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Assessing the value of species: a case study on the willingness to pay for species protection in Chile

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Abstract We conduct a valuation of species protection in central Chile's Campana National Park (CNP) using the choice experiment (CE) method. The CNP has been recognized as having global relevance for the conservation of biological diversity. Specifically, the aim is to estimate the willingness to pay (WTP) of park visitors for protection of different protected species in the area: popular species of flora and fauna that are known by visitors of the park, inconspicuous species (phytofagous, fungus) that are unknown to visitors, and species with conservation problems of which visitors are unaware. We also investigate the WTP for different levels of species biodiversity protection within the sample as the WTP for biodiversity protection is sensitive to the way in which biodiversity is presented to respondents. The levels of species biodiversity protection are represented using "icon" inconspicuous species and numbers of inconspicuous species protected in La Campana National Park. This methodology allowed us to obtain information on the sensitivity of the participants to the scope of the information provided. Overall, visitors attach positive and significant values to the local conservation of species. These values are derived not only from the desire to preserve popular species in the area but also from the preservation or assured existence of inconspicuous species that are protected in the park. Visitors behave as consumers who are sensitive to changes in the price of park admission as a result of the implementation of specific strategies for wildlife conservation management in the park. Furthermore, the study also elucidates the observations that the public is able to perceive biodiversity conservation in broader terms than a single species and that greater benefits are attached to the conservation of multiple species than single ones. Results also provide insights into methodological considerations regarding the conceptual framework used to assess the valuation of biodiversity changes in developing countries, including the level of biological diversity and the scale of the change.

Keywords Choice experiment · Willingness to pay · Species protection · Campana National Park · Chile

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Introduction

Valuation of species

In conservation discourses, information regarding preferences for species preservation has been recognized as essential because it affords the possibility of improving the understanding of individual preferences regarding wildlife and therefore reveals useful information for decision making in environmental management (Jakobsson and Dragun 2001; Hanley et al. 2003; Martín-López et al. 2007, 2011; Resurreição et al. 2010; Cerda et al. 2013a, b).

Considerable progress has been made in developing techniques for assigning monetary values to the benefits of species that are not exchanged in markets. One approach is simply to ask people for their WTP for protecting species through surveys and direct questioning (Mitchell and Carson 1989; Bateman et al. 2002). The underlying idea is that individuals have preferences for species conservation, which they will reveal if they are asked the appropriate questions. Contingent valuation (CV) and choice experiments (CE) are methods available for this purpose (Bateman et al. 2002).

It is broadly recognized that the economic methodologies that use WTP as a measure of the value of biodiversity and its elements have their limitations (Kahneman and Knetsch 1992; García-Llorente et al. 2011), and in isolation, they can never provide the final solution to any major policy issue. For example, the information presented to participants of economic valuation studies can significantly affect the perception that people have towards biodiversity (Mitchell and Carson1989; Bateman and Mawby 2004; Jacobsen et al. 2008; Resurreição et al. 2010). Thus, this information may affect individuals' WTP to protect biodiversity. This potential effect is an important methodological question for the application of non-market valuation techniques in the context of biodiversity protection. Christie et al. (2006) found that familiarity with species and information on rarity increase WTP, while Hanley et al. (2003) found a tendency towards higher WTPs for rare species than more common ones. Metrick and Weitzman (1994) argued that WTP for biodiversity protection is related to the popularity of the species. Other approaches have used icon species as symbols of biodiversity. Jakobsson and Dragun (2001) found that the participants' WTP to protect an icon species accounted for approximately 25 % of their WTP for the protection of all endangered species present in the area. An alternative approach to the icon species represents the number of species in question (Horne et al. 2005; Lehtonen et al. 2003; Jacobsen et al. 2008). A problem with quantitative listings and the icon species presentation method is the sensitivity to scope (Kahneman and Knetsch 1992), i.e., that people tend to state the same WTP irrespective of the quantity provided. Most of the studies have tested insensitivity to scope, primarily using the CV method with species that are generally popular with the public (e.g., Giraud et al. 1999). Veistein et al. (2004) valued "uninteresting" species using the same method. There are few examples in the literature that use CE to test for insensitivity to scope, and even fewer studies use CE to test sensitivity for unpopular species. An exception is Jacobsen et al.'s (2008) study, which analyzed the effects of presentations of species that were nearly unknown to the public using a CE. The authors stated that evidence for scope sensitivity is stronger in tests using CE than those using CV because it is much more difficult for the respondent to check the internal consistency of her choices in a CE framework.

We conduct a valuation of species protection in CNP in central Chile using the CE method. CNP has been recognized as having global relevance in biological diversity conservation (Elórtegui and Moreira 2009). Valuation of species can be an important tool to show the importance of conserving biodiversity in CNP and can establish starting points for the development of environmental management strategies.

Specifically, the aim is to estimate the WTP for the protection of different protected species in the park: popular species of flora and fauna that are known to park visitors, inconspicuous species (phytofagous, fungus) that are unknown to visitors, and species with conservation problems of which visitors are unaware. We also investigate the WTP for different levels of species biodiversity protection within the sample. The levels of species biodiversity protection are represented using icon inconspicuous species and numbers of inconspicuous species protected in La Campana National Park. This approach was also used by Jacobsen et al. (2008); however, we use more than two species and provide respondents with a broader biodiversity scenario. This methodology also allowed us to obtain information on the sensitivity of the participants to the scope of the information provided.

La Campana National Park

La Campana National Park is located in Chile's fifth region, between Santiago and Valparaíso, the two most urbanized regions of Chile (Fig. 1). The park corresponds to the core zone of the UNESCO Biosphere Reserve Campana-Peñuelas and protects a wide variety of flora and fauna species that characterize Chile's

