A response from the British Ecological Society to the Defra "25 year environment plan: measuring progress" consultation.

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Founded in 1913, we are the world's oldest ecological society, with over 6,000 members worldwide. As the voice of the UK's ecological community, we communicate the value of ecological knowledge to policymakers and promote evidence-informed solutions.

1. Whether the proposed framework describes the environment in a meaningful way.

The BES welcomes the necessary move towards a robust indicator set that could be used to measure and guide action as part of an adaptive management plan, in respect of the 25 Year Environment Plan (25 YEP).

1.1 Response indicators are needed

However, there are some current shortcomings to the proposed framework, particularly regarding how the indicators allow progress against national and international targets to be measured. Whilst the framework includes pressures, state ("asset") and benefit indicators, it fails to include response indicators, despite them being part of a widely recognised model for understanding the effectiveness of different interventions (the "**Response**-Pressure-State-Benefit" model)[1]. Without response indicators, the narrative of how policies and conservation action reduce pressures and improve the state of biodiversity is lost. This makes the indicators less understandable to the user, reduces accountability, prevents assessment of action effectiveness and reduces the capacity for adaptive improvement[2,3,4].

Confusingly, some of the "asset" indicators are categorised as a response, despite usually being categorised as a state. For example, H5 (waters achieving sustainable abstraction criteria) and H40 (extent…of terrestrial and marine protected areas in the UK Overseas Territories). The BES recommends a clear separation of "asset" indicators into state and response indicators, alongside the inclusion of a greater number of response indicators, such as the extent of protected areas in the England.

1.2 Greater coherence is needed with international and national targets

For these indicators to truly measure policy outcomes and inform adaptation, they must be clearly linked to national targets in the 25 YEP, as well as international targets including the CBD Aichi Targets and the UN Sustainable Development Goals. Many of the indicators that are arguably relevant to the 25 YEP targets, have not been marked as relevant. This includes H9, the "quantity, quality and connectivity of habitats", which directly measures progress against the 25 YEP target of "creating or restoring 500,000 hectares of wildlife-rich habitat outside the protected site network, focusing on priority habitats as part of a wider set of land management changes providing extensive benefits". Thus, reconsideration should be given to accurately matching each indicator to specific 25 YEP targets.

The same should be done to match indicators to international targets, especially given the failure to meet the 2010 Aichi Targets[5] and 2020 targets[6]. If national policy commitments do not reflect international targets, then efforts to reverse global biodiversity decline will remain ineffective. The

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[1] Sparks et al. (2011). Linked indicator sets for addressing biodiversity loss. *Oryx*, 45.
[2] Butchart et al. (2010). Global biodiversity: indicators of recent declines. *Science*, 328.
[3] Sparks et al. (2011). Linked indicator sets for addressing biodiversity loss. *Oryx*, 45.
[4] Tittensor et al. (2014). A mid-term analysis of progress toward international biodiversity targets. *Science*, 346.
[5] Butchart et al. (2010). Global biodiversity: indicators of recent declines. *Science*, 328.
[6] Tittensor et al. (2014). A mid-term analysis of progress toward international biodiversity targets. *Science*, 346.

proposed framework fails to nest its indicators within these international targets, and therefore indicators essential to aid reporting on international targets may be missed. For example, there appear to be no indicators for Aichi Target 13:

> *"By 2020, the genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity."*

Although an important dimension of biodiversity, and essential in the delivery of Aichi Target 13, genetic diversity is often missing from biodiversity assessments[7]. Defra should give greater consideration to ensuring indicators reflect progress on international targets, and to ensuring comprehensive data collection for all of the biodiversity variables that underpin such indicators.

