Compensating for ecological harm – the state of play in New Zealand

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Abstract: Ecological compensation involves measures to create positive conservation outcomes intended to offset the residual impacts of development (e.g. restoration planting, pest control). Rarely, however, have the exchanges arranged been subject to objective assessment. Here we assess 110 cases of ecological compensation involving diverse New Zealand ecosystems on the basis of how they addressed the six key implementation issues identified by McKenney and Kiesecker (2010: Environmental Management 45: 165–176): equivalence, location (i.e. spatial proximity), additionality, timing, duration and compliance, and currencies. Our research showed that habitat enhancement and protection is the most common form of ecological compensation, and that 72 of 110 case studies undertook compensation on the same site or immediately adjacent. The great majority (94.5%) of compensation was required by condition of resource consent to be demonstrated after the development had proceeded, with an average of 11.3 years of continuing management or monitoring required. The most common form of security other than a consent condition was a covenant (29 of 110 cases) followed by a resource management bond (25). We also found that in 97 cases there was no objective quantification of the compensation needed to make up for impact losses, with the requirements being devised by negotiation between parties with the assistance of expert input. We recognise the potential of ecological compensation as a policy tool, but recommend that significant improvements are made to its implementation to enhance ecological outcomes.

Keywords: ecological compensation; mitigation; offset; RMA

Introduction

The need to extract resources, alter land use and dispose of waste results in continuing adverse effects on biodiversity and ecosystems. Ecological compensation, although widely criticised for failures of implementation (Hornyak & Halvorsen 2003; Gibbons & Lindenmayer 2007; Burgin 2008; Walker et al. 2009), is promoted as a potentially important mechanism to alleviate the pressures of ongoing development and to contribute to achieving wider conservation goals (BBOP 2009; Quertier & Lavorel 2011; Gillespie 2012). Ecological compensation is typically an agreed positive conservation action intended to compensate for losses of habitat and ecosystem function caused by development and resource use. It is a commonly used mechanism that brings together the often conflicting priorities of environmental protection and economic development, in a system of trade-offs. These trade-offs are inherent in environmental management and occur at all stages of the development process (Murray & Swaffield 1994; Morrison-Saunders & Pope 2013).

At present, ecological compensation in New Zealand is implemented under both the Resource Management Act 1991 (hereafter RMA) and the Conservation Act 1987, typically as a condition of approval for development to occur. New Zealand does not have an explicit policy framework for ecological compensation. While ecological science contributes to the determination of appropriate compensation, such agreements are typically the product of negotiation between parties (Galatowitsch 2012). There is no national-level policy on the matter and very few regional and local planning instruments make specific reference to ecological compensation. Most resource consents do not include outcome-oriented conditions, as demonstrated in our related study of regulatory compliance with ecological compensation, where just 10 conditions of 245 specifically articulated a restoration-related outcome (Brown et al. 2013). In the general absence of goals that specifically relate to the implementation goals of ecological compensation, we draw upon an existing framework to facilitate assessment and evaluation of the New Zealand example. We examine the ecological compensation requirements in 110 case studies of resource consents issued under the RMA, against the six key implementation issues identified by McKenney and Kiesecker (2010): equivalence, location (i.e. spatial proximity), additionality, timing, duration and compliance, and the use of currencies and ratios in determining appropriate compensation. McKenney and Kiesecker discussed the overall approach to applying the concept, the presence or absence of the goal of no net loss of biodiversity, and the use of the mitigation hierarchy. We also consider these elements in the New Zealand context.

In New Zealand, ecological compensation is referred to mainly as mitigation, compensation or biodiversity-offsetting, with varying and evolving opinions on the distinctions between each of those terms that is not always consistent with use of that same term in other jurisdictions (Christensen 2008; Norton 2008). It is, however, likely that implementation issues across all types of ecological compensation are broadly the same, and are articulated in planning permissions ('resource consents' under the RMA) in a similar manner. In this research therefore, 'ecological compensation' is an umbrella term defined as:

> *Positive conservation actions required by resource consent, and intended to compensate for residual adverse effects of development and resource use* (Brown et al. 2013)

Ecological compensation under the RMA

The RMA, New Zealand's principal environmental legislation, does not specifically mention ecological compensation, nor is there a national-level policy to guide decision-making. Regional councils and city or district councils issue planning permission (in the form of resource consents) to allow activities to be undertaken that have adverse effects and sometimes require ecological compensation. A proposal to mitigate, compensate or offset ecological harm is one of the wide range of factors that a consent authority can take into account under section 104 of the Act (which outlines matters the decision-maker must have regard to in determining whether to grant the consent and under what conditions).

