BioOne COMPLETE

Residents' Versus Visitors' Knowledge and Valuation of Aquatic Mountain Ecosystems in the Catalan Pyrenees

Authors: Romagosa, Francesc, Miró, Alexandre, Buchaca, Teresa, and Ventura, Marc

Source: Mountain Research and Development, 40(3)

Published By: International Mountain Society

URL: https://doi.org/10.1659/MRD-JOURNAL-D-19-00040.1

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

Downloaded From: https://bioone.org/journals/Mountain-Research-and-Development on 28 Mar 2024
Terms of Use: https://bioone.org/terms-of-use

Mountain Research and Development (MRD)
An international, peer-reviewed open access journal
published by the International Mountain Society (IMS)
www.mrd-journal.org

MountainResearch
Systems knowledge

Residents' Versus Visitors' Knowledge and Valuation of Aquatic Mountain Ecosystems in the Catalan Pyrenees

Francesc Romagosa[1]*‡, Alexandre Miró[2]‡, Teresa Buchaca[2], and Marc Ventura[2]

** Corresponding author: Francesc.Romagosa@uab.cat*

‡ The first 2 authors contributed equally.

[1] School of Tourism and Hotel Management, and Department of Geography, Universitat Autònoma de Barcelona, 08193 Bellaterra, Catalonia, Spain
[2] Centre d'Estudis Avançats de Blanes (CEAB-CSIC), Carrer Accés Cala Sant Francesc, 14, 17300 Blanes, Catalonia, Spain

© 2020 Romagosa et al. This open access article is licensed under a Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/). Please credit the authors and the full source.

Understanding the perceptions of local residents of and visitors to mountain protected areas in terms of their knowledge of and the value they place on aquatic ecosystems is crucial to assess whether nature management and conservation actions will be accepted. This study analyzed the perceptions of visitors to and local residents of the Aigüestortes i Estany de Sant Maurici National Park and the Alt Pirineu Natural Park, both in the Catalan Pyrenees, in relation to aquatic mountain ecosystems. A 10 question survey was conducted on their knowledge and valuation of aquatic mountain ecosystems. Generalized linear models were applied to the responses, testing users' resident/visitor status and sociodemographic trends as predictor variables. Residents reported a greater level of knowledge of aquatic ecosystems than visitors, which contrasts with the higher valuation given by visitors. Specifically, young residents reported the lowest knowledge, and older residents valued the ecosystems least. Residents of Alt Pirineu Natural Park valued aquatic ecosystems lowest overall, and women residents valued specific aquatic ecosystems lowest. Respondents also highly valued conservation actions linked to the LIFE+ LimnoPirineus project, although residents placed less value on these than visitors. This study helps to fill a gap in the literature on users' knowledge and valuation of aquatic mountain ecosystems in protected areas. In addition, it provides helpful background for the development of nature management and conservation actions for mountain protected areas.

Keywords: *aquatic mountain ecosystems; Catalan Pyrenees; knowledge; perception; protected areas; resident; valuation; visitor.*

Peer-reviewed: *June 2020* ***Accepted:*** *July 2020*

Introduction

Mountain areas are composed of large numbers of natural habitats and agroecosystems, which constitute basic livelihoods and economic activities for local communities (Price 2004). Being remote and mostly far from major industrial and population centers, they include many areas with excellent conservation status (Cole and Landres 1996; Kernan et al 2009). Moreover, mountain areas attract tourists and visitors, for leisure, nature enjoyment, and physical activities (Zins 2006). Several mountain habitats have been included in protected areas and are subject to specific management and conservation measures (Worboys et al 2015). However, the establishment of such measures often entails restrictions on economic and private activity, and prohibitions or regulation of certain leisure or touristic activities (Primack 2014). The success and continuity of management and conservation measures depend largely on local social acceptance and users' acceptance in general (Arias 2015). Investigating this acceptance is therefore a research priority (Gleeson et al 2016).

