12 June 2012

Key ingredients for Biodiversity Offsets to Achieve No Net Loss

Toby Gardner and Amrei von Hase

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1. Introduction

Increasingly, governments, businesses and financial institutions are introducing regulations or voluntary corporate commitments to achieving no net loss or a net gain of biodiversity across the areas and development impacts for which they are responsible. Central to achieving these commitments is the sound design and implementation of biodiversity offsets to compensate for the residual impacts, i.e. those impacts that remain after developers have rigorously followed the mitigation hierarchy (i.e. to avoid, minimise, restore impacts) so as to limit the residual impacts on biodiversity to those that can actually be offset (Figure 1).

While biodiversity offsets reflect a level of responsibility beyond traditional environmental impact mitigation and risk management activities, significant concerns have been raised, particularly by the conservation community, about the use and practice of offsets. Key issues that have been raised include the potential for offsets to undermine the importance of prior impact avoidance, minimisation and restoration measures, and that over-simplistic approaches – that are in contrast to the inherently complex nature of biodiversity - make it impossible to guarantee equity in the exchange of biodiversity losses and gains. Another complication is the range of interpretations of no net loss itself: To some it means compensating only for the residual impacts from a specific project site which would not have occurred anyway (in absence of development). Others understand no net loss to mean no change in biodiversity from pre-development baselines across an entire region. More precautionary interpretations of no net loss emphasise that there are limits on what it is possible to offset, the importance of accounting for cumulative regional impacts from multiple developments, and the need to minimise risks associated with time lags in the delivery of uncertain biodiversity gains from offsets in exchange for certain losses from development.

To ensure that offsets contribute effectively towards reconciling development and conservation and achieving no net loss of biodiversity, it is essential to have a clear understanding of the key ingredients are for meeting this goal. This guidance document reviews the key conditions and considerations that underpin no net loss. A conceptual framework and decision-making process (Figure 2) is proposed to substitute the often ad hoc approaches evident in many biodiversity offset initiatives to date[1]. The primary focus here is on what constitutes best practice in biodiversity offset planning and design when addressing the residual impacts of individual development projects. It is also important to recognise that any offset policy should be set in an appropriate regional context, and that many other factors including legal, financial, institutional and political considerations, can represent major barriers to the delivery of successful biodiversity offsets and to achieving no net loss. Following the BBOP 2012 standard, and to avoid ambiguity, the term 'offset'

[1]Much of the thinking in this document has evolved through working with the multi-sector Business and Biodiversity Offsets Programme (BBOP), including the development of BBOP's best practice biodiversity offset principles and of the first Biodiversity Offset Standard.

here is limited to outcomes that fully compensate for any residual biodiversity loss (i.e. no net loss, or a net gain, is the end goal), thereby excluding partial and incommensurate non-ecological compensation.

