, and associated trophic cascades, deserve protection from the causes that led to their loss (30). However, the system of protected areas for nature conservation in the UK takes a compositional approach requiring management intervention to maintain stasis so that the features at designation remain unchanged. There is no easy way to change the features for which a site is designated for fear of potentially undermining the original protection afforded by the site. Thus in the case of an existing protected area undergoing ecological restoration under a locally originated policy of non-intervention, such as South House Moor, it will at some point be in breach of its designation. Even where no designation exists, the implication of a static biodiversity in the current system of protection is incompatible for areas governed solely by natural processes. As WRi has argued, protection for an increasing presence of wilder land in England arising through ecological restoration will need a readjustment in the way nature conservation is viewed (31). Indeed, WRi was amongst those arguing in the “Vision for a Wilder Europe” for natural processes to be a key element, and natural succession in particular arising from non-intervention being able to meet the demands of developing or guaranteeing a favourable conservation status in Natura 2000 sites (32). The Vision sought a more holistic, functional approach in Europe to meet the challenges of conservation of biodiversity where concepts like trophic cascades and apex species are also taken into account.

Connectivity between core areas is also a means of protecting and enhancing the gains from ecological restoration, as well as reversing habitat fragmentation (29,33). The concept of Forest Habitat Networks (FHN) where core areas are connected by well-wooded belts in the countryside, concentrated mainly along rivers and streams, has been explored throughout Britain by the Forestry Commission, with national and regional opportunity maps for it development in Scotland (34) Wales (35) and a region in England (36).

In a wider context, these FHN can be seen as part of an ecological network, as a system of movement routes, which allow species to travel between core areas. In its report on wild land in Europe for the Scottish Government, WRi described a modelling approach to developing an ecological network for wildcat in Germany – a *"wildcat rescue network"* - based on core areas of woodland habitat interlinked with potential new woodland corridors (37). The report noted that Scotland has mapping for ancient woodland and native woodland for core areas (38) mapping for FHN as well as mapping for Lowland Habitat Networks (39) and, when taken together, these spatial approaches to habitat and habitat networking constituted part of the datasets needed for ecological networking in Scotland. We recommended that the threatened status, but also the ecological importance of the wildcat in Scotland, argued for this ecological networking to have a focus on the wildcat, informed by the study in Germany, and with work to identify the important factors in habitat selection by wildcat.

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