Relations between aquatic ecosystems and humans are complex. Aquatic ecosystems provide society with a wide range of ecosystem services that contribute to human wellbeing (for example, water purification, climate regulation, water supply, regulation of floods, hydroelectric energy, maintenance of biodiversity, opportunities for recreation and nature tourism, scientific knowledge, among many others) (Millennium Ecosystem Assessment 2005; Borja et al 2012). In relation to the services associated with recreation and tourism, often referred to as cultural ecosystem services, emphasis has recently been placed on the importance of visits to natural areas, including aquatic ecosystems, as a way of improving health and wellbeing (Kaplan 1995; Bowler et al 2010; Hartig et al 2014; Romagosa et al 2015; Dustin et al 2018).

However, aquatic ecosystems, such as lakes and rivers, are degrading faster than other types of ecosystems due to industrial and recreational pressures (Cole and Knight 1990). Key threats include a proliferation of invasive species, increased pollution of waters, and the effects of climate change (increased drought, overexploitation of aquifers, etc) (Borja et al 2012). In protected environments, this degradation is reduced through conservation and management actions (Miró et al 2020). However, human activity alters these habitats and causes a number of impacts

Downloaded From: https://bioone.org/journals/Mountain-Research-and-Development on 28 Mar 2024
Terms of Use: https://bioone.org/terms-of-use

that require effective management. Many of these impacts result from an increase in tourism and leisure visits (Newsome et al 2002; Romagosa 2008) and affect the very cultural ecosystem services that attract the visitors (Taff et al 2019).

Perception is an essential part of how people experience and use ecosystems (Relph 1976). Perception studies on the natural environment are abundant in the international arena (eg Barber et al 2003; Burgess and Mayer-Smith 2011; Khew et al 2014; Moyle and Weiler 2017; Colley and Craig 2019). At a regional level, in Iberia, some studies have been carried out on perceptions of the landscape, especially from the perspective of using the natural environment as a place of leisure (Atauri et al 2000; Schmitz et al 2007). Other studies have used an environmental psychology approach to the social perception of aquatic ecosystems to analyze perceptions of coastal, marine, and fluvial environments in different parts of Europe and Oceania (eg Walker-Springett et al 2016). Faggi et al (2013) conducted one of the few studies to examine evaluations of "water landscapes" by residents of and visitors to a place, in this case, natural areas with water features in metropolitan Buenos Aires (Argentina). Aquatic ecosystems in mountain areas are particularly understudied, aside from a recent study by Wiejaczka et al (2018) that analyzed residents' perceptions of a proposed dam and reservoir in the Indian Himalayas.

The overall objective of this study was to investigate the different perceptions of local residents of and visitors to aquatic ecosystems in mountain protected areas. Specifically, we wanted to assess whether residents and visitors differed in their knowledge of and the value they placed on mountain lakes, streams, peatlands, and tufa-forming springs. Few studies have considered these factors, despite their implications for the management and conservation of such ecosystems across the world, as well as their contribution to sustainable development of mountains. Understanding the different sensibilities and perceptions of residents and visitors to these ecosystems could help policymakers and managers of protected areas to implement effective nature management and conservation actions that are socially accepted.

Study context and study area

This study was carried out under the framework of the European Union-funded LIFE+ LimnoPirineus project (restoration of lentic habitats and aquatic species of community interest in high mountains of the Pyrenees), which aims to mitigate human impacts on aquatic mountain ecosystems (LimnoPirineus 2015; Ventura et al 2017). The aim was to analyze the relationship between habitats subject to project intervention (lakes, streams, peatlands, and tufa-forming springs) and the population living in the surrounding area (residents), as well as people that visit the area (visitors). Previous studies on the profile of visitors to the protected areas considered here (see below) focused on visitors, one of the social groups studied in this project (Farías et al 2005; Farías 2011), but none has compared visitors and residents or analyzed aquatic ecosystems.

