Perception, demand and user contribution to ecosystem services in the Bilbao Metropolitan Greenbelt

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ABSTRACT

Peri-urban ecosystems are often managed as recreation areas or to enhance aesthetic value on the urban fringe. Scholars and land-use practitioners lack a current understanding of the supply of and the demands for these peri-urban ecosystem services (ES). In this study, we analysed the perceptions of 500 users and interest groups regarding the ES provided by the Bilbao Metropolitan Greenbelt (BMG) ecosystems in northern Spain, and we compared these perceptions to the demands for ES. The objective of this study is to understand user preferences and to thereby better orient land use planning. The results show that the demand for ES in the BMG did not correspond to what users perceived these ecosystems to provide. The respondents' perceptions appeared to be related to the management practices in the area, whereas their demand was related to the benefits they would like to obtain from the BMG. The interviewees were in favour of improvements to peri-urban rural areas, and the results suggested that the authorities should highlight the role of the BMG ecosystems with respect to regulating services and historic and cultural values to improve people's awareness of the ecosystems' capacity to provide benefits to society. Application of this framework also highlighted that there were differences in the perception of and demand for ES among different user groups. This holistic method of matching user demand with policy could be a useful tool to reorient ES-based land planning.

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1. Introduction

Although the concept of ecosystem services (ES) is increasingly being used and studied by scientists and policy makers, beneficiaries' demand for ES and their understanding of this concept, as well as their relative ranking of these services, have received limited attention (Lamarque et al., 2011). The small number of studies analysing the awareness of local people regarding the importance of the ES provided by different areas potentially impedes effective ES-based conservation efforts (Sodhi et al., 2010); however, if we aim to establish successful environmental policies for sustainability, the users must be involved, and their opinions and preferences, as well as their attitudes towards conservation, must be understood (Martín-López et al., 2007). There is a need for additional research on the demand for ES (Termorshuizen and Opdam, 2009), which could help policy-makers respond to stakeholders' priorities (Lamarque et al., 2011).

Perceptions and preferences regarding ES can be site-specific, based on local geographic and cultural characteristics, moral convictions, life experiences, and the use and non-use of particular areas (Costanza, 2000; Daily, 1997). Therefore, case studies are important for capturing local differences (Lamarque et al., 2011). The historical and place-specific set of social-ecological interactions of human beings with one another and with their environment, as well as the practices that yield diverse, autonomous and resilient social-ecological systems, may be considered our social-ecological heritage (Otero et al., 2013). To develop sound environmental management strategies, it is important to review the associated social-ecological history to understand the complex linkages among historical drivers of change, trends in ES and human well-being (MEA, 2005). Additionally, there is a scientific necessity to recognise the complex links between ecological and social systems (Vilardy et al., 2011) and to build conservation strategies based on deep bottom-up knowledge of how local social-ecological dynamics work (Otero et al., 2013). Changes in an ecosystem's state could promote changes in the flow of the ES and thereby affect human well-being at different spatial scales (MEA, 2005). It is misleading to make decisions based solely on the immediate societal benefits without weighing the consequences for ecosystem

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functioning and, ultimately, the impacts of changes in ecosystem functions on society (DeFries et al., 2004). Moreover, changes in land use can affect perceptions of a landscape's capacity to provide ES (Vihervaara et al., 2012).

Peri-urban open space represents a dynamic planning environment and is one of the dominant planning topics in the developed world (Koomen et al., 2008). The landscape is important to quality of life (Tobias and Müller Wahl, 2013) and must have a positive definition, based on its uses and people's perceptions, to be successful in protecting open spaces in growing city regions (Kühn, 2003). One way to contribute to the positive image of a place is to integrate it as a location-specific feature in place branding through landscape conservation measures, instead of in a strictly protection-oriented manner (Tobias and Müller Wahl, 2013). An ES framework could increase awareness of the importance of peri-urban ecosystems for inhabitants' well-being and to help them understand how the social-ecological system works. Moreover, the social preferences and demands for the services provided by ecosystems within this framework could direct land-use planning.

The peri-urban natural areas of metropolitan Bilbao have been important to its industrial development because of their wealth of iron and their capacity to supply different provisioning, regulating and cultural services. These ecosystems have been dramatically modified over the last two centuries by urban, industrial and port development; however, users recognise their potential to provide ES (Casado-Arzuaga et al., 2011). Ecosystem functions can have

economic, social and ecological value (De Groot et al., 2002), so it is not always necessary to express the value of ES in monetary terms. If our goal is to determine the social value of this area, it is essential to understand the perceptions and preferences regarding the ES provided by these peri-urban ecosystems. In this study, we examine whether there is a correspondence between users' perceptions of the ES provided by the Bilbao Metropolitan Greenbelt (BMG) ecosystems and their perceived demand for ES. The article employs a novel holistic approach to assessing policy with a pilot case study. The results obtained in these analyses may be useful in considering social participation in land-use planning.

