

Ecological compensation: an evaluation of regulatory compliance in New Zealand

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ABSTRACT

Ecological compensation is an example of a trade-off whereby loss of natural values is remedied or offset by a corresponding compensatory action on the same site or elsewhere, determined through the process of Environmental Impact Assessment (EIA). Ecological compensation actions are often criticized for having low levels of compliance: meaning that they are achieved only partially or not at all, while development activity proceeds with much greater certainty. Our research investigated compliance with 245 conditions relating to ecological compensation across 81 case studies across New Zealand under the Resource Management Act 1991.

Our research shows that present tools and practice in New Zealand are not adequately securing the necessary benefits from ecological compensation requirements, with 35.2% of requirements not being achieved. Significant variation in non-compliance with ecological compensation occurs between different activities, applicant types and condition types, while critical variables within the planning process influence levels of compliance. Our research demonstrates the importance of understanding the nature of non-compliance and of providing a consistent and robust decision-making framework for the consideration of ecological compensation in practice.

Keywords

Ecological Compensation; Compliance; Mitigation; Offset; Trade-offs; Consent conditions

INTRODUCTION

Ecological compensation is a positive conservation action that is required to counter-balance ecological values lost in the context of development or resource use, and is an intentional form of trade (Morrison-Saunders & Pope 2013). Trade-offs are determined through Environmental Impact assessment (EIA) which provides a framework for decision-making in relation to projects with adverse environmental effects. EIA enables the effects of a proposal to be predicted and for the development and agreement of appropriate ways in which to mitigate them (Bailey & Hobbs 1990; Bailey *et al.* 1992; Marshall 2001).

Evaluation of the use of ecological compensation internationally has found common themes of poor administration, failures of implementation, low scientific capability to deliver required outcomes, high risk of non-compliance and a lack of enforcement; reducing the effectiveness of policies and practice designed to safeguard ecological values (Gardner *et al.* 2009; Gibbons & Lindenmayer 2007; Gillespie 2012; Hornyak & Halvorsen 2003; Maron *et al.* 2012; Race & Fonseca 1996; Walker *et al.* 2009). This research paper focuses on the nature of non-compliance as it relates to ecological compensation. Of concern is that if compensation requirements do not materialise as agreed, then allowing those trade-offs does little but facilitate negative impacts on the environment (Bekessy *et al.* 2010). They also serve to undermine the credibility of impact assessment processes and environmental regulations if the outcomes realised regularly fall far short of expectations (Hornyak & Halvorsen 2003).

In New Zealand, the principal legislation that relates to ecological compensation is the Resource Management Act 1991 (the "RMA"), which sets out impact assessment (termed an 'Assessment of Environmental Effects' or AEE, outlined in Schedule 4 of the Act) within a sustainable management regime that mandates the avoidance, remediation or mitigation of adverse effects (Jackson & Dixon 2012; Morgan 2012; Resource Management Act 1991). Other than this broad mandate to address effects, there is presently no nationally agreed policy, guidance or legislation that articulates the concept of compensating for ecological harm through trade-offs, or that sets overall outcomes to be achieved (DoC 2010; Gillespie 2012; Madsen *et al.* 2010; Memon & Skelton 2004; Turner 2000). For example, Borrie *et al.* (2004) argued that practice in New Zealand was lacking in comparison to other jurisdictions due to policy ambivalence, implementation and enforcement issues and the lack of sufficient security measures available to ensure gains are realised and protected, noting:

"we are profoundly concerned about this situation because it is already leading to the cumulative loss of New Zealand's valued biophysical environments".

(Borrie *et al.* 2004 p.85)

Assuming that ecological compensation in some form or another is likely to persist as a policy tool, it is vital to improve the levels of compliance with compensation conditions and to better understand the nature of non-compliance, such that improvements can be made to the pre-decision stages of environmental impact assessment to reduce risk of default (Marshall *et al.* 2005). This research focussed on examining the levels of regulatory compliance with ecological compensation requirements in resource consents. We investigated what factors contributed to variation in those levels through a post-project implementation audit, based on 81 case studies, assessing compliance with 245 conditions that specifically related to ecological compensation.

Definition

A broad definition of ecological compensation for the purposes of this research was favoured in order to capture the range of current practice in New Zealand. Existing definitions were not appropriate, because they referred to matters that are not legally required in New Zealand including observation of the mitigation hierarchy and a goal of no net loss of biodiversity. The mitigation hierarchy places preference on avoidance of adverse effects, followed by minimisation of them and then, if required, the mitigation or offsetting of residual effects (McKenney & Kiesecker 2010). The observance of a mitigation hierarchy often occurs in practice in New Zealand (and indeed, is inherent within environmental impact assessment generally), but there is no statutory requirement or national level policy that requires that adherence to it be demonstrated. No net loss of biodiversity, which is commonly highlighted as a point of difference between biodiversity offsets and more conventional 'mitigation' (Brownlie & Botha 2009; Gardner & Hase 2012; McKenney & Kiesecker 2010; Moilanen *et al.* 2008). The goal of no net loss of biodiversity also does not exist in New Zealand legislation, although it is referred to from time to time in relation to specific cases.

