# Facilitating dynamic and inclusive biodiversity conservation in Britain

## An Anthropocene perspective

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# Facilitating dynamic and inclusive biodiversity conservation in Britain: An Anthropocene perspective

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# Executive summary

We propose an approach to conservation centred on achieving positive future trajectories of dynamic change, applied to all locations and species, and based on societal inclusiveness.

**Strategies to facilitate change**. We take an Anthropocene perspective, in which human society and biodiversity have been inextricably linked for over 10,000 years, and continuing biodiversity change is inevitable. The challenge is to identify circumstances under which change is acceptable or beneficial, without being tied to specific historic baselines. We outline a Resist-Accept-Facilitate (RAF) framework that could be applied to all conservation activities, from high-level planning and measurement (indicators) through to practical land and species management, to ensure that the facilitation of future biodiversity benefits receives as much attention as the resistance of change.

**Everywhere is important**. Different places are important for different things, such as particular species or ecosystem services, and people vary in how they value these features. We suggest a perspective whereby we evaluate what every area is most important for, and what they could be most important for in future by considering possible trajectories of biodiversity and ecosystem change. We propose zoning any region of interest, such as the UK, and applying the RAF framework in an inclusive manner to develop conservation strategies that are appropriate in each location and zone. This RAF approach will reconcile different conservation philosophies (such as traditional management, land-sharing/sparing, rewilding, novel ecosystems, ecosystem services, human wellbeing) because different conservation outcomes will emerge in different zones.

**Enabling species to move**. Genes and species undertake changes to their abundances and distributions in response to climatic and other environmental changes. We suggest that trans situ conservation be developed as a complement to traditional in situ (sites in the wild) and ex situ (in captivity) conservation. Trans situ conservation primarily involves Accept and Facilitate interventions within the RAF framework. It requires consideration of the connectedness and permeability of regions (facilitating colonisation for a majority of species and genes) and the value of new populations of colonising species and novel communities that arise from species range shifts. Trans situ conservation also considers the potential to translocate (assisted colonisation) species and genes that are unable to shift their distributions without direct intervention, highlighting the transnational needs of globally-threatened species rather than locally-rare ones whose future is secure elsewhere.

**For everyone**. The justification for conservation commonly focuses attention on the benefits that individuals and society derive from the natural world, yet the benefits are not shared equitably. The RAF approach asks people from a wide range of backgrounds ‘what they want’ from local landscapes so as to inform the development of more inclusive approaches to conservation both now and in the future. We identify ways in which the processes of conservation could incorporate an increased diversity of perspectives, whilst continuing to be informed by data and professional expertise.

## Contents

# Foreword

Natural England commission a range of reports from external contractors to provide evidence and advice to assist us in delivering our duties. The views in this report are those of the authors and do not necessarily represent those of Natural England.

This think-piece was commissioned by Natural England to provide a response to the challenge ‘if there were no legal protections for the natural world in England in 2021, what would you create in the face of climate change?’

The report has informed the development of a ‘Climate Smart’ Adaptive designations brief, providing recommendations to maintain protections in a time of rapid ecological change.

# 1. Scope

This article addresses four high-level and nine more specific questions that relate to the conservation of biodiversity and ecosystems during a period of rapid environmental change:

- How should we identify strategic priorities for conservation in a changing world?
  - How do we approach the conservation of biodiversity at a time of rapid environmental change? (Section 2)
  - How do conservationists decide when to accept or facilitate change? (Section 3)
  - How do conservationists set strategic goals and identify appropriate indicators of success during a period of rapid change? (Section 4)
- How do we identify what to prioritise in different locations?
  - How do we define conservation goals for all parts of a country? (Section 5)
  - What are the most appropriate strategies to facilitate increases in biodiversity and human benefits in all locations? (Section 5)
- Why, when and how should we manage the movement of species?
  - Under what circumstances, and how, should we intervene to facilitate the dispersal and colonisation of species? (Section 6)
  - How should the geographic origin of species influence our decisions to resist, accept or facilitate the spread of any species? (Section 7)
- How do we make conservation relevant to all groups of society and ensure that everyone benefits?
  - How can we embed participatory and inclusive processes into resist, accept or facilitate decision-making? (Section 8)
  - How can we best ensure that the benefits of dynamic biodiversity are shared by people of all social backgrounds? (Section 8)

This article is a response to the Natural England Challenge: “If we were arranging for the protection and conservation of important habitats, species and geological features in 2021 from scratch, what should we create in the face of environmental change?” It concentrates on the ‘environmental change’ component of the question. The article also considers elements of the ‘from scratch’ aspect of the challenge, in terms of conservation, but we also recognise that the biological world represents a continuum of change which did not start ‘from scratch’ at any point within human history. Past conservation interventions are already part of that history, with many species in Britain most abundant in, and some wholly confined to, existing protected areas. Hence, the aim of the article is to identify forwards-looking, positive approaches that build upon rather than set aside the past. This article focuses on biological change rather than on geological processes and features, and on terrestrial rather than marine ecosystems, but many of the same principles of accommodating dynamism and inclusive decision-making apply in these contexts too.

The remit of Natural England is England, and hence we emphasise biodiversity change and conservation in the UK, Britain and England, but the same broad principles should apply anywhere.

# 2. A dynamic past, present and future

Nature is not static, to be protected as it is. It is the dynamic consequence of multiple processes, including human activities. The distributions of British species and composition of ecosystems have been transformed by people over millennia. Every wild organism that exists today survives in a human-modified ecosystem and every benefit that humans obtain from biodiversity is, likewise, derived from ecosystems that have already been modified by people. In other words, human and non-human influences on the distributions and abundances of species, and on biological communities and ecosystems, can no longer be unpicked (Thomas 2017). These changes will continue for the foreseeable future in response to anthropogenic climate change and other environmental changes that are directly or indirectly driven by people. This poses serious challenges for conservation. Populations of animals, plants and microbes come and go, and species change their distributions at accelerated rates during periods of environmental change, altering the composition of biological communities. Given this dynamism, a key question is:

- How do we approach the conservation of biodiversity at a time of rapid environmental change?

The past and ongoing role of human activity in shaping today's biodiversity is challenging for the development of conservation priorities, but the challenge is not new. The importance of human influence on the English countryside and on the wildlife associated with it was already well appreciated in the mid-20th century, at the time when the British system of National Nature Reserves (NNR) and Sites of Special Scientific Interest (SSSI) was being established. This perspective was articulated in W.G. Hoskins' (1955) 'The making of the English landscape', and was reinforced in Richard Mabey's (1980) 'The common ground' and Oliver Rackham's (1986) 'The history of the countryside'. Recognition of the importance of traditional land management to the composition of the vegetation and to the survival of particular animal and plant species became increasingly well appreciated in the second half of the 20th century. This understanding has resulted in a focus on traditional management as a means to maintain the 'condition' of protected areas, often defined by the presence and abundances of particular focal species, and combinations thereof (for example the National Vegetation Classification [NVC]; Rodwell 1991a; 1991b; 1992; 1995; 2000).

However, historic management and the maintenance of cultural landscapes can no longer deliver the same biodiversity outcomes because nitrogen deposition, CO2 enrichment of the atmosphere, changing rainfall patterns, increasing temperatures, and the exchange of species between protected areas and the wider countryside mean that the composition of 'protected' communities is changing at a rapid rate. One response is to redouble management efforts, but we need to evaluate our continuing rationale for this.

Future decisions and priorities will inevitably diverge from those made over the last 75 years, not because those past decisions were wrong, but because of emerging realities in a rapidly changing 'Anthropocene' world, in which the increased human population and burgeoning consumption are major drivers of the Earth system, and there is no going

back. Research on the dynamics of species in modern fragmented landscapes (for example, Hanski 1999; Thomas & Kunin 1999), evidence of the polewards range shifts of many species in response to climate change (Hickling and others 2006; Mason and others 2015; Platts and others 2019), and widespread shifts towards biotas associated with increased nitrogen availability (Firbank and others 2008; Hayhow and others 2019) illustrate the magnitude of the challenge. The distributions of nearly all species are changing, and we know that there is currently an accelerated turnover of populations and species within local communities (Dornelas and others 2014; Suggitt, Lister & Thomas 2019). Retaining the status quo is not realistic. Rather than consider biological dynamism as 'a problem' that needs resisting, dynamism needs to be considered as the means by which species and ecosystems adjust to changing environmental conditions (Vellend 2016; Thomas 2017). We suggest, therefore, that encouraging positive changes that diverge from the past are as legitimate as more conventional approaches that focus on slowing declines.

