The Economic Value of Environmental Amenities and Restoration for Rural Land in New Zealand

A review for Tūmai Beach Sanctuary prepared by Soren Ian Moller

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Executive Summary

Environmental amenities located in rural lands and landscapes provide a range of ecosystem services to people. The economic value of these ecosystems services includes their use value, option value, and non-use value. These values are at least partially capitalised into land prices. Through a review of the literature from New Zealand, the US, and Australia, this study aimed to investigate the value of various environmental amenities associated with rural landscapes, and the extent to which they influence land prices.

Firstly, a theoretical framework was developed outlining economic value and ecosystems services. This conceptual model helps to explain which ecosystems services are likely to be capitalised into land prices. Secondly, the advantages and disadvantages of the two major methodological approaches to the valuation of environmental amenities were compared. These are the stated preference and revealed preference models. Thirdly, the results of relevant case-studies were examined. Stated preference studies suggest New Zealanders place a high value on environmental restoration and biodiversity. However, because the revealed preference method has not been widely used in New Zealand outside of urban markets, it is difficult to quantify the impact of environmental amenities on rural land prices. As a next best alternative, international studies gave a general indication of the impact of proximity to environmental amenities such as forests, wetlands, and the coast on land prices. Due to the case-specific nature of results, especially as they are linked to specific locations, these results must be treated with caution when removed from their original geographical contexts.

This review of five New Zealand and eighteen overseas case studies identified instances where people preferred property that:

1. offers good views, especially overlooking water (sea, lakes, rivers and estuaries)
2. has a diversity rather than uniformity of views
3. is relatively close to cities or towns that supply services, employment and schools
4. provides reliable vehicle access and proximity to an airport
5. provides or is close to recreational opportunities (swimming, boating, fishing, tramping, skiing)
6. is near the coast
7. has a reliable water supply
8. includes some forest, though is not predominantly forested
9. provides a diverse landscape with fragmented forest patches and more complex natural forest edges
10. is close to wildlife habitat, wilderness and/or protected natural areas
11. is contributing active restoration of biodiversity and ecosystems
12. is close to but not immediately next to rivers and wetlands
13. is not at risk of flooding
14. does not have odours or insects
15. has productive potential (forestry or agriculture).

The specific magnitude of these effects in terms of a dollar value of land cannot be directly applied to a New Zealand context without further primary research. However, the international literature gives a reasonable estimate of the likely direction of value impacts related to the proximity to environmental amenities, and the relative importance of different environmental amenities, in New Zealand.

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The Economic Value of Environmental Amenities and Restoration for Rural Land in New Zealand

Introduction

Economic valuation techniques are increasingly being applied to guide land use acquisition and ecological restoration interventions for the conservation of biodiversity and provision of ecosystem services (Pearce 2006). Calculation of the economic returns from land care and provision of services (eg. erosion and flood control, pest control, pollination, aesthetics) and recreational opportunities could incentivise restoration investments, prioritise where and when such investments are most cost-effective, and help achieve land owner and public consensus of how to strike the balances between trade-offs in land use for conservation and production (Polyakov *et al.* 2012). Economic tools focus on choice and the barriers and enablers for triggering change. Their application can guide managers on the likely level of adoption of ecological restoration investments on private land, the need or otherwise for provision of public funds to defray private landowner costs of restoration and associated provision of public good, and policy directives for regional scale environmental enhancement (Polyakov *et al.* 2012). Nevertheless, many of the intangible values motivating ecological restoration are extremely difficult to measure in dollar terms because the activity and its products are never, or at least only indirectly, traded in markets. Although economic valuation tools clearly have immense, and as yet are underused benefits for guiding conservation, they are unlikely to provide a complete picture if applied without the support of qualitative and soft-systems research tools (Phipps et al. 2011).

Protection and enhancement of ecosystem services in New Zealand's production landscapes is critically dependent on provision of ecological refuges from agricultural disturbance and intensification (Meurk & Swaffield 2000; Perley *et al.* 2001; Blackwell *et al.* 2008; Lee *et al.* 2008; Meadows *et al.* 2008; Moller et al. 2008a, b). A greater variety of plant species and a diversity of vegetation structure (especially shrubs and trees) will provide ecological opportunities for the persistence of biodiversity, which in turn provides pollination, pest control, decomposition and nutrient cycling to keep biological production going. An increasing proportion of farmers and other New Zealand citizens value biodiversity for its own sake and for aesthetic reasons, irrespective of the benefits it provides for production of food and fibre. Meurk & Swaffield (2000) suggest that at least 25% cover of woody vegetation is required to secure ecologically resilient pastoral ecosystems. If so, large areas of New Zealand's farming areas will have to be replanted for their long term sustainability. Some farmers are understandably concerned that such diversion of farmland to "non-productive" ends will affect their economic returns and land values, and the cost of planting can be

considerable and time consuming (Fairweather *et al*. 2010, Meadows 2012, Fukuda *et al.* in prep.[1]). Unfortunately there have so far been very few economic studies of the potential impacts, both positive and negative, of environmental amenities and restoration on rural land values in New Zealand.

This report provides a brief review of the available studies in New Zealand and overseas to indicate the likely direction of impacts on rural land values from the presence or proximity of woody vegetation and other ecological refuges (eg. lakes, rivers, estuaries, wetlands, coastline). My primary goal was to see whether reliable calculations of the economic value of environmental amenities and restoration are already available for New Zealand rural land. Subsidiary questions included how much such values are capitalised into land prices; whether the international literature might be able to predict what is happening in New Zealand; and what type of factors should be incorporated in future New Zealand research.

First, I develop a theoretical framework outlining economic value and ecosystems services. This conceptual model helps to explain which ecosystems services are likely to be capitalised into land prices. Second, I evaluate the advantages and disadvantages of the two major methodological approaches to the valuation of environmental amenities and conclude that revealed preference methods are by far the most reliable. Third, I examine the results of relevant case-studies in New Zealand. However, because it turned out that the revealed preference method has not been widely used here other than in urban markets, it proved difficult to quantify the impact of environmental amenities on New Zealand's rural land prices. As a next best alternative, I conclude by reviewing international studies to give a general indication of the impact of proximity to environmental amenities such as forests, wetlands, and the coast on land prices.