In the absence of an appropriate existing definition, ecological compensation is defined in the present research as:

“Positive conservation actions required by resource consent, and intended to compensate for residual adverse effects of development and resource use”

The compensatory requirements encountered in this research were referred to as mitigation, compensation or biodiversity offsets, were undertaken both onsite and offsite, and were both in-kind and out-of-kind exchanges. All shared the broad intention of counterbalancing the ecological impacts of the development in question by undertaking a project that had a positive conservation benefits (restoration, habitat creation), and were in addition to activities that sought to mitigate adverse effects directly (e.g. sediment control). Several requirements encountered would perhaps fail to strictly qualify as compensatory actions depending on the circumstances (e.g. translocation, which is considered 'avoidance' more than 'mitigation'); however they were treated in the consent as being intended to achieve the same purpose, so were subject to the same assessment. The validity of the requirements is not the subject of this research paper.

Research objectives

The present research aimed to answer three key questions:

- (a) Determining compliance - what are the levels of compliance presently being achieved with ecological compensation requirements in resource consents?
- (b) Determining variation in compliance - does the level of compliance differ between different types of activities, applicants and conditions, and in what ways?
- (c) Determining predictors of compliance - what process and consent variables are predictors of compliance?

Determining compliance

A lack of policy goals in New Zealand related to ecological compensation meant typical policy evaluation methods (Bennewer & Coglianese 2005; Laurian *et al.* 2010) could not be used for the present research. A case study approach was instead employed, whereby cases were assessed for their compliance with consent conditions. The assessment of compliance

was undertaken independent of agency monitoring records (often observed to be missing, incomplete or out of date) to ensure a consistent assessment across different councils. All conditions assessed were legally binding under the RMA – case studies that did not have specified enforceable compensation requirements were excluded from analysis. Projects were at varying stages of completion, but conditions were only assessed if sufficient time and progress had been made to assess it. Only the conditions that related to the ecological compensation were assessed, and were taken as a surrogate for goals of the policy tool in the absence of policy and guidance being available.

Determining variation in compliance

We determined that assessing compliance was the first step for this research, but that understanding the complexities of non-compliance was important as there is very little information, empirical data and peer reviewed literature in New Zealand on this important topic. Non-compliance is not typically uniform across all activity types, applicants and types of requirement (INECE 2009; Ministry for the Environment 2008; Shimshack 2007). In discussions throughout the country, most expert practitioners were easily able to recount the industries and other activity types that both dominated the consent application figures and those that were known to be non-compliant more frequently than others. Therefore, the principal activity that pertained to each condition was compared with compliance to investigate if there were differences in compliance between activity types in RMA consents. Applicants were grouped into 3 categories to compare relative compliance: public organisations, private companies and private individuals. A 'public organisation' for the purpose of this study included state-owned enterprises (registered companies that were typically former government departments, now operating on a commercial basis under the State-Owned Enterprises Act 1986) and agencies such as councils.

Some types of conditions were widely considered by the experts consulted in the planning of the research programme to be more likely to be complied with than others, for reasons of the availability of expertise, resourcing and other variables. The 245 conditions were clubbed into two categories comparing conditions which were administrative and non-administrative (i.e. action-based). The conditions were then further split into 14 groups that aligned broadly with their goals or purpose (as in Matthews and Endress, 2008) and compliance between those groups was compared.

Determining predictors of compliance

The present research examined the role that variables in the planning process and variables relating to the content of the consent play in predicting or otherwise influencing compliance. Understanding this role is important for ensuring that the impact assessment process, as far as possible, manages the risks of trade-offs. 'Process variables' related to the impact assessment process (presence of a professional ecologist, early mention of compensation in the process, compensation proposed by the applicant, detailed plan required before granting and public notification of the proposal) while 'consent variables' related to the requirements in the consent and nature of the trade-off (timing of the compensation action, requirement for an RMA bond, requirement for monitoring by the applicant and the presence of a review condition). An assessment of correlation with compliance was undertaken for the following variables to shed light on critical elements of the impact assessment process with respect to managing trade-offs.

Process variables

Professional input and assessment is widely considered to be an essential component of establishing and implementing robust exchanges in the context of ecological compensation (ten Kate *et al.* 2004), and maintains a degree of scientific rigour in respect of environmental management more broadly (Morrison-Saunders & Bailey 1999). The compliance of cases where the input of a professional ecologist had been engaged by the applicant was therefore compared with where the applicant had proceeded through the process without that advice.