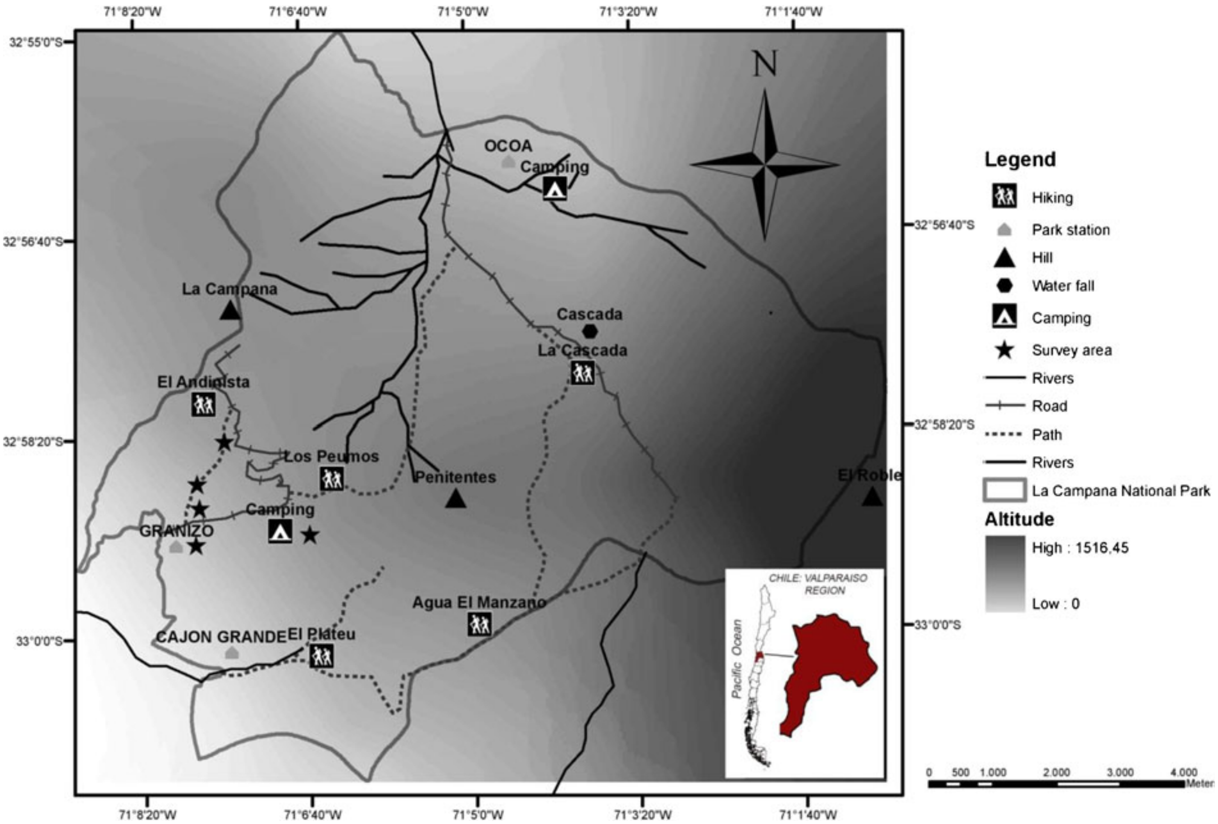

Fig. 1 La Campana National Park in central Chile

Mediterranean ecosystem. The area contains species that are categorized as endangered or vulnerable with respect to their conservation status, which determines how critical it is to protect these species (González et al. 2009; Lessa et al. 2010). The park is a unique biogeographical convergence center in South America, with northern, central, southern and Andean elements (Villaseñor and Serey 1986; Elórtegui and Moreira 2009). A total of 320 plant species are present in the park, distributed across 70 families. The abundant vegetation allows for the subsistence of a variety of fauna species (Elórtegui and Moreira 2009). The mammalian fauna of the park is rich in rodents and large populations of predators (Villaseñor and Serey 1986). For example, the *Octodon lunatus* is an endemic rodent species of Chile protected in the park listed as near threatened because it is likely to be in significant decline (but most likely at a rate of less than 30 % over 10 years) because of widespread habitat loss and degradation throughout much of its range, making the species close to qualifying as vulnerable (Lessa et al. 2010). The major threat to this species is the loss of habitat to agricultural expansion and livestock grazing. Urban expansion is also a threat to the species. It is thought that there has been a decline in population over the last 10 years (Lessa et al. 2010). The conservation of small mammal diversity is low on the environmental agenda (Amori and Gippoliti 2003; Entwistle and Dunstone 2000) despite increasing evidence of the role of these species in supporting ecosystems and more “attractive” species. There is a need for an increase in educational activities focusing on small mammal diversity and their ecological roles (Ceballos and Brown 1995).

Additionally, the park is one of the two places where the Chilean palm (*Jubaea chilensis*), a native species of flora emblematic of Chile, is protected from exploitation, which has caused it to be classified as vulnerable (González et al. 2009). The species has suffered a gradual reduction of its population over the last 150 years, with the estimated 120,000 palms that exist today being no more than 2.5 % of the population found at the beginning of the 19th century (González et al. 2009). From an economic perspective, this plant has been one of the most prized species in the central zone of Chile due to its two valuable products – its sap and seeds which are important for the food industry. In addition to this history of extensive use, there has been a drastic reduction in the accompanying native vegetation due to anthropogenic causes (González et al. 2009). The largest population of the species is protected in the Ocoa area of the Campana National Park. Given its current ecological condition, this study contributes to demonstrating its importance of its protection to citizens.

The park also contains a rich diversity of inconspicuous species such as phytofagous, fungus (Villaseñor and Serey 1986; Elórtegui and Moreira 2009). The scientific literature recommends extending the methodologies of valuation of only using charismatic megafauna species as conservation emblems (Prendergast et al. 1993; Williams et al. 2000; Martín-López et al. 2007). Thus, the park represents an adequate place for valuing inconspicuous biodiversity.

Conflicts between biodiversity conservation and economic development have increased, especially with the expansion of agriculture, tourism, and urbanization projects. Forest fires, domestic livestock entering the park, and the illegal extraction of Chilean palm seeds are also important threats to the area.

Valuation of species can be an important tool to demonstrate the importance of conserving biodiversity in the Campana National Park and establish guidelines for the development of environmental management strategies, as noted by local and regional decision makers.

Methods

Valuation methodology: the choice experiment

The CE is based on random utility theory (RUT) (McFadden 1973), which proposes that utility (e.g., of a wildlife conservation alternative) is separated into an observable component, which is a vector of attributes of the alternatives and individual characteristics of the respondent, and an unobservable component, known as the error (Lancaster 1966). In an environmental CE study, the alternatives are often described as different development or policy options (Bateman et al. 2002; Kanninen 2010) that are associated with changes in the quality of the good in question. Utility is given by the following expression:

$$U_{ij} = V_{ij}(X_{ij}, S_i) + \varepsilon_{ij} \quad \forall j \in C_i . \tag{1}$$

In this equation, U_{ij} is the utility an individual i is assumed to obtain from alternative j in choice set C_i. The parameter V_{ij} is the deterministic component, described as a function of the attributes of alternatives X_{ij}, which is a vector of attributes that are perceived by individual i for alternative j and characteristics of individual S_i. The random error term is ε_{ij}. Assuming utility maximization, the probability that alternative j is chosen by individual i over any alternative k out of choice set C_i can be expressed as the probability that the utility associated with alternative j exceeds that associated with all other alternatives including k. For details on the conditional probability that generates the multinomial logit model (MNL) (see McFadden 1973).

