

Non-market economic valuation of the benefits provided by temperate ecosystems at the extreme south of the Americas

Claudia Cerda · Jan Barkmann · Rainer Marggraf

Received: 7 September 2012 / Accepted: 21 January 2014 / Published online: 28 February 2014
© Springer-Verlag Berlin Heidelberg 2014

Abstract The island of Navarino, Chile, located at the extreme southern end of the Americas, is one of the few regions in the world with undivided and only slightly transformed temperate forests. Currently, fundamental issues are being addressed, such as how local fuel wood demands will be met without destroying primary forests and how a sustainable tourism industry may be developed. This study aims to inform these planning processes by providing data on the economic valuation of several non-market benefits provided by the temperate ecosystems of Navarino Island that have relevance to the local population. We focus this valuation on landscape esthetics, nature access restrictions, esthetic and ethno-symbolic benefits at the species level and the existence value of non-vascular endemic species. A choice experiment was applied to a sample of local residents ($n = 230$). Decisions about future development strategies were influenced by landscape esthetics being threatened by progressing levels of tourist

infrastructure, nature access restrictions in favor of both economic and conservationist concerns, continued visits of an ethno-culturally important hummingbird, the protection of a moss endemic to the sub-Antarctic forests and species diversity. From a non-market valuation perspective, local residents favor a low-impact tourism development scenario. Little is known about the monetary value of Chile's temperate forests. Knowledge of the economic value of Navarino's temperate forests facilitates the understanding of local natural resource management at the microlevel and assists in formulating conservation policies at the regional and national levels.

Keywords Choice experiment · Willingness to accept · Biological diversity · Navarino Island · Chile

Introduction

The appreciation of the economic value of biodiversity and ecosystem services has been recognized to be central to effective conservation efforts in the future (Butchart et al. 2010; Rands et al. 2010). Biodiversity provides a range of goods and services that are of fundamental importance to human beings in terms of health, well-being, livelihood and survival (TEEB 2010; Martín-López et al. 2012). Despite the vital importance of ecosystem services—the supply of benefits from ecosystems to society—leaders in both the private and public sectors have been slow to incorporate these benefits into decision making. This slow incorporation traces from a complex set of factors that extend well beyond science but, at its core, is the result of a poor characterization of the flow of services in the necessary biophysical and economic terms at the local and regional scales, which are most useful to decision makers (Chan

Editor: Wolfgang Cramer.

Electronic supplementary material The online version of this article (doi:10.1007/s10113-014-0591-2) contains supplementary material, which is available to authorized users.

C. Cerda (✉)
Department of Forest Resource Management, Faculty of Forestry Sciences and Conservation of Nature, University of Chile, Santa Rosa, 11315 La Pintana, Chile
e-mail: claudcerda@gmail.com; clcerdaj@uchile.cl

J. Barkmann · R. Marggraf
Department of Environmental and Resource Economics,
Institute of Agricultural Economics, Georg-August-Universität
Göttingen, 37073 Göttingen, Germany
e-mail: jrbarkma@gwdg.de

R. Marggraf
e-mail: rmarggr@gwdg.de

et al. 2006). In recent years, however, there have been tremendous advances in the science, economic valuation and social capacity needed for ecosystem-service conservation (Chan et al. 2006).

For the economic valuation of non-market values of biodiversity and ecosystem services, stated preference technique (SPT) is commonly used. SPT such as choice experiment (CE; Hensher et al. 2005) provides instruments to elicit willingness to pay (WTP) in the environmental management context. CE is being prominent in the economic valuation of biodiversity 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 (Bateman et al. 2002; Kanninen 2010). Many authors argue for the need to improve the design and application of the SPT by including people's views and values to produce a useful contribution to policy decisions on conservation and development (e.g., Wilson and Howarth 2002; Barkmann et al. 2008). Participants' views are not only essential for the development of survey instruments for stated preference methods (Barkmann et al. 2005), but they may also contribute to the interpretation and corroboration of the results of such studies.

In particular, the island of Navarino, located in Chile at the extreme southern tip of the Americas, is one of the few regions in the world with undivided and only slightly transformed temperate forests (Rozzi et al. 2004). However, economic pressures such as salmon farming projects, intensive tourism, construction of roads and other infrastructure are threatening the structure, function and composition of the biodiversity of the southernmost region of the Americas. Human influences associated with rapid social and economic changes in the local, regional and global scales may dramatically influence the fate of local and regional biological diversity. Navarino forms the main terrestrial part of the Cape Horn Biosphere Reserve (Rozzi et al. 2004), which emphasizes the international significance of this area for the natural heritage of mankind. It logically follows that local economic agents find themselves situated between globally defined conservation objectives and more locally perceived pressing needs for development. This scenario requires that the socioeconomic impacts of any conservation measure on the local population be carefully considered. One of the biggest obstacles facing the analysis of socioeconomic impacts of conservation measures is the lack of knowledge about the economic value of the non-market benefits generated by Chile's temperate forest ecosystems. Uncertainties exist with respect to the economic value of non-market benefits of natural systems, which are especially prevalent in developing countries (Cerda et al. 2013b), and still more in remote areas such as Navarino. Thus, SPT can contribute to

understanding the behavior and situation of local economic agents with respect to their demand for non-market benefits by analyzing welfare estimates of the non-market benefits provided by the ecosystems of Navarino.

The study aims to inform planning processes by providing data on the economic valuation of several non-market benefits provided by the ecosystems of Navarino Island that have relevance to the local population. To achieve this goal, a CE was conducted with local residents of Navarino. For the CE design, we used particular sources of benefits that are directly based on input from local residents.

Specifically, we focus on the value of charismatic fauna, species with ethno-symbolic cultural importance, endemic flora species, the number of protected species and two cultural values: landscape esthetics and the possibilities for leisure and recreation activities. Regarding cultural values, recent developments show the importance of assessing cultural and non-economic benefits (e.g., Daniel et al. 2012; García-Llorente et al. 2012; Cerda et al. 2013b) to enable economic and other methods to clarify the trade-offs and synergies involving cultural services.

The results of the study contribute to filling gaps in the existing literature on the economic value of non-market benefits of forests in developing countries. Because the study area is part of a UNESCO Biosphere Reserve, this research has global relevance.

Methodology

Study area

The island of Navarino is characterized by high habitat diversity and high cryptogam diversity (Rozzi et al. 2004). Together with the virtually uninhabited Cape Horn National Park, the D'Agostini National Park and a few smaller adjacent islands, Navarino forms the main terrestrial area of the Cape Horn Biosphere Reserve (Rozzi et al. 2004).

The citizens of Navarino comprise a culturally diverse group that includes members of the southernmost indigenous community in the world, the Yaghans. The population is concentrated in Puerto Williams, the capital of the southernmost Chilean Province, Magallanes y Antártica Chilena. The approximately 2,000 citizens include approximately 400 seasonal workers in the seafood-processing industry. The permanent residents are mainly employed by the Chilean Navy, the public sector and the fishing industry (Barkmann et al. 2005). Navarino can only be accessed regularly by air and a weekly ferry. The island has few roads and related infrastructure, and the ecological impacts of agriculture and tourism are low. After a period

of depressed development due to military tensions between Chile and the neighboring Argentina (Berghoefer et al. 2010), interest in tourism and salmon farming projects have increased sharply.

