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The Value of Native Biodiversity Enhancement in New Zealand:

A Case Study of the Greater Wellington Area

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Abstract

New Zealand's biodiversity consists of over 80,000 native plants, animals and fungi, many of which are indigenous and located on private property. To enhance native biodiversity and discourage activities that may deplete it, policies can be introduced that can encourage individual self-interest to coincide with social interest. Economic values for biodiversity can help to determine the best policy tools to use. In this project, we surveyed Greater Wellington Region households to determine their biodiversity enhancement values using the contingent valuation approach. Greater Wellington respondents placed a significant value on both private land biodiversity as well as public land biodiversity.

1. Introduction

New Zealand became a party to the Convention of Biological Diversity in 1993. By signing this agreement, a commitment was made to create a national biodiversity strategy and action plan to reduce biodiversity loss. The New Zealand Biodiversity Strategy was finalized in 2000. One of the goals of the strategy was to "enhance community and individual understanding about biodiversity, and inform, motivate and support widespread and coordinated community action to conserve and sustainably use biodiversity." Another goal was to "halt the decline in New Zealand's indigenous biodiversity" by maintaining and restoring the remaining habitats and ecosystems to a healthy state as well as to sustain other ecosystems. If these goals are achieved, there should continually be viable populations of indigenous species throughout the country (Ministry for the Environment, 2000).

One way to reduce biodiversity loss is to create public conservation estates. Currently, approximately 30% of the land area in New Zealand is protected within the public conservation estate. However, much of the land that is protected is land that is unfit for grazing or occupation, such as the high mountains of the Southern Alps. Less that 20% of the lowland areas, where a majority of residents work and reside, are protected. Therefore, to thoroughly protect biodiversity, not only does public land need to be protected, but so does private land (Ministry for the Environment, 2000).

The importance of private land for conservation has not only been recognized in the New Zealand Biodiversity Strategy, but it has also been recognized in many other government initiatives and laws such as the Resource Management Act of 1991, the Forest Amendment Act of 1993, the preliminary report of the Ministerial Advisory Committee entitled "Bio-What" and the final report of the Ministerial Advisory Committee entitled "Biodiversity and Private land," to name a few (Norton, 2001; Ministry for the Environment, 1991, 2000, and 2003). The most powerful and far reaching in its impact of those government initiatives is the Resource Management Act, the purpose of which is to affect activities on private land (Jay, 2000; Ministry for the Environment, 1991).

Many councils and other governmental organizations have learned that private support is a key issue in biodiversity management (Department of Conservation/Ministry for the Environment, 1998; Department of Conservation/Ministry for the Environment, 2003; Ministry for the Environment/Department of Conservation/Local Government New Zealand,

2003; Kneebone *et al.*, 2000; Kneebone, 2000). Private land is important not only because of its indigenous biodiversity, but because that is where the human population is living, working, and recreating (Norton, 2000). Private landowners can make a large contribution to biodiversity conservation. The Taranaki Regional Council reports that for every $1 the council spends on biodiversity conservation, a landowner will spend $10. This represents public interest and effort. Not only are some landowners concerned with biodiversity on their own properties, but they are also concerned with biodiversity in their communities and have started community groups to help achieve these goals, such as the Mangakotukutuku Stream Care Group in Hamilton, Friends of Maara Roa in Wellington, as well as the Royal Forest and Bird Protection Society throughout the country (Mangakotukutuku Stream Care Group, 2007; Friends of Maara Roa, 2007, Royal Forest and Bird Protection Society, 2007; Ministry for the Environment/Department of Conservation/Local Government New Zealand, 2003).

In conserving biodiversity on private lands, it is necessary to find ways to integrate indigenous biodiversity conservation with land uses rather than separate them (Kneebone *et al.*, 2000; Kneebone, 2000; Norton, 2000; Hartley, 1997). There is a need to take a "whole-property" perspective, which recognizes the need to both accommodate the economic use of the land and to reduce the impacts on biodiversity (Kneebone, 2000). Given the right support and incentives, landowners make the most effective stewards of the land and of the biodiversity associated with it (Kneebone, *et al.* 2000).

