An influential biodiversity market may not direct investment towards habitats of national importance

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Abstract

Biodiversity markets are proliferating globally, aiming to increase private investment to address conservation financing gaps. Markets commodify biodiversity to facilitate trade of biodiversity 'units' even across heterogeneous ecologies. However, the metric used to commodify biodiversity can strongly influence which habitats become valuable in biodiversity markets, and there has been little research on whether the biodiversity incentivised through markets maximises conservation value or is aligned with higher-level conservation goals. Here, we address this gap by using an ambitious national biodiversity market as a case study. We simulated habitat transitions in England's Biodiversity Net Gain metric to investigate which habitats deliver biodiversity gains from common habitat baselines, and explored how well these habitats aligned with those outlined in national conservation targets. Our results suggest that the biodiversity metric works well to incentivise avoidance of biodiversity impacts, but without policy coordination, the investment generated by biodiversity markets risks being allocated towards activities that do not maximise conservation potential.

1. Introduction

Mobilising finance is vital to halt and reverse losses to biodiversity (Seidl et al., 2021), with the global funding shortfall for conservation estimated at US$598–824 billion per year (Deutz et al., 2020). To address this deficit, a rapidly accelerating number of international policy goals, national policies, and voluntary initiatives are aiming to upscale private investment in conservation (zu Ermgassen et al., 2024; Löfqvist et al., 2023). These ambitions are embedded at the highest level: Target 19 of the Kunming-Montreal Global Biodiversity Framework aims to mobilise $200 billion per year for nature, largely through private finance (CBD, 2022).

One of the primary mechanisms through which these high-level initiatives are attempting to create opportunities for private investment in biodiversity is through the establishment of biodiversity markets. Biodiversity markets aim to facilitate private investment by assigning economic value to biodiversity in some form and allowing buyers to pay sellers for delivering improvements in biodiversity. By far the largest group of biodiversity markets globally are biodiversity compensation markets (estimated to generate >$11 billion/year; Deutz et al., 2020; UNEP, 2023). These compensation markets facilitate 'net outcomes' and so mandate that projects achieve no net loss or net gain of biodiversity by adhering to the mitigation hierarchy and purchasing biodiversity offsets to compensate for unavoidable ecological impacts (Josefsson et al., 2021). Compensatory biodiversity markets have been implemented for decades (Damiens et al., 2020) and are proliferating globally (zu Ermgassen et al., 2019). Biodiversity markets are likely to be a key tool toward mobilising private finance to achieve the goals embedded in high-level conservation policies. For example, in the UK, the government's Nature Markets Framework aims to drive £1 billion in private investment in nature by 2030 through a suite of biodiversity-related markets (HM Government, 2023) – this contrasts with public spending on UK conservation estimated at £600 million/year (JNCC, 2023).

1.1 Potential misalignments between the outcomes of biodiversity markets and high-level conservation goals

To enable market trading, biodiversity must be commodified into a unit of sale – 'the nature that capital can see' (Robertson, 2006). The diversity and complexity of biodiversity makes it difficult to reduce into a fungible unit, and so commodification typically involves the use of proxy metrics for biodiversity value (Robertson, 2006) based on the assumption that their score will reflect wider biodiversity (Cristescu et al., 2013). One common metric type is combined area-condition metrics (Marshall et al., 2020). Combined area-condition metrics multiply habitat area by a function of habitat condition, which is typically based on vegetative features (Borges-Matos et al., 2023). Examples include the Statutory Biodiversity Metric used for Biodiversity Net Gain in England (DEFRA, 2024a), and the Habitat Hectares metric originally used in Victoria's Native Vegetation Framework in Australia (Parkes et al., 2003). By assigning a numerical score to biodiversity, combined area-condition metrics enable relatively simple quantification of biodiversity losses and gains for trading even across heterogeneous ecologies (Carver & Sullivan, 2017; Stanley, 2024b).

However, the metric used to operationalise biodiversity in a market can have strong impacts on which habitats are most valuable in that market (Kolinjivadi et al., 2017; Stanley, 2024b). Markets tend toward delivering commodities–in the case of biodiversity markets, land management activities that aim to improve biodiversity by a measured amount–offering the greatest returns for the least cost. This is an inherent power of markets: when functioning effectively they theoretically incentivise innovation and allocate resources to actors who offer the best product at the lowest cost (Gómez-Baggethun & Muradian, 2015). Here, the variables quantified in a metric, such as habitat type and condition, become value drivers for the commodity. For example, for a biodiversity metric in which the heaviest-weighted component is number of trees, the value of habitats would largely be driven by their number of trees, and thus the market would incentivise delivering habitats which provide the greatest number of trees for the lowest cost.

