New Zealand Department of Conservation

Biodiversity offsets: relative offsetability of impacts

June 2012

Recommended Citation:
TBC (2012) Biodiversity offsets: relative offsetability of impacts. Unpublished report to the New Zealand Department of Conservation. The Biodiversity Consultancy Ltd.: Cambridge, UK.

This report has been written by The Biodiversity Consultancy Ltd., EURC, 72 Trumpington Street, Cambridge, CB2 1RR, UK.

Helpful comments, edits and suggestions came from Tom Brooks, Susie Brownlie, Lori Conzo, Toby Gardner, Amrei von Hase, Kerry ten Kate, Conrad Savy, Theo Stephens, Jo Treweek, Graham Ussher and Gerri Ward.

Note: this report provided the basis for development of a journal paper.
The general offsetability framework presented here is thus adjusted and improved in:
Pilgrim, J. D., Brownlie, S., Ekstrom, J., Gardner, T., von Hase, A., ten Kate, K., Savy, C., Stephens, T., Temple, H., Treweek, J., Ussher, G. & Ward, G. (submitted) A framework for assessing relative offsetability of biodiversity impacts.

Table of Contents

1. Executive Summary

This report has been prepared for the Biodiversity Offset Program (BOP) of the New Zealand Department of Conservation to help advance offset thinking in New Zealand and as a contribution to the Business and Biodiversity Offset Programme[1], of which BOP is a member. Given the pioneering nature of the subject, it is not intended as a definitive work but as a stimulus for discussion and broader debate. Biodiversity offsets are increasingly used globally for mitigation of development impacts. This report assesses appropriate limits to biodiversity offsets, and categories of offsetability below these limits. In other words, what types and scales of offsets are unlikely to be offsetable, and what categories of lesser risk exist below such a 'non-offsetable' limit. We ask the question: what types and scales of biodiversity loss might it be possible to offset, in theory and in practice? We do this first by creating a general, globally-relevant framework and then apply it to the New Zealand national context and a number of relevant case studies.

International approaches to limits to what it is appropriate to offset are first reviewed (Section 4), with key legislation and policy from the International Finance Corporation (IFC), New South Wales (Australia) and Western Cape province (South Africa) discussed in more detail.

A general framework is proposed for assessing the risk of undertaking like-for-like biodiversity offsets (Section 5). This draws from the review in Section 4, and from previous science and policy – particularly the IUCN Red List, Key Biodiversity Areas, and IFC Performance Standard 6. The framework involves first assessing biodiversity conservation concern, then assessing likelihood of offset successs (comprising residual impact magnitude, offset opportunity and offset feasibility), and finally combining these issues in a burden of proof framework.

Within the system of biodiversity conservation concern categories, offsets for areas with biodiversity of lower conservation concern can be progressively viewed as more feasible or more appropriate and thus a lower burden of proof applies to a developer proposing an offset at these lower conservation concern levels. Higher standards of proof are likely to be required by regulators from developers of projects in areas with biodiversity of higher conservation concern – e.g. developers might be required to prove 'beyond reasonable doubt' that offsets for areas with biodiversity of high conservation concern can be successful. Projects in areas with biodiversity of higher conservation concern might be subject to increasingly greater restrictions on, and/or standards of proof from, developers. Offsets might not be considered for projects with a high severity, extent and/or duration of residual impacts in areas with biodiversity of highest conservation concern.

External limits exist to offsets: they will be most feasible where biodiversity features to be offset still naturally occur in sufficient quantities near to, but outside of, the impacted management unit, and are declining fast in extent/quality or are already very degraded (and, in this latter case, proven techniques for restoration exist). Internal limits also occur: offsets will be most feasible where time lags to implementation and success are short or non-existent, established offset techniques exist, offset implementers and developers have proven experience, and secure, long-

1 http://bbop.forest-trends.org

term financing is in place at the outset – all factors which developers/regulators can influence to lower offset risks to biodiversity.

Section 6 explores the implications of application of the general framework to New Zealand, with particular consideration of the National Biodiversity Strategy. A prior series of case studies, although only loosely based on real national case studies and lacking key data, illustrated the power of the biodiversity conservation concern system in successfully separating case study areas into varying levels of concern, from Low to Extremely Conservation Concern. The general framework aligns closely with the proposed national policy statement on indigenous biodiversity[2], the national biodiversity strategy[3] and policies for conservation on private lands[4].

This section concludes that the general framework requires relatively little adaptation for a national context, primarily removal of consideration of risks since they are excluded from consideration of compensation/offsets within the New Zealand legislation. Further, the general framework would ideally be tailored where data exist at a finer scale than global. Suggestions are given for such adaptation, including the integration of nationally-threatened species, nationally 'historically rare' or 'naturally uncommon' ecosystems, and ecological districts (as 'functional areas', akin to 'service areas' for ecological function). The need is also highlighted for finalising a standardised, spatially-explicit, national (terrestrial, freshwater and marine) ecosystem classification to fit within a national offsetability framework – this classification must strike a balance between providing ample opportunity for biodiversity offsetting and conserving biodiversity, by enabling accurate assessment of irreplaceability and preventing inappropriate exchanges of dissimilar biodiversity. A draft adaptation of the general biodiversity conservation concern system is presented for New Zealand, issues discussed, and the relevance of other aspects of the general framework explored in relation to the New Zealand context. Overall, an adapted, nationally-relevant offsetability framework appears to offer high potential to support the national biodiversity strategy and priorities, particularly if multipliers are carefully integrated to support policy goals.

2 http://www.mfe.govt.nz/publications/biodiversity/indigenous-biodiversity/index.html
3 http://www.biodiversity.govt.nz/pdfs/picture/nzbs-whole.pdf
4 http://www.biodiversity.govt.nz/pdfs/protecting-our-places-brochure.pdf

2. Report at a glance

This report has been prepared for the Biodiversity Offset Program (BOP) of the New Zealand Department of Conservation to help advance offset thinking in New Zealand and as a contribution to the Business and Biodiversity Offset Programme, of which BOP is a member. Given the innovative nature of the subject, it is not intended as a definitive work but as a stimulus for discussion and broader debate. Biodiversity offsets are an increasingly used tool globally for mitigation of development impacts. This report assesses appropriate limits to biodiversity offsets, and categories of offsetability below these limits. The structure of the main body of the report is as follows:

- Introduction;
- Review of international approaches to limits to offsetability;
- General offsetability framework;
- Application of the general framework to the New Zealand context, and implications for national policy.

While, theoretically, there should be clear intrinsic limits to what can be offset, biodiversity is the quintessential non-fungible asset. Where limits to offsetability are set, they might depend less on clear intrinsic limits than on data availability or the strength of societal opinion. In Section 4, a review of international approaches to limits to what it is appropriate to offset uncovers relatively few explicit, quantitative upper limits to biodiversity offsets, but reveals two key points. First, ***where upper limits are defined for biodiversity offsets, these are rarely absolute***. There are usually exceptions to such limits given, such as where 'no practical alternative exists' or 'overwhelming socio-economic benefits occur', even though net biodiversity losses will be sustained. Second, despite the fact that exceptions are usually given to upper limits, ***in a number of the most developed programs the principle does exist that some biodiversity is not feasible to offset***. However, specifics are rarely given – just examples (e.g. under Australia's 2007 'Use of Environmental Offsets' discussion paper, and in South Australia). Key legislation and policy from the International Finance Corporation (IFC), New South Wales (Australia) and Western Cape province (South Africa) is discussed in more detail. Both the IFC and New South Wales take ***a tiered approach to biodiversity offsets, whereby biodiversity of higher conservation concern is considered less offsetable***. In all three approaches, ***core criteria for identifying biodiversity of conservation concern focus on species and habitats/ecosystems of high 'vulnerability' (threatened) and high 'irreplaceability' (limited distribution)***.

In Section 5, these criteria of vulnerability and irreplaceability are used to develop a general offsetability framework for assessing the risk of undertaking like-for-like biodiversity offsets (i.e. the appropriateness of biodiversity risks and achievability of different offsets). The framework involves first ranking biodiversity conservation concern, and then assessing residual impact magnitude, offset opportunity and offset feasibility – as follows:

	Steps	Key characteristics	Key considerations
1	Assess biodiversity conservation concern (Table 3)	vulnerability	*threatened species and ecosystems*
		irreplaceability	*restricted-range species and ecosystems*
2	Assess residual impact magnitude	severity	*what is the intensity of impacts at a given spatial scale?*
		extent	*what proportion of each biodiversity feature is impacted?*
		duration	*can offsets be implemented without time lags between impacts and offset gains?*
3	Assess offset opportunity	natural distribution	*will offsets be located where affected biodiversity (requiring offsets) is naturally found?*
		functional area	*does affected biodiversity (requiring offsets) perform any geographically-restricted functions (e.g. connectivity)?*
		spatial extent of offset options	*are sufficient comparable, additional, permanent offsets available for biodiversity to be offset?*
4	Assess offset feasibility	confidence in offset delivery techniques, adequacy of plans	*how likely are offset methods (e.g. restoration or conservation) to lead to required biodiversity gains?*
		offset implementation capacity	*are offset implementers likely to do a good job?*
		developer capacity	*are developers likely to do a good job?*
		financing	*is sufficient funding secured for the offset duration?*
5	Combine residual impacts and practical opportunities/constraints (offset opportunity/feasibility) to categorise likelihood of offset success (Table 4)		
6	Combine biodiversity conservation concern and likelihood of offset success in a burden of proof framework (Figure 4)		

Since service values of biodiversity[5] depend much more greatly on human values, which vary widely from place to place, only global existence values are incorporated here into the system of biodiversity conservation concern. Throughout, the system is based on an assumption of like-for-like offsetting. The addition of a trading up mechanism based on 'like-for-like or better' could be used as an offset strategy, but is defined much more by national offset availability and stakeholder views of biodiversity/offsets than biodiversity values *per se*. Practical application of trading up is also inhibited by the absence of defensible quantitative methods for 'like-for-unlike' (i.e. 'like-for-better') exchanges of biodiversity.

The categorical system results in identification of five levels of biodiversity conservation concern, which represent relative (not absolute) risks towards global extinction of a particular biodiversity feature: Low Conservation Concern; Medium Conservation Concern; High Conservation Concern; Very High Conservation Concern; Extremely High Conservation Concern. Extinction risks of undertaking offsets inherently include both risks of development impacts in an area and risks of offset failure. Thus 'Extremely High Conservation Concern' areas are those at which particular biodiversity features are so concentrated that even low impact development could pose serious threats to these features through offset failure or insufficient impact management. For example,

5 e.g. provisioning (such as food, fresh water), regulating (such as air quality regulation, carbon sequestration) and cultural (such as spiritual or recreational) values of biodiversity as identified by the Millenium Ecosystem Assessment (2005).

construction of a radio mast at such an area might have little predicted direct impact on a globally-threatened plant or its habitat, but a cigarette discarded by a construction worker could start a fire which causes the species' extinction. Quantified categories within this system are drawn from the most highly-developed science and policy globally to date – particularly the IUCN Red List, Key Biodiversity Areas, and IFC Performance Standard 6. This ensures that ***the system of biodiversity conservation concern categories is consistent with international best practice***.

The overall framework relies on the concept of 'burden of proof' – i.e. the obligation to present evidence showing there is limited or no danger in shifting from the lower-risk status quo (no additional development) to a new position (additional development) lies with the developer[6]. Similarly, the burden of proof would also lie with developers on practical aspects; to prove that the likelihood of fully compensating for significant residual impacts is likely to be high (e.g. owing to high offset opportunity and feasibility). Offsets for areas with biodiversity of lower conservation concern can be progressively viewed as more feasible or more appropriate and thus a lower burden of proof applies to a developer proposing an offset. ***Higher standards of proof are likely to be required by regulators from developers for areas with biodiversity of higher conservation concern*** – e.g. developers might be required to prove 'beyond reasonable doubt' that any offsets can be successful in these cases. Projects with a high extent (affecting a high proportion of a biodiversity feature), severity and/or duration of significant residual impacts might be subject to increasingly greater restrictions on, and/or standards of proof from, developers.

External limits exist: ***biodiversity offsets will be most feasible where biodiversity features to be offset still naturally occur in sufficient quantities near to, but outside of, the impacted management unit, and are declining fast in extent/quality or are already very degraded***. These limits might constrain the ability of developers and regulators to use offsets in some situations. Internal limits also occur: ***biodiversity offsets will be most feasible where time lags are short or non-existent, offset implementers and developers have proven experience, and secure, long-term financing is in place at the outset*** – these are all factors which developers/regulators can influence to lower offset risks.

Section 6 explores the implications of application of the general framework to New Zealand, with particular consideration of the National Biodiversity Strategy. Although the general framework makes several assumptions which are not likely to be applicable or desirable at a national level – such as assuming that nationally rare, but globally common, biodiversity is not a conservation priority – it was instructive to apply a previous version of this framework to several real-life national case studies. These showed that ***the general framework can be used largely 'as is' in a national setting, after removal of consideration of risks*** (versus residual impacts) to fit with current New Zealand legislation. Further, ***where good country- or region-specific data and classifications exist, the framework should be tailored to – and given greater detail for – local circumstances***. Such tailoring enables congruence with national or sub-national policy and legislation, and facilitates reflection of established societal values. National or sub-national level values are generally more fine-scale than global values, and so the general framework should be viewed as a 'minimum standard'. ***At minimum, all significant biodiversity, as defined by the proposed national policy statement, should be offset*** (i.e. this framework is required).

6 Credit for this approach is due to Jim Salzman, who first proposed it in relation to offsets.

The New Zealand system for classifying taxa according to threat of extinction is well suited for incorporation within the general framework. The national threat classification system also identifies taxa as 'Range Restricted' if they are confined to < 1,000 km^2, which will highlight species likely to lead to areas being listed as of higher conservation concern under the irreplaceability criterion.

A standardised, spatially-explicit, national (terrestrial, freshwater and marine) ecosystem classification needs to be in place for New Zealand before biodiversity offsets can be soundly planned. Such a classification would be based on abiotic data (e.g. on soils, geology and climate) plus biotic data, often at the level of land cover classes for terrestrial systems (e.g. sub-alpine shrubland, matagouri, manuka/kanuka). Singers and Rogers (in prep.) have developed an apparently suitable draft terrestrial classification, although it has not yet been spatially-applied. The current New Zealand land cover database is too coarse for the purpose of biodiversity offsetting, having only just over 20 native land classes. The Land Environments of New Zealand (LENZ) environmental classification system is a robust and widely accepted classification, and similar abiotic classification systems have been developed for river and marine environments in New Zealand. However, these only cover abiotic environments – not biological factors (Figure 1). ***Two national assessments help to identify historically rare/naturally uncommon ecosystems with higher irreplaceability***: Williams *et al.* (2007) identified 72 'historically rare terrestrial ecosystems', and a recent proposed national policy statement on indigenous biodiversity identifies 35 'naturally uncommon ecosystems', largely a subset of the historically rare terrestrial ecosystems. Both of these classifications have merit, but are problematic in practice without being nested within a standardised national ecosystem classification.

While it is largely beyond the remit of this report to recommend particular country-specific guidance on impacts, offset opportunity and offset feasibility, the proposed national policy statement on indigenous biodiversity[7] lists some non-biological conditions as potentially non-offsetable. These conditions are related to residual impact magnitude, offset opportunity and offset feasibility within the general framework. Likewise, biodiversity offsets as a strategy align strongly with Principle Seven of the national biodiversity strategy[8] (“Internalising Environmental Costs”). More specifically, the general framework has relevance to Principle Six (“Recognise Variable Capacity to Respond”) in that it recognises the variable capacity of offset implementers to develop and manage biodiversity offsets and to Principle Eight (“In situ Conservation”) in that it prioritises conservation within the natural ranges of biodiversity features, to the extent of favouring local 'functional areas' where ecological function is likely to best be maintained. The importance of conservation of biodiversity on private land is stressed in *Protecting our Places*[9]:

“National Priority One: To protect indigenous vegetation associated with land environments... that have 20% or less remaining in indigenous cover” refers to threatened environments, not ecosystems, but acknowledges that these environments are only imperfect surrogates for ecosystems. Section 6.1.2 of this report outlines how a standardised national ecosystem classification could be finalised in New Zealand, and threatened ecosystems incorporated into an

7 http://www.mfe.govt.nz/publications/biodiversity/indigenous-biodiversity/index.html
8 http://www.biodiversity.govt.nz/pdfs/picture/nzbs-whole.pdf
9 http://www.biodiversity.govt.nz/pdfs/protecting-our-places-brochure.pdf

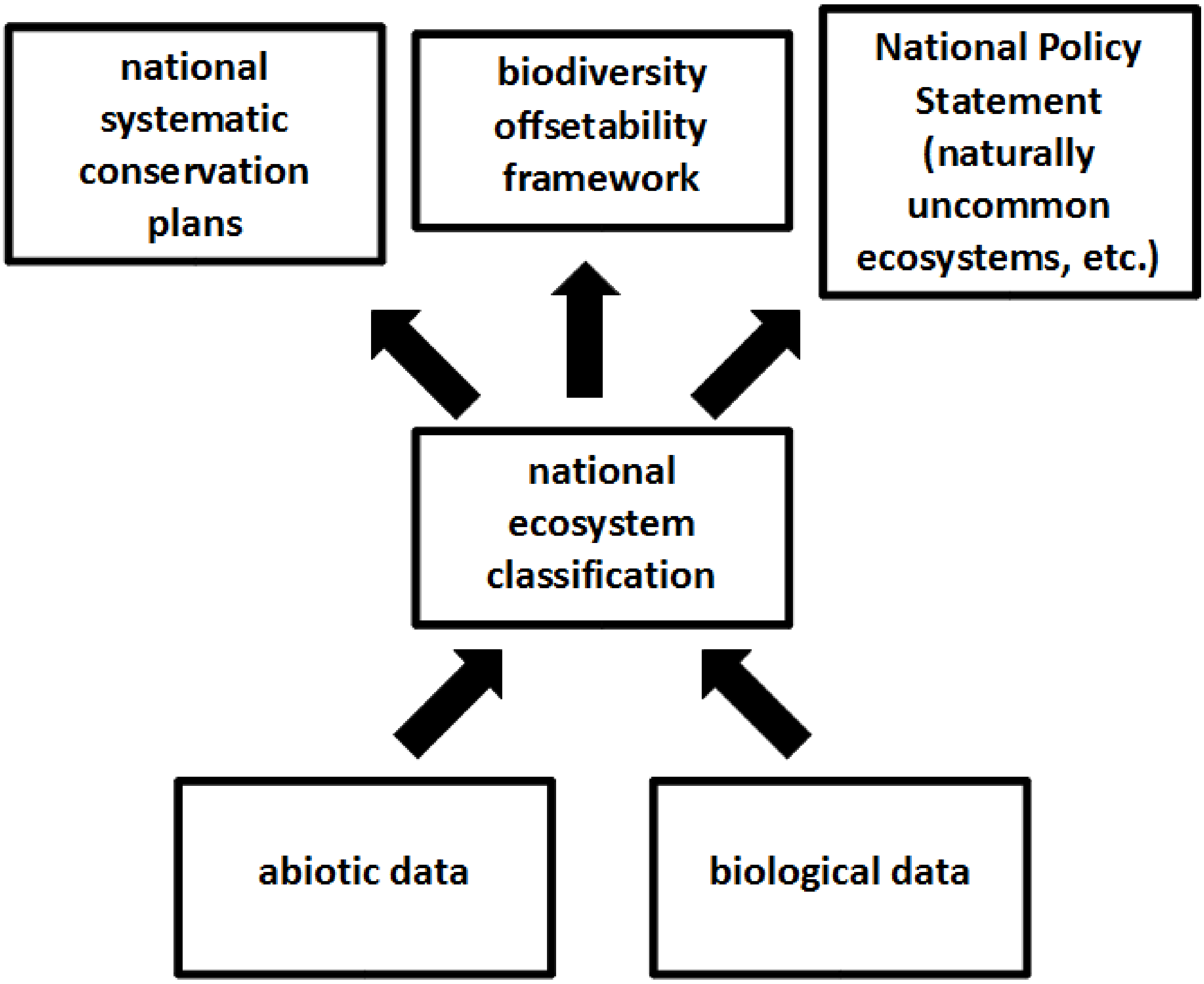
overall offsetability framework. Within a national biodiversity offsets policy, defining categories for offsetability of threatened ecosystems would help achievement of National Priority One.

