

Rewilding in the English uplands: policy and practice

Article (Accepted Version)

Sandom, Christopher J, Dempsey, Benedict, Bullock, David, Ely, Adrian, Jepson, Paul, Jimenez-Wisler, Stefan, Newton, Adrian, Pettoirelli, Nathalie and Senior, Rebecca A (2019) Rewilding in the English uplands: policy and practice. *Journal of Applied Ecology*, 56 (2). pp. 266-273. ISSN 0021-8901

This version is available from Sussex Research Online: <http://sro.sussex.ac.uk/id/eprint/78992/>

This document is made available in accordance with publisher policies and may differ from the published version or from the version of record. If you wish to cite this item you are advised to consult the publisher's version. Please see the URL above for details on accessing the published version.

Copyright and reuse:

Sussex Research Online is a digital repository of the research output of the University.

Copyright and all moral rights to the version of the paper presented here belong to the individual author(s) and/or other copyright owners. To the extent reasonable and practicable, the material made available in SRO has been checked for eligibility before being made available.

Copies of full text items generally can be reproduced, displayed or performed and given to third parties in any format or medium for personal research or study, educational, or not-for-profit purposes without prior permission or charge, provided that the authors, title and full bibliographic details are credited, a hyperlink and/or URL is given for the original metadata page and the content is not changed in any way.

Rewilding in the English Uplands: Policy and Practice

Christopher J. Sandom^{1,2,*}

Benedict Dempsey³

David Bullock⁴

Adrian Ely³

Paul Jepson⁵

Stefan Jimenez-Wisler⁶

Adrian Newton⁷

Nathalie Pettorelli⁸

Rebecca A. Senior⁹

¹ School of Life Sciences, University of Sussex, Brighton BN1 9QG, UK

² Wild Business Ltd, Beacon House, 113 Kingsway, London, WC2B 6PP, UK

³ SPRU, University of Sussex, Brighton BN1 9QG, UK

⁴ National Trust, Heelis, Kemble Drive, Swindon SN2 2NA, UK

⁵ School of Geography and the Environment, University of Oxford, Oxford OX1 3QY, UK

⁶Country Land & Business Association Limited, 16 Belgrave Square, London, SW1X 8PQ,
UK

⁷School of Applied Sciences, Bournemouth University, Bournemouth BH12 5BB, UK

⁸Institute of Zoology, Zoological Society of London, London, UK

⁹Department of Animal and Plant Sciences, Alfred Denny Building, University of Sheffield,
Western Bank, Sheffield, S10 2TN, UK

* Corresponding author, c.sandom@sussex.ac.uk

Keywords

Rewilding, Ecosystem processes, Ecosystem services, Biodiversity, Conservation,
Restoration, uplands, policy

5745 words

Introduction

Rewilding is gaining momentum as a new approach to restore and conserve biodiversity and ecosystem services, despite being imprecisely defined, controversial, and with limited explicit empirical supporting evidence (Lorimer *et al.* 2015; Svenning *et al.* 2016; Pettorelli *et al.* 2018). In a case study region (the English uplands), we discuss what rewilding means to practitioners and policy makers; the risks, opportunities and barriers to implementation rewilding is thought to present, and potential paths for policy and practice.

Rewilding has had strong uptake in Europe, including the UK (Svenning *et al.* 2016; Sandom & Wynne-Jones in press). A UK case study is particularly interesting for two reasons. First, many species have been lost through centuries of increasingly intensive land use and with little opportunity for natural re-colonisation species translocations are likely required for successful rewilding. Second, debate around rewilding is particularly intense with the UK's impending departure from the European Union and associated potential for considerable change of key policies, such as the Common Agricultural Policy (CAP), and the Habitats and Birds Directives. Here we highlight perceptions, concerns and possible ways forward for rewilding in post-Brexit upland England in which the 25-Year Environment Plan (25YEP; DEFRA 2018a) will frame policy. We also identify general lessons for those considering applying rewilding in other locations.

Rewilding and England's Uplands

Rewilding is increasingly prominent in policy discussions and land management practice in the UK. It was explicitly identified as a management option in the terms of reference for the UK Government's inquiry into 'the future of the natural environment after the EU referendum' (Environmental Audit Committee 2016) and has been the focus of a POSTNote

(Wentworth & Alison 2016). The charity Rewilding Britain has identified 13 active examples of British rewilding projects (Rewilding Britain 2017), although many others exist (Sandom & Wynne-Jones in press). Rewilding is being considered and pursued as a land management option by environmental NGOs (John Muir Trust 2015; Woodland Trust 2017) and private landowners. The environment is a devolved matter in the UK meaning the four national governments have legislative mandates to adopt their own environmental strategies. Here we focus on England and consider wider implications in our conclusions.