Early mention of ecological compensation in the process of impact assessment is good practice, as it enables a full analysis of the likely costs and benefits of the requirement (Morrison-Saunders & Pope 2013). Compliance in cases where there was clear evidence that the compensation had been discussed early in the application stages was compared with those where it was first considered very late in the process (such as in response to submitters at the hearing). Cases where the applicant had scoped and proposed the nature of the ecological compensation were also compared with where the council had proposed it, in a similar way to Bailey (1992) which distinguished between conditions that were proposed by the applicant and those imposed by the agency. This distinction was determined from reviewing the background information and officers' decision report under section 42(a) of the RMA.

Although it could be considered best practice, it is not a legal requirement that detailed plans for compensation requirements are provided to the agency prior to the decision, and for many reasons this requirement is delayed to a nominal period following granting (often, six months). In many cases, this approach has practical reasons, particularly for sites that require significant geotechnical modification. Delaying detail also enables the planning process to be sped up on the promise of more information to be submitted in broad accordance with an overall plan, but this promise is often not fulfilled. Whether or not a detailed plan was available at the time of decision was recorded for each case study.

Resource consent applications are sometimes publicly notified under section 94 of the RMA, if they are likely to result in significant effects beyond the subject site (Resource Management Act 1991). This forms the 'public participation' opportunity commonly referred to within impact assessment and invites additional scrutiny from the wider community of a given proposal (Morrison-Saunders *et al.* 2001; Morrison-Saunders & Early 2008). Compliance for conditions that were publicly notified was compared with those that were processed on a non-notified basis.

Consent variables

Timing of when a compensation action is required to be delivered affects the certainty of its delivery (Gardner & Hase 2012; Greer & Som 2010; Maron *et al.* 2012; McKenney & Kiesecker 2010; Walker *et al.* 2009). Requiring benefits from compensation actions to be demonstrated in advance of a project have self-evident advantages over those that are undertaken concurrent with or following a project. The timing of the compensation actions were divided between those which were required in advance, concurrent with, and required following the development, and their relationship with compliance compared.

A bond required under section 108 (Resource Management Act 1991), an "RMA bond", acts as a form of insurance on works required within a consent. A cash or bank guaranteed payment is made up front. In the event of a default by the applicant to meet bonded requirements, the agency is granted the ability to uplift the funds and carry out the required

works. Compliance with conditions that were part of cases that had RMA bond requirements was compared with cases where section 108 had not been used in respect of those conditions.

Monitoring of the actions and outcomes related to a project and the mitigation requirements that are present is a fundamental requirement of impact assessment follow up and good resource management practice and should be 'extensive and long-term' (Bailey *et al.* 1992). For each condition, it was recorded whether or not the relevant consent also contained a condition for the applicant or its agent to undertake monitoring.

The inclusion of a review conditions is standard practice in RMA consenting, although they are rarely triggered (Milne 2008). The review condition is based on section 128 of the Act which provides for the issuing agency to serve notice on the applicant of a decision to review the conditions of the consent for a range of possible reasons, including unforeseen level of adverse effects (Resource Management Act 1991). We tested whether the presence of such a condition did have a relationship with compliance in this study, in that its inclusion in consent conditions would act as a deterrent to non-compliance, although it was expected that it would not due to rarity of usage.

METHODOLOGY

The methodology used case studies to analysing compliance with ecological compensation requirements, which is a common approach in the literature to date (Breux *et al.* 2005; Hornyak & Halvorsen 2003; Reiss *et al.* 2009). Case study-based research is valuable for examining, at a detailed level, complex phenomena in context (Cassell & Symon 2004). In this research, investigation of a wide range of case studies enabled systematic micro-scale evaluation of EIA as outlined in Marshall *et al.* (2005). The way case studies were selected is described, followed by the methodology applying to addressing each of the three research questions.

Case study selection

For this research, regional and district councils were asked via email to provide examples of case studies that matched our criteria (Table 1).

Table 1. Case study criteria for data requested from Councils.

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- (d) Permission to have been issued between 1 Jan 1992 and 31 Dec 2010 under the Resource Management Act 1991
 - (e) Permission to have pertained to a negative effect on the biophysical environment, including but not limited to: resource take, vegetation clearance, discharges to land or water, stream, waterway or coastal modification under a Regional or District Plan
 - (f) Permission to have included a negotiation for ecological compensation under the Resource Management Act 1991
 - (g) A reasonable time has elapsed, such that the activity for which permission was granted ought to have been carried out
 - (h) Sites in which permission from both regional & territorial authorities were required are acceptable
 - (i) Sites in which an outline plan has been submitted with respect to a designation are acceptable, providing the compensation can be clearly attributed to the activity that the outline plan shows
 - (j) The compensation can be anything negotiated through the planning process; from planting, species translocation, financial contributions etc.
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Note: Permission can relate to private or public land and the applicant may be any entity, including a private landowner, commercial company, requiring authority and the Crown.