Economic Value and Ecosystems Services

An economic analysis[2] of the value of the environmental deals specifically with the benefits humans derive from environmental resources and amenities (Pearce 2006). Within this framework, *ecosystem services* are defined as the flow of benefits people obtain from ecosystems (Millennium Ecosystem Assessment 2003). The different values that are obtained from ecosystem services stemming from an environmental resource can be categorised as *use value*, *option value*, and *non-use value* (see *Fig. 1*). Use value accounts for the benefits of using an environmental resource. Use

[1] Yuki Fukada, Wendy McWilliam and Henrik Moller are currently completing analysis of shelterbelt provision and management on New Zealand dairy farms that emphasise the costs and benefits of woody vegetation for production.

[2] The case studies reviewed below adopt a neoclassical economics approach to natural resources. A full consideration of the advantages and limitations of the neoclassical framework are beyond the scope of this study. Steenstra (2008) provides a short introduction to the debate surrounding the appropriateness of the neoclassical approach, including a discussion of sceptical views toward 'monetary reductionism'. A significant criticism of economic valuation is its inability to accurately capture or do justice to cultural and intrinsic values, which are central to many people's interaction with, and understanding of the environment. On the other hand, Pearce (2006) addresses some of the criticisms towards economic valuation. While the shortcomings of the approach cannot be discounted, economic valuation does provide a useful, albeit incomplete, tool to assist decision making.

value may be direct or indirect. *Direct use value* provides a direct benefit to users, for example, timber from forests. *Indirect use value* is derived from the role ecosystems services play in supporting the function of ecosystems and the flow of direct use benefits. Examples include the purification of air and water, maintenance of biodiversity, and nutrient cycling. Option value accounts for the potential future benefits received from the environment. Non-use value includes e*xistence value*, which is derived from knowing that something exists, and *bequest value*, which comes from leaving something for future generations (McConnell and Walls 2005; Steenstra 2008; Ma and Swinton 2011).

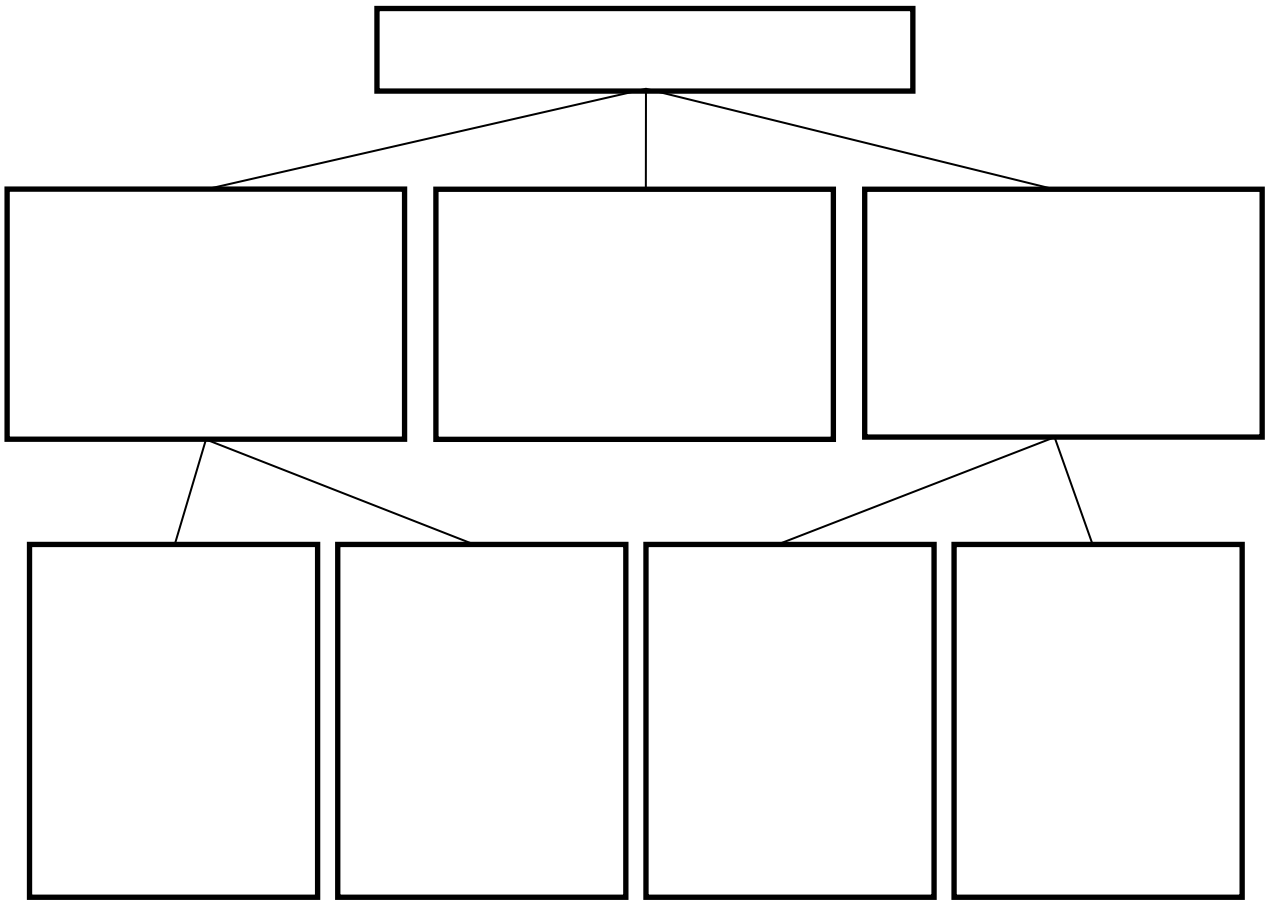

Figure 1: Economic Value of Environmental Resources

Based on their different use values, Ma and Swinton (2011) outline four basic types of ecosystems services located in rural land and landscapes. *Provisioning* ecosystems services provide direct use benefits such as the production of basic primary products from environmental resources. *Recreational, aesthetic,* and *cultural* ecosystems services provide direct use benefits such as access to recreational activities and scenic appeal. *Regulating* ecosystems services involve ecosystems processes that regulate aspects of the environment including water quality and quantity, erosion, pollination, climate, ecological disturbance patterns, pest populations, and other outcomes. Finally,

supporting ecosystems services underpin the existence of ecosystems and therefore enable the flow of other ecosystems services. Important examples of supporting ecosystems services include soil formation, nutrient cycles, and genetic biodiversity. Regulating and supporting ecosystems services provide indirect use value through the role they play in maintaining healthy functioning ecosystems, enabling and sustaining a stream of direct use benefits.

