IUCN Academy of Environmental Law
13th Annual Colloquium
'Forest and Marine Biodiversity'
7 – 12 September 2015, Jakarta, Indonesia

"Biodiversity Offsets: Adequacy and Efficacy in Theory and Practice"

by

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BIOLOGICAL DIVERSITY

Biological diversity has been described as 'the sum total of all biotic variation from the level of genes to ecosystems'.[1] It is important to remember, however, that biological diversity is not something that can be reduced to a single metric – it is a concept.[2]

One statutory definition of biological diversity, from the New South Wales *Threatened Species Act 1995* (the TSC Act), is that it means:

> the diversity of life and is made up of the following 3 components:
> (a) Genetic diversity – the variety of genes (or units of heredity) in any population,
> (b) Species diversity – the variety of species,
> (c) Ecosystem diversity – the variety of communities or ecosystems.[3]

The TSC Act definition of biological diversity comprises three discrete components. However, the TSC Act defines "biodiversity values" in a way that is not restricted to discrete components:

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[1] Andy Purvis and Andy Hector, 'Getting the Measure of Biodiversity' (2000) 405 *Nature* 212, 212, quoted in Joseph W Bull et al, 'Comparing Biodiversity Offset Calculation Methods with a Case Study in Uzbekistan' (2014) 178 *Biological Conservation* 2, 3.

[2] Paul Adam, 'Ecological Communities – The Context for Biodiversity Conservation or a Source of Confusion?' (2009) 13 *The Australasian Journal of Natural Resources Law and Policy* 7, 12.

[3] *Threatened Species Conservation Act 1995* (NSW), s 4(1).

> *biodiversity values* includes the composition, structure and function of ecosystems, and includes (but is not limited to) threatened species, populations and ecological communities, and their habitats.[4]

Other definitions of biological diversity are also broader in that they allow for other levels of diversity. Article 2 of the Convention on Biological Diversity (the CBD) contains one such definition:

> "Biological diversity" means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.[5]

Some commentators prefer the CBD definition because its open-endedness allows for an interpretation that does not exclude levels of biological diversity above community level.[6] For example, the CDB does not by its definition exclude consideration of landscape diversity. Landscape diversity may be an important consideration in planning for sustainable use over large geographic scales.[7]

Biodiversity conservation is not only about conserving *threatened* entities but also about the environment more broadly. This is something that can easily be forgotten when looking at biodiversity conservation from a legal perspective given the common focus of biodiversity-related legislation on species, ecosystems or communities that are *threatened*.[8]

As set out in the TSC Act definition, species diversity (the variety of species) is one component of biodiversity. The variety of species can be measured by species richness, relative abundance of a species in a particular area, and genetic differentiation among species. Species richness refers to the number of different species at a given location (site, habitat or other defined geographic region).

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[4] *Threatened Species Conservation Act 1995* (NSW), s 4A(1).
[5] *Convention on Biological Diversity*, opened for signature 5 June 1992, 1970 UNTS 79 (entered into force 19 December 1993), art 2.
[6] Adam, Ecological Communities, above n 2, 12.
[7] Ibid.
[8] For example, *Threatened Species Conservation Act 1995* (NSW); *Environmental Protection and Biodiversity Act 1999* (Cth).

Measures of species diversity differ from a mere enumeration of species richness by taking into account not only the number of species but also the number of individuals within each species (the relative abundance) within a particular location. In addition, species diversity measures may also take into account the amount of genetic differentiation among species.[9] Measures of species diversity therefore allow differentiation between communities with equal numbers of species but different patterns of species abundance.

Measures of species diversity can be described as alpha, beta or gamma diversity. Alpha diversity measures the number of species and their relative abundance within a single location or local area. Beta diversity measures the rate of change in the assemblage of species along the ecological gradient (ie it represents the changes in species composition that occurs along an ecological gradient within a community). Gamma diversity measures the turnover of species between sites within relatively homogenous habitat (ie it measures the spatial component that is independent of environmental gradients).[10]

Ecological integrity, an important notion relating to biodiversity conservation, refers to the earth's life-support systems.[11] The Land and Environment Court of New South Wales (NSW) has described ecological integrity in these terms:

> At a macro level, ecological integrity involves conservation of the ecological processes that keep the planet fit for life. They "shape climate, cleanse air and water, regulate water flow, recycle essential elements, create and recreate soil, and enable ecosystems to renew themselves".[12]
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> Maintaining ecological integrity involves maintaining ecosystem health. Ecosystems become unhealthy if their community structure (species richness, species composition or food web

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[9] Brian J Preston and Paul Adam, 'Describing and Listing Threatened Ecological Communities under the Threatened Species Conservation Act 1995 (NSW): Part 1 – The Assemblage of Species and the Particular Area' (2004) 21 *Environmental and Planning Law Journal* 250, 261.

[10] Ibid 262.

[11] John Moffet and Francois Bregha, 'The Role of Law Reform in the Promotion of Sustainable Development' (1997) 6 *Journal of Environmental Law and Practice* 1, 4; see also, Brian J Preston, 'The Role of the Judiciary in Promoting Sustainable Development' (2005) 9 *Asia Pacific Journal of Environmental Law* 109, 187.

[12] *Bentley v BGP Properties Pty Ltd* [2006] NSWLEC 34; (2006) 145 LGERA 234, 243-244 [60], quoting IUCN, UNEP and WWF, *Caring for the Earth: A Strategy for Sustainable Development* (Oxford University Press, 1992), 9.

> architecture) or ecosystem functioning (productivity, nutrient dynamics, decomposition) has been fundamentally upset by human pressures.[13]
>
> Maintaining ecological integrity also involves maintaining ecosystem functioning and ecosystem services. Ecosystem functioning is "the sum total of processes such as the cycling of matter, energy, and nutrients operating at the ecosystem level". Ecosystem services are "the wide array of conditions and processes through which ecosystems, and their biodiversity, confer benefits on humanity; these include the production of goods, life support functions, life-fulfilling conditions, and preservation of options".[14]
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> The conservation of threatened species is an essential action in the conservation of species diversity, and hence of biological diversity, and of ecological integrity.[15]

The loss of biodiversity reduces the efficiency of processes that are important to the productivity and sustainability of Earth's ecosystems.[16] There is mounting evidence that biodiversity increases the stability of ecosystem functions through time.[17] Further biodiversity loss will also accelerate change in ecosystem processes.[18]

A major justification for biodiversity conservation is the maintenance of ecosystem functions. There is no evidence to suggest, for example, that relatively species poor communities are less valuable in providing ecosystem services than species rich communities.[19] Adam suggests that the most important reason for conserving biodiversity is to support the essential role of biodiversity in providing ecosystem services – which are vital for the maintenance of human society and the survival of numerous other species.[20]

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[13] *Bentley v BGP Properties Pty Ltd* [2006] NSWLEC 34; (2006) 145 LGERA 234, 244 [61], quoting Michael Begon, Colin R Townsend and John L Harper, *Ecology: From Individuals to Ecosystems* (Blackwell Publishing, 4th ed, 2006), 645.
[14] *Bentley v BGP Properties Pty Ltd* [2006] NSWLEC 34; (2006) 145 LGERA 234, 244 [62], respectively quoting RA Virginia and DH Wall, 'Ecosystem Function, Principles of' in SA Levin (ed), *Encyclopaedia of Biodiversity* (Academic Press, 2001) vol 2, 345; G Daily and S Dasgupta, 'Ecosystem Services, Concept of' in SA Levin (ed), *Encyclopaedia of Biodiversity* (Academic Press, 2001) vol 2, 353.
[15] *Bentley v BGP Properties Pty Ltd* [2006] NSWLEC 34; (2006) 145 LGERA 234, 244 [63].
[16] Bradley J Cardinale et al, 'Biodiversity Loss and its Impact on Humanity' (2012) 486 *Nature* 59, 60; David U Hooper et al, 'A Global Synthesis Reveals Biodiversity Loss as a Major Driver of Ecosystem Change' (2012) 486 *Nature* 105, 105.
[17] Cardinale et al, above n 16, 60.
[18] Ibid 61; Hooper et al, above n 16, 105.
[19] Adam, Ecological Communities, above n 2, 12-13.
[20] Ibid 56.

Development has had and continues to have adverse impacts on biodiversity. As human populations increase, there is increased demand for development and areas of greater biodiversity sensitivity and value become more likely to be the subject of new development proposals. Such areas may now be considered for proposed developments because an increasing number of more ideally suited sites have already been developed.

MITIGATION HIERARCHY

The strategies for managing the adverse impacts of development on biodiversity are, in order of priority of action, avoidance, mitigation and offsets. These form the mitigation hierarchy. The mitigation hierarchy is 'the logical, sequential framework in which impacts are avoided, minimized, remediated and any residual impacts offset'.[21] Avoidance and mitigation measures should be the priority strategies for managing the potential adverse impacts of a proposed development. Avoidance and mitigation measures directly reduce the scale and intensity of the potential impacts of the development. Only then are offsets used to address the residual impacts that remain after avoidance and mitigation measures have been put in place.[22] Adherence to the mitigation hierarchy is central to biodiversity offsetting. Without prior application of the mitigation hierarchy, conservation actions would not qualify as offsets under most definitions of offsets. Further, providing offsets without prior mitigation of development impacts may not be feasible because of the magnitude of the unmitigated residual impacts on biodiversity.[23]

Under the mitigation hierarchy, the first strategy is to endeavour to avoid potential impacts of the proposed development on biodiversity. A fundamental requirement for conservation of biological diversity and ecological integrity is in situ conservation. In situ conservation of biodiversity involves conservation of ecosystems and natural habitats and the maintenance and recovery of stable populations of species in their

[21] IUCN and ICMM, *Independent Report on Biodiversity Offsets* (January 2013) 10, available at https://www.icmm.com/document/4934.
[22] *Bulga Milbrodale Progress Association Inc v Minister for Planning and Infrastructure and Warkworth Mining Ltd* [2013] NSWLEC 48; (2013) 194 LGERA 347, 379 [147].
[23] IUCN and ICMM, above n 21, 10.

natural surroundings.[24] Avoidance of impacts on biodiversity may be achieved through planning and assessment of the development, including suitable site selection and project design. Alternative solutions need to be considered, including alternative locations or routes, different scales or designs of development, or alternative processes to avoid biodiversity impacts.