2. Potential gaps in the headline indicators and / or system indicators and how to fill those gaps.

2.1 Species Population Trends

- **H6 Status of our native species:** The BES welcomes indicator H6, as it aligns with the 25 YEP ambition of 'taking action to recover threatened species, iconic or economically important species of animals, plants and fungi…', as well as Aichi Target 12 and SDG 14 and 15. However, there are limitations to the Red List Index, especially when used for common species and for identifying trends on smaller temporal scales[8]. Thus, H6 should be considered alongside other measures that allow various population trends to be tracked more closely in real time (e.g. H10).

- **H10 Characteristic species of farms, woods, wetlands, and coasts:** In line with the above, the BES encourages the additional use of trends in species abundance and distribution data[9]. However, we further recommend that H10 should be defined more broadly in terms of trends across **all** native species, for which data are available, and should be updated regularly as data availability increases. The Living Planet Index is a useful tool for tracking progress towards biodiversity targets and is frequently used at a global scale[10]. We would welcome a similar indicator for England, but one that provides an aggregated trend in abundance for a broader range of taxa. This could form one of the framework's most important indicators for communicating the state of England's biodiversity to the public, as it is fairly intuitive and broad ranging (see question 3). For clarity in communication, it could be called "Population trend of our native species".

[7] Pereira et al. (2013). Essential Biodiversity Variables. *Science*, 339.
[8] Butchart et al. (2007). Improvements to the Red List Index. *PLoS One*, 2.
[9] Mace et al. (2018). Aiming higher to bend the curve of biodiversity loss. *Nature Sustainability*, 1.
[10] Mace et al. (2018). Aiming higher to bend the curve of biodiversity loss. *Nature Sustainability*, 1.

- **S23 Abundance and distribution of priority species:** This indicator needs to be expanded and put under the "Cherished wildlife and wild places" headline – it is relevant to both 25 YEP targets and Aichi Target 12. A "priority species only" indicator could be made to match H6 (e.g. Status of our priority native species) and H10 (e.g. Population trend of our priority native species).

2.2 Other Species Metrics

The indicators in this framework fail to capture certain aspect of biodiversity, many of which may be essential to understand for conservation and the delivery of ecosystem services. The multiple dimensions of biodiversity is captured well in the Essential Biodiversity Variable Framework, which offers a standardised, cost-effective approach to global biodiversity monitoring, developed with the global targets in mind[11,12]. These dimensions include:

- **Genetic diversity:** Species in a fragmented landscape such as England's may suffer from low genetic diversity, which over time could pose a serious conservation risk[13]. As discussed in 1.1, we would recommend an indicator for genetic diversity.

- **Community composition:** As environmental disturbance increases, rare species tend towards extinction, while globally common species multiply and spread: a process known as biotic homogenisation[14]. Although common species may be able to deliver similar ecosystem services under current environmental conditions[15], the loss of rarer species could threaten the resilience of ecosystem function and service provision under predicted future environmental conditions[16,17]. Measuring these changes in species is therefore important in understanding changes to ecosystem function and service. Species richness may not accurately reflect this change, as the number of species may stay the same despite changes in the actual species present and their dominance ("community composition")[18]. The BES therefore recommends an indicator of community composition be included. One potential metric is the Biodiversity Intactness Index[19,20].

- **Functionality:** With increasing environmental disturbance, the functional diversity of communities may change, impacting the services that ecosystems provide[21]. In fact, functional diversity has been argued to be the most effective measure for detecting positive effects of