The component V_{ij} is assumed to be linear and additive in parameters:

$$V_{ij} = \beta_{\mathrm{ASC}} \mathrm{ASC}_j + \sum_{n=1}^{N} \beta_n X_{nj}. \tag{2}$$

In Eq. 2, X_{nj} is the attribute level of attribute n of the jth alternative. The parameter β_n is the value associated with attribute n. The alternative-specific constant or ASC_j equals 1 for alternative j (otherwise, 0) and can be included for j-1 alternatives. If the alternatives are generic, the ASCs can be set equal to each other. It is the role of the ASCs to take up any variation in choices that cannot be explained by either the attributes or the socio-economic variables (Bennett and Adamowicz 2001). Socio-demographic and attitude variables can be interacted with the ASC and/or attributes. Using the maximum likelihood method, estimates for the attribute parameters in the MNL model can be obtained. The utilities are expressed by parameter estimates produced by models in the logit family, such as the MNL or RPL (Louviere et al. 2000). If one of the attributes reflects cost implicit prices for an attribute are calculated using Eq. 3.

$$\text{Implicit price}(n) = -\left(\frac{\mu\beta_n}{\mu\beta}\right) = -\left(\frac{\beta_n}{\beta}\right) \tag{3}$$

In Eq. 3, β_n is the mean parameter of attribute n in a linear and additive utility function, $\beta_\$$ is the coefficient of the cost attribute, and μ denotes scale. The scale parameter μ is cancelled out in the calculation of implicit prices. Implicit prices reflect the maximum marginal willingness to pay (MWTP) for a marginal change in a single attribute on a ceteris paribus basis (Bennett and Adamowicz 2001).

Design of the choice experiment

Selection of attributes and levels

In focus groups with local administrators of the park, the following value dimensions were selected for valuation: popular species of fauna and flora, the existence value of inconspicuous species in the park, and the existence value of endangered species. To ensure that people understand these value dimensions, we conducted qualitative individual interviews with park visitors (n=149) prior to conducting the CE. The information collected in this qualitative phase of the research was exhaustively analyzed and used for the definitive selection of the attributes in the CE. The selection and design of the attributes are described in detail as follows:

Animals or plants that can definitely be seen on a visit in the long term During the qualitative phase of the research, we found that visitors showed a high degree of awareness regarding charismatic species of mammals, mainly the culpeo fox (*Pseudalopex culpaeus*), and emblematic species of flora, such as the Chilean palm. Lizards were also frequently mentioned as being interesting to children. Thus, the culpeo fox (*P. culpaeus)*, Chilean palm (*J. chilensis*), and slender lizard (*Liolaemus nigroviridis)* were selected to be included in one attribute.

Each species corresponded to a level of variation of the attribute. It was explained to participants that despite the efforts of the institution administering the park to counter threats, such as the illegal collection of Chilean palm seeds, forest fires, and the pressures of the housing market, that have developed in the surrounding area, it is not possible to guarantee the future existence of the species in the park, which may affect the possibility of visitors to see them. It was also explained to participants that if the culpeo fox and slender lizard disappear from the park, these species could still be found elsewhere in the country. However, as the park constitutes the primary area where the Chilean palm is protected in Chile, its extinction from the park could entail serious conservation problems for the species.

Inconspicuous species that have their existence secured in the park With this attribute, we assessed the WTP for different levels of biodiversity protection, which allowed us to analyze the sensitivity of participants to the scope of the information given.

It was explained to participants that similar to the existence of species that can be easily seen in the park, there are also a variety of species that are difficult to see and are unknown to most people. We also explained that due to current anthropogenic threats to the area, these species do not have a guaranteed future existence in the park, although the risk that they will disappear from the area in the short term is low. It was also mentioned that even if these species disappeared from the area, they might still be found elsewhere in Chile.

For estimating the WTP for different levels of biodiversity protection and test sensitivity to the scope of the information provided, the attribute was described as the preservation of the secure existence of 15 inconspicuous species present in the park. We first explained to participants that 15 inconspicuous species of animals and plants have been identified in the park. While explaining this, we presented them with an image, as shown in Fig. 2a. Next, we presented an additional image in which we used icon species by providing examples of inconspicuous species, inserting their images and scientific names in Fig. 2a (Fig. 2b). No information was provided for the remaining 12 species, i.e., they were kept anonymous.

The attribute varied across seven levels operationalized by different levels of biodiversity protection. The status quo presented was that none of the 15 species have a secure existence in the long term. The first three levels ensured the existence of each of the icon species in Fig. 2b. The fourth level of variation ensured the existence of the species of the first and second levels of variation combined. The fifth level ensured the existence of the species of the first, second, and third levels combined. In the last two levels, only the number of species maintained was provided. Thus, the last two levels

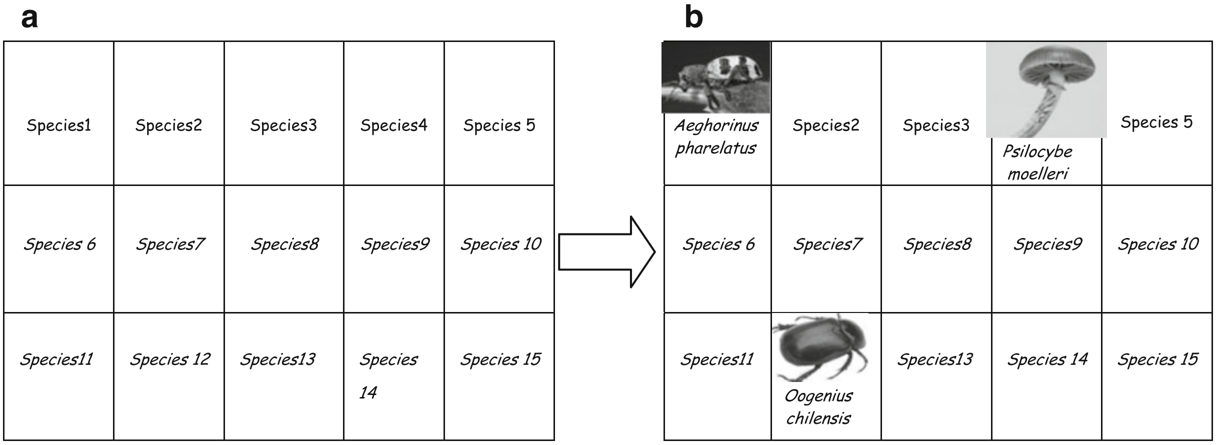

Fig. 2 Images presented to respondents. **a** First image presented. We did not identify any of the 15 inconspicuous species present in the park (note the image was presented in Spanish). **b** Image of "icon species" presented. Images and scientific names were shown to respondents.

maintained 3 and 12 of the species, respectively, presented in Fig. 2b, but they were not presented using their images and names (i.e., participants did not know which species were maintained, only that 3 or 12 from Fig. 2b were preserved).