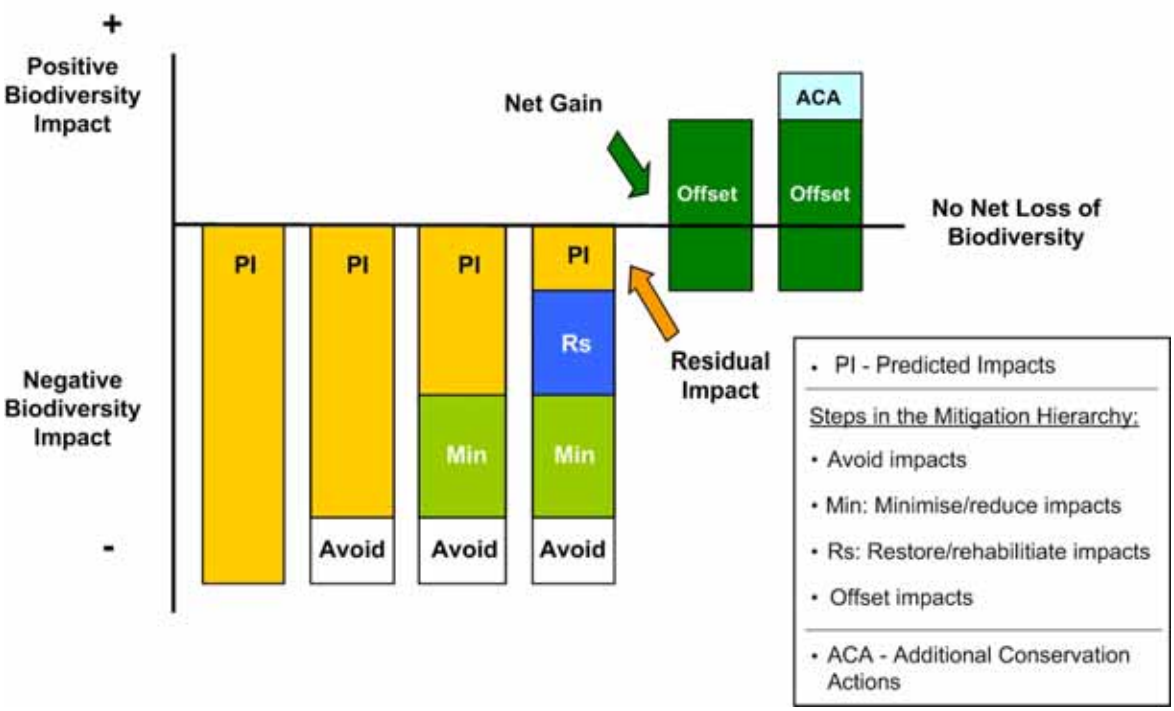

Figure 1. Adherence to the Mitigation Hierarchy (i.e. implementing measures to avoid, minimise and restore impacts prior to offseting) to limit adverse residual impacts to those that can be fully offset is crucial for achieving no net loss of biodiversity. (Figure adapted from BBOP, Rio Tinto, W Australia EPA).

2. Using offsets to help achieve no net loss of biodiversity

The relevance of biodiversity offsets to no net loss rests on two fundamental premises. First, the potential success of an offset depends on the extent to which prior steps in the mitigation hierarchy are designed and implemented so that they limit residual impacts to those that are possible to offset (Figures 1 and 2). This is crucial because some impacts are difficult, or even impossible, to offset - resulting in no net loss being unattainable (Figure 2). Second, irrespective of the care invested in offset design and implementation, an offset assumes a certain amount of residual biodiversity loss (even if temporary) at one location in exchange for a comparable gain at another.

To ensure no net loss of biodiversity, offsets need to meet three main conditions, namely that: (i) biodiversity gains are *comparable* to losses insofar as they are both appropriate (similar in kind or type) and adequate (similar in amount), (ii) gains are *additional* to what would have resulted in the absence of an offset, and (iii) gains are *lasting* and protected against significant risk (Figure 2). Meeting these objectives requires that consideration of the wider landscape context and timing of offset delivery forms part of the overall offset design process (Figure 2).