Approximately 12% of England is considered upland, which is reported to provide an estimated 70% of the country's drinking water, contain 53% (by area) of its Sites of Special Scientific Interest, 25% of woodland, 29% of its beef cows and 44% of its breeding sheep. Upland National Parks in England receive c.70 million visits annually (various sources, summarised in Upland Alliance 2016). The uplands are central to both biodiversity conservation and society as a whole, and their management has cascading impacts for the UK. To date, policy and practice in the uplands has primarily focused on food production and forestry, with secondary goals of supporting biodiversity and providing additional ecosystem services. Low soil fertility and steep slopes mean most upland farms are considered 'Severely Disadvantaged Areas' (DEFRA 2018b) and currently receive subsidy payments from the CAP (Pillar I) that makes up on average 19% (£18,104) of farm revenue in less favoured areas. A further 12% (£11,172) revenue for these farms comes from CAP agri-environment schemes (Pillar II) which seek to support conservation on farmland (Harvey & Scott 2016). The Department for Environment Food and Rural Affairs (DEFRA 2018b) reports that these uplands areas have the potential to benefit from new environmental land management schemes that could help 'encourage biodiversity, protect water quality and store carbon'.

Exiting the EU and the likely associated changes in subsidy regimes, combined with the UK government's stated policy of 'public money for public goods', has made discussion about the future of the uplands urgent. This is already underway with contributions from a wide range of interested parties including farmers, businesses, government bodies, NGOs and academics. In this context, rewilding presents one of many options for management of the uplands and analysis of practitioner perspectives illustrates how the concept of rewilding is interacting with rural land management in a dynamic political landscape.

Presenting practitioner perspectives

The perspectives presented here are the authors own, but also based on direct consultation with a wider group of practitioners and policy makers. The lead author contacted practitioners and policy makers, representing a range of conservation NGOs (e.g. Royal Society for the Protection of Birds, National Trust, Wildlife Trusts), protected area managers (e.g. Areas of Outstanding Natural Beauty (AONBs), National Parks (NPs)), government and professional bodies (e.g. National Farmers Union (NFU), Countryside Land and Business Association (CLA), Natural England, Forest Enterprise England, Confederation of Forest Industries), and businesses (e.g., Ecosulis, Conservation Capital, United Utilities), who attended an earlier event organised by the Upland Alliance and further stakeholders identified during the process, as well as academics active in the field. In total, the lead author contacted 73 individuals and spoke directly to 22. Interviews were semi-structured and aimed at discussing 1) what rewilding means; 2) what risks and opportunities rewilding presents; and 3) how rewilding could be applied or facilitated if desirable approaches are identified. This process identified seven active or possible future approaches that practitioners and policy makers associate with rewilding in England's uplands (Box 1).

Following the interviews, an independently-facilitated workshop on ‘Rewilding in the Uplands’ attended by 32 participants from 24 different organisations took place on May 2nd, 2017. Attendees were primarily practitioners from a variety of sectors, including: Conservation NGOs (6), Business (4), Professional membership organisations (3), BES (3), Protected areas (3), Government body (1), Upland special interest group (1), Independent (1) and ten academics from a variety of disciplines (Ecology, Geography, Social science). Unfortunately, government policy makers due to attend had to withdraw because of ‘purdah’ rules that prevented government employees discussing policy issues preceding the UK’s 2017 snap general election.

The lead author assigned workshop participants into five groups. Each group was made up of a mix of academics and practitioners from different sectors, women and men (1:2.5 ratio), and a variety of career stages where possible to attain a variety of perspectives. First, each group considered the risks and opportunities presented by the seven pre-identified approaches to rewilding (Box 1). The lead author selected thirteen example risk (seven) and opportunity (six) categories on the themes of biodiversity, and productive, regulatory, and cultural ecosystem services. Of the 13, ten were paired, i.e. the opportunity and risk were opposites – for example, increased habitat diversification (opportunity) versus increased habitat homogenisation (risk; the full list is given in Fig. 1; Sandom *et al.* 2018). Each group was asked to make a rapid assessment of whether each category should be considered a High, Medium, Low, Not Applicable, or Unknown risk or opportunity for each rewilding approach. The groups did not have to reach a consensus and could give a range as a response, for example Medium-High. Figure 1 and Table 1 report and use the highest opportunity or risk recorded by each group.

The pre-workshop interviews with policy makers and practitioners raised numerous issues that were reported to be barriers to rewilding. These were categorised into four main groups: 1) Inflexible, Out of date, Inappropriate policy, 2) Uncertainty of environmental outcomes (in terms of biodiversity and ecosystem service delivery), 3) Stakeholder resistance, and 4) Lack of clarity, media storms, and unhelpful debate. Each group was asked to discuss how these pre-identified barriers, or additional barriers identified by the group during the workshop, prevented implementation of the rewilding approach their group had been assigned, and to vote on which they thought presented the greatest challenge. Group 1 was an exception; they considered all three forms of passive rewilding because of the similarity between these approaches. Finally, the groups discussed and recorded potential solutions to the three barriers with the most votes for their rewilding approach.