2. Methodology

2.1. Study area

The social-ecological system (Anderies et al., 2004) of metropolitan Bilbao is located in the region of Bizkaia in Basque Country, northern Spain (Fig. 1). It is divided into 29 municipalities and has a high population density (2164 inhabitants per km²). In this region, urban areas are situated in the valley along the estuary of the river Nervión, delimited by small mountains and the coast to the north. The associated peri-urban ecosystems are called the Bilbao Metropolitan Greenbelt (BMG) and occupy almost 75% of its surface area. These ecosystems include beaches, cliffs, scrublands and forests (Fig. 1) and, depending on their management, can provide a wide range of valuable ES.
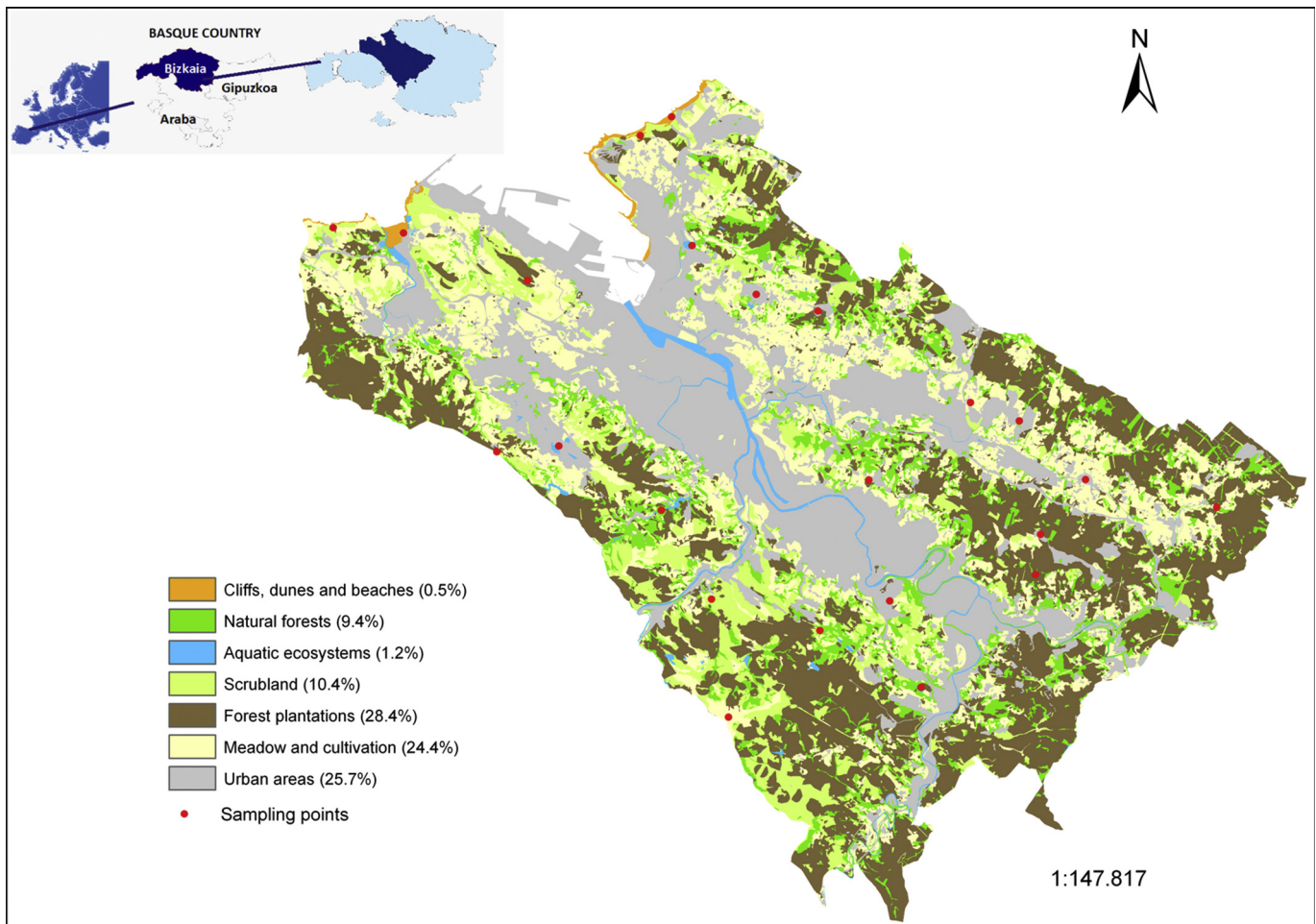

Fig. 1. Location of the study area, land uses and sampling points.

Exploitation of the iron ore, abundant in the region's mountains, led to the early industrial development of Bilbao in the mid-19th century but also resulted in a deep transformation of the peri-urban natural areas. The region's forests have contributed to air purification in the industrial period, as well as to wood production and flood mitigation. Wheat crops, vineyards to produce Txakoli (a typical Basque drink), apple trees for the production of cider, corn, bean plants, peppers and tomatoes occupied large areas before industrialisation, but most of this cropland disappeared due to the combination of fungal plagues at the end of the 19th century and urban sprawl at the beginning of the 20th. The mountains within the study area have also historically played an important role in the defence of the valley's municipalities during civil wars because they were considered strategic locations from which extensive areas could be controlled. Now, the area is known for recreation and natural beauty, but it has great potential to provide other ES.

Changes in the BMG ecosystems (intensive mining, deforestation, reduction of the original estuary through land reclamation, etc.) have contributed to economic development and substantial net gains in inhabitants' well-being, but the challenge now is to reverse the consequent degradation and to manage these peri-urban ecosystems to satisfy the demand for ES of city-dwellers and other stakeholders. Metropolitan Bilbao is experiencing an urban revitalisation, and these areas should be considered in this transformation for their potential to provide ES (Casado-Arzuaga et al., 2011).

2.2. Data collection

Direct in-person questionnaires that had been pre-tested in April 2009 were administered in May–June 2009 and May–July 2010. The sampling points were selected and distributed at sites in the BMG (Table S1, Fig. 1), considering the socio-economic and land-use characteristics of the municipalities (Casado-Arzuaga et al., 2011), and the sample population was randomly selected from the people at these sites. We also contacted other groups of interest, such as teachers, university researchers and students, public-administration technicians and the staff of environmental associations, who were interviewed outside of these sampling points. The respondents were asked whether they preferred to answer the survey in the local Basque language, which is spoken by 30% of the Basque population (EUSTAT, 2010), or in Spanish, the other official language of the Basque Country. Only adults were interviewed (>18 years old).

The survey was designed to determine the public's perception of the ES supplied by the BMG ecosystems and the respondents' demand for ES (Table S2), measured in terms of their willingness to contribute to the maintenance of these services, with the aim of analysing the correspondence between the two categories of answers. The objective was to obtain direct and useful data to support land-use policies based on public perceptions and opinions that could contribute to decision-making.

We interviewed 545 people, but because some of them did not answer all of the questions, the final dataset was composed of 500 questionnaires. A total of 423 questionnaires were completed at the BMG sampling points, and 77 were received from the other groups of interest. The dataset provided a representative cross-section of the adult users in the region (Casado-Arzuaga et al., 2011).

2.3. Questionnaire structure

The survey consisted of 30 questions and was divided into six sections, as in other studies (Martín-López et al., 2007). In the first section, the respondents were asked several questions to establish their knowledge of and interest in the BMG. The second and third sections included questions addressing their perceptions of the ES provided by the BMG and the importance of these services. In the fourth section, they were asked about the ES to which they would like to contribute to meet their demand for ES as well as their preferred payment vehicle. Finally, sections five and six included questions about visitors' environmental behaviours and attitudes, socio-economic data and the characteristics of the respondents' visits to the study area. Four questionnaire models were used, changing the order of the questions of the third and fourth sections to avoid possible sequence effects (Carson and Mitchell, 1995).