Biological dynamism is continuous. All of the biological communities in Britain have assembled from immigrant species since the end of the last Pleistocene 'ice age'. The post-glacial Holocene ecosystems that came into existence 10,000 to 12,000 years ago were 'novel ecosystems' in their day. Subsequently, the early successional woodland, grassland and heathland habitats generated by our ancestors, especially over the last ~5,000 years, were colonised by previously unprecedented mixtures of species. These new communities comprised species persisting from the pre-existing forest biota, other species that colonised from naturally open habitats nearby, and others from more distant locations within Britain, while many more would have arrived from continental Europe, either unaided or with the assistance of humans (Preston, Pearman & Hall 2004; Thomas 2009; Stace & Crawley 2015). The species that thrived and novel habitats that came into existence over this period form the core of today's conservation priorities despite being human-generated ecosystems. Species continue to arrive in Britain, spreading and forming new biological assemblages. Ecologists and conservationists generally accept and welcome the species associated with human-caused ecosystem changes that took place many hundreds to several thousand years ago, but more recently-formed ecosystems and new biotas are typically considered negatively. We contend that species which have arrived in new localities in the recent past, and which will do so in future, are no more or less likely to be problematic (although some are) for humans than those that pre-dated them, and that novel species, biological assemblages and ecosystems that have come into existence in recent decades and centuries are as worthy of interest as the succession of novel ecosystems formed earlier in human history.

The most widely articulated conservation narrative is one of biodiversity loss and endangerment, which is a true reflection of the population trajectories of many individual species. The growing lists of threatened species compiled by the International Union for Conservation of Nature (IUCN) and by individual nations are testament to such declines (Butchart and others 2010; IUCN 2020). However, this is an oversimplification. The number of species per island or per country in the world has, for the most part, been increasing in recent centuries (Sax & Gaines 2003), and that is true of Britain, where the number of introduced and colonising species has exceeded the number of national-scale

extirpations[1] . Britain supports populations of around 2,000 ‘non-native’ species (Roy and others 2014b; Defra 2020), each of which has increased from zero to their current distribution size. Therefore, even though many early- (called ‘native’ species) and mid-Holocene (for example, ‘non-native’ archaeophyte plants) colonists have declined, increases by more recent arrivals mean that net change can go either way. The story is nuanced because local diversity has gone up in some places and down in others, and the pattern of change depends on the spatial scale that is considered (Sax & Gaines 2003; Dornelas and others 2014).

We propose that this past history and accelerating 21st century changes demand a major re-framing of nature conservation to focus on the processes underlying ecological dynamics, reorienting biodiversity conservation in ways that lead to positive trajectories. We should recognise the historical dynamism of our species and habitats, and continue to protect many currently-cherished habitats and species, but also anticipate future change and identify how we might intervene to facilitate positive outcomes. This new framework recognises that the future will inevitably diverge from the past.

In conclusion, biological systems have always been dynamic and have been moulded by human activities for more than 10,000 years. Rather than consider this dynamism as a modern ‘problem’ that needs resisting, dynamism should be recognised as the means by which species and ecosystems adjust to changing environmental conditions, including those caused by humans. This narrative of the importance of humans to past, ongoing and future biological dynamism provides huge opportunities. We can celebrate (and regret in some instances) historical changes, navigate current change, and look forward to identifying positive directions of future change. By placing people centrally in the narrative, not only can we update priorities to reflect more recent biodiversity change, but it also becomes appropriate for the current conservation community to engage with a broad range of people whose multifarious and collective decisions in all areas of life ultimately determine trajectories of environmental change. Sharing decision-making in the places where most people live also has considerable potential to increase the equitability of conservation benefits.

[1] Extirpation refers to the loss of a species from a region, while the species itself survives in other parts of the world. This applies to most British losses because Britain contains few endemic species.

# 3. New strategies are needed in a time of change

'Protected area', 'preservation', 'risk analysis', 'vulnerability assessment', 'resilience' and even 'conservation' convey a sense of keeping things as they are, while habitat 'restoration', nature 'recovery', and 'rewilding' suggest that conservationists[2] are hankering after a 'better' past. Similarly, the establishment of conservation baselines (for example NVC plant communities) represents an ideology that things used to be better in the past. Baseline thinking is unrealistic in dynamic ecosystems because it lauds changes up to a certain baseline date or state but considers any subsequent changes that move the system away from that baseline as undesirable. Conservation discourses and policies are of course far more complex than this, but the emphasis of conservation is nonetheless mostly focussed on stopping something that is perceived to be undesirable from happening, rather than engaging fully with influencing future change in ways that are deemed to be desirable. For example, three of the five Nature Recovery Network objectives for England are articulated in the language of restoration and recovery, and 86% of recommended North American and European forest management responses to climate change have primarily focused on maintaining existing ecological patterns and processes (Hagerman & Pelai 2018). Reflecting on historic changes is vital because it provides understanding of ecological processes but returning to such a past state is unattainable.

In this section, we outline a general strategic approach to help identify when we might Resist change, and when we might Accept or Facilitate change. Trying to slow, stop, or reverse change has its place, but we need to adjust our attitudes and targets so that we do not expend increasing levels of effort and resources on 'losing battles'. Instead, we need to consider which of a number of possible future trajectories of change might be considered to be more or less positive[3] than others. In this section, therefore, we consider:

- How do conservationists decide when to accept or facilitate change?

In practice, conservationists do regularly operate adaptive management, adjusting goals and actions, for example in the context of climate change (Duffield, Le Bas & Morecroft 2021), but explicit forwards-looking strategies are rarely fully developed. Even when conservationists plan for and celebrate biological and conservation gains (Balmford 2012; Young and others 2014), successes are often valued because they represent some level

[2] We use the word conservationist to refer collectively to individuals and organisations, ranging from amateur naturalists through NGO and government agency professionals, to academics, and to anyone else with an interest. We do not imply any specific shared perspective on a particular issue.

[3] By positive, we mean directions of change that society deems to be preferable, given a number of possible feasible options (visions, storylines) for how the Anthropocene may develop.

of recovery from past harm. Preferences for historic states are widely encoded within species priority rankings, biodiversity indicators, priorities for site selection, measures of site management and condition, and (re)introduction policies, as discussed in the following sections.

Hence, they represent an institutionalised preference for ‘static’ and ‘native’ nature, which is out of kilter with biological reality and may also be out of step with current thinking[44] (Sandbrook and others 2019; Dempsey 2021). Increasing numbers of authors have emphasised the importance of developing future-oriented and realistic long-term conservation goals that incorporate dynamic change in our plans and actions (for example, Choi 2007; Millar, Stephenson & Stephens 2007; Thomas 2011, 2017, 2020; Corlett 2016; Williams, Ordonez & Svenning 2021).

Dynamic thinking is increasingly widespread, but the challenge is to identify what actions to take, and when. Several recent frameworks have moved in this direction (Table 1), including the Resist-Accept-Direct (RAD) change framework adopted by the US National Parks Service (Schuurman and others 2020). Although these frameworks differ in their details and wording, they all recognise the tension between trying to prevent or embrace change. Building on these, we propose a:

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**RESIST – ACCEPT – FACILITATE change framework for Anthropocene conservation.**

Most of the published schemes in Table 1 are specifically inspired by the challenge of climate change, and one (Truitt and others 2015) by the emergence of novel ecosystems (incorporating non-native species). However, the framework can apply in the context of any processes that cause change: nitrogen deposition, colonisation by non-native species, anthropogenic climate change, changing farming practices and other drivers of change, ideally in combination. To overcome institutionalised Resistance to change and nativism, this framework needs to be embedded within every aspect of conservation. It can be applied to overall conservation strategies (planning, setting targets, monitoring change), to

[4] Dempsey (2021) found that only 6 out of 30 participants surveyed for their perspectives on conservation in England aligned with a ‘Protection of Threatened Nature’ framing (a view that favoured native / historical species and habitats). On average, adherents to this perspective were a decade older than other participants. 2 out of 4 government agency participants took this view, as compared to only 4 out of the remaining 26 participants.

the conservation of places (sites, ecosystems, landscapes) and species, and to the provision of ecosystem services and human wellbeing.

