Environ Monit Assess (2013) 185:253–266
DOI 10.1007/s10661-012-2549-5

Valuing biodiversity attributes and water supply using choice experiments: a case study of La Campana Peñuelas Biosphere Reserve, Chile

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Received: 20 July 2011 / Accepted: 19 January 2012 / Published online: 25 February 2012

Abstract The main objective of this study is to assess public economic preferences for biodiversity conservation and water supply and to analyse the factors influencing those preferences. A survey based on the choice experiment method was carried out at Peñuelas National Reserve, Chile, an area that is threatened by both occasional forest fires and the growing housing market. The input of local administrators was used to define environmental attributes of the area related to biodiversity conservation and water supply. Attributes were selected for analysis by the choice experiment. The selected attributes were the following: existence of endemic orchid species, chances of observing animals with scenic attraction, additional protection for an endemic amphibian, and availability of drinkable water in the future. A monetary variable consisting of an increase in the rate for entry to the area was also incorporated to estimate willingness to pay (WTP) for additional protection for the selected attributes. Three hundred four Chilean visitors to the reserve were randomly selected for interviews. Econometric analysis based on the Theory of Utility Maximization shows that visitors are willing to pay to protect the selected attributes. WTP values for the attributes range from CHP $2,600 ($5.4) to $6,600 ($14) per person per visit. The results of this research provide reserve managers information about tradeoffs that could be used to enhance public support and maximise the social benefits of nature conservation management programmes.

Keywords Choice experiment · La Campana Peñuelas Biosphere Reserve · Endemic species · Willingness to pay · Chile

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Introduction

The establishment of protected areas is one way to preserve and conserve biological diversity and natural resources unique to and representative of a territory. In terms of the benefits it provides, biodiversity can be considered an asset that, paradoxically, is threatened (Simonetti et al. 2002). In Chile, different estimates warn about the status of biodiversity (OECD 2005; Figueroa and Calfucura 2006). Chile has used its natural resources at a rate far greater than is sustainable, placing it among the 50 least sustainable nations, with a natural resources consumption rate of 2.6 global hectares per person, exceeding the estimated rate of 1.9 global hectares per person that the earth can sustain (CONAMA 2010). The safeguarding of biodiversity and natural capital in the National System of Protected Areas has been an attempt to secure and

perpetuate these important resources and to simultaneously provide societal benefits. However, the social value of biodiversity is practically unknown, making the potential impact of a loss of biodiversity and its benefits insufficiently recognised. The ability to assess these societal benefits may be relevant in justifying the existence of protected areas that compete with economic activities that have potential negative effects on biodiversity. An approach that sheds light on this issue is the measurement of the general public's willingness to pay (WTP) for the protection of biodiversity and ecosystem services that protected areas provide (Mitchell and Carson 1989; Bateman et al. 2002; Han et al. 2010).

Stated Preference Techniques such as Contingent Valuation and Choice Experiments (see, for example, Bateman et al. 2002) provide instruments to elicit WTP in the environmental context. Both contingent valuation and choice experiments use survey questions to elicit statements of value from survey respondents. Contingent valuation studies generally pose written or verbal descriptions of the environmental change to be valued, whereas choice experiments pose the change in terms of modifications to the attributes of the item to be valued (National Research Council 2005: 119). Because these methodologies can quantify external benefits and costs caused by any kind of economic activity, they can help to efficiently allocate resources (Fischer and Hanley 2007). Moreover, they foster participatory public decision making and they may thus contribute to sustainable development (Fischer and Hanley 2007, see also Pearce and Barbier 2000; Bateman et al. 2002). For a more extensive overview of these methodologies, see, for example, Mitchell and Carson (1989), Bateman and Willis (1999), Bennett and Blamey (2001) and Bateman et al. (2002). The most well-known methodology to assess economic values of natural resources is contingent valuation. However, the use of choice experiment is growing, and it is likely to become more prominent in the economic valuation of biodiversity in the future because of its ability to estimate values for multiple services. Biodiversity provides multiple services, and the ability to estimate marginal values for specific services is important for policy analysis (see Bennett and Blamey 2001; Bateman et al. 2002; National Research Council 2005).

The main objective of this study is to investigate Chilean citizens' WTP for specific measures of biodiversity protection at the species level and for ensuring the provision of drinking water in the future. To achieve this goal, a choice experiment was performed. The study was conducted at Peñuelas National Reserve, located in the fifth Region of Chile (Valparaíso Region). The reserve is part of the Campana–Peñuelas UNESCO Biosphere Reserve. A growing housing market and occasional forest fires currently threaten the area. The demonstration of the social value of the area is of extreme interest for local decision makers confronting this problem. WTP data were obtained from a representative sample of Chilean citizens that visit the area. Factors influencing visitors' WTP were also explored. The results contribute to filling knowledge gaps regarding the socio-economic benefits of biodiversity conservation in protected areas. At the local level, decision makers gain methodological input to value the area. In the broadest sense, the findings of this study contribute to the literature related to WTP for nature conservation. Because the study area is a UNESCO Biosphere Reserve, indicating natural importance, international prestige and opportunity for sustainable development, the research has global relevance.

