Biological Conservation 252 (2020) 108861

Contents lists available at ScienceDirect

Biological Conservation

journal homepage: www.elsevier.com/locate/biocon

The hidden biodiversity risks of increasing flexibility in biodiversity offset trades

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ARTICLE INFO

Keywords:
Biodiversity offsets
No net loss
Market-based instruments
Conservation policy
Australian native vegetation
Biodiversity trading

ABSTRACT

Market-like mechanisms for biodiversity offsetting have emerged globally as supposedly cost-effective approaches for mitigating the impacts of development. In reality, offset buyers have commonly found that required credits are scarce and/or expensive. One response has been to seek improved market functionality, increasing eligible offset supply by allowing greater flexibility in the offset trading rules. These include increasing the size of geographical trading areas and expanding out-of-kind trades ('geographical' and 'ecological' flexibility). We summarise the arguments for and against flexibility, ultimately arguing that increasing flexibility undermines the achievement of No Net Loss (or Net Gain) of biodiversity where high-quality governance is lacking. We argue expanding out-of-kind trading often increases the pool of potentially eligible offsets with limited conservation justification. This interferes with vital information regarding the scarcity of the impacted biodiversity feature, thereby disincentivising impact avoidance. When a biodiversity feature under threat of development is scarce, expensive offsets are an essential feature of the economics of offsetting which communicate that scarcity, not a problem to be regulated away. We present examples where increasing ecological flexibility may be justifying the loss of conservation priorities. We also discuss how increasing geographical flexibility might compromise the additionality principle. We highlight alternative mechanisms for enhancing offset supply without the risks associated with increasing flexibility, including reducing policy uncertainty and improving engagement and awareness to increase landholder participation. Although there are legitimate reasons for increasing offsetting flexibility in some specific contexts, we argue that the biodiversity risks are considerable, and potentially undermine 'no net loss' outcomes.

1. Biodiversity offsetting regulatory markets

Biodiversity offsets are a globally significant mechanism for reconciling potential trade-offs between biodiversity and infrastructure expansion or other development projects (Bull and Strange, 2018; Shumway et al., 2018; zu Ermgassen et al., 2019a). Offsets are conservation actions taken to compensate fully for the residual biodiversity losses associated with development following the application of a mitigation hierarchy (e.g. avoid, minimise, remediate, offset), with the overall aim of achieving No Net Loss (NNL) or Net Gain of biodiversity (Bull et al., 2013a; Gardner et al., 2013). Within several jurisdictions around the world, offsets are supplied to proponents undertaking development or land clearing through regulatory markets or market-like mechanisms. These are systems characterised by market-like trades between buyers and sellers but are not 'free markets' for various technical reasons, including the buyers being coerced into purchasing through government regulations rather than transactions being voluntary (Koh et al., 2019; Vatn, 2015). Over 81,000km^2 of offsets globally

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https://doi.org/10.1016/j.biocon.2020.108861
Received 20 April 2020; Received in revised form 27 October 2020; Accepted 30 October 2020
Available online 14 November 2020

are currently implemented as a result of national biodiversity compensation policies (Bull and Strange, 2018).

The ultimate purposes of biodiversity offset regulatory markets are to internalise the value of biodiversity into the land-use planning process and deliver biodiversity gains that fully compensate for losses induced by development activities, in a cost-effective way (Calvet et al., 2015). Commonly, a government regulator sets an overall target outcome (e.g. 'NNL in native vegetation') and facilitates the establishment of trade infrastructure that connects landholders providing offsets with potential buyers, often with the help of brokers (Koh et al., 2019; Vatn, 2015). If the market-like mechanism functions effectively, in theory, landholders will compete to deliver the required biodiversity gains at the lowest price – which ultimately allocates the task of biodiversity conservation to the landholder who is able to deliver the required biodiversity most efficiently (Calvet et al., 2015). This relies on the strong and contestable assumption that the landholder does in reality meet their biodiversity obligation (Theis et al., 2020; zu Ermgassen et al., 2019b).

Regulators largely determine the biodiversity outcomes of regulatory offset markets, as they specify the requirements that trades must achieve in order to be compliant. Best practice guidance for voluntary offsets (e.g. BBOP, 2013; IUCN, 2016) suggests that biodiversity trades should be 'like-for-like' or better (i.e. gains or avoided losses should benefit the same biodiversity feature as was impacted, or a biodiversity feature that is more threatened), and should usually occur within the same geographical region. The rationale behind these conventional trading constraints is to maintain the functioning of the impacted ecosystem, and to ensure that the same community of people that loses out on a valuable biodiversity feature maintains access to an equivalent biodiversity feature (Bull et al., 2013a; Griffiths et al., 2019).

Whilst the explicit purpose of many biodiversity offsetting regulatory markets is to achieve NNL of biodiversity, in order to achieve buy-in from regulated industries, in practice offsetting policies are outcomes of negotiation processes among multiple stakeholders (Miller et al., 2015). As a result, offset policies often compromise on ecological theory in order to satisfy other economic or industry objectives (Calvet et al., 2015). This is risky as there is currently limited information on the actual effectiveness of offsetting schemes at delivering appropriate biodiversity gains (Gibbons et al., 2018; zu Ermgassen et al., 2019b). Ways in which economic/cost-reduction priorities interfere with the capacity of offsets to achieve no net loss in biodiversity include situations where policies: a) specify pre-set, often arbitrary multipliers (the ratio of biodiversity gains to losses required by the policy) that are lower than those required to truly achieve NNL (Bull et al., 2017; Laitila et al., 2014); b) systematically overestimate the counterfactual rates of habitat loss to make offset obligations easier to achieve through 'avoided loss' (offsetting where habitat loss is traded for an increase in the level of protection of existing habitat; Maron et al., 2015); and c) use streamlined and simplified biodiversity assessment methods to reduce transaction burden on developers (Lave et al., 2010; Sullivan and Hannis, 2015). There are many mechanisms through which economic considerations can be prioritised over biodiversity. These include pressure from vested interests, and situations where time-stressed under-resourced regulators are implicitly incentivised to rush through approvals without full scrutiny, or deliver outcomes supporting overarching government pro-development priorities over environmental ones (Clare and Krogman, 2013; Jacob and Dupras, 2020; Macintosh and Waugh, 2014).

