

Flood management and nature – can rewilding help?

Can fewer sheep, more trees, restoring rivers to their floodplains and reintroducing beavers help reduce flood risk? This article looks at the baggage in policy making when planning for flood-resilience and considering the rewilding options.

STEVE CARVER

If like me you were listening to BBC Radio 4 on 7 January then you too may have nearly choked on your morning coffee. Prof Alan Jenkins, Deputy Director of the Centre for Ecology and Hydrology (CEH) was on the Today programme about flooding. Interviewer John Humphrys opened with a provocative question: “The idea of rewilding, take all the sheep off the uplands etc., there’s no evidence it will work, is there?” To which Prof Jenkins replied “That’s absolutely correct. There is no compelling evidence that a link can be made.” He then went on to say “With these huge rainfall events one has to look more towards concrete infrastructure, if you like, flood defences.” The context was clearly whether more trees and fewer sheep in the uplands of Britain could somehow have prevented the disastrous flooding seen over the Christmas period. To be fair, what he said was strictly true. That is to say that the scientific evidence on the benefits of rewilding is sparse largely because rewilding is relatively new and so no long-term studies have been carried out specifically on this question. What we do have, however, is a growing body of data that relates to how human activities and land management impact on natural processes. It also depends on what your definition of rewilding is, but surely more trees and fewer sheep in our uplands would form part of the wider picture?

Fewer sheep, more trees... lessons in hydrology

I was surprised by the surety with which Prof Jenkins rounded on rewilding. I’m no hydrologist, but having studied as an undergraduate at Huddersfield back in the early 1980s I have a pretty good working knowledge. On a field class to Slapton Ley in Devon during the Easter of 1984 we learnt that sheep grazing compacts the soil and reduces infiltration capacity so increasing surface runoff in rainfall events. Woodland on the same soils has the opposite effect – so much so that even a first year undergrad with rudimentary equipment can see the difference.¹ More recent long-term experimental work by CEH and Imperial College at Pontbren in Wales has reinforced these results showing that removing sheep grazing and planting trees can increase infiltration capacities by as much as 67 times and reduce surface runoff by as much as 78%.² So not only does reducing sheep numbers and planting more trees reduce soil compaction and increase infiltration capacity, it also increases surface roughness, thereby slowing runoff, reducing soil erosion and trapping sediment. This must help alleviate downstream flooding pressures to some degree, surely?

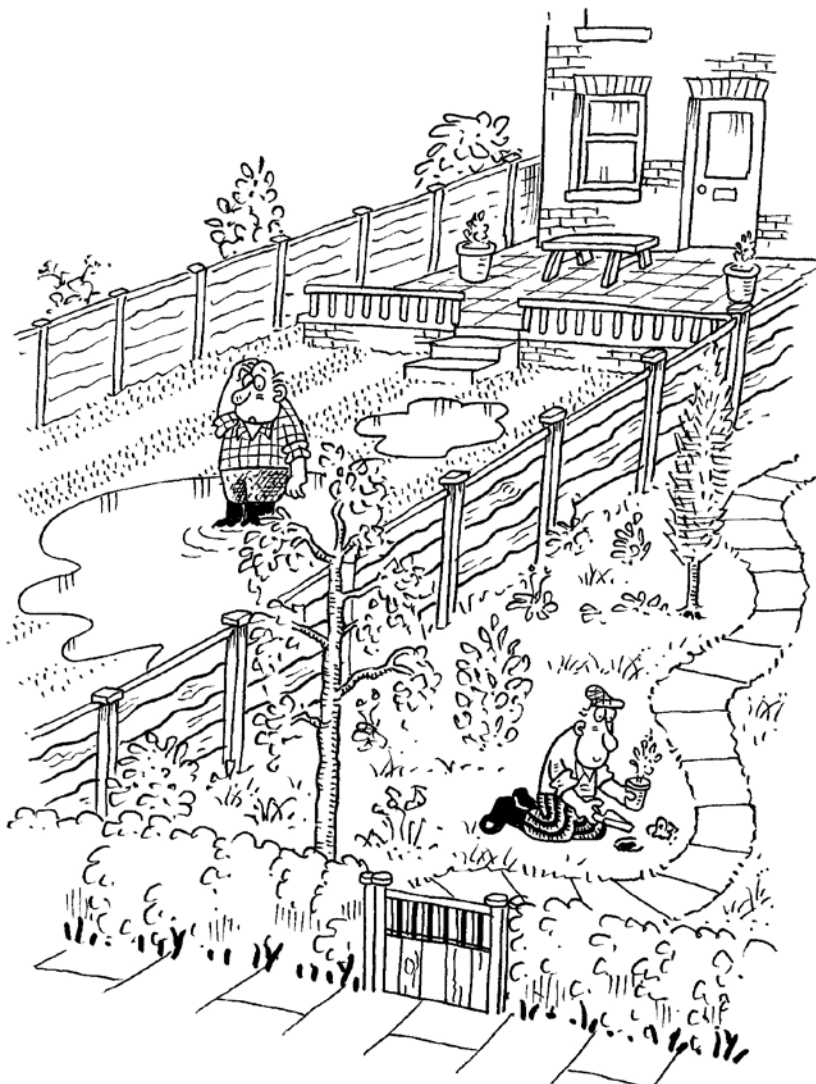
So I emailed Prof Jenkins shortly afterwards explaining my interest and asking for clarification. I got a terse reply simply directing me to materials available on the CEH web pages including a transcript of the interview wherein his statement on rewilding had mysteriously disappeared.³ Curious. Nevertheless, the long list of points made by CEH scientists on flooding and the need for integrated catchment management make for interesting reading, containing as they do much in the way of good common sense backed up by CEH’s long history of work in the field.⁴ These echo very much my own reading of the situation, with the exception of the potential benefits of rewilding and the need for a better appreciation of the social thalweg.⁵