This creates a major opportunity and risk for the designers of biodiversity markets. If the incentives generated through the commodification mechanism lead to delivery of biodiversity improvements which are well-aligned with high-level conservation goals, biodiversity markets can be an effective mechanism to achieve national conservation priorities. However, if these incentives are misaligned, markets have the potential to generate substantial investment, but allocated towards activities that do not maximise its conservation potential.

1.2 Current understanding of misalignment between market outcomes and conservation goals

The misalignment of biodiversity market outcomes with wider conservation objectives has been hypothesised (Lave et al., 2010; Robertson, 2006; Stanley, 2024b), but there are few empirical studies demonstrating it. One domain of evidence comes from the voluntary carbon market (VCM). Typically, the VCM values offsets based on the volume of carbon dioxide equivalent (CO_2e) reduced, avoided, or removed from the atmosphere. However, the use of CO_2e volume as a proxy for the value of sequestration projects such as afforestation impacts which forests are valuable in the market. Commodifying trees based solely on their short-term carbon sequestration potential has been criticised for encouraging monocultures of fast-growing, non-native tree species which have high rates of carbon assimilation and thus can be sold for high prices in the short term (Díaz et al., 2009; Stanley, 2024a), even though diverse, native forests achieve higher long-term carbon sequestration and co-benefits compared to monocultures (Abreu et al., 2017; Díaz et al., 2009; Jactel et al., 2021; Standish & Prober, 2020; Warner et al., 2023).

Preliminary patterns of commodification leading to misalignment of market outcomes have also been seen in North American wetland compensation systems. In the US wetland mitigation market, recent work has shown that there are strong incentives to use barrier removal as a management measure in the creation of wetland credits. Crediting rules allow project proponents to claim credits for the entire stream area across which barrier removal is being applied rather than areas adjacent to the barrier removal interventions, generating an unexpectedly large volume of credits relative to the environmental benefits yielded (Theis & Poesch, 2024). This risks encouraging actors to deliver only one type of restoration measure rather than considering those most appropriate for ecosystem restoration in each case.

Further exploration into potential mismatches between the outcomes of biodiversity markets and high-level conservation goals is vital if markets are to be harnessed to drive largescale private investment towards those goals. We address this gap by analysing the potential effects of the Statutory Biodiversity Metric on the outcomes of a new and internationally high-profile nature market, Biodiversity Net Gain in England. We reveal missed opportunities for the biodiversity market to better support high-level conservation goals, and highlight broader lessons for biodiversity markets globally.

2. England's Biodiversity Net Gain and high-level conservation goals

The UK's conservation priorities are outlined across several documents. The Environment Act 2021 (EA) set out a legally binding target to achieve the restoration or creation of 500,000 hectares of a range of 'wildlife-rich' habitats in England outside of protected areas by 2042 (UK Parliament, 2023). Action toward the EA target can be conducted through various mechanisms, including agri-environment schemes, government funds, nature markets, and ecological compensation (where only habitats in excess of the required compensation are counted toward the target). The list of wildlife-rich habitats includes Priority Habitats as defined in Section 41 of the Natural Environment and Rural Communities Act (S41 habitats), as well as other non-priority habitats which are considered wildlife-rich when of 'sufficient quality', as defined by either priority habitat descriptions or the statutory biodiversity metric (Natural England, 2024). In addition to the delivery of habitats of high conservation value mandated under the EA habitat target, the delivery of habitat heterogeneity has been recognised as a vital component in halting and reversing England's wildlife declines in a review of England's conservation approach (Lawton et al., 2010).

One means through which habitats of conservation importance could be created or restored is through an ecological compensation policy in England also introduced in the EA termed Biodiversity Net Gain (BNG), which came into force in February 2024 (DEFRA, 2024a). BNG mandates that most developments deliver a minimum 10% net gain of biodiversity, maintained for at least 30 years post-development (DEFRA, 2024a). Developers should follow the Biodiversity Gain Hierarchy to first avoid and minimise biodiversity impacts, then enhance or create habitats in the post-development phase to address any residual impacts and deliver a 10% gain. Habitats created in excess of the requirement to compensate for losses can be counted toward the EA habitat target. Post-development habitats can be delivered on-site (within the development footprint); off-site through purchase from a biodiversity market; or as a last resort option by purchasing statutory habitat credits from a government-sponsored public body (DEFRA, 2024a). Habitats are not entirely fungible, with penalties for compensatory habitat further away from the impact site and trading rules on which habitats can replace lost ones.

The biodiversity value of habitats is proxied using the Statutory Biodiversity Metric (hereafter referred to as the BNG metric), a combined area-condition metric (DEFRA, 2024a). The BNG metric is used to estimate the biodiversity 'units' of the baseline habitats found on the site before development commences and the habitats planned post-development, with a 10% unit uplift required. Biodiversity units are calculated by multiplying habitat area by scores for habitat type distinctiveness and condition. Where the delivery of post-development habitats is promised in the future (i.e. compensation measures which are implemented today are expected to deliver a habitat that matures years into the future), post-development units are penalised by the time taken to reach the habitat's target condition at a discount rate of 3.5% per year, and by habitat-specific discounts for difficulty of creation (Natural England, 2023).