The study was conducted in 2 protected areas in the Catalan Pyrenees (Spain): the Aigüestortes i Estany de Sant Maurici National Park (PNAESM) and the Alt Pirineu Natural Park (PNAP) (0°42′W–2°09′E; 42°52′–42°23′N; Figure 1).

PNAESM was one of the first protected areas in the Spanish Pyrenees (after the creation of the Ordesa y Monte Perdido National Park in 1918, PNAESM was the second national park to be created in that part of the Pyrenees, in 1955). Currently, it has a total surface of 14,119 hectares, most of which is publicly owned, although it is surrounded by a buffer zone of 26,733 additional hectares, which has a lower level of protection and includes more private land. Villages and traditional activities are found in this buffer zone. The total protected area of the national park and its surroundings is 40,852 hectares.

PNAP was created in 2003 and occupies 69,850 hectares of the northernmost areas of the Catalan Pyrenees, bordering France. It includes the highest peak in Catalonia: Pica d'Estats (3143 m). In this case, lands are mostly public (82%), but villages, in the majority of cases, are outside the boundaries of the protected area. From an environmental point of view, both protected areas have many similarities, especially in terms of the type of landscapes and mountain ecosystems, since they are located in the same biogeographical area. They are characterized by a glacial geomorphology, with hundreds of lakes and lagoons, and by a great diversity of natural landscapes, going from Mediterranean transitional habitats in the lowest parts of the area (valleys) to alpine habitats in the highest parts (mountain peaks). Some of the most representative ecosystems in the study area are the aquatic ecosystems included in our study (lakes, streams, peatlands, and tufa-forming springs). The wetlands in PNAESM (not those within PNAP) are also included in the Ramsar convention's list of wetlands of international importance.