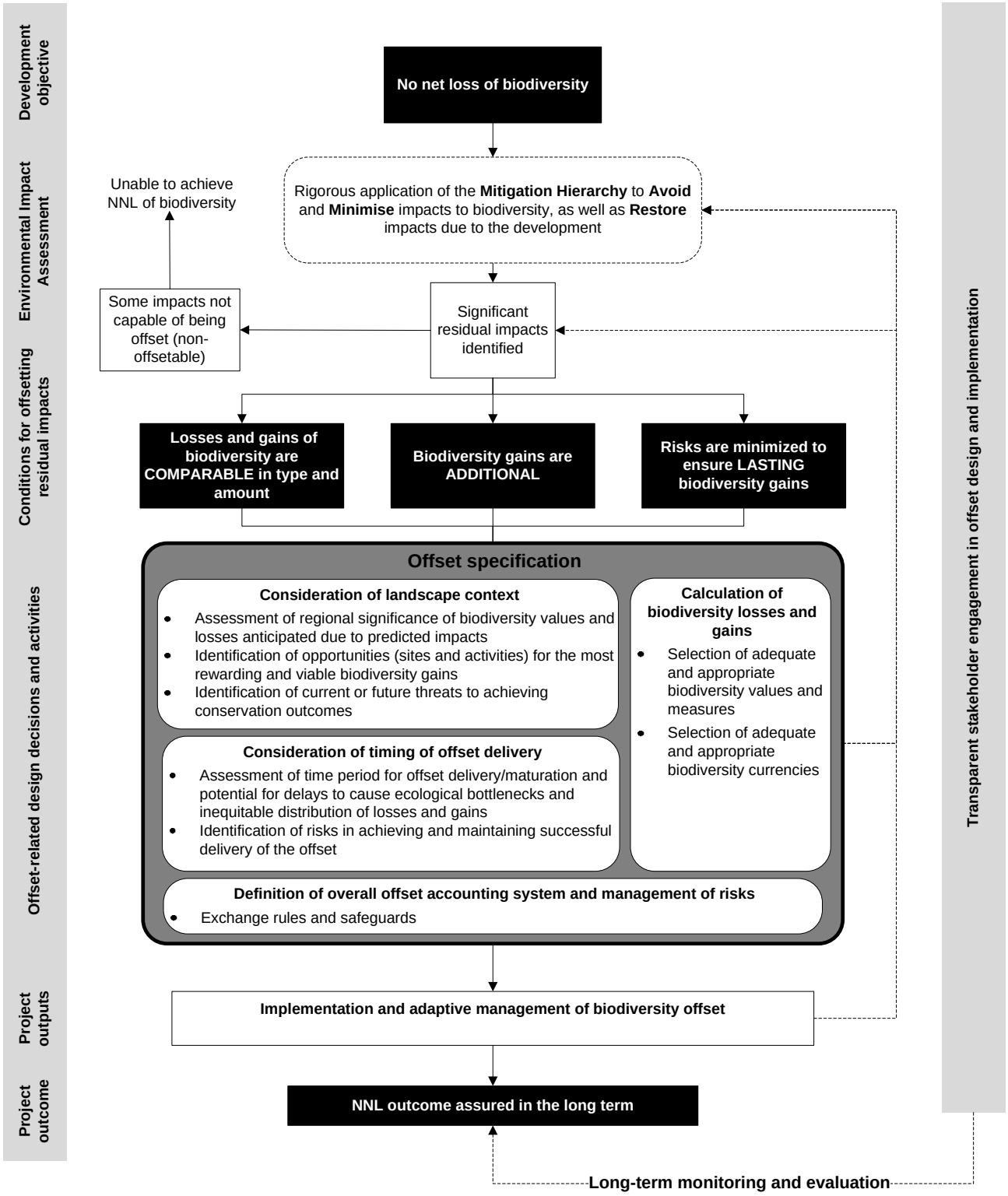

Figure 2. A framework for understanding key ingredients for achieving biodiversity offsets and no net loss.

2.1. Condition 1: Biodiversity losses and gains are comparable

To achieve no net loss an explicit biodiversity loss-gain calculation is required as part of the design process (and for tracking offset delivery) to ensure that biodiversity gains are comparable in type and amount to residual losses. To undertake this process in a systematic way, the following steps and decisions need to be taken (see section 3 for more details):

(i) the selection of representative biodiversity values and measures,

(ii) the choice of appropriate currencies to measure the biodiversity exchange (i.e. losses and gains), and

(iii) defining an overall offset accounting system to balance biodiversity losses and gains and to help ensure equity in the type, distribution and temporal delivery of biodiversity gains compared to losses

2.2 Condition 2: Biodiversity gains are additional

Gains in biodiversity from conservation activities at offset sites need to be additional to those that would occur if no offset was to take place. Offset management should also not displace harmful activities elsewhere (i.e. result in leakage) or otherwise lead to negative impacts on other biodiversity. In general, biodiversity offset gains can be achieved through two broadly categorised kinds of intervention:

- First, gains can be achieved by averting the loss and/or degradation of biodiversity by removing or reducing threats to habitats and species. This may involve creating, expanding and/or in some cases strengthening protected areas and ensuring management actions that guard against current or future risks to the affected biodiversity (e.g. through mechanisms such as land purchase, contractual agreements, conservation easements to limit legal rights to clear vegetation or to mine). For averted loss offsets to be defensible, it must be shown that ongoing or impending threats are imminent (and certainly within the timeline of the development project), and will have significant positive impacts on biodiversity. It is also essential that an offset results in direct measurable conservation outcomes. General 'structural' investments in local capacity building, research and environmental education may be valuable, but to qualify as part of an offset they need to produce relevant and measurable biodiversity gains.

- Second, biodiversity gains can be achieved through positive management actions that improve biodiversity condition at offset sites, e.g. through restoration or enhancement activities. Restoration refers to activities that specifically aim to return an area to its ecological condition prior to some anthropogenic impact, for example by removing and controlling invasive species, stabilising soil erosion and re-introducing native species. Despite the hopes pinned on successful restoration, there is currently considerable scepticism in the scientific community that the science and practice of restoration ecology is advanced enough to ensure – in most circumstances - the delivery of sufficient biodiversity gains to achieve no net loss.