This paper explores one aspect of offset trades that has so far received relatively little attention in the literature: offsetting flexibility (Bull et al., 2015; Habib et al., 2013; Yu et al., 2018). There are three main categories of flexibility in biodiversity offsetting: ecological, geographical, and temporal (Table 1, see Bull et al. (2015) for additional categories not addressed here). Here, we focus on the implications of ecological and geographical flexibility, as the impact of temporal flexibility (i.e. allowing impacts today to be compensated for through promised biodiversity gains delivered in the future) has been widely discussed and established (Bekessy et al., 2010; Bull et al., 2015; Buschke and Brownlie, 2020; Weissgerber et al., 2019; Yu et al., 2018). There is widespread agreement that biodiversity gains achieved in advance of the biodiversity loss associated with development are more likely to deliver NNL and entail better biodiversity outcomes compared to those promised in the future through restoration actions planned over long time horizons.

Table 1
Summary of the three main categories of flexibility in biodiversity offset trades.

Category of flexibility	Explanation
Ecological (also referred to as 'ecological equivalence')	Biodiversity offset policies have rules that determine which type of biodiversity is considered an acceptable replacement for lost biodiversity. Best practice guidelines promote 'like-for-like or better' trading rules (BBOP, 2013; IUCN, 2016), whereby lost biodiversity needs to be replaced by the same kind of biodiversity or one that is more ecologically valuable or threatened. As flexibility increases along this dimension, the ecological communities or species targeted by the offset actions can be increasingly different from those impacted by a development activity.
Geographical/spatial	Offset policies normally implement some constraints about where offsets need to be located relative to the impact causing the biodiversity loss. It is widely advocated that offsets should be located as close as possible to the initial impact site, so that people in the vicinity retain their access to nature and to improve the chance of ecological equivalence at levels below that of the categorical 'types' of biodiversity (e.g. populations, genes). Commonly, offset policies mandate that trades need to occur within the same administrative unit as the impacts (e.g. Biodiversity Net Gain in England is proposing to penalise trades which do not occur within the same local authority (Crosher et al., 2019)), or within the same defined ecological unit (e.g. compensatory wetland mitigation in the US under the Clean Water Act must occur within the same watershed). As geographical flexibility increases, offset sites can be further from the impact sites.
Temporal (offsets established in advance of biodiversity impacts are often called 'habitat banks')	Offset policies can specify how far in the future biodiversity gains need to be delivered in order to be considered acceptable to compensate for losses today. Some offset policies allow for offsets to deliver gains long into the future (e.g. in the proposed Biodiversity Net Gain policy in the UK, gains can be delivered up to 32 years into the future and count towards acquitting a developers' offset liability (Crosher et al., 2019)), others have constructed systems of habitat banking that ensure that a large proportion of the biodiversity gains are in place before the development impact occurs (e.g. wetland mitigation banking in the US). As temporal flexibility increases, biodiversity gains can be delivered further into the future.

Regulators set the degrees of flexibility permitted by the policy. Recent evidence (outlined below) suggests that several established offset systems have permitted increasing ecological and/or geographical flexibility over time, consistent with non-ecological objectives such as improving the function of offsetting market-like mechanisms through increasing the ease of trades (Needham et al., 2019). In early-stage offset systems where the regulatory architecture is still under development, such as the UK's Net Gain policy for development activities in England (Defra, 2019), questions surrounding flexibility are fundamental as, once embedded, they determine the future functioning of the policy.

2. The arguments for increasing offsetting flexibility

Offset regulatory markets are in general perceived to be inefficient because they are often characterised by low offset supply, high transaction costs (i.e. costs associated with measurement of the value of a trade, search for information, bargaining and decision-making (Cheung, 2016)) and a low volume of trades for a given credit type (Needham et al., 2019). Some of these transaction costs are essential. Organising offsets (e.g. conducting biodiversity assessments, encouraging landholder participation, monitoring compliance) is time consuming and contractually challenging (Evans, 2017; Vaissière et al., 2018); problems which ultimately contributed to the UK's biodiversity offsetting pilot (2012–2014) failing to secure any trades (Needham et al., 2019). These transaction costs can impose additional costs on offset purchasers looking to construct new infrastructure or developments (Buitelaar, 2004).

Recent work has outlined that biodiversity offset market-like mechanisms are likely to function most effectively from an economic perspective when they use simple, standardised units of biodiversity, when there is a large offset trading volume, and when there are large geographical trading areas (Needham et al., 2019, in press). As a result, increasing the geographical flexibility (e.g. Needham et al., 2019) and ecological flexibility (e.g. Habib et al., 2013; Minerals Council of Australia, 2018) of offsets have been proposed as ways of improving the functioning of these market-like mechanisms. The rationale behind this is that flexibility widens the number of offsets that are eligible to compensate for a given biodiversity impact, as the impacted biodiversity feature can be traded for a wider set of potential biodiversity features. Therefore, the supply of potential offsets increases, which reduces prices because competition between landholders to secure a buyer for their offsets increases (although real-world heterogeneity in biodiversity values across jurisdictions may deliver the odd exception, e.g. Needham et al., in press). Some regulators may also favour flexibility, as it increases the number of eligible offsets sites and therefore may reduce their administrative burden and costs.

