

Upland ecosystem health: defining the indefinable

Tim P. Burt, Penny Anderson, Andrew Coupar, Alistair Crowle, Alan Fielding, John E. Gordon, Rob Marrs, Bill Slee, Davy McCracken, Jeff Warburton, Alan Werritty and Des B.A. Thompson

*“Great things are done when men and mountains meet;
This is not done by jostling in the street.”*

From the ‘Notebooks’ (1792-94) of William Blake

Good health, rude health or just metaphors?

In his engaging paper in the June 2015 issue of the *Bulletin*, John Wiens asks if the concept of ecosystem health is useful? (Wiens 2015). He answers that: “Scientifically, it is distracting and unnecessary... ‘Ecosystem’ is a useful abstraction for things that actually do exist and that can be measured and managed, and ‘health’ is a useful metaphor for conditions that we deem desirable, whether for utilitarian or idealistic reasons.” Stimulated by Wiens’ critique, we accept that the term health when applied to ecosystems can be ambiguous (as we explain below), but we continue to view the concept of ecosystem health as both coherent and useful. In this article we outline the context underpinning the term ecosystem health. We unpack its diverse meanings and usage and provide suggestions on how it should be used. Finally, we offer criteria for its use in determining the current ecosystem health of Britain’s uplands.



Figure 1. The walk in to Sandwood Bay, NW Sutherland, Scotland. Photograph: Des Thompson.

Why does this matter? At the international governmental level, the UN meeting in October 2010, in Nagoya, Japan, adopted a revised and updated Strategic Plan for Biodiversity, including the so-called Aichi Biodiversity Targets for 2011-2020 (Convention on Biological Diversity, 2010). At least two of these targets deal with ecosystem health, the first indirectly: Target 14 (By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable); and the second directly: Target 15 (By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification). Although both of these targets emphasise the benefits arising from healthy ecosystems, the primary focus for both is ensuring the restoration of the biological and biophysical processes normally associated with supporting ecosystems and their many functions.

Inevitably, globally, nationally and indeed locally, an immense effort is being devoted to crystallising an understanding of these targets and how they can be met and measured – to say nothing of doing anything to meet them. In the EU (EC

2011) and UK (e.g. Defra 2011, Scottish Government 2015), policy papers set out the ambition and work planned to meet these Aichi targets, with significant scientific resources being put into this.

Hence, whilst we concur with much of Wiens’ commentary on the metaphors of health, and indeed the reasoning of Kolb *et al.* (1994), Costanza & Mageau (1999), and Lackey (2001) referred to by Wiens, we do see a scientific need to tease out what is meant by ‘ecosystem health’. But it goes much deeper than that. In their excellent new book *Protecting the Wild*, Reed *et al.* (2015) argue in favour of helping nature in ways that go beyond such targets and articulations to seize the chance to be far bolder about our ambitions for nature.

This still begs questions about health, condition, state or whatever metaphor we wish to use. The term health comes from the Old English *hælp*, meaning wholeness, being whole, sound or well. It can also have meanings straying into prosperity, happiness, welfare, preservation, and safety. When it comes to valuing these elements, we can think of attributes in terms of their vigour, organisation and resilience. In any discussion about ‘health’ it is easy to conflate a focus on the health of ecosystems (in terms of how well they function) with their impacts on the health of people who benefit from supporting ecosystems. Here we focus solely on the health of ecosystems and set aside their impact on human health.

Clearly, quantitative and qualitative measures of ecosystem health are important, and draw on the natural and social sciences. The 'value' of such health is a linguistic minefield. Positive values can be attributed to ecosystems in terms of the services they provide. But the actual valuation of these services is socially constructed – especially the value attributed to provisioning, regulating and supporting services. The privileging of one service over another depends on societal priorities, which shift and change over time (e.g. Hajer 1997).

In search of a healthy upland

Looking across the uplands of Britain, covering a third of the land surface, a pronouncement on the health of the uplands will elicit the full gamut of emotive responses. And no wonder, for what is good health to one onlooker can be poor for another. A moor teeming with red grouse, a hill top with spinning wind turbines, or a birch wood reaching up to a natural treeline are examples of healthy moors to some eyes, but not others. Much depends on the 'value' of the services being provided.

Let's take an upland vista in NW Scotland (Figure 1). This footpath leads you to one of Britain's most beautiful beaches – Sandwood Bay. Yet, the path has been heavily 'repaired', the surrounding blanket bog is eroded (and eroding, with consequent losses of carbon), the absence of any woodland regeneration is palpable, and when you examine the vegetation and assess it against 'condition' criteria (JNCC 2009), several habitats miss targets for species richness attributable to heavy grazing by sheep and red deer. Washed-out Scots pine stumps are remnants of a forest (which may have been overwhelmed naturally by blanket bog, or cut and burnt creating conditions that favoured bog development). To some, the path is an intrusion in a wild landscape (there used to be vehicular access, but that stopped), a possible barrier for less mobile invertebrates, a source of disturbance for some breeding birds and, leaving aside the active erosion of the path, the vegetation fringes are heavily modified.

But for each of these assessments we can provide a counter. Peat erosion is a dynamic process; the presence of woodland would be regarded as an incursion by some people; and vegetation

varies spatially and structurally, and what is of conservation interest to some is not to others. The presence of pine stumps is a cultural and palaeo-environmental phenomenon, and, given present-day climatic conditions, it is impossible to return to the conditions of their origins. The modified path vegetation and bare soils add to the structural diversity of habitat important for some invertebrates. These are examples of why the term 'health' is so heavily contested.