Deciding which offset activities are most likely to deliver appropriate, measureable and additional conservation outcomes in a particular situation is best done on a case-by-case basis and this will then inform the biodiversity loss-gain calculation and overall offset specification (Figure 2). Consideration needs to be given to the significance of the affected biodiversity, background rates of biodiversity loss in the region and at neighbouring sites to the development, foreseeable risks and threats to biodiversity

persistence and achievement of conservation outcomes, and evidence of successful management interventions (whether through risk reduction or restoration) in the same ecosystem.

2.3 Condition 3: Biodiversity gains are lasting

Biodiversity gains from an offset need to last at least as long as the residual impacts, which may well be indefinite for many development projects. Two sources of uncertainty and risk need to be considered (Figure 2): First, there is a possibility that offset activities underperform or fail - either because of management failure or due to an external threat (e.g. other development or climate change) that may jeopardise the long-term integrity of the offset. Second, unless offset gains are fully secured prior to impacts, time-delays in offset delivery can lead to ecological bottlenecks that threaten long-term biodiversity persistence (e.g. breakdown in ecological connectivity or disruption of key ecosystem processes and functions). A range of safeguard measures is crucial to ensure the long-term viability of offsets against the risk of failure or underperformance.

3. Specification of biodiversity losses and gains for achieving no net loss

Understanding how an offset can help ensure no net loss requires consideration of the specific landscape context, the timing of offset delivery, and the approach taken for calculating biodiversity losses and gains.

3.1 The importance of considering landscape context when planning for biodiversity offsets

To meet the three basic conditions for offsets to support no net loss (at least at the scale of individual projects), it is essential that the design and implementation of project-level offsets takes account of the wider-landscape context and that these considerations are built into decisions on the offset specification (Figure 2). There are at least three reasons for this

I. Estimates of biodiversity losses and gains cannot be made 'in isolation' (i.e. based only on information from a project site) and need to account for the regional significance of biodiversity values, including patterns of irreplaceability and endemism, and the use and cultural biodiversity values held by local people

II. A wider-landscape and regional perspective is needed to identify the most rewarding and cost-effective opportunities for securing adequate, additional and ecologically viable biodiversity gains, and hence determine the most appropriate set of offset activities and locations. In addition to directing offset activities themselves, spatial data on the distribution of biodiversity in the region targeted for development are vital for identifying areas where impacts should be avoided altogether (if no net loss is to be achieved), and

III. A landscape perspective is necessary to identify potential risks to the permanence of biodiversity gains (e.g. due to other planned development projects, encroachment by invasive species that may be difficult to control as part of the proposed offset, illegal settlements, etc.). To maintain

long-term biodiversity persistence, exchanges must replace ecological interactions and functions lost due to development impacts. Many landscape assessment and planning approaches attempt to perform this function by accounting for estimates of landscape condition (e.g. through fragmentation and connectivity metrics) in evaluating the suitability of candidate offset sites, including through simple scores of patch size and levels of habitat loss in areas neighbouring offset sites or more elaborate approaches using measures of biodiversity persistence and ecological connectivity.

3.2 The importance of considering the timing of offset delivery

Considerations of the timing of offset delivery are essential for ensuring comparability in the temporal distribution of biodiversity losses and gains, as well as for ensuring lasting conservation outcomes (Figure 2). Unless the biodiversity gains from an offset are delivered before the development impacts occur, biodiversity losses at the impact site will always exceed any biodiversity gains from the offset for a period of time. Such delays in offset delivery may result in bottlenecks in ecological resources such as the delayed recovery of key habitat resources that may be essential for the persistence of species of conservation importance (e.g. tree hollows, large tree boughs and fallen timber that characterise mature forest habitats).