There have been various empirical explorations of the potential ecological benefits of offsetting flexibility. Bull et al. (2015) and Habib et al. (2013) have explored the potential biodiversity gains from scrapping the 'ecological equivalence' aspect of offset trades, highlighting that constraining trades to a certain biodiversity feature such as a habitat type might deliver sub-optimal biodiversity outcomes if that feature is common and not considered a local biodiversity priority, and higher priority alternatives are available. Geographical flexibility may also be essential in contexts where impacted biodiversity is highly mobile or migratory, weakening the capacity of equivalent area-based offsets to sufficiently address biodiversity impacts (Bull et al., 2013b). In contexts where the aim is to offset historic habitat loss in highly modified landscapes retrospectively (i.e. after land use change has occurred and with no potential to influence the initial avoidance of impacts), flexibility can be necessary as there may be insufficient remaining appropriate offset sites. For example, Yu et al. (2018) describe an example from the Yellow River Delta in China where the only way that no net loss for each impacted wetland type could be achieved was through expanding the geographical scope of offsetting, allowing for offsetting in neighbouring regions. In some of the world's most prominent offset systems in Australia (Box 1), calls for increasing the flexibility of offset trading certainly resonate with influential vested interests whose activities are being regulated through offsetting policy. For example, relaxing the 'like-for-like' requirements of offsetting policies is the stated preference of some key business stakeholders, such as representatives of extractive industries (Minerals Council of Australia, 2018).

Reflecting these issues, there is pressure from regulated industries and deregulation-friendly governments to implement policy changes to reduce transaction costs and stimulate offset supply (Apostolopoulou and Adams, 2017; Lave et al., 2010), with environmental regulation perceived as a barrier to development. Pressure from regulated stakeholders to prioritise economic over ecological objectives is to be expected since biodiversity offsetting creates a regulatory framework

Box 1
Examples of Increasing flexibility in Australian state biodiversity offsetting systems

In Australia, biodiversity offsetting has emerged as a key tool in the policy mix aiming to reduce rapid rates of deforestation and biodiversity loss across the continent (Bradshaw, 2012; Kearney et al., 2019; Miller et al., 2015). Australia has lost one third of all its native vegetation since European settlement, and 61% of all 1136 nationally-listed threatened species are threatened by habitat loss (Kearney et al., 2019; Ward et al., 2019). Partially in response, most states have biodiversity offsetting policies, with the two most well established in the states of New South Wales and Victoria.

The first offsetting system in New South Wales (BioBanking; first offset trades in 2010) specified like-for-like trading requirements for both ecosystem types and threatened species (Department of Environment, Climate Change and Water, 2010). Since the introduction of the Biodiversity Conservation Act in 2017, a new level of flexibility has been incorporated into the state's approach to offsetting. Developers now have the choice of passing on their offset liability by paying into the Biodiversity Conservation Trust, a government-run fund. Although a hierarchy of preferred offsetting options is specified (i.e. preference is given to like-for-like or better in the same bioregion) there are no legal restrictions on the Trust offsetting using any habitat types anywhere in the state. As such, the option is open for both ecologically- and geographically-flexible offsetting.

In Victoria, there is also evidence of a trend (albeit less severe) towards flexibility from the original 2002 Native Vegetation Framework (Department of Sustainability and Environment, 2002) to today's native vegetation removal regulations. Notably, the policy goal was weakened from 'net gain' to 'no net loss' of biodiversity (Department of Environment, Land, Water and Planning, 2017a; Department of Sustainability and Environment, 2002). Initially, offset legislation incorporated a graded response, whereby strict like-for-like trades were required for vegetation of 'Very High' conservation significance and progressively weaker rules were allowed for vegetation as conservation significance decreased (Department of Sustainability and Environment, 2002). Since 2013 for general offsets (offsets for impacts to native vegetation where there are no threatened species present), there are no like-for-like restrictions. Offsets are required to have at least 80% of the 'strategic biodiversity score' of impact sites, which is a score derived from a systematic conservation prioritisation approach broadly representing habitat condition and rarity as well as the number of threatened species present (Department of Environment, Land, Water and Planning, 2017b). General offsets do have a geographical restriction, and are constrained to the same Catchment Management Authority or municipal district. For offsets to threatened species, there is a 'like-for-like' requirement, but no geographical restrictions on where those offsets are located throughout the state.

through which the biodiversity impacts of new developments are internalised and accounted for within the development process. This imposes a cost that regulated industries were previously able to externalise onto society as a whole.

In several Australian offset systems, there is evidence that states are under pressure to increase offsetting flexibility (Ives and Bekessy, 2015; Nature Conservation Council of NSW, 2016). For example, Queensland recently reviewed their native vegetation offsetting policy and emphasised the ambition to reduce 'green tape' (Queensland Government, 2019a, p11), with the justification that 'some proponents have experienced difficulty addressing impacts for environmental values which cannot be offset'. Victoria's most recent review highlighted the need to 'support the development of the market for low availability offsets' (Department of Environment, Land, Water and Planning, 2016), and a major motivation behind New South Wales's biodiversity legislation reform was to 'provide greater levels of flexibility to industry and landholders on how they manage biodiversity, including native vegetation' (Byron et al., 2014). These shifts aim to increase the supply of offset credits (thereby theoretically reducing prices). Consequently, numerous policy statements and modifications have occurred which increase offsetting flexibility (Box 1).