The respondents' perceptions' of the ES provided by the BMG were determined via an open question in which they were asked whether they believed that the ecosystems of the study area provided any benefits to society and what benefits they perceived (Table S2). The answers to this question were classified as provisioning, regulating or cultural services.

The third section consisted of a photo-questionnaire in which some ES were represented with photographs, along with a short explanation. The ES included in the photo-questionnaire were provisioning (providing water or food and materials), regulating (air purification, climate regulation, water regulation and soil formation) and cultural services (existence value of biodiversity, tourism and recreation, environmental education, aesthetic value, cultural heritage and scientific value) and were selected based on other studies (Castro et al., 2011; Martín-López et al., 2012) and classified following the Millennium Ecosystem Assessment (MEA, 2005). The interviewers explained that the ES included in the photo-questionnaire were some of the benefits that could potentially be provided by the study area. The respondents were asked to choose the five most important of these ES and to rank their importance from 1 to 5 (Table S2). The interviewees could also indicate other services they considered important beyond those represented in the photo-questionnaire.

In the fourth section of the questionnaire, the respondents were asked whether they would contribute to the conservation of the BMG ecosystems and about their preferred payment methods, which included (1) economic donation, (2) extra taxes, (3) 0.7% of their income tax returns (0.7% of income), (5) volunteer time, and (5) no possible contribution. Finally, to measure the relative demand for different ES, they were asked to choose the ES to which they would like to contribute, selecting a maximum of five.

2.4. Data analysis

We used multivariate exploratory techniques to examine the heterogeneity of the interviewees at the different sampling points (García-Llorente et al., 2008; Martín-López et al., 2007; Nunes, 2002), with the aim of classifying the BMG visitors (Table S1; Casado-Arzuaga et al., 2011).

The non-parametric Mann–Whitney and Kruskal–Wallis tests were used to analyse the respondents' perceptions of the ES provided by the BMG ecosystems (Table S3). Moreover, the responses to the photo-questionnaire were analysed via canonical correspondence analysis (CCA) to determine the relationships between user groups and the importance they attributed to specific ES. An analysis of variance (ANOVA) with multiple comparisons, together with Tukey's test ($\alpha = 0.05$), was used to define individuals' attitudes towards the ES analysed.

We used a binomial logit regression to predict the probability that a respondent would contribute to the conservation of the study area and to identify the socio-cultural factors linked to that answer. The dependent variable was coded as "1" if the respondent agreed to contribute to ES maintenance and "0" otherwise. Akaike's Information Criterion (AIC) was used to select the best model among all possible combinations of independent variables (Burham and Anderson, 2002).

We used a chi-squared test to analyse the perception of and demand for provisioning, regulating and cultural services. The non-parametric Kruskal−Wallis test with sequential Bonferroni correction was used to analyse whether the percentage of people who would contribute to the maintenance of each ES was affected by the respondent's user group.

Finally, a chi-squared test was carried out to test for differences between the modes of contribution and their relationship with the user groups identified.

3. Results

3.1. User groups

Five user groups were identified (Casado-Arzuaga et al., 2011): (1) *people without an environmental attitude*, (2) *weekend trippers*, (3) people who used the BMG to exercise or walk (*strollers and sportsmen/women*), (4) people who showed an interest in nature (*nature users*) and (5) *specialists*, which included teachers, university researchers and students, public-administration technicians and the staff of environmental associations. All individuals except those in the last group were interviewed at the BMG sampling points. Table 1 summarises the main characteristics of each user group.

3.2. Perception and importance of ES

When the interviewees were asked if they thought that the BMG ecosystems provided any benefits to society, only 2.2% of them answered that the benefits were few, and most of the respondents (88.2%) were capable of identifying ES. Cultural services were the most commonly perceived benefits, being indicated by 79.2% of the interviewees, while 31.4% of participants perceived regulating services as a benefit and only 1.8% indicated provisioning services (Table 2). Tourism and recreation (71.8%) and air purification (26.4%) were the most commonly indicated specific ES. All of the services included in the photo-questionnaire were cited spontaneously, although the majority were perceived by less than 10% of the people interviewed (Table 2). The only service mentioned that was not on our list was spirituality, which was mentioned by one interviewee.

With regard to the responses to the photo-questionnaire, 97.6% of respondents indicated cultural services as one of the five most important ES provided by the BMG, while 90.6% selected regulating services and 52.2% selected provisioning services (Table 2). The

observations were similar to the data obtained from the open question, but the percentage of people who indicated regulating and provisioning services increased considerably. The existence value of biodiversity and air purification were considered the most important ES and received the highest mean scores (Fig. 2, Table 2). Air purification was attributed the highest value (5) in the greatest number of surveys (18.6%), although the existence value of biodiversity was indicated by more people (71.6% compared to 63.2%; Table 2). Tourism and recreation, environmental education, climate regulation and water regulation were also considered important by the interviewees. In contrast, scientific value, soil formation, cultural heritage and food and material provisioning received the lowest mean scores, and these categories were indicated by less than 35% of respondents. In general, there was a correspondence between the percentage of people who indicated each ES and the mean value obtained for that service (Table 2).

3.3. Comparison of the perceptions of different user types

Significant differences were found among user types in the perception of certain regulating and cultural ES (Table 3). The *specialists* presented the highest variability regarding ES in the open question. They were capable of identifying all of the services included in the photo-questionnaire, except scientific value, before being asked the question. *Nature users* perceived regulating services at the highest rate (Fig. 3), though they also perceived the cultural services provided by the BMG. The remaining user groups were particularly likely to perceive some of the cultural services and air purification.

There were significant differences in the importance attributed by users to soil formation, tourism and recreation and scientific value (Table S4). Compared to the other user groups, the *specialists* considered soil formation and scientific value most important and tourism and recreation least important. Moreover, they considered aesthetic value to be the least important service, whereas the other user groups all indicated scientific value to be the least important service. All of the user groups considered the existence value of biodiversity to be the most important ES, with the exception of *people without an environmental attitude*, who thought that air purification was the most important (Table S4).