Therefore, the BNG metric is used to measure both the ecological value of a site today and predict the future value of the site following development alongside ecological compensation measures. It has two clear roles. Like-for-like compensation for rare and valuable habitats is required where possible (DEFRA, 2024b), and so by penalising the post-development value of these habitats (which are often difficult and timely to replace) it ensures that a larger area is required to replace the same unit value of destroyed habitat. This incentivises avoiding impacts to those habitats, consistent with the mitigation hierarchy. But in addition, the BNG metric is used to guide the activities of actors generating biodiversity offsets for sale into the market, and so the habitats that score the most units under the BNG metric are likely to be those implicitly incentivised in restoration projects for the market.

BNG permits the use of habitat banking, where habitat transitions are initiated in advance of unit sale to reduce the impact of these multipliers and thus increase the unit value of a site. However, it is unclear whether this resolves any potential misalignment between the BNG metric and high-level conservation targets by changing which habitat transitions are incentivised under the metric.

To explore what kinds of biodiversity the BNG metric and thus the BNG market is likely to deliver, we simulated the unit value of different habitats under the metric and explored the metric components that drive differences in unit value between habitats. We used the BNG metric to calculate the unit value of habitat transitions from 1 hectare of common pre-development habitats to almost all habitats they could feasibly be converted into within the 30-year timeframe of BNG. We explored how different broad habitat types scored; how the different groups of habitats outlined as UK priorities scored; and how results changed when transitions are started in advance of offset sale. Our results are essential for understanding which habitats may be implicitly incentivised under the BNG market, and thus the coordination between biodiversity markets and high-level conservation goals.

2.1 Methods

The purpose of our analysis was to determine, for a project proponent starting with a piece of land containing a common baseline habitat type, which habitats they would be implicitly incentivised to deliver by the BNG metric within the BNG market, and whether these habitats are aligned with the ambitions of overarching conservation goals. No information on the prices of different biodiversity units is publicly available in the BNG market, and so here we do not analyse the exact costs and benefits of delivering different habitat types. Instead, we look at the number of biodiversity units generated by transitioning land management towards different habitat types, and so we assume that habitat types which deliver biodiversity unit gains are likely to generate greater revenue than those which deliver unit losses. In practice, we know that biodiversity units for some habitat types will sell for more than others, and that some habitats are more expensive to create. The effect of these factors on the relative profitability of different habitat transitions under BNG is unknowable without public price and cost data. Therefore, we constrain this analysis to analysing and comparing differences in the occurrence of unit gains or losses between different habitat types.

The unit value of a post-development habitat is influenced by the habitat it is replacing: habitat transitions are either *creation*s (transitions to a different broad habitat; e.g. a grassland to a wetland) or *enhancement*s (transitions within the same broad habitat type to the same or higher distinctiveness and/or condition level; e.g. low distinctiveness grassland to a higher distinctiveness grassland), and these incur different temporal and difficulty risk penalties. Habitats can also be retained, maintaining the same unit value in the pre-development calculation. We selected the two most common pre-development habitat types identified in a dataset of real BNG projects (Rampling et al., 2024) as the baseline from which to simulate habitat transitions: these were cropland and poor condition modified grassland, comprising 53% of pre-development habitat in a sample of six early-adopter local authorities.

We simulated transitions from one hectare of pre-development habitat to forty-six habitats within four broad habitat types: woodlands, wetlands, scrubs, and grasslands, as these cover the majority of habitats which can be created from the chosen baselines. We simulated transitions to habitats of three condition levels (poor, moderate, and good)–totalling 131 habitat outcomes from each pre-development habitat baseline–and excluded those which could not be achieved within the 30-year BNG period (SI 1). See SI 2 for simulation examples. We calculated the change in biodiversity units associated with each habitat transition. We also excluded individually, and then together, the temporal and difficulty risk multipliers from transitions delivering a unit loss, to investigate the proportion that delivered a loss because of these multipliers.

To investigate the alignment of the BNG market with the UK's high-level conservation goals, we analysed its contribution toward a diversity of habitat types, and toward different groups of habitats outlined as UK priorities. For the former, we investigated whether the metric biased unit gains towards certain broad habitat types by comparing the number of habitat transitions within each broad habitat type that deliver a unit gain or a unit loss. For the latter, we identified which habitats of which condition levels were included in each of three groups of habitats: habitats which contributed towards the EA habitat target, S41 habitats, and very high- and high-distinctiveness habitats (SI 3). We evaluated S41 priority habitats and high- and very high distinctiveness in isolation from the EA target to identify whether BNG incentivised the delivery of habitats of the highest conservation priority. We explored whether habitats within these groups more often deliver a unit gain than those not in the groups.