If after implementing all reasonable avoidance measures, there are remaining impacts, the second strategy is to undertake mitigation of the remaining impacts. Examples of measures to mitigate on-site impacts might be to alter the project design to site the more intensive aspects of the development in the least environmentally sensitive area of the site or to undertake on-site rehabilitation or restoration of biodiversity. Measures might also be taken to mitigate off-site impacts on areas of biodiversity value, such as edge effects, weed invasion, altered fire frequency or altered hydrological regimes.[25]

If after all reasonable avoidance, mitigation and on-site rehabilitation measures have been taken according to the mitigation hierarchy, there are still residual impacts, offsets can then be considered. Offsets do not reduce the likely impacts of a project on biodiversity, but rather compensate for the residual impacts.[26]

Compensation for residual adverse biodiversity impacts encompasses both direct and indirect methods. The direct method is to establish off-site a biodiversity offset that provides measurable conservation gain to compensate for the residual adverse impacts on biodiversity arising from the development on the impact site. The conservation gain is the benefit that the offset delivers to the affected component of biodiversity, which maintains or increases its viability or reduces any threats of damage, destruction or extinction.[27]

Indirect methods are other compensatory measures that do not directly offset the adverse impacts on the components of biological diversity arising from the

[24] *Convention on Biological Diversity*, above n 5, recital 10 in Preamble, art 2.
[25] *Bulga Milbrodale Progress Association Inc v Minister for Planning and Infrastructure and Warkworth Mining Ltd* [2013] NSWLEC 48; (2013) 194 LGERA 347, 380 [149].
[26] Ibid 380 [150].
[27] Ibid 380 [151].

development on the impact site, but are expected to lead to benefits for the affected components. An example would be undertaking, or funding the undertaking of, research programs relating to the affected components of biological diversity.[28]

Indirect methods of compensation should only be used to compensate for residual impacts that cannot be offset directly.

This article focusses on direct compensation through the process of biodiversity offsetting. The central assumption on which offsetting is based is that adverse biodiversity impacts can be offset ‘if sufficient habitat can be protected, enhanced and/or established elsewhere’.[29] To qualify as an offset, ‘there must be equivalence between what is lost and gained’.[30] This is the goal and the purpose of offsetting. It is not possible for this to be achieved through indirect compensation.

Direct biodiversity offsets can be put broadly into two categories. First, a protection offset or averted loss offset involves protecting biodiversity on another site from further threats. The biodiversity gain is by averting the biodiversity loss that would otherwise have occurred by ongoing or anticipated impacts (ie through protecting a site that would otherwise have been lost). Second, a restoration offset involves restoring, enhancing or establishing biodiversity on another site by enhancement of a degraded site through restoration or rehabilitation of biodiversity on the other site.[31] What amounts to restoration in biodiversity offsetting varies widely; from translocations of single taxa to revegetation to generate new ecosystems.[32]

Biodiversity offsets are also sometimes categorised as either “in kind” or “out of kind”. In kind offsets conserve, restore or rehabilitate biodiversity that is equivalent to whatever components of biodiversity are lost at the impact site. Out of kind offsets

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[28] Ibid 380 [152].
[29] Philip Gibbons and David B Lindenmayer, ‘Offsets for Land Clearing: No Net Loss or the Tail Wagging the Dog’ (2007) 8 *Ecological Management and Restoration* 26, 27.
[30] Andrew Macintosh and Lauren Waugh, ‘Compensatory Mitigation and Screening Rules in Environmental Impact Assessment’ (2014) 49 *Environmental Impact Assessment Review* 1, 3.
[31] Martine Maron et al, ‘Faustian Bargains? Restoration Realities in the Context of Biodiversity Offset Policies’ (2012) 155 *Biological Conservation* 141, 142; Sarah A Bekessy et al, ‘The biodiversity bank cannot be a lending bank’ (2010) 3 *Conservation Letters* 151, 152.
[32] Maron et al, Faustian Bargains, above n 31, 142 .

compensate for adverse impacts with offsets that are not the same.[33] There is a preference for in kind offsets generally,[34] however, some conservation biologists are receptive to the idea that out of kind offsets are appropriate when "trading up" is possible ie in circumstances where 'trading losses in habitat of low conservation significance for gains in threatened habitat'.[35] For example, loss of a portion of an especially common ecological community might be offset with conservation gains in an ecological community of higher priority such as a critically endangered ecological community.[36] Options for in kind offsets must be properly considered and prioritised before resorting to out of kind alternatives in order to avoid, where practicable, a net loss of biodiversity. Moving from the generally more suitable use of in kind offsets to out of kind offsets should only occur when the out of kind alternative is clearly beneficial to biodiversity conservation.[37]

It is important to remember that compensation through biodiversity offsetting is a mechanism of last resort. Compensatory mitigation must not be used as a method to reduce environmental impacts to make a potentially avoidable project appear more acceptable.[38] Biodiversity offsets should not be used as a 'panacea for unbridled development'[39] or to justify adverse impacts.[40] The stepwise process of avoid, mitigate, compensate – the mitigation hierarchy – should be adhered to if the best outcomes for biodiversity are to be achieved.

[33] Bruce A McKenney and Joseph M Kiesecker, 'Policy Development for Biodiversity Offsets: A Review of Offset Frameworks' (2010) 45 *Environmental Management* 165, 168.
[34] Ibid; Bull et al, Comparing Biodiversity Offset Calculation Methods with a Case Study in Uzbekistan, above n 1, 3, citing Business and Biodiversity Offsets Programme (BBOP), *Standard on Biodiversity Offsets* (January 2012) http://www.forest-trends.org/documents/files/doc_3078.pdf.
[35] Joseph W Bull et al, 'Biodiversity Offsets in Theory and Practice' (2013) 47 *Oryx* 369, 372-373; see also Bull et al, Comparing Biodiversity Offset Calculation Methods with a Case Study in Uzbekistan, above n 1, 9.
[36] Joseph M Kiesecker et al, 'Development by Design: Blending Landscape-Level Planning with the Mitigation Hierarchy' (2010) 8 *Frontiers in Ecology and the Environment* 261, 263.
[37] Ibid.
[38] McKenney and Kiesecker, above n 33, 167, citing US Environmental Protection Agency and US Department of the Army (USEPA and USDA), 'Memorandum of Agreement between the Environmental Protection Agency and the Department of the Army Concerning the Determination of Mitigation under the Clean Water Act Section 404(b)(1) Guidelines' (6 February 1990).
[39] Bekessy et al, above n 31, 154.
[40] David A Norton, 'Biodiversity Offsets: Two New Zealand Case Studies and an Assessment Framework' (2009) 43 *Environmental Management* 698, 702.

STEPPING THROUGH THE MITIGATION HIERARCHY

While there is wide support for the notion of the mitigation hierarchy,[41] McKenney and Kiesecker identify a lack of quantitative guidelines for how the decision-making process is to be applied.[42] There appears to be a general lack of clarity as to how to know when to move from one step in the hierarchy to the next. Questions arise as to, first, how widely a proponent is required to search for alternatives that avoid adverse impacts before declaring that the adverse impacts are "unavoidable" and moving on to options for mitigation/minimisation, secondly, when is mitigation unfeasible and consideration of compensatory measures appropriate, and thirdly, what are the thresholds to be met in order to move between the steps?

There are some principles that assist in answering these questions and in stepping through the mitigation hierarchy.

Limits to offsetting

The first is the principle that there are limits to offsetting. This principle recognises that not every biodiversity loss can be offset. There are limits to offsetting because some biodiversity impacts are so large that they cannot be compensated for with sufficient equivalent offsets or in a socially acceptable way. Species extinction is the most commonly cited example of an impact that cannot be offset. Equally serious is ecological community extinction, which also amounts to an impact that cannot be offset.

Other impacts that would be effectively impossible to offset may include the loss of a large proportion of the population of an endangered species or of the occurrence of an endangered ecological community. Justifications for limits to offsetting include the uniqueness of the biodiversity component and quantitative thresholds based on irreplaceability and vulnerability.[43]

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[41] Macintosh and Waugh, above n 30, 3.
[42] McKenney and Kiesecker, above n 33, 167.
[43] IUCN and ICMM, above n 21, 18.

If the extent or degree of biodiversity loss is so large that it cannot be offset, there will be a need to avoid the impact in the first place. The principle of limits to offsetting therefore regulates stepping through the mitigation hierarchy.

Precautionary principle

Some assistance in answering these questions can be gleaned from the principles of ecologically sustainable development, particularly the precautionary principle. The precautionary principle is applicable 'where there are threats of serious or irreversible environmental damage' such as the kind of adverse impact to biodiversity that triggers application of the mitigation hierarchy. Where there are such threats, the precautionary principle prescribes that 'lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation'. The most successful way not to postpone measures to prevent environmental degradation, consistent with the first step of the mitigation hierarchy, is to avoid the degradation in the first place. In applying the precautionary principle, public and private decisions should be guided by 'careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment'.[44] This too is consistent with the first step of the mitigation hierarchy. It also suggests that before moving between the "avoid" and "mitigate" stages of the hierarchy, there must at the very least be some "careful evaluation" undertaken to avoid any adverse impacts.

While the principles of ecologically sustainable development have been criticised for being process-driven rather than outcomes-driven, the phrase 'careful evaluation to avoid, wherever practicable, serious or irreversible damage' does imply an outcome. The outcome, put simply, is that serious or irreversible damage to the environment must be avoided.

An example of outcomes-based legislation for biodiversity conservation that incorporates a stepwise process akin to the mitigation hierarchy exists under the

[44] *Protection of the Environment Administration Act 1991* (NSW), s 6(2)(a)(i); see also *Intergovernmental Agreement on the Environment* (1 May 1992) at [3.5.1] http://www.environment.gov.au/about-us/esd/publications/intergovernmental-agreement.

European Union's Habitats Directive.[45] The Habitats Directive provides limits on the granting of development consent in areas within the EU-wide network of nature protection areas known as *Natura 2000*.[46] Development that adversely affects the integrity of a *Natura 2000* site is not completely prohibited, but will only be permitted if there are no alternative solutions and if the development is in the overriding public interest – in which case compensatory measures must be taken to ensure the overall coherence of the network.[47] The outcome of a decision made under these provisions is the maintenance of the overall coherence of the *Natura 2000* network.[48]

The European Court of Justice (CJEU) has established that the precautionary principle is applicable to article 6(3) of the Habitats Directive.[49] Article 6(3) requires that development likely to have a significant impact on a *Natura 2000* site must be subject to appropriate assessment of the development's implications for the site and that the development shall only be approved 'after having ascertained that it will not adversely affect the integrity of the site concerned'.[50] The Court stated in *Landelijke Vereniging tot Behoud van de Waddenzee v Staatssecretaris van Landbouw, Natuurbeheer en Visserij* that article 6(3) integrates the precautionary principle so that 'where doubt remains as to the absence of adverse effects on the integrity of the site linked to the plan or project being considered, the competent authority will have to refuse authorisation'.[51] The application of the precautionary principle to the mitigation hierarchy is, therefore, likely to give rise to occasions where a proposed development should be refused.