The paper is organised as follows: "Methodology" section introduces the study area, the valuation approach and the design and application of the CE. The results and discussion follow. Finally, the main findings are summarised.

Methodology

Study area

The Peñuelas National Reserve is part of the National System of Protected Areas of the State in Chile. It is located in the fifth Region of Chile, specifically, in the province of Valparaíso (see Fig. 1). It consists of a 9,260 ha protected area that also includes the Peñuelas Lake (CONAF 2008). Native flora is represented by a mixed sclerophyllous forest that is protected. Birds represent the most diverse group of animals in the reserve. Peñuelas, in conjunction with the Campana National Park, is part of the UNESCO Biosphere Reserve "Campana Peñuelas". An important part of Peñuelas serves as a buffer zone to the biosphere reserve. In this zone, activities that are relevant to the welfare of the communities surrounding the reserve are conducted. Peñuelas provides direct and indirect

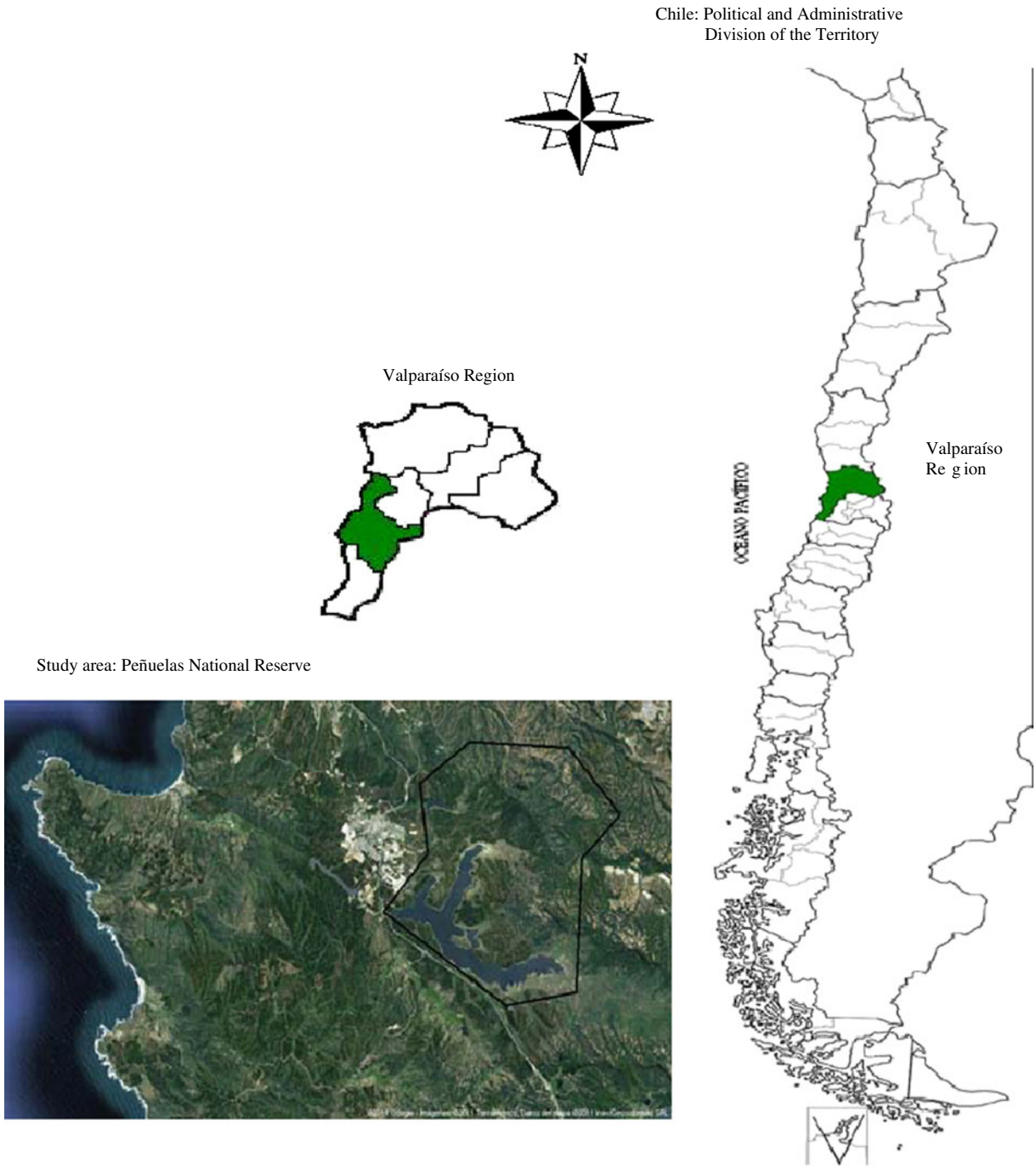

Fig. 1 Location of the Peñuelas National Reserve

benefits to the inhabitants of various nearby cities and towns. These benefits include, among others, the provision of potable water, recreation and tourism, the aesthetic services of biodiversity and environmental education opportunities. Currently, the reserve is threatened by the housing market and occasional forest fires (CONAF 2008). Thus, regional decision-makers involved in the management of the reserve have expressed the urgent need of valuing the reserve by incorporating the widest possible range of benefits.