Internationally, policies that address ecological compensation typically emphasise the mitigation hierarchy (i.e. avoid ecological effects, minimise impacts, and finally mitigate or offset the residual effects; McKenney & Kiesecker 2010; Gardner & von Hase 2012). While New Zealand law does not explicitly require adherence to the mitigation hierarchy, in a recent Board of Inquiry decision on a plan change and accompanying resource consent related to a major roading project (Transmission Gully), it was noted that a mitigation hierarchy was supported by ecological evidence and was broadly consistent with the RMA (Environmental Protection Authority 2011; Christensen 2012).

No net loss

Ecological compensation, and biodiversity offsets in particular, are often highlighted as a mechanism to achieve 'no net loss or preferably net gain' of biodiversity (ten Kate et al. 2004). This generally requires that what is lost in development is counterbalanced by conservation gains that are at least equivalent and preferably greater in value, although the definition of this goal and measurement of success or failure varies across stakeholders and jurisdictions (Bull et al. 2013). It is articulated in the first of the 10 principles on biodiversity offsets developed by the Business and Biodiversity Offsets Programme (BBOP 2009). The goal itself is criticised as being symbolic and rarely achieved (Burgin 2010), with Walker et al. (2009) referring to it as 'administratively improbable and technically unrealistic'. Further, as the Transmission Gully Board of Inquiry noted, applicants can choose to state 'no net loss' as a goal, but they are not legislatively bound to demonstrate that it has been achieved (Environmental Protection Authority 2011).

Key implementation issues

There have been several comprehensive reviews worldwide of ecological compensation schemes and most reveal significant problems with implementation and follow-up (Hornyak & Halvorsen 2003; Gibbons & Lindenmayer 2007; Burgin 2010; Walker 2010; Quertier & Lavorel 2011). Here we use the framework proposed by McKenney and Kiesecker (2010) (summarised in Table 1) to examine compensation in the New Zealand context, and generate recommendations aimed at improving implementation. We chose to use this framework because of its broad applicability and clear articulation of key matters that facilitate a consistency with transferable learning outcomes.

Ecological equivalence is a goal of compensatory mechanisms and can be determined at a range of scales. At the broadest scale, exchanges are grouped into in-kind or out-of-kind relating to the similarity of elements to be traded (McKenney & Kiesecker 2010). In-kind refers to protection or enhancement of a similar value while out-of-kind compensation involves different values of greater conservation significance (also referred to as a 'trade-up').

Compensatory works should occur near the site of impact (McKenney & Kiesecker 2010) to avoid negative ecological and social outcomes of compensation at a distance. In practice the investment of mitigation money leveraged from impacts on one habitat type is often used to ameliorate broader impacts affecting areas of higher strategic conservation importance (Blundell & Burkey 2007; McKenney & Kiesecker 2010). Aggregating efforts into large areas of habitat instead of many smaller and fragmented compensation projects located haphazardly around the landscape has been shown to perform better ecologically (Breaux et al. 2005; McKenney & Kiesecker 2010).

Additionality demands that compensatory actions are new and would not have occurred under the status quo (McKenney & Kiesecker 2010). Assessment of additionality requires that the future level of management under the status quo must be reliably forecasted, which is difficult. Common approaches include set-asides, habitat improvements or financial contributions. The level of additionality is dependent upon the current level of protection and management of the habitat (at a range of scales), as well as the inherent vulnerability of that habitat type. If the habitat set-aside is adequately represented elsewhere, already protected or not otherwise vulnerable, then it is not likely a new gain and therefore not additional (Gibbons & Lindenmayer 2007).

The timing of compensatory benefits should be similar to the loss so that temporal equivalence is achieved, and lags between impact and compensation are minimised. Planting to offset the loss of existing older habitat may take decades or centuries to be of similar value to an extant habitat, with the time lag potentially risking threatened species' population viability and leading to extinction (Gibbons & Lindenmayer 2007; Maron et al. 2010). Securing compensation gains in

Table 1. Key implementation issues identified by McKenney and Keisecker (2010).