There are essentially two approaches to addressing the problem of time-delays in biodiversity offsets. The safest option is to demonstrate that the requisite biodiversity gains have been secured before impacts occur, for example through a biodiversity banking system where developers can buy mature offsets from offset investors in order to license operations. Whilst this approach is unquestionably the best way of assuring that no net loss is achieved, it has practical limitations, including the need for access to a wide range of biodiversity credits to ensure ecological comparability between gains and losses (a so-called "savings bank"). An alternative approach is to compensate for delays in offset maturity by increasing the size of the offset through a so-called multiplier or mitigation ratio. This ratio may be calculated simply in proportion to the expected delay or through more complicated approaches using discount rates (requiring inevitably subjective and often controversial choices of discount rate and time-horizon for biodiversity recovery). The use of time-discounting to help set offset multipliers is advocated on the grounds that it is inherently unfair to compensate for a guaranteed immediate loss with a hypothetical future gain. Whilst this makes sense in terms of broadly determining equity in gains relative to losses, the use of multipliers based on time-discounting may do little or nothing to address the underlying problem that temporal delays can lead to critical shortages in ecological resources over time.

3.3. Calculating biodiversity losses and gains

Ensuring that an offset is capable of delivering no net loss requires making choices about the biodiversity components and currencies that are used to measure losses and gains (Figure 2).

I. Selecting representative biodiversity components and measures

Biodiversity is a broad, unifying concept that encompasses all forms, levels and combinations of natural variation, at all levels of biological organization, including compositional (e.g. individual species or species groups), structural (e.g. vegetation density) and functional (e.g. nutrient cycling rates) aspects. Therefore, as for any conservation strategy, only a small, carefully selected subset of biodiversity components can ever be measured and evaluated for biodiversity offsets and associated accounting systems.

Given this basic limitation, the integrity of an offset depends foremost on whether selected components of biodiversity can adequately represent expected changes in the conservation values that are most important to relevant stakeholders (including local people, conservation organisations and regulatory authorities). The following considerations are important when selecting appropriate biodiversity components, and adequate measures of their amount and condition:

- Type of development that is planned, and existing ecological knowledge regarding the expected direct and indirect (via changes in habitat structure and ecological processes) impacts on biodiversity;
- Spatial scale, duration and legacy effects of expected impacts;
- Existence values - e.g. based on irreplaceability and vulnerability measures for species and ecosystems
- Use and cultural values of biodiversity to people affected by development impacts
- Planned developments and/or land use plans in the area; and
- Availability, quality, and spatial scale (extent and resolution) of existing data, and the feasibility of acquiring new data across impact, reference and candidate offset sites for assessing loss and gain.

A rigorous assessment should demonstrate due diligence in giving attention to both biodiversity patterns (compositional and structural elements such as populations, species and habitat types) and ecological processes (biodiversity-mediated functional processes, e.g. ecological connectivity, species-specific habitat requirements, plant-animal interactions, keystone species).

Once selected, these biodiversity components can be summarised within a Key Biodiversity Components Matrix comparing different levels (e.g. species, habitats, ecosystems) with types of information (e.g. conservation priority, data availability) and the specific measures (e.g. abundance, counts, spatial distribution) that will be used to compare changes. Policy frameworks that recognise different levels of classification and grouping in species and habitat/vegetation type data (e.g. national lists of threatened species and systems of ecosystem or vegetation classification) vary significantly across the world yet need to be considered when determining the scope and focus of any biodiversity assessment. Our limited understanding of biodiversity means that it is always sensible to spread risks and employ a diverse set of biodiversity components that represent different levels and scales of biological organisation.

II. Selecting good biodiversity currencies

Once biodiversity components and associated measures of their status or condition have been selected they need to be integrated into a suitable currency (or set of currencies). This provides the basis for quantifying the nature and size of the offset required to compensate for specific residual impacts. The choice of currency is thus crucial as it forms the basis for measuring biodiversity losses and the gains needed to achieve no net loss. The use of a currency for biodiversity exchange is both a strength, because it provides the simplicity necessary to adopt a transparent accounting procedure, and a weakness since anything that is not explicitly and appropriately captured by the currency is at risk of being lost, or at least inadequately compensated for, in the exchange.

In simpler offset schemes, such as early US wetland mitigation, offsets were determined using only area as a currency (often on a 1:1 basis of losses relative to gains). However, the rise of biodiversity offsets in the last 10-15 years has witnessed the development and application of more meaningful metrics that incorporate information on the type, amount and condition of multiple biodiversity components. These include a number that are already established in legislation, including the Habitat Hectares index used in the Bushbroker program in Victoria, Australia, and the Environmental Benefits Index in Western Australia, and a growing number of proposals in the academic literature.