Random selection was not feasible for several reasons:

- a) There is no central national repository of consent information
- b) There is rarely any recording of compensation requirements in council filing systems
- c) Information collection and consent administration processes are highly variable across councils

The numbers of cases provided by the councils varied from one through to 12, with 110 offered across all regions of the country. Of those 110 cases, 81 had sufficiently progressed to enable compliance to be ascertained. Several prominent cases were also included at the suggestion of expert advisors to both increase the sample size and to capture important examples. The statistical significance of the sample size is not able to be determined, because agencies do not record the total number of consents issued with ecological compensation requirements each year.

The case studies were located all over New Zealand, in every region of the country and all related to one or a bundle of consents issued by a district or regional council (sometimes both). The most common form of compensation action was planting, such as habitat creation, restoration or enhancement. Other requirements included pest control, financial payments and the formal handover of tenure to an agency (vesting). Many of the trade-offs were indirect or loose, where quite dissimilar ecological values were exchanged (i.e. stream diversion and riparian corridor loss in exchange for restoration planting of hill slope habitat). This scenario is common in New Zealand where quantification and demonstration of ecological equivalence is not mandated.

Determining compliance

Previous studies overseas have found that low levels of routine consent monitoring and poor record-keeping by agencies have made desktop analyses of compliance, based on requested monitoring files, inadequate (Hornyak & Halvorsen 2003; Reiss *et al.* 2009; Walker *et al.* 2009). Reducing the reliance on agency record-keeping therefore seemed essential for the present research. As a result, the determination of compliance levels achieved with the 245 conditions was generally undertaken onsite; supported by an independent review of the relevant consent files, consultation with stakeholders, and investigation into other monitoring and financial data held by the issuing council (e.g. transaction information for the purpose of tracking a bond or financial payment). To assess compliance, a multi-point scale (Table 2) was used, similar to those commonly used by regional and district councils in enforcement and in previous studies of condition compliance (Breaux *et al.* 2005; Environment Canterbury 2009; Tonkin & Taylor 2012).

Table 2. The compliance scale used to assess each case in this study.

Compliance scale	Description
0 – No compliance	No apparent attempt to achieve compliance with the stated condition
1 – High level of non-compliance	Minor or insignificant attempt made to achieve compliance
2 – Medium level of non-compliance	Significant effort apparent in meeting the condition, but falls short of full compliance
3 – Satisfactory compliance	Acceptable compliance that is within a practical margin of error and minor flexibility

The compliance with conditions was assessed on a 0-3 scale as detailed in Table 2, rather than a simple 'yes' or 'no' mark to reflect that degrees of non-compliance are often present and to make the dataset more meaningful. A score of 0 was given where no effort was apparent to meet the conditions, and a score of 1 was given when some effort was apparent, but it fell well short of what was required. A score of 2 was given where the requirements were clearly not met, but a substantial effort had been made, while a score of 3 was given where the condition was demonstrably met. If there was minor deviation from the stated goals then a score of 3 was still given. For the sake of consistency, the score reflects the level of compliance *with the condition in question* and does not automatically translate to the level of seriousness of adverse effect. For example, a failure to submit a monitoring report, which would constitute a high level of non compliance in relation to the relevant condition, is not likely to cause a serious adverse effect.

Determining variation in compliance

Activity, applicant and condition types were grouped and compared for their respective relationship with compliance scores in order to better understand the nature of non-compliance. The consents were first divided into 10 activity type categories (see Table 5) in order to compare the activity type with the level of compliance achieved. It is important to note that each may contain elements of the other, such as subdivision consents that collectively included many of the other types of conditions; but the categorisation refers to the principal activity.

Secondly, consents were allocated to three applicant categories of private company, private individual and an aggregated category comprising state-owned enterprises and public organisations to compare compliance levels between them. Thirdly, conditions were clubbed into two categories: 'administrative' conditions, (generally paper-based such as the payment of a bond, lodging of a financial contribution or the vesting of land into estate of an agency) and 'non-administrative', which were those that were conservation action-oriented and typically related to an active requirement in the field such as planting. Finally, they were divided into 14 categories (Table 3) in accordance with the type of ecological compensation requirement they related to.

Table 3. Compensation consent condition categories.

Administrative	Non-administrative
RMA Bond	Hydrological changes
Mitigation trust	Maintenance/Pests
Plan content	Restoration intention
Monitoring	Planting
Consent notice/Covenant	Fencing
Vesting of land	Translocation
Financial Payment	
Protection (restriction)	

Determining predictors of compliance

As outlined in detail in the Introduction, a list of 9 variables (Table 4) likely to have an impact on eventual levels of compliance was developed with the input of expert advisors and a review of the literature on the implementation of ecological compensation.