The benefits provided by direct use values are easily identifiable to people. Where markets exist, they may also provide a source of income. Therefore, the direct use values of productive, recreational, aesthetic, and cultural ecosystems services are likely to be capitalised into land prices. For regulating and supporting ecosystems services which provide indirect use value, only those ecosystems services that strongly contribute to direct use values are likely to influence land prices. The extent to which they are capitalised will depend on people's awareness of their existence and their perceived importance (Ma and Swinton 2011).

A further feature of ecosystems services determining the extent to which they are capitalised into land prices is their status as *public goods* or *private goods*. Whether an ecosystems service is classified as a public or private good depends on the characteristics of ownership and consumption. The key traits defining private goods are excludability of ownership and rivalry of consumption. Excludability of ownership refers to the ability to exclude others from consuming the benefits of a good or service. Rivalry of consumption implies that the consumption of a good or service by one person reduces its availability to others. While goods or services that are excludable and rival are classified as private goods, those that are non-excludable and non-rival are public goods.[3] Although the property rights of rural land are legally well defined, the ecosystems services from those lands may not be. This is particularly important for regulating and supporting ecosystems services such as climate regulation, nutrient cycles and biodiversity. They have the properties of public goods in that they benefit the entire population. Because private actors lack an incentive to pay for public goods, their value is unlikely to be capitalised into land prices (Ma and Swinton 2011).

In summary, in terms of human benefit, the total value of environmental resources can be divided into use value, option value and non-use value. Economic theory predicts that ecosystems services that are private goods and have direct use value will be largely capitalised into land value. Ecosystems services that provide indirect use value may be partially capitalised. The non-use value and indirect use value of ecosystems services that have the characteristics of public goods will not be capitalised.

Methodologies for Valuing Environmental Amenities

Because many ecosystems services are not traded directly in markets, economists have developed a range of methods to infer the value of environmental amenities. The two major approaches to estimating the value of environmental amenities are stated preference and revealed preference

[3] The categories of private and public goods are ideal types. Agricultural products with well-functioning markets can be classified as private goods. On the other hand, ecosystems services that help to regulate the climate are an example of a public good. Most other ecosystems services will fall somewhere between these two extremes.

models. *Stated preference* methods rely on carefully designed surveys to determine preferences. These include the *contingent valuation* and *contingent choice* methodologies. The *revealed preference* approach uses *hedonic price analysis* – a regression of observed property prices against property and location characteristics, such as proximity to environmental amenities (McConnell and Walls 2005).

Stated Preference: Contingent Valuation and Contingent Choice

Stated preference methods use surveys to reveal individuals' preferences through choices in hypothetical markets. In the contingent valuation method, surveys ask respondents directly about their *willingness-to-pay* for a public good or service. Contingent choice models are based on a similar approach. However, they offer respondents choices among alternative options to characterise preferences and estimate values.

An advantage of the contingent valuation method is that it can estimate the full value of an environmental amenity, including non-use values. Revealed preference methods can only estimate use and option values. Similarly, contingent valuation studies offer the potential to provide more qualitative information, such as why people value certain environmental amenities, not just that a property has a higher value because of its proximity to an environmental amenity (McConnell and Walls 2005).

The downside of stated preference studies is that they rely on careful study design to produce credible results. Careful description and explanation of the good that is being valued are critical. Respondents must be able to clearly identify what they are valuing, including its quantity and characteristics (quality). The context in which it is being valued is also crucial to avoid the 'embedding problem', whereby respondents give a generalised value of a larger set of environmental amenities. Overestimation of value in response to hypothetical questions has been a serious and recurring problem. In addition to methodological issues, stated preference studies are relatively expensive and many suffer from small sample sizes (McConnell and Walls 2005).

Revealed Preference: Hedonic Analysis

The hedonic model is a technique used to value differentiated goods based on their component characteristics or attributes. Hedonic analysis uses a multiple regression to estimate the marginal implicit value of changes in specific land characteristics from their effect on prices. For rural land, the factors that affect price are likely to include agricultural production attributes, building structures, potential for development, and surrounding environmental amenities[4] (Drescher *et al*. 2001; Bastian *et al*. 2002; Stetler *et al.* 2010; Ma and Swinton 2011).

A significant advantage of the revealed preference approach is that it relies on actual market data to infer values. Particularly when combined with geographical information systems (GIS), relevant

[4] It is often impossible or impractical to observe ecosystems services directly. However, since they are sustained by natural resources and landscapes, proximity to environmental amenities serves as a useful proxy (Ma and Swinton 2011).

spatial data, including proximity to environmental amenities, are relatively easy to gather. This allows researchers to construct sufficiently large samples without cost being a major barrier. Consequently, hedonic analysis has been used extensively to investigate the relationships between land characteristics and price (Drescher *et al*. 2001; Fan *et al*., 2006; Cho *et al*., 2008; Polyakov *et al*. 2012). They have proved particularly useful for estimating the value of nonmarket environmental amenities and disamenities (McConnell and Walls 2005).

Hedonic analysis is not without its own criticisms and methodological challenges. Important choices include which statistical functional form to use (linear, quadratic etc.), the extent of the market under study, and selection of independent variables. Furthermore, the assumptions of the model may not always hold: if the housing market is not in equilibrium; or if the choices facing consumers are not fully continuous, offering a variable mix of attributes.[5] Finally, spatially auto-correlated errors are a general problem with hedonic models. Housing prices are influenced by a variety of factors, many of which will vary by spatial location. If variables that cause spatial variation are omitted from the model, or if the spatial scale of the effect does not match the scale of the measurement (measurement error), spatial correlation of the error terms will occur (McConnell and Walls 2005; Fan *et al*. 2006).

In summary, stated preference methods can potentially estimate a fuller range of benefits and ecosystems services associated with environmental amenities. However, they are generally more expensive, have smaller sample sizes, and present complex challenges in study design. For a focus on values capitalised into land prices, hedonic analysis is the most appropriate option. While it is necessary to be aware of the methodological issues that can distort the model, hedonic analysis is a widely used valuation method and has a proven record in estimating the implied value of environmental amenities. The particular strengths of the method are the use of actual 'revealed' market transactions, the relative ease of gathering large amounts of data, and associated low cost.