How then can we pronounce on the 'health' of such a landscape? Essentially, we can only do so once there is a view on objectives for the land. And here, we have to think of social, economic and environmental factors in shaping these. Pronouncements on health are often intermixed with those regarding 're-wilding' (e.g. Monbiot 2013, Wuerther *et al.* 2015), a mooted return to nature, and the expression – or presumed expression – of natural processes. 'Re-wilding' initiatives can actually involve a greater intensity of management than adopted in land uses being replaced. Whilst some people are seeking to make space for nature others assert a need to manage the food-water-energy nexus to better meet other pressing contemporary societal needs (FAO 2014).



What constitutes a healthy uplands depends on the perspective of the viewer. Photograph in Northumberland by T P Burt

Breaking out of the straightjacket

What can we say about the health of an upland ecosystem? The conundrum is really no different from the challenge of defining the importance of nature for conservation purposes. Ratcliffe (1977) took eleven years to craft the framework for nature conservation evaluation in the UK, and contributing to that were seminal writings by Arthur Tansley, Julian Huxley, Cyril Diver, Norman Moore and other extraordinarily talented pre- and post-War environmentalists (Thompson *et al.* 2015). By devising terms which captured

the essence of nature conservation value, the so-called 'Ratcliffe criteria', it was possible to contrast features and areas in a systematic way. This helped set the standard for wider international evaluations (e.g. Griffiths & Vogiatzakis 2011). Diversity, richness, naturalness, rarity and even 'intrinsic appeal' were terms which could be used to place in rank order sites of nature conservation importance. Interestingly, intrinsic appeal might now be equated with human physical and mental health derived from nature, but then was a construct for what Ratcliffe referred to as the "awkward philosophical point that different kinds of organism do not rate equally in value because of bias in human interest."

Unless we have a comparable framework for ecosystem health we will not be able to meet targets set in the EU and national policies. What is more, much time and energy will be dissipated in trying to work round and through all of this.

Criteria for ecosystem health

We propose three courses of action. First, if the term 'ecosystem health' is to be used, it should be recognised that the 'health' element is no more than a metaphor for what some people deem to be desirable. Its scientific basis is limited to the quantitative measurements of attributes, and contrasting these spatially and temporally. Second, there are some terms that can be used to embrace what we think of as 'health', at least as applied to the uplands, and we propose these in Table 1. In the way that Ratcliffe's (1977) criteria could be used to assess nature conservation value, we suggest that these could be applied to help us assess the ecosystem health of a range of upland landscapes. We suggest criteria and associated descriptions that reflect the current scientific consensus and are accessible to the non-specialist. We are not concerned here with societal values or intrinsic appeal; rather we are restricting ourselves to ways of measuring the health of the 'patient'. We could group the criteria under three headings:

- a) Condition – defined by *complement* and *diversity* (determined by the condition of a habitat or designated site, soil carbon stocks, species diversity, water quality, etc.);

CRITERIA	DESCRIPTION
Condition	
Complement	Number of communities and species, and range of variation, in an ecosystem type
Diversity	Representation of abundance of populations, communities and physical conditions (geology, soils, geomorphology) characteristic of a site
Processes	
Function	The range and robustness of the geophysical and biophysical processes underpinning the ecosystem
Productivity	The productivity of biota (e.g. animal, plant, fungi etc.) and viability and growth relative to natural environmental constraints
Durability	
Resistance	The ability to withstand and adapt to change physically and biologically
Resilience	The ability to recover from a substantive disturbance

Table 1. Summary descriptions of upland ecosystem 'health' criteria, grouped according to condition (complement and diversity), processes (function and productivity) and durability (resistance and resilience).

b) Process – defined by *function* and *productivity* (more difficult to find data sets for but includes connectivity/ fragmentation and critical load exceedance); and

c) Durability – a measure of the projected lifespan of the ecosystem given the prevailing conditions defined by the *resistance* and the *resilience* of the ecosystems (equally difficult to find datasets for, but includes changes in extent of restored habitat and extent of invasive non-native species).

Third, we would welcome any attempts to test this framework on a range of upland landscapes. There may be some long-term datasets that could be used to help with this. We offer this approach as a pragmatic means of trying to define the indefinable rather than as a contribution to what could, and shows signs of becoming, scientific sophistry in pursuit of international targets which simply seek nature in a "better" state.



Photograph by Des Thompson

Acknowledgements

We thank John Wiens for his stimulating paper, and Natural England and Hatfield College, Durham University for funding a workshop to develop some of the ideas presented here.

Tim Burt is Master of Hatfield College and Professor of Geography at Durham University; Penny Anderson established Penny Anderson Associates Ltd, and has been given a Life Achievement award from CIEEM partly for her upland management/ restoration work (2015); Andrew Coupar manages the Uplands, Peatlands and Earth Sciences Group in SNH; Alistair Crowle is an Upland Specialist with Natural England; Alan Fielding is a Director of the charity Highland Renewal, and Scientific Advisory Committee (SAC) Expert Adviser to Scottish Natural Heritage (SNH); John Gordon is an Honorary Professor in the School of Geography and Geosciences, University of St Andrews; Rob Marrs is Bulley Professor of Applied Plant Biology at the University of Liverpool; Bill Sless researches in rural development and is an Emeritus Fellow at the James Hutton Institute; Davy McCracken is Professor of Agricultural Ecology and Head of Hill & Mountain Research Centre at SRUC; Scotland's Rural College; Jeff Warburton is a Reader in the Department of Geography at Durham University; Alan Werritty is Emeritus Professor of Physical Geography, University of Dundee, and member of SNH's SAC; and Des Thompson is Principal Adviser on Biodiversity with SNH, and a Senior Research Fellow at Hatfield College.

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