“National Priority Two: To protect indigenous vegetation associated with sand dunes and wetlands; ecosystem types that have become uncommon due to human activity” and “National Priority Three: To protect indigenous vegetation associated with ‘originally rare’ terrestrial ecosystem types not already covered by priorities 1 and 2.” Section 6.1.2 of this report outlines how 'historically rare' or 'naturally uncommon' ecosystems in New Zealand such as these could be refined within a standardised national ecosystem classification, and incorporated into an overall offsetability framework. Within a national biodiversity offsets policy, defining categories for offsetability of these rare or uncommon ecosystems would help achievement of National Priorities Two and Three.

“National Priority Four: To protect habitats of acutely and chronically threatened indigenous species.” Section 6.1.1 of this report outlines how threatened species in New Zealand could be appropriately incorporated into an overall offsetability framework. Within a national biodiversity offsets policy, defining categories for offsetability of these threatened species would help achievement of National Priority Four.

Thus, ***the general framework aligns closely with the proposed national policy statement on indigenous biodiversity, the national biodiversity strategy and policies for conservation on private lands, and little adaptation would be necessary to fit the framework to a national context – primarily removal of consideration of risks*** (versus residual impacts). However, it would ideally be tailored to – and given greater detail for – the New Zealand context where data exist at a finer scale than global. Such adaptation might include at least the integration of nationally-threatened species, nationally 'historically rare' or 'naturally uncommon' ecosystems, and ecological districts (as 'functional areas', akin to 'service areas' for ecological function). There is also a high need to finalise a standardised, spatially-explicit, national (terrestrial, freshwater and marine) ecosystem classification to fit within the national offsetability framework – this classification must strike a balance between providing ample opportunity for biodiversity offsetting and conserving biodiversity, by enabling accurate assessment of irreplaceability and preventing inappropriate exchanges of dissimilar biodiversity. The classification would also support the proposed national policy statement on indigenous biodiversity, national systematic conservation planning, and other policy development (Figure 1). After finalisation of such a classification, ***an adapted, nationally-relevant offsetability framework appears to offer high potential to support the national biodiversity strategy and priorities***, particularly if multipliers are carefully integrated to support explicit policy goals.

Figure 1. Core importance of a national ecosystem classification to development of national policy. *A national ecosystem classification (such as that proposed by Singers and Rogers in prep.) will support an offsetability framework, the proposed national policy statement on indigenous biodiversity, national systematic conservation planning, and other policy development.*



3. Introduction

Most development activities inevitably have negative biodiversity impacts. Responsible developers, or those bound to do so by legislation, will seek to follow a mitigation hierarchy of avoiding, minimising and remediating potential impacts. Nonetheless, significant residual impacts might persist even after such a hierarchy is followed. In this case, residual impacts might be offset through such activities as conservation or restoration of biodiversity elsewhere. Such 'biodiversity offsets' are being increasingly used globally as a tool for compensation of residual development impacts. The New Zealand Department of Conservation (DoC) initiated a three year programme to investigate the concept of biodiversity offsetting in New Zealand in 2010. DoC is particularly interested in ascertaining how a robust, measurable and transparent biodiversity offsetting mechanism might be developed in New Zealand, providing best-practice methodologies and highest quality assurance, and how new developments on public conservation land can result in a positive net gain for biodiversity and enhanced ecological protection and preservation. This study aims to develop general guidance on offsetability of biodiversity impacts (i.e. the appropriateness of risks to biodiversity and achievability of offsets), explanation of how this could be adapted to the New Zealand context, and to marry together clear generic thinking on offsetability with the New Zealand biological and policy context. As such it particularly builds on a body of previous work by the Business and Biodiversity Offsets Programme (BBOP), notably Savy *et al.* (2008), von Hase and Stephens (2010a, b), Treweek *et al.* (2010) and BBOP (2011b).

In general, it is accepted that biodiversity offsets are appropriate only up to certain limits, owing to the vulnerability or irreplaceability of the biodiversity to be offset. This is, for example, the basis of BBOP Principle 4: “Limits to what can be offset: There are situations where residual impacts cannot be fully compensated for by a biodiversity offset because of the irreplaceability or vulnerability of the biodiversity affected.” Biodiversity features with higher vulnerability are those which are at risk of – or currently being impacted by – threats which might cause their loss (e.g. species threatened with extinction)[10]. Biodiversity features with higher irreplaceability are those which have fewer options for conservation (or, indeed, offsetting) in space or time (e.g. ecosystems which occur only on a very specific geology with a limited distribution, or birds which depend heavily on one or two wetlands during the course of migration)[11]. In a commentary on New Zealand, one author has suggested that, for these reasons, biodiversity offsets might not be appropriate for areas with “the presence of species listed as nationally threatened or of habitats that have less than a particular percentage of their total area remaining (e.g., <10%)” (Norton 2009; cf. avoidance of habitats with less than 30% remaining in New South Wales' offsets legislation, Section 4.2.2). Policy and legislation internationally gives guidance on limits up to which biodiversity offsets might be considered appropriate. However, little of this guidance is aimed beyond the national level, and even less draws upon international lessons from conservation planning. Policies from some of the international development banks (e.g. IFC and EBRD) are notable exceptions in both regards. This report thus sets out to assess appropriate limits to biodiversity offsets, and categories of offsetability below these limits, both at a conceptual level and given practical considerations. Appropriate upper limits to offsetability are fundamentally difficult to define as they – ecologically – ultimately rest upon avoiding extinction of biodiversity features; a fine line which it is difficult to

10 See Margules and Pressey (2000) for further discussion of the concept of vulnerability.
11 See Margules and Pressey (2000) and Ferrier *et al.* (2000) for further discussion of the concept of irreplaceability.

identify with precision. Below such limits, considerable challenges exist to establishing categories of offsetability in a way that is meaningful, clear and numerically quantified. Fundamentally, such categories must be established on the basis of how much extinction risk is acceptable to society. Such societal values do vary from nation to nation, so here care is taken to build upon existing systems in international conservation science. A process of broader debate would be needed to revise, agree and adopt final categories as a global or national standard.

Limits to what biodiversity can, or should, be offset fundamentally rest on what offsetting is aiming to achieve. Here, for practical reasons, it has been assumed that 'no net loss' at the project level is the minimum target, i.e. compensating for biodiversity with offsets at any location globally irregardless of local values[12]. Such a minimum target is, however, inappropriate because it would still result in losses to biodiversity at a landscape scale (Section 6.3, Gibbons and Lindenmayer 2007, Bekessy *et al.* 2010). While existence values of biodiversity can readily be compared (owing to their more global foundation), as can a few service values of biodiversity that are globally-relevant (e.g. carbon sequestration), most service values (e.g. cultural values, landscape values, water regulation values) are not readily comparable as they vary widely with human socio-economic situation (BBOP Thresholds Consultation Working Group 2008). Variance is even greater with regard to offset opportunity (largely an ecosystem degradation issue) and offset feasibility (largely a capacity-related issue). This report thus deals only with existence values of biodiversity[13] and provides guidance on residual impact magnitude, offset opportunity and offset feasibility issues to be considered, rather than attempting to prescribe a precise classification for very country-, site-, development- and developer-specific capacity issues. Such a quantitative classification will be ambitious even in the most data rich countries. None of this is to say that service values of biodiversity are not important – indeed, it will be very important to consider them during decision-making on biodiversity offsets (particularly in less developed countries where people are dependent on such services for a higher proportion of their livelihoods) – but simply that they cannot be considered in the same way here.

12 BBOP defines biodiversity offsets as “measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse biodiversity impacts arising from project development and persisting after appropriate prevention and mitigation measures have been implemented.” and further clarifies that “(t)he goal of biodiversity offsets is to achieve no net loss, or preferably a net gain, of biodiversity on the ground with respect to species composition, habitat structure and ecosystem services, including livelihood aspects.”

13 While definitions of existence and intrinsic values of biodiversity vary, the term 'existence values' is preferred here on the basis that most purported 'intrinsic values' of biodiversity (rarity, threat, etc.) are actually human (existence) values (e.g. see Attfield 1998).

4. International approaches to biodiversity offset limits

4.1 Brief review of international approaches

Madsen *et al.* (2010) identified 39 existing biodiversity offset-type programs around the world, and another 25 in various stages of development or investigation. Additional details on these and other programs are given by BBOP (2009) and Tanaka (2010). Key initiatives listed in these documents, plus some other key initiatives known to the authors of this report, are briefly reviewed in Tables 1 and 2, with particular reference to upper levels of biodiversity conservation concern for which offsets would be considered appropriate. As this report focuses on issues of offset risk and 'what is not feasible to offset', this review does not consider international approaches to lower thresholds to offsets (the theoretical point below which residual losses following mitigation are so insignificant[14] that there is no need for a biodiversity offset). Table 1 summarises policy and legislation in which – directly or indirectly – upper limits (what is not offsetable) are clear. These are often in the form of upper limits to acceptable impacts, which thus *de facto* become upper limits to offsetability. This table also details permitted exceptional circumstances, if any, in which such limits can be circumvented[15]. Underlying principles and challenges of the different listed approaches are not discussed, owing to time limitations. It should be noted that a number of the upper limits in these existing international approaches are based on factors other than ecological limits (e.g. for social, cultural, financial, legal or technical reasons).

Another set of countries have policy, legislation or guidance documents which discuss or enable biodiversity offsets, but without any specific or clear mention of upper limits (and often with no specific mention even of biodiversity offsets). These include: Argentina; Austria; Belgium; Chile; China; Costa Rica; Egypt; France; Ghana; India; Israel; Japan; Lithuania; Madagascar; Malaysia; Mongolia; Nepal; Netherlands; New Zealand; Pakistan; Panama; Philippines; Russia; South Korea; Sweden; Switzerland; Thailand; Uganda; and Vietnam.

Two common themes are worth noting from Table 1. First, where upper limits are defined for biodiversity offsets (which is not usually the case), these are rarely absolute. There are usually exceptions to such limits given, such as where 'no practical alternative exists' or 'overwhelming socio-economic benefits occur', even though net biodiversity losses will be sustained. Rare examples of absolute limits occur in the Western Cape Provincial Government of South Africa guidelines, which state that irreplaceable areas cannot be offset (DEA and DP 2011; further details below), and the draft BBOP methodologies, which recognise that species extinctions are not offsetable (BBOP 2009). Second, despite the fact that exceptions are usually given to upper limits, in a number of the most developed programs the principle does exist that some biodiversity is not feasible to offset. However, specifics are rarely given – just examples (e.g. under Australia's 2007 'Use of Environmental Offsets' discussion paper, and in South Australia). Outside of offsets-related policy and legislation, a concept of inviolate areas is more common. For example, the Indian Ministry of Environment and Forests stipulates 'no-go' areas for mining as those areas with > 30% gross forest cover or > 10% weighted forest cover. The rarity of absolute upper limits in offsets

14 Either in absolute terms or relative to the status of the biodiversity feature – for example, rapidly expanding species' populations or ecological communities might not merit offsetting if the impact of a development is minor.

15 Wider exceptions have been allowed in practice for legislation and policy with which the authors are familiar.

policy and legislation, and the frequency of exceptions to such limits where they do occur, reflects social, economic and political desire rather than ecological realities of achieving no net loss of biodiversity – there is no doubt that an absence of absolute upper limits will inevitably lead to irreplaceable biodiversity loss. In a parallel way, lower thresholds can lead to ongoing cumulative loss.

Table 1: Key policy, legislation and guidance on biodiversity offsets (with clear mention of upper limits)

Country/ authority	Most relevant policy, legislation and guidance	Date	Upper limit	Exceptions	Notes
Australia	Use of Environmental Offsets Under the Environmental Protection and Biodiversity Conservation Act 1999	2007	No specific limits, but "In some circumstances, suitable offsets may not be available to adequately compensate for the impacts of a development... For example, in 2001 the culling of Spectacled Flying Foxes by a large aerial electric grid on a lychee farm in north Queensland, adjacent to the Wet Tropics World Heritage Area was determined to be unacceptable. No amount of offsetting could appropriately compensate for the on-site impacts."		Discussion paper.
	New South Wales' BioBanking Assessment Methodology	2008	Adverse impacts on 'red flag areas' of high biodiversity conservation concern.	No exceptions are allowed where a red flag area comprises a highly cleared (≥ 90% by 1750) vegetation type with an area greater than 4 ha, not in low condition. Otherwise, exceptions are allowed if it is determined that strict avoidance is unnecessary.	'Low condition' is defined for various vegetation types based on the proportion of remaining ground cover in the area. Further discussion and detail is given in section 4.2.2.
	Queensland's Policy for vegetation management offsets, as updated	2006	None.		
	Queensland's Environmental Offsets Policy	2008	None.		Additional specific offset policies also exist for vegetation management, marine fish

					habitat and koala habitat.
	Queensland's draft Policy for Biodiversity Offsets (out for consultation)	2009	None.		
	South Australia's Native Vegetation Act 1991, as updated	1991	"Native vegetation should not be cleared if, in the opinion of the Council — (a) it comprises a high level of diversity of plant species; or (b) it has significance as a habitat for wildlife; or (c) it includes plants of a rare, vulnerable or endangered species; or (d) the vegetation comprises the whole, or a part, of a plant community that is rare, vulnerable or endangered; or (e) it is significant as a remnant of vegetation in an area which has been extensively cleared; or (f) it is growing in, or in association with, a wetland environment; or (g) it contributes significantly to the amenity of the area in which it is growing or is situated; or (h) the clearance of the vegetation is likely to contribute to soil erosion or salinity in an area in which appreciable erosion or salinisation has already occurred or, where such erosion or salinisation has not yet occurred, the clearance of the vegetation is likely to cause appreciable soil erosion or salinity; or	South Australia's Native Vegetation Regulations 2003 allow many exemptions on the grounds of practicality, suitability, relative biodiversity conservation concern, impacts, etc. However, South Australia's (2005) *Guidelines for a Native Vegetation Significant Environmental Benefit Policy* state "Situations may occur where native vegetation is considered to be of such high value that provision of a sufficient SEB to compensate for clearance cannot be achieved (e.g. last known remaining stand of critically endangered species or habitat)."	

			(i) the clearance of the vegetation is likely to cause deterioration in the quality of surface or underground water; or (j) the clearance of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding; or (k) — (i) after clearance the land will be used for a particular purpose; and (ii) the regional NRM board for the NRM region where the land is situated has, as part of its NRM plan under the *Natural Resources* *Management Act 2004*, assessed— (A) the capability and preferred uses of the land; and (B) the condition of the land; and (iii) according to that assessment the use of the land for that purpose cannot be sustained; or (l) the clearance of the vegetation would cause significant harm to the River Murray within the meaning of the *River Murray Act 2003*; or (m) the clearance of vegetation would cause significant harm to the Adelaide Dolphin Sanctuary”		
	Tasmania's General Offset Principles	2007	None.		
	Victoria's Native Vegetation Management Framework	2002	Clearing not permitted in 'very high' conservation significance areas, and generally not in 'high' or 'medium'	For very high conservation significance areas, if “exceptional circumstances	No guidance given on when exceptions can be made for high or medium conservation significance areas.

			areas.	apply (i.e. impacts are an unavoidable part of a development project, with approval of the Minister for Environment and Conservation (or delegate) based on considerations of environmental, social and economic values from a statewide perspective).”	For each category, multipliers are given, as well as limits on like-for-like, landscape role, offset quality (in all cases allowing some trading down) and amount of revegetation. Appendices 2 and 3 of the framework define 'very high', 'high', etc.
	Western Australia's Guidance for the Assessment of Environmental Factors (in accordance with the Environmental Protection Act 1986): Environmental Offsets – Biodiversity	2008	Significant adverse environmental impacts on ‘critical’ assets and, in some cases, on 'high' value assets.	In some instances, approval “by State Government Ministers to provide an essential community service (such as electricity, water, gas and transport infrastructure), public benefit, or to allow strategic social or economic development to occur.”	'Significant' is based on 2002 EIA Administrative Procedures. 'Critical assets' represent the most important environmental assets in the State that must be fully protected and conserved for: • the State to fulfill its statutory and policy requirements; • the State to remain sustainable in the longer term; and, • the EPA to comply with its general principles for advice and decision making.“ (Position Statement 9, 2002) Emphasis on like-for-like or better. Multipliers where danger of offset failure.
Brazil	Forest Code	1965	None.		
Canada	Habitat Conservation and Protection Guidelines, 2nd edition	1998	None.		
	Mosaic of national and provincial laws and policies				Per Madsen *et al.* (2010).
Colombia	Decree 1753	1994	None.		Per Madsen *et al.* (2010).

European Union	Birds and Habitat Directives	1992	None, as only applies to severe and imperative impacts.		
	Environmental Liability Directive	2004	None.		
Germany	Federal Nature Conservation Act, as updated 2002	1976	None.		
Mexico	General Act on Ecological Equilibrium and Environmental Protection	1988	None.		Overall, apparently no upper limits (Darbi *et al.* 2009).
	Program for Environmental Restoration and Compensation	2003	None.		
Paraguay	National Constitution				Enabling legislation only, but under criminal law so no incentive for prior compensation (Madsen *et al.* 2010).
	Forestry Law		Apparently, none.		Similar to Brazil's Forest Code (Madsen *et al.* 2010).
South Africa	KwaZulu-Natal Province Norms and Standards for Biodiversity Offsets	2009	"Residual impacts... of very high significance", e.g. on Critically Endangered species and ecosystems, Critical Biodiversity Areas, or irreplaceable ecological corridors.	In 'exceptional circumstances' where: (i) development will be authorised anyway owing to strategic interests; (ii) where time lags for on-site mitigation action would result in irreversible biodiversity loss; (iii) where on-site gains would be very limited and off-site gains could be much higher.	
	Western Cape Provincial Guideline on Biodiversity Offsets	2011	"Residual impacts... of very high significance" or where "Biodiversity losses would not be adequately compensated by offsets".	Some are entirely non-offsetable, but most can be offset in 'exceptional circumstances'.	Further discussion and detail is given in section 4.2.3.
USA	Endangered Species Act (with	1973	None.		