The relationships between the user groups and the importance they attributed to the ES analysed in the photo-questionnaire are shown in a CCA ordination diagram (Fig. 4). Factor 1 (explaining 53.03% of the variance) represented a trade-off between use and non-use services. This factor captured provisioning services and

Table 1

Main characteristics of the five user groups identified in the BMG. NPA = percentage of people who visited natural protected areas in the previous year. NGO = percentage of people who held a membership in an environmental organisation. Rural = percentage of people who resided in a rural municipality according to the definition of the Spanish Law for the Sustainable Development of the Rural Environment (Law 45/2007).

User group	N	%	Aim of visit	NPA (%)	NGO (%)	Rural	Age	Education level	Monthly income (€)
People without an environmental attitude	57	11.4	To spend the day To rest/relax Beach Dog	47.4	0	8.8	37	Secondary, university	1125
Weekend trippers	221	44.2	To spend the day Beach Landscape Friends	57.5	5.4	7.7	39	Secondary, university	1112
Strollers and sportsmen/women	113	22.6	To exercise To stroll	53.1	0.9	10.6	54	Primary, secondary	1289
Nature users	32	6.4	To exercise Nature interest Landscape	75	25	9.4	46	Secondary, university	1402
Specialists	77	15.4	−	85.7	19.5	5.2	32	University	1377

Table 2
Percentages of people who indicated each ES when they were asked about the benefits supplied by the BMG, when they had to choose the five most important services from those presented in the photo-questionnaire, and the percentages of people who would contribute to the maintenance of particular ES (demand).

Ecosystem services	Open question (%)	Photo-questionnaire				Demand (%)
		Mean score	Standard error	%	% Most important	
Cultural services	79.2	1.218	0.028	97.6	46.6	75
Tourism and recreation	71.8	1.568	0.084	49.2	12.2	21.2
Aesthetic value	9.6	0.936	0.068	35	4.4	15.8
Existence value of biodiversity	9	2.356	0.084	71.6	18	44.6
Environmental education	2.2	1.362	0.078	46.4	8.8	33.2
Cultural heritage	2	0.826	0.062	32.6	2.6	14.4
Scientific value	0.2	0.260	0.037	12	0.6	6.4
Regulating services	31.4	1.393	0.038	90.6	39	45
Air purification	26.4	2.170	0.089	63.2	18.6	23.8
Climate regulation	0.8	1.372	0.081	44.8	10.4	22.6
Water regulation	0.4	1.276	0.077	42.2	6.2	18.6
Soil formation	0.2	0.754	0.062	29.4	3.8	14.8
Provisioning services	1.8	0.991	0.053	52.2	14.4	24.8
Food and material provision	1.6	0.870	0.071	30.2	8	15.2
Water provision	0.4	1.112	0.077	33.2	6.4	14.2

utilitarian cultural services, such as tourism and recreation and cultural heritage, with positive scores, while regulating services, existence value of biodiversity, environmental education and scientific value were associated with negative scores. *Specialists* and *nature users* were negatively associated with this factor, whereas a positive association was detected for *people without an environmental attitude, weekend trippers* and *strollers and sportsmen/women*. On the other hand, water provision, air purification and cultural heritage contributed most to the positive scores of factor 2, while existence value of biodiversity contributed most to the negative scores (Table S5). This factor represented a contrast between the services that were more relevant in the past, scored positively, and those that were important at the time of the survey or could be essential in the future, which scored negatively. Before industrialisation people depended directly on the resources provided by the ecosystems in the area, such as water and food. In the industrial period air purification was a highly valued service because of the high levels of pollution and the regional identity related to the BMG was higher due to the close historical importance of the area. On the other hand, the conservation of the biodiversity in the BMG could be essential for the improvement in the provision of ES and climate and water regulation due to their

relevance in the mitigation of climate change and flooding. *Weekend trippers* and *nature users* were associated with the negative scores, whereas *people without an environmental attitude, strollers and sportsmen/women* and *specialists* showed a positive association with the second factor.

3.4. Demand for different ES

Eighty-eight percent of the interviewees indicated interest in conserving the BMG ecosystems. According to the logit model, the factors that influenced the probability that the respondents would contribute to conservation were their place of residence (rural or urban municipality), environmental behaviour (whether they had visited natural protected areas (NPA) in the previous year), age and gender (Table 4). The results indicated that the respondents were more willing to contribute to the conservation of the BMG when they came from urban municipalities, had visited a NPA during the previous year, were younger and were female.

When we analysed the relationship between the perception of the different types of ES (provisioning, regulating and cultural) that interviewees presented in the open question and their demand for ES after the explanation of potential benefits of the whole set of ES,
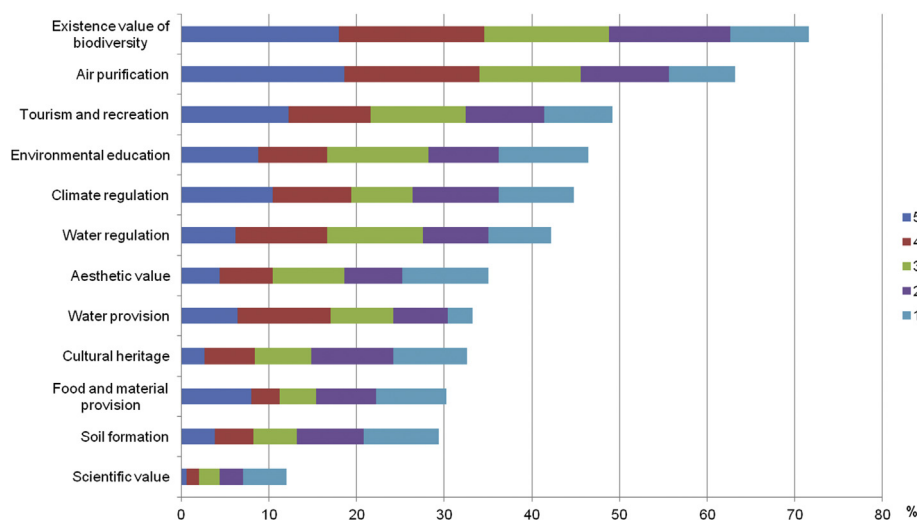

Fig. 2. Social perception of the importance of different ES in the surveyed population, expressed as the percentage of interviewees who indicated each ES and the ranking attributed to each ES (1–5).

Table 3
Percentages of people who perceived each ES in the open question based on a chi-square test, by user group.