**Table 1**. A Resist-Accept-Facilitate change framework for Anthropocene conservation*.

| Resist | Accept | Facilitate | Published scheme |
|---|---|---|---|
| Resist, Resilience | | Respond; Facilitate | Millar, Stephenson & Stephens 2007 |
| Manage against novelty | Tolerate | Manage for Novelty | Truitt and others 2015 |
| Adaptation (active, to maintain current conditions) | Adaptation (passive) | Transformation | Hagerman & Pelai 2018 |
| Climate-targeted amelioration, Low regrets amelioration | Low regrets tolerance | Low regrets connections; Climate-targeted translocations | Prober and others 2019 |
| Resist | Accept | Direct | Schuurman and others 2020 |
| Resist (active, passive), Resilience | Transform (autonomous) | Transform (direct, accelerate) | Peterson St-Laurent and others 2021 |

* *In some instances, we have paraphrased the original author wording or adjusted categories to show how different approaches map onto the three main response categories. Resilience is grouped with Resistance because these authors used resilience primarily in the sense of minimising change, but we recognise that resilience relates to all three categories (for example, Facilitating species turnover to allow resilience of ecosystem services, Dudney and others 2018). We prefer 'Facilitate change' to terms such as 'direct change' or 'transform', which imply greater control of species and ecosystems than is realistic.*

There is no single 'best way' to facilitate positive trajectories of change, so we suggest that the challenge for conservation and environmental organisations is to ensure that all strategies and practical activities are routinely scrutinised within a RAF framework (Figure 1), so as to consider options to engender positive change (the Facilitate part) as well as to retain historic features (the Resist part). It is important to emphasise that Resist, Accept and Facilitate are not mutually-exclusive options. Any given strategy or practical action should consider, and potentially embrace, elements of all three, an approach that may be

appealing because it presents a blend of options, rather than a stark abandon-change bifurcation. Efforts to retain individual species and maintain biological communities and ecosystems will still have a place, given our attachment (existing values) to particular places and species, and societies and infrastructures may be attuned to the local ecosystem services associated with that biodiversity. But attempts to 'retain the present' or 'restore the past' risk pouring an ever-increasing fraction of our resources into what may, ultimately, represent a lost cause. How much resource should be spent on trying to conserve arctic-alpine species from climate change in Britain, for example, if the same species have secure distributions in the high arctic or in the alpine tundras of Eurasian mountain ranges? 'We don't know enough, so we should carry on trying' comes the answer (Newman, Varner & Linquist 2017), a generic response that sounds reasonable until one considers the costs of Resistance and the opportunity costs. The ongoing costs associated with attempts to maintain or restore systems to a historical benchmark and the opportunity costs of not shifting direction towards Accepting or Facilitating change may be large, and these costs will increase progressively with the growing mismatch between historical ecosystems and the future physical and human environment. The RAF framework considers these new opportunities. Measures of conservation success are then defined by the extent to which Resist and Facilitate interventions meet the intended goals, while Accept outcomes are measured against prior expectations to evaluate whether Resist or Facilitate interventions are required in future.

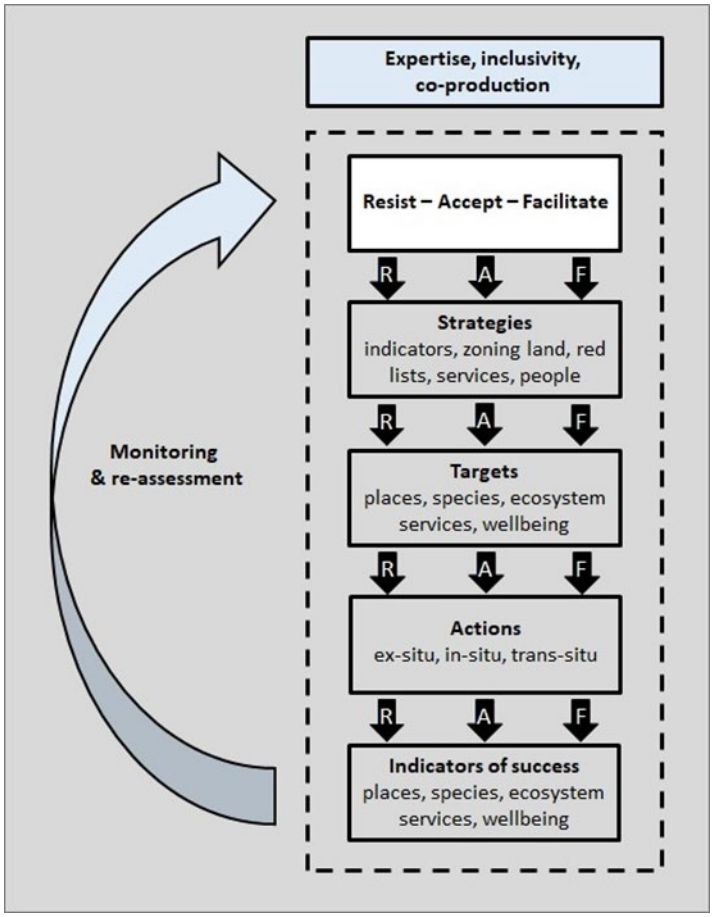


**Figure 1**. Schematic of a dynamic and inclusive framework for conservation

In conclusion, the RAF approach is a way of ensuring that a wide range of options is considered, the details of which will vary depending on whether one is future-proofing government legislation or local reserve management. In the following sections, we will first

consider conservation strategies, then the conservation of places (sites, ecosystems, landscapes; in situ approaches to conservation) and the challenges posed by dynamic species ranges (trans situ conservation), and finally return to the issue of involving a broader range of people in both the generation of ideas and decision-making. We concentrate on the Accept and Facilitate aspects of the RAF framework because they are not currently being considered as routinely as the Resist components in conservation planning and interventions.

# 4. Conservation strategies and indicators of change in a dynamic world

Strategic planning is critical to conservation because it reflects our values and aspirations, against which all policies, management and outcomes can be judged. Many of these aspirations include historic elements, such as our present-day cultural affinity for traditionally-managed ecosystems and historic landscapes, which then determine our restoration and recovery targets. Conservation in relation to these historical baselines potentially sets ourselves up for 'failure', as the present has already departed from the past, and the future will inevitably diverge even further (see Section 2). Adjusting our values and aspirations is never easy, but we must not synonymise 'change' with 'worse', or spend limited resources trying to maintain or restore unsalvageable historic features. In this section we address the question:

- How do conservationists set strategic goals and identify appropriate indicators of success during a period of rapid change?

We recommend that the Resist-Accept-Facilitate framework (Section 3) be implemented across all strategic decision-making and conservation targets, and in the design of the indicators by which we measure progress towards desired outcomes. The challenge is to ensure that our strategies and means of measuring progress do not inevitably lead us towards favouring Resist options in the RAF framework. We illustrate our approach in relation to species priorities and indicators, but similar principles apply to all areas of conservation.

**Setting strategic goals**. Species Red lists will still matter in the future, continuing to provide an input to national-level conservation plans and interventions. Distributions of species are dynamic and span national boundaries, and so we suggest focusing national Red list assessments around three criteria: the global rarity and endangerment of each species (for example IUCN designations), the importance of a particular country to each species (proportion of the total global population or genetic variation within a country), and future projections of both national and global rarity (based on risk and opportunity analyses; Thomas and others 2011; Pearce-Higgins and others 2017).

These criteria focus attention on the extent to which a given country contributes to global conservation goals. Projections will also highlight nationally threatened species that may be able to increase in future, recognising that many species which currently have marginal

distributions in the UK could become increasingly widespread in future (Parmesan and others 1999; Thomas & Lennon 1999; Wotton and others 2009; Chen and others 2011; Mason and others 2015). Similarly, many species that do not currently occur in Britain could, in the near future, have a significant fraction of their European population in this region (Carroll and others 2009).

Incorporation of projections as well as recent trends, and consideration of opportunities for species that are currently rare or not found within the UK will ensure that the Accept and Facilitate elements of the RAF framework are taken into consideration. Resist options would be focussed on globally endangered species with important populations in the UK, rather than on locally-unusual and ultimately doomed UK populations of species that will continue to be common elsewhere. Short-term Resist options may also be adopted for nationally-rare species for which longer-term climate-driven range expansions are expected.