In this project, our goal was to use a survey to discover how much Greater Wellington residents value indigenous biodiversity conservation on both private and public lands. This information can then be used to discover how to motivate people to contribute to indigenous biodiversity in New Zealand by way of planting native trees and shrubs, which can, in turn, attract native birds, insects, and fish to areas where they are either locally extinct or exist in extremely small numbers.

2. Methods

The goal of this study was to determine the value that Greater Wellington residents placed on biodiversity in their area. To accomplish this, we created a survey. The first version of our survey entitled "Trees and Plants in Your Yard: What Do You Think?" was created in September of 2006. The survey was edited and revised with feedback from several colleagues,[i] as well as results from two focus group sessions. The first focus group took
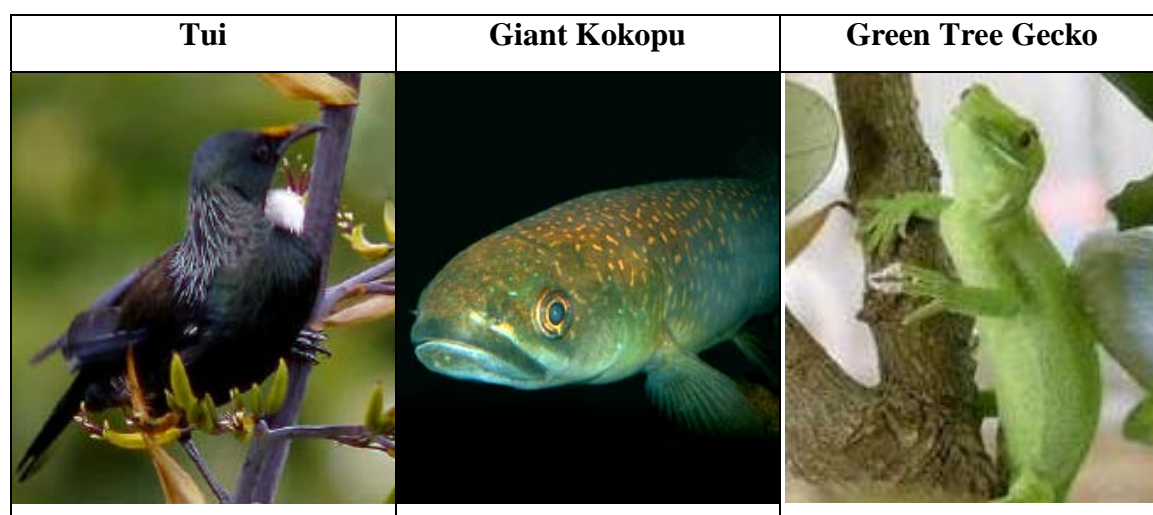
place in October 2006 in Rotorua and was attended by eight participants[ii], while the second focus group session took place in November 2006 in Cambridge. Twelve participants came to the second focus group session. After the second focus group, it was decided that the survey was well understood by participants. Therefore, only minor changes needed to be made to the survey before it was finalized[iii].

The final version of the survey was titled "Trees and Shrubs on Private and Public Lands: What Do You Think." It contained a cover page with a colour picture of a koru[iv] as well as eight pages of questions. Questions were divided into seven sections. The sections asked respondents about the trees and plants in the area where they lived, their concepts about an 'ideal' property, concepts about parks or reserves in their local area, contingent valuation questions, choice modelling questions, well being questions and a page of demographic questions. For the purposes of this paper, we will focus on demographic questions, questions relating to views of plants, and two contingent valuation questions.