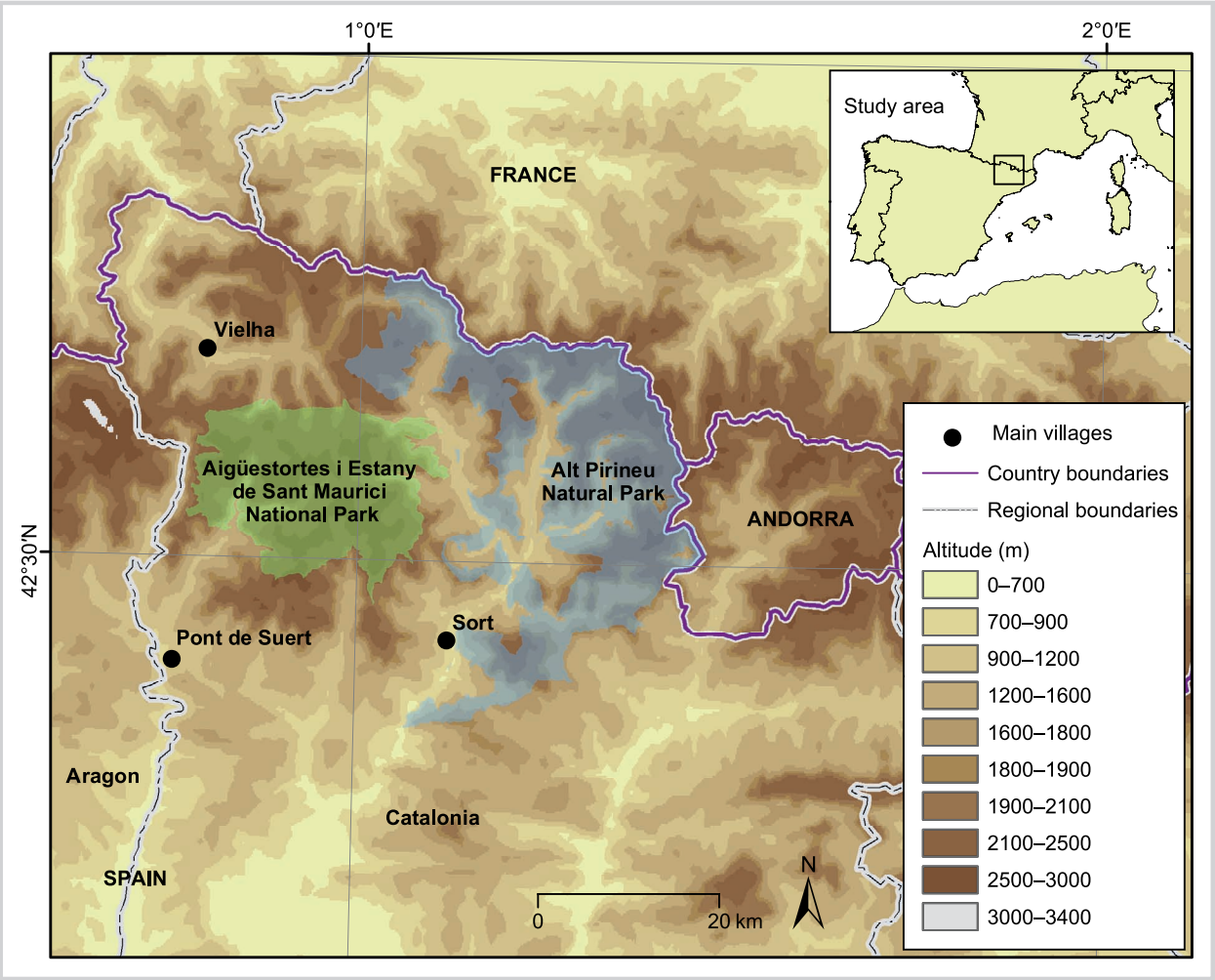
Methods

User surveys

We investigated local residents' and visitors' knowledge and valuation of aquatic mountain ecosystems by conducting user surveys in several villages within the 2 protected areas, and at the entry points to these areas. Users ($n = 315$) were asked 10 questions on aquatic ecosystems: 4 regarding their subjective knowledge of the ecosystem objectives of the LIFE+ LimnoPirineus project (lakes, streams, peatlands, and tufa-forming springs), 1 on the overall subjective importance of these ecosystems, and 4 on their subjective valuation of the aforementioned aquatic mountain ecosystems (Table 1). We included 1 last question on each user's subjective valuation of the LIFE+ LimnoPirineus project. This was asked after giving a summary of the main threats to aquatic mountain ecosystems and the related conservation actions of the project (Appendix S1, *Supplemental material*, https://doi.org/10.1659/MRD-JOURNAL-D-19-00040.1.S1). Respondents were asked to assess their degree of knowledge and the value they placed on the ecosystems using a Likert scale from 1 to 5 (lowest to highest, with equidistance between values). This scaled-response technique was chosen because it facilitates coding, quantification, and analysis (Veal 1997). In addition, respondents were asked for their domicile as either local residents or visitors, and visitors were asked for their city and area of origin. To characterize the sociodemographic

Downloaded From: https://bioone.org/journals/Mountain-Research-and-Development on 28 Mar 2024
Terms of Use: https://bioone.org/terms-of-use

FIGURE 1 Map of the study area. (Map by the authors)



profile of the respondents, the survey also enquired about users' age, gender, and educational level.

The survey protocol was reviewed with managers and technical staff of both protected areas to assure maximum representativeness of the target population. This was achieved through selection of: (1) survey areas, as different alternate sampling points, which in all cases had a high number of visits, and (2) days and times when surveys were carried out. Several sampling points where visitors could be accessed relatively easily were chosen in each park. Residents

TABLE 1 Description of the survey questions included as response variables in the generalized linear models (GLM).