The CJEU has also established that when assessing whether a proposed development will 'adversely affect the integrity of the site concerned', any

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[45] Council Directive 92/43/EEC adopted 21 May 1992: see European Commission, *The Habitats Directive* (2015) http://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm.
[46] Ibid.
[47] Ibid arts 6(3) and 6(4).
[48] Brian J Preston, 'Adapting to the Impacts of Climate Change: The Limits and Opportunities of Law in Conserving Biodiversity' (2013) 30 *Environmental and Planning Law Journal* 375, 377.
[49] *Landelijke Vereniging tot Behoud van de Waddenzee v Staatssecretaris van Landbouw, Natuurbeheer en Visserij* (C-127/02) [2004] ECR I-7405 at [55]-[59]; *Peter Sweetman, Ireland, Attorney-General, Minister for the Environment, Heritage and Local Government v An Bord Pleanála* (C-258/11) [2013] ECR 0 at [40]-[43], [48]; *Briels and others v Minister van Infrastructuur en Milieu* (C-521/12) [2014] PTSR 1120 at [26], [28].
[50] Council Directive 92/43/EEC, above n 45, art 6(3).
[51] *Landelijke Vereniging tot Behoud van de Waddenzee v Staatssecretaris van Landbouw, Natuurbeheer en Visserij* (C-127/02) [2004] ECR I-7405 at [57].

compensatory measures (offsets) that are part of the project proposal are not to be taken into account.[52] It follows that compensatory mitigation, such as offsetting, is not to be used as justification for omitting the avoid and mitigate steps of the mitigation hierarchy and subsequently authorising development that will adversely impact upon biodiversity.[53]

Conservation of biological diversity

Like the precautionary principle, the conservation of biological diversity and ecological integrity is a principle of ecologically sustainable development applicable to environmental decision-making. The conservation of biological diversity and ecological integrity 'should be a fundamental consideration' when informing policy-making, program implementation and decision-making.[54] The word "fundamental" means 'serving as, or being a component part of, a foundation or basis'.[55] This implies that conservation of biological diversity should be part of the foundation and basis – ie a primary factor – of decisions made within the mitigation hierarchy. It elevates the weight and priority that must be given to the conservation of biological diversity and ecological integrity relative to any other considerations in the decision-making process.[56] Consideration of the principle of the conservation of biological diversity and ecological integrity is not an end in itself. Rather it is a means to achieve the end of ecological sustainability, protecting and restoring the earth's ecological systems, that lies at the core of the concept of ecologically sustainable development. Achieving ecological sustainability requires the conservation of biological diversity and ecological integrity. Implementation of the principle of conservation of biological diversity and ecological integrity is, therefore, not only a process; it may also lead to a substantive outcome.

[52] *Briels and others v Minister van Infrastructuur en Milieu* (C-521/12) [2014] PTSR 1120 at [29], [32].
[53] See also *Briels and others v Minister van Infrastructuur en Milieu* (C-521/12) [2014] PTSR 1120 at [33].
[54] *Protection of the Environment Administration Act 1991* (NSW), s 6(2)(c); *Environment Protection and Biodiversity Conservation Act 1999* (Cth), s 3A(d); *Intergovernmental Agreement on the Environment*, above n 44 at [3.5.3].
[55] *Macquarie Dictionary* (6th ed, 2013) 601.
[56] Douglas E Fisher, *Australian Environmental Law: Norms, Principles and Rules* (Law Book Co, 3rd ed, 2014) 343.

Consideration of economic factors

In moving between the steps of the mitigation hierarchy, a decision-maker should also be less concerned about balancing the adverse impacts to the environment against the economic or social benefits of the proposed development. The primary considerations when applying the mitigation hierarchy are the adverse impacts on biodiversity and the extent or degree to which proposed measures to avoid, mitigate and compensate will result in no net loss of biodiversity. This is analogous to the process of listing species, populations or ecological communities as threatened under the New South Wales *Threatened Species Conservation Act 1995*.[57] At the initial stage of the listing process, the questions being addressed are scientific in nature. Social and economic factors are not considered.

Under article 6(4) of the Habitats Directive, proposed development that will adversely affect the integrity of a *Natura 2000* site can still be authorised if 'in the absence of alternative solutions' it must nevertheless be carried out 'for imperative reasons of overriding public interest, including those of social or economic nature' so long as compensatory measures are taken.[58] Guidelines published by the European Commission suggest that when considering alternative solutions in comparison to the proposed development 'the reference parameters for such comparisons deal with aspects concerning the conservation and maintenance of the integrity of the site and its ecological functions … other assessment criteria, such as economic criteria, cannot be seen as overruling ecological criteria'.[59] If it is determined that there are no alternative solutions, any 'imperative reasons of overriding public interest' are addressed. This is not a balancing of adverse impacts to the environment against economic benefits of the development – it is a threshold that must be met before there is any consideration at all about compensatory measures such as offsets. As stated by McKenney and Kiesecker, '[i]n evaluating the proposed impact site against

[57] *Threatened Species Conservation Act 1995* (NSW), Part 2. For a description of the listing process, see Preston and Adam, Describing and Listing Threatened Ecological Communities: Part 1, above n 9; Brian J Preston and Paul Adam, 'Describing and Listing Threatened Ecological Communities under the Threatened Species Conservation Act 1995 (NSW): Part 2 – The Role of Supplementary Descriptors and The Listing Process' (2004) 21 *Environmental and Planning Law Journal* 372.
[58] Council Directive 92/43/EEC, above n 45, art 6(4).
[59] European Commission, *Guidance Document on Article 6(4) of the 'Habitats Directive' 92/43/EEC* (2012), 7 http://ec.europa.eu/environment/nature/natura2000/management/docs/art6/new_guidance_art6_4_en.pdf. See also McKenney and Kiesecker, above n 33, 167.

potential alternatives, the main criterion is which site represents the least environmentally damaging option'.[60]

Wetlands mitigation in the United States first aims to avoid adverse impacts to the 'maximum extent practicable'.[61] Any unavoidable impacts are then to be minimised 'to the extent appropriate and practicable' and any remaining impacts require compensatory mitigation.[62] The word 'practicable' is defined in US regulations to mean 'available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes'.[63] Consideration of some economic factors is therefore permitted in ascertaining whether adverse impacts need to be avoided. However, the requirement that impacts are to be avoided to the "maximum extent" practicable minimises the risk that the concept of practicability provides an escape hatch for foot-dragging proponents or agencies.

CRITERIA FOR ENSURING THAT OFFSETTING ACHIEVES ITS PURPOSE

Biodiversity offsetting involves compensating for losses of biodiversity components at an impact site by generating ecologically equivalent gains elsewhere.[64] The uniting principle of biodiversity offset policies and programs around the world is one of achieving "no net loss". The meaning of no net loss is essentially that biodiversity gains achieved through offsets should be greater than the residual biodiversity losses that are caused by adverse impacts for a given development.[65]

Some conservation biologists argue that the domain within which offsetting is an appropriate response to adverse impacts to biodiversity is limited.[66] Offsetting that does come within that domain should satisfy a number of criteria for ensuring that any biodiversity loss is fully compensated for. The criteria for ensuring that offsetting

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[60] McKenney and Kiesecker, above n 33, 167.
[61] McKenney and Kiesecker, above n 33, 167, citing USEPA and USDA, above n 23.
[62] Ibid.
[63] *Protection of Environment*, 40 CFR § 230.3(l) (27 August 2015).
[64] Maron et al, Faustian Bargains, above n 31, 142 (Table 1).
[65] Joseph Bull, 'Comparing Biodiversity Offset Methodologies: Divergence in Securing "No Net Loss"' (2015) 85 *Decision Point* 6.
[66] Maron et al, Faustian Bargains, above n 31, 145.

achieves its purpose have been elucidated throughout the scientific literature, most noticeably over the past ten years. This article considers the recurring criteria from this body of literature and places them into four categories. The first two categories relate to the offset principle of equivalence, the third relates to the offset principle of additionality and the fourth relates to effective implementation and compliance.

Ecological equivalence in biodiversity offsetting is satisfied when 'the types of biodiversity values lost and gained are the same in nature and magnitude'.[67] In determining what sort of offset is required to fully compensate for lost biodiversity, the use of a single metric such as "area of habitat" has been widely discredited.[68] The use of simplified metrics that do encapsulate multiple components but produce a single value can likewise increase the risk that offsets will not be "like for like" because losses and gains in individual components can be masked by the single end value.[69] In contrast, the use of multiple metrics may result in a 'more comprehensive understanding of biodiversity losses and gains'.[70] Multiple aspects of equivalence need to be taken into account when determining the nature and magnitude of an offset site.

The first equivalence category will be referred to as "type equivalence" and is divided into three sub-categories: equivalency in the type of biodiversity, equivalency in the amount of biodiversity and equivalency in space and landscape context. The second category will be referred to as "equivalency in time" and is divided into two sub-categories: time lag and longevity. The third category refers to additionality, and requires that the biodiversity gains are caused by the offset actions and not by other factors that would have caused biodiversity gain in any event. The fourth category relates to effective implementation and compliance, ensuring that offsetting is completed and conservation gains supplied.

[67] Ibid 142 (Table 1).
[68] Bull et al, Biodiversity Offsets in Theory and Practice, above n 35, 371.
[69] Maron et al, Faustian Bargains, above n 31, 145.
[70] Bull et al, Biodiversity Offsets in Theory and Practice, above n 35, 371.

Type equivalence

To truly be compensatory, a biodiversity offset must be of the same type as the biodiversity that is lost. By "type equivalence" this article is referring to the need for components of biodiversity at an offset site to be equivalent to the components of biodiversity at an impact site. Because biodiversity cannot be easily measured, measurable components of biodiversity 'that adequately represent the range of biological phenomena in the project area and contribute the most to the overall biological diversity of a project area' need to be considered.[71]

Type equivalence needs to be addressed in both form (what it is) and function (what it does). It is not enough for specimens of a particular species of tree to be offset by specimens of the same species if the new specimens are not in a state to provide the same function (such as faunal habitat) as what was lost. Equally, it is not enough for a function provided by a specimen of a particular species of tree (again, such as faunal habitat) to be offset by a specimen of a completely different species of tree because that would inevitably result in biodiversity loss. For a biodiversity offset to have type equivalence it must be equivalent in form and function.