Contingent valuation questions were used to capture the value people would be willing-to-pay for native plants and animals on both public lands and private lands. To do this, we first presented the respondents with a picture of a native tui, giant kokopu, and a green-tree gecko (Figure 1). We then gave respondents some background on biodiversity:

> "New Zealand's native plants and animals are dependent upon each other. For example, the *Tui* and *Green Tree Geckos* will eat nectar from native flowers like the flax and pohutukawa while the *Giant Kokopu* likes to live in slow moving streams shaded by overhanging native vegetation. With the development of the land to meet the needs of people and the introduction of possums and rats, much of the native bush has disappeared, and what is left provides valuable food and places to live for native birds and other animals. Some of the native bush is on public land, but there is a lot of native bush on privately owned land."

Figure 1. Native Animal Pictures Presented with the Contingent Valuation Question.[v]

Tui	Giant Kokopu	Green Tree Gecko

Finally, we asked them two questions. The first related to private land and the second related to public land. We placed actual bid amounts in each survey that were determined during the focus group sessions. Bid amounts ranged from $0.50 to $1,500. The questions were as follows:

1. Sometimes incentives are offered to private landowners to encourage planting native trees on their property. Incentives can be free trees or rebates for trees that you purchase, but it can also be free advice about trees you can plant on your property.

   If part of your annual rates were dedicated to support programmes to plant **native trees and shrubs** on **private land**, would you be willing-to-pay an additional $ *(Note: number handwritten here)* in your annual rates? (If you do not own land now, please answer the question as if you did own land).

   Note: All funding would go towards this programme and not administrative fees.

   Please tick: ☐ Yes   ☐ No

2. Sometimes community organisations or council staff will plant native trees and shrubs on public land (e.g., gully restoration projects). If part of your annual rates were dedicated to support programmes to plant **native trees and shrubs** on **public land** (e.g. city parks and reserves), would you be willing-to-pay an additional $*(Note: number handwritten here)* in your annual rates?

   Note: All funding would go towards this programme and not administrative fees.

   Please tick: ☐ Yes   ☐ No

We used 21 different values in the questions ranging between $0.10 and $1,500. These values represented the amount the respondent was willing-to-pay annually in their rates. Each respondent was given the two contingent valuation questions in which were both assigned with the same willingness-to-pay (WTP) value. For instance, if a respondent was asked if he/she would be willing-to-pay $10 to support a tree planting initiative on private land, the next contingent valuation question will ask if he/she would be willing-to-pay $10 to support a similar initiative on public land.

Between December 2006 and April 2007, using randomly selected phone numbers from the Greater Wellington region, a total of 414 people were contacted by phone and asked if they would participate in our survey; of those, 182 agreed. Once agreeing to participate, the potential respondents were sent a survey packet which included a cover letter explaining the survey, a handwritten note thanking them for completing the survey, the eight page survey, a freepost return envelope, and a $1 scratch off lottery ticket used as an incentive to thank them for completing the survey. In all, 165 useable surveys were returned, for a response rate of those that agreed to complete the survey of 91%.

The contingent valuation questions used in the survey were of a single-bounded dichotomous choice type. These questions require a qualitative choice model. Logit and the probit regression models are the most widely used discreet choice methods (Capps and Cramer, 1985). The logistic model can be used when the dependent variable represents a qualitative response such as choosing among a set of discrete alternatives. It is typically used to explain a binary dependent variable (and hence can be called the binary logit model). The logit model also uses a relatively simple computational procedure, generates estimates similar to the probit model, and has been used in a number non-market valuation studies (e.g., Amirnejad, et al., 2006; Lee and Han, 2002; Loomis, 1990; Seller, et al., 1985). Thus, we elected to use the logit model with linear bids for this study. The probability that a person would say "**yes**" (P_i) to support of a native tree planting programme on either private or public land is represented by the following logit model:

$$P_i = F_\eta\left(\Delta V\right) = 1/(1 + \exp(-\Delta V)) = 1/(1 + \exp\{-\left(\alpha + \beta D\right)\}) \qquad (1)$$

where $F_\eta(.)$ represents the cumulative distribution function of a standard logistic variate, D represents the bid amount, and α and β are the unknown parameters to be estimated. Given the expectation that the probability of saying "yes" decreases at higher bid amounts, β should be preceded by a negative sign or simply $\beta \le 0$. The logit model in equation (1) is estimated using the maximum likelihood method.