	USFWS 2003 guidance for the establishment, use and operation of conservation banks)				
	Clean Water Act, as amended	1972	None; applies to all wetlands.		Relates to US wetlands compensatory mitigation.
	USFWS Habitat Evaluation Procedures	1980	None.		
Business and Biodiversity Offsets Programme	draft methodologies		Species extinction: “Where the residual negative impacts of a proposed project are likely to be so great as to lead to irreplaceable loss of biodiversity (e.g. global EXTINCTION of a species), no biodiversity offset could compensate for such loss. In these circumstances, biodiversity offsets would be impossible. Similarly, biodiversity offsets may be an inappropriate approach for a species or ecological community that is currently or has already undergone a significant decline, as the risk that the offset will fail could be too high.”		BBOP (2009): beyond global species extinction, the guidance in this handbook avoids setting clear limits to offsetability owing to the lack of consensus on such limits. Additional limits to offsetability were proposed by Savy *et al.* (2008), but not adopted by BBOP.
European Bank for Reconstruction and Development	Performance Requirement 6	2008	Measurable adverse impacts on functions of critical habitat; “reduction in population of any critically endangered or endangered species or a loss in area of the habitat concerned such that the persistence of a viable and representative host ecosystem be compromised.”	None.	Critical habitat is identified by “(i) its high biodiversity value; (ii) its importance to the survival of endangered or critically endangered species; (iii) its importance to endemic or geographically restricted species and sub-species; (iv) its importance to migratory or congregatory species; (v) its role in supporting assemblages of species associated with key evolutionary processes; (vi) its role in supporting biodiversity of significant social, economical or cultural

					importance to local communities; or (vii) its importance to species that are vital to the ecosystem as a whole (keystone species).”
International Finance Corporation	Performance Standard 6	2007	Measurable adverse impacts on the ability of critical habitat to support established populations of key species or functions of the critical habitat; reduction in the population of any nationally or globally critically endangered or endangered species.	None in current Performance Standard guidance, but this is being revised (see further discussion and detail in section 4.2.1.).	
World Bank	Operational Policy 4.04 - Natural Habitats	2001	“[S]ignificant conversion or degradation of critical natural habitats”.	None.	'Critical natural habitats' are existing and proposed protected areas, and supplementary areas defined by relevant authorities (these can include areas critical for threatened species). 'Significant' is the elimination or severe diminution of integrity of a biodiversity feature caused by a major, long-term change.

4.2 Key legislation and policy relating to upper limits for offsets

Several of the most advanced pieces of legislation and policy regarding biodiversity offsets are discussed in more detail below. The International Finance Corporation's Performance Standard 6 is the most globally relevant, applied, and important guidance on limits to biodiversity offsets. Australia, exemplified by the state of New South Wales, has the most developed guidance on biodiversity offsets after the United States, which has no specific upper limits on what can be offset. Finally, South Africa's Western Cape provincial guideline is of particular interest owing to its exclusionary threshold, past which biodiversity offsets are not considered, and its links to separate conservation planning policies and targets.

4.2.1 International Finance Corporation: Performance Standard 6

International Finance Corporation (IFC) standards are particularly important not only because it is the largest multilateral source of loan and equity financing for private sector projects in the developing world, but also because its standards have been adopted – at least on paper – by many other financial institutions; most notably the 77 which have adopted the Equator Principles[16]. IFC Performance Standard 6, on biodiversity conservation and sustainable natural resource management, considers impacts on 'critical habitat' – areas with high biodiversity value[17]. The previous standard allowed offsets for 'natural habitat'[18] but for critical habitat allowed “no measurable adverse impacts on the ability of the critical habitat to support the established population of species described in paragraph 9 or the functions of the critical habitat described in paragraph 9”, thus de facto not allowing offsets of measurable adverse impacts on critical habitat (as footnoted in the previous sentence; IFC 2006). The recently revised standard, however, has no such absolute limits[19], but instead has a two-tiered system for distinguishing among critical habitats, supported by recommendations on the likelihood of offset success, and a focus on no measurable adverse impacts on biodiversity features for which critical habitat is designated (IFC 2012). These 'habitats' are terrestrial, freshwater, marine or aerial geographical, discrete management units which can be larger than the project area itself. In this tiered system, the majority of 'tier 1' critical habitats are considered likely not offsetable. The new criteria are more transparent and quantitative, and align with IUCN guidelines on species and site assessment for global conservation concern. These essentially comprise areas required to sustain at least 10% of the global population of a Critically Endangered or Endangered species, areas that are one of 10 or fewer sites globally for Critically Endangered or Endangered species, and areas known to sustain at least 95% of the global population of a restricted-range or migratory/congregatory species at any point in its life cycle. Further, it is considered that critical habitats supporting 'regionally unique and highly threatened ecosystems' and 'key evolutionary processes' are likely very difficult (or impossible) to offset. In all cases, IFC considers the ‘like-for-like’ (in-kind) or better concept to be a fundamental requirement of offset design in critical habitats. The new requirements for projects in

16 www.equator-principles.com

17 “areas with high biodiversity value, including (i) habitat of significant importance to Critically Endangered and/or Endangered species; (ii) habitat of significant importance to endemic and/or restricted-range species; (iii) habitat of significant importance to globally significant concentrations of migratory species and/or congregatory species; (iv) regionally significant and/or highly threatened or unique ecosystems; and/or (v) areas which are associated with key evolutionary processes”. These areas are thus defined in a very similar way to Key Biodiversity Areas.

18 “land and water areas where the biological communities are formed largely by native plant and animal species, and where human activity has not essentially modified the area’s primary ecological functions”.

19 i.e. in the sense described in Section 4.1 of 'upper thresholds with no exceptions allowed'.

critical habitat are that "... [the] client will not implement any project activities unless it could be demonstrated that there will be net positive gains of those biodiversity values for which the critical habitat was designated" – indicating that projects within critical habitat will be expected to move beyond no net loss.

4.2.2 Australia: New South Wales' BioBanking Assessment Methodology

Australia has some of the most advanced biodiversity offset legislation and policy outside of the United States. It is driven by overarching national legislation and guidance, but refined in varying state policies. Particularly developed policy exists in New South Wales, primarily through its Native Vegetation Act (2003), Threatened Species Conservation Amendment (Biodiversity Banking) Act 2006, and BioBanking Assessment Methodology (2008). This latter guidance takes a slightly different approach to the IFC, but with similar results. Essentially, it requires avoidance of adverse impacts on 'red flag areas' of high biodiversity conservation concern, defined as:

(i) vegetation types that were > 70% cleared by 1750 and are not in low condition[20];

(ii) critically endangered or endangered ecological communities (listed under law), where the vegetation is not in low condition;

(iii) one or more threatened species that cannot withstand further loss in the catchment management authority area because either: the species are naturally very rare, critically endangered, have few populations or a restricted distribution; the species or their habitat needs are poorly known; or the species are populations officially identified as relevant for requiring or creating species credits.

However, a two-tiered approach is then taken, similar to the IFC. At the lower level, exceptions are allowed if the Director General determines that strict avoidance is unnecessary because the contribution to regional biodiversity values of vegetation/species to be impacted is low, or biodiversity values of the area are unviable or of low viability. At the upper level, no such exceptions are allowed at all where a red flag area comprises a highly cleared (≥ 90% by 1750) vegetation type with an area greater than four hectares, and the vegetation is not in low condition.

The biodiversity offset policy in New South Wales is not only among the most developed in Australia, but also the strictest in determining an absolute upper limit. Other States range from not stating any upper limit (Queensland and Tasmania) to stating upper limits which can, in exceptional circumstances, always be over-ruled.

4.2.3 South Africa: Western Cape Provincial Guideline on Biodiversity Offsets

This guideline, drafted in 2007 (Brownlie *et al.* 2007) and finalised in 2011 (DEA and DP 2011), outlines a few practical issues that would lead to biodiversity offsets not being considered, including when a full mitigation hierarchy has not been first followed and when the long-term security and viability of the proposed offset cannot be guaranteed. Under the National Environmental Management Act, three key elements in considering proposed biodiversity offsets are the significance of residual impacts, biodiversity values to be impacted and the ability of the applicant to implement mitigation measures. Significance ratings for residual impacts are given as

20 'Low condition' is defined for various vegetation types based on the proportion of remaining ground cover in the area.

low 'negligible impact', medium 'threshold of potential concern', high 'threshold of major potential concern' and very high 'the exclusionary threshold'.

The exclusionary threshold relates to the fact that biodiversity offsets would not be considered when residual impacts are of very high significance (likely constituting irreversible impacts, irreplaceable loss of resources, or jeopardised ecological integrity). More specifically, it is clarified that these circumstances encompass very high residual impacts on:

(i) Habitats identified as Critical Biodiversity Areas[21] in a published bioregional or fine-scale plan, or as a priority biodiversity area in other biodiversity plans, and/or as a core site in a biodiversity network;

(ii) Areas declared as Protected Areas or 'Protected Ecosystems', or for which a Biodiversity Management Plan has been approved in terms of these Acts;

(iii) Areas of irreplaceable biodiversity value identified by biodiversity specialists and supported by CapeNature, i.e. any habitat where its size, connectivity, structure, composition and condition would make it irreplaceable for ensuring persistence of an ecosystem or species;

(iii) Critically Endangered (irreplaceable loss) ecosystems identified in a biodiversity plan and ratified by a biodiversity specialist and/or CapeNature;

(iv) Critically Endangered and Endangered species, assessed by a biodiversity specialist and/or CapeNature;

(v) 'Special habitats' recognised in a fine-scale biodiversity plan, by CapeNature or by a biodiversity specialist;

(vi) Fixed processes at provincial to local level, identified on the Western Cape Provincial Spatial Development Framework or biodiversity or bioregional plans (i.e. with limited alternatives or substitutes and potentially important in enabling the persistence of biodiversity or delivery of ecosystem services of provincial importance);

(vii) Locally or provincially valued or important ecosystem services, with – for locally valued services – no local substitute (i.e. irreplaceable) or substitute only at high cost.

Provision is given, however, that all of these can be offset in 'exceptional circumstances', with substantial multipliers, where the biodiversity feature to be impacted is highly unlikely (95% certainty) to be viable in the long-term (i.e. already 'doomed'). It is not, in these cases, presumed that offsets will provide compensation for what is lost, but that they are the only option for compensation.

A particular point to note about the Western Cape guidance is the degree to which limits to offsetability are not defined *per se* in the guideline, but in referenced policy and targets such as published bioregional or fine-scale plans, and the Western Cape Provincial Spatial Development Framework – i.e. there is not a goal of 'no net loss', but of reduction to a particular accepted conservation target level. Treweek (2009) takes a similar approach to suggesting potential offset limits for the United Kingdom. This approach is in many ways (notably its spatially explicit nature) preferable to intrinsic definitions, as it allows for continued relevance despite updated policies and targets in future. It is, however, only feasible in countries or regions where sufficient conservation

21 Sites that are irreplaceable or 'important and necessary' to meet targets for biodiversity pattern and process, and large enough and connected enough to be functional and persist in the long term.

planning exercises have already been undertaken. It should also be noted that ecosystem threat levels provide the basis for required offset multipliers in the Western Cape, with higher multipliers required for more threatened ecosystems. This process is taken even further in KwaZulu-Natal, where specific multipliers are set for each ecosystem in the province, based on level of threat and conservation targets (Ezemvelo KZN Wildlife 2009).

5. General offsetability framework

This section outlines a general, globally-relevant framework for categorising relative offsetability (i.e. the appropriateness of risks to biodiversity and achievability of offsets). This is not a framework for deciding which projects should be approved ('go/no-go' decisions), which is a process generally taking place prior to this stage. However, the results of the framework, in clarifying the relative offsetability of a development, might suggest a need for modifications to project design or, in extreme cases, a revision of the earlier decision to proceed with the project. Practically, this framework defines categories for the varying biodiversity conservation concern of impact areas, and the feasibility or appropriateness of different offsets. Appropriate upper limits to offsetability are fundamentally difficult to define as they – ecologically – ultimately rest upon avoiding extinction of biodiversity features; an outcome which it is difficult to predict with precision[22], and drivers of which vary on a biodiversity feature-by-feature basis. Nonetheless, guidance is given on this issue in light of the framework.

As a general framework, this is based solely on global existence values, not service values, and does not incorporate societal values regarding such issues as whether invertebrates are equal to charismatic mammals. This framework has a general, global perspective and only considers like-for-like offsets, and thus takes as a starting point the fact that only global extinction of a particular biodiversity feature is wholly impossible to offset. The resolution or scale of biodiversity features is discussed further in Section 5.1, below. As a general, globally-relevant framework, it is also not directly applicable to any particular country or region[23]. Modifications necessary for a national or sub-national framework are considered in Section 6.

The general framework has four core considerations:

(i) biological (site biodiversity) conservation concern – *i.e. what have you got, and how important is it in a wider context?*

(ii) residual impact magnitude – *i.e. how much is likely to be lost?*

(iii) offset opportunity – *i.e. what options are there for restoration or enhancement elsewhere?*

(iv) offset feasibility – *i.e. what is the likelihood of successful restoration or enhancement?*

Conceptually, perhaps the easiest way to address these four considerations is via a stepped process of (i) assessing biodiversity conservation concern, (ii) assessing residual impact magnitude, (iii) assessing offset opportunity, and (iv) assessing offset feasibility. This approach is summarised in Table 2 and discussed in more detail in Sections 5.1-5.3.

Fundamentally, this framework relies on the legal concept of 'burden of proof', in that the obligation to present evidence showing there is limited or no danger in shifting from the lower-risk status quo (no additional development) to a new position (additional development) lies with the developer[24]. Government regulators or other stakeholders (such as non-governmental organisations) might already have conducted biological assessments nationally or sub-nationally

22 e.g. it is very difficult to predict the exact rate or severity of decline which would tip a species' population dynamics beyond the 'point of no return' (the extinction of the Passenger Pigeon *Ectopistes migratorius* is often cited as an example of a species which rapidly and unexpectedly plummeted to extinction, driven by significant, but far from total, depletion of the vast colonies upon which its breeding success depended). Population viability analysis attempts such predictions, but it remains a field very much in development.

23 e.g. it assumes impacts in one country could be offset in another, if biologically and technically feasible.

24 Credit for this approach is due to Jim Salzman, who first proposed it in relation to offsets at the Paris meeting of BBOP in September 2010.

(e.g. Lochner *et al.* 2003) that readily identify the level of conservation concern for biodiversity in a given management unit[25]. In many cases, developers might choose to accept this information. Otherwise, to prove that biodiversity in a management unit should actually be classified as of lower conservation concern, the burden of proof would lie with the developer. For example, a developer might wish to commission surveys in surrounding areas to prove that a given biodiversity feature is actually more widespread than previously known, and thus the level of conservation concern of the management unit to be developed is lower[26]. The burden of proof would also lie with developers on practical aspects; to prove that the likelihood of mitigating residual impacts is high (e.g. owing to high offset opportunity and feasibility). In all cases, regulators using this type of framework might require a higher standard of proof for higher risk scenarios (i.e. for sites of higher biodiversity conservation concern, or for less achievable offsets). For example, developers might be required to prove 'beyond reasonable doubt' that offsets for areas with biodiversity of high conservation concern can be successful, while only 'clear and convincing evidence' might be required for areas of lower conservation concern, and 'balance of probability' might be sufficient for areas of lowest conservation concern.

25 'Management units' are here defined, following the definition of 'discrete management units' by IFC Performance Standard 6 guidance and KBA 'site' delineation guidance (Langhammer *et al.* 2007), as geographic areas that could be considered discrete administrative or political units or discrete biological units for species or ecosystems for which they are identified. Further explanation is given in Section 5.1.

26 For example, initial assessments of mine sites in south-east Madagascar suggested a large number of site-endemic species. Surveys of nearby areas commissioned by Rio Tinto found a number of these species to be more widespread, increasing offset opportunity and feasibility.

Table 2: Summary of framework steps to assess relative offsetability.

	Steps	Key characteristics	Key considerations
1	Assess biodiversity conservation concern (Table 3)	vulnerability	*threatened species and ecosystems*
		irreplaceability	*restricted-range species and ecosystems*
2	Assess residual impact magnitude	severity	*what is the intensity of impacts at a given spatial scale?*
		extent	*what proportion of each biodiversity feature is impacted?*
		duration	*can offsets be implemented without time lags between impacts and offset gains?*
3	Assess offset opportunity	natural distribution	*will offsets be located where affected biodiversity (requiring offsets) is naturally found?*
		functional area	*does affected biodiversity (requiring offsets) perform any geographically-restricted functions (e.g. connectivity)?*
		spatial extent of offset options	*are sufficient comparable, additional, permanent offsets available for biodiversity to be offset?*
4	Assess offset feasibility	confidence in offset delivery techniques, adequacy of plans	*how likely are offset methods (e.g. restoration or conservation) to lead to required biodiversity gains?*
		offset implementation capacity	*are offset implementers likely to do a good job?*
		developer capacity	*are developers likely to do a good job?*
		financing	*is sufficient funding secured for the offset duration?*
5	Combine residual impacts and practical opportunities/constraints (offset opportunity/feasibility) to categorise likelihood of offset success (Table 4)		
6	Combine biodiversity conservation concern and likelihood of offset success in a burden of proof framework (Figure 4)		

5.1 Biodiversity Conservation Concern

Key points:

- *A system of biodiversity conservation concern categories for assessing the risk of undertaking offsets is presented, building on previous science and policy, particularly the IUCN Red List, KBAs, and IFC Performance Standard 6;*
- *Offsets for areas with biodiversity of lower conservation concern can be progressively viewed as more feasible or more appropriate and thus a lower burden of proof applies to a developer proposing an offset;*
- *Higher standards of proof are likely to be required by regulators from developers for areas with biodiversity of higher conservation concern – e.g. developers might be required to prove 'beyond reasonable doubt' that offsets for areas with biodiversity of high conservation concern can be successful.*

Considerable challenges exist to establishing categories for biodiversity conservation concern – whether for offsetting or other purposes – in a way that is meaningful, clear and numerically quantified. A process of broader debate would be needed to revise, agree and adopt any such categories as a global or national standard. However, the field of conservation planning has produced extensive analysis of methods and categorisations for biodiversity conservation conservation. The categorical system presented here is thus not an entirely novel system, but builds on considerable previous science and policy. In particular, it builds on (i) the development of quantitative, threshold-based criteria for assessing species' extinction risk (IUCN 2001, 2010; Rodrigues *et al.* 2006), (ii) collation of various approaches to identifying sites of biodiversity conservation concern into a single system known as Key Biodiversity Areas (KBAs: Eken *et al.* 2004, Langhammer *et al.* 2007), and (iii) introduction of a tiered system of biodiversity conservation concern (IFC 2010). The system proposed here builds on a similar tiered system, likewise developed around IUCN and site-based conservation prioritisation criteria, that was proposed by Savy *et al.* (2008).

Key Biodiversity Areas build on previous site-scale approaches, namely Important Bird Areas (IBAs: e.g. Fishpool *et al.* 1998), Important Plant Areas (IPAs: Anderson 2002, Plantlife International 2004), Important Mammal Areas (Linzey 2002), Important Sites for Freshwater Biodiversity (Darwall and Vié 2005), Alliance for Zero Extinction (AZE) sites (Ricketts *et al.* 2005), and the Ramsar Convention on Wetlands. Key Biodiversity Areas are now widely accepted globally, with increasing incorporation into national legislation (e.g. an Executive Order in the Philippines[27]) and funding priorities (e.g. for the Critical Ecosystem Partnership Fund[28]). The categorical system presented here (Table 3) thus has KBA principles and quantitative thresholds at its core, and closely approximates to categories used in the International Finance Corporation's Performance Standard 6 (IFC 2006, 2010).