In kind offsets, as described earlier, should satisfy all type equivalency criteria. Out of kind offsets, by definition, do not satisfy the type equivalency criteria. As set out earlier, out of kind offsets might only be useful where in kind offsets are not possible and, as put forward by Bull et al, where 'trading losses in habitat of low conservation significance for gains in threatened habitat'.[72]

Equivalency in the type of biodiversity

Equivalency in the type of biodiversity is fundamental to biodiversity offsetting achieving the goals of compensating for biodiversity loss and resulting in no net loss of biodiversity. Put simply, equivalence in the type of biodiversity requires that impacts on biodiversity are offset in a like for like manner. This requires equivalence

[71] Joseph M Kiesecker et al, 'A Framework for Implementing Biodiversity Offsets: Selecting Sites and Determining Scale' (2009) 59 *BioScience* 77, 79.
[72] Bull et al, Biodiversity Offsets in Theory and Practice, above n 35, 373.

between the components of biodiversity, and their habitat, that will be lost at the impact site and that will be gained at the offset site. This means that species of flora and fauna must be offset with the same species of flora or fauna, plant community types must be offset with the same or closely related plant community types, and aquatic habitat must be offset with the same aquatic habitat.

Different types of components of biodiversity and their habitats are not substitutable. For example, the loss of one vegetation type cannot be offset by restoration of a different vegetation type.[73] Similarly, the loss of individuals of one species of fauna or of their habitat cannot be offset by measures to increase the population of another species of fauna or to restore the habitat of another species of fauna.

More particularly, equivalence in the type of biodiversity requires identification and conservation of the particular aspects of the habitat of the type of biodiversity that will be impacted and restored. Different elements of habitat such as tree canopy, shrub layer and ground cover, coarse woody debris, tree hollows etc are not substitutable; otherwise habitat elements that are difficult or expensive to conserve or restore will continue to decline and be replaced by the growth of easier and cheaper habitat elements.[74]

In each of the above examples of non-equivalence, the losses of biodiversity remain uncompensated and there is a net loss of biodiversity.

Failure to satisfy equivalency in the type of biodiversity has been instrumental in courts not accepting proposed biodiversity offsets. In *Sanctuary Investments Pty Ltd v Baulkham Hills Shire Council*,[75] the Land and Environment Court of New South Wales found that the loss of an area of endangered ecological community of Sydney Turpentine-Ironbark Forest would not be offset by the preservation of a smaller area of the different endangered ecological community of Sydney Blue Gum High Forest some 12 km distant from the impact site.[76] In *Glendinning Minto Pty Ltd v Gosford*

[73] Bekessy et al, above n 31, 156.
[74] Ibid.
[75] [2006] NSWLEC 733; (2006) 153 LGERA 355.
[76] *Sanctuary Investments Pty Ltd v Baulkham Hills Shire Council* [2006] NSWLEC 733; (2006) 153 LGERA 355, 369 [58].

City Council,[77] the Land and Environment Court found that the loss of two areas of two vegetation communities, Red Bloodwood-Scribbly Gum-Heathy Woodland and Hairpin Banksia-Slender Tea Tree heath, and a known population of an endangered plant, *Hibbertia procumbens*, would not be offset by the conservation at another site of a different vegetation community, Sandstone Hanging Swamps, and habitat for a different endangered plant, *Darwinia glaucophylla*, as well as potential (but not established) habitat for the endangered plant, *Hibbertia procumbens*.[78] In *Bulga Milbrodale Progress Association Inc v Minister for Planning and Infrastructure and Warkworth Mining Ltd*,[79] the Land and Environment Court found that the loss of large areas of endangered ecological communities, including the short-range endemic community of Warkworth Sands Woodland, would not be offset by the preservation and restoration of other areas of different Ironbark forest and woodland vegetation communities.[80]

Genetic diversity is a component of biodiversity.[81] There are two important aspects of genetic diversity – the size of the local population gene pool and the presence of unique alleles (different forms of the same gene) in individual populations. To truly compensate for biodiversity loss, there should be equivalence of genetic diversity at the impact site and the offset site. For example, if individuals of a threatened species of plant are lost at the impact site and are also found at the offset site, in one respect there is equivalency in the component of biodiversity, but this might still be insufficient if the plants at the impact site are genetically different from the plants at the offset site. If so, there would be a net loss of genetic diversity, notwithstanding the species similarity of the plants at the impact and offset sites. Conservation of biological diversity requires conservation of significant genetic within-species variation, including by conservation of viable populations of all genetically isolated taxa within a species.[82] Understanding patterns of biodiversity loss is important for

[77] [2010] NSWLEC 1151.
[78] *Glendinning Minto Pty Ltd v Gosford City Council* [2010] NSWLEC 1151 at [66], [67], [69], [82], [83], [85]-[87].
[79] [2013] NSWLEC 48; (2013) 194 LGERA 347.
[80] Ibid 389-390 [203]-[205].
[81] *Threatened Species Conservation Act 1995* (NSW), s 4.
[82] Tony D Auld and David A Morrison, 'Genetic Determination of Erect and Prostrate Growth Habit in Five Shrubs from Windswept Headlands in the Sydney Region' (1992) 40 *Australian Journal of Botany* 1, 9-10.

biodiversity conservation because 'the capacity for future evolution is based, at least in part, on the depth of the gene pool'.[83]

Different species have different ecological amplitudes (ecological amplitudes are the limiting environmental conditions within which an organism can live). Species, with an intermediate ecological amplitude (and originally high genetic diversity) are more sensitive to sudden habitat decline than species with either especially high or especially low ecological amplitude.[84] This is because such intermediate species are in need of gene flow at the population level to maintain high genetic diversity – 'they are not adapted to maintain their essential level of genetic diversity in single small and isolated habitat fragments'.[85] Habel and Schmitt suggest that this has caused sudden and therefore unexpected extinctions in some species.[86] Such sensitivities are an example of why it is important to consider genetic diversity in decisions regarding biodiversity conservation such as the use of biodiversity offsets.

There is less commentary in the biodiversity offsetting literature on genetic equivalence than on the other subcategories of equivalence described in this article. Burgin identifies genetic diversity as an aspect of biodiversity that is important for long term survival of a species and counts genetics as one of the major areas of science that should underpin decisions relating to biodiversity offsetting.[87] However, despite the value of including evolutionary and genetic information in conservation being well established, it is rarely considered in policy and management.[88] Burgin goes so far as to say that the importance of genetics in conservation 'is largely ignored'.[89] In the restoration ecology literature, however, there is growing recognition of the need to conserve genetic diversity in ecological restoration,

[83] Janna R Willoughby et al, 'The Reduction of Genetic Diversity in Threatened Vertebrates and New Recommendations Regarding IUCN Conservation Rankings' (2015) 191 *Biological Conservation* 495, 496.
[84] Jan Christian Habel and Thomas Schmitt, 'The burden of genetic diversity' (2012) 147 *Biological Conservation* 270, 272-273.
[85] Ibid.
[86] Ibid 273.
[87] Shelley Burgin, 'BioBanking: an Environmental Scientist's View of the Role of Biodiversity Banking Offsets in Conservation' (2008) 17 *Biodiversity Conservation* 807, 811.
[88] Laura J Pollock et al, 'Phylogenetic Diversity Meets Conservation Policy: Small Areas are Key to Preserving Eucalypt Lineages' (2015) 370(1662) *Philosophical Transactions of the Royal Society B: Biological Sciences* 1, 1.
[89] Burgin, above n 87, 811.

including by collection and use of local provenance seeds, so as to match the habitats of the restoration (offset) site and donor (impact) site.[90]

Equivalency in the amount of biodiversity

A like for like offset must yield gains of an equivalent amount of the type of biodiversity compared to the loss of that type of biodiversity at the impact site. This requires quantitative measurement of the losses and gains to biodiversity and the scaling of compensatory gains.[91] The amount of biodiversity loss and gain can be measured in various ways, the appropriate way depending on the type of biodiversity impacted, including hectares, habitat hectares and species population sizes.[92]

The process for loss-gain calculations for biodiversity offsets generally involves four steps. First, select the type of biodiversity to be included in the offset calculation at the impact and offset sites, such as the species or ecological community. [93]

Second, select methods to collect data on the amounts of each biodiversity component in the field, such as measuring the quantities of these components directly (eg species abundance, canopy cover, or surface area of an ecosystem) or indirectly through a surrogate or indicator of the component of biodiversity (eg habitat area and quality as indicators of the abundance of a species). [94]

Third, convert the data (the measures/counts/metrics) into a fungible currency or currencies to allow comparison of biodiversity losses and gains. An example is Extent x Condition currencies involving a multiplication of quantity (extent) and quality (such as condition) eg the multiplication of the surface area of an ecosystem or habitat (or length for streams or volume for marine ecosystems) by the condition

[90] Kristina M Hufford and Susan J Mazer, 'Plant Ecotypes: Genetic Differentiation in the Age of Ecological Restoration' (2003) 18 *Trends in Ecology and Evolution* 147; Siegfried L Krauss and Tian Hua He, 'Rapid Genetic Identification of Local Provenance Seed Collection Zones for Ecological Restoration and Biodiversity Conservation' (2006) 14 *Journal for Nature Conservation* 190; Kristine Vander Mijnsbrugge, Armin Bischoff and Barbara Smith, 'A Question of Origin: Where and How to Collect Seed for Ecological Restoration' (2010) 11 *Basic and Applied Ecology* 300.
[91] IUCN and ICMM, above n 21, 17.
[92] Ibid 20.
[93] Ibid 22-23, 24-25.
[94] Ibid.

(quality) of the ecosystem or habitat, to derive a unit of currency that can be compared (eg 100 ha of forest at 50% condition equates to 50 habitat hectares whereas at 25% condition equates to 75 habitat hectares, both of which can be compared against a benchmark pristine forest of 100 ha regarded as being at 100% condition). [95]

Fourth, decide on the adjustments needed to achieve a fair exchange (to meet the objective of no net loss), including considering ratios, multipliers, time discounting, uncertainty and risk.[96]

The condition of the impact and offset sites may be affected by the extent (the size) of the sites but also by the shape, configuration and proportion of edge habitats (edge to area ratio) of the sites.