Results: Demographics and Views about Plants

Greater Wellington survey respondents were located in two regions: the Wellington Region (76%) and the Waiarapa Region (24%). Wellington Region respondents lived in Wellington City, Upper Hutt City, Porirua City, Lower Hutt City, and the Kapiti Coast District. Wairarapa Region respondents lived in Masterton, Carterton and Southern Waiarapa Districts.

Our average respondent was between the ages of 45 and 54 years old. Almost 81% of our sample was born in New Zealand and over 94% of our respondents considered themselves "New Zealanders," whether that be New Zealand European (87%), Maori (4%), or stating that they were a New Zealander, but did not specify further (3%). The rest of our respondents were from Australia, Samoa, Africa, Asia, and other European countries such as England. Most respondents had finished a tertiary education, but the amount of education fluctuated among respondents from those that completed primary school to those that completed a post graduate education.

Respondents had lived on average at their current location an average of 13 years; however, the median was seven years. On average, there were three people living in each home with an average household income between $50,000 and $75,000. The majority of respondents were female (66%) and the average size of their properties was almost 16 hectares. Average property size may be a misleading figure; however, since the median size property was only 0.08 hectares. We believe the median property size was small because many of the respondents lived in the urban area of Wellington City (Table 1).

Table 1: Survey Respondent Demographic Characteristics

Variable	Mean	Median	Maximum	Minimum	Standard Deviation
Age Group	Between 45 and 54 Years Old	Between 45 and 54 Years Old	Over 75	Under 25	--
Education	Tertiary Education	Secondary Education	Post graduate Education	Primary Education	--
Household Income (In 2007 NZ$)	Between $50,001 and $75,000	Between $50,001 and $75,000	Over $125,000	Less than $25,000	--
Sex Ratio (% Female)	62.42%	Female	Female	Male	48.58%
Born in New Zealand (% Yes)	81.09%	Yes	Yes	No	39.27%
Years Lived at Current Property	12.69	7.00	60.00	0.17	13.83
Number of People Living in the Home	2.65	2.00	8.00	1.00	1.35
Property Size in Hectares	14.37	0.08	607.02	0.007	70.93

A large majority (84%) of respondents owned their own property. This was important to know, as we asked them questions about plants on their property. 96% of respondents currently have trees on their property, with 74% of them having planted some or all of these trees.