Key issue	Explanation
Equivalence	Equivalence and similarity of compensatory action with the impact being addressed (i.e. in-kind or out-of-kind)
Spatial proximity	Location of compensation in relation to the site of impact, with an assumption that closer is better
Additionality	The compensation action must be a new contribution to conservation that would not have otherwise occurred
Timing	Timing of demonstrating the compensation, relative to the timing of the impact
Duration & compliance	The required longevity of the compensation action and security of delivery
Currency & ratios	Metrics used to determine exchanges including mitigation replacement ratios

advance is the most efficient and reliable means of orchestrating robust exchanges because it limits uncertainty (Bekessy et al. 2010; Gardner & von Hase 2012). Advance mitigation enables applicants to plan for and reliably demonstrate gains in advance, which may be important to securing access to diminishing resources such as minerals (Kuiper 1997; Greer & Som 2010).

Failure to secure compensation exchanges because of issues with duration and compliance is a common shortcoming (Race & Fonseca 1996; Hornyak & Halvorsen 2003; Gibbons & Lindenmayer 2007; Burgin 2008; Matthews & Endress 2008; Brown et al. 2013). Post-decision failures of compliance (and subsequent enforcement) undermine compensation, and society bears the burden of unfulfilled promises (Beder 2000; Hornyak & Halvorsen 2003; Gibbons & Lindenmayer 2007; Keane et al. 2008; Bekessy et al. 2010; Brown et al. 2013). Compensation should persist for as long as the impact and permanent losses should not be offset by temporary gains (Gibbons & Lindenmayer 2007). While monitoring and follow-up are widely recognised as being of critical importance, they rarely receive sufficient attention (Rubec & Hanson 2009).

Currencies that compare values of different habitats rely on surrogate measures of ecological value (Gibbons & Lindenmayer 2007). Assessment of habitat quality and condition can rely on predetermined indicators, or they may be established on an ad hoc, case-by-case basis (Quertier & Lavorel 2011). At the crudest level, extent of habitat lost and gained are compared (Quertier & Lavorel 2011). Habitat condition and rarity provide a more accurate reflection of ecological value, while use of multiple metrics or combinations of methods limits critical omissions (Kiesecker et al. 2009; Bull et al. 2013). However, methodologies continue to fail rigorous scrutiny, with a high likelihood of losses being obscured within broad considerations of value (Walker et al. 2009; Pawliczek & Sullivan 2011).

Methods

We assessed how each of the six implementation issues in McKenney & Kiesecker (2010) was addressed in 110 resource consents issued between 1991 and 2010 by 39 councils across the North and South islands of New Zealand. Consent information typically included the consent itself, supporting documentation such as ecological surveys and agency officers' reports, plans, and other documents such as covenants and was primarily provided on request by the issuing agency. Further details on selection of examples and study design are available in Brown et al. (2013), while Table 2 reflects the types of activities investigated. We used the case-study approach as it provided for the detailed, contextual and multidimensional analysis of a wide range of examples of ecological compensation, capturing variation and highlighting general trends beyond the circumstances of each individual situation (Gillham 2000; Crowe et al. 2011).

Equivalence

We grouped the case studies into four categories according to their principal effect, and compared that with the main form of compensation required for each (Table 3). In cases where a financial contribution was sought from the developer (n = 20), we differentiated between those that were ring-fenced for in-kind exchanges and those that had considerable flexibility in the way in which they were to be spent. An analysis of exchanges at the ecosystem level was not possible, as many consents did not contain enough information about the types of habitat involved in the exchange.

Spatial proximity

The shortest distance between impact and compensation sites was measured in kilometres, with zero distance indicating ecological compensation undertaken on or immediately adjacent to the impacted site. Where the financial payment did not define a destination site but gave a scale such as 'within catchment', the furthest distance from the site to the edge of the catchment was used.

Additionality

We devised questions for each of the common compensation actions (set-asides, habitat improvements, financial payments, or a combination), in Table 4, and interrogated the information to assess whether additionality was achieved.

Timing

The numbers of requirements to be achieved prior to, concurrent with, and after the development were tabulated and compared. The length of time required (in years) for delivery of the compensation was then also determined from the conditions of the resource consent.