Ecosystem services	People without an environmental attitude	Weekend trippers	Strollers and sportsmen/women	Nature users	Specialists	χ^2 (user groups)
Cultural services	84.2	77.8	75.2	81.3	84.4	3.560
Existence value of biodiversity	8.7	4.9	9.7	12.5	18.2	12.849**
Environmental education	0	1.8	0	3.1	7.8	15.299**
Tourism and recreation	77.2	73.8	61.9	75	75.3	7.289
Aesthetic value	5.3	9.5	13.3	9.4	7.8	3.288
Cultural heritage	0	1.4	0.8	6.3	5.2	9.304*
Scientific value	0	0	0	3.1	0	14.654**
Regulating services	24.6	27.1	33.6	53.1	36.4	11.244**
Climate regulation	0	0	0	3.1	3.9	14.634**
Air purification	24.6	27.1	32.7	53.1	33.8	10.424**
Water regulation	0	0	0.9	0	1.3	3.473
Soil formation	0	0	0	0	1.3	5.505
Provisioning services	1.8	0.9	2.7	0	3.9	3.970
Water provision	0	0	0.9	0	1.3	3.473
Food and material provision	1.8	0.9	1.8	0	3.9	3.806

*Significance level at 10%, **Significance level at 5%.

we found significant differences between the ES the respondents perceived and those they would like to benefit from ($\chi^2 = 18.6$, d.f. = 2, $p < 0.0001$). At the beginning of the questionnaire, the respondents were particularly likely to perceive the cultural services provided by the BMG ecosystems; however, although 75% of the respondents would contribute to improvements in these services, the proportions of people who demanded the conservation of regulating and provisioning services increased considerably, to 45% and 24.8%, respectively (Table 2). The analysis performed for each user group yielded the same results. Respondents would contribute more to the maintenance of provisioning and regulating services and less to cultural services compared to the percentage of people in each user group who perceived these services in the open question. The interviewees would contribute most to the existence value of biodiversity and environmental education, and respondents demanded improvements in these services (Table 2). In

contrast, the results showed that although tourism and recreation was the most perceived ES at the beginning of the survey, the respondents demanded other ES, and only 21.2% would contribute to this service (Table 2).

We found significant differences regarding the demand for ES among the user groups (Table 5). *Specialists* were most likely to contribute to the maintenance of most ES. Additionally, they demanded the most regulating services and showed the most interest in improving scientific and educational knowledge of the study area (Table S6). In contrast, the percentage of people in this group who selected tourism and recreation service was low compared to the other respondent groups. *Nature users* would contribute in particular to the maintenance of regulating services, in addition to the existence value of biodiversity and environmental education (Table 5); however, nobody in this group selected cultural heritage services and showed the least demand for
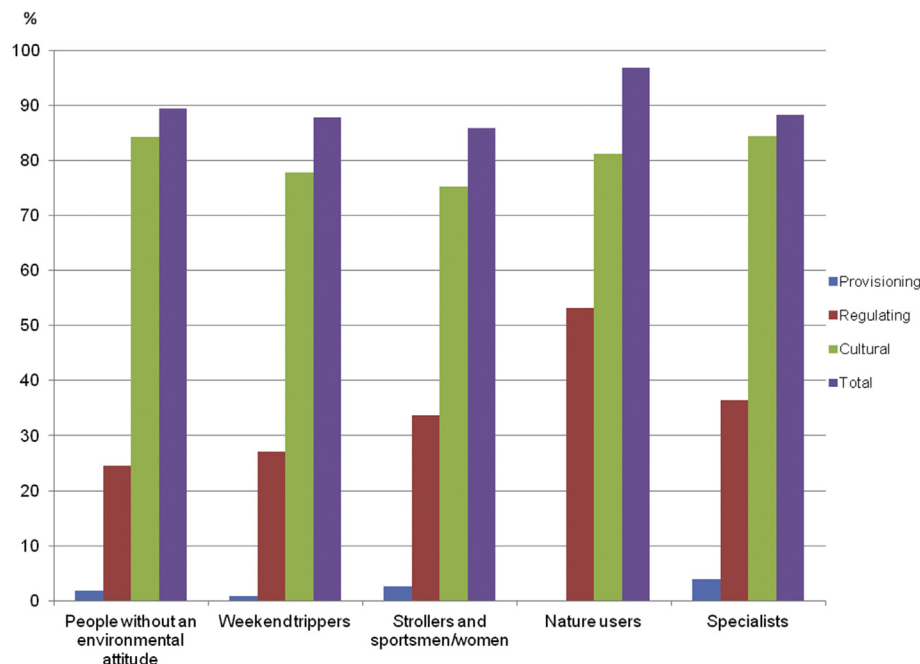