For habitat transitions which delivered a loss in units, we investigated how far in advance landowners would have to begin transitions before sale to deliver a unit gain and whether this ameliorated any biases towards certain broad habitat types or wildlife-rich habitats. Following the methodology above, we re-ran habitat simulations with transitions started iteratively either 1,2,3,4,5,7,10 years in advance, and recalculated the unit score of this habitat transition.

2.2 Results

The BNG metric incentivises a limited range of habitats

Simulating habitat transitions from cropland and poor condition modified grassland identified many habitat transitions which failed to deliver a 10% gain–or any unit gain–compared to retaining the low-quality habitat they replaced (Fig. 1).

Comparing the frequency of biodiversity unit gains across broad habitat types found that habitat transitions towards grasslands and scrubs more often delivered gains relative to transitions towards woodlands and wetlands (Fig. 2a). Broad habitat type had a significant influence on whether habitat transitions delivered unit gains or losses (χ^2=27.263, df=3, p<0.001). The same trend was apparent for a poor condition modified grassland baseline (χ^2=48.61, df=3, p<0.01; Fig 2b; SI 4).

The bias towards grasslands and scrubs is also evident in the units per hectare delivered by different habitat types (Fig. 3).

The BNG metric's alignment with different conservation priorities

The proportion of habitats contributing to the EA habitat target was larger in habitat transitions delivering a gain in biodiversity units than those delivering a loss, but this difference was very marginal (Fig 4a; Fisher's Exact Test, p=0.03621, Φ=0.2). There was no difference in the proportion of S41 habitats between transitions delivering a gain and a loss in biodiversity units (Fig 4b; χ^2=0.06783, df=1, p=0.06783, Φ=-0.18), and the proportion of high- and very high-distinctiveness habitats was smaller in transitions delivering a unit gain than those delivering a loss (Fig 4c; χ^2=14.587, df=1, p=0.0001339, Φ=-0.36). Results were largely similar from a poor condition modified grassland baseline (SI 5). Habitat transitions which deliver a loss in units include those to lowland mixed deciduous woodland of every condition level, a high distinctiveness S41 habitat which hosts diverse invertebrate and bird species (Fig 5; Lack & Venables, 1939; Stewart, 2001).

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Most habitat transitions which deliver a loss in biodiversity units do so because of risk multipliers

From cropland and poor condition modified grassland, a respective 90.7% (49/54) and 93.3% (42/45) of the transitions which delivered a biodiversity unit loss would deliver a gain if both the temporal and difficulty risk multipliers were removed. Figure 5 illustrates a habitat transition which delivers a unit loss, highlighting the contribution of post-development multipliers. For a breakdown of the multipliers, see SI 6.

Advance compensation does not ameliorate metric biases

Of the habitat transitions which delivered a loss in biodiversity units from a cropland baseline, the reduced temporal risk associated with advance compensation meant that 31.5% and 55.5% deliver a unit gain when the transition is started 1 or 5 years in advance of unit sale, respectively. Results were similar for poor condition modified grassland (SI 7). Even when landowners begin habitat transitions before unit sale, transitions to woodlands, wetlands, and other wildlife-rich habitats were still less likely to deliver unit gains than grasslands or scrubs (SI 8).

3. Discussion

We found that using the BNG metric–the biodiversity currency around which the BNG market is structured–almost half of the possible habitat transitions from common, low-quality baseline habitats would not deliver a gain in units under the current policy. In other words, a land manager starting with cropland or low-quality grassland would not receive any biodiversity unit uplift for delivering many high-quality habitats considered national conservation priorities. This is largely due to the influence of the post-development risk multipliers. In particular, transitions towards high and very high distinctiveness habitats, including many woodlands and wetlands, tend to deliver losses of biodiversity units under the BNG metric rather than gains from a low-quality baseline.

3.1 The BNG Metric incentivises avoidance but penalises creation of diverse habitats aligned with strategic priorities

Biodiversity offsets are conventionally applied as the final stage of the mitigation hierarchy, and one of the most common arguments in favour of compensation markets is the way they price in impacts to biodiversity into regulated sectors, thereby disincentivising damaging valuable or distinctive natural features (Pascoe et al., 2019). The post-development risk multipliers in the BNG metric work well to this end: where possible, high- and very-high distinctiveness habitats must be replaced with the same habitat type (DEFRA, 2024b), and the temporal and difficulty risk multipliers reduce unit score such that a much larger area of habitat is required to replace the same unit value. This larger area required for compensation will likely translate to a high price for developers damaging these habitats, and patterns found by zu Ermgassen et al. (2021) and Rampling et al. (2024) indicate that the BNG metric is an effective incentive for avoidance, with habitat clearance under BNG in their sample occurring mainly on degraded pasture or cropland rather than higher-quality habitats.