Existing currencies have been developed either on an ad hoc basis tailored to a given project, or using standardised scoring methods based on pre-defined indicators and approaches to improve feasibility and comparability across sites. Stepping back from the detail of specific proposals, it is helpful to think of the following questions when deciding on appropriate currencies:

- Can surrogate currencies can reliably and consistently represent changes in underlying biodiversity values, or are direct measures of valued biodiversity components needed?
- Are aggregated currencies adequate, or do multiple, disaggregated biodiversity components need to be accounted for explicitly so that losses of important components are not masked in the exchange?
- To what extent are context dependent data needed to take account of regional and national conservation priorities?

Preference should ideally be given to currencies based on direct, disaggregated and context-dependent measures of biodiversity that provide the most unambiguous and locally-relevant data (e.g. persistence probabilities of a regionally threatened species). However, in practice, the lack of relevant data (e.g. of good context-dependent data) and/or adequate resources to collect such data, as well as the need for easily communicable metrics, mean that aggregated surrogate measures that combine the extent of the affected area with a measure of condition are most commonly employed (e.g. the Habitat Hectares index). Simpler, surrogate measures are also likely to be favoured where there is little active scrutiny in auditing the offset process.

Estimates of biodiversity condition are necessary for most (even simple) biodiversity currencies. Measurements of ecological 'condition' or 'quality' can only be made with reference to some benchmark state(s) that provides a common reference point for evaluating biodiversity losses and gains across impact and offset sites. Despite its intuitive appeal, estimating changes in ecological condition is not trivial and requires sound local and regional ecological expertise.

No single currency can adequately account for all our concerns about biodiversity. As such it is invariably desirable or necessary for the overall offset design and accounting system to include multiple, complementary currencies that account for distinct biodiversity components at different levels of biological organisation (i.e. species, habitats and ecosystems). Biodiversity components of particular conservation importance should be dealt with individually in the biodiversity loss-gain accounting process to ensure that any changes can be easily assessed.

3.4 Defining the overall accounting system to achieve no net loss and safeguard offsets against failure

The overall offset accounting system integrates the choice of biodiversity components and currencies with ways of considering risk and uncertainty in offset delivery to determine the full set of design features that are necessary for achieving no net loss. The accounting system will encompass both qualitative (e.g. where, what) and quantitative (how much, in which condition) aspects of the offset that needs to be delivered to address a specific set of residual development impacts.

Accounting is ultimately a process for estimating the net balance, or equity, of exchanges. Beyond the selection of appropriate and adequate biodiversity currencies, data and model inadequacies mean that a set of restrictions or exchange rules is usually needed that can help account for changes and uncertainties in all three dimensions of difference between losses and gains (i.e. differences in type, space and time).

The most important restriction in any biodiversity exchange is to recognise that there are limits to what can be offset. Some biodiversity impacts are irreplaceable (e.g. extinction of a species), and some exchanges are not appropriate (e.g. kiwis for kākāpō). Where biodiversity components are highly irreplaceable or vulnerable it is likely that there will be no feasible offset options. Limits on what is acceptable to offset will vary in accordance with different legal frameworks and the values that societies hold regarding biodiversity.

Where an offset is deemed possible a number of so-called exchange rules are necessary to help ensure that biodiversity losses and gains are comparable:

- *Limits on what biodiversity components can be considered substitutable.* Where aggregated, surrogate currencies are used it is possible that increases in some biodiversity components (e.g. volume of dead wood) can mask negative (and undesirable) changes in others (e.g. loss of live trees). This kind of problem can be solved, at least in part, by establishing exchange rules that set minimum values (and possibly upper limits) to the individual components that make up any aggregated currency that can be

substituted. Where possible, such threshold values should be justified through validation against actual biodiversity data collected at reference sites.