New Zealand Case Studies

This section summarises relevant case studies from New Zealand. Yao and Kaval (2007) conducted an extensive search of published non-market valuation studies from New Zealand. They found 92 studies published between 1974 and 2005, primarily using stated preference methodologies (contingent valuation 58%, and choice modelling 8%, compared to hedonic pricing 7%). Of those studies that did utilise hedonic analysis, the vast majority focused on urban markets. A further search was conducted for studies published since 2005. Lincoln University's *New Zealand Non-Market Valuation Database* was particularly useful.[6]

The results of stated preference studies give an indication that New Zealanders place a significant value on biodiversity and environmental restoration. These studies captured a wide range of values,

[5] In reality, in many cases consumers are likely to face a limited range of choices. If so, consumers may not be achieving the greatest possible utility from their choices.

[6] New Zealand Non-Market Valuation Database: http://www2.lincoln.ac.nz/nonmarketvaluation/

including non-use values, but did not estimate the extent to which they are capitalised into rural land prices. From revealed preference studies, only Stillman (2005) examined the changes in rural land value in New Zealand from 1989 to 2003, but did not assess the impact of environmental amenities. The results of hedonic analyses from urban markets may not be applicable to rural property.

New Zealand Stated Preference Studies Valuing Biodiversity and the Environment

Case Study 1: Te Kouma Farm Park Benefit Transfer Study:

Kaval *et al*. (2004) conducted a *benefit transfer analysis* of the non-market value benefits for Te Kouma Farm Park on the Coromandel Peninsula. The benefit transfer method is a valuation tool which applies existing stated preference value data from comparable studies and transfers it to the new case study in focus.[7] For Te Kouma, direct use values from various recreational activities, indirect use values provided by ecosystems services, and non-use existence and bequest values were assessed.

Values for recreational activities were compiled based on a review of New Zealand recreational literature. Recreational activities likely to be participated in at Te Kouma Farm Park include: tramping, camping, environmental education, fishing, horse riding, mountain biking, rock-climbing, swimming, non-motorised boating, sightseeing, photography, relaxing outdoors, and picnicking. Since each person will participate in different activities, an average consumer surplus value was calculated as $28.05 per person per day (2003 NZD) (Kaval *et al*. 2004: Table 8, 22-23).

To estimate the value of ecosystems services, Patterson and Cole's (1999) study of direct and indirect values of different ecosystem types in the Waikato Region was applied. The results are presented in *Table 1*, below. The direct value of ecosystems is from provisioning ecosystems services (timber, agricultural products or the like). The indirect value is from other regulating and supporting ecosystem services provided. Ecosystems services relevant to Te Kouma Farm Park include climate regulation, disturbance regulation, water regulation, water supply, erosion control, nutrient cycling, food production, raw materials, waste treatment, gas regulation, recreation, climate regulation, biological control, pollination, genetic resources, habitat, and soil formation.

The non-use value of Te Kouma Farm Park was estimated based on a study by Environment Waikato (2003). Using stated preferences, this study found that people of the Waikato Area are in favour of protecting natural heritage lands for existence and bequest values. The average amount people were willing to pay to preserve heritage lands in the Waikato was $4 annually. The per-person value was aggregated across Waikato households to reach a total non-use value of $500,000 (2003 NZD) annually (Kaval et al. 2004).[8]

[7] See Kaval and Loomis (2003) for a discussion of the benefit transfer method's validity, reliability, and limitations.

[8] Aggregate values are based on 2001 Census data which reported 127,000 households in the Waikato region.

Table 1: Waikato Region Ecosystem Type Values

Waikato Region Ecosystem Types	Direct Annual Value (2003 $NZ/ha)	Indirect Annual Value (2003 $NZ/ha)	Total Annual Value (2003 $NZ/ha)
Estuarine	$2,155.62	$49,327.34	$51,482.96
Wetland	$5,294.71	$38,857.81	$44,152.51
Seagrass/Algal-bed	$4.44	$43,142.41	$43,146.85
Lake	$3,977.13	$18,550.34	$22,527.47
Mangrove	$1,484.07	$19,625.93	$21,110.00
River	$785.88	$18,550.34	$19,336.22
Horticultural	$19,049.84	$85.47	$19,135.31
Coastal Zone	$334.11	$8,593.63	$8,927.74
Forest	$1,133.31	$1,499.61	$2,632.92
Agricultural	$691.53	$437.34	$1,128.87
Scrub/Shrubland/Tussock	$155.40	$437.34	$592.74
Coastal Marine Area	$205.35	$362.97	$568.32
Cropland	$58.83	$94.35	$153.18

(Values provided by Patterson and Cole 1999, cited in Kaval et al. 2004: 27)

Case Studies 2 and 3: The Value of Biodiversity Enhancement:

Using a contingent valuation methodology, Kaval *et al*. (2007) surveyed greater Wellington respondents to determine their value for indigenous biodiversity enhancement. They created a hypothetical market to elicit respondents' willingness-to-pay to support biodiversity restoration through programmes supporting the additional planting of native trees on private and public lands. Over 60% of respondents were willing-to-pay for these schemes. The median value people were willing-to-pay was $174 annually for projects on public lands, and $166 annually for projects on private lands. The mean values were $192 for public lands, and $209 for private lands (2007 NZD). Urban respondents were more willing-to-pay for biodiversity enhancement than rural respondents, $190 compared to $69 for public lands ($188/$69 on private land).

Expanding on the Kaval *et al.* (2007) study, Yao and Kaval (2008) used similar methods to survey a sample of 457 New Zealand residents. The latter study featured an improvement in functional form, introducing an exponential model which proved superior to the linear form. Yao and Kaval (2008) report that the median willingness-to-pay should be used as the most appropriate measure of central tendency as the mean was likely to be distorted by very high value bids. This finding was backed by the end users of the research (regional council staff) who felt that the median values from the exponential model (which were the lowest) seemed the most realistic. Results indicate that a typical (median) respondent was willing-to-pay $42 (2007 NZD) annually to support a biodiversity programme, through the additional planting of native trees on private land, and $82 to support a similar programme on public lands.