Duration and compliance

We assessed the number of years of specific ongoing requirements articulated in consents through conditions, and the frequency of requirements for an RMA bond to be taken under s.108 of the Act. We also considered tenure, noting where compensation actions were required to be carried out

Table 2. Distribution of activity types in the consent case studies (n = 110).

Activity type	n	%
Subdivision	38	34.6
Infrastructure	14	12.7
Water discharge	12	10.9
Agriculture	11	10
Energy generation	10	9.1
Resource extraction	8	7.3
Water abstraction	7	6.4
Recreational	4	3.6
Waste management	4	3.6
Other	2	1.8

Table 3. An overview of exchanges encountered in each of the 110 consents, showing common exchanges.

	Principal compensation		
Principal effect	Habitat gain	Financial RF	Financial NRF
Domestication	34	0	0
Habitat loss	41	3	5*
Other	5*	1	2*
Water take/ discharge	10	5	4*
Total	90	9	11

RF, ring-fenced for in-kind exchange; NRF, not ring-fenced;
* out-of-kind exchange permitted or likely.

Table 4. Questions devised for common scenarios in order to determine additionality of compensation.

Compensation	Questions
Set-asides	1. Is there a formal means of protection in place for the set-aside? 2. Is the area of the habitat already formally protected by some other means (e.g. covenant)? 3. Is there provision for management actions to be undertaken? 4. Was the area subsequently given to a public agency for management purposes?
Habitat improvements	1. Will the works be undertaken to public or private land? 2. Do the works constitute the statutory responsibility of any agency? 3. Were the works already planned or required by another means (e.g. Clean Streams Accord)? 4. Did the works for improvement serve an additional purpose (e.g. stormwater detention)?
Financial payments	Were the actions already occurring or were they new?
Purpose	Was the compensation action primarily for avoidance or remediation purposes (e.g. translocation)?

on land of different tenure to the site of ownership. We then considered more permanent mechanisms such as covenants, consent notices and endowment funds, noting their relative frequency of use and aspects of their implementation.

Currency and ratios

We identified where a set method was used to determine the ecological compensation required in each of the cases, such as a set ratio of area of habitat damaged to area required to compensate for that damage.

Results

Equivalence

Most of the exchanges were equivalent at a high level, in that habitat loss was typically exchanged for habitat gain rather than for other more disparate gains (Table 3). 'Domestication' generally refers to subdivision, and is not included within 'Habitat loss' because although it sometimes resulted in habitat loss, more typically the subdivision was undertaken to pasture and the principle effects of the activity related more closely to immediate and long-term impacts of a pastoral environment being converted to more intensive residential development (e.g. increased impervious surface, noise and light disturbance).

There were three main forms of compensation: (1) habitat gain (whether by condition or extent), (2) financial payments that were designated for a purpose, or (3) those that were required but their destination was not specified. 'Habitat gain' refers to the creation, management or enhancement of natural areas, their legal protection, or a combination thereof. Riparian planting was included within this, and compensated for water takes and discharge consents (where compensation was defined) in more than half the examples (52.6%). Payments were not clearly ring-fenced in 11 of the cases encountered and some were difficult or impossible to track. The out-of-kind exchanges encountered also included funding for research and monitoring, and payments to agencies for other conservation actions. The habitat protected or managed as compensation was not necessarily similar to that which was removed. Rather, the most intact and best examples of remaining habitat on the site were subject to management actions such as supplementary planting of existing habitat, planting of new habitat, pest control, and fencing (i.e. habitat improvement).

Spatial proximity

Seventy-two of the 110 (65.5%) compensation requirements applied to sites that were on or adjacent to the site of impact, while a further 21 (19%) were required within 50 km of the site of impact. The remaining 17 (15.5%) were undertaken more than 50 km from the site of impact (Table 5). Of the offsite works encountered, 20 resulted from financial payments required in place of or in addition to works to be undertaken on-site, where money was pooled under a common fund or paid directly to an agency. The spatial limit of compensation was usually defined by the jurisdiction of an agency, or the geographic range of a contestable fund or mitigation trust.