The valuation approach

This study uses the choice experiment method to estimate WTP to assess public economic preferences for biodiversity conservation and for the water supply provided by the Campana Peñuelas National Reserve in Chile. Choice experiments were originally developed for marketing and transport applications by Louviere and Hensher (1982) and Louviere and Woodworth (1983). More recently, choice experiments have been employed to analyse public preferences towards environmental goods and services and to estimate their economic value. They are a generalised version of the popular contingent valuation method. Whereas contingent valuation method analysis presents a respondent with a simple "yes/no" decision for the provision of a particular environmental service at a particular price, choice experiments present the respondent with a menu of options of different environmental services at different prices. As reported by Hanley et al. (1998), choice experiments present several advantages over contingent valuation for approaching the valuation of environmental attributes of natural systems. Like the contingent valuation method, they can estimate the WTP for a particular change from the status quo. However, choice experiments can also assess trade-offs between various attributes of a particular good, service or impact, and they facilitate the disaggregating of values between different components, (Adamowicz et al. 1998). Hence, choice experiments can be superior to contingent valuation when the decision-making process focuses on the definition of priorities. They can improve the appropriateness of the information obtained for evaluating policy instruments (Perrings et al. 1995). The technique also avoids some biases that usually arise with contingent valuation namely, "embedding effects" and "yea-saying" (Hanley et al. 1998).

Recent examples of choice experiment studies include research on public preferences for biodiversity conservation and scenic beauty in Costa Rica (Biénabe and Hearne 2006), valuing the diversity of biological diversity (Christie et al. 2006), the benefits of biodiversity enhancement of nature-oriented silviculture (Meyerhoff et al. 2009), valuing changes in forest biodiversity (Czajkowski et al. 2009), community preferences on climate change in Germany (Rajmis et al. 2009) and preferences for sustainable forest management (Berniger et al. 2010). There is also some precedence for valuing wetland attributes (Carlsson et al. 2003). Hoyos (2010) showed a state-of-the-art environmental valuation with choice experiments. Related to protected areas, most choice experiment studies have been applied in the context of sustainable tourism development (see, for example, Hearne and Salinas 2002; Jacobsen and Thorsen 2010). A recent study was published that valued marine-protected areas using choice experiment (Wattage et al. 2011).

The Random Utility Theory (RUT; c.f. McFadden 1973; Manski 1977) provides the theoretical basis for integrating choice behaviour with economic valuation. Under RUT, the utility of a good is decomposed into an observable component that is a function of a vector of attributes and respondent characteristics and an unobservable error component. The respondents are presented with a series of choice sets, each usually containing three or more resource use options. From each choice set, respondents are asked to choose their preferred option. By repeating such choices among options with varying attribute levels, the researcher can infer which attributes significantly influence choice and the implicit ranking of these attributes. If one attribute is cost, the marginal WTP for an increase in any significant attribute can be calculated (Hanley et al. 1998). Given certain assumptions on the distribution of the error term, the probability of any particular option being chosen can be expressed in terms of a logistic distribution (McFadden 1973).

Design and application of the choice experiment

A necessary preliminary step to meaningful-stated preference valuation and analysis of biodiversity protection is a clear understanding of the specific attributes to be assessed in both the scientific and the policy contexts (Biénabe and Hearne 2006). Biodiversity needs to be presented in a way that facilitates the elicitation of preferences. To accomplish this, the attributes were selected using the criterion of Blamey et al. (2000) who state that one criterion for the selection of attributes in a choice experiment is their policy relevance. Focus groups of area administrators and regional decision makers were conducted to contribute to an adequate definition and description of the pertinent characteristics of the area to be valued. This led to a comprehensive definition of the attributes to be analysed. Decision makers at local and regional levels expressed extreme interest in the following dimensions of biodiversity values: the aesthetic value of

wildlife species; the existence value of plant and animal species endemic to the area but not necessarily attractive or known by visitors. Additionally, decision makers also suggested the need to measure the value of the provision of potable water to the cities of Valparaíso and Viña del Mar. Thus, this service was also included as an attribute.

Taking as reference the concept of total economic value[1] (TEV) and its value types (for details see Pearce and Moran 1994). Table 1 shows a classification of the values assessed by the study and the valuation purpose.