Both these studies suggest a significant value for biodiversity. They extend previous biodiversity valuation studies from New Zealand by focusing on a different biodiversity element – biodiversity

enhancement through planting native trees and shrubs for habitat creation. In contrast, other studies have focused on biodiversity conservation.

Case Study 4: Lake Rotoiti Biodiversity Management Choice Modelling:

Kerr and Sharp's (2008) choice modelling study provides an example of a valuation study for biodiversity conservation. They investigated community values surrounding wasp management options for Lake Rotoiti. Value estimates show that avoiding a decrease in native insect numbers that would result in 'few insects' remaining, is worth about $150 per year to the average household, while avoiding a decrease in native bird numbers that would result in 'few birds' remaining, is worth about $300 per year. Restoring native insect numbers to a level of 'plentiful insects', is worth about $90 per year to the average household, while restoring native bird numbers to a level of 'plentiful birds', is worth about $120 per. Because, the surveys entailed provision of comprehensive information about the conservation project, the values reported are not representative of values currently held by the community, with little understanding of wasp impacts or management options. Rather, the study aims to predict the values of an informed community, such as might exist following an informed public debate on the issue. Value estimates suggest that people would be willing to spend significant amounts of money to protect native biodiversity in this scenario.

New Zealand Revealed Preference Studies

Case Study 5: Examining Changes in the Value of Rural Land:

Stillman (2005) used the hedonic method to examine the determinants of rural land value and the determinants of changes in rural land value between 1989 and 2003. Agricultural productive factors were tested but proximity to environmental amenities was not. Results show the value of rural land reflects the profitability of agriculture as well as the returns to alternative land uses. Population density and distance to amenities are found to be the most important determinants of land value. Population density is strongly positively related to land value with a 10% increase in population per hectare correlating to a 13% increase in price. Land values declined by 1.7-2.1% per 10% increase in distance from the most important amenities (airports, beaches, ports, schools, and ski areas). Land values declined by 0.8% with a 10% increase in distance from the nearest large town.

In terms of change in value, the real value of rural land in all uses increased substantially over the study period. Land uses that were initially the least valued (commercial forestry, intensive and extensive pastoral, and arable) increased the most (240-300%). On the other hand, even the highest value uses (including lifestyle) increased by 125-165%. Land use in rural areas also changed considerably during the period. Somewhat surprisingly, these changes were essentially uncorrelated with changes in land values.

Urban Hedonic Analyses: Water Views and Environmental Amenities:

Bourassa *et al*. (2003) looked at residential sales from 1986 to 1996 in Auckland, Christchurch, and Wellington. They found average percentage price impacts of 6.6% in Wellington, 9.7% in Auckland,

and 10.9% in Christchurch. The implicit prices of water views were negatively related to supply within each market[9], and varied with changes in demand for housing. Similarly, Samarasinghe and Sharp (2010) found a premium for water views. Properties with a wide view of water sell for approximately 28% more than properties with no appreciable views. Slight and moderate water views had estimated 4% and 10% premiums respectively. Proximity to the coast also increases price (Grimes and Liang, 2009; Samarasinghe and Sharp, 2010).

In a preliminary study, Bicknell and Gan (1997) found a statistically significant relationship between waterway enhancement activities and property prices in Christchurch. Environmental enhancement activities included planting native species and promoting aquatic and bird life, resulting in increased recreational opportunities and indirect ecosystems services.

International Case Studies:

As an imperfect alternative, a summary of the international literature from the US and Australia is outlined below. These countries were chosen to reflect similarities to New Zealand society as colonial settler states from the rich 'developed' world.[10] Revealed preference studies investigating the determinants of rural land prices highlight the recreational and aesthetic values associated with proximity to environmental amenities, as well as productive factors. Revealed preference studies from urban and rural settings show that proximity to forests increases land values. Likewise, proximity to the coast has a strong influence on land values. The impact of wetlands on land values is more ambiguous, with different studies revealing amenities and disamenities associated with wetlands in different contexts. A range of stated and revealed preference studies of wetlands and wetland restoration are summarised. Results suggest that coastal wetlands and restored wetlands are valued and have a positive impact on surrounding land prices.

A note of caution; based on a review and meta-analysis of hedonic studies on the value of open-space, McConnel and Walls (2005) conclude that it is very difficult to generalise results from the wide range of studies conducted. Estimated values varied widely across studies, each one dealing with a particular region and time-period, and sometimes even within the studies:

> *Thus, one conclusion that we draw from the extant literature is that open space values are case-study specific. Policymakers looking for a specific dollar value to attach to a particular open space project may find it difficult to use the existing research for that purpose. What can be gleaned from the literature is some general results about the direction of particular effects, how values vary by location and other variables, and the differences between the methodologies used to estimate values.* (McConnell and Walls 2005: 62)

Therefore, the following case studies from the international literature are useful as an indicator of the general direction of particular effects. However, the specific magnitude or dollar value of proximity to environmental amenities cannot be directly applied to a New Zealand context.

[9] 18.6% of properties sold in Wellington during period had water views, 12.5% in Auckland, and 2.5% in Christchurch.

[10] Canada was also included in the search, but no relevant Canadian case studies were identified.

Hedonic Studies Investigating Environmental Amenities and Rural Land Values

Case Study 6: Ecosystems Services from Rural Landscapes in Southwest Michigan:

Ma and Swinton (2011) investigated ecosystems services linked to agricultural land in southwest Michigan. They found that ecosystems services values are associated with lakes, rivers, wetlands, forests and conservation lands within rural landscapes. On-site natural resources and landscapes that provide direct private amenities (or disamenities) are widely capitalised in land price. Lakes present within the land parcel increases price by 5.6% per 1% change in parcel area covered. Price also increases by 1.0% per 1% increase in the percentage of on-site forested area. However, on-site rivers were found to reduce land values by 8.8% per 100m of river in the parcel. This effect is probably due to the risk of erosion and flooding. On-site wetlands have an insignificant effect, which likely indicates a balancing between amenities and disamenities.

Environmental amenities in the surrounding area are also capitalised. Nearby rivers increase land values by 5.8% per 1000m closer to a river. In contrast to on-site rivers, owners can benefit from the recreational and aesthetic ecosystems services of a nearby river without the negative effects. Wetlands within a 1.5km radius increase land value by 3.1% per 1% increase in wetland share of surrounding areas. Nearby conservation land increases land price by 1.6% per 1% increase in share of surrounding areas. Its capitalisation into land price is mainly ascribed by the authors to recreational opportunities (Ma and Swinton 2011).