The privatization and commercialization of previously subsidized public services have dramatically raised the cost of living in this remote area, which has limited employment opportunities. At present, the ecological impacts of tourism and agricultural activities are low. However, the region's vast expanses of intact habitats currently face a number of challenges from coastal concessions for tourism and increased access via air and land routes (Berghoefer et al. 2010). In addition, fuel wood is extracted from primary forests, and there are signs of an overexploitation of some marine resources (King Crab, Centolla; Rozzi et al. 2004). Increasing tourism development that may affect the ecological quality of the area and the local residents' way of life is expected in the near future (Berghoefer et al. 2010).

Most of Navarino Island is public land owned by the state of Chile. The Ministry of National Goods (Ministerio de Bienes Nacionales) administers these lands and awards concessions to interested investors. There has been external investor interest in substantial tourism development, particularly in the ecologically sensitive west coast of Navarino. The municipal government began to implement local participation within the framework of a local Agenda 21 process only after the UNESCO approval of the Cape Horn Biosphere Reserve in 2005. Central issues, such as how to meet local fuel wood demands without destroying primary forests, how to develop a sustainable tourism industry and how to protect marine resources, were being addressed at the time of the study.

The choice experiment approach

This economic tool evaluates the public's preferences by asking respondents to choose from a series of alternatives of choice sets, each described in terms of different attributes and levels related to different management options (Turner et al. 2010). As a result, in CE studies, perceptions of benefits delivery can be explored to consider the preferences, trade-offs or potential conflicts among different stakeholders and management options (Barkmann et al. 2008; Kontogianni et al. 2010; García-Llorente et al. 2012).

In a CE interview, respondents are presented with a series of choice sets, each containing three development program options. From each choice set, respondents are asked to choose the option that they would prefer to see implemented. If one of the program attributes represents a change in respondent income, marginal compensating variation can be calculated for a statistically significant change in any attribute (Bateman et al. 2002). In a CE,

respondents are confronted with realistic, multidimensional trade-offs that mimic many real-life decision-making processes (Bateman et al. 2002). This value elicitation format is likely to reduce hypothetical bias (cf. Bateman et al. 2002: 74). Furthermore, CEs reduce protest responses because people may find it easier to rank alternatives without having to think in direct monetary terms. Even for willingness to accept formats used in assessing the loss of an endemic species, ethically prompted protest responses have been reported to be extremely rare (Cerdeña et al. 2007).

CE has been used for estimating the social importance in monetary terms of different components and topics associated with biodiversity, including particular species (Hanley et al. 2003; Martín-López et al. 2007; Jacobsen et al. 2008; McVittie and Moran 2010; Cerdeña et al. 2013a, b), ecosystems (Rolfe and Bennett 2000; Rolfe and Windle 2003; Wattage et al. 2011) and management options (Berniger et al. 2010; Jacobsen and Thorsen 2010; Balderas Torres et al. 2012; García-Llorente et al. 2012). Hoyos (2010) produced a highly advanced environmental valuation through the application of CEs.

Most of the empirical experience in the application of choice experiments has been collected in the developed world with very limited applications within developing countries. Exceptions include the studies by Biénabe and Hearne (2006) in Costa Rica, Barkmann et al. (2008) in Indonesia, Cerdeña et al. (2013b) in central Chile and Balderas Torres et al. (2012) in Mexico.

For this study, a CE was thought to be particularly suitable for the following reasons:

1. The evaluation of sustainable conservation options for Navarino necessarily involves multiple facets of the complex good "biodiversity;"
2. CEs allow for the concurrent economic estimation of these facets over a range of quantities and/or qualities, which makes the method more versatile and applicable in early planning processes, in which precisely quantified valuation scenarios have yet to be designed (Cerdeña et al. 2007).

The design of the choice experiment

Development of attributes and choice cards

Following the main guidelines of the Ecosystem Approach of the Convention on Biological Diversity, we selected the CE attributes using the input of the local community of Navarino. We first elaborated a list of potential benefits provided by the ecosystems of Navarino, including the esthetic and ethno-symbolic benefits at the species level and the existence benefits of non-vascular, endemic species. We also included the benefits of landscape esthetics,

the possibilities for leisure and recreation and benefits related to the local water supply.

The importance of these benefits for local people was corroborated in the second step of the study by employing an *image of nature analysis* (for details, see Barkmann et al. 2005). We sampled pre-theoretical cognitions (“images”) of nature and the human–nature relationship (Barkmann et al. 2005) using semi-structured questionnaire interviews. In collaboration with other project researchers, 54 interviews were conducted with local residents, including members of the indigenous Yaghan community ($n = 12$); permanent residents ($n = 28$), some of whom had European ties; navy personnel ($n = 5$); and public employees working for public authorities ($n = 9$). The first author of this article conducted 14 interviews (Yaghans: three, permanent residents: seven, navy personnel: one, public employees: three). The sampling strategy in this phase was snowball. The results of these 14 interviews were cross-checked with field notes and tape recordings of the other 40 interviews. The cross-check supported the notion that the attention and knowledge of respondents was focused on a small number of species and ecosystem services with direct links to human utilization and that leisure and esthetic functions were considered more important than water services. Specifically, the images of nature analysis documented that residents ascribe high importance to the largely unspoiled local landscapes. In addition to the abstract appreciation of the beauty of Navarino’s landscape, many interviewed citizens also stressed the sense of freedom resulting from a lack of access restrictions on the island.

The Magellanean woodpecker (*Camphepilus magellanicus*), the guanaco (*Lama guanacoide*) and the condor (*Andean condor*) are among the best known and most appreciated native animal species on the island. With respect to the non-vascular flora of Navarino, most respondents knew of the existence of mosses on the island when explicitly asked, but they did not attribute any specific use to them. Most participants showed poor knowledge with respect to specific symbols of the indigenous Yaghan culture related to biodiversity, although most residents of Navarino showed great interest in preserving this culture (Rozzi et al. 2004).

Based on this qualitative input from the images of nature analysis, the attributes and attribute levels were adjusted to match the dominant themes of the interviews. A pilot study of the choice experiment ($n = 45$) was conducted and resulted in only minor adjustments. For a summary of attributes and attribute levels used for the main CE study, see Table 1. We present details of the attributes as follows:

Change of the landscape by tourist infrastructure The link between the much appreciated esthetic services of

the Navarino landscape and the imminent plans for tourist development prompted us to combine both aspects in one attribute. Documents on spatial planning (*Plan Seccional*) describe an expansion of tourism infrastructure on Navarino. The attribute was operationalized into four levels, ranging from *very small* to *big change* (Fig. 1), based on the different impact levels of tourism infrastructure.

The qualitative pre-study interviews documented that residents ascribe a high degree of importance to the largely unspoiled local landscapes. The attribute was assessed using dummy codes to derive point estimates of the utility of each attribute level (Fig. 2; Bateman et al. 2002; Hensher et al. 2005).