When asked whether they would volunteer to plant trees and shrubs in their community on public land, 56.36% said they would. While this only represents a little over half of the respondents, this is an important number. If we could learn how to motivate more people to plant trees on public lands, this would make a significantly large impact on native biodiversity efforts. When asked whether they would volunteer to plant trees and shrubs on their own properties, 78.18% said they would. However, some of those that said no, also said they were either too old, or, since they rented the property, didn't feel like they could. We believe this represents the importance of encouraging them to help with public land plantings.
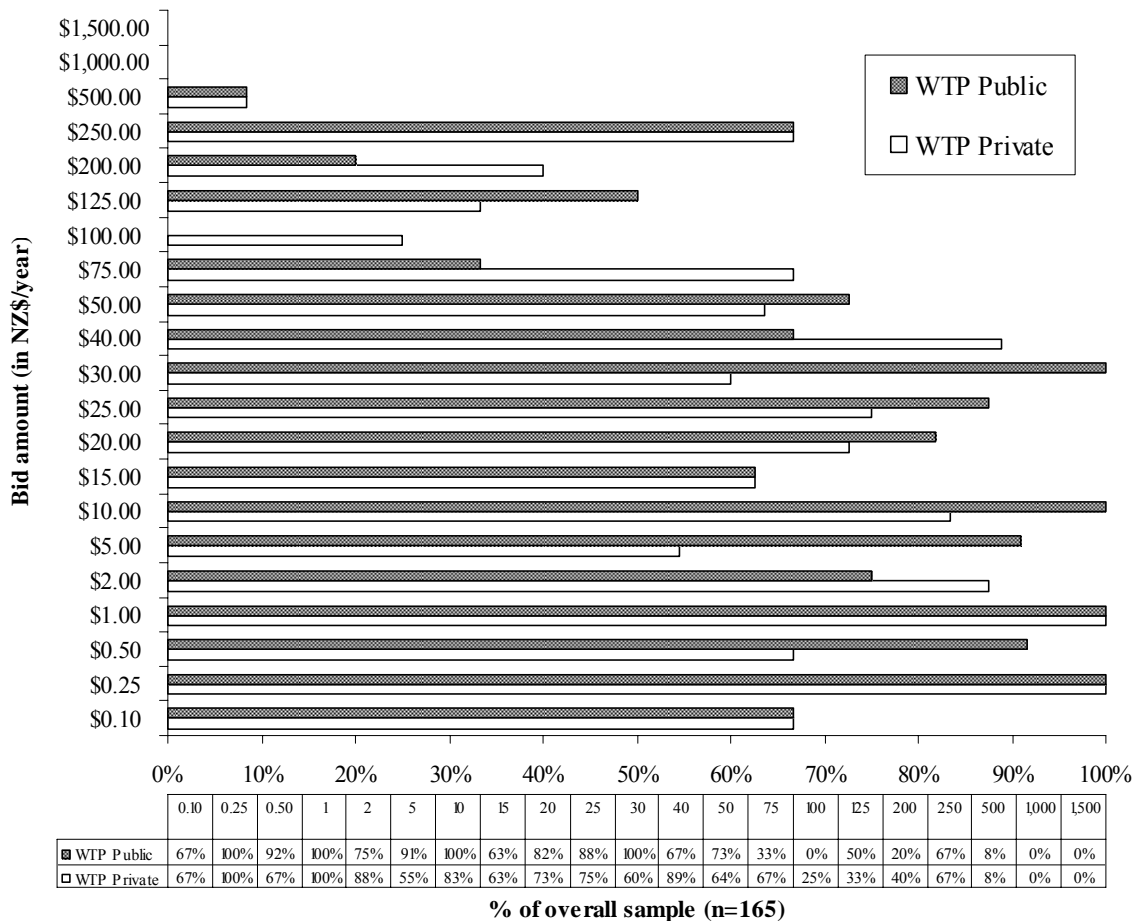
Results: Contingent Valuation Questions

Once we obtained some background information from the respondents (including their responses to our scoping questions), we then asked them our two contingent valuation questions.[vi] As stated previously, contingent valuation questions were used to capture the value that people would be willing-to-pay for native plants and animals on both public and

private lands. Overall, over half of the respondents were willing to support the planting of trees and shrubs on both private land (61%) and public land (67%).

Figure 2 illustrates the "yes" vote pattern of the sample over the 21 WTP values. There is a pattern here, although it may not be completely obvious in the mid-section of the graph, that people are willing-to-pay an annual amount in their rates more often at lower values than at higher values. As can be seen, no respondents would pay if values were greater than $500/annually, while 100% were willing-to-pay at values of $0.25 and $1/annually.

Figure 2. WTP to Support Planting Programmes on Private and Public land.