There are two major underexplored and unquantified risks of increased flexibility that threaten to undermine the desired NNL outcomes of offsetting market-like mechanisms. The first risk associated with increasing the ecological flexibility of offsetting (i.e. relaxing like-for-like) – especially in response to low supply – is the risk of interfering with information regarding the genuine scarcity of the impacted biodiversity feature, potentially disincentivising impact avoidance. The second risk, associated with increasing geographical flexibility, is that larger trading areas have the potential to deliver offsets with lower additionality, undermining the conservation outcomes associated with the offsets.

3. Flexibility interferes with information about biodiversity feature scarcity and disincentivises avoidance

Under best practice, biodiversity offsets must be implemented as an option of last resort, preceded by the implementation of the first three steps of the mitigation hierarchy (avoidance, minimisation, remediation). In many cases biodiversity offset systems trade uncertain future biodiversity gains for imminent losses (Maron et al., 2012; Weissgerber et al., 2019). This lack of certainty that the intended biodiversity gains will be delivered in reality means avoiding impacts – step 1 of the mitigation hierarchy – is crucial (Buschke and Brownlie, 2020; Hough and Robertson, 2009; Phalan et al., 2018 but see Bull and Milner-Gulland, 2020). Note here that there is a distinction between avoidance (i.e. avoiding impacts to biodiversity initially, first step of the mitigation hierarchy) and 'avoided loss' offsets, which are offsets that prevent biodiversity losses in an area that likely would have occurred without the offset. Under best practice principles, avoidance should be rigorously applied as the first step of the hierarchy, meaning that promises of compensation should not influence the requirement for adequate avoidance. However in practice, in some offset systems, despite the rhetoric of avoidance, offsetting appears to be the default response to biodiversity impacts (Clare and Krogman, 2013; Martin et al., 2016; Samuel, 2020). As a result, there is in reality a significant interaction between the offsetting and avoidance steps: a high degree of difficulty, and in particular a high price, associated with acquiring appropriate offsets will incentivise avoiding impacts in the first place (Koh et al., 2017; Pascoe et al., 2019). In this way, offsets represent a punitive-tax-like incentive to avoid causing biodiversity loss initially.

The major risk therefore with increasing ecological flexibility is that it interferes with communicating the scarcity of the impacted biodiversity feature, thereby potentially disincentivising avoidance of impacts to threatened biodiversity features. Offset requirements are often triggered specifically because the biodiversity feature impacted is threatened and/or scarce. If a threatened or scarce biodiversity feature is required to be compensated by the same biodiversity feature, then it is likely to be difficult or impossible to acquire an appropriate offset (because by definition, appropriate offsets are scarce), therefore incentivising avoiding impacts to that biodiversity in the first instance (Koh et al., 2017). Under conventional economic theory (critically explored in Spash, 2015), we might expect that the scarcity of the impacted biodiversity feature would be communicated via a higher price for appropriate offsets, although evidence from offsetting markets in the US suggests that offset prices do not always predictably follow changes in supply and demand (Robertson, 2008, 2007). Nevertheless, the difficulty of acquiring an appropriate offset provides essential biodiversity supply information – as such, it is an *essential feature* of biodiversity offset regulatory markets aiming to achieve NNL outcomes, not an economic inconvenience to be regulated away by increasing the supply of eligible offsets through increased flexibility of trades.

Opening the door to increased flexibility can have very real consequences for threatened biodiversity (Fig. 1). For example, in Australian biodiversity offsetting systems there are rarely restrictions that absolutely prohibit impacts on particular biodiversity features, with offsetting usually permitted if a compliant offset can be secured (e.g. Queensland permits the clearance of vegetation in national parks in return for offsetting with a multiplier of 10 (Queensland Government, 2019b)). As a further example, under Western Sydney Growth Centre's biodiversity offset program, flexibility has been built into the offset requirements. The Growth Centre (which includes plans to construct 200,000 new homes) impacts on several critically-endangered ecological communities, including Cumberland Plain woodland and Shale Sandstone transition forest. Since the inception of the Growth Centre in 2007, over 300 ha of these two communities have been converted to other land uses (Government of New South Wales, 2018). Whilst the scheme has so far achieved its (like-for-like) offsetting 'requirements', the Growth Centre was permitted to proceed with a commitment to avoided loss offsets using a multiplier of 1 (Government of New South Wales, 2006, p.6), which is well below a level sufficient to achieve NNL (Laitila et al., 2014). In effect, this equates to committing to a halving of remaining ecosystems. Regardless, in the event that there is 'insufficient available land' (p.13) for offsetting these threatened habitats, the inbuilt flexibility permits the program to offset using any grassy woodlands within the ecoregion, or indeed any other potential native vegetation. In short: flexibility circumvents the market incentive to avoid impacts to valuable habitats. Indeed, it may well permit considerable losses of these critically endangered habitats. If flexibility were not permitted, the scheme would have to avoid impacts to these ecosystems initially. This may come at some financial cost, but ultimately the policy goal is to achieve NNL of biodiversity and in this case flexible offsets do not facilitate this outcome. Of course, the loss of natural habitats also comes at considerable economic cost which is largely unaccounted for in offset pricing (including both market values such as the traded value of the price of carbon stored within natural habitats, and non-market values such as biodiversity's existence value, and underpinning the resilience of delivery of other ecosystem services). The example from the Western Sydney Growth Centre is not a unique case – similar dynamics have been found for offsetting under Australia's national environmental law, the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). Instead of disincentivising impacts to biodiversity initially, the inability of proponents to satisfy the 'like-for-like' requirements of the EPBC Act Environmental Offsets Policy has led to instances of flexibility in offset conditions, and an expansion of indirect (e.g. 'out-of-kind') offsetting. Such offsets do not result in a conservation gain for the affected biodiversity, thereby implicitly facilitating the loss of valuable biodiversity (Australian National Audit Office, 2020).