Bekessy et al emphasise that condition should not be used as the sole metric for determining offsets because habitats of high value, for example threatened ecosystems, are often found in a degraded state. To address this, the irreplaceability of an ecosystem should also be incorporated when determining how much compensation is required.[97] In addition, the dynamic nature of landscapes should not be overlooked when determining offset sites. For example, recently burned patches of vegetation that might be lost due to a proposed development should not be inadequately compensated for because they happen to temporarily lack certain habitat characteristics at the time that an offset site is being planned.[98]

Equivalency in space and landscape context

Biodiversity offsets should be designed and implemented to achieve equivalence in space and landscape context. Equivalency in space refers to the proximity of the offset site to the impact site. Situating offset sites near impact sites is a commonly used rule-of-thumb to improve equivalency in ecosystem composition: nearby sites

[95] Ibid.
[96] Ibid.
[97] Bekessy et al, above n 31, 154.
[98] Ibid 154-155.

are more likely to have similar species and habitats, and perform similar ecosystem functional roles.[99]

As discussed earlier, ecological equivalence must be in both form and function. Function includes the ecosystem services that are provided by the biodiversity to the surrounding landscape or to society. Ecosystem services (such as erosion control, water purification, pollination or provision of forest products)[100] should be compensated for at the offset site if those services are to be diminished at the impact site. In some circumstances, actions beyond offsetting will be required to adequately compensate for loss of ecosystem services at an impact site.[101] Such actions might include watercourse management, enrichment of planting for pollinators, or engineering measures such as erosion control, sedimentation ponds and culverts.[102]

The landscape context of the impact and offset sites is also important. Relevant considerations include the fragmentation and isolation or conversely the connectivity of the sites in their landscape; the value of surrounding native vegetation, including the type, extent and condition of surrounding ecological communities, or conversely of cleared areas; and the possibility of spill over effects or leakage of development impacts onto adjoining biodiversity.[103]

The landscape context also includes the abiotic components of the environment of the impact and offset sites, including the climatic, physiographic and edaphic factors. Climatic factors include precipitation, temperature, light, wind, humidity and fire. Physiographic factors include topographical elements such as aspect, slope, drainage and microclimates, and elevation. Edaphic factors include the physical, chemical and biological properties of the soils and the parent rock from which the soils are derived.[104] Even if the impact and offset sites are proximate to one another there may be material differences in aspects of their abiotic environments, which affect their equivalency.

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[99] IUCN and ICMM, above n 21, 47; see also Kiesecker et al, A Framework for Implementing Biodiveristy Offsets, above n 71, 80.
[100] IUCN and ICMM, above n 21, 35.
[101] Ibid 34-36.
[102] Ibid 35-36.
[103] Bull et al, Biodiversity Offsets in Theory and Practice, above n 35, 372.
[104] Preston and Adam, Describing and Listing Threatened Ecological Communities: Part 2, above n 57, 378-379.

Concerns about the lack of equivalency in space and landscape context were influential in the Land and Environment Court's decisions to not accept the biodiversity offsets proposed for a large, open cut coal mine[105] and a residential subdivision[106] impacting endangered ecological communities.

Time equivalence

In order for offsets to truly compensate for biodiversity loss there must also be equivalency in time. Biodiversity offset gains must be realised within an appropriate timescale for the biodiversity concerned. For example, a biodiversity offset proven to be equivalent in type, amount and space will still not effectively compensate for losses if it only achieves its goals in 100 years' time[107] or if the offset and the gains it provides do not endure for the period that the impact occurs.[108] There are two aspects of time equivalence: time lag and longevity.

Time lag

When biodiversity offsets are used in practice, there will very often be a time lag between the loss of biodiversity at the impact site and the attainment of biodiversity gains at the offset site.[109] Time lag is a problem where biodiversity values at the impact site are destroyed before the equivalent biodiversity values at the offset site have matured.[110] This is often the case because while some restoration activities are capable of an immediate effect, other restoration activities may not achieve their goal for years or even decades.[111] As an extreme example, trees can take upwards of 120 years to form hollows that perform the equivalent ecological function of old,

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[105] *Bulga Milbrodale Progress Association Inc v Minister for Planning and Infrastructure and Warkworth Mining Ltd* [2013] NSWLEC 48; (2013) 194 LGERA 347, 389 [203].
[106] *Sanctuary Investments Pty Ltd v Baulkham Hills Shire Council* [2006] NSWLEC 733; (2006) 153 LGERA 355, 369 [58].
[107] IUCN and ICMM, above n 21, 47.
[108] Ibid 31.
[109] Bull et al, Biodiversity Offsets in Theory and Practice, above n 35, 373; Maron et al, Faustian Bargains, above n 31, 145.
[110] Gibbons and Lindenmayer, above n 29, 29.
[111] Maron et al, Faustian Bargains, above n 31, 145.

hollow bearing trees that have been cleared.[112] As a less extreme example, research found that planted vegetation (as opposed to remnant vegetation) up to 20 years old was still inferior habitat for some fauna species when compared to remnant vegetation.[113]

When determining the appropriate offsets for biodiversity loss, what this hiatus means in practical terms must be considered. Bekessy et al state that it is possible for populations to drop below minimum viable population size during a period of time lag.[114] Maron et al state that long time lags may result in 'severe resource bottlenecks, during which a target species or community suffers increased vulnerability to other threats'.[115]

Where the biodiversity performs an important ecological function, such as an ecological corridor of importance for regional fauna migration, even the temporary loss of the area would cause long-term impacts on fauna populations. Another example of an ecological function that might be lost if clearing occurs before the offset matures is the essential breeding and feeding resources required by migratory species for short periods each year, such as migratory bird stopover sites or seasonal fruits and flowers for nomadic fauna species.

Biodiversity loss should not be allowed to occur where time lag would present an unacceptable risk to species, populations or ecosystem processes, even if the risk is temporary.[116] If time lag does present such risk, then the offset is not actually achieving its goal of fully compensating for biodiversity loss.

In *Gerroa Environment Protection Society Inc v Minister for Planning and Cleary Bros (Bombo) Pty Ltd*,[117] the Land and Environment Court addressed the risk posed by time lag by not permitting clearing of an existing wildlife corridor until sufficient

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[112] Gibbons and Lindenmayer, above n 29, 28, citing P Gibbons and D Lindenmayer, *Tree Hollows and Wildlife Conservation in Australia* (CSIRO Publishing, 2002).
[113] Gibbons and Lindenmayer, above n 29, 28, citing RB Cunningham et al, 'Reptile and Arboreal Marsupial Response to Replanted Vegetation in Agricultural Landscapes' (2007) 17 *Ecological Applications* 609.
[114] Bekessy et al, above n 31, 153, citing ML Shaffer, 'Minimum Population Sizes for Species Conservation' (1981) 31 *BioScience* 131.
[115] Maron et al, Faustian Bargains, above n 31, 145.
[116] Gibbons and Lindenmayer, above n 29, 29.
[117] [2008] NSWLEC 173.

functionality of a restoration offset that would operate as a replacement wildlife corridor was established.[118] The existing wildlife corridor was removed in 2015 after six years of annual reporting showed showing that the new Northern Corridor was operating as required by the conditions of consent.[119] In its seventh annual report in 2015, the proponent company stated that a review by a qualified ecologist found that 'indigenous plant species now established and growing in the Establishing Northern Corridor meet or exceed the requirements set out in the consent conditions' and that 'surveys for vertebrate animals in the Establishing Northern Corridor demonstrate an increase in the cumulative number of species present each time the surveys are carried out'.[120] This came seven years after the Land and Environment Court approved the consent conditions in 2008.

Longevity

For an offset to be truly compensatory, the gain in biodiversity at the offset site must continue at least for the duration of the loss at the impact site.[121] This is the offset principle of performance or longevity. The duration of the offset and the gains it yields need to be secured over time frames that can span changes in land ownership and tenure.[122] The duration will normally need to be in perpetuity because there will rarely be a complete reversal of the impact. Longevity can be secured through a variety of mechanisms, including insurance mechanisms, changing land tenure such as dedication as legal protected areas, and using land tenure agreements or instruments.

Additionality

Offsets must be supplementary and result in additional biodiversity conservation gain. This is the principle of additionality. It requires that offset gains are caused by

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[118] Ibid at [131].
[119] Cleary Bros, *Gerroa Sand Resource Annual Environmental Management Report: Period 01 July 2014 – 30 June 2015* (Cleary Bros (Bombo) Pty Ltd, 2015), page 1 of Annexure C. http://www.clearybros.com.au/page/projects/gerroa-sandmine-/environmental-reports-2008-2015/environmental-reports-2014-2015/
[120] Ibid 43.
[121] Bull et al, Biodiversity Offsets in Theory and Practice, above n 35, 373; Gibbons and Lindenmayer, above n 29, 30; Mckenney and Kiesecker, above n 33, 172.
[122] Gibbons and Lindenmayer, above n 29, 30.

offset actions and not by other factors or that the gains would not have happened in any event. Biodiversity gains must come about as a result of the conservation actions financed through the offset. If biodiversity gains are not caused by the offset actions, the offset does not demonstrate additionality. Where there is a little or no additionality, essentially no offset occurs and the residual impacts of the development on biodiversity remain.[123]

The IUCN and ICMM provide examples of offsets that do *not* demonstrate additionality:

- funding of protected areas that are already sufficiently financed by government programs
- protection of ecosystems such as forests or wetlands that are not threatened nor undergoing degradation: in these cases, intervention (eg putting a fence around a forest to protect it) would lead to no material change in reality
- investment in an offset for economic reasons, such as a tourist lodge: in this case, the investment would have happened anyway, and so would the biodiversity gains – hence, using this as an offset would not be additional to the business-as-usual scenario
- improvement in the condition of habitat through management financed by government (EU, Australian, etc) schemes to incentivize landowners to manage their land for biodiversity – once again, these outcomes are the product of existing incentives or actions, so the gains cannot be used to compensate for the impacts at a development site.[124]

Effective implementation and compliance

Ensuring that biodiversity offsets satisfy the criteria of type equivalence and time equivalence is necessary, but it will be insufficient if they are not implemented in practice. Whether offsets are effective or not is 'ultimately dependent upon adequate compliance'.[125] Without proper compliance, biodiversity offsets will not truly compensate for the loss of biodiversity at the impact site. Mechanisms need to be put in place to ensure long term implementation and compliance, including legal, financial, management and monitoring mechanisms.