Ma and Swinton's (2011) results support the predictions of the theoretical framework outlined above. Ecosystems services that support direct use values, such as recreational and aesthetic ecosystems services, were capitalised in land prices. Some regulating ecosystems services providing indirect use value relating to water, soil, and local climate are likely to have been partially capitalised by water bodies, forests, and conservation lands. Other ecosystems services that are public goods were not reflected in land prices.

Case Study 7: High Value of Environmental Amenities in Northwest Montana 'Wildland-urban Interface Communities':

A dramatic population increase within northwest Montana from June 1996 to January 2007 was largely driven by the high quality environmental amenities of the region. Results confirmed environmental amenities have a large positive effect on property values. Price increased with proximity to lakes, national forests, wilderness areas, and the entrance to Glacier National Park (Stetler *et al.* 2010).

Case Study 8: Agricultural Production Attributes and Environmental Amenities, Wyoming:

Bastian *et al*. (2002) found agricultural land prices in the Rocky Mountain region of Wyoming were explained by the level of both environmental amenities and production attributes. Statistically significant amenity variables associated with price increases included scenic view, wildlife habitat and angling opportunities. Scenic amenities had positive coefficients state-wide, with view diversity

(rather than uniformity) more highly valued. View diversity could be valued by the owner for the potential of future gains if land is developed for residential use.

Agricultural production variables and capital improvements were also significant in explaining price. Property size had a negative coefficient and was significant, indicating a diminishing marginal value (per acre) associated with increasing size. While the more distant and rural an agricultural property, the higher the per acre price. The trend for Wyoming rural property prices displayed a significant increase during the study period (Bastian *et al*. 2002).

Case Study 9: Value of Scenic, Recreational, and Productive Attributes, Wyoming:

Spahr and Sunderman (1999) used hedonic modelling to compare real estate values surrounding the resort of Jackson, Wyoming, and agricultural property throughout the remainder of the state. Attributes affecting the value of resort property were significantly different from those affecting the value of agricultural property (despite both being classified as agricultural land). Resort properties derived value from recreational and scenic amenities, streams, and trees. A view of Grand Teton Peak increased price by more than $18,000 (USD) per acre. The presence of a stream added approximately $5,266 per acre. Land with mature trees increased price by $12,700 per acre, while land with some trees increased price by $8,200 compared to land with little vegetation. Agricultural land values were influenced by a combination of productive and non-productive attributes. The relative scenic and recreational amenities of agricultural property also had a substantial effect on value. Agricultural land with very scenic or recreational attributes sold for $172 more per acre than agricultural land with little or no scenic or recreational potential.

Case Study 10: Determinants of Farmland Prices in Minnesota:

Drescher *et al*. (2001) found that farmland prices in Minnesota are influenced by location, agricultural production attributes, and non-agricultural demand factors. Farmland that offers a higher expected return from agricultural production has a higher price.

Minnesota is renowned for scenic and recreational amenities such as lakes and woodlands. Using a county level natural amenity index including climate, topography, and water measures, confirmed that counties possessing a relative abundance of natural amenities had higher land values.

Potential returns from agriculture and/or higher value activities, such as residential development, create an expectation that is capitalised into prices. However, if demand for land is primarily driven by non-agricultural factors, the productivity attributes of the land may not be significant determinants of price.

Population growth is shown to increase the demand for non-agricultural use and this expectation is reflected in higher land prices. High conversion rates to non-agricultural use increase expectations that nearby farmland will also be converted, and is capitalised into price. Further away from developed land, farmland also increases in value due to greater scarcity. Proximity to urban areas and access via highway linkages is also found to have a positive impact on prices.

Case Study 11: Effects of Proximity to Urban Centres, Recreational Amenities and Productive Factors, Kansas:

Nivens *et al*. (2002) found that proximity to urban centres and recreational amenities both had a positive and statistically significant impact on farmland value. The urban effect variable was calculated as the percentage of urban classified land within a radius of 10 miles of the parcel. The recreational effect variable was the percentage of land classified as water bodies within a radius of 10 miles. However, the urban and recreational effects were economically small and would not have a large impact on the per acre price of most land sold in Kansas. In contrast, a remotely sensed variable indicating the 'greenness' of land (as a proxy for productivity) was statistically significant and had an economically large positive effect on price.

Hedonic Studies Valuing the Proximity to Forests

Case Study 12: The Value of Forest Land and Degree of Urbanisation, Tennessee:

Cho *et al*. (2008) found that the amenity values of forest types vary with the degree of urbanisation. Proximity to evergreen forests (mostly conifer species) is valued positively in rural-urban interfaces. At the mean house price of $117,787 (2000 USD), moving 100m closer to an evergreen forest lot, from an initial distance of 1km, increased the average house price by $692. In contrast, deciduous and mixed forests are valued positively in urban centres. Moreover, a diverse landscape with fragmented forest patches and more complex natural forest edges are more highly valued in rural-urban interfaces compared to smooth, man-made boundaries in urban areas.

Case Study 13: Increasing Value of Forest Landscapes in the Southern Appalachian Highlands between 1990 and 2000:

Responding to demand for increased forest conservation measures, conservation easements, government purchases of forestland, and other similar initiatives have been implemented in the Southern Appalachian Highlands. Through a hedonic analysis, Cho *et al*. (2009) found that amenity values of mean forest-patch size and forest-patch density increased from 1990 to 2000 for areas with economically significant amenity values.

Case Study 14: Value of Proximity to Noosa National Park:

Use of the hedonic price method is relatively common in North America. By comparison, there is a paucity of applications of the hedonic price method within Australia, and particularly in the valuation of forested areas. Pearson *et al.* (2002) used unimproved land values to estimate the value landowners placed on an *urban* protected area, the Noosa National Park. 'Unimproved land values' implies that the land is valued as if it were bare, stripped of improvements such as houses or landscaping. Locational variables such as neighbourhood and surrounding amenities are included. Empirical results showed that the presence of Noosa National Park increased land values in the vicinity by 6-7%.