Fig. 3. Percentages of respondents in each user group who perceived at least one ES in the open question (total) and their perception in each category of ES (provisioning, regulating and cultural).
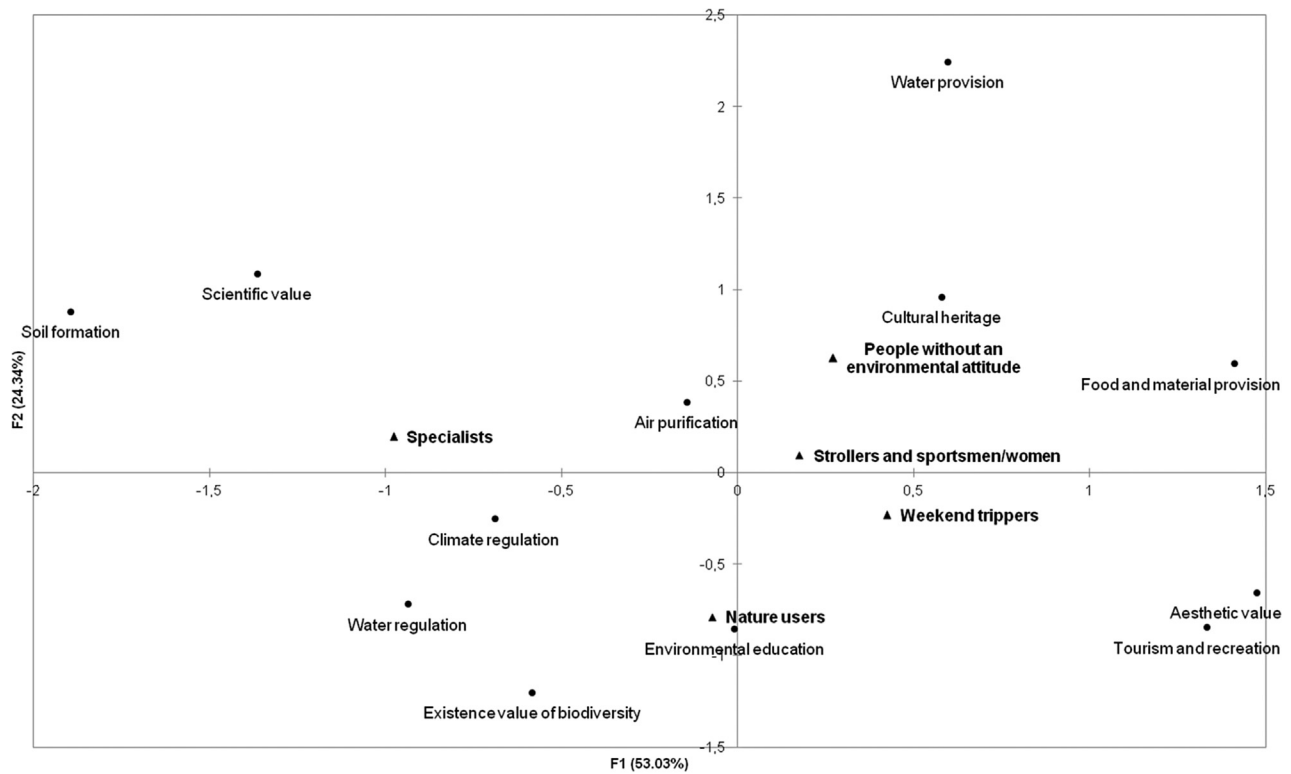
Fig. 4. CCA ordination diagram depicting the relationship between the user groups identified and their opinions about the relative importance of the ES in the BMG.

improvement of the provisioning services supplied by the BMG ecosystems. *Weekend trippers* were least likely to demand regulating services, scientific value and existence value of biodiversity. Among *people without an environmental attitude*, 35% would contribute to air purification, although they were particularly likely to demand cultural services. Finally, s*trollers and sportsmen/women* were most likely to select aesthetic value services, and they showed a strong preference for cultural services.

3.5. Preferences with regard to different means of contributing to conservation

The results obtained from the chi-squared test used to analyse the means of contributing to conservation (economic donation, extra taxes, 0.7% of income, willingness to volunteer time and no possible contribution) by user group are shown in Table 6. The preferred option for *weekend trippers*, *people without an environmental attitude* and *specialists* was volunteering time for conservation/restoration activities aimed at ES. *Strollers and sportsmen/women* and *nature users* were more disposed to donate 0.7% of their income. Furthermore, statistically significant differences were found for the "no possible contribution" option between the user groups, with the *specialists* selecting this option least frequently (Table 6).

4. Discussion

4.1. Differences in the perceptions and importance of ES

Societal dependence on ecological life-support systems is evident in subsistence economies, where communities depend directly on ecosystems for food and other necessary products. Nevertheless, in developed countries, most ES are not directly obtained or enjoyed from nature, but are "embedded" in market products (e.g. imported food), and socio-economic systems are becoming increasingly decoupled from natural ecosystems,

Table 4
Logit regression addressing the respondents' willingness to contribute to the conservation of the BMG ecosystems.

Variables	Coefficient	Standard deviation	z	$p > |z|$	[95% C.I.]*	
Constant	8.443	1.612	27.429	< 0.0001	5.284	11.603
Age	−1.650	0.409	16.292	< 0.0001	−2.451	−0.849
Rural	−1.177	0.407	8.358	0.004	−1.975	−0.379
NPA visitor	0.594	0.298	3.979	0.046	0.010	1.177
Male	−0.581	0.327	3.152	0.076	−1.222	0.060

$N = 500$.
Log-likelihood = 325.42, Wald Chi-square = 35.79, $(p > Chi^2) < 0.0001$.
AIC = 337.42.
Percentage of correct estimated predictions (%) = 88%.
*C.I. refers to its 95% confidence.
NPA visitor = If the respondent visited any natural protected area during the previous year.

Table 5
Percentages of people who demanded each ES, analysed through a chi-square test, by user group.

Ecosystem services	People without an environmental attitude	Weekend trippers	Strollers and sportsmen/women	Nature users	Specialists	χ^2 (user groups)
Cultural services	77.2	73.3	73.5	71.9	81.8	2.706
Existence value of biodiversity	47.4	39.8	46.1	50	51.9	4.374
Environmental education	26.3	29.9	30.9	34.4	50.6	13.171**
Tourism and recreation	29.8	21.7	22.1	21.9	11.7	6.810
Aesthetic value	15.8	13.6	23.9	9.4	12.9	7.838*
Cultural heritage	14.1	14.1	15.9	0	19.5	7.241
Scientific value	10.5	2.7	3.5	3.1	19.5	30.739***
Regulating services	52.6	38.5	41.6	46.9	62.3	15.086**
Climate regulation	17.5	20.4	17.7	31.3	36.4	12.725**
Air purification	35.1	17.6	23.9	25	32.5	11.834**
Water regulation	12.3	17.2	17.7	25	25.9	5.483
Soil formation	14.1	8.6	12.4	25	32.5	28.991***
Provisioning services	26.3	24.4	23.9	15.6	29.9	2.642
Water provision	24.6	12.7	11.5	12.5	15.6	6.318
Food and material provision	12.3	15.8	15.9	6.3	18.2	3.013

*Significance level at 10%, **Significance level at 5% and ***Significance level at 1%.

alienating the consumer from the links between the source ecosystems and final goods and services (Gómez-Baggethun and de Groot, 2010). Thus, where social and ecological systems are tightly linked and there is heavy reliance on ecosystem goods and services, one would expect awareness of ES to be high; the contrary would be expected in the developed world. Iftekhar and Takama (2007) found that approximately one-fourth of respondents on Nijhum Dwip Island (Bangladesh) stated that they were highly dependent on mangroves. Social and ecological systems are also tightly linked in the landscape surrounding Kibale National Park (western Uganda), where most respondents perceived forest fragments and wetlands to be useful and to provide ecosystem goods (Hartter, 2010). In this case study, in which the survival of inhabitants does not depend on the ES provided by the BMG ecosystems, almost all of the respondents perceived the benefits provided by the region, and 88.2% identified ES as a benefit. This percentage is higher than that obtained by Castro et al. (2011) in Almeria (Spain), where 78% of the interviewees thought that the ecosystems of their study area provided ES to society, and is similar to the value obtained by Martín-López et al. (2012). Recent studies indicate that the perception varies depending on the type of ecosystem analysed. For example, in Kibale National Park (Uganda), respondents were more likely to report that ES were provided by wetlands, rather than forests (32% and 8% of respondents, respectively; Hartter, 2010), and a study conducted in Spain found that recognition of ecosystems' capacity to supply services was higher for coastal systems, forests and wetlands than for rivers and streams, drylands and urban systems (Martín-López et al., 2012).