1. The many faces of rewilding – a blessing and a curse

Based on the pre-workshop structured interviews and workshop discussion it is clear rewilding means different things to different people. The lack of a single clear definition frustrates practitioners, policy makers, and academics, and along with the strong association between rewilding and reintroduction of large carnivores, means that rewilding is perceived by some as a ‘toxic’ term. However, there is recognition that rewilding encourages innovation and provides an opportunity to reconsider established land and water management strategies.

In practice, a diverse spectrum of approaches ranging from low-intervention land management to large predator translocations was identified when discussing what rewilding means (Box 1). Rewilding projects were often described as projects beginning with an active phase to restore ecological processes to move the ecosystem into a more functional starting

condition, followed by a low-intervention/passive phase, where outcomes are uncertain. The common thread linking these descriptions is the focus on restoring ecological processes to create more self-organising and self-sustaining ecosystems. Rewilding is aimed at delivering positive outcomes for biodiversity and society in general terms, but it typically represents a move away from species- and habitat-specific targets, allowing nature to determine these outcomes instead (Sandom & Wynne-Jones in press).

It is important to note that there was some disagreement amongst practitioners and academics about which land management approaches should be considered rewilding. For example, some participants particularly valued rewilding's bold and ambitious agenda and so excluded practices similar to conservation management, such as process-based habitat restoration and naturalistic grazing.

Box 1 Starts Title: Approaches to rewilding

Active Rewilding

Process-based habitat restoration

Process-based habitat restoration seeks to re-instate ecological processes with the aim of restoring a specific habitat. In some cases projects are already under way to restore certain upland habitats, most notably peatlands (e.g. Moors for the Future Partnership). This has been achieved by blocking drains and gullies and re-establishing vegetation communities to restore hydrological processes. The focus on the restoration of ecological processes is consistent with rewilding thinking, but the targeted habitat-based outcome means it is an approach more associated with traditional ecological restoration.

Wild/Naturalistic grazing

139 Wild or naturalistic grazing is the restoration of large herbivore regimes that are either wild
140 or seek to mimic wild/natural regimes respectively. It can be employed to restore
141 grazing/browsing/dunging/trampling as processes to allow ecosystems to respond naturally or
142 to maintain or improve the ecological condition and value of specific landscapes/habitats.
143 The former is more consistent with rewilding thinking. As an example, Wild Ennerdale
144 reports that they introduced herds of Galloway cattle to restore a natural disturbance process.

145 *Individual species translocations/reinforcements, removals or management to restore*
146 *processes*

147 Several species with the potential to restore degraded ecological processes could be
148 considered for translocation/reinforcement to the English uplands, including the Eurasian
149 lynx, pine marten, wild cat, beaver, white-tailed eagle, and osprey. Under this approach,
150 where and when appropriate, a specific species is introduced to restore ecological processes.
151 Alternatively, a species might be removed or controlled to restore more natural ecological
152 interactions. This could include the eradication of an invasive species, or control of a native
153 one in the absence of its predator. Beaver returning to Britain is an example of a species
154 translocation to restore process (to dam rivers and slow their flow), while the control of red
155 deer is an example of species control in the absence of its predator.

156 *Species translocations/reinforcements or removals to restore functional communities*

157 This is the restoration of whole communities of species, particularly functionally important
158 and severely impoverished communities such as large carnivores and herbivores. This could
159 be implemented nationally or targeted within a landscape-scale conservation area, such as an
160 IUCN Category II or IA National Park. This requires large areas and restoration of food-web
161 complexity, it is the most ambitious rewilding approach discussed. As far as we are aware,
162 this is not currently under serious consideration in England's uplands, but the aspirations of

163 Trees for Life and the Alladale Wilderness Reserve in Scotland are consistent with this
164 approach.

165 *Passive Rewilding*

166 *Patch-scale*

167 At the simplest end of the rewilding spectrum, landowners leave patches of their land to
168 nature. Interviewees reported that farmers in the uplands are often aware that some of their
169 land may be better suited to uses other than agricultural production, such as supporting
170 wildlife or buffering wetlands.

171 *Landowner-scale*

172 Landowners can also choose to re-purpose all their land and leave it to nature. Some
173 interviewees reported that this form of rewilding is already taking place in the uplands, with
174 slow-moving ecosystem change (including natural afforestation) occurring over recent
175 decades.

176 *Landscape-scale*

177 Landowners and managers can co-operate and agree a lower-intervention strategy over their
178 combined land. Wild Ennerdale in the Lake District is an example where three large
179 landowners are co-operating, with support from the state agency Natural England, to take a
180 wilder approach.