Access to nature for private and conservation interests Many interviewed citizens also stressed the sense of freedom resulting from a lack of access restrictions on the island. For a respective attribute, three levels of access restrictions were defined. The status quo level was defined as *not restricted*. For a *middle restriction* level, most of the western region of the island was closed off. Such restrictions are quite likely to materialize within the next decade because concessions for hotels of several thousand hectares in size on the west coast of Navarino were recently granted by the Chilean Ministry of National Goods. A *high restriction* level additionally closed off the uninhabited southern part of the island. Because (1) circulating spatial planning zoning proposals for the island are viewed as being rather restrictive by many residents (*Plan Seccional*) and (2) most landscape and nature-related recreational activities actually occur at the “*unrestricted*” north coast, none of the respondents in the pre-test or pilot studies commented negatively on the hypothetical nature of the access restriction attribute levels. To identify potential biases due to focusing on either a tourism investment or a conservation justification for the access restrictions, we sub-sampled for this attribute, citing either private or conservation reasons for the access restrictions. Maps of the island were used to present the levels of restrictions to respondents.

Possibility of seeing animals According to the qualitative interview data derived from the images of nature analysis, the Magellanean woodpecker (*Camphepilus magellanicus*), the guanaco (*Lama guanacoide*) and the condor (*Andean condor*) are among the best known and most appreciated native animal species on the island. In addition, local residents know that these species are of extreme interest to scientific groups. Within a total economic value framework and considering the arguments of esthetic appeal given by respondents in the qualitative phase of the study, these are representative species that supply esthetic ecosystem

Table 1 Attributes and levels used for the main choice experiment application

Valuation dimension	Attribute	Levels (coding)
Esthetic quality of landscape	Change in landscape due to impact of tourist infrastructure (Fig. 2)	Dummy-coded levels
		Very small change ^c
		Small change
		Medium change
Access ^a	Access restrictions to nature for private interests	Not restricted (1) ^c
		Medium restrictions (2)
		Very restricted (3)
Esthetic value	Possibility of seeing animals (Magellanic woodpecker, Guanaco, Andean condor)	25 % more than now (1) as now (2) ^c
		25 % less than now (-2)
Ethno-symbolic value	The hummingbirds visit Navarino	They do not come to the island anymore (-1)
		Not secure visit (0) ^c
		Secure visit (+1)
Existence value	Probability of extinction of an endemic moss	Increased probability (-1)
		Low probability (+1) ^c
		Very low probability (+1)
Species diversity	Number of types of animals and plants	400 types
		800 types
		1,600 types ^c
		- CHP30,000 ^b
Payment vehicle	Monthly income change	CHP0 ^c
		+ CHP20,000
		+ CHP30,000
		+ CHP40,000

^a A split sample differentiating access restrictions for private and conservation concerns
^b CHP100 ~ 0.16 dollars at the time of the main study
^c Status quo level

services.¹ In particular, the Magellanean woodpecker is sensitive to forest management because it requires old-growth forest habitats. Comments in the pre-study interviews countered the notion that the respondents perceived seeing these animals more often to be better than seeing the animals as often as they do now. Seeing them less often was clearly regarded as a loss. A linear coding directly using the percentage of changes (-25; 0; +25 %) resulted in an insignificant attribute. Informed by dummy-coded attribute levels, an adjusted nonlinear coding was applied (-2; 0; +1; Louviere et al. 2000).

A hummingbird visits Navarino Although our qualitative interviews revealed a poor level of knowledge on the part of most inhabitants with respect to specific symbols of the indigenous Yaghan culture, we decided to include the “visit of the hummingbirds” as an attribute. The Magellanean colibri (*Sephanoides sephanoides*) appears

occasionally throughout Navarino and is a key figure in Yaghan cosmology (Rozzi et al. 2004). Thus, continued visits of the hummingbirds are of ethno-symbolic value not only to the Yaghan community but also to the Navarino population as a whole because the population takes an active interest in the survival of the Yaghan culture. The hummingbird habitat is mainly formed by “notro” (*Embothrium coccineum*) thickets (Rozzi et al. 2004). This habitat is susceptible to damage by a variety of economic development activities. A linear coding representing the levels of hummingbird presence was applied (-1, 0, +1).

Probability of the extinction of an endemic moss Benefits of attributes such as the protection of an endemic moss did not spontaneously appear in the qualitative phase of the study. However, scientists on Navarino Island have made great efforts to communicate the importance of the island’s mosses and lichens. Furthermore, many residents of Navarino have actively participated in tourism programs whose purpose is to show the importance of protecting the

¹ We recognize, however, that also other values (e.g., existence values) may be embedded in the valuation of people.



Fig. 1 Location of Navarino island at the extreme south of the Americas in Chile. *Source* Berghoefler et al. (2006)

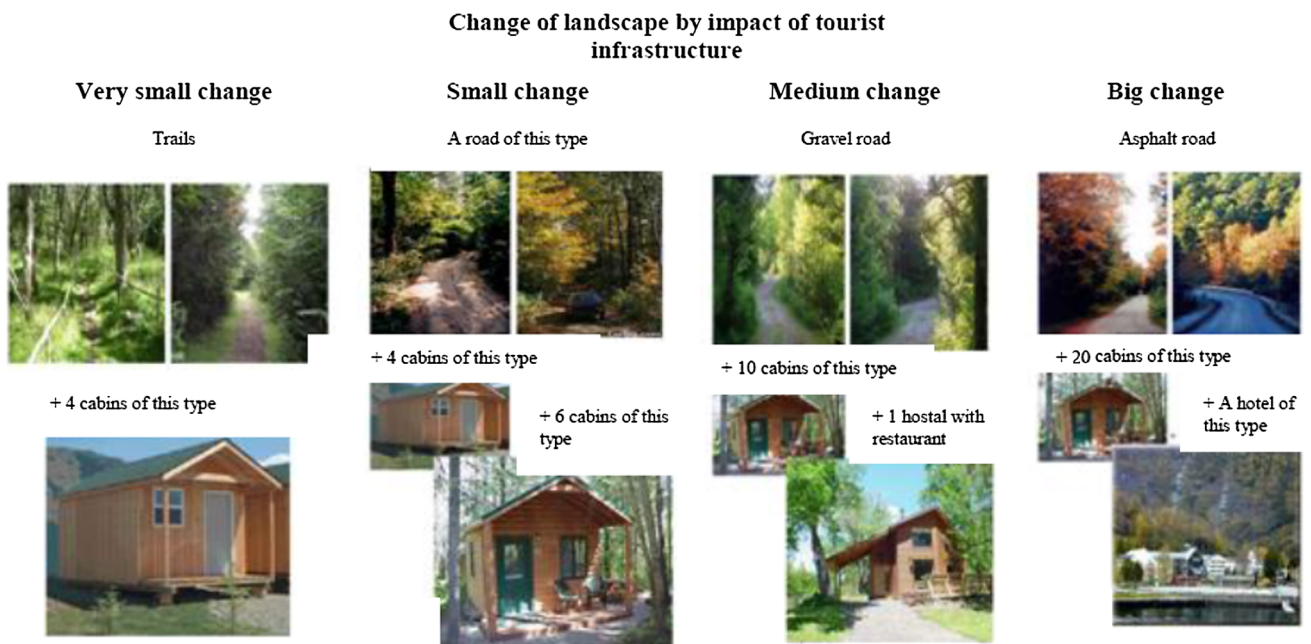


Fig. 2 Graphical representation of the levels of the “landscape change attribute,” as presented in the CE survey

island’s bryophytes for their global importance. Thus, valuing the existence of such species or other similar species is not unfamiliar to participants.