Rewilding aside, we need to look carefully at the whole catchment, not just at the biophysical landscape (terrain, climate, soils, vegetation, etc.) and the hydrological processes that determine river flows and flood events, but also at the complex interplay of social, cultural, political and economic factors that govern land use, management, ownership, revenue and people. In particular we need to concern ourselves with the politics of power and responsibility. There are deep-rooted and powerful vested interests in maintaining the status quo in the British uplands and keeping them just the way they are. While these people are very happy to accept agricultural and environmental subsidies, they remain almost wholly focused on the production of food and fibre and management of the land for ‘sporting’ activities, often at a financial loss if it wasn’t for subsidies.⁶ Much of this management takes place with very little regard for what goes on downstream as regards flood protection. In most instances, land owners are just happy to get water off their land as quickly as possible, and from there into the local water course and away downstream at which point it becomes an SEP.⁷ Almost all environmental service delivery is based on a ‘What’s in it for us?’ or ‘What little can we get away with?’ attitude. Aldo Leopold sums it up perfectly thus: “When the private landowner is asked to perform some unprofitable act for the good of the community, he today assents only with outstretched palm. If the act costs him cash this is fair and proper, but when it costs only forethought, open-mindedness, or time, the issue is at least debatable”.⁸

Climate change and increasing intensity of rainfall means that the return periods of large flood events are getting shorter.⁹ As yesterday’s “unprecedented” becomes tomorrow’s “normal” we are likely to see more floods like those that hit northern Britain over the 2015 Christmas period and the flooding of the Somerset Levels in 2014. The personal misery and costs to the individual are hard to calculate and, I am sure, even harder to bear, but what is clear is that as flood frequencies and levels increase, some quite radical measures will need to be taken to alleviate the problem. This doesn’t simply mean pouring more concrete and building ever higher flood defences to protect beleaguered downstream communities as Prof Jenkins might suggest. Nor does it imply having to dredge channels to increase flood water throughput. Instead, we must take a long hard look at upstream land use and management practices.

The causes of flooding

Heavy and prolonged rainfall, especially onto ground that is already saturated, is the principal cause of flooding, but how we manage the land upstream of flood prone



areas can have a significant effect. Land drainage, deforestation, overgrazing, bare ground, and channelisation of rivers together with increasing urbanisation and associated impervious surfaces have combined to exacerbate the flood problem. Even flood defences can make flooding worse in unprotected areas immediately up and downstream of the farms and communities they are designed to protect through backing up in front of constrictions that hard flood defences create or rushing flood waters on downstream.

Grants made available for upland drainage in the 60s and 70s aimed at improving grazing were taken up with enthusiasm by many land owners. Look at an aerial

image on Google maps of the Pennines and other peat moorlands and you'll often see a dense herring-bone pattern of linear ditches or "grips" criss-crossing the hills. These have, as intended, lowered the water table, drying out the peat, changing heather to grass and increased the drainage density. This has the combined effect of significantly increasing the speed at which rain can runoff the land and into our rivers, reducing lag times and potentially increasing the "flashiness" of the river and thus, as an unintended consequence, its propensity to flood.¹⁰ While there is contradictory evidence as to the exact effects of grips on floods it seems likely that overall they can only make matters worse. In a peculiar turn of fortune, grants are now available for blocking the very grips the same land owners dug, but now with the aim of reducing drainage densities and rewetting the moors.¹¹

Can grouse moor management increase flood downstream?