Species and ecosystems are the key biodiversity features in this system. Taxonomically, this framework operates at the level of the biological species as this is the most frequently used and consistent system internationally, including by such relevant systems as the IUCN Red List. A similar approach was taken by Savy *et al.* (2008). At a national or sub-national level, it might be feasible and desirable to use finer taxonomic units such as subspecies or populations (or the phylogenetic species concept).

In the context of this analysis, ecosystems are functionally equivalent to 'bioregionally-restricted assemblages', which have proved to be the most difficult criterion for applying KBA criteria. Ecosystem definition has significant remaining challenges but, since KBA development, significant political and technical advances have been made in the use of ecosystems in conservation planning, most notably the drafting of a system for quantitative, categorical assessment of their threat (Rodriguez *et al.* 2011), vulnerability categories from which are included here. Ecosystems are not as well classified globally as species, and this framework assumes existence or development of a suitable standardised ecosystem classification for the country or region in question, based on not only biotic factors such as vegetation type, structure and species composition but also abiotic factors such as climate, soils and landforms. Ecosystem classification should occur at many scales, to reflect the nested nature of ecosystems, and it is thus important to define *a priori* a scale of classification within the country or region in question that strikes a balance between providing ample opportunity for biodiversity offsetting on the one hand and on

27 http://elibrary.judiciary.gov.ph/index10.php?doctype=Executive%20Orders&docid=a45475a11ec72b843d74959b60fd7bd645eeea09431e7
28 www.cepf.net

the other hand conserving biodiversity, by enabling accurate assessment of irreplaceability and preventing inappropriate exchanges of dissimilar biodiversity.

It is reasonable to adopt similar quantitative thresholds for vulnerability and irreplaceability categories for ecosystems and species if their geographic range frequency distribution is believed to be similar, i.e. if ecosystems are, in general, as widely distributed as the taxonomic units (species, sub-species, populations, etc.) that are incorporated in the framework[29]. A national or sub-national level ecosystem classification is likely to produce smaller-scale ecosystem ranges than species ranges (because it would be, in part, based on combinations of those ranges), in which case different quantitative thresholds for vulnerability and irreplaceability categories would need to be used for ecosystems. If ecosystem ranges are generally smaller than species ranges, higher thresholds will be required for ecosystems because a higher proportion of ecosystems would meet absolute irreplaceability and vulnerability criteria. Ultimately, irreplaceability of ecosystems would best be included by reference to national or regional systematic conservation plans that identify biodiversity priorities based on a clear conservation goal with specific targets (Section 4.2.3)[30].

Since service values of biodiversity depend much more greatly on human values, which vary widely from place to place and are often more substitutable (e.g. replacement of reedbeds with sewage treatment plants), only global existence values of biodiversity are incorporated into this categorical system – an approach that aligns with earlier attempts at developing global categories (Savy *et al.* 2008). Throughout this document, the system is based on an assumption of like-for-like offsetting. Like-for-like or better might be used as an offset strategy in many countries, but is defined much more by national offset availability than biodiversity values *per se*. Like-for-like or better also depends on a robust method for quantifying exchanges of different biodiversity, which is lacking to date. Throughout, the geographic unit of analysis is called a 'management unit'[31]. 'Management units' are here defined, building on the definition of 'discrete management units' by IFC Performance Standard 6 guidance and KBA 'site' delineation guidance (Langhammer *et al.* 2007), as *geographic areas that could be considered discrete administrative or political units or discrete biological units for species or ecosystems for which they are identified* – e.g. leasehold areas, protected areas, discrete forest blocks or wetlands, watersheds, etc. It is important to note that 'management units' can thus often be larger than actual development sites, and are almost always larger than project impact/footprint areas within development sites. Definition of management units can be complex in areas with a matrix of small-scale land tenure (administrative units) across a fairly homogeneous habitat (biological unit). In such cases, the management unit is best defined as the unit (administrative or biological) that best covers all potential direct and indirect impacts from the development – owing to associated infrastructure and pollution, as well as the precautionary principle, this might often be the larger of two possible units.

Broad management units are used here (and by other major initiatives such as the developing IFC Performance Standard 6 and KBA site delineation guidance) because they better incorporate overall risks of secondary and cumulative impacts. Focusing analysis (such as Environmental Impact

29 This assumption underpins the work of Rodriguez *et al.* on ecosystem threat status (J. P. Rodriguez *in litt.* 2011).
30 Such plans are, however, not yet well developed in New Zealand, and there is much opportunity to integrate development of ecosystem-based conservation planning with biodiversity offsetting.
31 While noting that this term can be confusing, given that no management of the whole area is necessarily implied, this terminology fits with prior (IFC and KBA) usage.

Assessments) solely on predicted impact areas on a project-by-project basis can produce perverse incentives to stage developments into several different applications, each of low impact but cumulatively of high impact. Further, focusing analysis solely on predicted impact areas can mean that indirect (or 'secondary') impacts on neighbouring areas are insufficiently considered.

Biodiversity conservation concern levels listed in the system represent relative risks towards global extinction of a particular biodiversity feature, on a 'trigger' or 'weakest link' principle (whereby a site is classified in the highest priority level for which it is triggered by any biodiversity feature). Here, a holistic consideration of offsets is taken, in which extinction risks of undertaking offsets inherently include both risks of development impacts at a site and risks of offset failure. The two are inextricably linked – at least with mandatory offsets – because the development cannot proceed without offsetting significant residual impacts, and the offset would not be required without the development and the risks it poses. It is insufficient to solely consider risks of offset failure (risks of not achieving predicted 'gains'), without also considering risks of development impacts (risks of predicted 'losses', which might be equal or greater to those planned). Such an artificial separation does exist in some policy and literature on the premise that a 'go/no-go' decision can be taken without consideration of offset potential – in reality, offsets and other mitigation measures are an integral part of most development plans and are considered to some level when a 'go/no-go' decision is made.

The highest irreplaceability level (≥ 95%) details sites at which particular biodiversity features are so concentrated that even low impact development at these sites can pose serious threats to these features through offset failure or insufficient impact management (i.e. high *risks* exist). International best practice is to consider such broader landscape impact risks, rather than to focus narrowly on predicted impact areas. For example, construction of a radio mast at such a site might have little predicted direct impact on a globally-threatened plant or its habitat, but a cigarette discarded by a construction worker could start a fire which causes the species' extinction. Another example might be where a wind turbine development is predicted to have little direct impact on globally-threatened reptiles at a site owing to low terrestrial footprint, but maintenance roads facilitate access by invasive predators which might eliminate the reptile populations.

Categories for the highest (≥ 95%) irreplaceability level are based on those for Alliance for Zero Extinction sites (which are also ≥ 95%), the second level (≥ 10%) is based on tier 1 of criterion 1 for identification of critical habitat (IFC 2012), and thresholds for the third irreplaceability level (≥ 1%) have a basis in KBA thresholds (which are also ≥ 1% for globally significant congregations and source populations), thresholds for identification of Ramsar sites (Criteria 6 and 9), and thresholds for critical habitat (tier 2 of criteria 2, and criteria 3b and 3e; IFC 2012). More detailed explanation on KBA thresholds can be found in Chapter 4 '*Criteria and thresholds for Key Biodiversity Areas*' in Langhammer *et al.* (2007). Categories for irreplaceability levels are loosely based on the principle that risks to species and ecosystems are non-linear, tending towards logarithmic (e.g. Walker *et al.* 2008c), as illustrated in Figure 2. Although these quantitative categories do build on prior science, they are necessarily preliminary and require further testing and broader debate – which it is hoped that this report will stimulate.

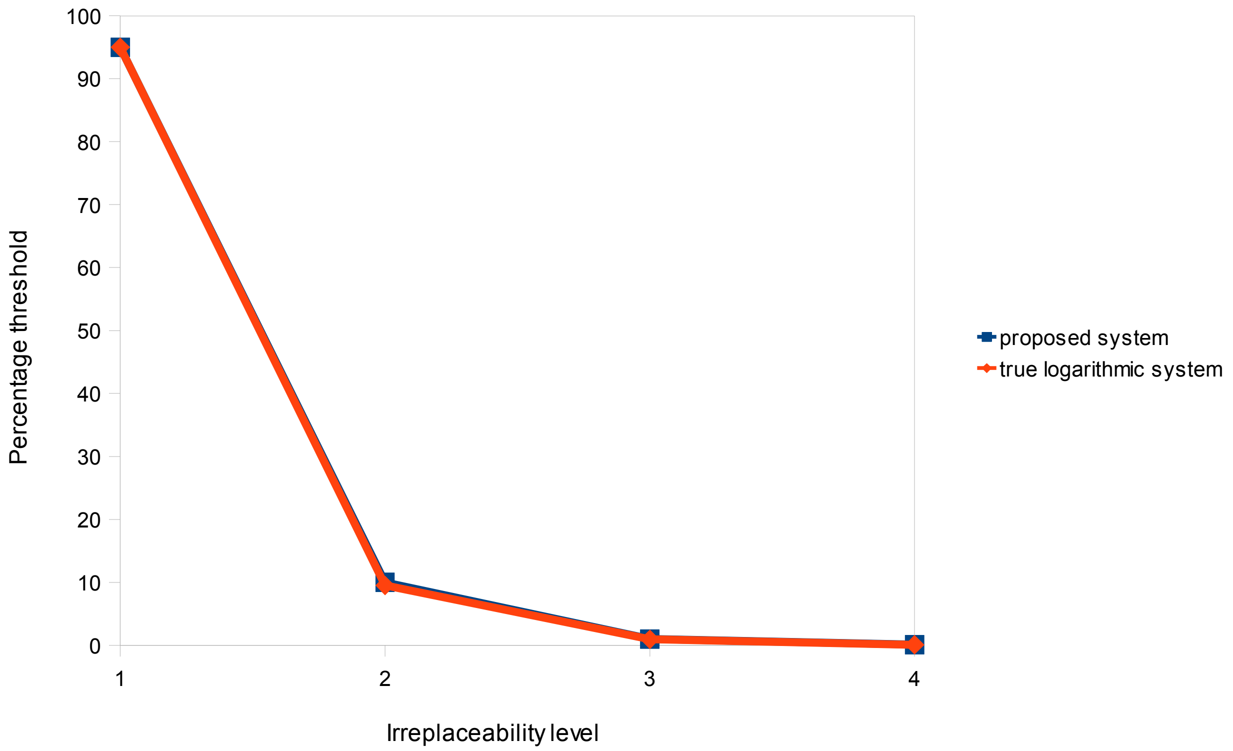


Figure 2. Comparison of thresholds for a truly logarithmic risk system and those proposed for irreplaceability (in Table 3). *Thresholds for irreplaceability categories in the proposed offsetability framework are loosely based on the principle that risks to species and ecosystems are non-linear, tending towards logarithmic.*

All other things being equal, offsets for areas with biodiversity of lower conservation concern (from 'Extremely High Conservation Concern' down to 'Low Conservation Concern') can be viewed as more feasible or more appropriate and thus a lower burden of proof applies. In order to achieve biodiversity goals, regulators are likely to find it necessary to altogether prohibit developments in management units with biodiversity of higher conservation concern (i.e. to set absolute upper limits to offsetability in order to reduce the risk of net loss of the most vulnerable/irreplaceable biodiversity, e.g. Savy *et al.* (2008) At minimum, it is likely that only projects with residual impacts of low magnitude, available[32] and feasible offsets, and known developer/offset implementer competence would be allowed in all Extremely High Conservation Concern and most Very High Conservation Concern management units. Medium Conservation Concern and Low Conservation Concern management units offer progressively more room for regulators to allow higher impact projects, less proven offsetting techniques, lower developer/offset implementer capacity. Higher standards of proof would reasonably be required by regulators from developers for offsets for areas with biodiversity of higher conservation concern. Low Conservation Concern management units could be viewed as the lower threshold for offsetting, at which offsets might not be required, if cumulative loss is not an issue. However, some regulators might find it necessary to require offsets for all residual impacts on biodiversity that could be considered to some degree vulnerable

32 e.g. including replacement values created prior to development through systems such as 'biobanking'.

or irreplaceable, or that has local values, in order to implement a national no net loss policy designed to halt biodiversity decline.

To some, only five levels of conservation concern to encompass the whole range of biodiversity that occurs at a site-level might be too few, and it can be argued that finer division would result in greater understanding of, and distinction among, relative priorities by developers and regulators. To others, even five levels of conservation concern might be overly complex and a simple two level system (similar to that of the IFC) might be desired. We feel a five-level system is the appropriate balance between these two viewpoints, particularly when tailoring is intended at a national level in a country with high biodiversity data quality and quantity. It is possible that it might be desirable to aggregate some conservation concern levels (e.g. Extremely High and Very High, Medium and Low) in countries with limited biodiversity data, but this general system allows for both such aggregation and for greater definition in countries with extensive biodiversity data (such as New Zealand[33]).

Table 3: A draft system for categorising biodiversity conservation concern, based on irreplaceability and vulnerability rankings[34]. Irreplaceability is the percentage of the global range or population of a biodiversity feature sustained by the area of analysis. Vulnerability categories refer to relative risk of extinction in the wild.

Vulnerability of biodiversity feature[35] / Irreplaceability of management unit	Critically Endangered	Endangered	Vulnerable	Near Threatened/ Least Concern	Data Deficient/ Not Evaluated
Sustaining ≥ 95% of global range/population	Extremely High Concern	Extremely High Concern	Very High Concern	High Concern	Assign to a threat level or apply precautionary principle[36]
Sustaining ≥ 10% of global range/population	Extremely High Concern	Very High Concern	High Concern	Medium Concern	
Sustaining ≥ 1% of global range/population	Very High Concern	High Concern	Medium Concern	Low Concern	
Sustaining ≥ 0.1% of global range/population	High Concern	Medium Concern	Low Concern	Low Concern	
Sustaining < 0.1% of global range/population	Medium Concern	Low Concern	Low Concern	Low Concern	

33 A simple three tier system of biodiversity conservation concern assessment in New Zealand, that grouped together sites with (for example) 10% and 99% of a species' population, would ignore a wealth of fine-scale biodiversity data available nationally, group together sites of extremely different irreplaceability and conservation concern, and provide much more limited (less well-defined) guidance to developers and decision-makers.

34 It should be noted that this table is necessarily a simplification – for example, elements of irreplaceability are intertwined in the vulnerability axis because threat assessments, such as that developed by IUCN (2001), usually consider range restriction as one element of threat. For example, about 85% of criteria under which amphibians are listed as globally threatened are B, C, or D – all of which are principally based upon irreplaceability (Stuart *et al.* 2008).

35 Vulnerability categories (e.g. Endangered) are borrowed from those used by IUCN (2001). In all cases, 'threatened species' can also refer to sub-globally threatened species, where these species are endemic to the assessment region and assessed against Red List guidelines (IUCN 2001). In practice, at least in the short-term, 'threatened ecosystems' is likely to refer to national-level classifications of threatened ecosystems.

36 Where any species/ecosystems have not been assessed using guidelines based on the IUCN Red List, the onus should be on developers to ensure screening using RAMAS Rapid List (www.ramas.com/RapidList.htm), and to ensure full assessment of species where such a process suggests they might be threatened. Where there are simply insufficient data to assign a particular threat category, the precautionary principle should be used to assign the highest likely categorisation.

Although Langhammer *et al.* (2007) provide plentiful useful and relevant guidance on issues with identifying site-based biodiversity conservation concern, (such as species' records of different age, coarse resolution data, taxonomic biases), several key technical issues are worth mentioning with regard to this biodiversity conservation concern system. First, throughout, proportions of a species' global population should be calculated based on the following hierarchy of preference: (i) population size; (ii) area of occupancy; (iii) extent of occurrence or number of known sites (these latter two options can only really be chosen among on a case by case basis). These proportions of global population should also be those sustained on a cyclical or otherwise regular basis during a species' lifecycle – this facilitates inclusion of sites important for species which are only *temporarily* geographically-restricted[37]. Proportions could also be based, particularly for marine species, on the contribution of the site as a source for the overall population[38]. Last, although no global classification of ecosystems exists, it is felt that moving to an ecosystem-based approach will offer significant advantages over the Key Biodiversity Areas approach of 'bioregionally restricted assemblages', which requires significantly more underlying data to be applied across all taxa. The onus will be on use of appropriate standardised national/regional ecosystem classifications or establishment of these where they do not currently exist. The similarity in definition of categories used for threatened ecosystems and species here implies a similar frequency distribution of global ecosystem and species range sizes.

5.2 Impact: residual impact magnitude

Key points:

- *Projects with a high severity, extent and/or duration of residual impacts might not be considered for management units with biodiversity of higher conservation concern, or might be subject to increasingly greater restrictions on, and/or standards of proof from, developers.*

The magnitude of residual impacts in a management unit should be viewed in terms of the key biodiversity features of that management unit, particularly those of highest conservation concern as identified using the above system (Table 3). Key components of impact are severity, extent and duration[39]:

37 For example, congregatory or migratory species: such sites could comprise breeding colonies or other sites used during the non-breeding season where large numbers of individuals gather at the same time (e.g. for foraging and roosting), or bottleneck sites through which significant numbers of individuals of a species pass over a concentrated period of time (e.g. during migration). It should be noted that a particular data issue exists for congregatory/migratory species which have a degree of population 'turnover' at sites. For example, surveys of a wetland on the migration route of Black-tailed Godwit *Limosa limosa* might produce maximum daily counts each year of about 15,200 birds (just over 2% of the global population; Delany and Scott 2006), but each of these counts is based on only one day. Many more godwits are likely to use the wetland over an entire migration season, which could last months. It is difficult to quantify what proportion of a species passes through an area over the course of a year, but it is clear that an area will often have much greater importance to a congregatory/migratory species than any one day count can reveal. This is particularly true for dynamic migratory staging, rather than more static non-breeding, areas. Counts of total population use of a site are, ultimately, optimal – and the reason why the prior 1% Ramsar threshold (which was not aligned in KBA criteria with other priority species such as restricted-range or threatened species) has been aligned in the system presented here.

38 For example, "the Caribbean Spiny Lobster *Panulirus argus*... occurs at some sites in the Caribbean islands that disproportionately generate the majority of settling juveniles of this species" (Langhammer *et al.* 2007).

39 Environmental impact language is extremely variable, and includes some other factors (e.g. frequency) not particularly relevant here. The terms adopted in this document are those we consider most relevant to impacts/offsets.

The severity of residual impacts to biodiversity features of a management unit
- i.e. to what degree do impacts which cannot be remedied affect key species, ecosystems or other biodiversity?
We use 'severity' to refer to how great or intense residual impacts are on biodiversity at a fixed spatial scale (for example, they may result in 50% mortality in any given hectare where they occur). Even where a development does have extensive impact on key biodiversity features – for example across 80% of a species' global range – impacts might not be of a very high severity – for example, resulting in a total loss of < 0.001% of the species' population. The greater the severity of residual impacts, the higher the actual negative effects on biodiversity features, and the higher the standards of proof that are likely to be required by regulators from developers to justify that impacts have an acceptable risk. However, in general, the severity of impacts is likely to be less relevant than the extent of impacts because severity will often be quite similar among projects and project designs (particularly related to footprint impacts, which generally have a 100% negative severity), of lower significance to biodiversity than impact extent, and quite difficult to estimate (involving predictions of future reactions of biodiversity to development).