To test for the presence of existence values, a moss species endemic to the sub-Antarctic forests of southern Patagonia was chosen for the CE. For species such as

Tayloria mirabilis, the forests of Navarino constitute a substantial portion of their habitat. Large-scale development projects or forestry operations can affect this fraction of the entire habitat and may result in increased risks of extinction. However, small protected areas on Navarino were hypothesized to reduce extinction risks. The moss relied on its habitat on Navarino Island for its continued survival. The existence value attribute had three levels: (1) increased probability of extinction because of habitat destruction, (2) low probability of extinction (current situation) and (3) very low probability of extinction because of specific habitat protection measures. This quantification is certainly too unspecific to be used with models of habitat quality or even spatial population dynamics with which actual extinction risks could be approximated. However, for the methodological purposes of an attribute within this study, the employed quantification appears sufficient.

Diversity of species This issue did not arise spontaneously in the qualitative interviews. However, the topic was considered a suitable way to introduce a systemic and long-term perspective into the valuation of sustainable development options, as the corresponding economic insurance benefits refer to benefits from the ecological insurance hypothesis on species diversity’s effect on the stabilization of ecosystem processes (cf. Yachi and Loreau 1999). It was presented to respondents as *the number of types of animals and plants that indicate “health, resistance and vigour of nature”*. Attribute levels were designed based on the assumption that more extreme development scenarios may result in a long-term loss ranging from one-quarter to one-half of the species on the island, thus generating a substantial loss of species diversity.

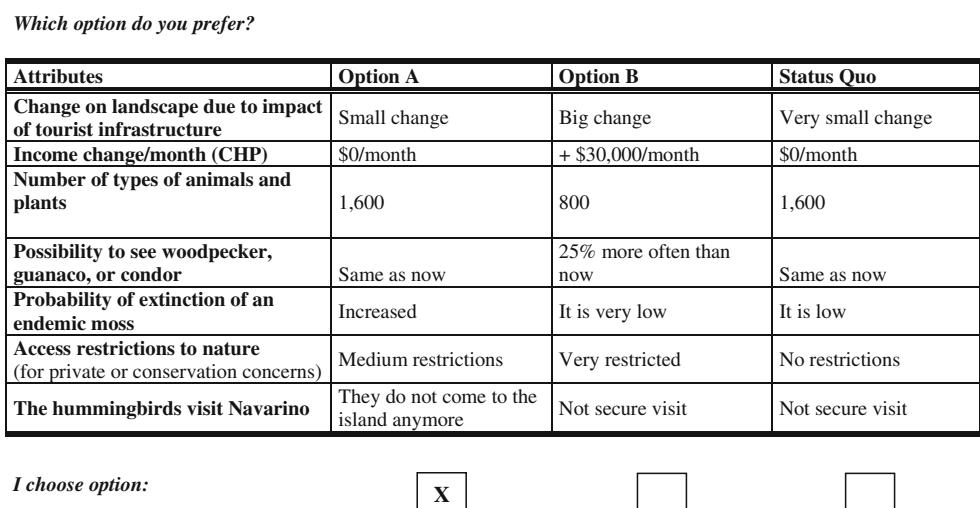
Monthly income change Willingness to accept (WTA) appeared to be more appropriated than WTP. In the pre-

study interviews, the subjective title prompted some respondents to protest the proposition that they should pay for maintaining the environmental status quo, including open access for leisure activities. Thus, we used a change in income, which was mainly operationalized via increases in monthly income, because many realistic choice options imply a deterioration of the ecological status quo. An assessment of how realistic it would be for residents to use changes in income as a payment vehicle showed the feasibility of this format. Furthermore, the WTA issue has advantages: a “warm glow of giving” effect (Kahneman and Knetsch 1992) is expected to be diminished because the CE did not imply a voluntary contribution to the protection of species.

We used a mixed WTA/WTP format of the monetary attribute including three levels with increases in income, e.g., the willingness to accept compensation versus one level that included a decrease in income, because some combinations resulted in biodiversity improvements. However, the specific planning guidelines, the ecological situation of the area and the feelings of residents with respect to their rights on the territory call for interpreting the results in terms of willingness to accept compensation.

We generated a reduced orthogonal main effects design (Louviere et al. 2000). In total, 32 different options were obtained. Using a *mix and match* procedure (Chrzan and Orme 2000), these options were combined into choice sets, with options A and B and one status quo option. The options were assigned to four blocks of eight choice sets each. One of the blocks was randomly assigned to each respondent. Beyond strict adherence to the technical design procedures described above, the experimental design was primarily guided by concerns for overall plausibility for respondents and less by issues of optimized statistical power or balance (Fig. 3).

Fig. 3 Example of one of the eight choice sets presented to the respondents in the choice experiment (translation from Spanish)



Questionnaire structure

An introductory section within the interview explained the objective of the study to the respondents: to obtain the opinions of local residents with respect to potential changes to the landscape and nature of Navarino Island. It is suggested that the frame be linked to some real-world process (Kanninen 2010). Several spatial and conservation planning processes had been initiated on Navarino Island at the time of the study. Thus, we based the frame of the attributes of the CE on this planning process to enhance the credibility of hypothetical scenarios within the CE. The attributes were then framed as the outcome of a governmental development program on the implementation of the Biosphere Reserve and sustainable development on the island. Multilevel development programs that address many different aspects are not unfamiliar to locals. An example is the local development plan (Plan de Desarrollo Comunal; PLADECO), which covers issues related to development and conservation of the area. It is also important to emphasize that this is an island whose nature is relied upon by its people for both recreation and subsistence, so the objects of valuation of this study did not prove to be at all unfamiliar to respondents. To accentuate neutrality, respondents were repeatedly reminded that this research did not originate from any pro-conservation NGO and that there were no pre-defined interests regarding the future of Navarino. A “pro-conservation” subtext in the survey instrument was carefully avoided. In fact, we included attribute levels clearly referring to economic development (hotels in the case of the change in landscape). Additionally, the attribute on access restrictions was split sampled with access restrictions either for conservation purposes or for economic development interests. It was clearly explained 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 reduce cognitive demand, visual materials such as photographs and maps of the island (Figs. 1, 2) and photographs of several species involved in the study were used. Qualitative questions were included for each attribute. Eight choice sets were presented to respondents in the third phase of the interview. The two final sections contained socio-demographic questions. We include extractions from the CE questionnaire online (Electronic Supplement).

Administration of the survey

The main survey was administered in 2005 through face-to-face interviews conducted by the first author and two well-trained Chilean university students. Although teachers and navy personnel could be sampled systematically, we

had to apply snowball sampling for all of the other resident groups to balance the coverage of the main permanent resident groups according to national census data (INE 2002). We could only access major sections of the population (e.g., construction workers, fishermen) via personal recommendations that could not have been achieved otherwise, despite several weeks devoted to the survey campaigns. Finally, 235 local residents were interviewed from a total of 1,328 permanent residents.