Grouse moor management and especially "muirburn"¹² is detrimental to water quality, wildlife and dissolved organic carbon¹³, but can muirburn really increase runoff? When done badly and especially when adjacent to drainage channels/streams, the answer is almost certainly a qualified yes because it increases the amount of bare peat leading to increased surface runoff, although there is a lack of detailed evidence to prove this conclusively. Nevertheless, Hebden Bridge which was hit hard by flooding on Boxing Day 2015 is downstream of the Walshaw Moor Estate. This is the grouse moor at the centre of a prosecution case brought by Natural England against the moor's owner Richard Bannister for allegedly digging unauthorised drainage channels and excessive burning of heather on blanket bog.¹⁴ Certainly, grouse moor management is not beneficial to flooding even if shooting interest groups try to make out otherwise. Only recently have the Moorland Association and the Heather Trust realised that they need to do something to mitigate the worst effects of their activities and improve their public image with events such as "bogathon" aimed at improving the water retention capacity of their members' moors.¹⁵ Many of these moors would have been mixed woodland in the past and would revert to woodland again if not managed specifically to maximise the surplus population of grouse for shooting.

Aside from driven grouse shooting and deer stalking in Scotland, sheep grazing is the dominant activity in most of upland Britain. Intensive grazing with domestic livestock has two effects on hydrology: reducing and simplifying vegetation cover to a close-cropped grass sward by grazing, and compacting thin mineral soils through trampling. The former reduces interception storage and surface roughness, as well as reducing biodiversity, while the latter reduces infiltration capacity through compaction and increases surface runoff.¹⁶ During prolonged periods of heavy rainfall, there is precious little to hold the water in the hills, resulting in increased downstream flood risk.¹⁷

The flooding of the Somerset Levels during early 2014 resulted from heavy and prolonged rainfall, made worse by questionable land management practices. Farming maize and potato crops in the catchment increases the area of bare soil in the winter months which, because it is compacted by mechanisation, reduces infiltration capacity. Increased surface runoff and soil erosion are the result. This



The River Liza in Ennerdale, which is unconstrained and free to shift its course.

is especially true on steeper slopes near to water courses where the eroded soils end up being deposited in Rivers Parrett and Tone, reducing their capacity and further exacerbating the flooding problem.¹⁸ Nutrients leaching directly from bare fields into river courses also encourage in-channel weed growth which reduces flow velocities and traps more sediment, further reducing cross-sectional area, leading to calls to dredge the affected rivers.¹⁹

Engineered solutions

Engineering solutions rarely treat the cause; rather they attempt to address the effects. Demands from flooded farmers and residents to dredge rivers to help maintain their capacity and transfer flood waters downstream are a knee-jerk reaction to the threat of flooding. For dredging to be effective it needs to be carried out along the whole length of the main river which is costly in terms of both money and riverine habitats and ecology. While local dredging may be effective in reducing

flooding in the immediate vicinity, and is desirable in a few instances, it only speeds the flood waters on to multiply the flooding downstream.²⁰ In addition, sediment in the river channel comes from erosion of soils, hillsides and river banks upstream, but why so much that it causes problems from choked river channels downstream? Clearly, we wouldn't have to dredge if the sediment supply was reduced by ensuring better vegetation cover (again, more trees) protecting vulnerable soils, hillsides and river banks from overgrazing (yet again, fewer sheep).

Similarly there is a limit to just how high we can build flood defences to protect farmland and urban areas on the flood plain. Like dredging, pouring concrete is also expensive and, while a very visible form of flood defence to local residents whose homes and businesses are at risk, it is not the answer. Money thrown at building extra flood defences after high profile flooding is just a response aimed at saving political face. Ultimately, engineered flood defences will always fail in the face of

increased rainfall intensity and shortening return periods as we cannot afford to keep on building them higher and higher.