In the Appendix, we present the information provided to participants to explain this attribute.

Change in population of the degu costina (O. lunatus) Different population sizes of the degu costina (*O. lunatus*) were included as an example attribute concerning an endemic species with conservation problems that are mostly unknown to visitors. The levels of variation were proposed as positive variations in population size; for the status quo, the population size remains the same and then increases by 10, 25, and 50 %.

Improvements in tourist infrastructure As some tourists may be interested in tourism development more than in conservation of biodiversity, to provide participants with a more realistic CE, an attribute regarding improving the tourism infrastructure in the park was incorporated. It was explained that these improvements would be implemented at specific camping and picnicking sites and hiking trails. It was also specified that these improvements would not significantly affect the conservation status of the species considered in the other attributes. The levels of variation in the attribute were dichotomous: "yes" when there are improvements and "no" when no improvements are made.

A monetary-based attribute was incorporated into the WTP format. This attribute was operationalized as a re-pricing of the area admission fee as a result of the implementation of specific measures for wildlife conservation in the park (Enneking 1999). The attribute had five levels of variation (from $3): $5, 7, 9, 11 and 13. Table 1 displays the attributes and levels examined in the study.

Survey design and application

Experimental design

For the orthogonal main-effects experimental design, a fraction of 64 out of the $4^2 \times 2^1 \times 6^1 \times 8^1$ possible combinations of attribute levels was selected (Louviere et al. 2000). Clearly, it would not be practical to ask respondents to consider this number of alternatives. Fortunately, it is not necessary to do so. The answer lies in the use of statistical experimental designs which provide the means to select subsets of the total set of possible alternatives for use in an experiment in a statistically efficient manner. We used a fractional factorial design consisting of just 64 alternatives out of a possible 1536. The design merely specifies the levels as numbers, and it is up to the designer to ascribe meaning to them. Our design has the property of orthogonality meaning that each of the variables has zero correlation with any of the others. The practical effect of this is that the influence of changes in any of our attributes on the respondents' choices can be identified

Table 1 Attributes and levels used in the study

Value dimension	Attribute	Levels of variation
Protection of charismatic/ popular/emblematic species	Species of flora and fauna that can definitely be observed in a visit:	**No species**
		Pseudalopex culpaeus (PC)
		Jubaea chilensis (JCH)
		Liolaemus nigroviridis (LN)
Protection of inconspicuous species	Secured existence of:	**No species**
		Oogenius chilensis (OCH)
		Aegorhinus phaleratus (AP)
		Psilocybe moelleri (PM)
		Oogenius chilensis + *Aegorhinus phaleratus* (OCH+AP)
		Oogenius chilensis + *Aegorhinus phaleratus*+*Psilocybe moelleri* (OCH+AP+PM)
		3 other species in Fig. 2b (3 sp)
		12 other species in Fig. 2b (12 sp)
Conservation of unpopular species with conservation problems	Population change (%) of *degu costina*	**0**, 10, 25,50
Tourism possibilities	Improvements in tourism infrastructure of the park	Yes
		No
	Cost of entry into the area ($/person/visit)	**3**, 5, 7, 9, 11, 13

Bold indicates the status quo.

and measured. The orthogonal main-effects design was derived using SPSS12.0 (Louviere et al. 2000). The 64 profiles were grouped into eight versions of the questionnaire, resulting in eight sets of choices for each respondent. Using a mix-and-match approach (Louviere et al. 2000), a second set of profiles was created and subsequently combined into choice scenarios that consisted of two (generic) alternatives, A and B. The final design step ensured within-alternative orthogonality. The inclusion of a status-quo option allows for economic welfare measures. The presentation order of the attributes in the choice set was randomized to avoid any possible internal sequencing effects (Glenk 2007).

Structure of the CE questionnaire

The CE questionnaire presented to participants consisted of four parts. An introductory section in the interview explaining the objective of the study to participants focused on the necessity of obtaining the opinion of Chilean visitors at the park with respect to different changes in the nature of the place as an important input for designing a new government conservation program for the park. We explained that by changing the way that we use nature, we could change the conditions for different wildlife species, and that, depending on which initiatives are taken, different species will be favored. Some of these species are endangered or declining in number, while others are common. It is being planned to take individual initiatives to improve the living conditions for wildlife inside of the park. These initiatives will benefit specific species.

In the second part, each attribute and its levels of variation were thoroughly explained to the participants. In addition to the verbal explanation, images and photographs related to the species considered were used to facilitate the participants' understanding. With respect to the monetary attribute, it was explained that implementing different alternatives comes at a cost for park visitors as the government budget is not sufficient to fund additional conservation efforts inside protected areas (CONAMA 2009). Participants were also advised

OPTION A	
Species of flora and fauna that can definitely be observed in a visit	Culpeo fox
Inconspicuous species that have their existence secured in the park	*Oogenius chilensis* + *Aeghorinus pharelatus* + *Psilocybe moelleri*
Change in the population of Degu	10%
Improvements in touristic infrastructure	No improvements
Increase in the entrance fee	$13

OPTION B	
Species of flora and fauna that can definitely be observed in a visit	Chilean palm
Inconspicuous species that have their existence secured in the park	*Oogenius chilensis* + *Aeghorinus pharelatus*
Change in the population of Degu	25%
Improvements in touristic infrastructure	Improvements
Increase in the entrance fee	$5

STATUS QUO	
Species of flora and fauna that can definitely be observed in a visit	No secured possibility of seeing species
Inconspicuous species that have their existence secured in the park	No species has its existence secured
Change in the population of Degu	No change
Improvements in touristic infrastructure	No improvements
Increase in the entrance fee	$3

I choose: ☐ ☐ ☐

Fig. 3 Examples of choice sets exactly as they were presented to participants

to remember their budget constraints in the case of choosing an alternative other than the status quo. The choice sets were presented in the third part of the interview (Fig. 3). Further qualitative questions related to each attribute being valued were also included. Finally, we collected additional data on respondent and household characteristics, including data related to the choice task (e.g., difficulty, confusion), background data concerning the attributes (e.g., past experience, present use), and several socio-economic characteristics (e.g., age, education, wealth).