The extent of residual impacts to biodiversity features
- i.e. what proportion of each biodiversity feature is impacted?
We use 'extent' to refer to how geographically extensive residual impacts are in relation to a given biodiversity feature (extent is thus inversely related to viability of the remaining portion of that feature). For example, development impacts might affect only a very small absolute area, but this might be a high extent of a restricted-range species global distribution, and thus potentially a very significant impact. In general, the greater the extent of residual impacts, the higher the standards of proof that are likely to be required by regulators from developers to justify that impacts have an acceptable risk. In general, the extent of impacts is likely to be quite variable among projects and project designs, of high significance to biodiversity, and relatively easy to estimate. Although increasing extent of residual impacts will in general have a progressively higher negative effect on biodiversity features, this is far from absolute: developments might potentially have high extent of impacts (e.g. residual impacts across 80% of a species' range) but have negligible effects on priority biodiversity features (e.g. because severity of impacts, such as low-level pollution, is very low). Significant opportunities exist for careful design of the location of development activities within management units to reduce or avoid the extent of residual biodiversity impacts.

Duration of residual impacts
- i.e. can offsets be implemented without time lags between impacts and offset gains?
To prevent extinction bottlenecks (e.g. Maron *et al.* 2010), and thus achieve no net loss of biodiversity, it is optimal to have no delay (time lag) between project impacts and required offset gains[40]. Time lags can be avoided via habitat or species banking. Time lags might be acceptable to some degree for (offsets of biodiversity features in) management units with biodiversity of lower conservation concern (e.g. Classes 1 and 2 in Table 4 are likely to be acceptable for most Medium Conservation Concern and Low Conservation Concern management units in Table 3), where

40 With any delay, there is a risk of extinction bottlenecks – particularly in restoration offsets, where biodiversity values are initially lost (at the development site), these values do not exist until they are restored after a relatively long period of time (at the offset site). Time lags might not appear to be an issue for averted loss offsets because biodiversity values already exist at the offset site, but gains are not really achieved until those biodiversity values are conserved until the stage in time when it is predicted that they would have been lost without the averted loss offset (i.e. under a business as usual scenario).

extinction bottlenecks are unlikely, but regulators might mandate habitat/species banking for biodiversity features at obvious risk of such bottlenecks (e.g. only Classes 3 and 4 in Table 4 are likely to be generally acceptable for management units with biodiversity of Extremely High Conservation Concern and Very High Conservation Concern in Table 3). Even when it is not considered necessary to mandate absolutely no delay, regulators might not consider it appropriate to offset biodiversity features that cannot be restored in reasonable timeframes (Morris *et al.* 2006; Treweek 2009). These timeframes should be 'reasonable' for the biodiversity features to be offset, thus shorter for – for example – species with short generation lengths and well-understood ecology than for species that are slow to reproduce or for which factors underlying breeding success are poorly understood[41]. However, timeframes should still be relevant to human policy and governance timescales. For example, Treweek *et al.* (2010) state that "In Germany... habitats which have taken more than 50 years to develop to maturity are considered not suitable for offsets (Wolfgang Wende and Holger Ohlenburg, pers. comm.)", owing to a combination of temporal loss (to almost a generation of humans) and the ecological risks of attempting re-establishment of such slow-developing habitats.

Higher severity, extent and/or duration of residual impacts pose higher risks to biodiversity, and thus are less offsetable. Projects with a high severity, extent and/or duration of residual impacts might thus not be considered for management units containing biodiversity of higher conservation concern (Table 3), or might be subject to increasingly greater restrictions on, and/or standards of proof from, developers[42]. Where several well-justified estimates exist of the severity, extent or duration of impacts, e.g. from a local community or a non-governmental organisation as well as the developer, higher estimates should be precautionarily used, unless a developer can provide a higher standard of proof for lower estimates. Non-significant residual impacts need not be offset (i.e. need not be considered under this framework) unless cumulative impacts are a problem.

5.3 Offset opportunity and offset feasibility

Key points:

- *External limits: offsets will be most feasible where biodiversity features to be offset still naturally occur in sufficient quantities near to, but outside of, the impacted management unit, and are declining fast in extent/quality or are already very degraded (and, in this latter case, can be restored);*
- *Internal limits: offsets will be most feasible where time lags are short or non-existent, offset implementers and developers have proven experience, and secure, long-term financing is in place at the outset – all factors which developers/regulators can influence to lower offset risks.*

Rather than prescribe a precise classification for what are in fact quite country-, site-, development- and developer-specific issues, at a general, globally-relevant level it is only realistic to provide guidance on key issues to be considered. At a national or sub-national level, it is possible to imagine development of a more precise framework (e.g. based on Table 4), with quantitative thresholds for categories based on societal desires and targets developed through

41 i.e. taking into account practical considerations. It should be noted, however, that ecological risks to the latter set of species are actually higher.

42 The lower predictability of indirect (or 'secondary') impacts means that a likelihood axis might also need to be introduced to account for the probability of various impacts (e.g. 'certain', 'likely', 'unlikely', etc.)

stakeholder processes – expressed in terms of 'required offset gains'. Societal desires vary in terms of, for example, overall environmental goals, geographic restriction, or acceptable timelines. Required offset gains might thus be based on principles of 'no net loss' (requiring at minimum a 1:1 offset ratio[43]) or might be based on a desire to restore degraded ecosystems (thus requiring higher offset ratios). Required offset gains could be geographically restricted to the same county, district or other political unit as impacts in order to most directly compensate local human existence or service values, or to facilitate continued ecological function. Alternatively, required offset gains could be time-restricted in relation to impacts – for example, a system of habitat or species banking might be mandated by which there is no time delay between impacts and offsets. This general guidance does not consider such local values.

5.3.1 Offset Opportunity

An assessment of offset opportunity should assess the extent to which land that can sustain impacted biodiversity features (e.g. species' populations or ecosystem types) is available to be an offset. This depends on external factors which are sometimes outside a developer's control. Key issues to consider are:

Natural distribution of the biodiversity features to be offset
- i.e. will offsets be located where affected biodiversity (requiring offsets) is naturally found?
Offsets should almost always be within the natural distribution of the biodiversity feature (as defined *a priori*). There is an assumed preference for offsets to be as near as possible to the site at which the biodiversity feature is impacted (e.g. for greater genetic similarity, owing to local human values, etc.) but this depends on the goals defined for No Net Loss in a particular situation. Very occasionally, it might be desirable to establish offsets outside of the natural distribution of the biodiversity feature, for example for a species highly threatened by invasive alien species on an offshore island or to a new climate envelope for a species with poor dispersal under climate change (e.g. Loss *et al.* 2011). However, such instances should be avoided except as an absolute last resort as they might have other, unintended consequences on the offset biodiversity feature or the area to which it is introduced (IUCN 2002). Also, reconstruction of an ecosystem type outside its natural range is very unlikely to be achievable.

Functional area of the biodiversity features to be offset
- i.e. does affected biodiversity (requiring offsets) perform any geographically-restricted functions (e.g. connectivity)?
Regardless of service values of biodiversity to humans, biodiversity features might perform ecological functions within 'functional areas' (akin to 'service areas'[44] for ecological function); geographic areas that are more restricted than their entire natural distribution (i.e. relatively 'near' to impact areas). Some ecological and evolutionary processes or functions of ecosystems might not be transferable (and thus not offsetable on a like-for-like basis). These particularly include habitat/ecological connectivity and links across gradients (ecotonal, altitudinal, etc.), which are increasingly recognised as important in facilitating ecosystem persistence and adaptation (e.g. in

43 i.e. all biodiversity features offset at equal or better levels to impacts, in terms of a combination of area and condition (or, for species, population).
44 The geographic area within which an offset can be located, determined by the type of resource being protected, any physical limitations for creating offsets, and administrative/political boundaries.

the face of climate change). For example, wetlands often cannot effectively be offset at sites remote from the impact, because the species that they support vary from place to place, and they play a particularly important role in local ecological function. In the United States, first- (and sometimes second-) order watersheds[45] are thus considered to be appropriate service areas for wetlands (albeit perhaps based more on human service values).

It might thus be desirable to *a priori* restrict offsets to within the same ecological functional area, which will generally be near the impact area. Close proximity of offset and impact areas is thus generally desirable, although offset sites should not be in close proximity to impact areas with significant risk of indirect impacts (e.g. fire, pollution, or disturbance) – they should be distant enough to avoid leakage of these impacts.

Spatial extent of offset options available for the biodiversity features to be offset
- i.e. are sufficient comparable, additional, permanent offsets available for biodiversity to be offset?
At minimum, it must be possible to produce required offset gains (see 5.3) from available habitat that is not already occupied by other, unchangeable land uses or already effectively conserved and protected[46]. This is a condition of additionality. Exact calculations of quantity of land area or species' populations necessary will depend on required offset gains and the offset methods to be used: For restoration offsets, available land of the same ecosystem type must be degraded to an extent that restoration can provide sufficient offset gains AND equal or better habitat quality[47]. For averted loss offsets[48], available land of the same ecosystem type or populations of the same species must be declining fast enough in extent and/or quality that conservation can provide sufficient offset gains. This is what von Hase and Stephens (2010a) and BBOP (2011b) highlight as the opportunity of vulnerability: offsets of highly vulnerable biodiversity features, although having higher risks than offsets of lower vulnerability features, are likely to have more spatial options for offsets (see Figure 3). Few spatial opportunities exist for offsets of highly irreplaceable biodiversity (Ferrier *et al.* 2000), particularly when it is also under low threat (low vulnerability – e.g. because what little remains is all securely protected and fully managed). However, risks increase with both irreplaceability and vulnerability. Offsets are of least relevance as a strategy for biodiversity of low irreplaceability and low vulnerability (approximating to a 'lower threshold' for offsets). Thus, offsets will generally be most feasible and relevant for biodiversity features of low irreplaceability and moderate vulnerability. In areas of extreme and ongoing habitat loss it might potentially only be necessary to offset little more than the same area of land with an averted loss offset – as long as some temporal loss of biodiversity is acceptable (see duration of delays in Section 5.2) and there is high confidence that high rates of habitat loss/degradation can actually be countered (a difficult prospect in many areas). Conversely, in areas with little ongoing habitat loss, it might be necessary to restore much greater areas of land to produce gains in habitats or species' populations equivalent to residual impacts.

45 A small stream that has no tributaries is a first-order stream; it drains a first-order watershed. Two or more first-order streams combine to form a second-order stream draining a second-order watershed (the aggregate of all the first-order watersheds contributing to the stream).

46 For example, in planned offset sites, legal obstacles such as land tenure, land use zoning or easements do not prevent establishment and management of offsets.

47 In order to prevent trading down. 'Equal or better habitat quality' should be judged by context, and could include issues such as spatial clumping or connectivity of habitat patches.

48 Including those classified by BBOP as 'averted risk' and 'arrested degradation', versus 'restoration offsets' which here include those classified by BBOP as 'restoration' and 'reconstruction': http://bbop.forest-trends.org/guidelines/glossary.pdf

The natural distribution, functional area, and quantity of biodiversity features to be offset all provide external limits to the practicality of an offset. Offsets will be most feasible where biodiversity features to be offset still naturally occur in sufficient quantities near to, but outside of, the impacted management unit, and – at a regional level – are declining fast in extent/quality (although, again, countering high rates of habitat loss/degradation can be a difficult prospect in many areas) or are already very degraded (and possible to restore); Figure 3.

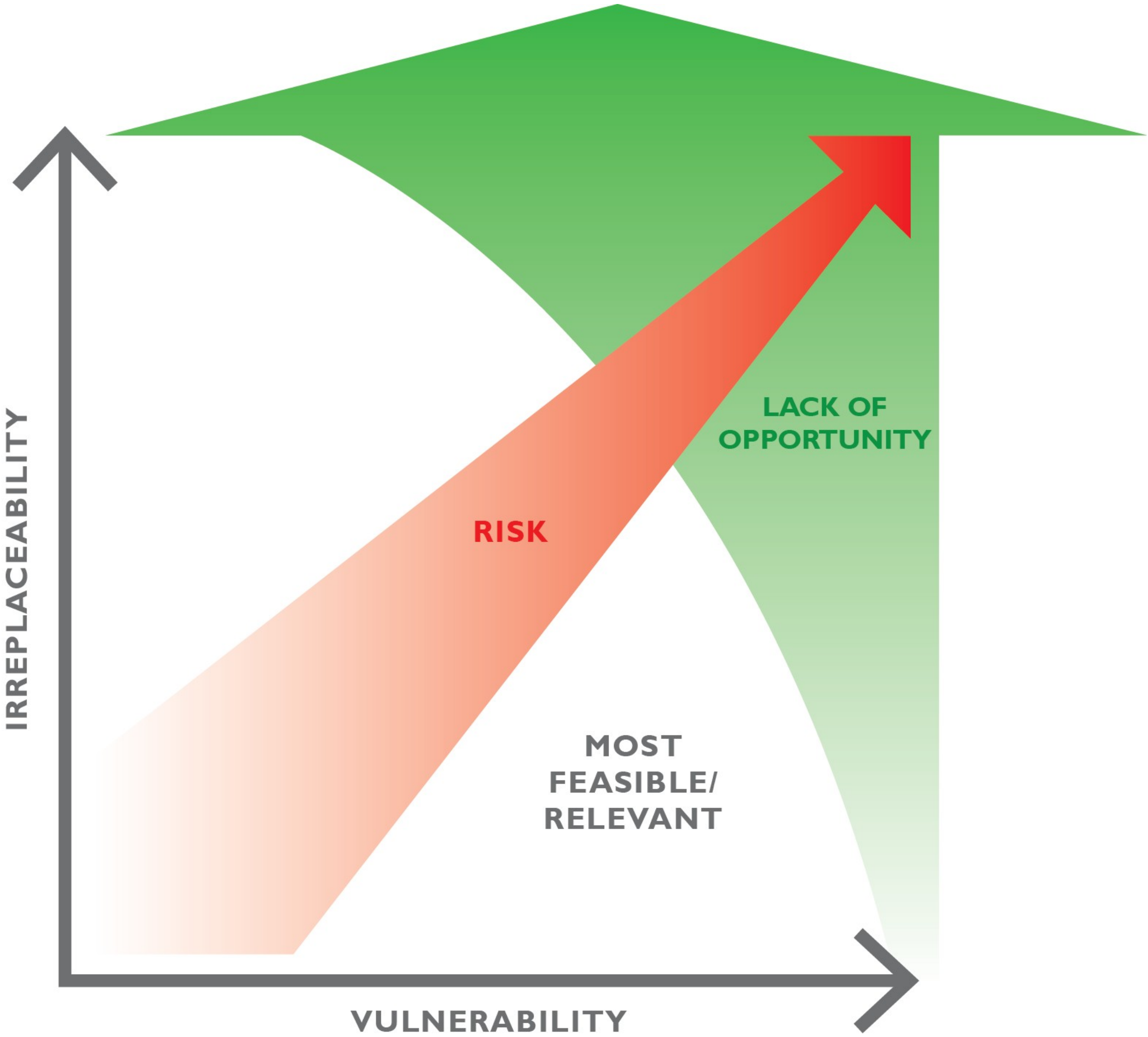


Figure 3. The conceptual relationship between vulnerability, irreplaceability, risk and opportunity. *Risk increases when biodiversity is more irreplaceable and/or vulnerable; opportunity is greatest when biodiversity is highly vulnerable but of limited irreplaceability (few options for offsetting exist where biodiversity has been little depleted and is well protected); thus offsets will generally be most feasible and relevant for biodiversity features of low irreplaceability and moderate vulnerability.*

5.3.2 Offset Feasibility

Assessment of the practical feasibility of offsets should include temporal, technical, capacity and financial considerations. These are all largely internal factors, within a developer's control, and thus improvements can be requested by regulators before developments proceed. Key issues to consider are:

Confidence in offset delivery techniques
- i.e. how likely are offset methods (e.g. restoration or conservation) to lead to required biodiversity gains?
The degree to which predicted offset gains are likely to be produced is in part a function of the degree to which relevant offset techniques (e.g. of conservation, protection, or restoration) have been accepted and proven to be successful. For less accepted or proven techniques regulators are likely to require higher standards of proof from developers (e.g. through further piloting of techniques) and might mandate insurance or bonds to cope with uncertainty and risks of offset failure (Burgin 2008). For example, because restoration is *per se* often less successful than conservation/protection, Victoria State allows progressively smaller proportions of restoration within habitats of higher conservation significance. An important issue to be considered (as with all conservation efforts) is leakage under different offset techniques – for example, cessation of stock grazing might be a useful conservation method, but where will stock be pastured instead? Removal of invasive plants is often positive for conservation, but might lead to spread of invasive mammals to adjacent areas. Also, incorporation into a protected areas system might not be entirely successful if – as is usually the case – illegal uses cannot be wholly prevented.

Offset implementation capacity
- i.e. are offset implementers likely to do a good job?
The degree to which offset implementers are likely to succeed in producing predicted offset gains is largely determined by the degree to which they have capacity and proven, positive experience in relevant offset techniques (e.g. conservation, protection, or restoration) at a relevant scale. Regulators might require implementers with lower capacity or less (or more negative) experience to build in project support to higher regulatory supervision and provide greater ratios of offsets (via mandated multipliers) to allow for risks of failure. Even where required offset gains have already been produced through habitat or species banking, questions will remain as to whether the offset implementer is able to maintain these gains over time. This is, in part, a question of financing (discussed below), but also of provision for monitoring and reporting, which will be optimal if carried out by an independent third party – preferably including regulatory authorities[49].

Developer capacity
- i.e. are developers likely to do a good job?
The degree to which developers pose a threat to the sites beyond predicted residual impacts is largely determined by the degree to which they have capacity and proven, positive experience in similar types and scales of developments as those proposed. Developers with lower capacity or less (or more negative) experience might be refused permission by regulators to conduct

49 Necessarily, regulators might not have existing capacity to monitor offsets, so might wish to build requirements into legislation for offset implementation to include funding for periodic regulatory monitoring by relevant authorities.

developments at management units with biodiversity of higher conservation concern, or might only be permitted to do so with additional precautionary measures. Developer capacity and experience are, for example, key compliance considerations for IFC (2012).

Financing

- i.e. is sufficient funding secured for the offset duration?

Greater confidence in offset success will occur where a financial mechanism (a sound costed business plan, endowment fund, etc.) for achievement, long-term management and long-term monitoring of required offset gains is in place before project impacts take place. Regulators are likely to stipulate what financial mechanisms must be in place at what stages in the development and offset process. For example, the offset needs to be secure in the case of divestment, if the development is less profitable than anticipated, or even if the developer and/or offset implementer goes into receivership (Teresa 2008).

The certainty of offset techniques, offset implementer and developer capacity, and financing are all internal limits to the practicality of an offset. They are thus all factors which developers (and regulators) can influence in order to lower offset risks. Offsets will be most feasible where offset implementers and developers have proven experience, and secure, long-term financing is in place at the outset, and – from a policy standpoint – where there are real, substantially-sized penalties for non-achievement.