**Identifying appropriate indicators**. Indicators play an important role in conservation planning at national and global scales, measuring progress in relation to particular strategic goals. The challenge is to scrutinise biodiversity indicators using the RAF framework to ensure that indicators are not biased towards detecting declines, which might direct resources towards ultimately futile attempts to Resist.

Many existing indicators are not compatible with dynamic systems. There are a number of known issues around which, where, when and why species populations are monitored, and how they are compiled into indicators, and their potential to generate estimates of change that are biased towards decline (Fournier, White & Heard 2019; Leung and others 2020). Indicators are sometimes instigated in response to perceived decreases in specific populations, invariably generating declining metrics. A more generic issue is that any departure from a previous state is liable to be interpreted as a loss or deterioration. For example, if the total number of species and abundance summed across all species in the UK remains constant, but there is species turnover, native species indicators (based on those species present at the start of a time series, or earlier) will invariably decline and non-native indicators (based on species that arrive) will increase. Despite no net change, both of these outcomes are treated as negative as they represent departures from the historical state, whether applied nationally or to individual sites.

Indicators in times of rapid change are likely to be improved by the ability to draw on whole assemblage monitoring (for example, Outhwaite and others 2020), including recent arrivals and localised species that have potential to spread, so that both losses and gains are included. In particular, standard ecological metrics of total abundance, diversity and international rarity[5] are preferable because they are not a priori biased towards or against

[5] Unbiased metrics include the numbers of species per site or region of interest (species richness), evenness (whether species are of similar abundance or not) and measures that account for both richness and

reporting declines, and thereby do not lead us disproportionately towards any one of the three Resist-Accept-Facilitate strategies. Positive biodiversity change would then be defined by specified changes to these indicators (such as a growth in the number of species at monitored sites), reflecting conservation success. Comparable unbiased measures for habitats and ecosystems can be developed.

In conclusion, conservation strategies and indicators during a time of rapid environmental change need to be placed in an international context and use metrics that assess both gains and losses. A disproportionate focus on losses is likely to result in substantial opportunity costs and heavy reliance on the Resist element of the RAF framework.

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evenness, combined with their functional attributes. Beta diversity metrics that measure differences between locations (to test for homogenisation) can be calculated. Rarity can be measured, for example, by summing the inverse of global range sizes for species at site or regional levels. All species (native and non-native) are added together to calculate these metrics.

# 5. Everywhere matters, but for different reasons

Conservation options that focus on physical sites need to take into account the realities of environmental change and the contributions of nature to human wellbeing in the places where people live. Thus, it is important to consider appropriate conservation actions everywhere (the whole Earth matters; Büscher and others 2017), not just in currently designated protected areas. In this section, we consider the following pair of questions:

- How do we define conservation goals for all parts of a country?
- What are the most appropriate strategies to facilitate increases in biodiversity and human benefits in all locations?

Many discussions have emerged in recent years about the pros and cons of different approaches to conservation, one of which is the ‘land sparing’ and ‘land sharing’ debate (Fischer and others 2014). Some argue that we should cherish biodiversity in protected areas (sparing some land for nature) whilst leaving remaining areas to be exploited; others that it is preferable to integrate people, biodiversity and ecosystem services everywhere (wildlife friendly land sharing). However, ‘spared’ sites are never devoid of human impact (Section 2), and ‘shared’ landscapes will undoubtedly fail to protect some species that are sensitive to human activities. Recognition that there are gradients of the intensity of human impacts and different categories of human modified ecosystems (Anthromes, Ellis 2015) provides a resolution. Different blends of sparing and sharing will be relevant at different points along the intensity gradient. Rather than imagine that there is a single ‘best’ strategy, it is more relevant to ask: where should we implement different conservation strategies, and in which combinations?

Our suggested approach, therefore, is to zone the country, or a region, into places which are more or less important for different environmental benefits. With this framing, adding greater biodiversity and social interest to urban greenspaces, combining productive agriculture with safeguarding people and wildlife in rural settings, rewilding certain landscapes, and protecting rare species in reserves are not alternatives, but appropriate conservation interventions in different places. To some extent, this is already the case. Conservation protection levels are already zoned in many countries, including in the UK, from the most human-free locations possible (IUCN Category 1), through managed sites for biodiversity (such as UK SSSIs) to multi-use landscapes where people and biodiversity coexist (such as UK National Parks and Areas of Outstanding Natural Beauty). The current approach recognises the gradient of levels of ‘naturalness’ and of the integration of human activities in the landscape that we advocate. However, in practice, interventions have then primarily taken a Resist approach, such as incentivising traditional management, developing restoration projects, imposing planning constraints and excluding people, rather than using a forwards-looking RAF framework. We would therefore advocate Accepting and Facilitating positive changes in each zone.

Our existing zones[6], however, are relatively coarse and have developed via a series of historical steps rather than as an overarching plan. Hence, we advocate identifying – and mapping - as many desired features as possible, using a combination of professional expertise (from multiple disciplines and sectors) and the social aspirations of multiple potential beneficiaries (using social science approaches, such as citizen assemblies - see Section 8). The outputs of qualitative and quantitative conservation prioritisation analyses are conventionally used to highlight priority areas for additional conservation (such as the Aichi 17% protection target in recent years), but this general strategy can also be used to identify the key features of every location considered. The latter shifts the question away from 'which are the most important locations for conservation?' to 'what is each location most important for?' The information emerging from these analyses, once freely shared, can empower local populations, decision-makers and practitioners to take the national and global context into account when discussing the merits of any possible conservation option at a given location. This can also feed into the development of incentives or subsidies to encourage private landowners to direct their management approaches towards the most appropriate actions (for biodiversity and people) on their land. Individuals and organisations often take great pride in local features (species, ecosystems, etc.) that are 'special' to a given site and hence there is unlikely to be any great conflict with 'traditional conservationists' - whose voices can still be heard. The overall conservation outcomes of the processes we advocate will not be a single optimal 'national plan', but will be a co-produced enterprise aiming to meet multiple goals within a forward-facing framework.

The RAF assessment challenge for each zone and location is to improve future biodiversity and human wellbeing trajectories whilst not necessarily being tied to any specific framing of the past. This is not easy, because multiple psychological barriers constrain us from embracing change, uncertainty and unfamiliar options (Gifford 2011; Lacroix, Gifford & Chen 2019). Collective decision-making will, therefore, benefit from professional support to articulate Resist expenditure and opportunity costs and to help identify (via future scenarios) realistic Accept or Facilitate options within the RAF framework. These need to be specific enough to be actionable (Heller & Zavaleta 2009).

In the remainder of this section, we provide a number of examples for different tiers of a zoned landscape to illustrate some of the possible options available (additional categories will be identified) and how different conservation strategies may be appropriate in different contexts.

**Biodiversity priority zones**. Populations of conservation-priority species and some ecosystems are disproportionately concentrated within a small amount of the current

[6] We emphasise zones because there will be commonalities in the challenges facing different places within a particular zone, but we also recognise that each specific site or landscape will have unique attributes. Hence, the zones will be a means to identify realistic options as a basis for discussions, rather than a specific blueprint for each place.

landscape (see Section 4), in sites that do not necessarily score highly for other conservation or historical features. Implementation of the RAF process would include the identification of which priority species and ecosystem types could be retained (Resist), and whether continued or changed management could provide new or additional ecosystem services or opportunities for species expanding their geographic ranges (Accept, Facilitate).

**Buffer zones**. Sites in close proximity to biodiversity priority zones are locations to which currently rare species could potentially spread in future, given their (often) relatively limited dispersal capacities. Buffer zones could be enhanced by reducing agricultural intensity so as to provide additional foraging opportunities, reduce mortality and improve connectivity between other land-use types (Donald & Evans 2006; Threadgill and others 2020). Given the complexity of current landscapes, such buffer zones are likely to be buffer 'networks' rather than continuous areas, and they provide opportunities to increase habitat heterogeneity. 13 With appropriately-designed access, these buffer zones would have considerable potential to support recreation use of the countryside and enjoyment of wildlife, enhanced by species spillover (Brudvig and others 2009)

**Cultural landscapes**. Locations and landscapes that score highly for historic landscape attributes and for elements of biodiversity that are linked to historical management practices (for example, associated with traditional coppicing of deciduous woodlands) could still be the focus for the continuation and possible expansion of landscape traditions, but only in specific landscapes. Concentrating such activities in a few historic landscapes would provide educational and economic opportunities, recreational interest, and maintain specific elements of biodiversity linked to traditional management (with sufficient concentrations of management in particular landscapes to maintain viable populations).