Econometric analysis

Statistical models derived from random utility theory (McFadden 1973) predict choice behavior as a function of the attributes that characterize potential choice options. Through an analysis of the choice patterns among the options, the relative influence of attributes on the choices can be inferred, and marginal economic values for an increase or decrease in statistically significant attributes can be calculated (Bateman et al. 2002). The utility function can be separated into an observable component, V_{in} , and an unobservable (error) component, ε_{in} :

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

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

$$\Pr_{in} = \Pr(V_{in} + \varepsilon_{in} > V_{jn} + \varepsilon_{jn}, \quad \text{all } j \in C)$$

If a deterministic utility component V_1 is hypothesized to be a linear function of attribute Z_1 itself plus an interaction term of the attribute Z_1 with an individually varying socio-demographic 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 (Barkmann et al. 2008).

Choice models were generated using the software package LIMDEP/NLogit 9.0. Analyses revealed a risk of violation of the independence from irrelevant alternatives (IIA) necessary assumption for the application of the (simpler) conditional logit model (Hensher et al. 2005). Thus, we used nested logit (NL) models that partially relax the IIA assumption (Hensher et al. 2005: 518) to account for systematically differing error variances among the choice cards that can lead to IIA violations (see Hensher et al. 2005: 418). The inclusive value (IV) of the degenerated branch was set to 1.0 (Hensher et al. 2005: 570). Scale parameters were normalized at the lowest level (RU1; Hensher et al. 2005: 538). We selected the best fitting tree structure with an IV value between 0 and 1 (Hensher et al. 2005: 494).

An alternative-specific constant (ASC) was coded as 1 for the non-status quo options A and B and as 0 for the status quo option. Seven socioeconomic variables (i.e., age, sex, income, number of children, years of education, time on the island and planned duration of stay) were introduced into NL models as interaction terms with the ASC to test for influences on choice. Only education was significant, and it was included in the reported NL models. A weighting factor for each respondent was included in the quantitative CE analysis to account for remaining sampling bias with respect to the occupational data of the last Chilean census for Navarino Island.

Estimation of marginal WTA

Marginal WTA values were calculated for one marginal unit of disfavored change in the respective attributes. For nonlinear attributes, marginal WTA values 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.

Additionally, beyond the marginal WTA estimations for single attributes, we present simplified scenario calculations to indicate the magnitude of potential policy implications. Preferences for scenarios can be obtained by multiplying the coefficients of each attribute by the respective attribute levels given in Table 1. Thus, a conservation scenario, a development scenario and an intermediate scenario between conservation and development were generated from the attribute levels presented in Table 1.

Changes were obtained and presented in terms of deviation from baseline or current levels (status quo) to the respective scenarios.

These scenarios are specified in Table 5. We perform the scenarios considering significant attributes only ($P < 0.05$).

Results

Descriptive results

Of the 235 local residents who were interviewed, two individuals did not complete the choice task because they perceived the interview as too pro-environmental, and three respondents were classified as not responding to the CE task because of insufficient cognitive capability to complete the task. The analyses are therefore based on the remaining 230 respondents. Twenty-six respondents (11 %) always chose the status quo. No respondent manifested doubts to the effect that the scenarios would not be considered realistic enough to qualify for potential

Table 2 Socio-demographics of the respondents ($n = 230$)

Variable	Sample average	Navarino average
Age (>15 years old) (years)	36.3	35.4
Sex (% male) (>15 years old, %)	43	67
Children (% persons with children)	80.4 %	NA
Education (years of school education)	12.8	11.0
Income (CHP/month)	\$423,600	NA
Time on the island (years)	11.4	NA
Expected time on the island in the future (years)	13.0	NA

NA not available

implementation. An overview of the socio-demographic sample characteristics is given in Table 2.

Econometric results

Table 3 shows the results from a NL model with interactions between the socio-demographic variables and the ASC. The *inclusive values* (IV) are not significantly different from 1 and indicate that the independence of irrelevant alternatives condition (IIA) holds for this model (Hensher et al. 2005). The model is highly significant ($P < 0.0001$). All attributes emerge as significant determinants of choice, with the exception of the *possibility of*

Table 3 Nested logit model

Variable	Attributes
Landscape change	
Small change	0.1626**
Middle change	0.1407***
Big change	-0.2608*
Access restrictions (private)	0.1485***
Access restrictions (conservation)	0.1096**
Possibility to see animals	0.0213 ^(ns)
Visits of hummingbirds	0.5773***
Moss existence	0.2301***
Diversity of species	0.0006***
Income change ^a	0.0067***
ASC*education [mean] ^b	-0.3648***
Log likelihood	-1641.26
$P(\chi^2)$	<0.0001
Inclusive value (IV)	0.9842
Adj. ρ^2 (Pseudo R^2)	0.2197

*** Significant at $P \leq 0.001$, ** significant at $P \leq 0.01$, * significant at $P \leq 0.05$

^{ns} not significant

^a Cost coefficients for CHP1,000/year/household

^b Raw coefficients multiplied by the sample means

seeing animals (Table 3). *Income change* is a highly significant predictor of choice ($P < 0.001$). The results indicate that “Education” has statistically significant effects on choosing either option A or option B. The $ASC \cdot education$ coefficient shows that higher levels of education result in a decreased attractiveness of the offered changes versus the status quo.

The model displays the expected signs for the attribute terms: positive utility for more secure hummingbird presence, lower probabilities of extinction of an endemic moss and higher levels of ecosystem health. For *landscape change*, we find positive utility for small and middle change. The current situation (very small change) is viewed as clearly worse than more change because of more tourism infrastructure (small change and medium change). In contrast, large changes, which were visually represented by a huge international-type seaside or lakeside hotel, asphalt paved roads and parking lots, are viewed the most negatively. Positive utility is found for *additional levels of restrictions for both private and conservation interests*.

Willingness to accept calculation

We used a mixed WTA/WTP format of the monetary attribute with three WTA attribute levels and one WTP attribute level. This design feature can provide separate WTP and WTA values for the investigated environmental attributes. More detailed and informative preference data for local stakeholders and local administrations can be generated in this way. Thus, the size of the WTA/WTP disparities can easily be calculated for the single attribute (for details on WTP/WTA disparities, see, e.g., Sugden 2005), calculating two interaction terms as the product of income change and two dummy variables that indicated either the WTA or the WTP format.² As in several other studies, we found evidence of WTP/WTA disparities that argue for reporting both values to stakeholders and administrators. A WTA/WTP of 2.8 is found in our sample, which indicates that the WTA values are nearly three times as high as the WTP values (for more details, see Cerda et al. 2007; Barkmann et al. 2008). This value is close to the median WTA/WTP ratio of 3.2 found in a meta-analysis of stated preference studies (Sayman and Öncüler 2005). This finding indicates that the average valuation is markedly lower if respondents are required to pay to avert reductions in environmental quality, as opposed to their minimum compensation requirement for accepting the same change. We note, however, that the concrete planning issues on Navarino Island argue for the utilization of our results in their WTA form.