Several exchanges involved financial contributions to pools of funding for conservation purposes, including mitigation trusts and endowment funds. Mitigation trusts are common, such as the Taranaki Tree Trust (Taranaki Regional Council), the Hei Tini Awa Trust (Horizons Regional Council) and the Turanganui a Kiwa (Gisborne District Council). Establishing a trust or fund in this way enables councils to access funds from private and public bodies to undertake wider ecological restoration programmes in association with the community, in addition to receiving compensation payments. Several energy generation and waste management companies have established these structures within their consents to fund a wide programme of compensation measures, usually via contestable funding of an agreed amount (paid annually or as a one-off payment).

Additionality

Thirty-eight (94.5%) of 40 set-asides were of land not otherwise protected, and included requirements for management (Table 5). Sixty-three of 110 compensation actions occurred on private land. Seven cases included works that are part of the statutory duty of an agency, such as the management of an existing protected area administered by a council under the Reserves Act 1977. Six financial payments contributed to works that were already occurring, such as existing pest control programmes, and therefore were not additional. Most management actions were new works, and the majority of financial payments were also for works that were not otherwise planned, and so were truly additional. Twenty cases included compensation that fulfilled more than one purpose, such as the creation or enhancement of a water feature that would later be used for stormwater disposal, detention and treatment. Ten cases included the vesting of habitat in a public agency and these cases were a mix of those that required a degree of management to occur before handover and those that were immediately vested, such as extensions to existing reserves on the subject-site boundary. Seven actions described as compensation were not in fact compensatory actions, but rather prevention of damage. These included translocation of threatened species from the site and retaining or restoring fish passage when diverting or obstructing waterways.

Table 5. Results of analysis of key implementation issues (note that more than one metric applies to 'Duration and compliance'. (See Table 3 for equivalence issue.)

Implementation issue and metric	Variable	*N*	%
Spatial proximity: Distance in kilometres between site of impact and site where ecological compensation was carried out	0	72	65.5
	0.2–3 km	13	11.8
	3.1–10 km	1	0.9
	11–20 km	3	2.7
	21–50 km	4	3.6
	51–100 km	3	2.7
	101–200 km	9	8.2
	201–300 km	4	3.6
	301+ km	1	0.9
Additionality: Compensation actions encountered in case studies with respect to additionality	Set-aside of unprotected land	38	34.5
	Set-aside of land already protected	2	1.8
	Set-aside with provision for management	33	30
	Set-aside with no management*	7	6.4
	Management actions to public land	29	26.4
	Management actions to non-public land	63	57.3
	Financial payment for new works	15	13.6
	Financial payment for works already occurring	6	5.5
	Statutory duty or responsibility	7	6.4
	Habitat creation or enhancement already planned	3	2.7
	Enhancement of a dual-purpose feature	20	18.2
	Actions were monitoring, avoidance or remediation measures	17	15.5
	Vestment to public agency to manage	10	9.1
Timing: Time frame (years) for ecological compensation to be initiated or completed relative to the impact	Prior	6	5.5
	Concurrent	44	40
	After	60	54.5
Duration and compliance: Mechanisms used to secure compensation action	Condition of consent, designation or consent order	102	92.7
	Other agreement (e.g. Memorandum of Understanding)	15	13.64
	Combination	8	8.8
Duration and compliance: Mechanisms used to secure long-term gains	Covenant	29	26.4
	RMA Bond (s.108)	25	22.7
	Consent notice (s.221)	13	11.8
	Vestment into reserve status	11	10.0
	Mitigation trust or endowment fund	7	6.4
Duration and compliance: Tenure of site of compensation action	Same site, same owner	67	60.9
	Another site third party	40	36.4
	Another site same owner	3	2.7
Duration and compliance: Number of years of required action following granting as required by consent	None	41	37.2
	0.1–5 years	37	33.6
	6–10 years	13	11.8
	11+ years	19	17.3
Currency and ratio: Evidence of a formal approach to quantifying the degree of compensation required	No evidence	97	88.2
	Area	10	9.1
	SEV (Stream Ecological Valuation method)	3	2.7

(*) No specific management refers to management actions not being prescribed in the consent, and does not include situations where the land is vested under a public agency with an existing maintenance programme.