Case Study 15: Valuing Environmental Assets on Rural Lifestyle Properties in Victoria, Australia:

Polyakov et al. (2012) presented a hedonic pricing model that quantified the value of the remnant native vegetation captured by owners of rural lifestyle properties in rural Victoria, Australia over 21 years. The study focused on the five Local Government Areas (LGAs) in Central Victoria, Australia, stretching from northern outskirts of Melbourne's metropolitan area to the Murray River. About 25% of 1.5 million ha in the study region is covered by native remnant vegetation and other woodlands, the rest is being cleared mainly for extensive agriculture. The region is dominated by irrigated (mostly on the north-east) and dry-land agriculture, with some horticulture and lifestyle farming in proximity to major population centres. GIS and a smart statistical modelling were able to remove spatial auto-correlation problems and a trend analysis accounted for changes in property values over the study period. Prices were adjusted to the 2011 price level using the Australian consumer price index. The resulting large sample size (sales of 3,121 properties) provides a robust estimate of revealed preference for native forest and associated environmental and amenity values.

The Remnant native vegetation had a positive but diminishing marginal implicit price. The value of lifestyle properties is maximized when their proportion of area occupied by native vegetation is about 40%, at which point it increases property value by about $13,500/ha (AUD 2011) or by about 12% of the average property price. However, tree cover exceeding 80% reduces property value below the value of property with no tree cover. Most lifestyle landowners would receive benefits from increasing the area of native vegetation on their land. This finding is consistent with Race et al. (2010) who found that lifestyle landowners undertake a considerable amount of work to re-vegetate and enhance native vegetation in similar Australian environments. Pannell and Wilkinson also found that lifestyle landholders hold positive views about re-vegetating part of their properties, but that 'most lifestyle landholders have a strong reluctance to make environmentally beneficial changes that occupy the majority of their land' (Pannell and Wilkinson 2009: p. 2686), consistent with Polyakov *et al.*'s (2012) finding of negative marginal values at high areas of vegetation.

Although the primary interest of this study is its robust calculation of the value of native forest, the study also confirmed the value of many of the other amenities identified in the other case studies reviewed. Location characteristics were shown to be important in determining lifestyle property values. Accessibility of recreational opportunities as measured by distance to lakes, rivers, and park increase property values. Being located one kilometre closer to the river, lake or park increases the value of the lifestyle property by $5,791/ha, $1908/ha, and $4,702/ha respectively (AUD 2011). Population interaction index, a measure of accessibility to employment, services, and entertainment amenities, have a positive effect on lifestyle property values. The elasticity of this variable is 0.82, indicating that increase of population of the urban centres and localities by 1%, or a move 1% closer to populated places, increases the value of a lifestyle property by 0.82%. For example, increase of the population of town 10 km from the property by 10000 people or increase of the population of town 20 km from the property by 20000 people would increase property value by $963/ ha. Finally, their time trend variable indicated that the values of lifestyle properties increased by 5.8% per year on average after inflation.

Coastal, Estuarine and Wetlands Studies

Case Study 16: Meta-review of the Value of Wetlands:

Based on their meta-review of the value of open space, McConnell and Walls (2005) found that whether wetlands have value to nearby residents depends on type of wetland, location of study, and proximity to wetland. According to hedonic studies, wetlands and forested wetlands in rural areas tend not to have value. Wetlands in more urban locations and those with more open water are valuable.

Case Study 17: Meta-review of the Recreational, Aesthetic and Cultural Values of Coastal and Estuarine Ecosystems:

Ghermandi *et al.* (2009) conducted a literature review on the valuation of recreational, aesthetic, and cultural services provided by estuarine and coastal ecosystems. They compiled a dataset of 320 primary valuation studies from around the world. As they explain (2009: 3):

> *Coastal and estuarine ecosystems deliver a wide range of goods and services, many of which provide material benefits such as food supply, regulation of water quality processes, storm protection, and carbon storage. An important component of the flow of services from coastal ecosystems to human beneficiaries, however, takes place as benefits that are of a non-material nature and that affect people in their spiritual, social, and cultural dimension. By supporting recreational activities, delivering spiritual and religious values, and providing aesthetic beauty, coastal and estuarine ecosystems are believed to substantially contribute to the well-being of both coastal and inland inhabitants.*

Their review revealed that recreational activities are a major component of the use values of estuarine and coastal ecosystems. Different studies came to a range of different values from different types of recreational activities, different ecosystem types, and levels of environmental quality. Aesthetic values from scenic views were found to significantly increase the price of residential housing in the proximity of coastal and estuarine ecosystems. Finally, the average non-use value elicited in the literature for existence, option, and bequest of estuarine and coastal ecosystems was substantial at $191.6 per person, per year (2003 USD).

Case Study 18: Choice Modelling Study of the Macquarie Marshes, NSW:

This choice modelling case study evaluated the Macquarie Marshes, an ephemeral wetland in north-west New South Wales. The final usable data set covered 318 Sydney respondents. Morrison *et al.* (1998) found that people were willing-to-pay to increase the area of the Marshes, the frequency of bird breeding, and the number of endangered and protected species present. On the other hand, it was also found that respondents were willing to pay to maintain rural employment which may be negatively affected by increasing the area of Marshes.

Case Study 19: Hedonic Analysis of the Value of Wetlands in the Perth Metropolitan Area:

Urban wetlands in the Perth metropolitan area were valued using a hedonic analysis. From July 2005 to June 2006, data from 1,741 residential sales were collected. Sales price was modelled as a function of structural attributes, neighbourhood attributes, and wetland attributes. It was found that proximity to wetlands increased the sales prices of properties. For the mean sales value, the marginal implicit price of being closer to a wetland by 1 metre, was $829 (AUD). The value of

proximity to wetland rapidly declined in the first few hundred metres from the wetland edge, possibly related to views and ease of access. Past this point value continued to decrease, but at a slowing rate, to a distance of around 1.5 km. The combined effect of proximity to the coast and the nearest wetland increased the price of property dramatically (Tapsuwan *et al*. 2007).

Case Study 20: Meta-review of Studies Valuing Watershed Restoration:

Measured by various methodologies, Hurd (2009:3) found that, "researchers consistently conclude that watershed restoration has significant economic benefits." Contingent valuation studies have shown willingness-to-pay for wetland and creek restoration and associated biodiversity preservation and pollution abatement. Hedonic pricing studies show a trend of watershed restoration being correlated with increasing housing values. However, what holds in one area cannot necessarily be transferred to another, as some studies have shown a decrease in value associated with proximity to wetlands. Results should be used as a guide, with explicit mention of correlations, not causation.