The interviewees perceived the three categories of ES in different ways. Cultural services were the most evident to the respondents, as has been found for respondents in urban and industrialised areas in Spain (Martín-López et al., 2012), but regulating services were also perceived, although other studies have found that they are sometimes overlooked (Agbenyega et al., 2009; Calvet-Mir et al., 2012); however, Castro et al. (2011) and Martín-López et al. (2012) found that regulating services were the most likely to be perceived by stakeholders. This result could have arisen in the first study because the investigators considered biodiversity conservation as a regulating service, whereas in the second study, most of the analysed areas were located in natural protected areas and the conservation management strategy of ecosystems had an effect on the ES perceived by people (Martín-López et al., 2012). In contrast, few respondents perceived the importance of the BMG ecosystem in the supply of provisioning services, as they were aware that the food and water they consumed and other materials they used were not produced by or obtained from these peri-urban ecosystems. Nevertheless, other studies have shown that respondents identified provisioning services in particular (Vilardy et al., 2011) or ES more closely linked to anthropogenic landscape components or agricultural activities (Lamarque et al., 2011). The high perception of tourism and recreation services observed at the beginning of the survey may be related to the fact that the respondents were highly aware of the urban services in which local and regional governments invest most of their conservation budget; this investment is usually aimed at improving recreational equipment and the aesthetic value of peri-urban natural areas. For example, the government institutions surveyed by Agbenyega et al. (2009) placed the greatest value on the information function of community woodlands, specifically on walking, providing a beautiful landscape, and cultural benefits. Vejre et al. (2010) found that the arguments for the designation and protection of areas in the peri-urban landscapes of the north of Copenhagen were primarily

Table 6
Comparison of respondents' preferred means of contributing, analysed through a chi-square test, by user group.

Means of contributing	User groups					
	People without an environmental attitude	Weekend trippers	Strollers and sportsmen/women	Nature users	Specialists	χ^2 (user groups)
Economic donation	15 (26.3%)	41 (18.5%)	21 (18.6%)	5 (15.6%)	20 (26.0%)	3.845
Extra taxes	5 (8.8%)	14 (6.3%)	6 (5.3%)	2 (6.3%)	5 (6.5%)	0.763
0.7% of income	12 (21.1%)	65 (29.4%)	37 (32.7%)	11 (34.4%)	17 (22.1%)	4.748
Willingness to volunteer time	16 (28.1%)	76 (34.4%)	29 (25.7%)	10 (31.3%)	33 (42.9%)	7.011
No possible contribution	9 (15.8%)	25 (11.3%)	20 (17.7%)	4 (12.5%)	2 (2.6%)	10.804**

**Significance level at 5%.

based on aesthetics and the potential for recreational use. On the other hand, the respondents appeared to consider the recent industrial past of the study area, as more than a quarter named air purification as an important service. In contrast, only 2% of the interviewees perceived cultural heritage services, and only 1.6% named the provision of food or other resources, showing that they might have forgotten the historical importance of the area in the development of the region and of Basque Country and its strategic relevance to the defence of the metropolitan area during civil wars, even though some abandoned mines, structures from the earliest industrial activities and defence features remain.

Perceptions of the importance of particular ES obtained using the photo-questionnaire varied considerably from the responses to the open question, as was also found by Lamarque et al. (2011). After the interviewers explained some of the potential services that the BMG ecosystems could provide, the importance attributed by the respondents to regulating services increased considerably. Furthermore, some ES that were not perceived at the beginning of the survey subsequently acquired a high importance for respondents, such as the existence value of biodiversity, environmental education, climate regulation and water regulation. Regulating services are sometimes unfamiliar to the general public (Vihervaara et al., 2012), but after these ES were explained in the photo-questionnaire, people became capable of identifying them in the BMG and attributed high importance to them. The existence value of biodiversity and air purification were the most important ES for the interviewees. Air quality has been considered one of the most significant ES in studies conducted in various countries, such as Uganda (Hartter, 2010), Uruguay (Vihervaara et al., 2012), Spain (Castro et al., 2011; Martín-López et al., 2012) and Hong Kong (Lo and Jim, 2010a,b). Additionally, biodiversity has been perceived to be the most important ES in other studies (Agbenyega et al., 2009; Lamarque et al., 2011; Martín-López et al., 2012; Vihervaara et al., 2012), and there are also reports concluding that the provision of food and materials or recreation were highly relevant to the respondents (Calvet-Mir et al., 2012; Raymond et al., 2009; Vilardy et al., 2011; Zhen et al., 2010). On the other hand, although we did not ask about the relationship among different ES, some respondents might have made connections between them; when they were ranking the ES in the photo-questionnaire, some respondents commented that the tight interrelationship among some ES made the task difficult, as was also found by Lamarque et al. (2011) and Lewan and Soderqvist (2002).

4.2. Demand for ES and different ways of contributing to their conservation

The percentage of respondents who declared willingness to contribute to the conservation of the BMG was higher than the ranges obtained in studies of willingness to pay for urban green spaces (Adams et al., 2008; Cho et al., 2005; López-Mosquera and Sánchez, 2011; Tyrväinen, 2001) and was similar to the value obtained by Lo and Jim (2010a), who found that 85.3% of the respondents expressed willingness to pay for the conservation of urban green spaces in the compact city of Hong Kong. The last study found that the respondents' motivations for paying for a hypothetical greening program in Hong Kong included producing green spaces to improve air quality, the existence value of trees (making them worth preserving), aesthetic values and supplying recreational and social activities.