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[11] Pereira et al. (2013). Essential Biodiversity Variables. *Science*, 339.
[12] Pettorelli et al. (2016). Framing the concept of satellite remote sensing essential biodiversity variables: challenges and future directions. *Remote Sensing in Ecology and Conservation*, 2.
[13] Lai and Pullen. (2005). Distribution and conservation of genetic diversity among UK calcareous grassland regions. *Biodiversity and Conservation*.
[14] McKinney & Lockwood. (1999). Biotic homogenization: a few winners replacing many losers in the next mass extinction. *Trends in Ecology and Evolution*, 14.
[15] Winfree et al. (2015). Abundance of common species, not species richness, drives delivery of a real-world ecosystem service. *Ecology Letters*, 18.
[16] Leitao et al. (2016). Rare species contribute disproportionately to the functional structure of species assemblages. *Proceedings of the Royal Society B*, 283.
[17] Oliver et al. (2015). Biodiversity and resilience of ecosystem functions. *Trends in Ecology and Evolution*, 30.
[18] Hillebrand et al (2017). Biodiversity change is uncoupled from species richness trends: Consequences for conservation and monitoring. *Journal of Applied Ecology*, 55.
[19] Scholes & Biggs. (2005). A biodiversity intactness index. *Nature*, 434.
[20] Newbold et al. (2015). Global effects of land use on local terrestrial biodiversity. *Nature*, 520.
[21] Cardinale et al. (2012). Biodiversity loss and its impact on humanity. *Nature*, 486.

biodiversity on ecosystem service provision[22,23]. Thus, we welcome the functional indicators that have been included.

2.3 Ecosystem Metrics

- **H7 Condition of protected sites – land, water and sea:**
    - In line with H40, 25 YEP targets and international commitments (e.g. Aichi Target 11), this should include "extent" in the title of the indicator.
    - "Extent of Protected Areas (for biodiversity)" is usually considered a response indicator[24], and should be in this framework as well.
    - National Nature Reserves should be one of the designations included, especially as this designation is incorporated into the readily available indicator[25]. Additionally, it is important that only areas primarily protected for biodiversity are included (e.g. excluding National Parks and AONBs in their current form).
    - One major issue in the current protected area network is that each individual site is too small[26], therefore a further indicator could be added to monitor the average size of protected areas.
    - Finally, increased funding and effort will be needed to ensure better monitoring and therefore a more accurate indicator. Almost half of England's SSSIs have not been examined in the last six years[27] and therefore their current "condition" score may not be reflective of their actual state.

- **H9 Quantity, quality and connectivity of habitats:** The BES values an indicator that reflects the Lawton principles, which are important in creating resilient ecological networks[28]. It remains unclear what this indicator would comprise of and more clarity would be needed to judge its applicability to the Lawton principles. It appears directly related to the 25 YEP and should be marked as so. Furthermore, this would be better as a response indicator rather than an "asset".

2.4 Sustainability

- **S20 Total income from farming:** Whilst we appreciate the importance of measuring economic return from investing in ecosystem services, we would suggest that it is the profitability of all rural land management that is measured, not purely farming. This would capture for instance, the economic benefits of providing public goods, or the economic benefits of tourism.

[22] Balvanera et al. (2006). Quantifying the evidence for biodiversity effects on ecosystem functioning and services. *Ecology Letters*, 9.
[23] Diaz et al. (2006). Biodiversity loss threatens human well-being. *PLoS Biology*, 4.
[24] Tittensor et al. (2014). A mid-term analysis of progress toward international biodiversity targets. Science, 346.
[25] Defra. (2018). Biodiversity 2020: A strategy for England's wildlife and ecosystem services. Indicators.
[26] Shwaartz et al. (2017). Scaling up from protected areas in England: The value of establishing large conservation areas. *Biological Conservation*, 212.
[27] Unearthed. (2018). Nearly half of England's 'most important wildlife sites' at risk after not being monitored for years. Available at: https://unearthed.greenpeace.org/2018/09/07/half-england-sssi-sites-not-monitored/
[28] Isaac et al. (2018). Defining and delivering resilient ecological networks: Nature conservation in England. *Journal of Applied Ecology*, 55.