² The results of this analysis are available from the authors upon request.

Table 4 Estimates of economic values (in Chilean Pesos) ($n = 230$)

Attribute	“Marginal” ^a unit used for calculation coding	WTA/WTP (CHP/month)
Change of landscape by impact of tourist infrastructure	Very small change to small change	24,268
	Very small change to middle change	21,000
	Very small change to big change	−38,925
Access restrictions to nature for private concerns	Next restriction level	20,005
Access restrictions to nature for conservation concerns	Next restriction level	15,723
Possibility of seeing woodpeckers, guanacos and condors	–	–
Hummingbirds visit the island	Next level of securing humming bird presence	83,637
Probability of extinction of an endemic moss	Low probability of extinction (+1) to increased probability of extinction (−1)	61,348
Diversity of species	Loss of 1 of 1,600 species on the island	99
ASC·education	Deviation from status quo as offered by choices	−45,503

^a The marginal step represents a change from a status quo level to an adjacent attribute level

Table 4 displays the “marginal” WTA for an average respondent. The impact of tourist infrastructure on Navarino’s landscape is a nonlinear attribute. The change from the status quo level of *very small change* to a *big change* level with paved roads, parking lots and large hotels decreases utility, and a minimum WTA of around CHP38,900/month (\$77) is required. Shifts to a small change with more cabins and better trails would increase utility and thus would not require compensation but could command a WTP of up to ~CHP21,000/month (\$50).

Progressive access restrictions to the island for both conservation and private initiatives increase utility. Thus, additional levels of restrictions would not require compensation but do represent a WTP of between CHP15,000/month (\$25) and CHP20,000/month (\$40), with a lower marginal WTP value for restrictions due to conservation concerns. The survey respondents likely considered employment and economic development opportunities for the island which were associated with access restrictions due to private interests. At ~CHP83,000/month (\$130), marginal WTA is much higher for a one-level reduction with regard to continued visits of the ethno-culturally

Table 5 Exemplary scenario calculation

Attribute	Coefficient	Status quo (level)	Conservation scenario (level)	Intermediate scenario (level)	Development scenario (level)	Change (Status quo to conservation scenario)	Change (Status quo to intermediate scenario)	Change (Status quo to development scenario)	Change conservation scenario* coefficient	Change intermediate scenario* coefficient	Change development scenario* coefficient
Landscape change											
Small change	0.1626	0	1	0	0	1	0	0	0.1626	-	-
Medium change	0.1407	0	0	1	0	0	1	0	-	0.1407	-
Big change	-0.2608	0	0	0	1	0	0	1	-	-	-0.2608
Access restriction (private)	0.1485	1	1	2	3	0	1	2	0	0.1485	0.297
Access restriction (conservation)	0.1096	1	3	2	1	2	1	0	0.2192	0.1096	0
Visits of the hummingbirds	0.5773	0	1	0	-1	1	0	-1	0.5773	0	-0.5773
Moss existence	0.2301	1	1	1	-1	0	0	-2	0	0	-0.4602
Diversity of species	0.0006	1,600	1,600	1,550	800	0	-50	-800	0	-0.03	-0.48
Income change	0.0067	0	30	20	-30	30	20	-30	0.201	0.134	-0.201

important Magellanean hummingbird to Navarino. Increasing the probability of the extinction of an inconspicuous endemic moss from *low* (+1) to *increased* (-1) is valued at approximately CHP61,000/month (\$101). For this attribute, nonlinearity manifests itself in the identical coding of *very low* probability (+1) and *low* probability (+1). Consequently, the value of improved protection versus the status quo is zero. Finally, the loss of 1 of an estimated 1,600 species of the island’s biota results in a reduction in species diversity of the local ecosystems, which is valued at ~CHP99 WTA/species/month (\$0.2).

Table 5 shows the results of the simplified scenarios calculation. To highlight the trade-offs among the scenarios, we assume that the outcomes from each scenario occur instantaneously and ignore the impact of the development path. The results suggest that the community of Navarino prefers conservation to development, with strong conservation ranking the highest. In a conservation scenario, the secure visit of the hummingbirds is the most valued change, indicating that the community’s acceptance of a negative change for this attribute is extremely low. In an intermediate scenario, access restrictions to nature for both private and conservation interests is the most valued change, indicating that additional restrictions are sufficient to compensate for losses in hummingbird visits, a less secure existence of the moss and less species diversity. In a development scenario, the implementation of access restrictions to nature for private concerns is the most important change valued by people.

Discussion

Implications of the results

The significance of the monetary attribute indicates that respondents evaluated change in income as an important factor. This finding suggests that local Navarino residents act as income change-sensitive consumers within the context of the management of the island’s forests. Because our valuation study was designed based on the information needs of a real-world planning situation, we consider the low number of protest responses to be an indication of the plausibility of the choice experiment’s payment design features. Although the specific planning guidelines, the ecological situation of the area and the feelings of residents with respect to their rights on the territory call for interpreting the results in terms of willingness to accept compensation, the results must be used with caution as we found disparities between WTA and WTP. For all attributes, the WTA values are nearly three times as high when calculated using the unified estimation of the payment vehicle coefficient, as in this paper.

The attribute related to hummingbirds on the island was very strongly valued by respondents when the value was explained in the CE interview. With this attribute, we aimed to assess the ethno-symbolic value of the natural systems of Navarino. The Yaghan culture is the world's southernmost indigenous culture and is close to becoming extinct. The Navarino population includes the last surviving representatives of the Yaghans, constituting a community of 60 persons. Therefore, the civil community and the Yaghan community physically share the same island. Thus, general aspects of the Yaghan culture are well known within the civil community of Navarino, and the Navarino population takes an active interest in the survival of Yaghan culture. Therefore, we argue that the major reason for the high value placed on hummingbirds is the real importance that the civil community of Navarino attributes to the existence of the Yaghan community. It is possible that this high value incorporates not only the ethno importance of the hummingbird but also other values related to the existence of the Yaghan culture. Thus, this value figure may have overestimated preferences because some additional value components may have played a role.

In addition, because we assessed WTA values, it is difficult to compare our ethno-symbolic value estimate to studies that have valued species using a WTP frame. Applying the calculated WTA/WTP difference, a WTP/month/resident of approximately CHP30,000 is obtained, which amounts to 5–8 % of typical monthly incomes. Other studies report values in the range of <0.1–1 % of respondent income (Kotchen and Reilig 2000; Turpie 2003; Amirnejad et al. 2006). The within-subject design has most likely narrowed the WTA/WTP ratio (Sugden 2005), potentially by deflecting some respondent attention from his/her personal budget constraint. The budget constraint is irrelevant for the WTA choices but must be respected strictly when WTP choices are made. Thus, we suggest that the results of our model should be interpreted as a conservative willingness to accept compensation values because some WTP format choice cards were used.