181 Box 1 Ends

182 **2. Risks and opportunities – higher risk, higher reward?**

183 Surveying the views of the workshop participants indicated that both the perceived risks and
184 opportunities of passive rewilding increase with spatial scale (Fig. 1, Table 1). In large
185 ecosystems that are either largely intact or where the potential for natural re-colonisation is
186 high, passive rewilding is perceived to allow natural processes to support a diverse,
187 functional, and 'service-rich' ecosystem. However, in more impoverished ecosystems with
188 low natural re-colonisation potential and currently supported by human management, passive
189 rewilding may risk further homogenising of the system because of missing ecological
190 processes.

191 Practitioners perceive the relationships between risk and opportunity to be more complex for
192 active rewilding (Fig. 1, Table 1). Interestingly, opportunistic species reintroduction was
193 perceived to be lowest risk for lowest reward, likely reflecting the opportunistic element of
194 this approach. However, participants reported this to be a difficult approach to assess because
195 of the breadth of options and outcomes possible. Process-based habitat restoration was
196 perceived to offer the best risk-to-opportunity ratio, suggesting greater comfort with more
197 controlled and targeted approaches even when seeking to work with natural processes.
198 Species translocation to restore fully functional communities was perceived to offer the
199 greatest opportunity for the highest risk. The three approaches that include species
200 translocations (including wild/naturalistic grazing) were all perceived to risk increased
201 human-wildlife conflict.

202 Reviewing the literature reveals a similar story; rewilding presents often-contrary perceived
203 risk and opportunity. For example, rewilding has been promoted as a means to restore and
204 conserve biodiversity, mitigate flooding, improve water quality, sequester greenhouse gasses
205 (GHGs), restore and conserve soils, increase tourism, and re-engage society with nature.
206 Conversely there have also been warnings that rewilding might threaten biodiversity

(particularly rare species), reduce the economic viability of agricultural production, emit GHGs, increase flood risk, threaten cultural landscapes, and increase human-wildlife conflict (Sandom *et al.* 2016).

It is important to emphasise that participants at the workshop compared best- and worst-case scenarios when considering risks and opportunities of the different approaches to rewilding. Landowners and managers, in consultation with all stakeholders, need to decide whether a rewilding approach is likely to deliver a net benefit or cost in their specific circumstances. This should include careful consideration of implementation strategies that monitor developments so timely interventions can prevent unacceptable outcomes, if needed.

3. Barriers to rewilding – a complex web of factors

The workshop highlighted that resistance from landowners/occupiers is a major barrier to implementing rewilding. However, landowner resistance reflects a variety of cultural, economic and practical factors. Culturally, there is often a strong connection to production in the uplands. Landowners or managers typically do not want to lose the utility of the land, and want to leave a farming-based land use as a legacy to their children and grand-children. Some species reintroductions conflict with tradition, culture, and neighbour relationships in the uplands, and may represent an economic threat to game and livestock rearing. A perceived focus on large carnivores has been effective at bringing the rewilding agenda to the fore but, as a controversial form of rewilding, has also polarized opinion and drawn opposition to the term rewilding more generally.

Economic barriers to rewilding include subsidy policy, which is generally focused on supporting production and associated activities. For example, CAP payments support

230 production and environmental protection only on productive land. Ponds, dense vegetation
231 and trees - all possible outcomes of rewilding - are classified as temporary or permanent
232 ineligible features and may make land they cover ineligible for CAP-based 'Pillar I' subsidy
233 payments that are tied to the area of farmable land. While 'Pillar II' CAP payments are
234 largely environmentally focused, and have scope to support actions to help alleviate flooding,
235 improve water quality, and restore wildlife habitats (GOV.UK 2017), they maintain the *status*
236 *quo* of a productive landscape rather than facilitating process-driven rewilding. These
237 schemes also cover too short a time period (~5-10 years) to be applicable or effective in
238 allowing many positive impacts of rewilding to manifest. Schemes covering 20 years or
239 more, with on-going monitoring and review, are needed for rewilding to deliver key public
240 goods and services, for example, woodland establishment and blanket bog recovery.

241 Other policies also create barriers to land-use change. Inheritance tax relief allows for land
242 and property occupied for agricultural purposes to be passed to the next generation free of
243 tax; this does not apply to buildings and land used for conservation. More indirectly, while
244 rewilding has been associated with non-productive revenue streams, such as tourism and
245 payments for ecosystem services (PES), these may not be attainable by all landowners or
246 tenants. For example, tourism requires suitable local infrastructure and skill sets, and PES
247 requires national or local schemes to be in operation.