**Ecosystem service zones**. The primary benefit in some zones may be regulating ecosystem services, such as the sequestration of carbon in peat bogs, forests and in the soils of permanent grasslands (Ostle and others 2009). The ecosystem service may be delivered to humans that are geographically remote from the place itself: carbon sequestration globally through its buffering impact on climate change, and water retention protecting floodplain communities downstream. Hence, the RAF process should always take account of local actions that can provide benefits outside of the zone under consideration.

**Low production systems**. Locations that currently score relatively low for biodiversity, for agricultural production, and for recreational visits nonetheless provide opportunities to focus on Accept and Facilitate components of the RAF planning approach - there is not much to lose! These are the places where land-sharing and rewilding strategies have most to offer, providing additional income from visitors and greatly enhanced biodiversity and ecosystem services, for example through Environmental Land Management (ELM) schemes. Complete long-term 'abandonment' (apart from residents and visitors) of a significant fraction of the land surface would likely deliver large biodiversity and human dividends.

**Intensive arable landscapes**. Maintaining UK agricultural production is important to ensure that UK environmental measures do not drive (via increased food imports) land use change and intensification in parts of the world that are more biodiverse than the UK. However, rural populations in the UK may be negatively impacted by surrounding intensive agriculture. The Resist and Facilitate parts of the RAF framework would, in consultation with rural communities, build on existing schemes and legislation to concentrate strips of non-intensive vegetation adjacent to rights of way, roads, railways, and around rural properties and village/town edges, as well as along water courses. This way, rural communities and visitors experience more biodiversity (whilst Accepting change) without serious impact on the total amount of land allocated to high-production farming systems. Research should also continue into how the environmental impacts of these systems can be reduced without sacrificing yield (Pywell and others 2015; Gagic and others 2021).

**Urban greenspaces and novel ecosystems**. Multiple novel ecosystems have come into existence in recent centuries but, with notable exceptions (some quarries for example), most are not designated as priority conservation sites. Urban environments are particularly important for pollinators and other insects, especially allotments and gardens (Baldock and others 2019; Padovani and others 2020; Tew and others 2021). Incentives such as garden centre discounts could be introduced to develop gardenscapes that are especially rich in biodiversity. Urban parks are generally much less diverse but most accessible to less 14 affluent members of society (who may lack gardens). Increased floristic and structural plant diversity in communal greenspace would improve biodiversity, potentially leading to increased wellbeing (Marselle and others 2019) provided that people perceive those increases in biodiversity (Dallimer and others 2012).

In all of these situations, it is valuable to think about the temporal and spatial scales of conservation interventions. Resistance strategies should be informed by whether they can succeed throughout the coming century, and the spatial extent of interventions will determine whether they can encompass the spatial scales at which many ecological and ecosystem processes operate. In most but not all situations, it is also valuable to consider the potential to increase habitat heterogeneity. Heterogeneity is a dependable predictor of species diversity (Stein, Gerstner & Kreft 2014), provides microclimatic variation that can buffer populations against extreme weather, and generates microrefugia for existing species as well as locations where incoming species can establish as the climate changes.

In conclusion, our approach is to zone landscapes. Whatever the precise details of analyses, the mechanisms of consultation, and the ownership of decisions, we propose a total land prioritisation system, not one where some areas are protected and others receive little or no attention. Each area is then considered with a Resist-Accept-Facilitate framework of adaptive management to ensure positive future trajectories of change.

# 6. The concept of trans situ conservation for dynamic biodiversity

Considering individual sites and landscapes is not sufficient if we wish to manage biological change in the Anthropocene, given that a high proportion of species are on the move (Hickling and others 2006; Mason and others 2015; Platts and others 2019). Under climate change, it is as legitimate for conservation interventions to attempt to Facilitate expansions at the leading (or polewards) edge of a species' range as to limit the rate at which the trailing (or equatorwards) edge retreats. In the long run, Facilitating leading-edge expansions may be more effective if avoiding retreats requires an indefinite Resist commitment. This requires consideration not only of where species currently are, but also where species might exist at different times in the future. In this section, we focus on the movement of species' distributions (and their genes by implication; Hewitt 2000) because species are the elements of biodiversity that shift when environmental conditions change, and newly-arriving species may be as important as current species to future ecosystem functioning. We ask:

- Under what circumstances, and how, should we intervene to facilitate the dispersal and colonisation of species?

In Table 2, we summarise trans situ conservation as a new positive RAF approach to dynamism. The trans situ approach can include: (i) the management of specific locations that may either encourage or discourage the establishment of new species (see Section 5), (ii) the design and management of landscapes to Facilitate range expansions (or Resist the arrival of species that are deemed undesirable), (iii) identification of species for which trans situ interventions are most needed, and (iv) the transport by people of species from one location to another, also known as 'assisted colonisation'. In this section we consider topics (ii) to (iv), in turn.

**Landscapes for facilitating species expansion**. Many local and landscape-scale conservation projects aim to restore habitat conditions to encourage recolonisation by species that disappeared in the relatively recent past (Davies and others 2005; Lawson and others 2012). The Royal Society for the Protection of Birds (RSPB), in particular, has undertaken habitat creation and adaptive management projects to encourage bird range expansions, including the recolonisation of Britain by some species that were extirpated historically (Hiley and others 2013; Ausden 2014). However, most projects of this nature focus on habitat restoration for locally rare and extirpated species (Resist strategies) more than on promoting long distance range expansions by species that were not previously present (Facilitate strategies). A more systematic Facilitate strategy has the capacity to benefit additional species. Without this, most species that will undertake long distance range expansions will be habitat generalists and specialists of widespread habitats, of limited conservation concern (Warren and others 2001; Platts and others 2019)

**Table 2**. Approaches to accommodate biodiversity change and facilitate positive trajectories, adapted from Thomas (2020). This approach identifies the value of accepting and encouraging dynamism during the conservation planning process (see Section 4), identifying new priorities for in situ management in the wild (see Section 5), establishing the role of ex situ (in captivity) measures contributing to the movement of species and, in this section, trans situ approaches encouraging the movement of species.

| Strategy | Resist | Accept and Facilitate |
|---|---|---|
| **Planning: Strategic prioritisation, targets, monitoring** | Focus on priority areas, maintaining status quo, attempts to reverse past changes (restoration) | Acceptance and facilitation of dynamic ranges, with novel ecosystems and co-benefits |
| **In-situ: Protected areas, ecosystem management** | Local focus on protecting current ranges and ecosystems, restoration and reintroduction | Regional and global perspectives, focus on refugia, heterogeneous environments, engineered ecosystems |
| **Ex-situ: Zoos, botanic gardens, gene and seed banks** | Back-up collections, to support reintroductions | Providing options for trans-situ conservation |
| **Trans-situ: Facilitating movement to new locations** | Landscape scale conservation and ecological corridors for (meta)population persistence | Improving connectivity (stepping stones, corridors), translocations, facilitating ecosystem transitions |

Many localised and specialist species are failing to spread, although some relatively rare specialists are expanding their ranges by moving in stepping-stone fashion from protected area to protected area (Thomas and others 2012). Corridors and stepping-stone arrangements of habitat permit species to shift large distances over multiple generations (Hodgson and others 2011, 2012), and these schemes are most likely to be effective if they connect large aggregations of habitat, thus linking source (meta)populations to potential destinations. Perhaps the most visionary existing climate-change scheme is Buglife's B-lines, which has a long term aim to restore a large-scale network of flower-rich meadows across Britain, so as to enable pollinators and other insect species to spread via habitat stepping-stones continuously from the south-eastern to the north-western parts of Britain. B-lines are focussed on a habitat that has largely disappeared (hence, it is about

Resistance as much as Facilitation[7]), and the total area of new meadows is still modest, but it is nonetheless both ambitious and inspirational. The challenge is to connect up additional different types of ecosystem, including novel ones, at a broad geographic scale. Given the high quality of biodiversity recording data available for the UK, identifying suites of species with potential to spread through particular habitat networks and landscapes is feasible.