However, our results show that this characteristic of the BNG metric may trade off with the degree to which the BNG market is likely to contribute towards a heterogeneous landscape of habitats important to English conservation goals. We also demonstrate that a metric's alignment to conservation goals depends on how those goals are defined. This demonstrates that small subjective changes to the definition of habitats of conservation priority are important and mask more complex interpretations of whether conservation policies can be considered effective. When we parsed out the habitats of highest conservation priority (S41 habitats and high- and very high- distinctiveness habitats), we see that these habitats are more likely to deliver a unit loss (though the former not significantly), whereas a range of habitats which contribute to the EA habitat target deliver a unit gain under BNG, including for example, good condition Other Neutral Grassland (ONG). ONG is an umbrella habitat representing at least four distinct vegetation sub-communities and has been shown to vary greatly in invertebrate abundance and diversity (Duffus & Atkins et al., 2024). In our dataset it delivers more units per hectare than most more distinctive, priority habitats which are more difficult to create. From low quality baselines, the BNG metric risks incentivising transitions to 'fast delivery' grasslands like ONG *en masse* rather than transitions to a diversity of policy relevant habitat types to achieve national targets.

This is due to the incentivisation of fast delivery habitats and a lack of incentive for the creation of multi-habitat sites. Multi-habitat landscapes have been shown to be more diverse and stable (Hackett et al., 2024) and plant community heterogeneity on both field- and landscape-levels increases aboveground diversity (Brüggeshemke et al., 2022; Le Provost et al., 2021). Metrics like the BNG metric risk missing opportunities to encourage habitat heterogeneity and habitat diversity.

Whilst empirical validation of our simulation results was not possible due to the nature of BNG data provided by developers, the bias towards grasslands and scrubs in our results supports empirical findings from Rampling et al. (2024) that the most commonly delivered habitat through BNG is ONG in six councils that adopted BNG before its national rollout. Furthermore, whilst our analysis did not incorporate the profit associated with each habitat transition and so cannot be used to explicitly infer market incentives, we make tentative conclusions based on the assumption that habitat transitions which deliver a biodiversity unit loss are unlikely to be delivered under BNG. The BNG metric has the potential to implicitly incentivise the BNG market toward delivering a limited range of habitats with a short time to target condition and low difficulty of creation, at the expense of diverse and distinct habitats in locations they are well-suited for.

Given that an estimated fewer than 10% of habitats will be delivered off-site under BNG (Duffus et al., 2024; zu Ermgassen et al., 2021), it is important to maximise the benefits delivered by off-site BNG. Local Nature Recovery Strategies (LNRSs) seek to direct finance from BNG to achieving local priorities for nature by applying a 15% uplift to unit score (before risk multipliers are applied) for habitat transitions which will further the proposed measures in an LNRS or which are described as locally ecologically important and can be demonstrated as providing ecological linkage to other strategically significant locations (DEFRA, 2024b). However, this uplift is unlikely to counter the impact of the risk multipliers such that many habitats otherwise delivering a unit loss deliver a gain when recorded as strategically significant – the post-development woodland in Fig. 3b for example would continue to deliver a unit loss even if awarded a 1.15 strategic significance multiplier. Similarly, whilst high and very high distinctiveness habitats receive multipliers of 6 and 8 respectively, this is applied before post-development multipliers and so their post-development score is often reduced below that of poor-quality baselines like cropland and modified grassland. No direct mitigation of the risk multipliers is possible from low-quality baseline habitats, even if site conditions make creation of wildlife-rich habitats less difficult than typical, and so landowners still incur the same penalties. Whilst beginning habitat transitions in advance of unit sale reduces the risk of biodiversity outcomes failing to be achieved (Bekessy et al., 2010), this creates a financial risk for landowners–a known barrier to entering environmental markets (Alvarado-Quesada et al., 2014)–and our results demonstrate that it does not address the metric's biases.

3.2 Implications for Biodiversity Net Gain

Our results demonstrate that the BNG metric incentivises avoidance well but consequently risks guiding the BNG market towards delivering a limited range of mid-quality habitats, missing opportunities to deliver a diversity of habitats which support high level conservation objectives. Transitioning from no net loss to net gain can be difficult (Bull & Brownlie, 2017): whilst the ability of the BNG metric to incentivise avoidance can mitigate the impact of development on biodiversity, it may require alterations to better incentivise more diverse and ecologically valuable offsets to better contribute to broader conservation goals.