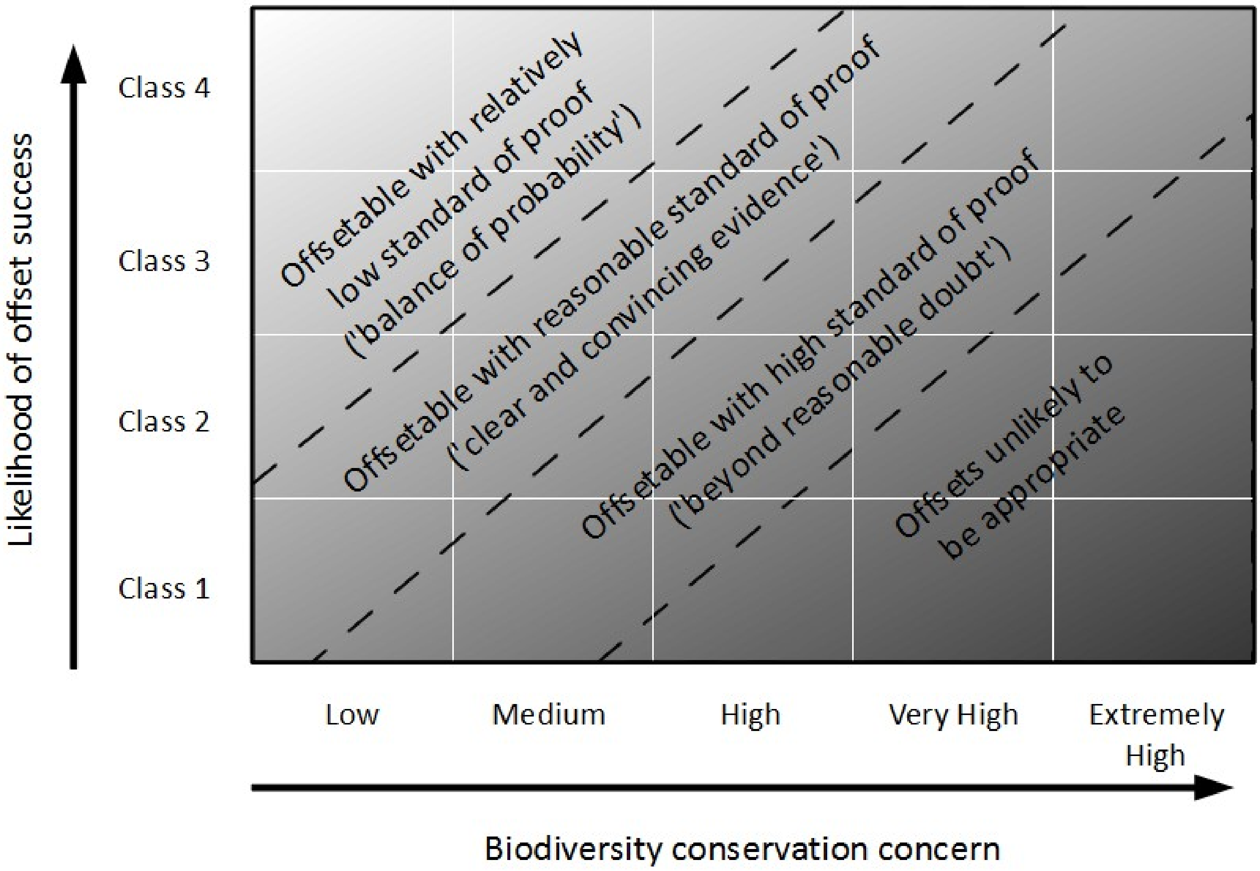
Table 4. Example system for assessing the likelihood that project impacts can be successfully offset on the basis of residual impact magnitude, offset opportunity (availability of areas for offsetting), and feasibility (as indicated by offset planning, budget provision and capacity). Subjective terms (e.g. 'major') will need clear definition in applied frameworks. Overall likelihood of success is indicated by the lowest category for which a project is ranked on any table row. 'Success' relates to whether particular no net loss targets can be achieved, and thus implicitly and importantly requires consideration of whether unaffected portions of affected biodiversity features remain viable after impacts

Issue	Sub-issue	Criterion	Class 1 (lowest likelihood)	Class 2	Class 3	Class 4 (highest likelihood)
Residual Impact Magnitude	Severity	Declines of each biodiversity feature at a set spatial scale (e.g. per square kilometre)	Severe	Major	Minor	Very limited (but still significant)
	Extent	Proportion of range/population of each biodiversity feature impacted	Majority	Large	Small	Very small (but still significant)
	Duration	Time after impacts until offset gains replace affected biodiversity, relative to viability	Long-term	Medium-term	Short-term	Gains prior to impacts
Offset Opportunity	Spatial	Potential for restoring affected biodiversity functions elsewhere	None	Possible	Possible	Possible
		Area available for offset within natural range	Limited	Limited	Reasonable	Much
		For restoration offsets, restorable condition compared to impacted area	Worse	Worse	Equal or Better	Better
		For averted loss offsets, landscape-level condition of affected biodiversity	At or near original; increasing	Good; decreasing	Reasonable; decreasing rapidly	Poor; decreasing rapidly
Offset Feasibility	Technical	Availability of proven relevant methods for restoration, protection, etc.	No proven methods	Few proven methods	Some proven methods	Many proven methods
		Adequacy of long-term offset implementation plans	Inadequate	Credible plan exists	Credible plan exists	Credible plan exists
		Adequacy of long-term offset monitoring plans	None	Lacking detail	Adequate	Excellent
	Financial	Funding for long-term offset implementation	Post-impacts	Post-impacts	Some pre-impacts	Fully pre-impacts
		Funding for long-term offset monitoring	None	Inadequate	Lacks funding for independent input	Includes funding for independent input
	Capacity	Experience of offset implementer in relevant methods at necessary scale	None or significantly negative	Limited	Some	Extensive, largely positive
		Experience of developer in correctly predicting environmental impacts and risks in similar projects	None	Limited	Some	Extensive

5.4 Combining biodiversity conservation concern, residual impact magnitude, and offset opportunity/feasibility in a burden of proof framework

A burden of proof framework (Figure 4) is used to combine previous assessment of the level of biodiversity conservation concern of the management site (Table 3), residual impact magnitude, offset opportunity and offset feasibility (Table 4). Offsets might not be necessary for biodiversity features that are rapidly expanding, resilient, and secure – with impacts that have negligible effects on this expansion – but such a 'lower threshold to offsetability' is not discussed further here. Offsets might not be appropriate for most management units with biodiversity of Extremely High Conservation Concern or, more practically, where key (perhaps non-biological) issues mean that offsets have a low likelihood of success (a 'higher limit to offsetability'). In other cases, offsets might be undertaken for management units with biodiversity of higher conservation concern with higher standards of proof and/or where likelihood of offset success make offsets easier (e.g. where impacts are low, offset opportunity is high, and offset feasibility is high). This framework should be iteratively applied during project design as information on impacts and offsets improves.

Figure 4. Burden of proof conceptualisation of offsetability, combining biodiversity conservation concern and likelihood of offset success[50]. Offsets might only be appropriate for areas with biodiversity of highest conservation concern where the likelihood of offset success is highest. Offsets with the lowest likelihood of success are only appropriate for areas with biodiversity of medium and low conservation concern. A practical framework may thus, e.g., view offsets as unlikely to be appropriate for: Class 1 likelihood of offset success for areas of High, Very High and Extremely High conservation concern; Class 2 for Very High and Extremely High concern; and Class 3 for Extremely High concern.



50 The normal standard of proof in Civil Law (including environmental law) in most countries is 'balance of probability'. Criminal Law usually requires the higher standard of 'beyond reasonable doubt'.

6. Application of a general offsetability framework to the New Zealand context

6.1 Tailoring the general offsetability framework to a national context

The general framework presented in Section 5 can be used 'as is' in a national or sub-national setting but, where good country- or region-specific data and classifications exist, would be better tailored to – and given greater detail for – local circumstances. Such tailoring enables congruence with national or sub-national policy and legislation, and facilitates reflection of established societal values. National or sub-national level values are generally more fine-scale than global values, and so the general framework should be viewed as a 'minimum standard'. For example, to take an example of species threat classification, Grey-headed Albatross (also known as the Grey-headed mollymawk) *Thalassarche chrysostoma* is globally classified as Vulnerable but listed in New Zealand as Nationally Critical owing to its small and fast-declining population in the country (Miskelly *et al.* 2008): this finer-scale approach than global simply reflects an understandable desire to avoid national extirpations as well as global extinctions. Conversely, the Critically Endangered Spoon-billed Sandpiper *Eurynorhynchus pygmaeus* is not listed as threatened in Vietnam (part of its winter range): this coarser-scale approach than global is not advisable as it will raise extinction risks.

6.1.1 Taxonomic definition, vulnerability and irreplaceability

Key points:

In New Zealand: Nationally-threatened species can essentially be substituted for globally-threatened species;

Further consideration is necessary for incorporation of non-endemic species, and nationally-threatened subspecies or populations.

The New Zealand system for classifying taxa according to threat of extinction (Townsend *et al.* 2008) is intended to complement the global perspective provided by the IUCN Red List (IUCN 2010). It is focussed at the national level, and provides a more sensitive classification for taxa with naturally restricted distributions and small numbers as a result of the insular rarity prevailing in the country. The core threatened categories comprise, in decreasing order of importance, 'Nationally Critical', 'Nationally Endangered' and 'Nationally Vulnerable'. Below these, At Risk (akin to the IUCN classification 'Near Threatened') categories comprise 'Declining', 'Recovering', 'Relict' and 'Naturally Uncommon'. As with the IUCN Red List, primary criteria for assessing the threat status of taxa are population trend and total number of mature individuals, augmented by secondary criteria related to the number and size of sub-populations and area of occupancy.

For taxa endemic to New Zealand, the New Zealand system is well suited as a threat classification, and nationally threatened species could readily be used for the corresponding threatened species levels in Table 3. This will, however, weight the threat of national extirpation at a similar level to the threat of global extinction. For example, as mentioned above, Grey-headed Albatross is globally considered Vulnerable but listed in New Zealand as Nationally Critical owing to its small and fast-declining population in the country. Equal categories for globally and nationally threatened species are not problematic as long as legislation for threatened, non-endemic taxa does not compromise legislation for threatened endemic or globally threatened taxa, for example owing to high transaction costs of government or judicial involvement which could lead to the country having insufficient resources to tackle both global and national priorities. If such compromises might occur, from a global extinction-risk perspective we would advise using higher thresholds for categories for threatened, but non-endemic, taxa than for threatened endemic or globally threatened taxa. Nationally At Risk species could, if desired, also be incorporated into the offsetability framework, but necessarily with higher thresholds for categories that reflect their considerably lower vulnerability. The proposed national policy statement on indigenous biodiversity suggests incorporation of At Risk species into a definition of significant biodiversity, and so At Risk species are here included within the lowest conservation concern level alongside non-threatened species (this does not mean that impacts on a high proportion of an At Risk species' range/population would be considered Low Risk, as shown in Table 5).

One potential issue with the New Zealand extinction-threat classification system for taxa is that some species are listed under various threat classifications according to their subspecies, while other species have no subspecies and so are only listed once. Incorporation of this system directly in the general framework would result in species being given greater consideration according to the number of subspecies they have since (i) they would be considered more times, owing to more listings, and (ii) they would generally be considered at higher conservation concern levels, owing to higher intrinsic risk to smaller populations. If New Zealand places societal value on all listed species and subspecies, and has resources to tackle subspecies conservation without compromising the survival of species, this is not a problem. If this is not the case, this issue could be partially resolved by only incorporating species, with species with multiple subspecies incorporated at the threat level of their least threatened subspecies[51]. Goal 3 of the 2000 *New Zealand Biodiversity Strategy* refers to maintaining and restoring "viable populations of all indigenous species and subspecies across their natural range", and thus suggests that society nationally does, at minimum, value all subspecies.

6.1.2 Ecosystem definition, vulnerability and irreplaceability

Key points:

In New Zealand: It is a priority to finalise a spatially-explicit national (terrestrial, freshwater and marine) ecosystem classification;

Such a classification must allow practical biodiversity offsetting, enable accurate assessment of irreplaceability, and prevent inappropriate exchanges of dissimilar biodiversity;

National 'historically rare' or 'naturally uncommon' (restricted-range) ecosystems are those likely to be of most conservation concern owing to their irreplaceability.

New Zealand does not have a standardised national ecosystem classification in use at present, other than the little-developed and rarely-used Atkinson vegetation classification system (e.g. Atkinson and Blaschke 1991), which has not been spatially-applied. A number of other

51 The threat level of the least threatened subspecies being the most indicative of the threat status of the species as a whole.

classification systems, dealing with particular New Zealand geography or biomes, are reviewed by Singers and Rogers (in prep.) but are likewise unsuitable. A spatially-explicit classification system would need to be in place before biodiversity offsets could be soundly planned. Such a system would be based on abiotic data (e.g. on soils, geology and climate) plus biotic data, often at the level of land cover classes for terrestrial systems (e.g. sub-alpine shrubland, matagouri, manuka/kanuka). Such land cover classes would normally be derived from remote sensing, refined by ground-truthing surveys. The current New Zealand land cover database is too coarse for the purpose of biodiversity offsetting, having only just over 20 native land classes.

The classification system developed by Leathwick *et al.* (2003a, b) for Land Environments of New Zealand (LENZ) is a robust and widely accepted classification but only deals with abiotic (not biotic) factors. Similar abiotic classification systems have been developed for river (Snelder *et al.* 2004; Leathwick *et al.* 2007) and marine (Snelder *et al.* 2005) environments in New Zealand. Aspects of these environment classifications could be incorporated into a standardised national ecosystem classification[52]. These environment classifications cannot, however, be simply directly overlaid with biotic data to produce an ecosystem classification, as this would produce a classification that was disproportionately fine-scale for early seral habitats (e.g. fire-induced manuka/kanuka shrublands), which tend to be quite similar across different environments.

Ecosystem classification can occur at many scales, and it will be important to strike a balance between enabling practical biodiversity offsetting (tending to coarser scales) and preventing inappropriate exchanges of dissimilar biodiversity or enabling accurate assessment of irreplaceability (tending to finer scales). This balance will vary with societal values, ecological context and social settings. It is worth noting that South Africa, one of the most advanced countries with regard to biodiversity offsets, uses a national ecosystem classification of 437 vegetation types as the basis for offsetting. Given that South Africa is almost five times the size of New Zealand, from a purely practical level this closely approximates to the scale of LENZ level II (100 environments). However, it has been shown that the most appropriate LENZ scale for depicting biodiversity pattern, reflecting patterns of past clearance, and relating to people's uses and perceptions of the landscape is level IV (Walker *et al.* 2008b). Trade offs will occur: while a fine scale (such as that of LENZ level IV) will most accurately reflect biodiversity pattern, it will also reduce the feasibility of offsets – a practical balance should be found. Final decision on the most appropriate national ecosystem classification level should also take into account decisions made on appropriate taxonomic units (Section 6.1.1). If ecosystems are identified that are, in general, as widely distributed as the taxonomic units, then similar thresholds for categories to the general framework can be used. If finer-scale ecosystems are identified, as seems likely, higher thresholds for categories for vulnerability and irreplaceability would probably be desirable.

Singers and Rogers (in prep.) propose a subjective standardised national ecosystem classification based on abiotic and biotic factors, with a conceptual distinction between zonal and azonal ecosystems – a distinction which avoids the problem of disproportionately finely separating early seral habitats. In total, they define 149 (57 zonal, 92 azonal) ecosystems. Bearing in mind the scale of peoples' use and perceptions of the landscape (above), this classification might be sufficiently detailed for forest ecosystems but not for some non-forest (e.g. alpine) ecosystems (G. Rogers *in*

52 i.e. a classification that combines abiotic and biotic factors.

litt. 2012). Singers and Rogers recognise that their subjective system is a first attempt and will inevitably be refined – and transition to a more quantitative classification – over time. This need for refinement and improvement over time will always be the case with any environmental classification and is already taking place through trial of the draft classification by the site optimisation unit of the Natural Heritage Management System of DoC. More critical are the needs to make the classification spatially explicit through mapping across New Zealand and to extend the classification to freshwater and marine realms. The ecosystem classification that they propose contains a practical number of ecosystems for offsetting, but further investigation will be necessary to clarify whether it is ideally suited – particularly whether it sufficiently reflects stakeholder perceptions of the landscape and whether it defines ecosystems that are generally as widely distributed as the taxonomic units to be used in a national offset scheme. In addition, for the purposes of offsetting, it will be crucial to understand varying vulnerability and irreplaceability of ecosystems within this classification – or indeed any other classification that is ultimately developed.

The most developed ecosystem vulnerability framework in New Zealand has been developed by Walker *et al.* (2005, 2006). These authors propose a system for classifying New Zealand's terrestrial environments according to threat, based on LENZ level IV. Five categories were defined on the basis of past habitat loss and current legal protection and comprise, in decreasing order of threat, 'Acutely Threatened' (<10% indigenous cover remaining), 'Chronically Threatened' (10–20% cover remaining), 'At Risk' (20–30% cover remaining), 'Critically Underprotected' (>30% cover remaining, <10% legally protected), and 'Underprotected' (>30% cover remaining, 10–20% protected). All other environments are considered less reduced and better protected. In addition to being based solely on environments, rather than ecosystems, this classification system differs significantly from that of Rodriguez *et al.* (2011) in primarily basing threat on *proportion* of total decline to date (rather than *rate* of past/current/future decline), not incorporating total distribution, and in incorporating level of protection for the latter three categories. Nonetheless, Acutely Threatened, Chronically Threatened and At Risk environments have a lot of overlaps with Critically Endangered, Endangered and Vulnerable categories developed by Rodriguez *et al.* (2011) for globally threatened ecosystems. A similar threat classification scheme for ecosystems (once finalised in New Zealand) could potentially be used in place of globally threatened ecosystems in the general framework. Critically Underprotected and Underprotected ecosystems would present the greatest opportunities for offsets owing to the prevalence of unprotected areas suitable for averted loss offsets[53]. Other threatened ecosystems would also present opportunities for averted loss (Figure 3), but would have less available offset options.

Two national assessments highlight ecosystems which are most likely to rank higher on the irreplaceability axis of the biodiversity conservation concern categories system, by identifying restricted-range ecosystems in New Zealand:
(i) Williams *et al.* (2007) identified 72 'historically rare terrestrial ecosystems' (an early draft of 43 'originally rare ecosystems' from this analysis was included in Ministry for the Environment 2007) of less than 1,340 km^2 in extent (0.5% of New Zealand's land area);

53 and restoration offsets, but averted loss offsets can – by their nature – only occur in under-protected ecosystems, i.e. those declining in quantity/quality.

(ii) a recent proposed national policy statement on indigenous biodiversity[54] identifies 35 'naturally uncommon ecosystems', largely a subset of the historically rare terrestrial ecosystems.
Both of these classifications have merit, but are problematic in practice without being nested within a standardised national ecosystem classification. Once a full standardised ecosystem classification is completed for New Zealand, it will facilitate standardised identification of naturally restricted-range ecosystems.