Natural flood management

While many flood defence projects focus on reducing local impacts by protecting flood-prone areas with walls, barriers, gates and wash lands, a few recent projects have begun to address the problem at source with natural flood management (NFM) techniques. “Slowing-the-flow”²¹ and other similar demonstration projects show how changes to upstream land use, insertion of large woody debris (LWD) dams in streams, increased surface storage, etc. can slow down runoff by increasing lag times and attenuating flow peaks and so reduce soil erosion, increase sediment trapping. All of which can reduce downstream flooding and benefit habitats and wildlife, and be achieved without costly and intrusive engineering works.²²

River restoration projects can also have benefits by allowing flood plains to store flood waters and increasing the length and roughness of the thalweg, so reducing its overall gradient, slowing flows and increasing flood response times.²³ River restoration employs NFM approaches together with “soft engineering” such as reinstating meanders, re-profiling banks, increasing floodplain woodland/scrub, creating floodplain mires, etc.²⁴ In essence, rivers flood periodically and overflowing onto wooded floodplains is nature’s way of coping with flood waters. Giving back a river’s freedom on its floodplain through river restoration might mean allowing farmland to flood, but surely this is better than the alternative of flooded homes and businesses?

Free-ranging rivers in unconstrained flood plains have shown how we can increase resilience of catchments to flood events. A good example here is the River Liza in Ennerdale, Cumbria. In both the 2009 and 2015 floods the river responded to the heavy rainfall by escaping the confines of its banks and onto its floodplain. This is what natural floodplains are for, but while the river overflowed, the floodplain absorbed the extra water and energy but also effectively “filtered” the flood waters of its sediment load before discharging into Ennerdale Water. This had the effect of both attenuating the flood peak and reducing its sediment load. Whereas other rivers in adjacent valleys all flooded and lakes in the region all witnessed massive increases in turbidity, Ennerdale remained clear and flooding downstream was minimal. The difference is reasonably attributable to differences between Ennerdale and other Lake District rivers. Not only is the River Liza in Ennerdale free to move around its floodplain, the fell sides in the valley are subject to less grazing and have considerably more trees than their neighbours wherein bare, sheep-grazed hillsides and channelised rivers are more the norm.²⁵

Beavers doing it for free

At the recent Upland Hydrology conference in Leeds I sat through a whole day of talks and discussions about NFM projects. All were about human-engineered NFM approaches which try to mimic the effects of natural in-stream LWD dams and wetlands in limiting downstream flooding. Not once did any of these presentations mention beavers until I brought it up in the final Q&A session, much to the chagrin of the CLA and Moorland Association representatives on the panel.



The History Wall in Cockermouth, itself acts as a flood barrier and depicts some of the recent flood history of the Cumbrian town, where the rivers Cocker and Derwent converge.

We are facing an establishment (land owners, farmers, politicians) who hold it in their power to do something positive to address the flooding problem (e.g. reintroduce beavers and restore rivers to their floodplains) and yet the desire to remain in control prevents a simple measure that could do much of what is needed essentially for free.²⁶ This has led to calls for beaver reintroductions in order to realise the benefits for flooding, water quality, habitats and biodiversity.²⁷ While there are some local dis-benefits associated with localised flooding, experience from abroad shows that this can be safely managed and land owners appropriately compensated.

The social thalweg

Flooding is a good example of what we might call a “wicked” problem characterised by the interplay between the physical causes and effects layered on top of a complex mix of social, cultural, political, economic and behavioural factors. It is also intensely geographical, not just in the patterns of weather, climate, soil, and land use, but in how people respond to and view the problem. The social thalweg shows how this changes as you travel upstream from point of impact to the source of the problem. It also varies as to who you are and where you live relative to the flood risk.

To home owners and businesses with property on lowland floodplains in towns and cities like Taunton, Cockermouth and York, the risk of periodic flooding is a way of life. Flood insurance can be difficult to find or extremely expensive, meaning that those least able to afford it are also those least resilient to the effects of flooding. Flooding is perhaps seen as being an immediate problem associated only with bad weather and one to be addressed by bigger and better flood defences, with costs justified in terms of how many individual properties (and voters) are protected. There is in many ways a disconnection in people’s minds between the causes of flooding and its immediate effects.

Meanwhile further upstream at the problem's source, the opposite is true. People are more likely to be connected to the land through employment in agriculture, forestry or other forms of land management or by association through tourism and service industries. However, the disconnection is now likely to be between the effects of land management and flooding downstream through an unwillingness to recognise that their own activities might be making life difficult for those people further downstream.²⁸

Is rewilding really the answer?

If fewer sheep, more trees, restoring rivers to their floodplains and reintroducing beavers can be considered to be rewilding, then the answer to the above question is yes! The evidence for some or all of these approaches applied in combination along a river point to rewilding reducing risk at flood prone points. A fully coordinated and integrated policy through the full course of the river can ensure maximum benefits at minimum cost and risk. This includes mapping of the spatial configuration of contributing areas and flood alleviation measures, since slowing the flow at one point may exacerbate the problem by delaying its flood peak to coincide with a flood peak coming downstream from higher in the catchment.