Application of the questionnaire

A pilot study was conducted on a sample of visitors (n=100), implying minimal adjustments to the questionnaire. The main CE was applied to a representative sample of Chilean park visitors using representative simple random sampling. Five hundred and four visitors were interviewed during the months of October 2011 and January 2012 (For the feasibility of this sample size, see Louviere et al. (2000) or Hensher et al. (2005)). Three previously trained university students conducted the interviews on both weekdays and weekends. Visitors were interviewed primarily in the camping area and hiking trails. Those older than 18 who had an income were interviewed. To minimize potential interviewer effects, interviewers were randomly assigned to different areas of the park visited by tourists.

Data analysis and WTP calculations

For the econometric analysis of the data, RUT (McFadden 1973) was used to explain the probability that a conservation alternative would be chosen. A multinomial logistic model (Hensher et al.2005) was calibrated using LIMDEP NLogit 9.0 software. The species attributes were assessed using dummy codes to derive point estimates of the utility for each attribute level (Bateman et al. 2002; Hensher et al. 2005), as presented in Table 1. The cost attribute entered into the models as continuous variables using the actual attribute levels (Table 1). The ASC is 1 for the development alternatives and 0 for the status-quo option (Bateman et al. 2002; Hensher et al. 2005).

Implicit prices (WTP) were calculated using the approach proposed by Louviere (2006). Thus, the WTP for each attribute level was calculated with reference to the status-quo level of each attribute.

To test for the influence of socio-demographic variables on choices, interaction terms with the ASC were generated (Bateman et al. 2002; Barkmann et al. 2008). The model was generated stepwise by initially including all statistically significant interaction terms from the single interaction models and then deleting the non-significant interaction terms individually.

Results

All 504 visitors completed the choice task. None of the participants expressed doubts about the scenarios presented or complained about the payment method used. Ten respondents always chose the status quo, reporting that they could not afford the payment. Thus, 98 % of the participants conducted transactions incorporating the attributes at least once in the eight choices that had to be made. Table 2 shows the resulting estimates from applying a logit model to the sample. The parameter estimates, standard errors, and 95 % confidence intervals are shown. On the right of the table, the marginal WTP is presented.

Econometric results

Table 2 indicates that all of the attribute-level coefficients are significant (p<0.001) and yield the expected positive values. The monetary attribute is statistically significant (p<0.001) and negative, which was expected because increases in the admission price to the area were offered.

The results of the model that includes AGE effects indicate that this variable has statistically significant effects (p<0.05) on choosing option A or B. The AEC × AGE coefficient shows that the older a participant is, the more attractive the offered changes are compared to the status quo.

Table 2 Resulting estimates from applying a logit model (n=504)

Variables	Logistic model parameter	Std. err.	Lower bound 95 % (CI)	Upper bound 95 % (CI)	MWTP[a] ($)
Popular species					
Culpeo fox (*Pseudalopex culpaeus)*	1.2028*	0.0759	1.0540	1.3515	8.63
Chilean palm (*Jubaea chilensis*)	1.0443*	0.0729	0.9014	1.1871	7.49
Slender lizard (*Liolaemus nigroviridis*)	0.4898*	0.0773	0.3382	0.6413	3.51
Inconspicuous species					
Secured existence of:					
a) *Oogenius chilensis* (OCH)	0.5195*	0.1009	0.2375	0.6648	3.72
b) *Aegorhinus phaleratus (AP)*	0.4571*	0.1031	0.1584	0.6021	3.28
c) *Psilocybe moelleri* (PM)	0.5401*	0.0934	0.2798	0.6753	3.87
d) *Oogenius chilensis* + *Aegorhinus phaleratus (OCH + AP)*	0.6951*	0.0959	0.4317	0.8342	4.98
e) *Oogenius chilensis* + *Aegorhinus phaleratus* + *Psilocybe moelleri (OCH + AP + PM)*	0.8286*	0.0928	0.5901	0.9704	5.95
f) Other 3 species (3 sp)	0.8623*	0.0955	0.5918	0.9987	6.18
g) Other 12 species (12 sp)	1.0791*	0.0957	0.9995	1.2194	7.74
Improvements in the touristic infrastructure	0.3926*	0.0532	0.2668	0.4801	2.81
Change in the population size of *Octodon lunatus*					
10 %	0.3348*	0.0734	0.1910	0.4787	2.40
25 %	0.3731*	0.0687	0.2384	0.5077	2.67
50 %	0.5476*	0.0669	0.4164	0.6787	3.92
Cost of entrance to the area ($/person/visit)	−0.2787*	0.0001	−0.2787	−0.2790	-
Interaction term:					
ALTERNATIVE SPECIFIC CONSTANT × AGE	0.0929**	0.0409	0.0127	0.1730	-
Log likelihood	−3863.08				
P(Chi^2)	<0.0001				
Pseudo-R^2	0.21				
Number of observations	4.032				

*p<0.001, **p<0.05

[a] 1 USD=500 Chilean pesos at the time of the study.

The *P. culpeaus* species was preferred over *J. chilensis and L. nigroviridis*. With respect to the inconspicuous species attribute, the results show nearly identical WTP estimates for preserving either of the inconspicuous species that were identified with their images and scientific names (Fig. 2b). The results also show that respondents express preferences for more species rather than fewer. Analyzing the qualitative and quantitative levels of the attribute, the WTP increases as more iconic species are protected, reaching approximately \$4.98 when two iconic species are secured and approximately \$5.95 when three species are secured simultaneously. However, these differences are not significant, as indicated by the confidence intervals. In the two last quantitative levels, the secured existence of three of the 15 inconspicuous species presented in Fig. 1b that were kept anonymous reached a WTP of \$6.18. The protection of twelve of the anonymous inconspicuous species presented in Fig. 2b reached a WTP of approximately \$7.74. Participants were willing to pay \$2.81 to implement improvements in the tourism infrastructure. We also note that increases in the population size of *O. lunatus* also increase WTP.

Motivations for WTP

Results on participants' motivations for protecting the species considered in the study are presented in Tables 3, 4, and 5.