6.1.3 Risk versus impact/effect in New Zealand legislation

Key point:

- *In order to fit with current New Zealand legislation, a national offsetability framework needs to be focused on residual impacts through removal of consideration of potential risks.*

National legislation globally varies in treatment of risk (the possibility/probability of something happening) and impact (the result of something happening). As explained in Section 5.1, incorporation of overall risks of secondary and cumulative impacts is generally preferable. Focusing legislation solely on predicted impact areas on a project-by-project basis can produce perverse incentives to stage developments into several different applications, each of low impact but cumulatively of high impact. Further, focusing solely on predicted impact areas can mean that indirect (or 'secondary') impacts on neighbouring areas are insufficiently considered. Owing to varying treatment globally and issues with restricting offsets legislation solely to impacts, versus risks, the general offsetability framework was developed on a precautionary basis to include all potential risks.

The New Zealand Resource Management Act requires reduction of all significant risks (e.g. accidental fire, oil spills) to negligible levels as part of preventative mitigation (contingency and risk management plans). It does so in stipulating a “duty to avoid, remedy, or mitigate any adverse effect on the environment”, defining 'effect' as including “any potential effect of high probability” and “any potential effect of low probability which has a high potential impact”, and – for significant biodiversity – requiring statutory agencies to not consent damage or require maximal redress with compensation and mitigation. Thus, national legislation considers only potential or actual residual impacts under requirements for compensation (offsets). In view of this, adaptation of the general offsetability framework to New Zealand requires focusing on residual impacts by removal of consideration of potential risks. This would require lowering of thresholds for categories within any nationally-specific version of Table 3 of the general framework (in order to have similar relevance) and removal of severity/extent/duration of residual impacts in any nationally-specific version of Table 4.

54 http://www.mfe.govt.nz/publications/biodiversity/indigenous-biodiversity/index.html

6.1.4 A system of biodiversity concern categories for assessing risk of undertaking offsets in New Zealand

Key points:

- *At minimum, all significant biodiversity, as defined by the proposed national policy statement, should be offset (i.e. this framework is required);*
- *Regulators might require relatively low standards of proof for offsets for management units with only biodiversity of Low Conservation Concern;*
- *Regulators might wish to avoid offsets for management units with Extremely High Conservation Concern biodiversity, and possibly those with Very High Conservation Concern biodiversity.*

A tailored system of biodiversity conservation concern categories for New Zealand might thus look similar to Table 5, and would then be integrated with an analysis of practical issues (akin to Table 4) to produce an overall burden of proof framework (akin to Figure 4). As a result of focusing on residual impacts (smaller than potential risks), thresholds for categories within Table 5 have been lowered (i.e. the 95% threshold removed from Table 2) in order to have similar relevance. It should be noted that this lowering of thresholds, and removal of severity/extent/duration of residual impacts in any nationally-specific version of Table 4, would necessitate revision of any nationally-specific version of Figure 4 in order to ensure that the burdens of proof relating to 'biodiversity conservation concern' and 'likelihood of offset success' remain appropriate.

In this national context, management units with biodiversity of Extremely High Conservation Concern (and some with Very High Conservation Concern biodiversity) might well be considered non-offsetable because they represent “a non-negligible proportion of what remains of their type” or are “now so rare or reduced that there are few options or opportunities for delivering the offset”. This follows principles outlined in the proposed national policy statement on indigenous biodiversity: “For the avoidance of doubt, in accordance with the principles of Schedule 2, there are limits to what can be offset because some vegetation or habitat and associated ecosystems, is vulnerable or irreplaceable. In such circumstances off-setting will not be possible and local authorities will need to take full account of residual adverse effects in decision-making processes.” It should be noted that sites with biodiversity of Extremely High Conservation Concern are intrinsically extremely rare, and this situation will not be common.

It is worth revisiting here Norton's (2009) suggestion that biodiversity offsets might not be appropriate for areas with “the presence of species listed as nationally threatened or of habitats that have less than a particular percentage of their total area remaining (e.g., <10%)”. This seems unnecessarily precautionary as it would effectively rule out biodiversity offsets in the first three columns of Table 5 owing to presence of threatened species (and, in the first column, owing to presence of Acutely Threatened ecosystems. Biodiversity offsets can, however, be implemented with relatively low risk in some areas with threatened species or Acutely threatened ecosystems, as Table 5 demonstrates.

Just as there are upper limits to acceptable risks for society, beyond which regulators might not wish to allow offsetting (e.g. perhaps excluding management units with biodiversity of Extremely

High Conservation Concern and Very High Conservation Concern), there are lower limits or levels of risk which might not be considered important enough to trigger offsetting requirements. Management units with biodiversity of Low Conservation Concern could be viewed as the lower threshold for offsetting, at which offsets might not be required, but some regulators (likely including those in New Zealand, given current national policy) might wish to require offsets for all residual impacts on biodiversity that could be considered to some degree vulnerable or irreplaceable, in order to make progress toward the national goal to halt biodiversity decline by implementing a national no net loss policy. At maximum, a lower limit in New Zealand has been circumscribed by the term 'significant' within the 1991 Resource Management Act, which requires statutory agencies to recognise and provide for the protection of “areas of significant indigenous vegetation and significant habitats of indigenous fauna” – e.g. by not consenting damage or requiring maximal redress with compensation and mitigation. Thus all 'significant' biodiversity must be avoided or offset[55]. The term 'significant' was not defined in the Resource Management Act, and so there has been some debate on how best to define it in order to provide agencies with guidance (Norton and Roper-Lindsay 2004, 2008; Walker *et al.* 2008a). The recent proposed national policy statement on indigenous biodiversity reiterates the attempt in *Protecting Our Places* to provide guidance, by defining significant areas as including at minimum: (i) naturally uncommon ecosystems (as listed in Schedule One of the statement); (ii) indigenous vegetation/habitats associated with sand dunes; (iii) indigenous vegetation/habitats associated with wetlands; (iv) Acutely and Chronically Threatened LENZ IV land environments; and (v) habitats of threatened and At Risk species. This minimum set is quite similar to management units with biodiversity of Low Conservation Concern in the illustrative biodiversity conservation concern system adapted for New Zealand from the general system (Table 5). It is more inclusive in some ways (notably including even tiny fragments of uncommon and threatened ecosystems or species' populations, and including At Risk species) and less in others (notably not incorporating At Risk ecosystems). In conclusion, the proposed national policy statement definition of significance – particularly if amended to include At Risk ecosystems – could be used as a coarse filter to assess whether this framework need actually be used.

The spatial scale of Table 5 is at the scale of the extent of the biodiversity feature globally, though this would be *de facto* nationally for almost all biodiversity features in New Zealand since national-level threat classifications are used for species and ecosystems[56].

55 This is not to say that non-significant biodiversity need not be offset. Indeed, several legal decisions make it clear that this is not the case in New Zealand (T. Stephens *in litt.* 2011).

56 Hypothetically, however, there could be examples such as a non-threatened congregatory seabird which has 10% of its global population in New Zealand: a management unit with 9% of the national population would be ranked at irreplaceability level four as this is 0.9% of the global population.

Table 5. An illustrative system for categorising biodiversity conservation concern, tailored to New Zealand. *This system would have to be reviewed, and potentially considerably altered, through a stakeholder process nationally (particularly with regard to the quantitative thresholds for categories).*

Vulnerability of impacted biodiversity feature / Irreplaceability of range/ population impacted	**Globally or Nationally Critically Endangered taxa; Acutely Threatened ecosystems**	**Globally or Nationally Endangered taxa; Chronically Threatened ecosystems**	**Globally or Nationally Vulnerable taxa; At Risk ecosystems**	**Nationally At Risk or non-threatened taxa; Critically Underprotected, Underprotected or non-threatened ecosystems**	**Globally or Nationally Data Deficient or Not Evaluated**
≥ 10% of global range/population	Extremely High Concern	Extremely High Concern	Very High Concern	High Concern	Assign to a threat level or apply precautionary principle[57]
≥ 1% of global range/population	Extremely High Concern	Very High Concern	High Concern	Medium Concern	
≥ 0.1% of global range/population	Very High Concern	High Concern	Medium Concern	Low Concern	
< 0.1% of global range/population	High Concern	Medium Concern	Low Concern	Low Concern	

6.1.5 Residual impacts, offset opportunity and offset feasibility

Key points:

In New Zealand: The general offsetability framework aligns closely with the proposed national policy statement on indigenous biodiversity, and little adaptation would thus be necessary to fit the framework to a national context;
Ecological districts provide a suitable foundation for functional areas.

While it is largely beyond the remit of this report to recommend particular country-specific guidance on impacts, offset opportunity, offset feasibility and lower thresholds for offsetting, it should be noted that the proposed national policy statement on indigenous biodiversity lists other conditions (not detailed under Section 6.1) as potentially non-offsetable. These also relate to elements of the general framework, namely if management units are:

"securely protected and in good condition so there is little opportunity to offset the biodiversity components in a reciprocal manner" (relates to Offset Opportunity: Quantity of offset options; Section 5.3.1); or

"threatened by factors that cannot be addressed by the available expertise" (relates to Offset Feasibility: Offset implementer capacity; Section 5.3.2).

The spirit is thus similar to that proposed in the general offsetability framework, but the national policy statement has less detail on specific levels of acceptability for impacts, offset opportunity and offset feasibility. In addition, the proposed national policy statement states that offset design will demonstrate that:

"management arrangements, legal arrangements (eg, covenants) and financial arrangements (eg, bonds) are in place that allow the offset to endure as long as the effects of the activity, and preferably in perpetuity" (relates to Offset Feasibility: Financing; Section 5.3.2);

"a biodiversity offset management plan... contains specific, measurable and time-bound targets for the biodiversity offset; predicts when no net loss/net gain will be achieved"(relates to Residual impacts: Duration of residual impacts; Section 5.2).

It can thus be seen that the proposed national policy statement already aligns closely with the general framework proposed in Section 5, and little adaptation would be required to adopt this at a national level.

With regard to 'functional areas' (see Section 5.3.1 on offset opportunity), LENZ III or IV environments could perform this function but are non-contiguous areas. Ecological regions or districts, defined as contiguous areas (McEwen 1987), could be the most appropriate functional areas. There are 268 ecological districts in 85 ecological regions in New Zealand. Whether

57 Where any species/ecosystems have not been assessed using guidelines based on the national or IUCN Red Lists, the onus should be on developers to ensure screening using RAMAS Rapid List (www.ramas.com/RapidList.htm) or other nationally-appropriate methods, and to ensure full assessment of species where such a process suggests they might be threatened. Where there are simply insufficient data to assign a particular threat category, the precautionary principle should be used to assign the highest likely categorisation.

ecological regions or districts are most appropriate would depend on a consideration of how much ecological function would be retained by offsetting within large ecological regions versus small ecological districts (likewise, if LENZ is used to define functional areas). Societal desire to offset biodiversity near to impacts on biodiversity, regardless of ecological function, could well lead to a choice of finer-scale, ecological districts as functional areas (these would be more comparable with the scale of first- and second-order watersheds used as service areas for wetland offsets in the United States).

6.2 Application of the general offsetability framework to New Zealand case studies

The general offsetability framework presented in Section 5 is applicable at a global level. It thus makes several assumptions which are not likely to be applicable or desirable at a national level. For example, it assumes that nationally rare, but globally common, biodiversity is not a conservation priority for stakeholders in a given country. Nonetheless, during its development it was instructive to apply it to several national case studies, with some potential national adjustments as suggested in Section 6.1. A series of case studies was presented alongside an earlier version of the framework. Although only loosely based on these real-world case studies, and rather lacking in data, these case studies illustrated the power of the biodiversity conservation concern categorisation in successfully separating the case study management units into varying levels of concern, from Low to Extremely High.

6.3 Implications for the New Zealand National Biodiversity Strategy/Protecting our Places

Key points:

- *An adapted, nationally-relevant offsetability framework offers high potential to support the national biodiversity strategy and priorities, particularly if multipliers are carefully integrated to support policy goals.*

The 2000 New Zealand Biodiversity Strategy lays out four goals for conserving and sustainably managing New Zealand's biodiversity, of which the most relevant here is “Goal 3: Halt the decline in New Zealand's indigenous biodiversity”. This includes maintaining and restoring remaining natural habitats and ecosystems to a healthy functioning state, enhancing critically scarce habitats, and maintaining and restoring viable populations of all indigenous species and subspecies across their natural range. Biodiversity offsets as a strategy align strongly with Principle Seven of the biodiversity strategy (“Internalising Environmental Costs”) - i.e. that “[w]here an activity imposes adverse effects on biodiversity, the costs of mitigating or remedying those impacts should be borne by those benefiting from the activity”. The general framework outlined above also has relevance to Principle Six (“Recognise Variable Capacity to Respond”) in that it recognises the variable capacity of offset implementers to develop and manage biodiversity offsets (Section 5.3.2) and to Principle Eight (“In situ Conservation”) in that it prioritises conservation within the natural ranges of biodiversity features, to the extent of favouring local 'functional areas' where ecological function is likely to best be maintained (Section 5.3.1).

The key desired outcomes in the biodiversity strategy include preventing further human-induced extinctions, making a net gain in the extent and condition of land habitats and ecosystems important for indigenous biodiversity, maintaining the extent and condition of freshwater habitats and ecosystems, and maintaining marine habitats and ecosystems in a healthy, functioning state. Given the historic loss and degradation of New Zealand's biodiversity, and ongoing development in the country, it is hard to imagine such desired outcomes being met without a significant change in strategy that – as stated in Principle Seven – shifts costs of environmental restoration from those that suffer environmental impacts (e.g. society at large) to those that cause them (e.g. developers). In theory, biodiversity offsets result in no net loss of (i.e. 'maintain') biodiversity through development. This is not the same, however, as resulting in no net loss of biodiversity overall (at a landscape level). In averted loss offsets (cf. restoration offsets), a developer offsets *its own* residual impacts on biodiversity simply by stopping loss at another site that would otherwise have occurred. Nonetheless, biodiversity is still impacted at the development site (Gibbons and Lindenmayer 2007, Bekessy *et al.* 2010). No net loss *overall*[58] can only be achieved in a biodiversity offsets system through the judicious use of multipliers (Box 1) and successful restoration. Unfortunately, truly successful examples of restoration – outside of the field of invasive species control – are few and far between, so any biodiversity offsets system is likely to result in overall net loss of biodiversity, which can only be minimised rather than eliminated (Bekessy *et al.* 2010).

New Zealand's biodiversity strategy plans a strong role for private landowners in conservation of biodiversity. For example, the desired outcome for biodiversity on land includes "[a] more representative range of natural habitats and ecosystems is secure in public ownership, complemented by an increase in privately owned and managed protected natural areas." Likewise, Objective 1.2, Activity h) is to "(p)romote landowner and community awareness of opportunities to conserve and sustainably use indigenous biodiversity, and to protect and maintain habitats and ecosystems of importance to indigenous biodiversity on private land." A key way forward for conservation of biodiversity in New Zealand is seen as providing incentives to private landowners. For example, Objective 9.7, Action b) is to "(i)nvestigate and raise awareness of the range of incentives (including financial, information and property-based mechanisms) which resource managers can use to encourage and reward sympathetic management of indigenous biodiversity." Although biodiversity offsets are not specifically mentioned in the strategy, they are clearly a tool that fits within this range of incentives by valorising conservation and restoration of land with indigenous habitats. The importance of conservation of biodiversity on private land is stressed further in *Protecting our Places* (Ministry for the Environment 2007)[59].

Protecting our Places outlines four national priorities. The implications of the offsetability framework outlined in this report is discussed below for these priorities:

"National Priority One: To protect indigenous vegetation associated with land environments (defined by Land Environments of New Zealand at Level IV), that have 20% or less remaining in indigenous cover." This priority refers to threatened environments, not ecosystems. *Protecting our Places* itself acknowledges that these environments are only imperfect surrogates for ecosystems. Section 6.1.2 outlines how a standardised national ecosystem classification could be developed in

58 i.e. at the landscape, regional or national level at which an offsets system operates.
59 http://www.biodiversity.govt.nz/pdfs/protecting-our-places-brochure.pdf

New Zealand, and threatened ecosystems incorporated into an overall offsetability framework. Within a national biodiversity offsets policy, defining categories for offsetability of threatened ecosystems would help achievement of National Priority One.

Box 1. Multipliers

Regulators might sometimes require higher offset multipliers or 'offset ratios' (i.e. greater than one hectare or habitat hectare offset for each one impacted) in an attempt to deal with uncertainty or time preference (Moilanen *et al.* 2009). These are often not appropriate situations in which to use multipliers. First, uncertainty of result is not always reduced by quantity (e.g. the chance of flipping two coins and getting a 'heads' the second time is not influenced by the result of the first flip). Second, extinction risks of habitat bottlenecks are not reduced by requirements for greater amounts of habitat at a future time. Multipliers could, however, be an appropriate method of dealing with uncertainty of accuracy or precision, such as of predicted residual impacts or of offset gains. Insurance could be the best method for dealing with uncertainty over offset results. Although insurance is a relatively new idea in offsetting, it is not uncommonly used to ensure that mining companies can guarantee rehabilitation upon closure, even if the company collapses beforehand (e.g., in Zambia, through providing bonds to the national Environmental Protection Fund). Requiring provision of certain (at least short-term) gains up-front is the best way to deal with time preference, e.g. via habitat or species banking (Carroll *et al.* 2007, Bekessy *et al.* 2010). Lack of such methods to deal with time preference will raise risks of extinction owing to habitat or population bottlenecks (Bekessy *et al.* 2010), and thus potentially compromise achievement of the national biodiversity strategy.

Multipliers are most useful when trying to ensure no net loss, or even net gain, towards an overall policy goal or systematic conservation plan (e.g. Brownlie *et al.* 2007). These are what BBOP (2011a) refers to as 'end-game' or 'conservation outcome' multipliers. For example, the proposed national policy statement on indigenous biodiversity in New Zealand requires offset design to demonstrate that "it contributes to and complements biodiversity conservation priorities/goals at the landscape and national level." Thus, regulators might require high multipliers for offsets that impact depleted ecosystems, e.g. those that would be classed as Acutely Threatened, Chronically Threatened or At Risk, in an attempt to achieve net gain in these ecosystems (i.e. increasing their current extents towards historical levels). Such an approach would not only facilitate contribution to national strategic goals, but would send price signals to developers with geographic options for development – steering flexible development away from more highly threatened ecosystems because of higher costs of offsetting. Without a systematic conservation plan, a thresholds-based approach to offsetting could result in slow, attritional accumulation of minor 'insignificant' impacts over time.

"National Priority Two: To protect indigenous vegetation associated with sand dunes and wetlands; ecosystem types that have become uncommon due to human activity" and "National Priority Three: To protect indigenous vegetation associated with 'originally rare' terrestrial ecosystem types not already covered by priorities 1 and 2." Section 6.1.2 outlines how 'historically rare' or 'naturally uncommon' ecosystems in New Zealand such as these could be refined within a standardised national ecosystem classification, and incorporated into an overall offsetability framework as 'restricted-range ecosystems'. Within a national biodiversity offsets policy, defining categories for offsetability of these rare or uncommon ecosystems would help achievement of National Priorities Two and Three.

"National Priority Four: To protect habitats of acutely and chronically threatened indigenous species." The category of 'Chronically Threatened' species is based on the old threat classification of Molloy *et al.* (2002). This has since been updated by Townsend et al. (2008), and Chronically Threatened species incorporated within the category 'At Risk'. Section 6.1.1 outlines how 'Acutely Threatened' species in New Zealand could be appropriately incorporated into an overall offsetability framework as 'threatened species', and discusses how 'At Risk' species could be incorporated with higher thresholds for categories. Within a national biodiversity offsets policy, defining categories for offsetability of these threatened species would help achievement of National Priority Four.