Improving connectivity will not have universal benefits, however. Dispersal rates vary, such that landscapes may be more or less connected for different species (Thomas & Kunin 1999). Ornithologists, for example, have focussed on the provision of habitat 'landing pads' within existing and new reserves and landscapes because bird dispersal is great enough for species to colonise over long distances, while entomologists have focussed on connected habitat networks. Botanists, by contrast, may question the capacity of most plant species to spread, however well connected a landscape might appear (see below). Care is also needed that potentially expensive large-scale connection projects do not simply accelerate the movement of species that are already moving successfully (Threadgill and others 2020).

Despite these caveats, the great advantage of connected landscapes is that they can Facilitate expansions by a wide range of species over long periods of time, not just those that are the focus of specific conservation interventions. They also have potential to be linked to new recreational opportunities, such as establishing long-distance walking/cycling trails.

**Identifying species and genetic variation for trans situ conservation.** Identifying particular species that require bespoke interventions requires formal assessment of the challenges each species faces. Many such assessment methodologies exist (Foden and others 2019), the most effective of which (in terms of predicting change) incorporates observed and projected trends, building on IUCN Red listing approaches (Thomas and others 2011; Wheatley and others 2017). This methodology recognises new opportunities as well as risks that arise from climate change, and hence dovetails with the RAF approach. It has already been applied to over 3000 native British plants and animals (Pearce-Higgins and others 2017). However, Britain supports large numbers of non-native species, and the future biota will contain many more native European species that have not yet established. This type of assessment exercise should be extended, therefore, to all species within a much wider region, so as to assess whether there are opportunities in Britain to develop conservation strategies for species that are not yet present.

Extension of this approach to recognise endangered genetic variation and to Facilitate the spread of functionally-important climate adaptations is currently at an early stage (Minter and others 2020), although it is not unusual for foresters to take account of climate change

[7] A greater focus on Facilitate could link more garden pollinator communities into the network

when selecting genetic provenances to plant. The approach that has been applied to species (Thomas and others 2011, Pearce-Higgins and others 2017) could equally be carried out to identify globally-threatened European races, subspecies and regional populations at the trailing edges of species distributions, which often contain unique genetic variation (Hewitt 2000).

One would normally prioritise species and genetic races for bespoke attention if they are internationally threatened or particularly important for ecosystem functions, whereas most measures for non-endangered species and genes would be encompassed by landscape-scale connectivity, as previously discussed.

**Assisted colonisation**. Perhaps the most controversial component of adaptive planning for climate change is about the extent to which the conservation community might intervene to move species and genes directly, particularly those that are threatened. Challenging as this may be, not intervening can also be thought of as a 'decision', which in some circumstances would effectively be the decision to allow a species to become extinct. The rationale for assisted colonisation is that many species face ecological barriers that are prohibitively expensive or impossible to overcome by connected-landscape approaches. For example, local species richness of butterflies has tended to increase in central and northern Britain since 1970 as a consequence of the climate-linked range expansions of southerly species, but richness has not increased in the south, in the absence of colonists crossing the English Channel from continental Europe (Menéndez and others 2006). The English Channel gives British decision-makers an especially difficult challenge - whether to intervene - whereas species just walk, fly or get blown across national borders elsewhere in Europe. Assisting the movement of species from Europe is an option to overcome this barrier.

Reintroduction, often rebadged as rewilding, is one kind of assisted colonisation that has been gaining ground in recent years. These ventures are proving popular with naturalists, and inspire a wider public, although they need careful consultation with local stakeholders. This approach can be extended to releasing species outside their former historic distributions. For example, marbled white butterflies that we experimentally translocated northwards from East Yorkshire to County Durham (Willis and others 2009) have provided a magnet for butterfly enthusiasts in the north. It is not unusual for there to be a degree of scepticism and disapproval in the conservation world prior to introductions, followed by joy when they succeed - although conflicts with landowners and visitors can also arise when large or predatory vertebrates are released. Noting these exceptions, most releases can be re-framed as empowering people to take positive actions for the future of wildlife in a warming climate, rather than as disruptions of the past.

As Anthropocene temperatures exceed the Holocene maximum, and soon reach and exceed the temperatures of previous interglacials, it is far from obvious why we should only support the return of species (traditional reintroduction) that have been recorded as present in Britain at some time in the Holocene. It is equally rational to consider the release of species recorded in Britain during warm periods at any time in the last million years. However, most species lack a fossil record and undocumented species might be

just as successful in Britain in future, contributing to species diversity and to ecosystem functions and services. How do we choose?

A major challenge for assisted colonisations is the lack of appropriate protocols and governance, to help guide those choices. The most straightforward approach is to start with the existing IUCN guidelines on releases into the wild (IUCN/SSC 2013), which sanction releases in locations outside known historic distributions for species that are threatened (for example due to climate change) or where the introduced species would restore ecosystem functions. As an example, the Pyrenean desman is the sole member of its genus, currently listed by IUCN as ‘vulnerable’, declining rapidly and projected to be endangered by climate 18 change (Morueta- Holme, Fløjgaard & Svenning 2010; Charbonnel and others 2016; Quaglietta and others 2018). As such, the Pyrenean desman might be a higher priority to release in Britain than Eurasian lynx, a species listed by IUCN as ‘least concern’ (IUCN 2020). In the case of Britain, we might also include the potential to transfer non-endangered European species whose colonisation of Britain is constrained by the English Channel or by areas of intensive farmland in the near-continent.

Human activity already dominates the long-distance dispersal of plants, and hence assisted colonisation (whether intentional or otherwise) will be a major force in the development of new plant communities, the animal communities they support, and ecosystem services. Thousands of non-native - but not yet naturalised - plant species originating in warmer climates are already growing in our gardens, and relatively few of these are likely to have undesirable impacts (Thomas & Palmer 2015a). Gardens will be the main source of new plant species becoming part of the British flora. There are many opportunities for the gardening and conservation communities to come together in a more positive way, to this end, rather than outcomes being left to chance. For example, gardeners could maintain collections of climate-endangered European plant species (following the ethos of existing species and variety collections), play a role in assisted colonisation (for example, in the semi-wild naturalisation of threatened species in parks, instead of propagating ‘standard’ varieties), and contribute to the deliberate planning of novel ecosystems (along with pollinator and entomological specialists) in the most human-modified environments. Gardeners could become the main driving force in trans situ plant conservation - with appropriate planning and regulation in place, and following conversations between conservationists, the gardening community and the horticultural industry.

In conclusion, in order to Facilitate species movements in response to the changing climate, approaches are needed to improve connectivity at both landscape and geographic scales, and to consider opportunities for the assisted colonisation of globally-threatened species and for those species facing major barriers to dispersal.

# 7. Dynamic biogeography or species invasions?

Accepting and facilitating the dispersal of species to new locations potentially runs up against measures that aim to prevent the arrival or movement of species that are deemed to be undesirable in some way. Nearly all crop pests, vectors of diseases, and the like, are relatively mobile or occupy already-connected habitats, and hence increasing the connectivity of less-intensively used habitats is unlikely to increase their prevalence. The spread of non-native species is another consideration, given the widespread assumption in conservation that 'native is better than foreign'. Conservation since the mid-20th century has valued genetic, species and community nativism, for example favouring local seed sources in restoration projects and defining site management targets in terms of the preferred relative abundances of native species. Nativism is also embedded in species priority rankings, biodiversity indicators, priorities for site selection, site management goals, and introduction policies. This represents a philosophical approach to the relative value of species and genes based on their origins, rather than a utilitarian view, and it embodies a static framing of the natural world rather than the dynamic perspective we are advocating.

We take the view that a 'nativist' approach to the distributions of species is conceptually flawed. Indeed, the concept of a species having a 'native range' is questionable when a 19 majority of species are on the move today, and when nearly all 'British' species have shifted their distributions by over 1000 kilometres in the past 15,000 years. Hence, we ask:

- How should the geographic origin of species influence our decisions to resist, accept or facilitate the spread of any species?

The best way to tackle this question is to evaluate each species in turn, rather than to group species into preordained categories, such as native or not. But first, it is worth considering the implications of species arrivals.