Table 4. Variables that were considered for each case, categorised as either process or consent variables.

Process		Consent	
Variable	Explanation	Variable	Explanation
Professional ecologist	Was a professional ecologist engaged by the applicant during the process of applying for consent?	Timing	Was the compensation action was required prior, concurrent with or following the activity that has been consented (i.e. a development)?
Early mention	Was the compensation action was mentioned early in the process, or alternatively was it late in the process at around the time of granting in response to agency or submitter concerns	RMA bond	Was a bond required for the compensation works (i.e. under section 108 of the RMA)?
Applicant proposed	Was there evidence that the applicant proposed the compensation action?	Monitoring	Was monitoring required as a condition of the consent?
Plan before	Was a detailed plan submitted prior to consent being granted?	Review condition	Was a review condition under Section 128 of the RMA present in the consent?
Notification	Was the consent in question notified, limited notified or non-notified		

Data analysis

The Chi-squared test was used to determine whether significant relationships existed between a response variable (the score attained in a ranking of regulatory compliance) and a range of predictor variables, as it has been used before in previous compliance audits (Bailey *et al.* 1992; Hornyak & Halvorsen 2003). Chi-squared test assesses whether paired observations on two variables, expressed in a contingency table, are independent of each other, the null hypothesis being that they are. In this case, each (mostly binary) predictor variable was compared against the categorical response variable for the level of compliance attained. Under the null hypothesis, the compliance levels will be similar in the presence or the absence of the factor. However, differing compliance levels will result in a larger value of the Chi-squared test statistics and a smaller p-value. Chi-squares tests were conducted at a 5% level of significance, i.e. the null hypothesis was rejected if the p-value was smaller than 0.05 (Agresti 1996).

RESULTS

In summary, the present research has examined 81 case studies, comprising 259 separate conditions of consent, across New Zealand, for the levels of compliance with ecological compensation requirements. For 14 of those conditions, it was not possible to determine whether they had been complied with or not so they were excluded from the analysis.

Determining compliance

For the 245 conditions assessed, compliance overall was 64.8%, meaning that in approximately two-thirds of cases the condition's requirements were met (Figure 1). The remainder were non-compliant to varying degrees [0 (15.2%), 1 (9.4%) and 2 (10.7%)].

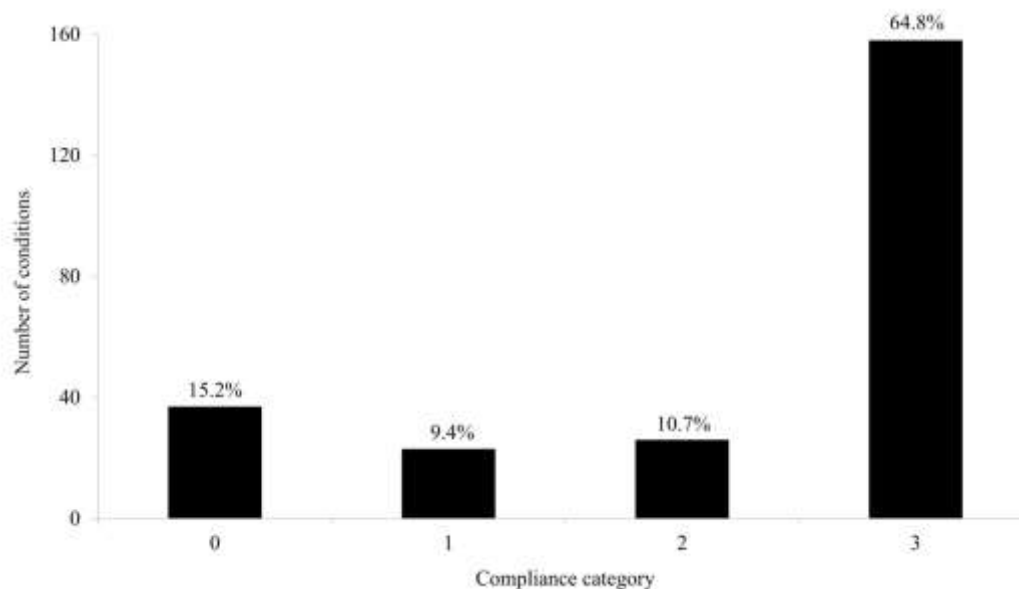


Figure 1. Number of conditions compliance categories. Percentage values at top of bars shows proportion in that category of the total number of different conditions recorded in this study (n = 245).

Determining variation in compliance

Compliance varied significantly with consent type ($X^2 = 73.207$, $df = 9$, $P = 0.000$) as shown in Table 5. Consents related to agriculture exhibited the lowest overall level of compliance (4.76% with a score of 3), whereas energy generation successfully complied in respect of all 11 conditions assessed (100% with score of 3).