248 Conservation policy also presents institutional barriers to rewilding, particularly the need to
249 maintain the UK's 77 Habitats Directive Annex I Habitats in 'favourable condition' (JNCC
250 2014). Under this directive, a habitat's range, area, specific structures and compositions, and
251 future prospects are considered in comparison to its status in 1994, when the Habitats
252 Directive came into effect. This fixed-date baseline is ecologically arbitrary and promotes a
253 static and preservation-focused form of conservation. This 'compositionalist' approach

(Gillson, Ladle & Araújo 2011; Jepson & Schepers 2016) constrains rewilding's process-led philosophy, which allows gains and losses of specific species and vegetation communities as dictated by the naturally varying interactions between plants, animals, and their environment. These issues also apply to listed species; their range, population, habitat availability, and future prospects must be favourable and so preserved according to the 1994 baseline. The Habitats and Birds Directives have done much for biodiversity conservation and discussing change is not without risk, but Brexit has begun this discussion and review and improvement of this legislation is also likely to be necessary to halt the decline in biodiversity.

Other practical barriers include the need for large areas to apply more ambitious forms of rewilding. Landscape-scale projects almost certainly require collaboration and long-term commitments among individual landowners. Specific examples, such as Wild Ennerdale, suggest cooperation is possible in some circumstances and for some forms of rewilding. However, while ambitious approaches might appeal to early adopters, with current barriers, it is highly likely at least some neighbouring landowners would not support rewilding on their land.

The collective barriers to rewilding are an interdependent set of practical, social, and institutional obstacles greater than the sum of each obstacle alone and capable of limiting innovation in conservation and land management. The complexity associated with rewilding is not a surprise. However, we emphasise the importance of viewing barriers to potential rewilding holistically and, critically, not simply attributing blame to specific stakeholder groups. We recognise a large number of interlinked barriers, and if rewilding approaches are to be successful, changes will need to be effected across a number of different areas in various ways.

4. Potential future approaches – practical suggestions for flexibility and diversity

278 *Innovation fund:* An innovation fund would be a mechanism to support innovative and
279 diverse projects, including but not restricted to rewilding. Such a fund could take on a similar
280 structure to the Nature Improvement Area fund and the current Countryside Stewardship
281 Facilitation fund, and be part of the proposed Nature Recovery Network in the 25YEP. Both
282 funds encourage a bottom-up, land manager-driven approach to designing and developing
283 projects tailored to local needs and situations.

284 *Conservation property relief:* Introducing Conservation Property Relief to match Agricultural
285 Property Relief for inheritance tax would remove a key barrier, providing opportunities to
286 improve biodiversity conservation and the delivery of diverse ecosystem services.

287 *Results-based payments:* There is interest in moving indicators for agri-environmental
288 payments (i.e. CAP Pillar II payments) from actions towards results (25YEP). Results-based
289 payments are being trialled by Natural England with farmers in the Yorkshire Dales where
290 farmers are being paid for success in producing species-rich meadows and/or good quality
291 wetland habitat (Natural England 2017). The Dartmoor Farming Futures initiative has also
292 reported positive results of giving farmers greater ownership when developing strategies to
293 achieve mutually agreed agri-environment goals (Manning 2017). Although potentially
294 riskier for landowners/managers, with less certainty of income, this approach gives
295 landowners/managers greater autonomy to determine how to achieve mutually-agreed goals.
296 A key point of discussion would be agreeing whether broad enough goals (i.e. positive
297 outcomes for biodiversity and the delivery of ecosystem services rather than specific habitat
298 or species targets) could be set to allow a rewilding approach.

299 *Payments for ecosystem services:* The CAP is arguably a payment for ecosystem services
300 scheme, but one that supports food production and farmland biodiversity. An alternative
301 approach would be to incentivise a wider range of environmental goods and services, and

may be consistent with the Government's increased focus on 'public money for public goods' (DEFRA 2018b). This could still include food production, but also flood alleviation, water purification, GHG sequestration, and environmental health and leisure resources more directly (Gawith & Hodge 2017). Any such approach would require analysis of what is valued in a particular landscape or region, and therefore what land managers should be paid to deliver, something already being considered under the Countryside Stewardship scheme. The mechanism for linking what landowners should deliver to the desired public benefits for a region is challenging. However, this could build on the work already done by the Natural Capital Committee, which proposes linking specific land uses with ecosystem service delivery (Natural Capital Committee 2014). Thus, a locally-active body (e.g. County Council, Environment Agency) could determine the value of landowners delivering grassland, woodland, or wetlands in their region and reward landowners accordingly. The regionally-targeted Landscape Character Assessments (DEFRA 2014) may provide some of the information needed to understand regional needs, as well as the cultural and natural heritage of the region that would need to be taken into account.

Longer-term funding: Long-term funding for any scheme would be needed to allow rewilding projects to develop toward the delivery of biodiversity and ecosystem service benefits. One suggestion is for 'conservation covenants' operating on at least a 20-year timescale, and preferably longer, with monitoring, payments in instalments, and appropriate break clauses.