**Most arrivals have limited impact**. Most species have relatively modest impacts in ecological communities, regardless of whether they are native or the duration that they have been present in a given location (Williamson 1996). This is widely accepted among community ecologists and invasion biologists, despite multiple studies having been carried out on the minority of non-native species that have relatively large ecological effects. Maintaining or developing Resist strategies (as the default position) because a few recently-imported species are regarded as harmful is not rational when a majority of all species are shifting their distributions. Some native species are harmful too, and hence multi-species comparisons are needed to compare the dynamics and potential impacts of native and 'non-native' species.

One such study found plant community change in Great Britain to have been dominated by abundance changes (including increases) of native species, rather than by the changing abundances and distributions of non-native species (Thomas & Palmer 2015a).

They concluded that both native and non-native species were responding to environmental drivers of change, rather than the non-native species being the major cause of change. They also discovered that “the diversity of native species is increasing in locations where the diversity of non-native species is increasing, suggesting that high diversities of native and non-native plant species are compatible with one another". Considering all taxa, there are no documented instances of the ~2000 non-native species established in Britain driving any native species extinct from the whole of Britain (although a few native species have declined as a result; Roy and others 2012).

Biodiversity change at any given location (such as a site or country) represents a balance between gains (new arrivals) and losses (extirpations). Labelling the new arrivals as ‘non-native’, ‘foreign’, ‘alien’ or ‘invasive’ and previous residents that are extirpated as ‘native’ is not a helpful way to articulate the compositional turnover of species assemblages. For example, 51 species of moths have become extirpated from Britain since 1900, whereas 137 moth species have colonised and established in Britain over the same period, including 53 since 2000 (Fox and others 2021). None of the extirpations has been caused by the new arrivals, none of the extirpated species is globally extinct, and the net effect of this faunal turnover has been to increase the total diversity of the British lepidopteran fauna. This turnover can, typically, be expected to increase (compared to no turnover) the match between the changing environment and species’ adaptations. For example, the establishment of heat-adapted species (whatever their origins) as the climate warms, and local declines and extirpations of cold-adapted species, on average increase community level adaptations. Resist strategies that try to prevent arrivals and prevent losses of ‘native’ species work against these natural ecological processes of distribution and abundance changes, rather than with them.

**When and how to intervene**. We suggest dropping the consideration of species nativism from discussions - and instead make judgements on the basis of each species’ impacts (Davis and others 2011). Regardless of their origin or their duration of presence, some species are harmful to human interests or harm species of conservation concern (for which Resist strategies would be considered), most species have limited impacts (for which Accept and landscape-scale Facilitate options are appropriate), and some are conservation targets (Sections 3, 6) or provide desirable ecosystem services (for which Facilitate approaches would be applied). Perceptions of benefit and harm that stem from the perceived nativeness of species are unhelpful, but this will require a shift in the mindsets of many ecologists and conservationists.

For species that are currently established in Britain, we can merge native and non-native species lists, and consider the consequences of each species at any given location. In this regard, clearing ‘invasive’ non-native holm oak saplings from some coastal calcareous grasslands, and grassland management to prevent ‘native’ ash, hawthorn and yew encroachment are conceptually similar (Thomas & Palmer 2015b), in both instances aiming to prevent ecological succession of a (preferred) human-maintained grassland to woodland. We will want to manage and control many species in future, for multiple reasons, but incorporating the nativeness of species into these discussions makes no sense in the context of dynamic biodiversity.

Lists of potentially harmful non-native species have already been developed (for example, Roy and others 2014a), and specific measures can be imposed on imports to reduce the likelihood of their arrival, and then to control them if detected. We argue (Section 6) that it is just as valid to develop a list of potentially desirable species to target for Facilitation as it is to develop lists of potentially harmful species to Resist. Some species are not compatible with one another locally, and hence conservationists may sometimes wish to intervene to manage these changing interactions, particularly if the 'losing' species is internationally endangered. Fortunately, it is rare for species arrivals to exclude other species from their entire geographic ranges[8], and new arrivals from continental Europe have long Pleistocene and Holocene histories of co-existing with the British biota elsewhere in Europe.

Nonetheless, there will be instances where conservationists wish to intervene. Maintaining geographic separation can be an effective temporary way to manage such interactions (Resist approaches), as illustrated by the removal of grey squirrels from Anglesey to protect red squirrels, and taking measures to avoid the importation of signal crayfish to Ireland[9]. In many instances, these are only holding operations, and the longer-term solution lies with changing the ecological interactions (Heard and others 2015; Twining, Montgomery & Tosh 2020). However, negative (competitive, predatory etc.) interactions are a feature of every ecological community that exists. Hence, separation and control are also commonly used to manage interactions between different native species, such as building artificial islands and fencing to keep mammalian predators away from ground-nesting birds, repeatedly disturbing the ground to prevent rare annual plants from being out-competed by perennials, or preventing woodland succession on conservation grasslands. Virtually all 'habitat management' achieves its goals by altering the interactions among species, regardless of species origins.

In conclusion, we suggest that specific Resist measures should only be taken against particular (native and non-native) species that are known to be harmful, rather than allow the perceived risk of a few harmful additions to the British biota drive a broad-scale 'nativist' Resist agenda. Facilitating new arrivals and embracing the dynamism by which species and ecosystems adjust to changing environmental conditions is likely to bring far more benefit than harm (Section 2).

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[8] This conclusion applies to continental biotas such as in Britain.

[9] The red squirrel is incompatible with the imported grey squirrel, and the white-clawed crayfish with the introduced signal crayfish. In both instances the native and introduced species share pathogens, to which the introduced species is more resistant. The red squirrel is listed as Least Concern by IUCN, but the white-clawed crayfish is listed as Endangered, making the crayfish a higher conservation priority. The signal crayfish is still absent from Ireland.

# 8. Inclusiveness

Conservation is not just about species and habitats, it is about people. Humans benefit from the natural world, through natural capital or ecosystem services, and through culture, wellbeing and enjoyment. These benefits and costs require us to explore how best we can manage dynamic biodiversity in our landscapes in a way that leads to win-wins for biodiversity and people. For conservation initiatives to be sustainable in the long-term we need buy-in from the wider population. This will be impossible without understanding what it is that people want from their environment, their perceptions of dynamic change (including newly-arriving species and novel ecosystems), and ensuring that all groups in society have a say.

In this section we discuss why it is important that conservation decision-processes around the RAF framework are more inclusive. This inclusive approach is not a new concept for Defra or Natural England, as both the 25 Year Environment Plan and Landscapes Review highlight the importance of it. The challenge is to ensure that this engagement goes beyond the 'usual set' of interest groups. In this section, we focus on the following questions:

- How can we embed participatory and inclusive processes into resist, accept or facilitate decision-making?
- How can we best ensure that the benefits of dynamic biodiversity are shared by people of all social backgrounds?

There are pragmatic and ethical reasons for making conservation decision-making more inclusive, improving access to conservation areas, and ensuring that the benefits people derive from biodiversity and ecosystems are shared equitably. Conservation choices are based on values, but these choices have often been based on the values of a fairly limited subsection of the population. Scientists and professional conservationists can inform debate and devise ways to achieve a specific goal, but they cannot be the sole arbiters when values are based on human preferences. Certain stakeholders also have disproportionate influence through lobbying and land ownership, thereby potentially marginalising the majority in the decision-making process. National Park and AONB trustee boards lack diversity too (Glover and others 2019). Decisions are unlikely to represent the variety of values within the UK or have the support of the majority when they are made by a limited portion of the population. Conservation needs to address the 'who it is for' as well as the 'what is the goal', so that conservation decisions are supported and the outcomes enjoyed by the many. This will require input from a wider group of both researchers (for example in the social sciences and humanities) and society in order to set objectives under the RAF approach.

**Why engage?** From a pragmatic perspective, higher stakeholder engagement and participation can shape locally appropriate decisions, increase trust and reduce conflict between stakeholders, and also increase the feeling of ownership, which can in turn lead to greater support and more effective implementation of agreed objectives (Sterling and others 2017). There are also physical and mental health benefits from spending time in the

natural environment (White and others 2019; Collins and others 2020), such that expanding greenspace benefits to more of the population (for example through the zoning approach in Section 5) will help maintain a healthier population, with social benefits and reduced pressure on the NHS.