[123] IUCN and ICMM, above n 21, 19.
[124] Ibid 19.
[125] Gibbons and Lindenmayer, above n 29, 30.

UNCERTAINTY AND RISK

Causes and types of uncertainty

Even where biodiversity offsets are planned to satisfy the criteria for equivalence, additionality and compliance, there remain issues around whether future gains will be achieved due to uncertainty and risk. Uncertainty and risk for offsetting projects come from a combination of factors relating to ecological uncertainty (type equivalence and time equivalence), uncertainty as to the additionality of the offset, and uncertainty in the actions of developers and offset providers (compliance).[126]

Uncertainty in ecology is of two main types: epistemic uncertainty (uncertainty in determinate facts) and linguistic uncertainty (uncertainty in language).[127] Epistemic uncertainty is uncertainty associated with the knowledge of the state of a system and includes measurement error (limitations in measuring equipment and observational techniques); systematic error (bias in the measuring equipment or the sampling procedures); natural variation (biological systems that change with respect to time, space or other variables in ways that are difficult to predict); apparent inherent randomness (biological systems and processes that appear random because of incomplete information); model uncertainty (arising from imperfect representations of physical and biological systems); and subjective judgment (interpretation of data, particularly when data is scarce and error prone).[128]

Linguistic uncertainty arises because the language, both legal and scientific, used in relation to biodiversity, and the impacts and offsetting of the impacts on biodiversity, is uncertain in many respects. Linguistic uncertainty arises from the vagueness, context dependence, ambiguity, indeterminacy of theoretical terms, and underspecificity or unwanted generality in the language used.[129]

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[126] Bull et al, Biodiversity Offsets in Theory and Practice, above n 35, 376.
[127] Helen M Regan, Mark Colyvan and Mark A Burgman, 'A Taxonomy and Treatment of Uncertainty for Ecology and Conservation Biology' (2002) 12 *Ecological Applications* 618, 618.
[128] Ibid 618-621.
[129] Ibid 621-624.

Take as an example an endangered ecological community. The concept of an endangered ecological community refers to an ecological community that has been listed as endangered under threatened species legislation. The language in which the ecological community is described in the listing inevitably is uncertain. This generates linguistic uncertainty. The New South Wales Court of Appeal has said of the statutory listing process for endangered ecological communities that '[t]he intricacy of all ecological communities means that some indeterminateness is bound to arise from the form of expression used to describe them'.[130] Adam explains that the concept of "ecological community" in itself is a key source of uncertainty in biodiversity legislation. Even within the ecological science community, there is debate around the concept of ecological community that goes back to the early 20th century and is as of yet unresolved. There remains 'a very broad spectrum of views … about the nature, definition and utility of the concept of ecological community'. [131]

The statutory description of the endangered ecological community, however it is expressed, needs to be applied to the ecological communities that occur on the impact and offset sites to ascertain whether they fall within or without the statutory description. This requires collection and interpretation of data from the impact and offset sites. Inevitably, there will be epistemic uncertainty in describing the ecological communities. Matching the statutory description of an endangered ecological community (with its linguistic uncertainty) to the survey data and other factual information about the ecological community that occurs at the impact and offset sites (with the epistemic uncertainty) introduces further uncertainty into the process.[132]

The same linguistic and epistemic uncertainties that arise when planning biodiversity offsets for an endangered ecological community are also applicable when planning offsets for a particular species. Linguistic uncertainty in defining a biodiversity offset for a species could, for example, be introduced through the statutory definition of the

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[130] *VAW (Kurri Kurri) Pty Ltd v Scientific Committee* [2003] NSWCA 297; (2003) 58 NSWLR 631, 635 [9] (Spigelman CJ).
[131] Adam, Ecological Communities, above n 2, 19-20.
[132] For a comprehensive analysis of the linguistic and epistemic uncertainty that arises in the statutory listing process for endangered species see Preston and Adam, Describing and Listing Threatened Ecological Communities: Part 1, above n 9; Preston and Adam, Describing and Listing Threatened Ecological Communities: Part 2, above n 57.

word “species”. In the TSC Act, the word “species” is defined to include ‘any defined sub-species and taxon below a sub-species in any recognisable variant of a sub-species or taxon’.[133] This definition has been described as inclusive and pragmatic but it does not actually articulate any particular concept of species. There is considerable debate in the biological literature as to the definition and nature of the concept of species. Species concepts include the biological, morphological and phylogenetic species concepts.[134] In contrast, the *Environmental Protection and Biodiversity Conservation Act 1999* (Cth) does use the biological species concept in its definition of the word.[135] This highlights the importance of being aware of and addressing linguistic uncertainty when planning biodiversity offsets.

Returning to the requirements for equivalence, there can be uncertainty in the interpretation and application of the criteria for type equivalence (biodiversity type, amount, and space and landscape context) and time equivalence (time lag and longevity). There can also be uncertainty in determining whether there will be additionality and compliance.

The risks that uncertainty introduces are of underestimating the biodiversity loss at the impact site, overestimating the biodiversity gain at the offset site, or otherwise incorrectly concluding that the objective of no net loss in biodiversity will be assured. Each of these errors would mean that the offset site will be inadequate to compensate fully for the loss of biodiversity at the impact site.

There is further uncertainty and risk associated with restoration offsets. In general, it cannot be assumed that efforts to restore a degraded area will successfully result in restoration to a state comparable to an impact site.[136] Current understanding of restoration science suggests that 'complete reconstruction of only relatively simplified native vegetation is feasible’.[137] While revegetation may create habitat for some species, 'recreation of ecosystems with all component species and functions has

[133] *Threatened Species Conservation Act 1995* (NSW), s4(1).
[134] Preston and Adam, Describing and Listing Threatened Ecological Communities: Part 1, above n 9, 251-252.
[135] *Environmental Planning and Biodiversity Conservation Act 1999*, s 528.
[136] Maron et al, Faustian Bargains, above n 31, 143.
[137] Gibbons and Lindenmayer, above n 29, 29.

proved prohibitively expensive or impossible'.[138] Uncertainty around achieving restoration outcomes is particularly high where the offset site is significantly modified (abandoned farmland, for example) or where strong abiotic drivers of ecosystem processes (such as hydrological factors) need to be reversed.[139] Uncertainty may be relatively lower, however, where the offset involves the removal of a threatening process such as controlling of invasive species, or where only particular biotic elements need to be restored.[140]

Not only is there uncertainty concerning whether the offset will mature at all, there can also be uncertainty concerning the state into which the offset will mature. '[E]cosystems cannot generally be shoehorned into a predetermined restoration trajectory'[141] and there are multiple examples of where habitat that is recreated on a highly degraded site does not resemble the original target ecosystem.[142] The process of ecological succession is not fixed and an ecological community can develop along different successional pathways leading to different seral communities and climax communities.

Uncertainty is also introduced by risk from stochastic events such as fire, storms or disease, and can be 'further exacerbated by the potential for interaction effects from background climate variability and environmental change'.[143] Uncertainty can also come from the influence of cumulative effects of other existing and likely future activities in and around the impact and offset sites.

It is known that climate has ultimate control over the broad outer limits of species distribution; it follows that changes to the earth's climate will be reflected in changes

[138] Bekessy et al, above n 31, 152, quoting S Wilkins, DA Keith and P Adam, 'Measuring Success: Evaluating the Restoration of a Grassy Eucalypt Woodland on the Cumberland Plain, Sydney, Australia' (2003) 11 *Restoration Ecology* 489.
[139] Maron et al, Faustian Bargains, above n 31, 145; Norton, above n 40, 704, both citing Robert H Hilderbrand, Adam C Watts and April M Randle, 'The Myths of Restoration Ecology' (2005) 10 *Ecology and Society* 19.
[140] Maron et al, Faustian Bargains, above n 31, 144, 145, citing Hilderbrand, Watts and Randle, above n 139.
[141] Gibbons and Lindenmayer, above n 29, 28, citing Hilderbrand, Watts and Randle, above n 139.
[142] Maron et al, Faustian Bargains, above n 31, 144.
[143] Ibid 145, citing James A Harris et al, 'Ecological Restoration and Global Climate Change' (2006) 14 *Restoration Ecology* 170.

to species' distribution and ecology.[144] To survive the continued onset of anthropogenic climate change, many species may need to relocate in order to remain 'within their envelope of climate tolerance'.[145] This is one way that climate change introduces uncertainty into biodiversity offsetting. For example, what if a particular faunal species is the target of a biodiversity offset plan, but years or decades into the future that species is no longer able to survive in the altered climatic conditions existing at the offset site? In such a case, there would be a net loss of biodiversity.

There is also uncertainty around the practical implementation of biodiversity offsets (compliance). There will always be a risk of non-compliance. Non-compliance can take a variety forms, for example: non-compliance with the mitigation hierarchy, proposing insufficient compensation, offsets not being implemented or offsets only being partially implemented.[146]

Mechanisms to reduce uncertainty

It is important that planning for biodiversity offsets consider all relevant types of uncertainty.[147] Mechanisms have been proposed to alleviate the uncertainties and risks regarding criteria of equivalence and compliance. This article briefly describes eight such mechanisms, five intended to deal with uncertainty in equivalence (averted loss offsets, offset banks, adaptive management, time discounting and bet hedging) and three intended to deal with uncertainty in compliance (insurance, legal obligations and bonds).

Averted loss offsets

One potential way of dealing with uncertainty is by protecting a site with the desired biodiversity that would otherwise be lost (a protection or averted loss offset) instead of restoring the desired biodiversity on an already degraded site (a restoration

[144] Paul Adam, 'Going with the Flow? Threatened Species Management and Legislation in the Face of Climate Change' (2009) 10(S1) *Ecological Management and Restoration* S45.
[145] Ibid S46.
[146] Bull et al, Biodiversity Offsets in Theory and Practice, above n 35, 374.
[147] Ibid 375.

offset). This sort of protection offset is also known as an averted loss offset and reduces risk and uncertainty associated with a restoration offset achieving the desired biodiversity gain. The desired biodiversity already exists on the averted loss offset site at the time the biodiversity loss occurs on the impact site. There is, therefore, no risk that the offset will not mature, that it will take many decades to mature, or that it will mature into something other than the target ecosystem.