6.4 Further analysis necessary for adaptation to the New Zealand context

This report has only focused on relative offsetability, and not on other biodiversity offset-related issues such as the need for adequate currencies or – indeed – whether the appropriate political context exists to administer and regulate biodiversity offsets for effective outcomes (e.g. Walker *et al.* 2009). These are extremely important considerations, but beyond the remit of this report. This report assesses the potential for adaptation of a general offsetability framework to the New Zealand context (Section 6.1). This is, of course, illustrative and needs testing, refinement and peer review. Further analysis specific to offsetability should particularly include:

6.4.1 Scientific issues

- Assessment of the most appropriate approach to subspecies and nationally-threatened, non-endemic taxa, given practical limits to New Zealand's resources and capacity for conservation (see Section 6.1.1);
- Development of a spatially-explicit, standardised, national (terrestrial, freshwater and marine) ecosystem classification that is coarse-scale enough to enable biodiversity offsetting yet fine-scale enough to accurately assess irreplaceability and avoid inappropriate exchanges of dissimilar biodiversity (see Section 6.1.2). Such an exercise is also important for Objective 9.2, Action a) of the national biodiversity strategy ("Develop effective methods of ecosystem classification and mapping biodiversity..."), and related actions for terrestrial (1.1, a), freshwater (2.1, b) and marine (3.1, b) ecosystems;
- Adaptation of the national system for categorising the threat status of environments to fit this new standardised national ecosystem classification (see Section 6.1.2);
- Refinement of current national 'historically rare' or 'naturally uncommon' (restricted-range) ecosystem definitions to fit this new ecosystem classification (see Section 6.1.2);
- Assessment of how/whether the scale of ecosystem classification (in relation to the frequency distribution of species'/taxa ranges) might necessitate altering either the threat classification for ecosystems or thresholds for categories of threatened ecosystems in the framework (see Section 5.1);
- Development of national/regional systematic conservation plans that clearly and spatially

define conservation targets (without which an offsetability framework is likely to lead to slow attritional cumulative impacts on biodiversity);

- Assessment of appropriate lower thresholds to offsetting (i.e. with the goal of halting the decline in New Zealand's biodiversity, what biodiversity features or scales of impact do not need to be offset).

6.4.2 Policy issues

- Development of policy on the spatial scale of 'no net loss' (e.g. project, district, regional or national scale);
- Development of policy on the temporal scale of 'no net loss' in order to clarify in which cases species-/habitat-banking versus loan-based systems[60] will be most appropriate;
- Development of nationally-appropriate guidance on definition of management units to ensure consistent, objective definition of such units within New Zealand;
- Development of policy to ensure cumulative impacts are considered together (to avoid slow attrition of biodiversity);
- Consideration of approaches to offsetting or substituting service values of biodiversity (e.g. provisioning, regulating, supporting and cultural values), particularly regarding more localised service areas likely desired for such values;
- Refinement of criteria related to impacts, offset opportunity and offset feasibility to fit with the New Zealand context and evolving policy (see Section 6.1.5);
- Assessment of appropriate functional areas for preserving ecological function (see Section 6.1.5);
- Quantification of suitable multipliers for offsetting species and/or ecosystems of varying vulnerability and irreplaceability in order to meet national conservation plan targets (see Sections 5.1 and, e.g. 4.2.3) and – ideally – preparation of national/regional systematic conservation plans that clearly and spatially define conservation targets;
- If like-for-better offsets are desired in New Zealand, develop a defensible method for comparing impacts and offsets among different species and/or ecosystems of varying vulnerability and irreplaceability in order to meet national conservation plan targets. This method will also likely depend on availability of national/regional systematic conservation plans that clearly and spatially define conservation targets.

60 i.e. those allowing temporal loss of biodiversity features.

7. References

Anderson, S. (2002) *Identifying Important Plant Areas.* Plantlife International: London, UK.

Atkinson, I. A. E. and Blaschke, P. M. (1991) Vegetation. Pp. 26-33 in: Milne, J.D.G., Clayden, B., Singleton, P. L. and Wilson, A. D. (Eds.) *Soil description handbook*. DSIR Land Resources: Lower Hutt, New Zealand.

Attfield, R. (1998) Existence value and intrinsic value. *Ecological Economics* 24: 163–168.

BBOP Thresholds Consultation Working Group (2008) Thresholds for livelihood- and cultural-values. A BBOP Working Paper. Business and Biodiversity Offsets Programme (BBOP): Washington, D.C.

BBOP (2009) *Biodiversity Offset Design Handbook.* Business and Biodiversity Offsets Programme (BBOP): Washington, D.C.

BBOP (2011a) Draft Guidance on No Net Loss and Loss-Gain calculations in biodiversity offsets. Draft document of the Business and Biodiversity Offsets Programme (BBOP): Washington, D.C.

BBOP (2011b) Guidance on Principle 4 and limits to what can be offset. Draft document of the Business and Biodiversity Offsets Programme (BBOP): Washington, D.C.

Bekessy, S. A., Wintle, B. A., Lindenmayer, D. B., Mccarthy, M. A., Colyvan, M., Burgman, M. A. and Possingham, H. P. (2010). The biodiversity bank cannot be a lending bank. *Conservation Letters* 3: 151–158.

Brownlie, S., Botha, M., Helme, N. and van Zyl, H. (2007) *Provincial guideline on biodiversity offsets*. Provincial Government of the Western Cape, Department of Environmental Affairs & Development Planning: Cape Town, South Africa.

Burgin, S. (2008) BioBanking: an environmental scientist's view of the role of biodiversity banking offsets in conservation. *Biodiversity and Conservation* 17: 807-816.

Darwall, W. and Vié, J. C. (2005) *Identifying important sites for conservation of freshwater biodiversity: extending the species-based approach.* IUCN: Gland, Switzerland and Cambridge, UK.

DEA & DP (2011) *Information Document on Biodiversity Offsets.* EIA Guideline and Information Document Series. Western Cape Department of Environmental Affairs & Development Planning (DEA&DP): Cape Town, South Africa.

Delany, S. and Scott, D. (2006) *Waterbird Population Estimates, Fourth edition.* Wetlands International: Wageningen, Netherlands.

Eken, G., Bennun, L., Brooks, T., Darwall, W., Fishpool, L., Foster, M., Knox, D., Langhammer, P., Matiku, P., Radford, E., Salaman, P., Sechrest, W., Smith, M. L., Spector, S. and Tordoff, A. (2004) Key biodiversity areas as site conservation targets. *Bioscience* 54: 1110-1118.

Ezemvelo KZN Wildlife (2010) *Norms and Standards for Biodiversity Offsets: KwaZulu-Natal Province, South Africa*. Ezemvelo KZN Wildlife: Pietermaritzburg, South Africa.

Ferrier, S., Pressey, R. L. and Barrett, T. W. (2000) A new predictor of the irreplaceability of areas for achieving a conservation goal, its application to real-world planning, and a research agenda for further refinement. *Biological Conservation* 93: 303-325.

Fishpool, L. D. C., Heath, M. F., Waliczky, Z., Wege, D. C. and Crosby, M. J. (1998) Important Bird Areas criteria for selecting sites of global conservation significance. *Ostrich* 69: 428.

Gibbons, P., and Lindenmayer, D. B. (2007) Offsets for land clearing: No net loss or the tail wagging the dog? *Ecological Management & Restoration* 8: 26–31.

von Hase, A. and Stephens, T. (2010a) Assessing development impacts on biodiversity. Unpublished draft document for discussion by the BBOP Advisory Group.

von Hase, A. and Stephens, T. (2010b) Situations in which impacts may be difficult to offset. Unpublished draft document for discussion by the BBOP Guidelines Working Group.

Hitchmough, R., Bull, L. and Cromarty, P. (Compilers) (2005) *New Zealand Threat Classification System lists.* Department of Conservation: Wellington, New Zealand.

IFC (2006) *Performance Standard 6. Biodiversity Conservation and Sustainable Management of Living Natural Resources.* International Finance Corporation: Washington DC, USA. <http://www.ifc.org/ifcext/sustainability.nsf/Content/PerformanceStandards>

IFC (2012) Performance Standard 6 – V2. Biodiversity Conservation and Sustainable Management of Living Natural Resources. January 1, 2012. International Finance Corporation: Washington DC, USA.
<http://http://www1.ifc.org/wps/wcm/connect/bff0a28049a790d6b835faa8c6a8312a/PS6_English_2012.pdf?MOD=AJPERES>

IUCN (2001) *IUCN Red List Categories and Criteria – version 3.1*. International Union for Conservation of Nature and Natural Resources (IUCN): Gland, Switzerland and Cambridge, UK.

IUCN (2002) *IUCN Technical Guidelines on the Management of Ex-situ populations for Conservation*. International Union for Conservation of Nature and Natural Resources (IUCN): Gland, Switzerland.

IUCN (2010) IUCN Red List of Threatened Species. Version 2010.4. <www.iucnredlist.org>

Landcare Research (2011) New Zealand Lizards Database.

<http://nzlizards.landcareresearch.co.nz>

Langhammer, P. F., Bakarr, M. I., Bennun, L. A., Brooks, T. M., Clay, R. P., Darwall,W., De Silva, N., Edgar, G. J., Eken, G., Fishpool, L. D. C., Fonseca, G. A. B. da, Foster, M. N., Knox, D. H., Matiku, P., Radford, E. A., Rodrigues, A. S. L., Salaman, P., Sechrest, W. and Tordoff, A. W. (2007) *Identification and Gap Analysis of Key Biodiversity Areas: Targets for Comprehensive Protected Area Systems.* IUCN: Gland, Switzerland.

Leathwick, J., Wilson, G., Rutledge, D., Wardle, P., Morgan, F., Johnston, K., McLeod, M. and Kirkpatrick, R. (2003a) *Land environments of New Zealand – Nga Taiao o Aotearoa*. David Bateman: Auckland.

Leathwick, J., Morgan, F., Wilson, G., Rutledge, D., McLeod, M. and Johnston, K. (2003b) *Land environments of New Zealand: A technical guide*. David Bateman: Auckland.

Leathwick, J. R., Collier, K. and Chadderton, L. (2007) *Identifying freshwater ecosystems with nationally important natural heritage values: development of a biogeographic framework.* Department of Conservation: Wellington, New Zealand.

Linzey, A. V. (2002) Important Mammal Areas: A US pilot project. In: *Society for Conservation Biology. 16th Annual Meeting: Programme and Abstracts.* Durrell Institute of Conservation and Ecology: Canterbury, UK.

Lochner, P., Weaver, A., Gelderblom, C., Peart, R., Sandwith, T. and Fowkes, S. (2003) Aligning the diverse: the development of a biodiversity conservation strategy for the Cape Floristic Region. *Biological Conservation* 112: 29-43.

Loss, S.R., Terwilliger, L.A. and Peterson, A.C. (2011) Assisted colonization: Integrating conservation strategies in the face of climate change. *Biological Conservation* 144: 92-100.

Madsen, B., Carroll, N. and Moore Brands, K. (2010) *State of Biodiversity Markets: Offset and Compensation Programs Worldwide*. Ecosystem Marketplace: Washington, DC.

Margules, C. R. and Pressey, R. L. (2000) Systematic conservation planning. *Nature* 405: 243–253.

Maron, M., Dunn, P. K., McAlpine, C. A. and Apan, A. (2010) Can offsets really compensate for habitat removal? The case of the endangered red-tailed black-cockatoo. *Journal of Applied Ecology* 47: 348–355.

Millennium Ecosystem Assessment (2005) *Ecosystems and Human Well-Being: Synthesis*. Island Press: Washington, DC.

Ministry for the Environment (2007) *Protecting our Places: Information about the Statement of National Priorities for Protecting Rare and Threatened Biodiversity on Private Land.* Ministry for the Environment: Wellington, New Zealand.

Miskelly, C. M., Dowding, J. E., Elliott, G. P., Hitchmough, R. A., Powlesland, R. G., Robertson, H. A., Sagar, P. M., Scofield, R. P. and Taylor, G. A. (2008) Conservation status of New Zealand birds, 2008. *Notornis* 55: 117–135.

Moilanen, A., Van Teeffelen, A. J., Ben-Haim, Y. and Ferrier, S. (2009) How much compensation is enough? A framework for incorporating uncertainty and time discounting when calculating offset ratios for impacted habitat. *Restoration Ecology* 17: 470–478.

Molloy, J., Bell, B., Clout, M., de Lange, P., Gibbs, G., Given, D., Norton, D., Smith, N. and Stephens, T. (2002) *Classifying species according to threat of extinction: A system for New Zealand.* Threatened species occasional publication 22. Department of Conservation: Wellington, New Zealand.

Morris, R. K. A., Alonso, I., Jefferson, R. G. and Kirby, K. J. (2006) The creation of compensatory habitat–Can it secure sustainable development? *Journal for Nature Conservation* 14: 106–116.

Norton, D. A. (2009) Biodiversity offsets: two New Zealand case studies and an assessment framework. *Environmental management* 43: 698–706.

Norton, D. A. and Roper-Lindsay, J. (2004) Assessing significance for biodiversity conservation on private land in New Zealand. *New Zealand Journal of Ecology* 28: 295–305.

Norton, D. A. and Roper-Lindsay, J. (2008) Assessing significance under the RMA- moving forwards: a reply to Walker *et al.* (2008). *New Zealand Journal of Ecology* 32: 238–239.

Pickard, C. R. and Towns, D. R. (2008) *Atlas of the amphibians and reptiles of New Zealand*. Department of Conservation: Wellington, New Zealand.

Plantlife International (2004) *Identifying and Protecting the World's Most Important Plant Areas: A Guide to Implementing Target 5 of the Global Strategy for Plant Conservation.* Plantlife International: Salisbury, UK.

Richardson, J. (2005) *NIWA atlas of New Zealand freshwater fishes*. Available from: www.niwascience.co.nz/rc/freshwater/fishatlas

Ricketts, T. H., Dinerstein, E., Boucher, T., Brooks, T. M., Butchart, S. H. M., Hoffmann, M., Lamoreux, J. F., Morrison, J., Parr, M., Pilgrim, J. D., Rodrigues, A. S. L., Sechrest, W., Wallace, G. E., Berlin, K., Bielby, J., Burgess, N. D., Church, D. R., Cox, N., Knox, D., Loucks, C., Luck, G. W., Master, L. L., Moore, R., Naidoo, R., Ridgely, R., Schatz, G. E., Shire, G., Strand, H., Wettengel, W. and Wikramanayake, E. (2005) Pinpointing and preventing imminent extinctions. *Proceedings of the National Academy of Sciences of the United States of America* 102: 18497-18501.

Rodrigues, A. S., Pilgrim, J. D., Lamoreux, J. F., Hoffmann, M. and Brooks, T. M. (2006) The value of the IUCN Red List for conservation. *Trends in Ecology & Evolution* 21: 71–76.

Rodriguez, J. P., Baillie, J. E., Ash, N., Benson, J., Boucher, T., Brown, C., Burgess, N. D., Colleen, B., Jennings, M., Keith, D. A., Nicholson, E., Revenga, C., Reyers, B., Rouget, M., Smith, T., Spalding, M., Taber, A., Walpole, M., Zager, I. and Zamin, T. (2011) Establishing IUCN Red List Criteria for Threatened Ecosystems. *Conservation Biology* 25: 25-29.

Savy, C., Ekstrom, J., Tordoff, J., ten Kate, K., Semroc, B., Stephens, T., Gardner, T. & Stalmans, M. (2008). Business and Biodiversity Offsets Program (BBOP) Consultation paper: Thresholds for Biodiversity Offsets. Unpublished document of the Thresholds Consultation Working Group, BBOP, Washington, D.C.

Snelder, T., Biggs, B. and Weatherhead, M. (2004) *New Zealand River Environment Classification User Guide*. Ministry for the Environment: Wellington, New Zealand.

Snelder, T., Leathwick, J., Dey, K., Weatherhead, M., Fenwick, G., Francis, M., Gorman, R., Grieve, J., Hadfield, M., Hewitt, J., Hume, T., Richardson, K., Rowden, A., Uddstrom, M., Wild, M. and Zeldis, J. (2005) *The New Zealand Marine Environment Classification*. Ministry for the Environment: Wellington, New Zealand.

Stuart, S. N., Hoffmann, M., Chanson, J. S., Cox, N. A., Berridge, R. J., Ramani, P. and Young, B. E. (2008) *Threatened amphibians of the world.* Lynx Edicions, Barcelona.

Tanaka, A. (2010) Novel biodiversity offset strategies: Satoyama Banking and Earth Banking. In: *IAIA10 Conference Proceedings: The Role of Impact Assessment in Transitioning to the Green Economy.* 30th Annual Meeting of the International Association for Impact Assessment (IAIA), 6-11 April 2010, International Conference Centre Geneva, Switzerland.

Teresa, S. (2008) Financial Considerations. In: Carroll, N., Fox, J. and Bayon, R.(eds.) *Conservation and Biodiversity Banking: A Guide to Setting Up and Running Credit Trading Systems.* Earthscan, London, pp. 127-155.

Townsend, A. J., de Lange, P. J., Duffy, C. A. J., Miskelly, C. M., Molloy, J. and Norton, D. A. (2008) *New Zealand Threat Classification System manual*. New Zealand Department of Conservation: Wellington.

Treweek, J. (2009) Scoping study for the design and use of biodiversity offsets in an English context: Final report to Defra. Unpublished report.

Treweek, J., von Hase, A. and ten Kate, K. (2010) Approaches to establishing guidelines on impacts that cannot be offset... Options for the BBOP GWG to consider. Unpublished draft prepared for discussion by the BBOP Guidelines Working Group, 23 Feb 2010.

Walker, S., Price, R. and Rutledge, D. (2005) *New Zealand's remaining indigenous cover: recent changes and biodiversity protection needs*. Landcare Research: Dunedin.

Walker, S., Price, R., Rutledge, D., Stephens, R. T. and Lee, W. G. (2006) Recent loss of indigenous cover in New Zealand. *New Zealand Journal of Ecology* 30: 169–177.

Walker, S., Brower, A. L., Clarkson, B. D., Lee, W. G., Myers, S. C., Shaw, W. B. and Stephens, R. T. (2008a) Halting indigenous biodiversity decline: ambiguity, equity, and outcomes in RMA assessment of significance. *New Zealand Journal of Ecology* 32: 1–13.

Walker, S., Price, R. and Rutledge, D. (2008b) *New Zealand's remaining indigenous cover: recent changes and biodiversity protection needs.* Department of Conservation: Wellington, New Zealand.

Walker, S., Price, R. and Stephens, R. T. (2008c) An index of risk as a measure of biodiversity conservation achieved through land reform. *Conservation Biology* 22: 48–59.

Walker, S., Brower, A. L., Stephens, R. T. T. and Lee, W. G. (2009) Why bartering biodiversity fails. *Conservation Letters* 2: 149-157.

Williams, P. A., Wiser, S., Clarkson, B. and Stanley, M. C. (2007) New Zealand's historically rare terrestrial ecosystems set in a physical and physiognomic framework. *New Zealand Journal of Ecology* 31: 119-128.