Values presented are the percentage of yes votes (n=165) representing
how much people would be willing-to-pay annually in their rates (2007 NZ$)

	0.10	0.25	0.50	1	2	5	10	15	20	25	30	40	50	75	100	125	200	250	500	1,000	1,500
▩ WTP Public	67%	100%	92%	100%	75%	91%	100%	63%	82%	88%	100%	67%	73%	33%	0%	50%	20%	67%	8%	0%	0%
☐ WTP Private	67%	100%	67%	100%	88%	55%	83%	63%	73%	75%	60%	89%	64%	67%	25%	33%	40%	67%	8%	0%	0%

% of overall sample (n=165)

To determine the WTP amounts for the questions, logit regressions were run, as our dependent variable was binary. Our base model for whether people were willing-to-pay for a program to plant trees on public land was significant at the 99% confidence level. The results of the public model are as follows (with P-Values in parenthesis):

WTP for Plants on Public Land (yes, no) = 1.110 – 0.007 Bid Amount
                                          (0.000) (0.000)
McFadden R-squared = 0.191;   LR statistic (1 df) = 42.200

The negative sign on the bid amount indicates what we see in the figure: that people are more willing-to-pay for biodiversity enhancement schemes on public land at lower annual rate values than higher.

Our base model for whether people were willing-to-pay for a program to plant trees on private land was also significant at the 99% level. The results of the private model are as follows:

WTP for Plants on Public Land (yes, no) = 1.657 – 0.010 Bid Amount
                                          (0.000) (0.000)
McFadden R-squared = 0.289;   LR statistic (1 df) = 60.773

Again, we find that people are more apt to be willing-to-pay for a biodiversity enhancement scheme at a lower value than a higher value.

Parameter estimates from the logit regression model can be used to calculate the median, mean and confidence intervals of the expected WTP value. The median WTP (WTP_{median}) can be calculated using the formula suggested by Hanemann (1984) while the mean WTP (WTP_{mean}) can be computed using Hanemann (1989).

$$WTP_{median} = -(\alpha / \beta)$$

(2)

$$WTP_{mean} = \{\ln(1 + \exp(\alpha))\} / - \beta$$

(3)

where α is the estimated logit regression constant and β is the coefficient of the WTP bid amount.

Although we are aware that there are several methods to calculate the confidence intervals of median WTP such as the method proposed by Krinsky and Robb (1986; 1990) and the delta method (Greene, 2005), we elected to calculate the 90% confidence interval from the mean WTP using the simulation approach of Park et al. (1991). This simulation approach has been adopted in several environmental valuation studies that use single bounded-dichotomous choice contingent valuation questions, similar to the ones we used here (e.g., Dupont, 2004).

Mean, median, and confidence intervals (CI) calculated are presented in Table 2 These results show that respondents have a significant WTP for planting native trees and shrubs on private and public lands, therefore indicating their value for biodiversity. The median value for trees and shrubs on public lands was $174.05, with a mean of $192.38. While the median value for private land was $166.30, with a mean of $208.99.

Table 2. Greater Wellington Respondents Willingness-to-pay for a Program to Plant Trees and Shrubs on Public and Private Land.

Values represent how much people would be willing-to-pay annually in their rates (2007 NZ$)

	Median Willingness-to-Pay	Mean Willingness-to-Pay	90% Confidence Interval on Mean willingness-to-pay	
			Lower Bound	Upper Bound
Public Land Willingness-to-Pay	$174.05	$192.38	$146.81	$283.52
Private Land Willingness-to-Pay	$166.30	$208.99	$154.36	$326.13

While these results will be very informative to land managers, we took our data another step further to see if we could understand our results in more depth by investigating whether there was a difference for WTP values between rural and urban populations.

Breaking down the data into rural and urban respondents shows us that urban respondents were more willing-to-pay almost three times more annually in their rates ($190) for biodiversity enhancement on public land than their rural counterparts ($69).   Therefore, while the average of all respondents was $174, this result presents a picture that is slightly biased. We also found that a similar result holds true for biodiversity schemes on private lands. Overall, respondents were willing-to-pay $166 annually. However, urban respondents were willing-to-pay $188, while rural respondents were only willing-to-pay $69 (Table 3). This is a significant difference and must be taken into account when developing biodiversity enhancement schemes.