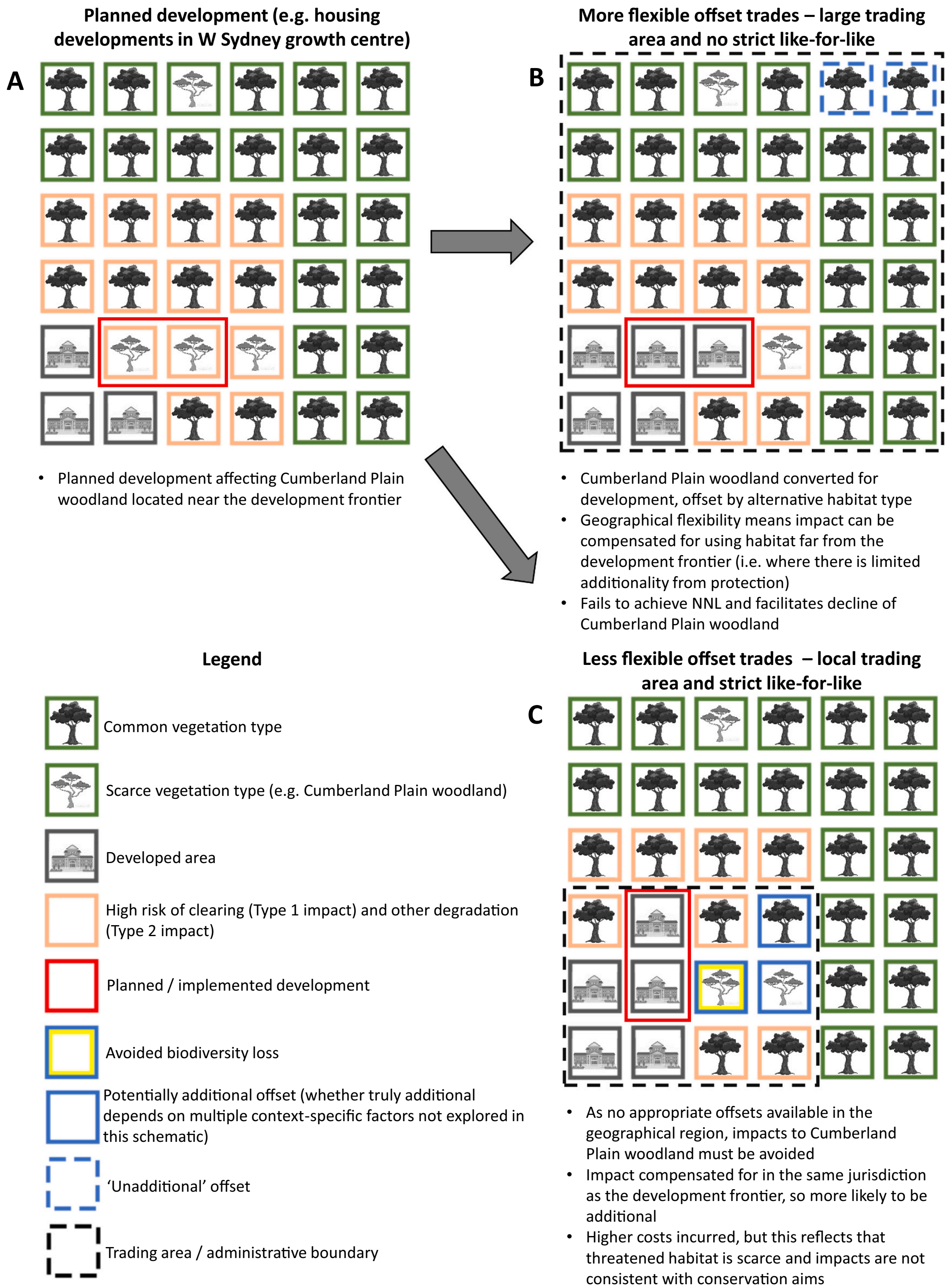

Fig. 1. Schematic diagram of the potential biodiversity outcomes associated with flexible, and inflexible offset trading using an illustrative case study (offsetting impacts to Cumberland Plain woodland under the Western Sydney Growth Centre offsetting policy). A) A development is planned, proposing to clear two units of Cumberland Plain woodland. B) Under more flexible trading rules, a different habitat type is permitted to offset impacts to the threatened habitat type, and the offset is located far from the development frontier. This means the incentive to avoid impacts to the threatened habitat initially has been undermined. Also, as the offset is located far from threats, the offset is likely to offer less additionality. C) Under less flexible trading rules, offsetting impacts to Cumberland Plain woodland has become challenging or expensive, as available offset sites are scarce. This incentivises developers to change their development plan to avoid some impacts to the threatened habitat initially. One unit of Cumberland Plain woodland is lost for development, and compensated for with an offset, and another unit of loss is avoided entirely. Whilst this schematic is used here to demonstrate the ecological benefits of rigid trading rules, in the real world the effectiveness of this offset at achieving NNL is dependent on other complexities not explored here. These complexities include the actual offset ratio used for the avoided loss offsets (1:1 as demonstrated here is far too low to achieve anywhere close to absolute NNL in reality); and the degree to which offsets are preventing Type 1 versus Type 2 impacts.