Timing

One hundred and four of 110 (94.5%) compensatory actions were required concurrently with the development or following its completion (Table 5). There were only six requirements for prior action (5.5%), and in most cases they were developer-driven, such as boutique subdivisions where most of the ecological restoration took place prior to application, for dual purposes of conservation and amenity. Most requirements involved the protection of extant habitat and its enhancement with some supplementary planting, while others involved planting from scratch. There was little evidence that the time lag between impact and compensation action (e.g. planting reaching maturity) was a factor in decision-making. In one instance, however, an applicant was required to undertake habitat enhancement activities in a nearby reserve in addition to establishing the new area of planting. The consent assumed that enhancement works would help maintain habitat values in the vicinity in the 10 years until the new planting matured.

Duration and compliance

Compensation was usually secured by making it a condition of consent. Some agreements were secured by an alternative means such as a Memorandum of Understanding or other form of side agreement. In eight cases, both an agreement and a consent condition reflected the compensation requirements (Table 5).

The gains required to meet compensation requirements were secured with covenants, consent notices under s.221 of the RMA, mitigation trusts and other endowment funds, and they included land vested with agencies for protection purposes. An RMA bond provides for a cash or bank-guaranteed bond to be held by the agency to be uplifted in the case of default. Twenty-five consents required that a bond be held by the agency under s.108 of the RMA (Table 5). Sixty-seven of 110 compensation actions (60.9%) were required to occur on the site of impact, while nearly all the others occur on a different site with unconnected tenure.

Resource consent conditions may specify a length of time within which specific tasks have to be carried out, such as pest management and monitoring. The mean number of years for continuing requirements in consents where this was stipulated was 11.3 with an overall median of 7.4. The figures related to years of management do not include outside arrangements such as covenants, which often require action for longer, perhaps even in perpetuity.

Currency and ratios

In 97 cases (88.2%) no objective metric had been applied and in 10 cases area was used as an informal metric of biodiversity loss. Three of the 110 consents reflected the application of the Stream Ecological Valuation method (Rowe et al. 2009).

Discussion

Most exchanges are undertaken between broadly similar values, and habitat improvement and set-asides are by far the most common means of compensating for ecological harm. Many cases where financial contributions had been sought left open the possibility of a significantly unlike exchange. Although out-of-kind exchanges are becoming more common around the world there is a lack of tools or guidelines for decision-making for unlike exchanges (McKenney & Kiesecker, 2010). If New Zealand follows the rest of the world in the increasing frequency of out-of-kind exchanges, methods and decision support tools will be needed if compensation is to be quantified and objectively determined.

The majority (77.3%) of compensation requirements were carried out within 3 km of the site where the loss occurred, but many occurred much further away. If off-site compensation becomes more common, a lack of a formal framework in which to manage exchanges will be limiting. By contrast, many jurisdictions around the world orchestrate exchanges of biodiversity more systematically through large-scale operations (e.g. US wetland mitigation banking; Burgin 2010; BenDor & Riggsbee 2011). Uncontrolled off-site compensation could lead to an expansion of low quality 'restored' habitat in the place of destroyed high quality habitat. Macro-scale landscape changes cannot be detected with piecemeal methods (BenDor & Riggsbee 2011). Most instances of compensation at a distance were enabled by mitigation trusts. The use of mitigation trusts has potential advantages, but care is required in drafting project eligibility requirements. We noted significant variation in the deeds and other governing criteria for trusts, with some having very specific requirements related to the key general principles for use of the funds.

Compensation was typically required during or after a development, although best practice typically calls for implementation in advance to reduce risks to ecosystems and species (McKenney & Kiesecker 2010; Gardner & von Hase 2012; Pilgrim et al. 2013). The few examples of prior requirements is likely due in part to a lack of formal mechanisms to recognise prior works. In two cases there was clear evidence in background documents that the agencies involved were reluctant to accept that the works are additional if they are undertaken in advance and outside the consent process. Some types of consents, such as subdivisions, provide an opportunity to tie some achievements to the release of the s.224C certificate (certification that confirms that the conditions of subdivision consent have been met, issued by a city or district council), but most consents issued under the RMA (e.g. land use consents) have no such option.

Compared with many other jurisdictions, New Zealand landowners and agencies face few statutory requirements as regards ecological management. Habitat improvements such as weed and pest management or fencing of streams, wetlands or lake are typically a decision of the landowner. Therefore, most new management actions to habitat on private land in New Zealand are considered additional, owing to an absence of a minimum standard of land management and alternative statutory means for compelling actions such as pest control.