Policymakers developing biodiversity markets may investigate several potential changes to address these problems. Recent research highlighted the need to integrate different sources of financing and match them with the kinds of habitat they are best suited to delivering, to ensure that the biodiversity financing system as a whole achieves objectives aligned with overarching conservation goals (zu Ermgassen et al., 2024b). By assessing the conservation outcomes delivered by different funding streams and biodiversity-related markets, policymakers could identify ‘cold spots’, types of biodiversity which are not being effectively funded via nature markets as they are not valued enough under commodification mechanisms. The role of public funding could be emphasised for these habitats, or subsidies introduced to tip the balance of incentives in favour of delivering these habitats through market mechanisms. For example, our analysis demonstrates that many woodland and wetland habitats are unlikely to be incentivised under BNG. Whilst woodlands might be incentivised by other biodiversity-related markets like the Woodland Carbon Code and some wetland might be incentivised under Nutrient Neutrality, we expect that some habitats of conservation priority will not be delivered as desired by any of these markets.

Several changes to area-condition metrics like the BNG metric could be considered, whilst ensuring that changes do not undermine the powerful incentive to avoid harming high-quality habitats initially under the current system. One change may involve relaxing the post-development difficulty multiplier where a site can be demonstrated to fulfil the correct ecological conditions to deliver high-quality habitats. For example, relaxing the difficulty multiplier for lowland calcareous grassland on sites with calcareous soils may avoid incentivising the delivery of an inappropriate neutral grassland type. Relaxing the risk multipliers should only be done in the presence of correct ecological conditions and habitat creation expertise, and should not override the much larger area required in compensation for lost habitat to ensure no net loss of biodiversity (Bull et al., 2017).

3.3 Potential lack of coordination between the outcomes of biodiversity markets and conservation priorities

More broadly, our simulation study demonstrates that within biodiversity markets, commodification mechanisms risk delivering outcomes that are not well aligned with higher-level conservation goals. We demonstrate that similarly to trends seen in the VCM, choice of proxy metric can have large effects on which habitats become valuable in biodiversity markets, and in this case may lead to the delivery of a limited diversity of habitats with limited alignment with conservation priorities.

Biodiversity markets are rapidly proliferating around the world, and are expected to become an important component of conservation policy and key strategy for achieving global conservation funding goals. Several metrics have been developed based on the BNG metric, including those developed for use in Sweden, Singapore, the Americas, and a global metric (AECOM, 2024; CLIMB, 2024; Ramboll, 2024). However, for them to actively contribute to higher-level conservation objectives, it is essential that the incentives generated under biodiversity markets align with these high-level objectives, or mechanisms risk generating funding for conservation but investing it in lower quality habitats which make limited contribution to overall conservation goals.

We identify a risk that conservation investment generated via BNG–one of the world's most high-profile biodiversity markets–may lean towards funding the delivery of habitats of relatively low ecological value, which are poorly aligned with national policy objectives.
Our results suggest that the biodiversity metric works well to incentivise avoidance of biodiversity impacts, but the investment generated by biodiversity markets risks being allocated towards creating many relatively common habitats which are not of highest conservation value, missing a key opportunity to align markets with overall national conservation objectives.

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Author contribution statement

N.M., N.E.D., S.O.S.E.z.E. and J.W.B. conceptualised the study. N.M. collected the data. N.M. analysed the data and produced the figures. N.M., N.E.D., S.O.S.E.z.E. and J.W.B. wrote the manuscript.

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Figure 1. Stacked bar chart illustrating each baseline habitat type, with the proportion of habitat transitions which deliver a unit gain (yellow) and unit loss (orange) from these baselines represented. Numbers at top represent total number of possible habitat transitions from each baseline.