The selection and design of the attributes of Table 1 are described in detail as follows:

- Chances of observing animals in a visit: The Peñuelas National Reserve provides refuge to a variety of animal species that have scenic potential, mostly birds, reptiles and mammals. As the Peñuelas Lake is located in the reserve, visitors can only access this area where most recreational fishing practices are carried out. At the lake, visitors can primarily observe birds. Because people do not have the opportunity to visit the sclerophyllous forest and mixed shrub land, it is very difficult to see other species such as mammals or reptiles that have aesthetic value and are also protected in the reserve. Thus, in terms of the chances of observing animals in one visit, the attribute was varied on two levels with respect to the current situation (safely[2]-only birds): safely-birds and mammals (level 1); safely-birds, mammals and reptiles (level 2).
- Existence of different endemic orchid species: The endemic orchids of Peñuelas are one of the main findings in the area in recent years (CONAF 2008). About ten species of orchids have been identified in the reserve (CONAF 2008), and they are becoming one of the main attractions for foreign tourists. The attribute was varied on two levels with respect to the current situation (no species has its existence secured in the reserve): five species have their existence secured in the reserve (level 1) and ten species have their existence secured in the reserve (level 2). This quantification allows for the assessment of embedding effects,[3] specifically insensitivity to scope.[4]
- Extra protection for an endemic amphibian: The inclusion of this attribute has a scientific and political justification. At the time of the study, managers of the reserve were interested in exploring visitor preferences for unknown species, many of which deserve to be preserved. Due to national interest in preserving the Chilean frog (*Caudiverbera caudiverbera*), this species was chosen. The Chilean frog is endemic to Chile and is currently in danger of extinction (Díaz-Páez and Ortíz 2003). Since the 1990s, the frog has been listed as an endangered species so it does have some legal protection, although very little has been done in Chile in terms of its preservation. As a result, this vulnerable species has declined to an estimated 30% of the population that existed 10 years ago. One of the places where the species is protected in Chile is the Peñuelas National Reserve. Attribute levels were varied according to specific actions within the reserve to protect its habitat. These actions focused on improving the level of scientific knowledge of the species and its habitat, which would contribute to ensuring its existence. The attribute levels were the following: no specific actions within the reserve to protect its habitat (status quo), medium research effort described as a sporadic monitoring of its habitat, a large research effort described as a continuous monitoring of its habitat.

[1] According to Pearce and Moran (1994), conceptually, the TEV of an environmental resource consists of its use value (UV) and non-use value (NUV). A use value is a value arising from the actual use made of a given resource. Use values are further divided into direct use values (DUV), which refer to actual uses such as fishing and timber extraction, indirect use values (IUV), which refer to the benefits deriving from ecosystem functions such as a forest's function in protecting the watershed, and option values (OV), which are values approximating an individual's willingness to pay to safeguard assets for the option of using them at a future date. Non-use values are usually divided between a bequest value (BQ) and an existence value (EV). Bequest values measure the benefit accruing to any individual from the knowledge that others might benefit from a resource in the future. Existence values refer to the benefit derived from the existence of any particular asset.

[2] Indicates the chances of observing a particular kind of animal.

[3] Not presented here.

[4] Embedding effects occur when one good is valued differently if it is included in a bundle of other goods as compared to an individual valuation of the good (Kahneman and Knetsch 1992; Dehnhardt and Meyerhoff 2002). The phenomenon is also known as *insensitivity to scope* (i.e., insensitivity to the quantity information presented to respondents).

Table 1 Values analysed in the study and the purpose of valuation

Typology of values (TEV)	CE attribute	Purpose of valuation
Direct use	Chances of observing different animals in a visit	Assessing the aesthetic value of biodiversity
Direct use/option	Availability of drinkable water	Assessing the value of direct benefits
Non use	Existence of endemic orchids	Assessing the existence value of endemic species
Non use	Existence of an endemic amphibian (*C. caudiverbera*)	Assessing the value of endemic species, usually unknown by the general public, with conservation problems

– Availability of drinking water in the future: This attribute focuses on determining the benefit for visitors in the future of ensuring the availability of drinking water from Peñuelas Lake to communities in the fifth region currently using the resource. There were two levels of variation for the attribute with respect to the status quo (drinking water not guaranteed for any part of the population): level 1—the availability of water is guaranteed for 25 years to the population that currently uses it; level 2—the availability is guaranteed for 50 years.

As improvements to the attributes were offered with respect to the status quo, WTP was the appropriate measure to quantify the benefits of the attributes considered in the study. In a valuation scenario that involves protected areas, Elsasser (1996) stated that a plausible payment vehicle for participants is an increase in the rate of entry to the area. As visitors pay for using the recreational service of the place, they are quite likely to perceive an increase in the rate of entry as a realistic change. The monetary attribute was varied between two levels with respect to the current price ($1,500/person/visit): $3,000/person/visit; $4,500/person/visit.