Case Study 21: Benefits Transfer Estimating the Direct and Indirect Use Values Associated with a Coastal Restoration Project, Biscayne Bay, Florida:

In Florida, invasive species have displaced native plants and animals and altered coastal ecosystem and hydrologic processes. Lee and Bwenge (2007) applied a benefits transfer method to assess the direct and indirect use value of restoring damaged ecosystems in Biscayne Bay Florida.[11] The present value of a perpetual stream of ecosystems services from a restored ecosystem was estimated to be between $53 million and $57 million (2006 USD). The cost of the project was $16 million. Thus the net benefit from the restoration project is estimated to be $37 million to $41 million. The annual benefit from direct and indirect use associated with the Biscayne Bay restoration project is estimated to be between $1,600,000 and $1,700,000.

Case Study 22: Combined Stated and Revealed Preferences for Restored Coastal Wetlands:

Earnhart (2001) employed a new methodology, combining hedonic pricing and choice-based stated preference methods, to value environmental benefits. Earnhart (2001: 8) claims that, "By combining the stated and revealed preference methods, the joint model enhances the strengths and diminishes the drawbacks of each individual method." This study examined the housing market of Fairfield, Connecticut, between 1994 and 1996. Fairfield contains several environmental amenities and has been experiencing an improvement in the quality of its coastal wetlands. Results showed that restored wetlands were associated with positive increases in nearby property values, while disturbed wetlands were associated with decreases in property values.

Case Study 23: Contrasting Values of Coastal and Inland Wetlands, North Carolina:

Bin and Polasky (2003) utilised a hedonic price model to estimate how proximity to wetlands affects property values. Their study used data from residential property sales from Carteret County, North Carolina, between July 2000 and July 2002. Two general categories of wetlands are differentiated – coastal and inland wetlands. Wetlands may provide amenity values such as open space, enhanced

[11] Non-use values were not included.

views, and wildlife habitat. They may also provide disamenities such as odours and insects. Different wetland types vary widely from primarily open water to heavily vegetated wetlands. As such they may provide a different mix of amenities and disamenities.

Results indicate that proximity to wetlands affects property price on the mainland but not on the Outer Banks of coastal barrier islands. On the mainland, proximity to inland wetlands lowers property values, while proximity to coastal wetlands increases property values. Moving from an initial distance of 600 feet from the nearest inland wetland to 52 feet (the closest allowed by the structure of the data) decreases house value by $10,100 (2002 USD). Moving from an initial distance of 600 feet from the nearest coastal wetland to 52 feet raises estimated mainland property values by $13,600.

The conclusion that coastal wetlands are more highly valued than inland wetlands matches results found elsewhere. However, one of the difficulties in interpreting these results is that proximity to coastal wetlands is tied closely to proximity to Pamlico Sound and intracoastal waterways, for which there is a large premium. The two variables are collinear and their effects could not be fully disentangled.

The negative value of inland wetlands contrasts with some previous studies that have used data from urban areas. In these studies the positive value of wetlands may be due to having open space protected from development rather than any specific characteristics of wetlands as an environmental amenity. Cartaret County is a rural county with no town or city with a population over 8,000. Compared to urban environments, there is no shortage of open space or wetlands.

As Bin and Polasky (2003:19) conclude:

> *Taken in total, our results suggest that the value of wetlands for nearby property owners depends heavily on the context. Both the type of wetlands being valued and the type of housing market appear to matter. Forested or shrub dominated wetlands in rural areas with lots of existing wetlands and other water resources may generate negative values. Open water wetlands in areas with scarce wetlands, other water resources, and open space (as in many urban areas) are likely to generate positive amenity value.*

Discussion and Conclusions

This study presented (i) a theoretical framework outlining the economic value of ecosystems services, (ii) a comparison of the strengths and weaknesses of the stated and revealed preference approaches to estimating these values, and (ii) a summary of case studies from New Zealand, the US, and Australia, investigating the value of ecosystems services associated with rural environmental amenities.

The economic value of environmental resources comprises of use value, option value, and non-use value. Economic theory predicts that ecosystems services providing direct use value will be largely capitalised into land prices, whereas those providing indirect use value will only be partially capitalised. The public or private goods properties of ecosystems services will also influence the

degree to which their value is capitalised. Ecosystems services that resemble public goods are not expected to be capitalised. The empirical results of revealed preference case studies support these findings. In particular, productive, recreational, and aesthetic ecosystems services providing direct use value were consistently shown to influence land price. Ma and Swinton (2011) also provide evidence for smaller effects associated with some regulating ecosystems services providing indirect use value.

The two most prominent approaches for estimating the values of environmental amenities are the stated and revealed preference methodologies. Stated preference methods are more versatile because they can estimate a fuller range of values including non-use values. Also sample size (the number of respondents reporting their preferences) can be largely controlled by researchers to meet statistical requirements. However, there are significant methodological challenges associated with stated preference study design and they should not be used in this instance for predicting the absolute or proportion of property values that is driven by different land and location characteristics. The revealed preference approach of hedonic price analysis is the most appropriate method to estimate the impact of environmental amenities on land values. The use of actual market data is a particular advantage of hedonic analysis, but such data are not readily available for New Zealand rural settings.

Stated preference studies suggest New Zealanders generally place a high value on environmental restoration and biodiversity. Contingent valuation surveys investigating the value of a hypothetical scheme supporting biodiversity enhancement through the planting of native trees on public and private land showed a significant willingness-to-pay for these schemes (Kaval *et al.* 2007, Yao and Kaval 2008). However, because the revealed preference method has not been widely used in New Zealand outside of urban markets, it is difficult to quantify the impact of environmental amenities on rural land prices.

International case studies provide an imperfect alternative, indicating the general impact of proximity to environmental amenities on land prices. Revealed preference studies from the US and Australia provide evidence that the proximity to environmental amenities providing recreational and scenic values, including forests, the coast, and restored coastal wetlands has a positive impact on land prices. However, estimated values vary between studies from different geographical locations. The case-specific nature of results implies that the international literature is useful as an indication of the general direction and relative importance of particular effects. However, the specific magnitude of these effects in terms of a dollar value cannot be directly applied to a New Zealand context.

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