Table 5. The distribution of cases (%) across the compliance scale for different categories of consent assessed in this study.

Consent category	Number	0	1	2	3
Energy generation	11	0.0	0.0	0.0	100.0
Education	8	0.0	0.0	12.5	87.5
Subdivision	104	8.7	11.5	6.7	73.1
Resource extraction	30	13.3	3.3	13.3	70.0
Recreational	14	7.1	14.3	14.3	64.3
Water discharge	22	9.1	9.1	18.2	63.6
Water take	10	0.0	20.0	20.0	60.0
Infrastructure	18	27.8	11.1	5.6	55.6
Waste management	6	16.7	16.7	16.7	50.0
Agriculture	21	71.4	4.8	19.0	4.8

Note: See Table 2 for a description of the compliance scale.

Compliance varied significantly with applicant type ($X^2 = 13.243$, $df = 6$, $P = 0.039$) as shown in Table 6. Public organisations and state-owned enterprises exhibited greater

likelihood of attaining compliance (75.51%), followed by private companies (65.49%) and private individuals (54.72%).

Table 6. The distribution of cases (%) across the compliance scale for different categories of applicant assessed in this study.

Applicant category	Number	0	1	2	3
Combined SOE/PO	49	14.3	8.2	2.0	75.5
Private company	142	10.6	11.3	12.7	65.5
Private individual	53	26.4	5.7	13.2	54.7

Note: See Table 2 for a description of the compliance scale.

Administrative conditions were generally complied with more often than non-administrative ($X^2 = 34.022$, $df = 3$, $P = 0.000$). Conditions that are administrative in nature were fully complied with in 82.61% of cases, which is significantly more often than those that require action on the ground (49.61%) as shown in Table 7.

Table 7. The distribution of cases (%) across the compliance scale for administrative and non-administrative conditions assessed in this study.

	Number	0	1	2	3
Administrative	115	13.0	2.6	1.7	82.6
Non-administrative	129	16.3	15.5	18.6	49.6

Note: See Table 2 for a description of the compliance scale.

The two categories were further broken down in Table 8, and showed that mitigation trust establishment exhibited the lowest level of compliance of the administrative conditions; however as there are only two examples they are unlikely to provide an accurate indication of expected compliance.

Table 8. A breakdown of the distribution of cases (%) across the compliance scale within the administrative and non-administrative condition categories presented in Table 7.

Administrative	Number	0	1	2	3
Bond	14	14.3	0.0	0.0	85.7
Mitigation trust	2	50.0	0.0	0.0	50.0
Plan content	29	0.0	6.9	3.5	89.7
Consent notice/Covenant	18	11.1	5.6	0.0	83.3
Vesting of land	8	0.0	0.0	0.0	100.0
Financial Payment	17	17.7	0.0	0.0	82.4
Monitoring	22	31.8	0.0	4.6	63.6
Protection (restriction)	5	0.0	0.0	0.0	100.0
Non-administrative					
Hydrological changes	5	0.0	20.0	40.0	40.0
Maintenance/Pests	38	7.9	18.4	18.4	55.3
Restoration Intention	10	50.0	20.0	0.0	30.0
Planting	58	10.3	15.5	22.4	51.7
Fencing	17	35.3	5.9	11.8	47.1
Translocation	1	100.0	0.0	0.0	0.0

Note: See Table 2 for a description of the compliance scale.

Determining predictors of compliance

Nine variables related to the planning process were tested for their relationship with compliance with the 245 conditions. Five variables that were considered did show a significant relationship with the eventual level of compliance attained (Table 9).

Table 9. Pairs of predictors with statistically significant differences in the distribution of cases (%) across the compliance scale, pairs are marked with the same symbol ($p < 0.5$).

Predictor	Number	0	1	2	3	
Action required after activity	139	19.4	12.2	11.5	56.8	*
Action required concurrent or before	105	9.5	5.7	9.5	75.2	*
Action proposed late in process	101	27.7	11.9	15.8	44.6	+
Action proposed early in process	143	6.3	7.7	7.0	79.0	+
Action not proposed by applicant	84	25.0	8.3	15.5	51.2	°
Action proposed by applicant	160	10.0	10.0	8.1	71.9	°
Detailed plan not required before granting	182	17.0	8.2	12.1	62.6	*
Detailed plan required before granting	59	5.1	13.6	6.8	74.6	*
RMA bond not required	150	16.7	6.0	13.3	64.0	-
RMA bond required	94	12.8	14.9	6.4	66.0	-

Note: See Table 2 for a description of the compliance scale.

Higher levels of compliance ($X^2 = 9.911$, $df = 3$, $P = 0.019$) occurred where the requirements were required before or concurrent with an activity (75.24%) of requirements were met in comparison to when the requirements were not required to be done until following the project (56.83%). The point in the planning process at which the compensation is first proposed also has a significant relationship with compliance ($X^2 = 34.236$, $df = 3$, $P = 0.000$). If the compensation was raised and discussed early in the process, the requirements were met in 79.02% of cases, compared with 44.55% for those that were discussed late in the process, typically at the time of granting.