Table 2 shows the attributes and their levels of variation and coding for econometric analysis. Using the attributes and variation levels presented in Table 2, 16 conservation options were obtained from an orthogonal main-effects design (Louviere et al. 2000) performed using the SPSS (version 19.0). Throughout the *mix and match* procedure (Chrzan and Orme 2000), these options were combined into election sets with alternatives A and B as well as a status quo. The options were allocated to four blocks of four election sets each. The blocks were randomly distributed among the participants (Hensher et al. 2005). Figure 2 shows an example of a set of choices.

Design and structure of the valuation questionnaire

The questionnaire itself consisted of four parts.[5] The first part contained an introductory section to explain the objective of the study. In this section, it was clearly explained to respondents that the information would be delivered to local decision makers. The second section consisted of an exhaustive explanation of each attribute and its levels. To avoid confusion and to reduce cognitive demand, photographs related to the attributes were used.[6] For the attribute "chances of observing animals in a visit", it was explained to respondents that, in addition to the birds that they observe in the fishing area, the reserve contains other beautiful and interesting species to see. A photograph containing two emblematic foxes (*Pseudalopex culpeo*, *Pseudalopex griseus*) protected in the area were used as an example of mammals that can be seen. For reptiles, a photograph of three striking lizards was also shown.

To exhibit the attribute "existence of an endemic amphibian," a black and white photograph of the species was presented to respondents. A poster containing the ten orchid species present in the reserve that was recently used by the administrators to promote the area was presented to explain the endemic orchid attribute and its levels of variation. All photographs used in the study were provided by the administrators of the area.

[5] An English translation of the questionnaire is available from the author upon request.

[6] The validity of using photographic representations to assess perception of nature was established by different studies (e.g., Shuttleworth 1980; Kaplan and Kaplan 1989). When individuals viewed photographs, the information within the image was not the only factor that influenced their attitude because the images generated memories of past experiences and previous knowledge (Williams and Cary 2002).

Table 2 Attributes and levels of variation used in the study. Italic indicated status quo

Attribute	Levels of variation/coding	Expected effect on the welfare
Chances of observing animals in a visit	*1=Safely: only birds* 2=Safely: birds and reptiles 3=Safely: birds, reptiles and mammals	+
Availability of drinkable water	*1=Not guaranteed* 2=Guaranteed for 25 years 3=Guaranteed for 50 years	+
Existence of endemic orchids	*1=No species has its existence secured* 2=5 species have their existence secured 3=10 species have their existence secured	+
Existence of an endemic amphibian (*C. caudiverbera*)	*1=No research is carried out in the reserve to protect its habitat* 2=Medium research effort 3=Large research effort	+
Increase in the entrance fee	*1,500 CHP/person/visit* 3,000 CHP/person/visit 4,500 CHP/person/visit	−

CHP Chilean pesos

The choice sets were presented to respondents in the third part of the questionnaire. Each respondent was asked to complete the choice experiment section by selecting one of the three available options for each of the four attributes (Fig. 2).

The next section included questions related to participants' perceptions about the government's use of taxpayer's money and how able they felt to pay a price increase to enter the reserve. These data reflect the standard practice in the application of stated preference methods in the context of biodiversity and its services to include attitudinal variables that link attitudes and intended behaviour as revealed by surveys. These data help (1) to explain individual preference variations and (2) to relate preferences to underlying respondent values in order to support the validity of results generated from hypothetical stated preference surveys (Bateman et al. 2002: 113, Arrow et al. 1993).

OPTION A		**OPTION B**		**STATUS QUO**	
Chances of observing animals in a visit	Safely: Birds and mammals	**Chances of observing animals in a visit**	Safely: Birds, mammals and reptiles	**Chances of observing animals in a visit**	Safely: Only birds
Availability of drinkable water	Guaranteed for 50 years	**Availability of drinkable water**	Guaranteed for 25 years	**Availability of drinkable water**	No guaranteed
Existence of endemic orchids	No species has secured its existence	**Existence of endemic orchids**	10 species have their existence secured	**Existence of endemic orchids**	No species has secured its existence
Existence of an endemic amphibian	Large research effort to protect its habitat	**Existence of an endemic amphibian**	Medium research effort to protect its habitat	**Existence of an endemic amphibian**	No research effort to protect its habitat
Increase in the entrance fee	$3,000	**Increase in the entrance fee**	$4,500	**Increase in the entrance fee**	$1,500

I choose: ☐ ☐ ☐

Fig. 2 Example of a set of choices exactly as presented to participants

In addition, I included a time pressure test (c.f. Fischer and Hanley 2007). Enumerators rated the time pressure that the respondent seemed to feel on a scale from −3 (not at all, very relaxed) to +3 (very much under pressure). With the respondent time pressure indicator, I tested the hypothesis that this variable is a predictor of choice.