Table 3: Willingness-to-pay values of rural and urban Greater Wellington respondents

For biodiversity enhancement on private and public lands representing
how much people would be willing-to-pay annually in their rates (2007 NZ$).

Land Type	Median	Mean	90% Confidence Interval	
			Lower Bound	Upper Bound
Public Land				
Rural	$ 68.69	$ 69.43	$ 39.00	$ 395.13
Urban	$ 189.91	$ 213.30	$ 158.05	$ 337.55
Private Land				
Rural	$ 69.26	$ 82.96	$ 42.75	$ 499.56
Urban	$ 187.80	$ 236.00	$ 168.92	$ 413.34

3. Discussion and Conclusions

In this paper, we presented the results from a 2007 Greater Wellington survey conducted to discover how residents value native biodiversity in their area. When asked whether they would be willing to participate by physically volunteering their own labour to plant native trees and shrubs on public lands in their area, over 50% were willing. We believe this is an important result. There are many volunteer groups, such as stream care groups, which already participate in native planting projects around the region. However, these groups are small and do not represent anything close to 50% of the population. The significant interest identified in this study, should be taken advantage of if the Greater Wellington Regional Council truly wants to develop a biodiversity enhanced region. We believe that the next step to be taken from here should be to learn how to motivate this 50% of Greater Wellington Residents to take part in planting activities.

To determine the value people have for biodiversity enhancement, contingent valuation questions were asked. Questions asked respondents whether they would be willing-to-pay for a planting scheme on private land and a planting scheme on public land. Over 60% of respondents were willing-to-pay for these schemes. On average, people were willing-to-pay $174 annually in their rates for projects on public lands and $166 annually for projects on private lands. This information shows that New Zealand residents feel strongly about biodiversity in New Zealand and are willing to give up a portion of their income to support it.

When WTP values were broken down between rural and urban respondents, however, a much more detailed story was seen. Both rural and urban residents were willing-to-pay for biodiversity enhancement schemes; however, rural residents were willing-to-pay a significantly lower amount than their urban counterparts. For public lands, urban respondents were willing-to-pay $189/annually while rural respondents were only willing-to-pay $68/ annually. For private lands, we see the same pattern. Urban respondents were willing-to-pay $187/ annually, while rural respondents were only willing-to-pay $69/ annually. Therefore, if rates were ever to be used for biodiversity enhancement schemes, differences between rural and urban residents must be taken account of and if one standard rate is to be selected, the lower version is advised.

As New Zealand is a large mecca for native plants and animals found nowhere else in the world, it is important to protect and enhance what is left. The country has already taken steps forward by becoming a party to the Convention of Biological Diversity and committing to reduce biodiversity loss. The results of this survey show that residents of the country strongly support native biodiversity. Therefore, we believe land managers can use this information to proceed with successful biodiversity enhancement projects.

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i   Colleagues that provided important feedback included Riccardo Scarpa, Amber Bill, Tim Porteous, Caren Shrubshall, Kirsten Forsyth, Michelle Bird, Bruce Burns, and Thomas Wilding.

ii   For more detail on Focus Group 1, refer to Kaval and Yao, 2006.

iii   For more detail on Focus Group 2, refer to Yao and Kaval, 2006.

iv   A native New Zealand tree fern frond.

v   Sources of photos:
Photo of Tui on Flax:
http://www.tiritirimatangi.org.nz/images/Birds/tui-on-flax.jpg
Taken by Max McRae.

Photo of Giant Kokopu:
http://www.streamcare.org.nz/Giant%20kokopu%20TRC%2015-3-04%20g.jpg T
Taken by Stephen Moore of the Hamilton Mangakotukutuku Stream Care Group.

Photo of Green-Tree Gecko:
http://www.wellingtonzoo.com/animals/animals/reptiles/gecko.html

vi   For a PDF copy of the questionnaire, please contact one of the authors.