Table 3 Motivations for protecting popular species

The existence of which species would you prefer to secure in the long term?	*Why?*
Culpeo fox (*n*=257)	*It is beautiful.* (*n*=107)
	It is vulnerable to human threats. (*n*=48)
	It is nearly extinct. (*n*=45)
	It has ecological role, it is part of a chain. (*n*=35)
	It is endemic. (*n*=9)
	It is part of nature. (*n*=7)
	It is similar to humans. (*n*=6)
Chilean palm (*n*=219)	*It plays an important role in the ecosystem.* (*n*=58)
	It is endemic. (n=45)
	It is beautiful. (*n*=37)
	It is more vulnerable to forest fires. (*n*=24)
	It contributes to the identity of this region. (*n*=21)
	It provides oxygen, honey, and other products to humans. (*n*=14)
	It is very slow growing. (*n*=8)
	It is part of nature. (*n*=8)
	It is nearly extinct. (*n*=4)
Slender lizard (*n*=28)	*It has a right to exist.* (*n*=13)
	It is charismatic. (*n*=8)
	It has a role in ecosystem functioning. (*n*=7)

Discussion

Motivations for the WTP for protecting species

Using the concept of total economic value (TEV; Pearce and Moran 1994) as a reference, the obtained WTPs are motivated by both use and non-use values. This finding indicates that a valuation of biodiversity aspects should examine all components of TEV rather than individual elements of it. In general, use values are the main value dimensions that motivate participants to secure the existence of the different species included in the study. However, contrary to what we had expected, people not only recognize the charismatic value of the fauna and flora but also their ecological importance. Non-use values, i.e., existence values, were also reported by participants. The arguments "it is nearly extinct", "it is part of nature", and "it is endemic" seem to be related to existence value. "It is endemic" seems to be related to what Krutilla had in mind in 1967 when he introduced the concept of existence value, as he argued that irreversibility and uniqueness were both essential for existence value. Additionally, Madariaga and McConnell (1987) opine that existence value is likely to be the most important for environmental assets that are unique and irreplaceable. Option values are represented by arguments such as "it exists for some reason", which may imply that respondents do not consider it a good idea to destroy the habitat of a species because the species may be important or useful after additional investigation. Thus, a visitor's total value of a resource may be composed of various combinations of use values and non-use values. Generally, definitions of non-use values preclude the direct users of the resource from holding non-use values,

Table 4 Motivations of participants for protecting inconspicuous species

Some people think: it is bad if these species disappear from the park, some do not care. What is your opinion?	*Why?*
Care (n=487)	*They are important for maintaining ecological equilibrium; they are part of a chain; they are important for the formation of soil.* (n=282)
	They exist for some reason. (n=120)
	They are part of nature; they have the right to exist. (n=82)
	They are beautiful. (n=2)
	I want my children to know them. (n=1)
Do not care (n=17)	*We do not see them.*

such as existence values. However, we observe that visitors to the park, who are direct users, derive utility by viewing the aesthetic beauty of the wildlife, protecting them because it improves ecological integrity, and by not using the species as a resource. Babu and Suryaprakash (2004) make a similar argument, indicating that a recreationist's total valuation of a resource is composed of use and non-use values from which they introduce the concept of quasi-existence value. The evidence for existence values can have important policy implications, especially in developing countries, as tourists may have a positive WTP for protecting the biodiversity of the areas that they visit, despite not using this resource at all.

Econometric results

A logit model was used to predict respondents' choices. The resulting model is found to be statistically significant and have acceptable explanatory power. The age of a respondent explains individual preference variations generated through the hypothetical stated preference survey.

All of the attributes influenced the respondents' choices regarding which conservation option to choose. Strong positive effects of securing the existence of popular species, inconspicuous species, and species with conservation problems were noted in the model. The order of preferences obtained from the CE application clearly reflects the popularity of charismatic species, such as the culpeo fox and Chilean palm, as expected. The fox and palm are species with high cultural relevance at the local level. People also positively value the existence of less popular species. Negative impacts on less popular species may represent a relatively greater threat or biological significance in the ecosystem than some more charismatic species (Martín-López et al. 2007; Resurreição et al. 2010).

We also investigated visitors' WTP for different levels of biodiversity protection. This consideration also allowed us to approximate ourselves to obtain a somewhat improved understanding of the sensitivity of the participants to the scope of the information provided. Economically consistent measures of WTP are expected to adjust with the scale of the change (Smith and Osborne 1996; Resurreição et al. 2010). In other words, respondents are assumed to be able to distinguish between different quantities/qualities of the good and reflect this variability in their valuation function (Chilton and Hutchinson 2003). To test this assumption, we used an attribute operationalized by 15 unknown, inconspicuous species present in the park. The levels of biodiversity protection were presented using icon species and number of species. The results indicate that the respondents, through their choices, react to differences in the number of secured inconspicuous species. WTP clearly increases with the number of species, and there also seems to be a decreasing marginal WTP for more species. However, the increasing WTP is not proportional (Corso et al. 2001); thus, one could argue that participants only partially adopted a sensitivity test to the scope of the information given (Jacobsen et al. 2008). However, with 12 species, one

Table 5 Motivations of participants for protecting the degu

Some people think: it is bad if these species disappear from the park, some do not care. What is your opinion?	*Why?*
Care (n=483)	*It is part of a chain.* (n=184)
	It exists for some reason. (n=162)
	It is part of nature in the park.(n= 137)
Do not care (n=21)	*It is just a rat; more of them could become a plague.*

might expect signs of decreasing marginal value for the last species. Technically, the documented valuation pattern could be described as an extremely and strongly diminishing marginal utility of additional inconspicuous species that people have not considered previously. As Turner et al. (2003) and Resurreição et al. (2010) state, this finding may also indicate that asking respondents to consider changes in the total number of species, even at regional scales, may be "beyond the margin of analysis", imposing difficulties on accurate assessments of such changes on human welfare.

The WTP for protecting three unpopular species for the participants as a whole (level 6) was not greater than that obtained to protect three anonymous species, as presented in Fig. 2b (level 7). This result differs from those of other studies (e.g., Jacobsen et al. 2008), which reveal that using icon species to evaluate biodiversity, even when the species are unknown to people, can lead to a dramatic overestimation of the economic value of preservation when using quantitative measures of the species to conserve biodiversity. In our study, a possible explanation of this difference is that the information, specifically the context provided to participants, is part of the history. Jacobsen et al. (2008) find dramatic differences in WTP and obtain much higher WTP for iconified species than for a given number of species. However, the authors do not provide information on the total number of endangered species to the group of respondents. In our case, participants were informed that the three iconified species are 3 of the 15 present in the park that could potentially disappear from the area. Thus, we do not find significant differences in the WTP for protecting a group of iconified species and the WTP for protecting a number of anonymous species. However, we obtain a very similar WTP for protecting a popular species, such as the culpeo fox and Chilean palm, than for protecting 12 inconspicuous species, regardless of which specific species they are. This result is in line with a suggestion made in the literature related to the economic values obtained using popular species, which indicates that greater obtained economic value is due to species that are known and popular (Metrick and Weitzman 1994). Veistein et al. (2004) find fairly similar biodiversity values whether the species is described using icons or not, implying that the value is more a "symbolic one". We can analyze this finding because we can compare the WTP for one iconified species versus the WTP obtained for 3 or 12 anonymous species. The value of the last quantitative level is much higher and statistically different. Thus, the argument of Veistein et al. (2004) would not explain this difference.