Socioeconomic information (gender, age, educational status, monthly income of individual, and residence location) was also collected. These questions were included in the last part of the instrument.

Administration of the choice experiment questionnaire

This study focuses on Chilean visitors to the reserve as data on average Chilean preferences for nature conservation is scarce in the country. A pilot study was conducted with 100 visitors during September 2010 involving minor adjustments to the instrument. The main survey was carried out face-to-face inside the reserve by three previously trained university students during November 2010 and January 2011. A representative random sampling was used to apply the interview. All participants were required to be at least 18 years old and in charge of a group. To encourage individuals to answer the questionnaire, each adult visitor received a letter at the entrance to the area in which was outlined and stated the purposes of the study and a request for cooperation in the event of being selected as a participant.

Econometric analysis of data and estimation of WTP

Based on the Random Utility Theory, an additive utility function linear in parameters was assumed with respect to the attribute levels as coded in Table 2. The utility function can be separated into an observable component V_{in} and unobservable (error) component ε_{in}:

$$U_{\text{in}} = V_{\text{in}} + \varepsilon_{\text{in}}$$

where, U_{in} is the total utility of option i for individual n. The probability (Pr) that individual n will choose option i over option j within the complete choice set C is given by:

$$\text{Pr}_{\text{in}} = \text{Pr}\left(V_{\text{in}} + \varepsilon_{\text{in}} > V_{\text{jn}} + \varepsilon_{\text{jn}},\ \text{all}\, j\ \in\ C\right)$$

If a deterministic utility component V_1 is hypothesised to be a linear function of attribute Z_1 itself, plus an interaction term of the attribute Z_1 with an individually varying sociodemographic variable A, V_1 can be expressed as:

$$V_1(Z_1, A) = c_A Z_1 A + c_1 Z_1$$

where, c_A is the utility coefficient of the interaction term (Bateman et al. 2002). In the econometrically estimated utility models, a positive coefficient c indicates a positive influence of the respective term on choices and, thus, on utility. To reduce collinearity between the interaction term and the non-interacted attribute term, the sociodemographic variable A was standardised before being multiplied by Z_1. The vector of the utility coefficient was usually estimated with maximum likelihood estimation techniques. Usually, the estimated choice models include an alternative specific constant (ASC) that picks up systematic differences in choice patterns between the three choice cards. The ASC was coded "1" for cards A and B, and "0" for the status quo option (status quo-ASC).

Choice models were generated using the software package LIMDEP/NLogit 9.0. To test for the influence of sociodemographic variables on choice, participants' perceptions of how the government uses taxpayer money and the time pressure that respondents seemed to feel, interaction terms were generated with the ASC and these variables (c.f. Bateman et al. 2002; Hensher et al. 2005). The improved model was generated stepwise by initially including all statistically "significant" interaction terms from single interaction models and then deleting nonsignificant interaction terms one by one.

For an estimation of marginal WTP, the coefficient of the change in increase in the entrance fee attribute estimated under this model was used to calculate marginal WTP (c.f. Louviere et al. 2000; Bateman et al. 2002). Linear utility functions were assumed for all attributes, and marginal WTP was obtained by dividing the monetary attribute coefficient by the coefficient of each attribute. The analysis was made on a "*ceteris paribus*" basis, given that everything else is held constant.

Results and discussion

The choice experiment was administered to 304 Chilean visitors using a random sampling strategy. No one

expressed doubts about the scenarios presented. Likewise, no one protested against the payment vehicle used. All participants traded the current situation (status quo) for environmental improvement at least once. Table 4 shows the results obtained with the calibration of logistic models.

Sample characteristics

The socioeconomic characteristics of the sample at Peñuelas National Reserve are summarised in Table 3. The data show that Peñuelas attracts Chilean tourists with a wide variety of socioeconomic characteristics. In general, the middle-aged, middle- and lower-educated (59% were under university degrees), and middle-income (CHP 600,000 and less per month; 40%) was the most frequent group. Respondents were mostly males (73%). Over half of the respondents came from the same region in which Peñuelas is located.

Table 3 Socioeconomic characteristics of the sample at Peñuelas National Reserve

Characteristics	Frequency in the sample	Percent (%)
Gender		
Female	83	27
Male	221	73
Educational status		
Primary school	15	5
Secondary school	82	27
Technical education	81	27
University	107	35
Post degree	19	6
Age		
16–30 Years	69	26
31–45 Years	146	48
46–60 Years	61	20
61 Years and above	18	6
Individual monthly income (CHP)		
CHP 300,000 and less	0	0
CHP 301,000–400,000	24	8
CHP 401,000–500,000	36	12
CHP 501,000–600,000	61	20
CHP 601,000–700,000	85	28
CHP 701,000–800,000	55	18
CHP 801,000–900,000	30	10
CHP 901,000 and more	12	4
Residence location		
Fifth region	181	60
Other region	123	40

Econometric results

Table 4 shows results from a base multinominal logit model (MNL) model (a) without interaction variables and a MNL model (b) with interaction terms between the ASC and sociodemographic variables, attitudinal variables, and time pressure terms.