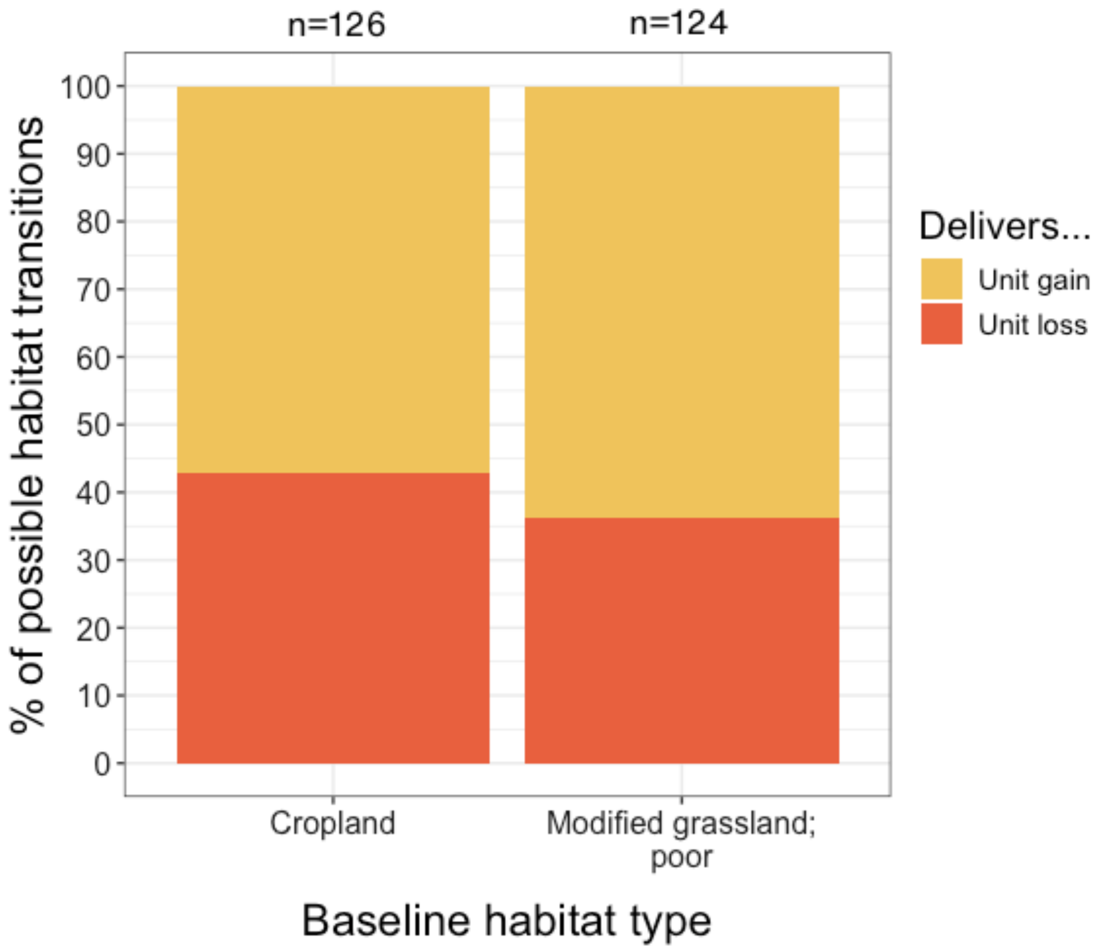

Figure 2. The broad habitat type breakdown for all habitat transitions; habitat transitions which deliver a gain in units; and habitat transitions which deliver a loss in units, from a baseline habitat of a) cropland, b) poor condition modified grassland. The number of habitat transitions in each category is provided.

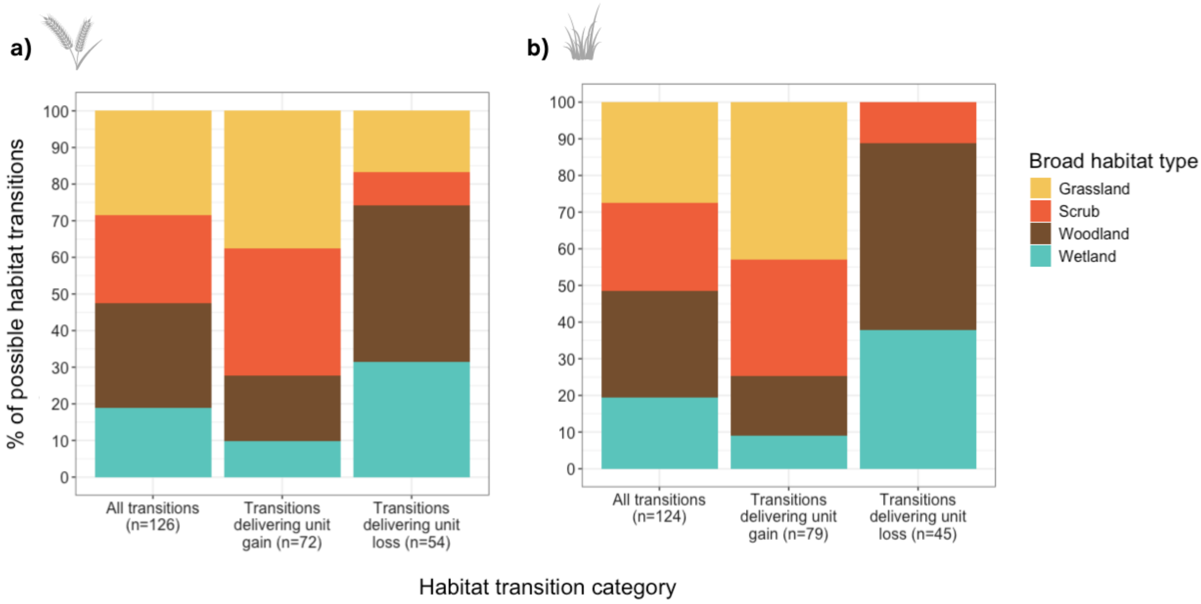

Figure 3. Change in biodiversity unit per hectare given by example habitat transitions from a) cropland b) poor condition modified grassland baselines. The first seven habitats in each panel represent the seven highest scoring habitat transitions from each baseline, and the last seven represent a selection of other habitat transition examples. All transitions are towards good condition habitats. Icon = broad habitat type. Note that the habitat 'dunes with sea buckthorn' was excluded as it is restricted to specific coastal habitats in East Anglia.