However, despite averted loss offsets having some advantages, they are strongly criticised due to the limited circumstances under which they result in true additionality.[148] This is because the goal of no net loss relies on the accuracy of the proposition that the loss of biodiversity at the offset site would have occurred in the absence of additional protection. The use of averted loss offsets introduces a new risk that the protection of a site will be permitted as an offset, 'even if loss of the offset site itself would have had to be offset'. In this way, according to Maron et al, 'averted loss can only generate "gains" compared to a baseline of ongoing decline'.[149] Bekessy et al proffer that the use of averted loss offsets at all 'admits defeat from the outset', stating that '[a]n effective net-gain policy would ensure that future losses, if unavoidable, would themselves be offset'.[150]

Offset banks

To address uncertainties relating to time lag, the use of a biodiversity "savings bank" has been suggested in order that biodiversity offsets are realised (have reached ecological equivalence) before any biodiversity loss occurs at an impact site.[151] Such banks work by allowing landholders to generate "credits" by enhancing and protecting biodiversity values on their land that can be subsequently sold to offset biodiversity loss from development.[152] However, great care must be taken to ensure

[148] Maron et al, Faustian Bargains, above n 31, 145.
[149] Ibid 142, see also 145-146; see also Martine Maron, Jonathan R Rhodes and Philip Gibbons, 'Calculating the Benefit of Conservation Actions' (2013) 6 *Conservation Letters* 359; Maron et al, 'Locking in Loss: Baselines of Decline in Australian Biodiversity Offset Policies' (2015) 192 *Biological Conservation* 504.
[150] Bekessy et al, above n 31, 152.
[151] Ibid 153; Norton, above n 40, 704.
[152] Burgin, above n 87, 809.

that any offset credits generated amount to restoration that is above and beyond the landholder's standard "duty of care" or existing legislative obligations.[153]

Maron et al disagree with the effectiveness of the savings bank approach explaining that in places where much restoration is already conducted on a voluntary basis by individual landholders or community groups, the creation of an offsets savings bank could create a temptation for selling credits, despite the fact that they can then be used to trade for biodiversity destruction elsewhere, effectively eroding the genuine additionality of offsets.[154]

Adaptive management

The actions being used at an offset site in order to restore habitat and achieve biodiversity gains should be periodically monitored and reviewed; management should not be 'set in concrete at the outset' but instead must be able to adapt and change if the intended goals are not being reached.[155] Adaptive management is an approach for managing ecosystems for conservation of biodiversity that has gained worldwide interest and support[156] and can help to resolve the uncertainties around the achievement of restoration goals in offsetting.[157] For this type of management, dual objectives for both restoration and for learning are set when offsets are initially planned.[158]

Adaptive management involves dealing with uncertainty through 'a structured improvement of relevant knowledge, while seeking to minimise risks associated with ongoing management, which inevitably arise from imperfect information about system response'.[159] It is a stepwise/progressive approach to management, not necessarily a method of trial and error.

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[153] Bekessy et al, above n 31, 153.
[154] Maron et al, Faustian Bargains, above n 31, 146.
[155] Gibbons and Lindenmayer, above n 29, 30.
[156] David A Keith et al, 'Uncertainty and Adaptive Management for Biodiversity Conservation' (2011) 144 *Biological Conservation* 1175, 1175.
[157] Maron et al, Faustian Bargains, above n 31, 146.
[158] Ibid.
[159] Keith et al, above n 156, 1175.

Although not directly related to biodiversity offsetting, the New Zealand Supreme Court held in *Sustain Our Sounds v New Zealand King Salmon* that in order for there to be adaptive management there needs to be: good baseline information; effective monitoring of adverse effects with appropriate indicators; thresholds to trigger remedial actions; and the capacity to remedy negative effects before they become irreversible.[160]

Adaptive management approaches to biodiversity offsetting were required by the Land and Environment Court in *Gerroa Environment Protection Society*[161] and in *Newcastle & Hunter Valley Speleological Society Inc v Upper Hunter Shire Council and Stoneco Pty Ltd*.[162] In *Newcastle & Hunter Valley Speleological Society*, the court stated that:

> In adaptive management the goal to be achieved is set, so there is no uncertainty as to the outcome and conditions requiring adaptive management do not lack certainty, but rather they establish a regime which would permit changes, within defined parameters, to the way the outcome is achieved.[163]
>
> …
>
> The conditions of consent requiring monitoring and adaptive management would operate over the life of a project (and, in the case of rehabilitation, beyond it). Over this period there are likely to be changes in technology, understanding of issues and the environment (for example in 30 years time climatic conditions might be different from those currently prevailing). An adaptive management regime provides the potential for addressing changes without creating a requirement to seek formal amendment of conditions.[164]

In that case, the conditions of consent requiring monitoring and adaptive management were to operate over the life of the project and beyond the life of the project where relating to rehabilitation.[165]

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[160] *Sustain Our Sounds Inc v New Zealand King Salmon Company Ltd* [2014] NZSC 40; [2014] 1 NZLR 673 at 702 [105].
[161] *Gerroa Environment Protection Society Inc v Minister for Planning and Cleary Bros (Bombo) Pty Ltd* [2008] NSWLEC 173 at [132].
[162] [2010] NSWLEC 48; (2010) 210 LGERA 126.
[163] Ibid 161 [184].
[164] Ibid 161 [187].
[165] Ibid.

Time discounting

The costs and benefits arising from human activities that impact on the environment may often occur in different time periods. For example, the cost of mitigating greenhouse gas emissions may be incurred in the present but the benefits of that action will only be evident many years, decades or even centuries in the future. Decisions need to be made in the present as to whether the future benefits of reducing greenhouse gases outweigh and therefore justify incurring the costs of greenhouse gas mitigation now. In order to make such decisions the costs and benefits over different periods of time need to be made commensurable. This is commonly done by discounting future costs and benefits back to a present value by applying a discount rate.[166]

The same theory can be applied when calculating the magnitude of biodiversity offsets required to adequately compensate for biodiversity loss.[167] This is one way of dealing with the uncertainty surrounding time lag. The problem is that the loss of biodiversity at the impact site occurs in the present but the gain of biodiversity on a restoration offset site may not accrue until some time in the future.

The present value of a future gain in biodiversity is less than the value of a present gain in biodiversity. There are various factors causing variation in value over time, including:

(a) risk: biodiversity gain in the future is discounted because it may not happen or not happen to the full extent;
(b) lost opportunity cost of the use of biodiversity: the opportunity cost is the loss of value due to temporary biodiversity loss during the impact-offset transaction;
(c) rate of return on biodiversity capital: biodiversity can yield more biodiversity through population growth or regeneration if protected from threatening

[166] See Brian J Preston, 'Economic Valuation of the Environment' (2015) 32 *Environmental and Planning Law Journal* 301, 324-326.
[167] IUCN and ICMM, above n 21, 43, 50.

processes, but temporary biodiversity loss during the impact-offset transaction causes a loss of future biodiversity amount and hence value;

(d) change in the marginal value of biodiversity: for biodiversity, there is frequently deflation due to increased rarity; and

(e) pure time preference: there is a preference for benefits or consumption sooner rather than later.[168]

These factors can be reflected in a time discount rate that is applied to future losses or gains in biodiversity to express them in present value terms.[169]

The present value (PV) of the biodiversity gain from a restoration offset "n" years in the future, when the discount rate is "r", is given by the formula PV=biodiversity gain/$(1+r)^n$. The choice of the discount rate is a topic of ongoing debate, but it should reflect the reasons why time delays matter for biodiversity conservation, including the risk of the offset site not yielding the full biodiversity gain, the lost opportunity cost of the use of biodiversity, the rate of return on biodiversity capital, the change in the marginal value of biodiversity and pure time preferences.[170]

Let me use an example to illustrate how significantly discounted a future biodiversity gain can become. Assume an impact site of 100 hectares of a particular biodiversity type (such as a particular ecological community) in 100% condition is to be developed and all biodiversity value of the impact site will be lost (assume this total loss in biodiversity value equates to 100 BV units). Assume also that there is available an offset site of 100 hectares on which restoration of that particular biodiversity type can be successfully undertaken but it will take 50 years for the biodiversity type to reach 100% condition and hence attain a total biodiversity value of 100 BV units. The present value of a biodiversity gain of 100 BV units 50 years in the future at a discount rate of, say, 5% would be PV=100 BV units/$(1.05)^{50}$, which is

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[168] Jacob McC Overton, RT Theo Stephens and Simon Ferrier, 'Net Present Biodiversity Value and the Design of Biodiversity Offsets' (2013) 42 *Ambio* 100, 102.

[169] Overton, Stephens and Ferrier, above n 168, 103; Atte Moilanen et al, 'How Much Compensation is Enough? A Framework for Incorporating Uncertainty and Time Discounting when Calculating Offset Ratios for Impacted Habitat' (2008) 17 *Restoration Ecology* 470, 472, 475, 477; Frederico Montesino Pouzols, Mark A Burgman and Atte Moilanen 'Methods for Allocation of Habitat Management, Maintenance, Restoration and Offsetting, When Conservation Actions Have Uncertain Consequences' (2012) 153 *Biological Conservation* 41, 42, 47, 49.

[170] Overton, Stephens and Ferrier, above n 168, 107-108.

about 9 BV units. This reveals the problem of time lag. Expressed in present value terms, the immediate loss of biodiversity on the impact site (100 BV units) far exceeds the future gain of biodiversity on the offset site (9 BV units).

The problem of time lag can be solved by inverting the question. Expressed in terms of biodiversity value units, how many biodiversity value units of the desired biodiversity type would be needed 50 years in the future using a discount rate of 5% in order to compensate for the loss today of 100 BV units of that biodiversity type at the impact site. The answer is yielded by the formula $x=100$ BV units$*(1.05)^{50}$, namely 1147 BV units. This could be converted to a ratio of the immediate biodiversity loss to the future biodiversity gain, namely 100 BV units to 1147 BV units or 1:11.47. If biodiversity value is uniformly distributed over the impact site and the offset site, so that each unit of area (such as a hectare) is assumed to yield the same amount of biodiversity value as another unit of area, this would mean that the area of the offset site that would need to be set aside today to compensate for the immediate loss of biodiversity loss on the impact site can be calculated by applying the offset ratio. In the example given, to compensate for the immediate loss of the biodiversity type on 100 hectares of the impact site, 1147 hectares would need to be set aside today on an offset site in order that it may be restored to yield the desired biodiversity gain 50 years in the future.

Time discounting can result in unworkably large numbers, especially where there is a long time lag between the biodiversity loss on the impact site and the biodiversity gain on the offset site. For some endangered species and ecological communities the areas of habitat of the species or ecological community required may exceed what actually exists or is achievable. For proponents of development and offset projects, the areas required may be economically unacceptable.