Standardised monitoring of biodiversity and ecosystem services outcomes: Monitoring can be time-consuming and expensive, potentially making it unviable. However, to demonstrate the public is receiving goods and services for public money invested, rigorous monitoring is important. A standardised, efficient and effective protocol to monitor biodiversity and ecosystem service outcomes is needed. As discussed above, this would need to correspond to

specific land-uses and their respective quality, quantity, and connectedness (Lawton *et al.* 2010; Natural Capital Committee 2014). Using citizen science approaches (e.g. Manning 2017) and advances in remote sensing technology, including satellite monitoring (Pettorelli *et al.* 2017) and drones (Barbosa, Atkinson & Dearing 2015) may help achieve this.

Outdoor laboratories: The need for experimentation and innovation is limited by multiple designations of sites. For example, National Nature Reserves (NNRs) have a mandated role as outdoor laboratories, and could be used to test the effectiveness of different approaches to conservation. However, nearly all NNRs are also SSSIs, which are mandated to maintain favourable condition of listed habitats and species limiting the scope for experimentation. NNR policy is being reviewed which could help determine how their role as outdoor laboratories could be better realised while maintaining favourable condition of key species and habitats. This could include linking clusters of NNRs to create larger conservation areas where rewilding is encouraged for interlinking land and water, or establishing new experimental rewilding zones as part of the proposed Nature Recovery Network (25YEP).

5. Conclusions

We have discussed seven rewilding approaches identified by academics, practitioners and policy makers to explore and clarify the range of rewilding-related ideas being considered in practice in England's uplands. However, we note that they are not all mutually exclusive and can be combined, they fall along a spectrum of rewilding ambition, and that these approaches represent a managed withdrawal of direct human management of nature, either directly (passive) or after some remedial action (active).

This withdrawal is arguably the common theme that connects rewilding's otherwise varied meanings (Pettorelli *et al.* 2018) and presents the greatest barrier to implementing rewilding more widely because of how it interacts with policy and culture. Policy, such as the CAP and

350 the Birds and Habitats Directives, is process driven and directed at supporting, encouraging,
351 and enforcing the implementation of management to deliver specific ecosystem service,
352 species, or habitat targets and thus creates legislative and economic barriers to rewilding
353 approaches. Landowners' and managers' strong cultural connection to production, traditional
354 land uses and landscapes they and their forebears have crafted also presents barriers to
355 implementing rewilding because of resistance to reducing human influence on nature. Yet,
356 these barriers are not universal. Land owners/managers can forego production, target their
357 efforts on undesignated land, work with officials to get special dispensation to take a
358 rewilding approach, and embrace a new culture where nature has a stronger role. This
359 explains the rewilding that has taken place already. The degree and direction of change to
360 policy, incentives and culture in the future will determine the degree to which approaches to
361 land management associated with rewilding are embraced in England's uplands.

362 The risks, opportunities, barriers, and solutions discussed here have relevance to other
363 regions of the world where society has largely tamed nature, has strong policy and cultural
364 connections to productive or other traditional land uses, and has nature conservation policy
365 focused on management of rare habitats and species that remain. The history and policy
366 shared between England, the UK, and the EU mean this discussion is particularly relevant in
367 Europe, albeit with some caveats. For example, in mainland Europe, agricultural land
368 abandonment and higher natural recolonization potential, as seen with the natural expansion
369 of large predators and herbivores (Deinet *et al.* 2013), mean landscape-scale passive
370 rewilding is likely more achievable and possibly more beneficial here compared to most
371 British landscapes. In contrast, other isolated and particularly disturbed ecosystems, such as
372 Australia where invasive species and severe megafauna extinction are particular issues,
373 practitioners are likely to need to focus on more active rewilding approaches (Rewilding
374 Australia 2018).

While the human cultural, policy, and economic barriers to implementing rewilding are likely to share some common themes over much of the tamed world, diverse environments, histories and specific cultures mean approaches to implementing rewilding will vary regionally, nationally, and internationally. To allow rewilding opportunities to be realised more broadly while minimising risks, policy frameworks within which rewilding operates must be sufficiently flexible and the practitioner's toolbox diverse to overcome varied and interlinked challenges.

Authors' Contributions

CJS conceived the idea. CJS and BD wrote the manuscript with support, input, and final approval from all co-authors.

Acknowledgements

CJS acknowledges support from a NERC Knowledge Exchange Fellowship (NE/P005926/1). We would like to thank Rob Cooke, Ben Connor (British Ecological Society), John Gorst (United Utilities), Christopher Price (CLA), Jonathan Spencer (Forest Enterprise England), Pat Thompson (RSPB), Rob Yorke (Independent commentator) and all other anonymous interviewees and participants of the Rewilding in the Uplands workshop for sharing their views.