4. Expanding geographical trading areas may undermine additionality for avoided loss offsets

A second argument for promoting strict trading rules that applies specifically to avoided loss offsets is that offsets within smaller geographic trading regions may yield greater conservation additionality than larger areas (Giannichi et al., 2020). Additionality is a key concept in biodiversity offsetting: for an offset to truly achieve NNL, it must achieve a conservation gain that would not have happened in the absence of the activities associated with the offset (Gordon et al., 2011; Maron et al., 2013; McKenney and Kiesecker, 2010). All things being equal, large trading regions are likely to contain a larger number of potential offset sites which are under limited or no threat of development (Giannichi et al., 2020). The problem with increasing geographical trading areas in the name of improving functioning of the market-like mechanism in theory is that areas under low development pressure tend to 'soak up' the offset obligations of areas with high rates of development because of the lower economic opportunity costs of offset establishment (Ibid; Fig. 1). Areas with low development pressure are those that are least likely to be under threat. As a result, offsets located in these areas will offer the least additionality (conservation management will deliver a smaller conservation benefit relative to the counterfactual of what would have occurred without the offset). Similar patterns have been demonstrated to undermine the effectiveness of protected areas (Geldmann et al., 2019; Venter et al., 2018). Relaxing the geographical restrictions on offsets may tend to draw offsets away from areas where they would be more likely to be additional, and drive them towards areas where they offer limited gains relative to the counterfactual, thus undermining NNL outcomes. As a separate issue, smaller trading regions may also be socially desirable because of the potential inequity of reducing affected peoples' access to nature by relocating it further away (BenDor et al., 2007; but see Bateman and Zonneveld, 2019).

This issue is compounded if policies do not have robust methods for assessing offset additionality (Maseyk et al., 2020). In some avoided loss offsetting policies, including Australian native vegetation offsetting systems, the way additionality is operationalised is that sites which are not under formal legal protection are implicitly assumed to be under threat of land clearing or ecological degradation, regardless of their location or threat level (Maron et al., 2015). Hence, the policies assume that simply giving an unprotected site legal protection through an offsetting agreement achieves an outcome that is additional (e.g. in Victoria, this is referred to as 'security gain' (Department of Environment, Land, Water and Planning, 2017c)). However, working out whether an offset is truly additional requires an analysis of future threats (and probabilities of ecosystem degradation) to the site under the offsetting and counterfactual scenarios, which is rarely done in practice. Protection may well not deliver additional gains in some contexts (Sonter et al., 2020). For example, if a patch of native vegetation that is not under formal protection is still standing after decades of land management, it is likely that that patch is under limited threat (i.e. because either clearing is uneconomic for landholders, or because the landowners hold pro-environmental attitudes and would likely have maintained that land even in the absence of formal protection (Selinske et al., 2016)). Other ways that additionality is commonly operationalised include using offset multipliers or assuming that offset management will improve the future biodiversity value of a site, but neither of these guarantee additional outcomes (Bull et al., 2017; Dorrough et al., 2019). Further, offsets can only deliver gains due to avoided losses if they protect habitat that is itself not subject to a mandatory offset requirement following clearance (see discussion in Maron et al. (2018) and Maseyk et al. (2020); Fig. 1). Type 1 impacts are impacts that would themselves trigger their own offset requirement (e.g. clearance of native vegetation for a new development), and Type 2 impacts are those that would not trigger their own offset (e.g. offsets that prevent a threatening process that is not subject to an offset, such as livestock grazing in areas of native vegetation). In reality, avoided loss offsets preventing Type 1 impacts offer no additionality, because they prevent the clearing of something that would trigger its own offset requirement if cleared. Only avoided loss offsets preventing Type 2 impacts can offer any true additionality. However, avoided loss offsetting systems in operation today in general fail to account for this subtlety, and this remains a fundamental flaw in the way gains due to avoided losses are calculated, undermining the ability of avoided loss offsets to achieve no net loss of biodiversity.

Whilst the risk of geographical flexibility undermining additionality applies primarily to offsetting policy frameworks that permit the preservation or enhancement of existing habitats as offsets, this is non-trivial – avoided loss offsets represent approximately 20% of all of the world's recorded biodiversity offsets by number, covering approximately 50,000km^2 (Bull and Strange, 2018). Systems based purely on restoration or habitat creation, such as those in the US and Germany, are less likely to suffer from these drawbacks as additionality is implicit in the act of habitat creation (assuming that habitat would not have passively regenerated under the do-nothing counterfactual; but see Sonter et al. (2017)). This risk would be reduced for offsets which calculate the additionality on a case-by-case basis and integrate this into the calculation of the appropriate offset multiplier (e.g. some large voluntary offsets summarised in Maseyk et al. (2020)).

5. Improving regulatory market function without inducing the risks of flexibility

As discussed above, flexible trading rules are perceived as solutions to issues relating to 'thin markets' (characterised by low offset supply), including price volatility, strategic behaviour, and market collapse (Adjemian et al., 2016; Needham et al., 2019). However, we contend that there are other mechanisms that can be used to improve the function of offset regulatory markets without introducing offset flexibility that risks undermining biodiversity outcomes. The key point is that the difficulty of securing an appropriate offset trade is a function of two properties: a) the availability of appropriate offset sites containing the impacted habitat type (itself influenced by the absolute scarcity of the threatened habitat type); and b) transaction costs associated with the process of offsetting. The aim of actions to improve the functioning of the market-like mechanism should ideally be to reduce transaction costs, whilst leaving the information about the scarcity of the biodiversity feature intact. Some of the key determinants of transaction costs include a lack of landholder awareness about offset policies, regulatory uncertainty (the regulations surrounding offset policies tend to change frequently), and the degree of trust landholders have in offset administrators (Coggan et al., 2013). These factors can be improved without changing offset trading rules through increasing investments in education and communication about the programme, engagement with previously unreached landholders, and introducing policy stability by committing to keeping the regulation unchanged for a set period of time. We acknowledge these are challenging, but it should not be the default option to increase flexibility and risk the policy's ecological outcomes just because alternative mechanisms for improving market function are difficult to achieve. Additionally, an important driver of price volatility and strategic behaviour between buyers or sellers in thin markets is asymmetrical information (Adjemian et al., 2016), which occurs when one party has better information about the market or the good/service being transacted than the other party. For example, the offset seller is likely to have a better understanding of their true opportunity costs than the buyer, which may permit them to charge higher prices than the seller would in reality be willing to accept. This can be addressed through better public offset registries and data on offset transactions, such as the public offset registries implemented by Western Australia or France (Government of France, 2020; Government of Western Australia, 2020). All of these actions could be implemented without interfering with the information about the scarcity of the biodiversity feature.