Compensation proposed by the applicant (and subsequently included in the consent) is also more likely to be complied with (71.88%) compared with that which is imposed by the agency or advocated for by submitters, with those conditions being met in 51.19% of cases ($X^2 = 14.768$, $df = 3$, $P = 0.002$). In cases where a plan was required prior to granting, the compliance levels were significantly higher ($X^2 = 7.961$, $df = 3$, $P = 0.047$) with 74.58% of conditions being met, compared with 62.64% where a detailed plan was not submitted prior. A condition with a bond attached to it under section 108 of the RMA is more likely to be complied with than one that did not require a bond ($X^2 = 8.083$, $df = 3$, $P = 0.044$), although the percentages of 64.00% and 65.96% respectively were very similar.

Table 10. Groups of predictors without statistically significant differences in the distribution of cases (%) across the compliance scale, groups are marked with the same symbol ($p < 0.5$).

Predictor	No.	0	1	2	3	
Professional ecologist not involved	65	18.5	9.2	15.4	56.9	*
Professional ecologist involved	179	14.0	9.5	8.9	67.6	*
Monitoring requirements absent	71	11.3	7.0	14.1	67.6	+
Monitoring requirements in consent	173	16.7	10.4	9.2	63.7	+
Review condition not present	122	16.4	9.8	9.0	64.8	°
Review condition present	122	13.9	9.0	12.3	64.8	°

Notification	79	12.7	11.4	11.4	64.6	*
Limited notification	15	40.0	0.0	13.3	46.7	*
Non-notification	150	14.0	9.3	10.0	66.7	*

Note: See Table 2 for a description of the compliance scale.

There was no significant relationship between the input of a professional ecologist and the eventual level of compliance; neither did a requirement for monitoring. Review conditions included under section 128 of the RMA were present in approximately half of the cases, and did not have a significant relationship with compliance; neither did the requirement for public notification (full or limited) of the initial consent application (Table 10).

DISCUSSION

Three research questions were posed at the outset and the following discussion deals with each in turn, providing interpretation of the results and comparing and contrasting our results with others obtained in New Zealand and internationally. The results show that two-thirds (64.8%) of conditions relating to ecological compensation are satisfactorily met. However, it is the nature of non-compliance with the remainder that is the focus of this paper; and in particular, the ecological implications of that non-compliance. The results go on to show that the level of non-compliance is not evenly distributed through the different activities, applicant types and condition types. Finally, variables within the planning process and those related to the final form of the permission that is granted, show varied relationships with compliance that are of interest to improving the practice of managing trade-offs within environmental impact assessment.

Determining compliance

The level of overall compliance with conditions was 64.8%, meaning that in two thirds of cases the condition's requirements were met satisfactorily. The Ministry for the Environment (MfE) coordinates a biannual survey of local government agencies, investigating (among other things) levels of monitoring and compliance with consent conditions. The 2010/2011 MfE survey reported that of the consents that 'required monitoring', 68% were monitored and 72% of those 68% found to be complying with their conditions (Ministry for the Environment 2011). Note that this level of compliance considered all conditions in contrast to our research which focussed only on compensatory conditions. Nevertheless, overall compliance levels found were of a similar magnitude.

A compliance audit of several artificial waterway projects in Western Australia by Bailey et al (1992) found a similar compliance rate of 63% with conditions that related to the mitigation of adverse effects. Hornyak & Halvorsen found compliance rates of 44% and 60% for country road agency and general public wetland mitigation requirements respectively. Breaux et al (2005) found that an assessment of 18 wetlands saw 17 ranked as 'good' for compliance, with 8 fully complying with both permit criteria and ecological indicators of success (Breaux *et al.* 2005). This research suggests that better and increased use of security and insurance mechanisms, and research and innovation into alternatives is needed; as our research (like most) show levels of compliance that mean a large proportion of ecological compensation requirements do not eventuate.

Determining variation in compliance

The heterogeneity of non-compliance across industries and activity types is best reflected by the contrast of compliance levels between agriculture and energy generation, which was extreme and appears to signal a need for further research as to the reasons for such different levels of performance in this study. In respect of applicants, highest levels of compliance were achieved by public organisations, followed by private companies and then private individuals. Hornyak & Halvorsen (2003) found, by contrast, the county road agency in Michigan, USA (a 'public organisation' with a significant degree of interaction with the regulator) was less likely to comply with requirements (44%) compared with permittees that were part of the general public (either 'private companies' or 'private individuals'), with compliance levels of 60% (Hornyak & Halvorsen 2003). The data also showed that non-administrative conditions are much less likely to be complied with than administrative, which reveals that although overall compliance compares favourably with national level estimates, that the nature and scale of non compliance with respect to ecological outcomes is inferior. These findings contrast with previous studies that found no difference in compliance across condition types (Bailey *et al.* 1992).