Just as hard-engineered flood defences alone don't cut it, then neither will soft-engineered or NFM techniques when used in isolation. We still need hard flood defences to protect flood-prone towns and cities at critical points on the floodplain. Integrated catchment management is the way forward, and distributed rewilding to address the problem at source and intercept and slow flood waters along the river thalweg must be part of this mix. The flood-response-review cycle needs to be broken and the sticking plaster approach highlighted by Dieter Helm²⁹ replaced with a radical overhaul of how we plan for, manage and minimise the impacts of flooding. While Helm maintains this can be addressed by proper economics (what flood defences we need, what we can afford and how to manage it within a proper institutional setting) and while he talks a lot about natural capital, he fails to address the issues of how combined NFM and rewilding approaches may be far cheaper in the long run than traditional hard-engineered approaches.

Who pays?

This will be foremost in the minds of land owners who are being asked to modify their activities in the uplands and the farmers whose most productive floodplain fields might be flooded to save homes and businesses in downstream urban areas. Where the costs are borne by the few in areas remote from the many who benefit, it is likely that land owners and farmers in rural areas and especially those in the uplands will bear the brunt of any land use and policy changes. Paying land owners up and down the catchment to do the right thing might be one way forward. This should be through public funding for grip blocking, rewetting, cutting heather instead of burning, woodland regeneration, reduced grazing pressure, insertion of LWD dams (or better still beaver reintroductions so they can do it for us), river restoration, creating wash lands and wetlands, allowing farmland to flood, and other measures. As the NFU representative and county advisor at the Upland Hydrology conference said "We'll do anything you like... as long as you pay us for

it". Being an economist, Helm attacks this question head on and calls for a small flood levy, paid either through our water bills or insurance which when multiplied across the whole UK population represents a huge sum of cash.

How this is actually spent is open for debate, but it should not be used to pay land owners for flood-sensitive land use management practices while they continuing to receive monies for practices that exacerbate the flood problem. The other radical change required is to bring all the communities involved together in a catchment-wide participatory planning exercise to plan and decide how to address the flooding problem, how to adapt existing policies, and how to increase resilience and accountability throughout the social thalweg.

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Rewilding National Parks: moor than meets the eye

Wildlife conservation in England's National Parks comes under scrutiny from many different camps. The most recent challenge is from advocates of rewilding, but are the landscapes and ecosystems across the National Parks actually lacking what prominent voices in the rewilding lobby claim?

MERIEL HARRISON

The journalist George Monbiot is a welcome provocateur, often challenging long-held assumptions about conservation practice. Dartmoor National Park Authority was well aware of this when it invited him to speak at the UK National Parks Conference in 2015. A conference should be about debate, after all – and George provided it in spades, both during his speaking slot¹ and a subsequent panel discussion.² However, his recent *Guardian* article³ slamming moorland management and sheep grazing in Dartmoor and Exmoor National Parks presents an argument that on closer examination, like an old woolly jumper, reveals a number of holes.

Nothing but heather?

In describing the moorland as "miles and miles of bugger all" Monbiot echoes the fool in Hugh MacDiarmid's poem *Scotland Small*?⁴ who views the hillside and cries "Nothing but heather!" because he has not looked closely enough to see the bog asphodel, cotton grasses, bilberry, tormentil, mosses, sundews and butterflies brimming with colour and life. How incomplete, indeed. One could add a litany of moorland birds: cuckoo, whinchat, stonechat, skylark, meadow pipit, wheatear, dunlin and snipe. The heathland and moorland habitats of upland Exmoor and Dartmoor are the basis for two large Special Areas of Conservation, designated under the European Commission Habitats Directive. The UK has around 75% of all the heather moorland in the world, and SAC status recognises the international importance of these south-western wet and dry heath and blanket bog areas.

Of course, these National Parks are not solely devoted to upland moorland; Dartmoor and Exmoor National Parks also encompass many other valuable and protected habitats including extensive and rare coastal oak woodlands. The assemblage of different wildlife-rich habitats within what are relatively small areas is no small part of the Parks' outstanding value for wildlife conservation. The tapestry of moorland, woodland, farmland, stream and river valleys, coast and cliffs are not only attractive to human visitors, but allow a wide range of species to make their homes there.

It does seem a strange time to be agitating for reduced grazing of England's uplands, when we know this is already happening. The trend in recent decades has been towards a decreasing intensity of grazing and a resultant increase in areas of scrub