6. When flexibility is justifiable

From a biodiversity perspective, we would argue that flexibility is rarely justifiable once real-world implementation issues are taken into account. Institutional factors that influence when flexibility is justifiable include when: a) the offsetting market-like mechanism is embedded within a planning system that includes strict avoidance of threatened biodiversity features; or b) regulatory institutions have the capacity and resources to implement strategic offsetting actions whose biodiversity benefits unquestionably exceed those of like-for-like trading rules. In planning systems with strict avoidance, if implemented effectively, flexibility cannot be used for legitimising losses to threatened biodiversity. For example, the proposed Net Gain policy in England is explicit that offsetting under Net Gain will not weaken existing protections for biodiversity, or be used to justify impacts to irreplaceable habitat (Defra, 2019). This protection is imperfect, and harm to irreplaceable biodiversity can still occur if it is considered to be in the overriding public interest for political or economic reasons. However, in these contexts a bespoke compensation package is agreed and it does not occur within the framework of the offsetting policy. The argument for flexibility being more justifiable where regulators have high levels of capacity is that centralised bodies may able to implement a more systematic and well-planned approach to offsetting that targets local biodiversity priorities than case-by-case offsetting (Habib et al., 2013). However, so far implementation of these approaches has been limited (for example, as of February 2019, of the AUD$9.6 million paid into Queensland's offset fund at the time, only AUD$1.5 million had been committed or spent on offsets (Queensland Government, 2019a)). Until such systems are demonstrably effective, we suggest that this this approach to enabling increased flexibility through a centralised body will undermine impact avoidance and conservation outcomes (Fig. 2).

It is especially important that conservationists are alert to when flexibility is being advocated for purely because appropriate offsets are expensive: indeed, if offsets for a specific biodiversity feature are expensive, this may well be an indication that the biodiversity feature is scarce or threatened and so flexibility might not be justified for that feature. In these cases, the worst outcome from a biodiversity perspective is that regulators deprioritise offsetting exactly because it is expensive – a situation aptly demonstrated by the Warragamba Dam proposal in New South Wales, where a state-owned utility company attempted to reclassify impacts to critically-endangered species habitats as 'indirect impacts' in order to avoid their high offset costs (Hannam, 2020; Sanda, 2020). Deprioritising offsetting when expensive gravely undermines the economic logic for having offsetting systems in the first place.

7. Getting the 'right' level of flexibility

The major difficulty in setting the 'optimal' degree of flexibility that should be permitted in an offsetting system is that ultimately the outcomes of flexibility are mediated by an unobservable characteristic, which is the intention or motivation behind the actor advocating flexibility. Simplistically, the ideal policy from a biodiversity perspective (which is the stated purpose of NNL policies) would allow flexibility when it helps with the achievement of the specific policy goal (i.e. is motivated by achieving NNL or net gain in biodiversity), and restrict it when motivated by other factors which undermine the likelihood of achieving the policy goal, such as simple cost minimisation. In practice, this information is challenging to discern, and so regulators rely on heuristics such as 'like-for-like or better' trading rules, with each policy determining the classifications for what types of biodiversity count as like-for-like (McKenney and Kiesecker, 2010). Although 'like-for-like or better' trading rules are widely accepted, it is worth reflecting that, supposedly in the name of NNL, many of these rules permit the loss of threatened biodiversity as long as it is replaced with other types of threatened biodiversity. Such a premise has recently been questioned under the newly-proposed 'target-based ecological compensation' framework (Simmonds et al., 2020), where it has been suggested that 'drawing down' on existing biodiversity should only be permitted if that biodiversity feature is above its 'target level' (i.e. for a species, an appropriate target might be not being classed as threatened on the IUCN Red List; for a habitat type, it might be a target percentage of the historical habitat extent remaining). Similar principles might be used to determine when flexibility is considered acceptable, with the exact