The respondents particularly demanded cultural services, especially those related to the existence value of biodiversity and environmental education, over recreation or aesthetic value. Surveys are useful tools for raising community awareness (Warren-Rhodes et al., 2011), and respondents perceived the need for the general public to obtain a critical level of basic knowledge about nature (Lewan and Soderqvist, 2002). One of the indirect results obtained in this study was that the respondents appeared to be aware that contributing to environmental education services would help people to acquire better knowledge about the area and that they would learn to appreciate natural areas once they understood the benefits these ecosystems have supplied or might supply to society. The existence value of biodiversity was the other service most demanded by the interviewees, potentially indicating that they favoured the restoration or maintenance of peri-urban ecosystems for conservation. Moreover, although regulating functions may not provide direct economic benefits, they preserve the environmental conditions necessary for most of the other ecosystem functions that provide direct benefits (De Groot, 1992), and almost half of the interviewees demanded regulating services.

On the other hand, the respondents knew that the food and materials they consumed did not come from the peri-urban ecosystems that surrounded the metropolitan area, and they stated that they would like to improve this situation. This finding corresponds with the growing literature on alternative food networks (AFNs), which emphasises a local scale and proximity, promoting linking of peri-urban farmlands and cities (Paül and Haslam McKenzie, 2013). Preservation and multifunctional development of peri-urban agriculture is increasingly acknowledged for production of local food, as well as for recreational, educational and other social services (Zasada, 2011). Home gardens could also be an important tool for restoring ES in degraded zones, such as marginal lands or abandoned plots in urban areas, due to their potential to provide a wide range of ES and to build community resilience to fluctuations in market prices and environmental conditions (Calvet-Mir et al., 2012). Iftekhar and Takama (2007) found that more than 40% and 20% of respondents suggested horticulture and agriculture, respectively, as alternative uses of forestland.

Volunteering time was the preferred means of contribution, followed by 0.7% of income. Considering that we are in an economic crisis, this finding provides support for the recent proposal to include a box for contributing to environmental conservation on income-tax returns.

4.3. Users consideration

The perceptions of the ES provided by the BMG ecosystems and the importance attributed to them differed among the user groups. A similar result was also found in other studies (Agbenyega et al., 2009; Castro et al., 2011). The results obtained from the CCA ordination diagram showed that the respondents attributed differing levels of importance to the analysed services depending on the direct or indirect benefits they received and on their past or future perspectives. The respondents' demand for ES also varied, showing that they had different preferences with respect to how they would like decision-makers to manage the peri-urban ecosystems of the BMG. A good understanding of stakeholders' perceptions of and demand for ES is essential for effective policy implementation and research (Lamarque et al., 2011). To avoid future conflicts, community participation should account for the heterogeneity of stakeholder groups' perceptions and valuations of ecosystem goods and services (Rönnbäck et al., 2007).

People without an environmental attitude and *strollers and sportsmen/women* recognised the importance of the BMG in supplying provisioning services, and they appeared to remember the industrial past of the study area and the relevance of cultural heritage. *Weekend trippers* attributed high importance to aesthetic value and recreation services, and although they were aware of the BMG ecosystems' potential to provide benefits to society, they were least likely to demand regulating services and existence value of

biodiversity. These three user groups were particularly likely to demand cultural services, but the importance they attributed to regulating services increased considerably compared to their initial perception. On the other hand, *nature users* and *specialists* perceived the importance of regulating services from the beginning of the survey, and their demand for these services was high. Moreover, *specialists* recognised the importance of the scientific value of the study area, which could signify that they were aware of the importance of studying the linkages and relationships among the past and future ES supplied by the BMG.

4.4. Limitations of the methodology and improvements for the future

One limitation of the methodology used in this study is that the interviewers' could have influenced some responses, especially after they described the ES potentially provided by the study area; however, we think that making a list of the ES and asking about them is a good way to analyse interviewees' perceptions and demands from a single perspective and is necessary to avoid educational biases. Measurement errors, defined as errors associated with inaccuracies in the responses recorded on the survey instruments, can arise from the effect of the interviewers on the respondents' answers to the survey questions (Groves, 1989), so it is necessary to be careful when designing and making the survey. On the other hand, the educational performance of the questionnaire could be assessed testing the relationship between the ES scoring and the demand and the methodology could be improved by including specific questions about the interviewees' recommendations for planning to reinforce their demand for particular ES.

Similar surveys could be performed in different study areas to measure residents' and visitors' perceptions of and demands for the ES provided by the analysed ecosystems. This method could be used to gather information about opinions and preferences for ES and is a useful tool to show decision-makers whether their decisions are meeting societal demands.

5. Conclusion

Users value the BMG ecosystems not only because of their recreational attractions but also for the other ES these peri-urban ecosystems provide and for their future capacity to provide these services. Without any previous knowledge of ES, the respondents perceived the most evident ES, i.e., those they had used or benefited from directly, such as recreation. In contrast, after the interviewees had been given more information, they demanded ES that they had not perceived at the beginning of the survey. The demand for ES in the BMG did not correspond to what users perceived these ecosystems to provide. Peri-urban ecosystems are often managed as recreation areas or to enhance aesthetic value on the urban fringe, and the respondents' perceptions appeared to be related to this pattern; their demand, however, was related to the benefits they would like to obtain from the BMG ecosystems.

Ecosystem management proposals useful to decision-makers could be designed based on the respondents' demands for ES. The interviewees appeared to be aware of the need to depend less on other places for the provision of food and were in favour of improvements in peri-urban rural areas. Moreover, the results suggested that the authorities should restore or maintain some areas to conserve species and highlight the BMG ecosystems' role in the provision of regulating services and historic and cultural values as respondents generally lacked knowledge of the past and potential importance of the area. Environmental education is fundamental to improving awareness of ecosystems' capacity to benefit society, and a simple explanation, such as the one presented in this study,

could have a positive impact in this arena. An increase in environmental education and volunteer programs could also bolster the cultural identity of inhabitants and incorporate this area into the place brand of metropolitan Bilbao.

Application of this framework has allowed consideration of ES that are sometimes overlooked and has highlighted differences in the perception of and demand for the analysed ES among user groups. This holistic method of matching demand with policy could be useful in reorienting land-use planning based on ES. Future decisions regarding the management of the BMG ecosystems should be re-oriented from recreation to improving the natural functions of these peri-urban ecosystems, increasing their capacity to supply provisioning, cultural and regulating services and satisfying the demands of different stakeholders, while favouring the well-being of inhabitants.

Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.jenvman.2013.05.059.

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