Data accessibility

Data available from the Dryad Digital Repository doi:10.5061/dryad.d460505

Biosketch

396 **Chris Sandom** is a Lecturer at the University of Sussex and Co-Director of Wild Business
397 Ltd with a particular interest in rewilding and predator-herbivore-vegetation interactions.

398 **Benedict Dempsey** is a PhD student at the Science Policy Research Unit at the University of
399 Sussex, currently researching the issue of human control of nature in ecology and
400 conservation, and with additional interests in international development and humanitarianism.

401 **David Bullock** is Head of Species & Habitat Conservation at National Trust and Chair of
402 Vincent Wildlife Trust, with especial interests in wildlife management and reversing declines
403 in biodiversity. **Adrian Ely** is Senior Lecturer at SPRU-Science Policy Research Unit at the
404 University of Sussex, where (amongst other things) he researches the regulation and
405 governance of agricultural innovation. **Paul Jepson** is Course Director of Oxford
406 University's MSc/Phil in Biodiversity, Conservation and Management and Senior Research
407 Fellow at the Smith School of Enterprise and the Environment. He has a long standing and
408 active interest in rewilding and is a member of the supervisory board of Rewilding Europe.

409 **Stefan Jimenez Wisler** is a Land Use Policy Adviser at the CLA and interested in bringing
410 ambitious environmental ideas into practice. **Adrian Newton** is a conservation ecologist at
411 Bournemouth University, UK, with a particular interest in forest ecosystems. **Nathalie**
412 **Pettorelli** is a Senior Research Fellow at the Zoological Society of London, a charity
413 concerned with the worldwide conservation of animals and their habitats. **Rebecca Senior** is
414 a PhD student at the University of Sheffield and completed a secondment with the charity
415 Rewilding Britain in 2016, investigating the potential for rewilding at different spatial
416 scales within the UK.

Table 1: Total opportunity and risk scores for each approach to rewilding across six potential opportunities and seven potential risks of rewilding (as given in Fig. 1) as scored by groups of conservation and land management practitioners and academics at the Rewilding in the Uplands workshop. Scoring was across a four point scale, 0 = none to 3 = high. The groups could give a range of scores during the workshop, e.g. medium to high, totals represent summing maximum risk or opportunity scores.

Fig 1: Bar graphs of the highest perceived risks and opportunities presented by different approaches to rewilding to biodiversity and example ecosystem services according to groups of conservation and land management practitioners and academics at the Rewilding in England's Uplands workshop. 0 = none, 1 = low, 2 = medium, 3 = high, risk or opportunity. Bars are mean \pm 1 SE. n = the number of groups that responded. u = the number of groups that indicated the risk or opportunity was unknown. When n and u do not equal five it indicates some groups did not assign a score.

Rewilding Approach	Opportunity	Risk
Patch scale passive rewilding	8.2	5.3
Landowner scale passive rewilding	13.0	13.8
Landscape scale passive rewilding	16.0	15.4
Processed based habitat restoration	13.0	8.5
Wild/Naturalistic Grazing	12.6	11.7
Opportunistic species reintroduction	8.8	7.6
Species reintroduction to restore functional communities	15.3	13.2



436

437 **References**

- 438 Barbosa, C.C.D., Atkinson, P.M. & Dearing, J.A. (2015) Remote sensing of ecosystem
439 services: A systematic review. *Ecological Indicators*, **52**, 430-443.
- 440 DEFRA (2014) Landscape and seascape character assessments.
441 <https://www.gov.uk/guidance/landscape-and-seascape-character-assessments>
- 442 DEFRA (2018a) A Green Future: our 25 Year Plan to Improve the Environment. (ed. F.R.A.
443 Department of Environment).
- 444 DEFRA (2018b) Health and Harmony: the future for food, farming and the environment in a
445 Green Brexit. (ed. D.f.E.F.R. Affairs). APS Group.
- 446 Deinet, S., Ieronymidou, C., McRae, L., Burfield, I.J., Foppen, R., Collen, B. & Böhm, M. (2013)
447 Wildlife comeback in Europe: The recovery of selected mammal and bird species.
448 Zoological Society of London.
- 449 Environmental Audit Committee (2016) Future of the Natural Environment after the EU
450 Referendum. [http://www.parliament.uk/business/committees/committees-a-](http://www.parliament.uk/business/committees/committees-a-z/commons-select/environmental-audit-committee/news-parliament-2015/future-of-natural-environment-after-the-eu-referendum-launch-16-17/)
451 [z/commons-select/environmental-audit-committee/news-parliament-2015/future-](http://www.parliament.uk/business/committees/committees-a-z/commons-select/environmental-audit-committee/news-parliament-2015/future-of-natural-environment-after-the-eu-referendum-launch-16-17/)
452 [of-natural-environment-after-the-eu-referendum-launch-16-17/](http://www.parliament.uk/business/committees/committees-a-z/commons-select/environmental-audit-committee/news-parliament-2015/future-of-natural-environment-after-the-eu-referendum-launch-16-17/)
- 453 Gawith, D. & Hodge, I. (2017) Envisioning a British Ecosystem Services Policy. Cambridge
454 Centre for Science and Policy.
- 455 Gillson, L., Ladle, R.J. & Araújo, M.B. (2011) Baseline, Patterns and Process. *Conservation*
456 *Biogeography* (eds R.J. Ladle & R.J. Whittaker). John Wiley & Sons Ltd. .
- 457 GOV.UK (2017) Countryside Stewardship.
458 [https://www.gov.uk/government/collections/countryside-stewardship-get-paid-for-](https://www.gov.uk/government/collections/countryside-stewardship-get-paid-for-environmental-land-management)
459 [environmental-land-management](https://www.gov.uk/government/collections/countryside-stewardship-get-paid-for-environmental-land-management)
- 460 Harvey, D. & Scott, C. (2016) Farm Business Survey 2014/2015: Hill Farming in England.
461 University of Newcastle.
- 462 Jepson, P. & Schepers, F. (2016) Making space for rewilding: creating an enabling policy
463 environment. *Rewilding Europe Policy Brief*
- 464 JNCC (2014) Habitats. <http://jncc.defra.gov.uk/page-4064>
- 465 John Muir Trust (2015) Rewilding: Restoring ecosystem for nature and people.