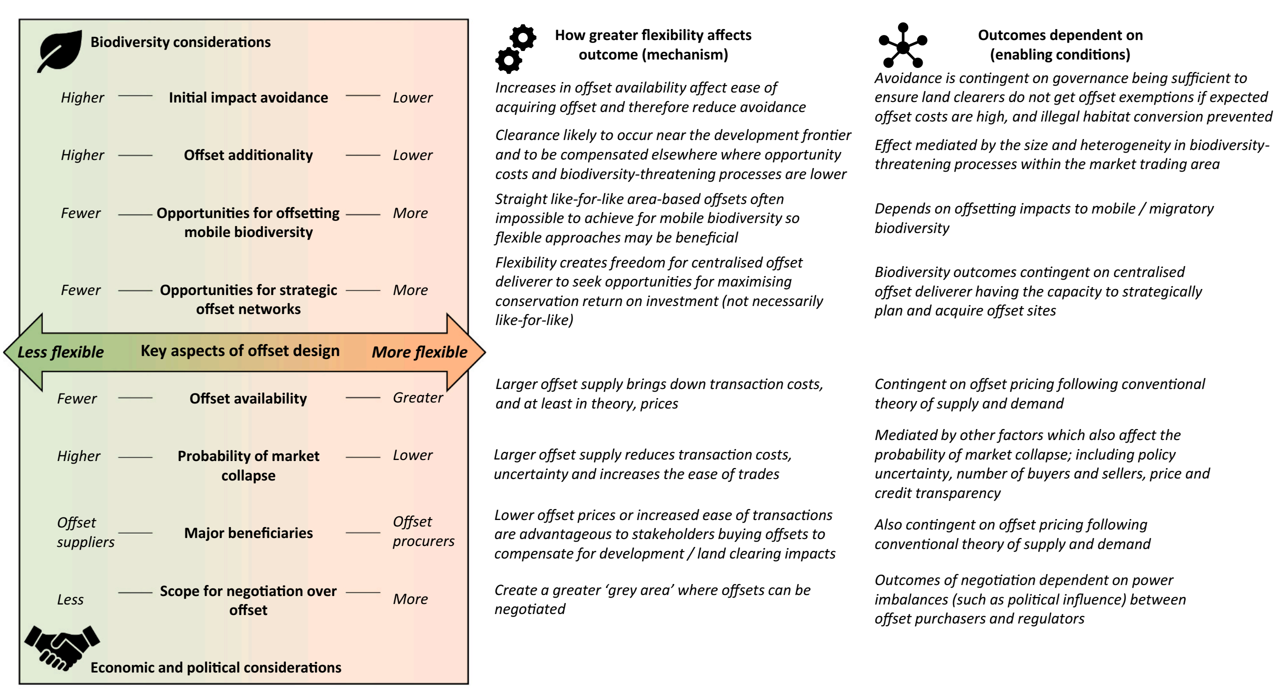

Fig. 2. Summary of the advantages and disadvantages of changing the flexibility of offset trades, the mechanisms through which outcomes are achieved, and the factors that those outcomes are dependent on. The top half denotes ecological outcomes, and the bottom half denotes economic and political outcomes.

threshold tailored to the local policy aim and context.

8. Implications for existing and emerging offsetting systems

The main implication is that regulators setting the trading rules of offset policies need to be aware that there are multiple mechanisms for dealing with problems associated with thin markets, each associated with drawbacks and advantages. Although offset policies are in practice always imperfect because they are trying to satisfy multiple objectives (i.e. ecological, economic, political), some changes which are intended to satisfy non-biodiversity objectives can fundamentally undermine the core biodiversity objectives. Additionally, they can somewhat undermine the theoretical strengths of even applying market-like mechanisms to biodiversity management issues in the first place. Changing the level of flexibility inevitably generates winners and losers, and it is always worth questioning who they are and why their interests are being prioritised or deprioritised. In general, we contend that increasing flexibility tends to increase satisfaction of economic objectives and favour the interests of offset procurers (e.g. developers). Given the current generally low capacity of offset system regulators, this often detracts from the ecological objectives of the policy.

In the case of Australian offsetting systems, we would suggest that policymakers need to consider whether overall biodiversity outcomes (the sum of biodiversity impacts avoided - as step one of the mitigation hierarchy - and those successfully offset) are more likely to achieve NNL objectives under flexible or strict trading policies. We would argue that, as it stands, no net loss is more likely to be achieved under strict policies. There are also important lessons for all of the world's many emerging offsetting and biodiversity compensation systems (zu Ermgassen et al., 2019a), as decisions on trading rules embedded at the outset have an overwhelming influence on their biodiversity impacts (Calvet et al., 2015). There are less significant implications for North American offsetting systems, both because the policies already freely allow trades between different types of wetlands (i.e. they are highly ecologically flexible), and because they are primarily restoration-based programs, so it is usually easier to ensure that offsets are truly additional.

9. Conclusion

The case has previously been made for increasing the flexibility of biodiversity offset trades (Habib et al., 2013), however, here we argue that restricting the flexibility of trades has some highly desirable properties. Most importantly, in offsetting systems where impact avoidance is imperfect and is influenced by the difficulty of securing offsets, like-for-like offsetting drives the unobservable process of impact avoidance (Pascoe et al., 2019), whereby threatened aspects of biodiversity remain unimpacted because insufficient offsets are available. This process has been largely unaddressed in the offsetting literature (Phalan et al., 2018), even though avoidance is widely considered the most important aspect of the mitigation hierarchy (Hough and Robertson, 2009; zu Ermgassen et al., 2019a). Geographical trading restrictions also have the potential to enhance the additionality of offsets, which is a fundamentally important property that defines their associated biodiversity outcomes (Gordon et al., 2011; Maron et al., 2013). To ensure biodiversity offsetting market-like mechanisms are fit to tackle ongoing biodiversity declines we encourage policymakers and practitioners involved in existing offsetting systems and emerging systems around the world to prioritise the biodiversity objectives of these policies. Ultimately, this requires clear thinking about whether increasing flexibility helps to achieve these policies' fundamental biodiversity goals, or hinders them.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

The authors would like to thank the valuable contributions of Peter Ridgeway. S.O.S.E.z.E is supported through UK's Natural Environment Research Council NERC's EnvEast Doctoral Training Partnership [grant NE/L002582/1], in partnership with Balfour Beatty. They received funding for this work from the University of Kent and the University of Queensland's Centre of Biodiversity and Conservation Science, and are particularly grateful to Dr. Blake Simmons for their funding assistance. N.S. acknowledges the Danish National Research Foundation for funding for the Center for Macroecology, Evolution and Climate (grant number DNRF96). M.M. was supported by Australian Research Council Future Fellowship 140100516. This research received support from the Australian Government's National Environmental Science Program through the Threatened Species Recovery Hub.

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