Both models are highly significant ($P<0.0001$; Table 4). In both models, all attributes emerge as significant determinants of choice ($p<0.05$). The models display the expected signs for the attribute terms: positive utility for more types of species seen by visitors, positive utility for ensuring the provision of drinkable water in the future, positive utility for more orchid species protected and for additional protection of an endemic amphibian. The sign of the payment vehicle attribute indicating an entrance fee increase is negative, as expected. The sign of the ASC is positive, indicating positive utility as one moves away from the status quo.

A number of socioeconomic indicators such as income, education, gender, and age were tested as possible explanatory variables. Model (b) reveals that income and gender have an impact on choice. This conforms to the belief that environmental protection is a normal good and individuals will be willing to contribute more to the environment as their income increases. Chilean visitors with higher incomes are relatively more likely to pay an increase in the entrance fee.

In addition, the perceived response efficacy of the government's use of taxpayer money has a highly significant influence on choice. The model shows that a less favourable perception rating results in less utility for choosing the offered options.

The variable "pressure of time the respondent seemed to feel" is also significant. The model predicts that a greater time pressure rating results in less utility as one move away from the status quo, as expected.

Willingness to pay calculation

For an estimation of marginal WTP, there is a return to model (b), which fits the data no worse than model (a)

Table 4 Base MNL model and MNL model with interactions terms

Variables	(a) Base MNL model	(b) MNL model with interaction terms
Chances of observing animals in a visit	0.41696***	0.4258***
Availability of drinkable water	0.65474***	0.6541***
Existence of endemic orchids	0.26068***	0.2603***
Additional protection for an endemic amphibian	0.52912***	0.5377***
Increase in the entrance fee	−0.0001***	−0.0001***
ASC	0.32914*	
INCXASC (1000CH)		0.0129***
GENXASC		−0.59429*
IMPUXASC		−0.08701*
PRETIXASC		−0.18134**
Log likelihood	−998.077	−980.202
P(Chi^2); DF	<0.0001; 7	<0.0001; 11
Pseudo-R^2	0,09	0.11
Number of observations	1,216	1,216

*P<0.05, **P<0.001, ***P<0.0001

(log likelihood ratio-test of model fit improvement: 37.01; $\chi_{(4DF)}^2$=9.49 at 95% confidence). The marginal WTP for a one-level increase in protection of the area attributes is presented in Table 5. Mean values range from about 2,600 CHP per visitor per visit for protection of an additional orchid species to about $6,500 CHP for one more year of available drinkable water in the future (Table 5).

Discussion

By the use of a choice experiment, a number of attributes that increase the utility derived from a natural protected area were identified. The results are contextual, i.e., they are the result of a single study conducted in a specific place. The study participants are visitors to a national protected area, which probably affects the results as visitors of natural areas are more likely to be interested in nature. However, the visitors to Peñuelas National Reserve are not high-income tourists. On the contrary, they represent middle- or lower-income Chilean citizens. The likelihood of applying the results to other areas is an empirical question that can be tested by further studies in similar and different areas. Keeping this in mind, there are some aspects of the research that are worth emphasising. The study reported here represents one of the few attempts to use choice experiments to value the benefits of biodiversity and environmental services in South America. The results provide evidence that participants are willing to pay for environmental conservation. They also provide information on social preferences for the characteristics of Peñuelas. The study approach provides richer information than could have been obtained from simple qualitative judgments. Because participants were forced to make choices

Table 5 Marginal WTP

Attribute	Marginal mean WTP/visitor (CHP[a]/visit)
Chances of observing animals in a visit	4,258
Availability of drinkable water	6,541
Existence of endemic orchids	2,603
Additional protection for an endemic amphibian	5,377

[a] Chilean Pesos (1 USD ~485 CHP at the time of the study)

between attributes, they had to decide which characteristics of the reserve were most important to them. Such decisions are an important component in the management of natural resources. Thus, a choice experiment provides a structured context in which public preferences for the management of ecosystems can be assessed quantitatively. Increases in the entrance fee could finance conservation-oriented management, including the protection of biodiversity and ecosystem services. In this context, how citizens perceive that the government uses taxpayer money should be assessed to establish any mechanism of payment for nature conservation.

The information generated by the study has several implications. First, the Peñuelas Reserve currently faces funding problems as the state contribution and entrance fees are barely enough to cover operating costs. The study results may shed light on how to design and implement a conservation programme fund with public support. This fund would provide funding for management of the area, including the conservation of biodiversity and ecosystems. Second, the study provides valuable information on how to bring the importance of biodiversity to the general public. This topic is of interest given the lack of evidence regarding the social valuation of biodiversity in Chile. Third, the incorporation of the vision of the area managers in the design stage of the study allows for considering stakeholder preferences in the development and improvement of management tools for the conservation of natural resources.