- **H30 Percent of the total amount of wood that grows in English woodlands that is harvested / S16 Area of woodland in England / S21 Volume of timber brought to market:** These indicators, although already established, need to be more refined to better describe UK woodlands, specifically by following the "Response-Pressure-State-Benefit" model more closely. For example, whilst H30 is currently marked as a benefit, harvesting of trees can also be a pressure, especially if the trees harvested are from ancient, native forests. Much like S20, we understand the need to measure economic return of investing in ecosystem services, however, the loss of important sites to biodiversity should not be regarded as a benefit. In all these woodland indicators, it is important to address the biodiversity value of different tree age classes and types. Ancient, native (e.g. mainly broadleaf in England) woodland is of greater biodiversity value than recently planted non-native (e.g. conifer) woodlands[29,30,31]. The indicators should capture this information to more easily identify which indicator is a pressure and which is a benefit.

2.5 Overseas Territories

- We welcome the inclusion of indicators for the UK Overseas Territories. The number of products in indicator H37 could be expanded to include products associated with tropical deforestation, such as soy and beef[32]. Overseas indicators could be important in educating consumers about the impacts of their purchases, potentially altering demand and thus the market[33].

3. Whether the overall number of headline and system indicators is appropriate. Are there too many, too few?

Engaging the public is a crucial step in reversing biodiversity decline, as consumer choices and actions can have dramatic impacts globally[34]. Education and engagement can empower people to make choices and take action based on sound science, with reliable recommendations[35]. Thus, a good environmental indicator must be easily understandable in its concept, presentation and interpretation of the data[36].

For this framework, the hierarchical structure of the metrics within headline indicators should, in principle, make it easier to report overall progress. This kind of forward-thinking has not always been in evidence in previous strategies and frameworks. However, the structure and volume create a

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[29] Peterken & Game. (1984). Historical Factors Affecting the Number and Distribution of Vascular Plant Species in the Woodlands of Central Lincolnshire. *Journal of Ecology*, 72.
[30] Bremer & Farley. (2010). Does plantation forestry restore biodiversity or create green deserts? A synthesis of the effects of land-use transitions on plant species richness. *Biodiversity and Conservation*, 19.
[31] Parliamentary Office of Science & Technology. (2014). Ancient Woodland. POSTnote 465.
[32] Nepstad et al. (2014). Slowing Amazon deforestation through public policy and interventions in beef and soy supply chains. *Science*, 344.
[33] Nepstad et al. (2014). Slowing Amazon deforestation through public policy and interventions in beef and soy supply chains. *Science*, 344.
[34] Novacek. (2008). Engaging the public in biodiversity issues. *PNAS*, 105.
[35] Novacek. (2008). Engaging the public in biodiversity issues. *PNAS*, 105.
[36] Brooks & Bubb. (2014). Key Knowledge for Successful Biodiversity Indicators. UNEP-WCMC, Cambridge.

complexity that will make it hard to communicate effectively and potentially prohibit engagement with the public. The naming system does not help: indicators H1-H40 are actually system indicators that nest within the 15 headline indicators, rather than headline indicators themselves. The other 25 indicators (S1-S25) are also system indicators, but do not nest under headlines. It is currently difficult to see some of the "S" indicators' purpose, and it may help to place them under a headline or remove them completely.

There is also a lack of clarity on how contrasting indicators will be integrated into an overall framework. For example, H10 is one of three system indicators (along with H8 and H9) that report on the Headline of "changes in nature on land and water that affect our lives and livelihoods". H10 is also one of 20 (from a total of 65) indicators that "tell us about farmland assets". However, H10 is not an "it" but itself a complex composite of existing metrics for birds, butterflies and bats (and potentially new metrics for other taxa). Another by-product of this complexity is that it will be harder to trace through the implications of assumptions and design decisions. For example, it seems likely that some datasets will end up contributing to multiple indicators, such as species data being used to indicate habitat quality (H9). This would create non-independences among the various indicators, which will not be apparent to users of the data, and may create an inaccurate picture of England's environment.

7. The balance and scalability between local and national levels.

Ideally, in order to understand the impacts of different actions, indicators should be scalable between local and national level. This may also facilitate public engagement by educating people over their local environment and the impacts of their actions on it. Having the necessary datasets to deliver this aspiration in the future should be a clear objective.