466 Lawton, J.H., Brotherton, P.N.M., Brown, V.K., Elphick, C., Fitter, A.H., Forshaw, J., . . .
 467 Wynne, G.R. (2010) Making Space for Nature: a review of England's wildlife sites and
 468 ecological network. Report to Defra.

469 Lorimer, J., Sandom, C., Jepson, P., Doughty, C., Barua, M. & Kirby, K.J. (2015) Rewilding:
 470 Science, Practice, and Politics. *Annual Review of Environment and Resources*, Vol 40,
 471 **40**, 39-62.

472 Manning, J. (2017) Dartmoor Farming Future - Evaluation Report to Dartmoor National Park
 473 and Natural England.

474 Natural Capital Committee (2014) The state of natural capital: Restoring our natural assets.

475 Natural England (2017) Grassland Pilot: Wensleydale, Yorkshire Dales. *Results Based Agri-
 476 environment Payment Scheme (RBAPS)*.

477 Pettorelli, N., Barlow, J., Stephens, P.A., Durant, S.M., Connor, B., Buhne, H.S.T., . . . du Toit,
 478 J.T. (2018) Making rewilding fit for policy. *Journal of Applied Ecology*, **55**, 1114-1125.

479 Pettorelli, N., Buhne, H.S.T., Tulloch, A., Dubois, G., Macinnis-Ng, C., Queiros, A.M., . . .
 480 Nicholson, E. (2017) Satellite remote sensing of ecosystem functions: opportunities,
 481 challenges and way forward. *Remote Sensing in Ecology and Conservation*, **4**, 71-93.

482 Rewilding Australia (2018) Rewilding Australia. <https://rewildingaustralia.org.au>

483 Rewilding Britain (2017) Examples of rewilding.
 484 <http://www.rewildingbritain.org.uk/rewilding/rewilding-projects/>

485 Sandom, C.J., Clouttick, D., Manwill, M. & Bull, J.W. (2016) Rewilding Knowledge Hub:
 486 Bibliography - Version 1.0. (ed. W. Business). Rewilding Britain.

487 Sandom, C.J., Dempsey, B., Bullock, D., Ely, A., Jepson, P., Jimenez-Wisler, S., . . . Senior, R.A.
 488 (2018) Data from: Rewilding in the English Uplands: Policy and Practice. Dryad Digital
 489 Repository.

490 Sandom, C.J. & Wynne-Jones, S. (in press) Rewilding a country: Britain as a case study.
 491 *Rewilding* (eds N. Pettorelli, S. Durant & J. Du Toit). Cambridge University Press.

492 Svenning, J.C., Pedersen, P.B.M., Donlan, C.J., Ejrnaes, R., Faurby, S., Galetti, M., . . . Vera,
 493 F.W.M. (2016) Science for a wilder Anthropocene: Synthesis and future directions for
 494 trophic rewilding research. *Proceedings of the National Academy of Sciences of the
 495 United States of America*, **113**, 898-906.

496 Upland Alliance (2016) Upland Statistics for England: Sources for the Infographic.
 497 [https://uplandsalliance.files.wordpress.com/2016/11/upland-statistics-for-england-
 498 sources.pdf](https://uplandsalliance.files.wordpress.com/2016/11/upland-statistics-for-england-sources.pdf)

499 Wentworth, J. & Alison, J. (2016) Rewilding and Ecosystem Services. (ed. Parliamentary Office
 500 of Science and Technology).

501 Woodland Trust (2017) Rewilding: Working with nature.

502