Bet hedging

Time discounting is a method only for dealing with uncertainty associated with the timing of biodiversity offsets. Time discounting does not overcome the problem of mismatch of biodiversity losses and gains. Applying time discounting as the only means for addressing uncertainty will not result in like for like biodiversity offsets because, using the example given above, even if there will be the desired biodiversity gain on 1147 hectares at the offset site 50 years in the future, there is still no biodiversity gain now. Time discounting also does not alleviate the uncertainties associated with type equivalence such as: whether the amount of biodiversity loss was accurately measured; whether a restoration offset site will develop into the target habitat or ecological community; or whether enough of the offset site will be maintained or mature into the target habitat or ecological community so that the biodiversity loss is fully compensated for.

Issues around uncertainty that are not addressed by time discounting can be dealt with by the use of multipliers. Ordinarily this is done by increasing the area of the offset site to a size beyond the area strictly required to compensate for the biodiversity loss.[171] This is a way of hedging bets.

Using multipliers provides greater probability that a given restoration goal will be achieved by allowing a margin for error and generating environmental room for manoeuvre. Consistent with the precautionary principle, this approach weights actions in favour of environmental benefits in the face of uncertainty.[172] If, for example, we lose 100 hectares of a particular ecological community, but only set aside 100 hectares of an averted loss offset to compensate for that loss, there will be no margin for error. Despite having type equivalency at a particular point in time, there could still be a risk of fire, flood or famine that will compromise the offset site. Applying a multiplier to that assessment, so that greater than 100 hectares are set aside as the averted loss offset, gives a better guarantee that the appropriate biodiversity offset of at least 100 hectares will be maintained into the future.

In *Bulga Milbrodale Progress Association*,[173] the proponent mining company had proposed the removal of 22% of the extant area of the critically endangered Warkworth Sands Woodland ecological community as part of the proposed expansion of its mining operations. An ecological expert witness considered that the removal of that percentage of the extant area significantly exacerbated the risk of the

[171] Bull et al, Biodiversity Offsets in Theory and Practice, above n 35, 373.
[172] *Telstra Corporation Limited v Hornsby Shire Council* [2006] NSWLEC 133; (2006) 67 NSWLR 256, 276 [162].
[173] *Bulga Milbrodale Progress Association Inc v Minister for Planning and Infrastructure and Warkworth Mining Ltd* [2013] NSWLEC 48; (2013) 194 LGERA 347.

ecological community's extinction in the medium term and consequently recommended an upfront offset ratio of 6:1 (achieved through averted loss offsets).[174] However, such an offset ratio would have required some 640 hectares of extant Warkworth Sands Woodland to be set aside as averted loss offsets when only 646.8 hectares of Warkworth Sands Woodland remained in existence. As such, the expert's recommendation, with which the Land and Environment Court agreed, was that impacts on the Warkworth Sands Woodland from the proposed mine expansion needed to be avoided altogether (by being restricted to the impacts already approved under the original development consent).[175]

This example from *Bulga Milbrodale Progess Association* relates to averted loss offsets. Biodiversity offsets that are generated through restoration or rehabilitation generate some uncertainties that do not arise when using averted loss offsets. When restoration offsets are used, multipliers might also increase the probability that the target habitat or ecological community will develop at all, to the extent required, or within a short enough timeframe so that there are no irreversible or unacceptable impacts to other components of the environment in the meantime.

In *Gerroa Environment Protection Society*,[176] while the Land and Environment Court did not expressly describe the application of a multiplier, it was satisfied that offset sites (including restoration offsets) in the order of 20 times the area of vegetation to be lost from the expansion of a sand mine amounted to sufficient compensation for that loss.[177]

Despite the theoretical advantages that multipliers provide in dealing with uncertainty, Bull et al and Maron et al both suggest that the information available in practice is often insufficient to generate realistic multipliers and that arbitrary multipliers that are applied with unclear justification, may be 'insufficient to address

[174] Ibid 394 [234].
[175] Ibid 394 [235]-[236].
[176] *Gerroa Environment Protection Society Inc v Minister for Planning and Cleary Bros (Bombo) Pty Ltd* [2008] NSWLEC 173.
[177] Ibid at [129]-[130].

correlated losses or total failure of an offset scheme'.[178] Bekessy et al are also critical of the use of multipliers on the basis that, owing to the large uncertainties associated with restoring biodiversity, multipliers are 'difficult to compute and likely to be unworkably large'.[179] Multipliers may be so large that they would be both politically and economically unacceptable to proponents of offset projects[180] or, as in the example from *Bulga Milbrodale Progress Association*, so large as to be practically impossible.

Other forms of bet hedging, apart from increasing the area of the offset site using multipliers, include increasing the number of offset sites or simultaneously exploring multiple restoration options/methods in order to spread the risk of failure more widely (in comparison to most restoration projects which simply implement a single management option, usually current best practice).[181]

Insurance

Another possibility for dealing with uncertainty in offsetting is to require proponents of offsetting projects to purchase insurance that will cover the risk of the offset failing.[182] If an offset fails, but the proponent of that project is insured against the failure, there may still be a possibility for the offset ultimately to succeed because attempting to secure the necessary biodiversity gains through a second attempt will not be as prohibitively costly to the proponent as it might have been had the project not been insured. Maron et al argue that the development of an insurance market for biodiversity restoration would also increase clarity around policy requirements and introduce additional incentives to avoid high-risk trades of any offset credits.[183] Insurance is a way of better guaranteeing compliance even in the face of initial offset failure.

[178] Bull et al, Biodiversity Offsets in Theory and Practice, above n 35, 373, see also 375-376; see also Maron et al, Faustian Bargains, above n 31, 145, both citing Moilanen, above n 169.
[179] Bekessy et al, above n 31, 153, citing Moilanen et al, above n 169.
[180] Maron et al, Faustian Bargains, above n 31, 145.
[181] Maron et al, Faustian Bargains, above n 31, 146; IUCN and ICMM, above n 21, 50; Moilanen et al, above n 169, 476.
[182] Maron et al, Faustian Bargains, above n 31, 146.
[183] Ibid.

In *Gerroa Environment Protection Society*,[184] the Land and Environment Court required the proponent to implement a planning agreement that provided for insurance of the offset site 'against the impact of fire or vandalism'.[185]

Legal obligations

In practice it may not always be clear who bears the responsibility for delivery of offsets at any given time (during and after implementation).[186] Responsibilities, including funding, must be established prior to development and offset approval to ensure that offsets are managed, protected and monitored and ultimately provide full compensation for biodiversity loss.[187] To deal with the risk of non-compliance, any obligations relating to the restoration and maintenance of an offset site must also run for the duration of the project at the impact site and after the completion of the project.

Issues of non-compliance might arise in the event that there is a change in ownership or in occupancy of the land upon which a biodiversity offset site is located. In order to ensure that offset goals are achieved, restoration and management obligations must be secured across time frames that span ownership or occupancy changes.[188] One way of achieving such security is by requiring offsetting obligations to run with the land by placing a covenant on the land's title.

In *Gerroa Environment Protection Society*, the Land and Environment Court required the proponent to enter into a planning agreement that provided for implementation of compensatory planting, protection of the offset site in perpetuity, implementation of a landscape and rehabilitation management plan and insurance (as described above).[189] The planning agreement was required to be registered on the title of the land in accordance with the *Real Property Act 1900* (NSW).[190]

[184] [2008] NSWLEC 173.
[185] Ibid at [133].
[186] Bull et al, Biodiversity Offsets in Theory and Practice, above n 35, 375.
[187] Bekessy et al, above n 31, 155.
[188] Gibbons and Lindenmayer, above n 29, 30.
[189] *Gerroa Environment Protection Society Inc v Minister for Planning and Cleary Bros (Bombo) Pty Ltd* [2008] NSWLEC 173 at [133].
[190] Ibid.

In *Newcastle & Hunter Valley Speleological Society*, the Land and Environment Court imposed a condition that there be a conservation agreement registered under the *National Parks and Wildlife Act 1974* (NSW) or, if such an agreement was not possible, the registration of a public positive covenant on the title of the land.[191]

Bonds

The risk of non-compliance might also be dealt with by requiring the payment of a bond by the proponent of the offset project. Forfeit of the bond would be triggered on breach of offsetting obligations. Such a bond was required by the conditions of approval placed on the expansion of a sand mine by the Land and Environment Court in *Gerroa Environment Protection Society*.[192] Provided that the sum of a bond is substantial enough, it may not only ensure compliance with offsetting obligations but also deter proponents from attempting to use biodiversity offsets as merely justification for causing adverse impacts to biodiversity in the first place.

CONCLUSION

Biodiversity offsets are the final strategy for managing adverse impacts of development on biodiversity. They should only be employed to address the residual impacts that remain after the other strategies in the mitigation hierarchy of avoidance and mitigation of impacts on biodiversity have been implemented. Biodiversity offsets do not reduce the residual impacts but rather are intended to compensate for them.

In order to achieve this goal of compensation, biodiversity offsets must achieve certain offsetting criteria or principles, including equivalency in the type of biodiversity at the impact and offset sites; equivalency in time between the biodiversity losses at the impact site and the biodiversity gains at the offset site; additionality so that the offsets result in additional biodiversity gain to the business as

[191] *Newcastle & Hunter Valley Speleological Society Inc v Upper Hunter Shire Council and Stoneco Pty Ltd* [2010] NSWLEC 48; (2010) 210 LGERA 126, 169-170 [247].
[192] *Gerroa Environment Protection Society Inc v Minister for Planning and Cleary Bros (Bombo) Pty Ltd* [2008] NSWLEC 173 at [134].

usual situation; and effective implementation and compliance so that the offset achieves in practice the goal of compensating for the residual impacts on biodiversity.

However, even if biodiversity offsets are designed to achieve these criteria, there will always be uncertainty and risk associated with the design and implementation of biodiversity offsets. Such uncertainty and risk needs to be addressed. Various mechanisms can be adopted to alleviate uncertainty and risk regarding the criteria of equivalence and compliance. Only if biodiversity offsets are designed and implemented taking into account the offsetting criteria and making allowance for uncertainty and risk, will they achieve their goal of compensating for residual biodiversity impacts.

Biodiversity offsets are, therefore, not the first strategy to be used to manage adverse impacts of development on biodiversity or a quick and cheap means to secure approval. They are demanding and often costly. They should be used as the last resort. However, viewed correctly and designed and implemented properly, they can be a valuable mechanism to address biodiversity loss.