With respect to preferences for increasing the population of the degu, biodiversity valuation studies often address the WTP for species survival. Many policy initiatives, however, target the population levels of wildlife more generally because many preservation projects are focused on increasing the populations of species. Thus, this focus raises an issue of how people's WTP for species conservation measures will be affected if valuation questions are not phrased as "preserve or not" questions but also address population increases (Jacobsen et al. 2012). In this study, we selected the degu because its current conservation status is problematic (Lessa et al. 2010). From dummy coding the levels of increased population size, we found that WTP increases when the population size increases. Few studies have considered aspects of species valuation when a population increase is not regarded as a bad thing (Freeman 2003; Adamowicz et al. 1998).

In summary, the results indicate that distinguishing between different types of species has an effect on the WTP of participants. The findings demonstrate that CE constitutes a promising tool for addressing issues of sensitivity to the scope of the information provided. These methodological aspects should be further investigated in studies aimed at analyzing the cognitive effects of economic value at the species level that use in-depth interviews about knowledge and attitudes regarding species and habitats. Finally, following these results, it is recommended that studies estimating the economic value of wildlife should take care when conservation involves icons or emblematic species that are known to the participants.

Conclusion

Overall, visitors to La Campana National Park attach positive and significant values to the conservation of local species. These values are derived not only from the desire to preserve popular species in the area but also from the preservation or assured existence of inconspicuous species that are protected in the park. Visitors behave as consumers who are sensitive to changes in the admission price to the area as a result of the implementation of specific strategies for wildlife conservation management in the park. Furthermore, the study sheds light on the observation that the public is able to perceive biodiversity conservation in wider terms than a single species and that greater benefits are attached to the conservation of multiple species than individual ones. Results also provide insight on methodological considerations regarding the conceptual framework used to assess the valuation of biodiversity changes in developing countries, namely the level of biological diversity and the scale of the change. Efforts to value multiple species or multiple groups of species should increase, as multiple species or multiple groups of species may imply an improvement in public perceptions and awareness of the ecological and functional inter-relationships among organisms.

Finally, the economic values obtained for emblematic and well-known species should be used with caution, as this strategy can lead to an overestimation of value.

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Appendix

Explanation of the attribute related to inconspicuous species (note that this is a translation from Spanish):

> "*The park is also home to difficult-to-see plant and animal species and an important part of their habitats nationwide. Examples of these species are insects and mushrooms. Despite the efforts of the park staff who manage the park, problems such as forest fires and the effects of livestock in the area currently make their existence here uncertain in the long term. We do not know if under the present conditions, these species will continue to exist in the park in the future. However, even though this place is an important part of their habitat in the country, if they disappear from here, they might be found elsewhere in Chile, although they may also be at risk in other places.*"
>
> *"Fifteen of these species have been identified in the park (Fig. 2a is shown to the interviewee). Some examples are Oogenius chilensis, Aegorhinus phaleratus, and Psilocybe Moelleri (each is clearly indicated by presenting images of each along with their scientific names in Fig.2b)."*

References

Adamowicz, W., Boxall, P., Williams, M., & Louviere, J. (1998). Stated preference approach for measuring passive use values; choice experiments and contingent valuation. *American Journal of Agricultural Economics, 80*, 64–75.

Amori, G., & Gippoliti, S. (2003). A higher–taxon approach to rodent conservation priorities for the 21st century. *Animal Biodiversity and Conservation, 26*(2), 1–18.

Babu, A., & Suryaprakash, D. (2004). *The quasi existence value of forest biodiversity: A theoretical and empirical overview. In the Sixth Annual BIOECON Conference on the Economics and the Analysis of Biology and Biodiversity*. UK: Kings College Cambridge.

Barkmann, J., Glenk, K., Keil, A., Leemhuis, C., Dietrich, N., Gerold, G., & Marggraf, R. (2008). Confronting unfamiliarity with ecosystem functions: the case for an ecosystem service approach to environmental valuation with stated preference methods. *Ecological Economics, 65*, 48–62.

Bateman, I., & Mawby, J. (2004). First impressions count: interviewer appearance and information effects in stated preference studies. *Ecological Economics, 49*, 47–55.

Bateman, I., Carson, R., Day, B., Hanemann, M., Hanley, N., Hett, T., et al. (2002). *Economic valuation with stated preference technique: A manual*. Cheltenham: Edward Elgar.

Bennett, J. W., & Adamowicz, W. (2001). Some fundamentals of environmental choice modelling. In J. Bennett & R. Blamey (Eds.), *The choice modelling approach to environmental valuation* (pp. 37–69). Cheltenham: Edward Elgar.

Ceballos, G., & Brown, J. H. (1995). Global patterns of mammalian diversity, endemism and endangerment. *Conservation Biology, 9*, 559–568.

Cerda, C., Barkmann, J., & Marggraf, R. (2013a). Application of choice experiments to quantify the existence value of an endemic moss: a case study in Chile. *Environment and Development Economics, 18*, 207–224.

Cerda, C., Ponce, A., & Zappi, M. (2013b). Using choice experiments to understand public demand for the conservation of nature: a case study in a protected area of Chile. *Journal for Nature Conservation, 21*, 143–153.

Chilton, S. M., & Hutchinson, W. G. (2003). A qualitative examination of how respondents in a contingent valuation study rationalize their WTP responses to an increase in the quantity of the environmental good. *Journal of Economic Psychology, 24*, 65–75.

Christie, M., Hanley, N., Warren, J., Murphy, K., Wright, R., & Hyde, T. (2006). Valuing diversity of biodiversity. *Ecological Economics, 58*, 304–317.

CONAMA. (2009). *Creación de un Sistema Nacional Integral de Áreas Protegidas para Chile: Documentos de Trabajo [Creation of a comprehensive system of protected areas for Chile: Working Documents]*. Chile: Santiago.

Corso, P. S., Hammit, J. K., & Graham, J. D. (2001). Valuing mortality-risk reduction: using visual aids to improve the validity of contingent valuation. *Journal of Risk and Uncertainty, 23*, 165–184.

Elórtegui, S., & Moreira, A. (2009). *Parque Nacional La Campana: Origen de una Reserva de la Biósfera en Chile Central*. Viña Del Mar: Taller la Era.