Active management of protected areas in New Zealand is critically important to the persistence of the biodiversity values. New Zealand has a large portion of land protected for the primary purpose of conservation at 8 763 300 hectares or 33.4% of the total land area (Ministry for the Environment 2010). Funding for the management of protected areas is typically constrained, however, and there is an absence of quantifiable and time-bound goals for biodiversity management (Green & Clarkson 2005).

Compensation payments can result in planned works being carried out sooner than expected. For example, if a council uses a compensation payment to fund a planting project, the advancement of the work can increase the additionality of the gain. Of critical importance to assessing additionality, particularly on public land, is that compensation requirements do not simply result in cost-shifting (Christensen 2008). Cost-shifting is when compensation payments displace other funding used for a given conservation purpose.

Duration and compliance is of concern in New Zealand, as recent research has found that many compensation requirements are not met (Brown et al. 2013). Most compensation requirements (70.9%) cease within 5 years – usually specifying an expectation of the end of agency monitoring and oversight, particularly where there is no corresponding agency monitoring regime for covenants or consent notices (which is commonly the case). Compensation requirements are usually expressed as conditions of consent, while a range of other mechanisms are used to secure those actions including RMA bonds, covenants and mitigation trusts.

The most basic form of security is robust conditions that set clear and detailed requirements, set out in an enforceable document such as a consent or side agreement referred to in that consent, designation, or a consent order. The likelihood of securing any given compensation requirement, and to enforce it in the case of default, diminishes with increasing ambiguity

of stated requirements. In some cases, conditions that had been negotiated were not actually included in the consent itself, omitting a clear legal mandate for the consent holder to undertake the works (Marshall 2001). This is of serious concern, because the conditions represent the key means of ensuring that the adverse effects of the activity are avoided, remedied, or mitigated (Ministry for the Environment 2001).

The research also revealed significant issues with the security measures that are imposed to ensure compensation works occur. Covenants and consent notices were commonly used but very few agencies appear to have a formal means of recording and archiving them in a way that ensures their regular monitoring and evaluation. We also noted that the use of endowment funds or mitigation trusts was becoming common, particularly in large projects where there is a wide range of effects. However, our research showed that more than half of the financial payments required as compensation had indeterminate ends, meaning that they might or are likely to result in out-of-kind exchanges, potentially leading to ongoing environmental losses.

We encountered few instances of quantification or standardised methods of compensation assessment. The level of compensation seems to have been determined primarily by the resourcing by and willingness of the applicant, and the council specifying and insisting on a minimum standard. Financial payments were typically determined via negotiation, rather than an objective assessment of the magnitude of effects, or against a consistent and transparent cost scale.

In the recent case of Transmission Gully, a project involving the extension of a road through significant habitat, the quantification of the offset through an 'environmental compensation ratio' was discussed. The Court noted that ratios would be 'always a subject of debate', and that the final determination of appropriate mitigation was reasonably the domain of the judiciary and not any one method (Environmental Protection Authority 2011).

Conclusion

Ecological compensation is an increasingly common mechanism around the world, which has the potential to significantly contribute both to ameliorating the impacts of continued development and augmenting wider conservation efforts. Our review of process and consent variables suggests that the consideration and implementation of ecological compensation in New Zealand is noticeably ad hoc. Therefore, ecological compensation as it is presently implemented is unlikely to achieve environmental protection goals.

It is difficult to evaluate the effectiveness of ecological compensation without strategic and consent-specific goals for ecological compensation. Unambiguous goals are needed to specify what compensatory mechanisms are to achieve, what types are acceptable in what situations, and when ecological compensation is unlikely to be appropriate. Goals should be measurable, such that, in time, a quantitative analysis can be undertaken on the implementation of these mechanisms in New Zealand. Increased emphasis upon monitoring and compliance by agencies is also necessary such that instances of default can be identified and rectified as soon as possible. We conclude that the application of ecological compensation under the RMA in New Zealand requires significant improvement if the ongoing erosion of the natural capital upon which our prosperity and economy ultimately depends is to be slowed and reversed. Ecological compensation remains a catalyst for creating greater synergies between ecological and economic interests, but the successful implementation of the concept is some way off.

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