Similar arguments can be used for interpreting the obtained value for the existence of the endemic moss. Regarding this attribute, the participants effectively traded increased risks of extinction for economic benefits, confronting transactions among conservation, socioeconomic development and income changes. In addition, the environmental education and sustainable tourism programs of Navarino that are focused on highlighting the global importance of the region's bryophytes allowed for the respondents' relative familiarity with this attribute. Even if the participants knew nothing about the existence of this species and would thus not consider the knowledge that the species lives on Navarino to be useful, the economic valuation interview represents a starting point in the

construction of preferences (Kopp 1992). If people possess the conviction that humans must preserve the natural world, it is quite likely that they will suffer a loss of welfare from learning that an endemic species of the place in which they live may go extinct due to human actions. People do not need to know the species by name or be able to identify it fully to suffer welfare losses due to problems with its conservation (Kopp 1992). The quantitative estimate of existence values is, however, a complex procedure and requires a specific adaptation of assessment strategies. Some methodological developments that can be observed 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.

Concerning the tourism attribute, our results clearly show that from a non-market value perspective, a small-scale tourism scenario is favored by the respondents over more aggressive large-scale tourism projects involving enormous resort hotels and heavy additional road construction. A more detailed analysis of the single attributes was included in the study for the *change in landscape by impact of tourist infrastructure* attribute. The results clearly indicate that people are willing to accept landscape changes in favor of additional tourist infrastructure, but only to a certain extent. Our dummy-coded analysis indicated that the utility associated with large-scale tourist infrastructure is negative. The most preferred levels of landscape change are "small" and "medium." The results indicate, therefore, that respondents perceived not only the potential damage to the landscape but also the economic benefits that additional infrastructure could bring to the island. This input is important for the planning processes that aim to develop a sustainable tourism industry on the island.

The NL models' results indicate that restrictions for both private (such as tourism development) and conservationist concerns are positively valued by the respondents. It is most likely that some respondents associated the restrictions with private initiatives (e.g., tourism) and business development, which could mean more employment or investment options on the island. This scenario is, in fact, quite likely because large land concessions along the west coast of Navarino have been granted for tourism. Many respondents perceived tourism as the major economic development opportunity on Navarino. However, conservation also appears to be accepted by the local residents, even if it results in access restrictions to some parts of the island.

Tests were performed to determine whether the benefits of species diversity can be materialized empirically as

WTA. The responses to the qualitative questions included in the CE questionnaire reflect that respondents understood the explanations for this attribute; the attribute's high degree of significance indicates preferences for protecting species diversity. Although the economic value obtained seems to be low, the results constitute empirical evidence for economic preferences for species richness against unknown threats to the human–nature relationship.

An unexpected result is that local residents do not show preferences for the attribute “possibility of seeing animals.” At the time of the study, several projects were being conducted on Navarino to assess local knowledge regarding the woodpecker. It has been proposed as an emblematic species for the conservation of the ecosystems of Navarino. Prior to this study, the inhabitants of the island had responded to several surveys whose purpose was to identify the knowledge of this species among locals. The effects of this information on the woodpecker could have affected the valuation of condors and guanacos as we included the three species in the same attribute. At the moment of the interview, many participants indicated that they would like more research efforts into other species.

Decision making

Although the focus of this paper is largely applied, some policy implications should be briefly outlined. CEs of the type conducted here provide local and regional planners with estimates of the economic importance of several non-market attributes of the potential paths toward development of the island. In our case, these figures do not relate to detailed existing plans or projects. Instead, we have presented our results in an early stage of the discussions on the biosphere reserve management plan to members of the local stakeholding and decision-making communities. Thus, we aimed to influence decisions about what type of projects appear promising with regard to the economic preferences of the local population on natural systems, rather than to appraise specific projects. The results of our study show that conservation scientists and planners may be ill-advised to eschew the results of stated preference studies, which often document substantial popular support for natural resources protection. The method applied here can be used in conjunction with other forms of stakeholder engagement such as narrative and multicriteria analysis. CE can represent an empowering tool to inform participative decision making if it is designed and applied to the Convention on Biological Diversity Ecosystem Approach principles. Although the decision to use a CE conducted with individual respondents precludes the application of more strongly participative valuation techniques, such as group valuation (Wilson and Howarth 2002), when following the CBD Ecosystem Approach, the application

includes the following participative aspects: (a) choice experiment attributes directly based on the input from the extensive qualitative phase of the images of nature analysis were identified, (b) the identification was important for the development of the CE instrument and useful for the interpretation of the results and (c) the CE itself is a tool that gives the local respondents an “economic voice” with regard to different sustainable development scenarios on the island, our study contributes to the improvement of the opportunities and capacity of the local population to participate actively in the design of a socially, economically and ecologically sustainable future for the island.

Conclusion

From a policy perspective, this study shows the significance of the non-market values provided by ecosystems to the population of Navarino Island in Chile. Based on our results, CE provided useful information about individual preferences that complement biological research. The results have increased our understanding of the economic values of temperate ecosystems in Chile by empirically demonstrating the following: (1) The application of CEs to value temperate ecosystems in one of the most pristine regions of the world revealed that the inhabitants were able to exchange priorities between conservation and tourism development. (2) Local residents favor a model of small-scale tourism development, and the economic voice of Navarino's local residents does not favor the development of large-scale tourism projects. Materially, the utility attached to the landscape change attribute, the particularly high compensation requirement for access restrictions due to private developments, and the high levels of appreciation for most of the species, including the existence of an endemic moss, suggest that respondents favor a careful approach to local economic development. (3) Economic preferences exist even for the protection of less popular species.

Future research should address the dynamic of non-market values in developing countries because they may change over time with changing government policy and economic conditions.

Acknowledgments Financial support was provided by BMBF (German Federal Ministry of Education and Research), FKZ 01LM0208.

References

- Amirnejad H, Khalilian S, Mohamad H, Majad A (2006) Estimating the existence value of north forests of Iran by using a contingent valuation method. *Ecol Econ* 58:665–675