Enneking, U. (1999). *Okonomische Verfahren Im Naturschutz. Der Einsatz der Kontingenten Bewertung im Entscheidungsprozess [Economic processes in Nature: The use of contingent valuation in decision making processes]*. Frankfurt: Peter Lang Publishing.

Entwistle, A., & Dunstone, N. (2000). *Priorities for the conservation of mammalian diversity. Has the panda had its day?* London: Cambridge University Press.

Freeman, A. M. (2003). *The measurement of environmental and resource values: Theory and methods* (2nd ed.). Washington, DC: Resources for the Future.

García-Llorente, M., Martín-López, B., Díaz, S., & Montes, C. (2011). Can ecosystem properties be fully translated into service values? An economic valuation of aquatic plant services. *Ecological Applications, 21*(8), 3083–3103.

Giraud, J. L., Loomis, J. B., & Johnson, R. L. (1999). Internal and external scope in willingness to pay estimated for threatened and endangered wildlife. *Journal of Environmental Management, 56*, 221–229.

Glenk, K. (2007). A split sample experiment to test for effects of attribute order in choice experiments. In J. N. Meyerhoff, N. Lienhoop, & P. Elsasser (Eds.), *Stated preference methods for environmental valuation: Applications from Austria and Germany* (pp. 81–103). Marburg: Metropolis.

González, L., Bustamante, R., Navarro, R., Herrera, M. A., & Toral, M. (2009). Ecology and management of the Chilean Palm (*Jubaea chilensis*): history, current situation and perspectives. *Palms, 53*, 68–74.

Hanley, N., MacMillan, D., Patterson, I., & Wright, R. E. (2003). Economics and the design of nature conservation policy: a case study of wild goose conservation in Scotland using choice experiments. *Animal Conservation, 6*, 123–129.

Hensher, D., Rose, J., & Greene, W. (2005). *Applied choice methods—A primer*. Cambridge: Cambridge University Press.

Horne, P., Boxall, P. C., & Adamowicz, W. L. (2005). Multiple-use management of forest recreation sites: a spatially explicit choice experiment. *Forest Ecology and Management, 207*, 189–199.

Jacobsen, J., Boiesen, J., Thorsen, B., & Strange, N. (2008). What´s in a name? The use of quantitative measures versus "Iconised" species when valuing biodiversity. *Environmental and Resource Economics, 39*, 247–263.

Jacobsen, J., Hedemark Lundhede, T., & Thorsen, B. (2012). Valuation of wildlife populations above survival. *Biodiversity and Conservation, 21*, 543–563.

Jakobsson, K., & Dragun, A. (2001). The worth of a possum: valuing species with the contingent valuation method. *Environmental and Resource Economics, 19*, 211–227.

Kahneman, D., & Knetsch, J. L. (1992). Valuing public goods: the purchase of moral satisfaction. *Journal of Environmental Economics and Management, 22*, 57–70.

Kanninen, B. (2010). *Valuing environmental amenities using stated choice studies. A common sense approach to theory and practice*. Dordrecht: Springer.

Lancaster, K. (1966). A new approach to consumer theory. *Journal of Political Economy, 74*, 132–157.

Lehtonen, E., Kuuluvainen, J., Pouta, E., & Rekola, M. (2003). Non-market benefits of forest conservation in southern Finland. *Environmental Science and Policy, 6*, 195–204.

Lessa, E., Ojeda, R., & Bidau, C. (2010). *Octodon lunatus*. In: IUCN 2011. IUCN Red List of Threatened Species. Version 2011.2. www.iucnredlist.org. Accessed 24 Aug 2012.

Louviere, J. (2006). What you do not know might hurt you: some unresolved issues in the design and analysis of discrete choice experiments. *Environmental and Resource Economics, 34*, 173–188.

Louviere, J., Hensher, D. A., & Swait, J. D. (2000). *Stated choice methods. Analysis and application*. Cambridge: Cambridge University Press.

Madariaga, B., & McConnell, K. (1987). Exploring existence value'. *Water Resources Research, 23*(5), 936–42.

Martín-López, B., Montes, C., & Benayas, J. (2007). The non-economic motives behind the willingness to pay for biodiversity conservation. *Biological Conservation, 139*, 67–82.

Martín-López, B., González, J., & Montes, C. (2011). The pitfall trap of species conservation priority setting. *Biodiversity and Conservation, 20*, 663–682.

McFadden, D. (1973). Conditional logit analysis of qualitative choice behavior. In P. Zarembka (Ed.), *Frontiers in econometrics* (pp. 105–142). New York: Academic Press.

Metrick, A., & Weitzman, M. L. (1994). Patterns of behavior in biodiversity preservation. Washington, DC: The World Bank Policy Research Working Paper, 1358, 36 pp.

Mitchell, R., & Carson, R. (1989). *Using surveys to value public goods: The contingent valuation method*. Washington, DC: Resources for the Future.

Pearce, D. W., & Moran, D. (1994). *The economic value of biodiversity. IUCN—The World Conservation Union*. London: Earthscan.

Prendergast, J. R., Quinn, R. M., Lawton, J. H., Eversham, B. C., & Gibbons, D. W. (1993). Rare species, the coincidence of diversity hotspots and conservation strategies. *Nature, 365*, 337–337.

Resurreição, A., Gibbons, J., Ponce Dentinho, T., Kaiser, M., Santos, R., & Edward-Jones, G. (2010). Economic valuation of species loss in the open sea. *Ecological Economics, 70*, 729–739.

Smith, V. K., & Osborne, L. L. (1996). Do contingent valuation estimates pass a "scope" test? A meta analysis. *Journal of Environmental Economics and Management, 31*, 287–301.

Turner, R. K., Paavola, J., Cooper, P., Farber, S., Jessamy, V., & Georgiou, S. (2003). Valuing nature: lessons learned and future research directions. *Ecological Economics, 46*, 493–510.

Veistein, K., Hoen, H. F., & Strand, J. (2004). Sequencing and the adding up property in contingent valuation of endangered species: are contingent non-use values economic values? *Environmental and Resources Economics, 29*, 419–433.

Villaseñor, R., & Serey, I. (1986). *Guía de Reconocimiento de las Especies Arbóreas y Arbustivas frecuentes en el Parque Nacional La Campana [Guide to recognition of common three and shcrub species in the Campana National Park]*. Valparaíso: CONAF.UPLACED.

Williams, P. H., Burgess, N. D., & Rahbek, C. (2000). Flagship species, ecological complementarity and conserving the diversity of mammals and birds in sub-Saharan Africa. *Animal Conservation, 3*, 249–260.