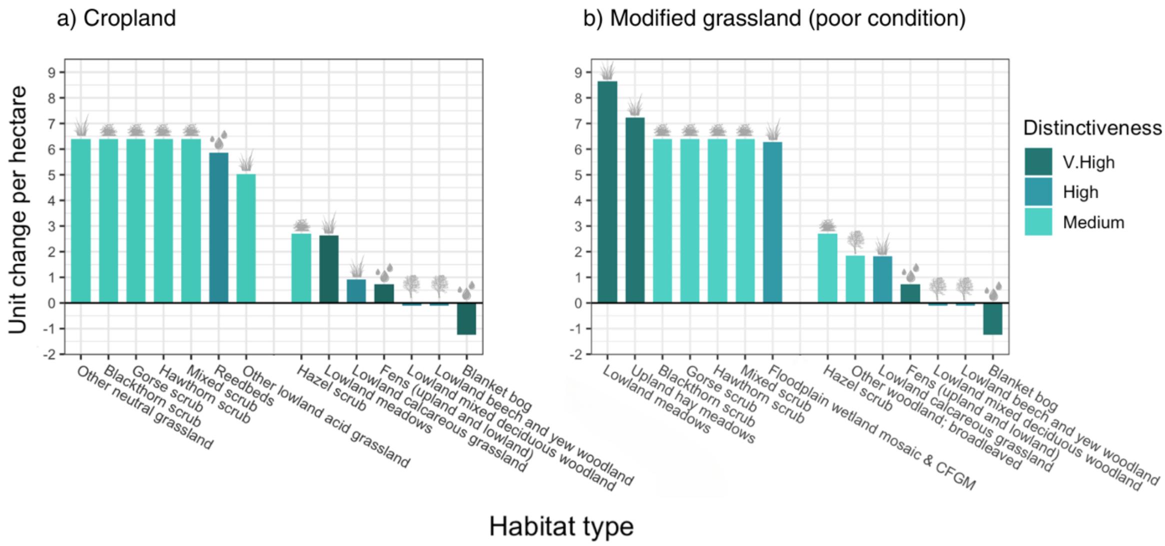

Figure 4. Stacked bar chart illustrating the proportion habitat transitions which a) contribute towards the EA habitat target, b) deliver S41 habitats, c) deliver high or very high distinctiveness habitats, for transitions which deliver a gain or loss from a cropland baseline. Numbers at top represent total number of possible habitat transitions from each baseline.

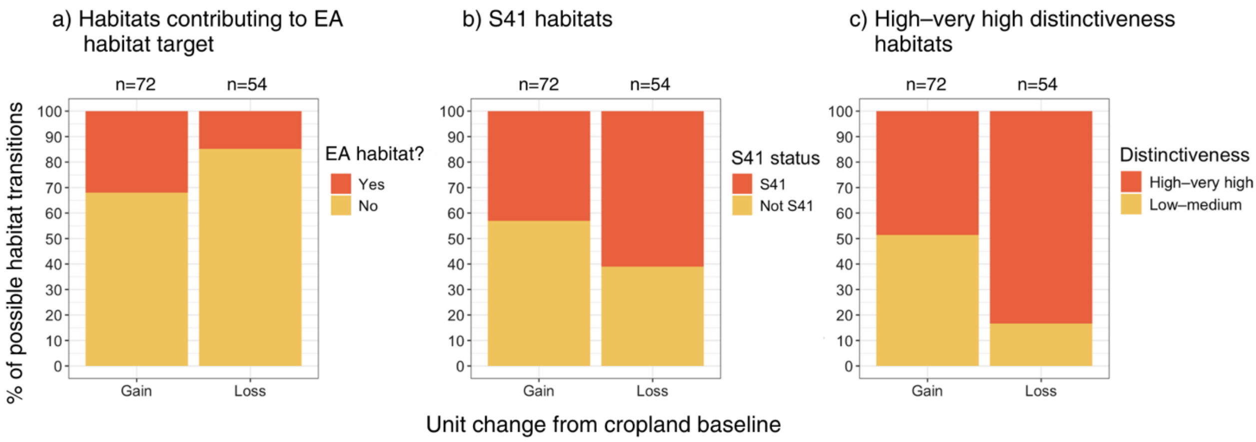

Figure 5. Decomposed biodiversity unit score of a) pre-development cropland (condition NA) and b) post-development lowland mixed deciduous woodland habitat (moderate condition) in an example habitat transition which delivers a unit loss. Black text = value of each component 'multiplier'; white text = final unit score for each habitat. Figures made with waterfalls package in R (Parsonage, 2022).