Understanding the specific profile of non-compliance in an area can help agencies and their communities prioritise scarce education and monitoring resources, in order to improve their enforcement strategies (Hornyak & Halvorsen 2003). This research shows that level of non-compliance differs between the type of activity, applicant and condition type; and indicates that regulatory agencies would benefit from understanding the relevant trends within their jurisdiction in order to ensure environmental impact assessment procedures take account of different trends and risks.

Determining predictors of compliance

Understanding the variables that are more likely to have an impact on the eventual level of compliance can help to inform and improve planning practice, and this assists agencies in managing risk of default through the impact assessment process. Of the 9 variables hypothesised to correlate with compliance, 5 showed significant correlation while 4 were weakly or not correlated.

Factors with insignificant impact on compliance

Variables which the dataset showed were insignificant in terms of a relationship with eventual levels of compliance included the input of a professional ecologist, the presence of monitoring requirements for the applicant or third party, public notification of the application, and the presence of a review condition.

In most cases, the professional ecologist (if there was one engaged during the initial planning stages), did not appear to have been retained throughout implementation. This was difficult to determine due to quality of record-keeping in many cases, so was not part of the formal assessment. For example, if a report was produced by an ecologist a period of time following implementation, it could not be assumed that he or she had overseen the implementation works. The lack of apparent effect of a professional ecologist's input may also signal low quality advice being provided to clients, or poor efficacy of the manner in which professional contributions are considered in project planning. Further research on these matters is desirable.

The presence of monitoring requirements in the consent did not have a strong correlation with higher levels of compliance, which was somewhat surprising. There are a number of possible explanations for this. The first is that the monitoring conditions were only met 63.64% of the time. The second is that the monitoring conditions were of varying quality and detail, from requiring a letter confirmation of works having met conditions at the time of assessment, through to detailed and long-term monitoring of water quality with appropriate feedback loops. Finally, there was evidence of reports having been submitted but not necessarily being acknowledged or acted upon by the agency, which may diminish the incentive to comply if there is a perception of a lack of oversight. Our results also showed that public notification had no significant relationship with compliance, and neither did the presence of a review condition.

Factors with significant impact on compliance

Where compensatory actions were required before or concurrent with the consented activity, the likelihood of compliance was observed to be significantly higher. There were very few examples of prior requirements, so it is not clear to what degree prior requirements are also stronger than those that are undertaken concurrently. It is also usually impractical to delay projects until after full outcomes of an ecological compensation requirement are demonstrated. At present in New Zealand, there is no formal framework to package advance mitigation programs as may be able to occur overseas (including species banking, wetland mitigation banks and credit trading in other forms). It is probable that an absence of regulatory certainty that the works will be recognised as compensating for a later activity dissuades developers from undertaking advanced works.

Where compensation requirements were mentioned early in the process, and presumably better integrated into project planning including timelines, eventual levels of compliance are higher. The data indicates that compliance is more likely to be achieved if the full scope and nature of activities are determined by the time of granting consent. Together, the correlation with compliance of both the early mention of ecological compensation, and the detailed planning through the project planning stages is strong. This aligns with best practice for the purpose of managing trade-offs in environmental impact assessment, where systematic consideration of a project and detailed planning is viewed as critical (Morrison-Saunders & Pope 2013).

The presence of an RMA bond on a condition had a significant positive correlation with compliance although weaker than most other measures. A weaker correlation than expected could be due to a number of factors. For example, bonds are often set too low, so that they are insufficient to pay for the works required. Where default occurs and a bond is in place that is unlikely to cover the cost of the works, the requiring agency may not undertake to take action as they will be required to meet the shortfall. Overall, bonds were only required in 25 cases of 110 cases overall. For a mechanism that represents a relatively simple form of insurance, the low usage of the section 108 provision for a bond to be requested was surprising. Throughout the research, it was apparent the available security measures were often not utilised, and that further innovation into improving the range of these measures available would be advantageous.

CONCLUSION

The results of the research also show that there is a clear need to understand the complexities of non-compliance as they apply to trade-offs that justify development at the expense of ecological values. Our research showed that 64.8% of ecological compensation requirements

are met, and that there was significant variation in compliance across different activity, applicant and condition types. The significant number of conditions not complied with indicate that present tools and practice within the domestic field of impact assessment are not securing the necessary benefits from ecological compensation requirements that are required. Our research also showed that process-related and consent-related variables are often powerful predictors of levels of compliance. Understanding the nature of non-compliance will assist in improving the manner in which trade-offs such as ecological compensation are managed in environmental impact assessment.

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