- *Limits on declines in ecological condition between impact and offset sites.* A fundamental problem with simple 'area × condition'-based currencies is that increases in the size of an offset may be allowed to compensate for decreases in its condition. Such risks may be limited by applying an exchange rule which requires that key indicators of ecological condition either do not change significantly, or can only increase between impact and offset sites
- *Integrating the design of project-level offsets into a wider conservation planning framework*. Both existence and cultural values of biodiversity are by definition context dependent (e.g. species composition, rarity, endemism, human use). Thus offset designers carefully need to assess the compositional similarity and regional significance of both expected losses and potential gains of biodiversity. Indeed, this regional assessment is central to the selection of appropriate biodiversity measures and currencies in the first place. Efforts to ensure compositional similarity between losses and gains for unmeasured components of biodiversity can be assisted by various spatial restrictions, such as setting a maximum allowable distance between impact and offset sites, or restricting exchanges to within the same 'service area' (a term used in US wetland mitigation banking) as defined by a watershed, vegetation type or by the area of occupation by local people affected by biodiversity losses. A number of simple index-based frameworks have been developed to incorporate landscape and regional biodiversity values alongside site-based estimates, using data on percent cover and condition of vegetation types, or rates of change in habitat area and condition, as well as more elaborate frameworks that incorporate spatially explicit data on biodiversity patterns and processes.

These basic restrictions and exchange rules complement a good biodiversity currency and are intended to minimise undesirable, inequitable and unexpected outcomes. Additional safeguards usually need to be integrated into offset design and implementation process (i.e. rigorous adherence to the mitigation hierarchy, assurance that offset activities are genuinely additional, comprehensive selection of measures and currencies that account for compositional, structural and functional components of biodiversity). Particular emphasis needs to be placed on a precautionary approach in situations where risk and uncertainty are high, as is invariably the case for all but the simplest ecosystems. Uncertainty in the performance of offset interventions is best minimised by selecting offset activities based on existing evidence of their effectiveness. In addition, many existing offset schemes employ risk-aversion multipliers as a precautionary measure to increase the size of an offset and safeguard against uncertain outcomes. Whilst intuitive, such multipliers are often generic and determined by the conservation significance of affected biodiversity rather than being linked to specific risks and mitigation measures (e.g. probability of seedling survival in a restoration planting - although this is often very hard to do in the case of uncertain threats such as climate change, illegal changes in land management etc). In order to provide reasonable

guarantees of achieving no net loss risk-aversion multipliers may be prohibitively large (e.g. greater than 1:100), though ratios that are implemented in practice are often even than levels that are required by local legislation. Moreover, and as in the case of time delays and resource bottlenecks, multipliers are wholly inappropriate for situations where there is a risk that the offset intervention may fail entirely.

The safest way of limiting the risk of offset failure is to secure biodiversity gains before impacts occur. Where this approach is not feasible, a precautionary approach to the entire offset design and implementation process (including employing multiple offset sites and activities and accounting for a wide range of biodiversity components, as well as the use of generic multipliers) is likely to be necessary.

4. Offset implementation: the most important step

Ultimately, conservation outcomes from biodiversity offsets will depend only partly on the adequacy of currencies, exchange restrictions and other design-features used, important as they may be. Yet, for the most part, good outcomes will be determined by factors that affect the success of offset implementation over the long term. These factors include economic and financial safeguards and incentives, the strength and degree of implementation of legislation, institutional capacity, data availability and access to technical expertise. Thus it is important to balance scientific rigour with practical realities (and implementation opportunities and constraints) without jeopardising what offsets are intended to achieve. Claims of no net biodiversity loss or a net positive impact are laudable yet ambitious. Key to the widespread acceptance and uptake of biodiversity offsets is the identification of cases in which - despite proposed mitigation/compensation measures, but short of impact avoidance - no net loss of biodiversity will not be achieved. While in such cases development projects (and associated compensation) may be approved anyway due to other public and private interests, these projects should not claim to be doing an offset.

Offsets are receiving increasing interest from business, government, finance and conservation sectors across the world, meaning that the kinds of opportunities and challenges discussed here will become increasingly prevalent. In many parts of the world a lot of work remains to be done to shift the concepts of no net loss and biodiversity offsets from symbolic policies into clear, practical guidance underpinned by sound ecological science.

5. Suggested further Reading

Business and Biodiversity Offset Programme (BBOP) guidance documents from 2009 and 2012 (available at http://bbop.forest-trends.org/pages/guidelines) including:

- Biodiversity Offset Design Handbook, Implementation Handbook, Cost-Benefit Handbook (2009)
- Resource papers on Limits To What Can Be Offset and on No Net Loss (2012)
- Resource papers on Offsets and EIA (2009)
- BBOP Standard on Biodiversity Offsets: Principles, Criteria and Indicators Framework and associated Guidance Notes (2012)

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