- Balderas Torres A, Skutsch M, Lovett JC, MacMillan DC (2012) The valuation of forest carbon services by Mexican citizens: the case of Guadalajara city and La Primavera biosphere reserve. *Reg Environ Change*: 1–20. doi:10.1007/s10113-012-0336-z
- Barkmann J, Cerda C, Marggraf R (2005) Interdisziplinäre analyse von Naturbildern: Notwendige Voraussetzung für die ökonomische Bewertung der natürlichen Umwelt. *Umweltpsychologie* 9:10–28
- Barkmann J, De Vries K, Dietrich N, Glenk K, Keil A, Leemhuis C, Marggraf R (2008) Confronting unfamiliarity with ecosystem functions: the case for an ecosystem service approach to environmental valuation with stated preference methods. *Ecol Econ* 65:48–62
- Bateman I, Carson R, Day B, Hanemann WM, Hanley N, Hett T, Jones Lee M, Loomes G, Mourato S, Özdemiroglu E, Pearce D, Sugden R, Swanson R (2002) Economic valuation with stated preference techniques: a manual. Edward Elgar Ltd, Cheltenham
- Berghoefer U, Cerda C, Fistic S, Jax K, Rozzi R (2006) An ecosystem profile of Navarino and the Cape Horn region. BIODONCHIL a Chilean-German research project. Unpublished report
- Berghoefer U, Rozzi R, Jax K (2010) Many eyes on nature: diverse perspectives in the Cape Horn biosphere reserve and their relevance for conservation. *Ecol Soc* 15(1):18
- Berniger K, Adamowicz V, Kneeshaw D, Messier C (2010) Sustainable forest management preferences of interest groups in three regions with different levels of industrial forestry: an exploratory attribute-based choice experiment. *Environ Manage* 46:117–133
- Biénabe E, Hearne RH (2006) Public preferences for biodiversity conservation and scenic beauty within a framework of environmental services payments. *For Policy Econ* 9(4):335–348
- Butchart SHM, Walpole M, Collen B, Van Strien A, Scharlemann JPW, Almond REA et al (2010) Global biodiversity: indicators of recent declines. *Science* 328:1164–1168
- Cerda C, Diafas J, Barkmann J, Mburu J, Marggraf R (2007) WTP/WTA design strategies for choice experiments in early planning stages: experiences from Chile and Kenya. In: Meyerhoff J, Lienhoff N, Elsassner P (eds) Stated preference methods for environmental valuation: applications from Austria and Germany. Metropolis, Marburg, pp 139–173
- 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. *Environ Dev Econ* 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. *J Nat Conserv* 21:143–153
- Chan KMA, Shaw MR, Cameron DR, Underwood EC, Daily GC (2006) Conservation planning for ecosystem services. *PLoS Biol* 4(11):e379. doi:10.1371/journal.pbio.0040379
- Chrzan K, Orme B (2000) An overview and comparison of design strategies for choice-based conjoint analysis. Sawtooth Software Research paper series, Sequim, WA
- Daniel TC, Muhar A, Arnberger A, Olivier A, Boyd JW, Chan KMA, Costanza R, Elmqvist T, Flint CG, Gobster PH, Grêt-Regamey A, Lave R, Muhar S, Penker M, Ribe RG, Schuppenlehner T, Sikor T, Soloviy I, Spierenburg M, Taczanowska K, Tam J, Von der Dunk A (2012) Contributions of cultural services to the ecosystem services agenda. *PNAS* 109(23):8812–8819
- García-Llorente M, Martín-López B, Nunes PALD, Castro AJ, Montes C (2012) A choice experiment study for land-use scenarios in semi-arid watershed environments. *J Arid Environ* 87:219–230
- Hanley N, Shaw WD, Wright RE (eds) (2003) The new economics of outdoor recreation, 1st edn. Edward Elgar, Cheltenham
- Hensher D, Rose J, Greene W (2005) Applied choice methods: a primer. Cambridge University Press, Cambridge
- Hoyos D (2010) The state of the art of environmental valuation with discrete choice experiments. *Ecol Econ* 69:1595–1603
- INE (Instituto Nacional de Estadísticas) (2002) Censo Nacional de Población (online). www.ine.cl. Last access June, 2009
- Jacobsen JB, Thorsen BJ (2010) Preferences for site and environmental functions when selecting forthcoming national parks. *Ecol Econ* 69:1532–1544
- Jacobsen JB, Boiesen JH, Thorsen BJ, Strange N (2008) What's in a name? The use of quantitative measures versus iconised species when valuing biodiversity. *Environ Resour Econ* 39:247–263
- Kahneman D, Knetsch J (1992) Valuing public goods: the purchase of moral satisfaction. *J Environ Econ Manag* 22:57–70
- Kanninen B (2010) Valuing environmental amenities using stated choice studies. Springer, Dordrecht
- Kontogianni A, Luck GW, Skourtos M (2010) Valuing ecosystem services on the basis of service-providing units: a potential approach to address the endpoint problem' and improve stated preference methods. *Ecol Econ* 69(7):1479–1487
- Kopp R (1992) Why existence value should be included in cost benefit analysis. *J Policy Anal Manage* 11(1):123–130
- Kotchen M, Reilig S (2000) Environmental attitudes, motivations, and contingent valuation of non-use values: a case study involving endangered species. *Ecol Econ* 32:93–107
- Louviere J (2006) What you do not know might hurt you: some unresolved issues in the design and analysis of discrete choice experiments. *Environ Resour Econ* 34:173–188
- Louviere J, Hensher DA, Swait JD (2000) Stated choice methods: analysis and application. Cambridge University Press, Cambridge
- Martín-López B, Montes C, Benayas J (2007) Economic valuation of biodiversity conservation: the meaning of numbers. *Conserv Biol* 22(3):624–635
- Martín-López B, Iñiesta-Arandia I, García-Llorente M, Palomo I, Casado-Arzuaga I, García Del Amo D et al (2012) Uncovering ecosystem service bundles through social preferences. *PLoS One* 7(6):e38970. doi:10.1371/journal.pone.0038970
- McFadden D (1973) Conditional logit analysis of qualitative choice behaviour. In: Zarembka P (ed) *Frontiers in econometric*. Academic Press, New York, pp 105–142
- McVittie A, Moran D (2010) Valuing the non-use benefits of marine conservation zones: an application to the UK Marine Bill. *Ecol Econ* 70:413–424
- Rands M, Adams W, Bennun L, Butchart S, Clements A, Coomes D et al (2010) Biodiversity conservation: challenges beyond 2010. *Science* 329:1298–1303
- Rolfé JC, Bennett JW (2000) Testing for framing effects in environmental choice modeling. Choice Modelling Research Report No. 13, University College, The University of New South Wales, Canberra
- Rolfé J, Windle J (2003) Valuing the protection of aboriginal cultural heritage sites. *Econ Rec* 79(245):585–595
- Rozzi R, Massardo F, Anderson C (2004) The Cape Horn biosphere reserve: a proposal for conservation and tourism to achieve sustainable development at the southern end of the Americas. Ediciones de la Universidad de Magallanes, Punta Arenas
- Sayman S, Öncüler A (2005) Effects of study design characteristics on the WTP-WTA disparity: a meta analytical framework. *J Econ Psychol* 26:289–312
- Sugden R (2005) Anomalies and stated preference techniques: a framework for a discussion of coping strategies. *Environ Resour Econ* 32:1–12
- TEEB (2010) The economic of ecosystems and biodiversity: ecological and economics foundations. Earthscan, London

- Turner RK, Morse-Jones S, Fisher B (2010) Ecosystem valuation: a sequential decision support system and quality assessment issues. *Ann N Y Acad Sci* 1185:79–101
- Turpie J (2003) The existence value of biodiversity in South Africa: how interest, experience, knowledge income and perceived level of threat influence local willingness to pay. *Ecol Econ* 46:199–216
- Wattage P, Glenn H, Mardle T, Van Rensburg T, Grehan A, Foley N (2011) Economic value of conserving deep-sea corals in Irish waters: a choice experiment study on marine protected areas. *Fish Res* 107:59–67
- Wilson M, Howarth R (2002) Discourse-based valuation of ecosystem services: establishing fair outcomes through group deliberation. *Ecol Econ* 41:431–443
- Yachi S, Loreau M (1999) Biodiversity and ecosystem productivity in a fluctuating environment: the insurance hypothesis. *Proc Natl Acad Sci USA* 96:1463–1468