Ethically, increasing stakeholder engagement in decision making is a more democratic and just approach, enabling representation and empowerment of marginalised groups (Reed 2008; Sterling and others 2017). It is important that all parts of UK society are able to share the benefits of spending time in nature but, currently, the BAME community, those with lower incomes and older people are less likely to spend time in the natural environment (Boyd and others 2018; Natural England 2019; 2020). These groups also tend to suffer from health inequalities and this makes it even more important that the wellbeing benefits of greenspaces are accessible to all groups.

As ever with conservation, there won't be a one-size fits all solution - examples of a few options for engagement and participation, and how they could fit into the RAF framework, are illustrated in Table 3. There is a risk that increased participation may lead to increased costs, be more time consuming, and lead to additional conflicts as people with a wider range of perspectives engage in the decision-making process (Stringer and others 2006; Sterling and others 2017). However, this diversity of opinion already existed, and hence it was simply being ignored. Conflicts may also arise from increased visitor numbers enjoying protected areas, including soil erosion and disturbance to wildlife. This highlights the importance of considering the resources required and selecting an appropriate type of participation approach in relation to each goal. Following the zoning ideas in Section 5, different levels of participation will be appropriate for different locations, and there may be some conservation areas where it is not feasible or beneficial to encourage higher visitor numbers (the moral argument to increase the diversity of visitors remains, even if total numbers do not increase). Local data collection about who is and is not participating in decisions and using conservation areas, relative to the profile of surrounding communities, can help to identify the best strategies to understand how to make these areas more inclusive, building on the recent work of Natural England (Natural England 2019; Boyd and others 2018).

Participation should be seen as a process of continual negotiation and decision-making, not a one-off activity to be completed (Reed 2008). The best process(es) to adopt will depend on the context. For example, citizen assemblies can be used to ensure broader participation in setting national-scale priorities and policies, following the model of climate change citizen assemblies to develop socially acceptable approaches to an environmental challenge (Devaney and others 2020; Climate Assembly 2020), whereas other approaches may be more appropriate to engagement and decision making in local communities (Table 3).

**Table 3**. An abridged selection of types of participation (see Reed and others 2008; Hurlbert & Gupta 2015; Sterling and others 2017 for additional types and examples). Level of participation can vary within each of these categories.

| Strategy | Resist | Accept and Facilitate |
|---|---|---|
| **Volunteering: Voluntary involvement, e.g. in local management - most success to date engaging with diverse groups** | Local actions to assist in management to maintain and restore habitats | Creating new wildlife habitats and gardens, important for wellbeing and biodiversity conservation |
| **Consultation: Dialogue between stakeholder groups, from local to national scales - levels of inclusiveness and participation vary** | Consultations are often limited to particular sectors that may be predisposed towards Resisting change. | Wider involvement in strategy development at local and national levels, with expectations established at start[10] |
| **Citizen Assembly: Representative sample of citizens brought together to learn, discuss, and recommend approaches to particular issues (experts providing evidence)** | Potential to communicate costs / complexities of conserving status quo | Incorporating a wider range of perspectives within national priority and strategy development, to communicate benefits of Accept/Facilitate |
| **Citizen Science: Voluntary biodiversity data collection - participation can vary from data collection to developing research questions** | Data collection for species trends and monitoring, for entire taxonomic groups, or a focus on invasive, rare or indicator species | Input to local & national monitoring of species range shifts. Opportunity to engage with novel ecosystems and changing biodiversity and drive research focus |

[10] To avoid mismatched expectations; e.g. miscommunication in the UK Marine Conservation Zone stakeholderled site selection ended with participant disappointment as far fewer sites were designated than expected, eroding trust in the participatory process (De Santo 2016).

| | | |
|---|---|---|
| **Co-management: Power, responsibility, decision-making & enforcement of rules are shared among stakeholders** | Few opportunities for true co-management (where multiple groups have equal say in decision-making) | RAF zoning involves co-management, enabling local people to contribute to priorities and management |

Everyone matters. Everyone has a right to a pleasant environment, and is deserving of having a say in how the world changes. The challenge for the conservation community is to break down barriers, encourage underrepresented groups ‘in’ and embrace a diversity of perspectives. The barriers are multifold. The countryside being perceived as a ‘white’ environment by the BAME community is one such barrier (Roberts and others 2019). Ensuring representation on decision-making bodies, providing institutional support for grassroots initiatives such as ‘Black Girls Hike’, and supporting advertising and social marketing campaigns featuring members of the BAME community could all play a role in facilitating inclusion, participation and the wellbeing derived from dynamic biodiversity. Likewise, inaccessible entrances and pathways limit enjoyment and participation by those with disabilities (Boyd and others 2018), whereas deprived communities may lack (pleasant).

local greenspaces or be able to afford transport to protected areas in the countryside. Breaking down barriers could also extend to those whose interests lie outside biodiversity and conservation, such as those motivated, for example, by wellbeing, recreation and health, by archaeology, by literature, aesthetics and our imaginings of nature, or by ‘where our food comes from’ in the countryside. Experiences and needs vary within and between groups of people, so it is important that many people with different backgrounds share their experiences and participate in decision making.

We suggest that it would be possible to undertake a major step change that cuts across education and inclusion, where inclusion involves a wider range of people and interests. This would facilitate multi-direction knowledge exchange, rather than being education by conservationists of others. This could range from inclusive discussions of the archaeological, historical, geological, biological and recreational interest associated with particular sites, and the development of historically-themed landscape parks, to engagement with the media to integrate rather than separate different disciplines. Despite many excellent exceptions, typical conservation narratives focus on the species and ecological communities themselves rather than on their social, historical or geological origins. Protected area visitor centres do often contain historical photos, and sometimes deeper histories, but these historical perspectives often take the form of a romanticised perspective of a ‘better’ past that today’s conservationists are striving to maintain. That romanticisation typically ignores the conditions under which most people were living, and how the ‘struggle’ between people and nature shaped today’s ecosystems. Historical narratives will be able to emphasise that there has been a dynamic relationship between humans and the biological world for many millennia. Representing a more factual and balanced account of people as both ‘generators’ and ‘destroyers’ of biodiversity in the past

sets the scene for updated RAF strategies that focus more attention on generating future change in directions that are regarded as socially positive by people of all backgrounds.

In conclusion, increasing participation and partnerships between citizens and professionals will enable conservation to make robust decisions in an inclusive manner, recognising the dynamism of biodiversity and the historical and on-going shaping of landscapes by humans. For those whose interests lie outside biodiversity or geology, renewed and richer storytelling has the capacity to enthuse people and ensure that everyone has access to nature, as well as embracing the reality of ongoing change and strategies to ensure that we facilitate a resurgence of biodiversity for current and future generations. Simply saying that everyone is welcome, however heartfelt, is not sufficient. Genuine engagement will require careful examination of every RAF process by every relevant organisation and citizen group to break down barriers and cement inclusiveness within the decision-making process.

# 9. Synthesis

Biological systems are dynamic and cannot be stopped from changing, nor are they separated from human social development. In the changing Anthropocene world, we recognise that some changes may be regarded as positive and others as negative. As such, we propose a Resist-Accept-Facilitate (RAF) approach to decide conservation strategies and interventions so as to ensure that Facilitating positive change is contemplated as routinely as ways to Resist change. We suggest that a Resist strategy should only be attempted in situations where interventions are feasible in the long term, and for species whose 25 conservation within the UK is of international importance. Whilst we have focussed on biodiversity change in terrestrial and freshwater ecosystems, the principles of accommodating dynamism apply equally to marine ecosystems and to geological processes, especially to erosion and depositional processes in marine and riverine systems.

The RAF approach can be applied everywhere, to identify what each location is important for, who benefits, and how the same or different benefits can be increased in future[11] . Likewise, the RAF approach can ensure that species are able to shift their distributions across increasingly-connected landscapes, and that species which are unable to disperse are considered for human-assisted translocation. The targets for translocations should be focussed on internationally endangered species, and on other species that face insurmountable barriers to dispersal, such as the English Channel.

Conservation should be ‘by the people, for the people’. Hence, inclusive partnerships between professional conservationists and citizens, and shared decision-making, should permeate all aspects of the RAF conservation planning and delivery, including terrestrial, freshwater and marine biological systems, and geological processes. This approach has the potential to facilitate biodiversity outcomes that benefit everyone.

[11] From practical policy and implementation perspectives, the overall strategies, zonation approach and increased inclusiveness can be accommodated within the development of the Nature Recovery Network and Local Nature Recovery Strategies proposed in the 2021 Environment Bill.

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