To provide a more detailed analysis, two different logit models were used to predict respondents' choices: a base logit model without interactions and a model including interactions between the ASC and sociodemographic and attitudinal variables. The resulting models were found to be statistically significant. Sociodemographic variables explain individual preference variations generated from hypothetical stated preference surveys.

All attributes influenced respondent choices as to which conservation option to choose. Strong positive effects including the chances of observing animals in a visit, availability of drinkable water in the future, existence of endemic orchids and additional protection for an endemic amphibian were noted in the models. The significance of the monetary attribute indicates that respondents evaluated the increase in the entrance fee as an important factor. This means that visitors to Peñuelas react to changes in the entrance as fee-sensitive consumers in the context of the reserve's biodiversity and environmental services management.

Regarding the chances of observing different types of animals, the methodological approach tried to assess aesthetic values of biodiversity protected in the area. People might be interested in visiting sites besides the fishing area where they have the possibility of observing different types of animals. This information is important for identifying sites with potential for tourism where it is more likely for visitors to observe animals different from the birds seen in the Peñuelas Lake area. During the interview, most respondents expressed interest in their children being able to see other attractive species to which the economic value obtained could have been added a bequest value. Because specific species of mammals and reptiles were presented as examples to the participants through photographs, the economic value obtained may be attributed mainly to these species.

According to the economic value obtained, the availability of drinkable water was the most important attribute for participants. People attach great importance to the future availability of drinking water to the cities of Valparaíso and Viña del Mar. The statistical significance of this attribute in participant choices was expected because most visitors are direct users of this resource. The result can be interpreted as an option value of the reserve attributed to the ability to enjoy the resource in the future. Because this is a service provided by direct use of a natural system, variables associated with perceived risk may help explain the value of this attribute and may represent motivation for future research.

Regarding the protection of the endemic amphibian, people are willing to contribute monetarily to promote research to better protect the species. One question that arises in this analysis is exactly what motivated people to protect a species that most did not even know existed in the reserve.

Respondents were asked before the CE exercise if they cared about the existence of the amphibian, and they were required to give reasons for their opinions. Fifty-eight percent of respondents indicated an existence value motivation, arguing that the species has the right to exist. The rest of the respondents cited direct use values: it is important for science; it is important for ecosystem functioning; it is attractive to children. Species existence rights can be regarded as an ethical motivation (Stevens et al. 1991; Sagoff

2004) that may affect the willingness of people to protect species. The results of this study coincide with the findings of Kotchen and Reiling (2000) and Spash et al. (2009). Kotchen and Reiling (2000), which found that respondents who ascribe higher importance to ethically based motivations were willing to participate in a monetary valuation exercise. Similarly, Spash et al. (2009) found that the stated WTP can be justified by ethical motivations.

When participants were asked before the CE about their motivations to protect the endemic orchids, the main responses show existence and aesthetic value components.

Although it was not addressed in this study, an important question is if respondents reacted to the number of species protected. A detailed analysis of the single levels of the attribute by dummy coding them indicated respondent sensitivity to the scope of attribute variation. The highest level of protection (represented by 10 species protected) was valued higher that the intermediate level of protection (represented by five species protected). More finely graduated levels may shed further light on this effect. Regardless, the value obtained for this attribute is the first economic indicator of the importance of protecting Chilean flora for citizens.

In summary, this study shows evidence for the economic value of conservation at the species level. The emotions of respondents are of empirical concern when valuing species. In particular, high rates of protest responses have been documented in the literature that can invalidate results from stated preference techniques. In this study, no respondent protest was motivated by ethical reasons regarding the format of payment used in the interview. The quantitative estimate of the conservation values is, however, a complex procedure and requires specific adaptation of assessment strategies. Some methodological developments that can be seen when using choice experiments include providing more realistic conservation transactions and including multiple values simultaneously, which improves the separation of values through the requirement that participants must choose between different categories of value. Open-ended questions that give participants the opportunity to explain their choices should be incorporated into the assessment interview.

This research also shows that CEs, including an initial research step of focus group consultation with decision makers, can aid in incorporating stakeholder preferences into the design and evolution of conservation policy instruments. Choice experiments were shown to be an appropriate method for investigating public preferences about direct- and non-use values attached to the conservation of protected areas.

Finally, the introduction of a spatial dimension to economic valuation through the use of "spatial economic valuation" methodology and the production of economic value maps is worthy of further investigation. The adoption of a spatial approach to economic valuation is desirable in terms of producing more accurate economic valuation figures.

Acknowledgements Funding for this project was provided by the Vice-Rector for Research and Development at University of Chile. I thank the many students who helped with the survey conduction and data coding. My thanks to Mr. Claudio Ilabaca, representing the managers of the Peñuelas Reserve, for his assistance and support.

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