Question type	Question name	Description
Knowledge	1 Knowledge of lakes	What is your subjective knowledge on mountain lakes?
	2 Knowledge of streams	What is your subjective knowledge on mountain streams?
	3 Knowledge of peatlands	What is your subjective knowledge on mountain peatlands?
	4 Knowledge of tufa-forming springs	What is your subjective knowledge on mountain tufa-forming springs?
Valuation	5 Importance of aquatic ecosystems	How important are aquatic mountain ecosystems to you?
	6 Valuation of lakes	What is your subjective valuation of mountain lakes?
	7 Valuation of streams	What is your subjective valuation of mountain streams?
	8 Valuation of peatlands	What is your subjective valuation of mountain peatlands?
	9 Valuation of tufa-forming springs	What is your subjective valuation of mountain tufa-forming springs?
	10 Valuation of LIFE+ LimnoPirineus	What is your subjective overall valuation of the actions of the LIFE+ LimnoPirineus project?

 https://doi.org/10.1659/MRD-JOURNAL-D-19-00040.1

Downloaded From: https://bioone.org/journals/Mountain-Research-and-Development on 28 Mar 2024
Terms of Use: https://bioone.org/terms-of-use

TABLE 2 Terms included as predictor variables in the generalized linear models (GLM).

Term type	Term name	Description
Main effect	Domicile	Binary factor determined by the domicile of the survey respondents, either Resident or Visitor
	Age	Three-level ordered factor determined by the age of the respondents: Young (16–40), Middle (41–64), and Old (65–89)
	Gender	Factor determined by the self-perceived gender of the respondents
	Education	Three-level ordered factor determined by the education level of the respondents: Primary, Secondary, and Graduate
	Area	Binary factor determined by the protected areas where the survey was done, either Aigüestortes i Estany de Sant Maurici National Park (PNAESM) or Alt Pirineu Natural Park (PNAP)
Interaction	Domicile×Age	Two-way interaction term of Domicile and Age factors
	Domicile×Gender	Two-way interaction term of Domicile and Gender factors
	Domicile×Education	Two-way interaction term of Domicile and Education factors
	Domicile×Area	Two-way interaction term of Domicile and Area factors

were mostly surveyed in their own villages. Respondents were selected by the interviewer randomly approaching potential respondents, briefly explaining the study objectives, and asking them to answer the questionnaire. Only 1 person in a group was surveyed in order to avoid bias. Confidentiality and anonymity of answers were assured.

Statistical analyses

We investigated the relationship between the survey answers and the domicile (resident/visitor status) and sociodemographic profile of respondents using Gaussian (normal) generalized linear models (GLM). To allow for over- and underdispersion, we made the distribution of the regression models flexible (quasi-models) by including a free dispersion parameter (Hastie and Pregibon 1992). These models offered the best fit to the data and prevented violation of normality and homoscedasticity assumptions. Other parametric or nonparametric models, such as ordinal logistic regression, ordinal probit regression, GLMs with gamma, Poisson, or binomial distributions, or nonparametric analysis of variance (ANOVA) tests, showed weaker performance and lower predictive ability. We performed one GLM on each of the 10 survey questions (Table 1) using the data from the 315 completed questionnaires. Responses to the questions were included in the models as dependent variables. Nine terms relative to the domicile and sociodemographic attributes of respondents were included in the models as predictor variables: the 5 respondent attributes of Domicile, Age, Gender, Education, and Protected area, and the 4 terms of 2-way interaction between Domicile and the other 4 sociodemographic variables (Table 2).

The significance of predictor terms was checked by subjecting the models to ANOVA and χ^2 tests. Differences within categories of factors and interactions were tested by performing post-hoc pairwise tests based on estimated marginal means with Bonferroni adjustment when there were 2 or more pairwise tests (significance level $\alpha = 0.05$) (Searle et al 1980). To identify the direction of main and interaction effects, all significant terms were plotted by categories of factors using violin plots (a combination of a box plot and a kernel density plot). No plots could be drawn in cases where all data in the given factor category had the highest value of 5. All analyses and graphics were computed with R statistical software (R Core Team 2018), using the basic functions and the packages *emmeans* (Lenth 2019) and *vioplot* (Adler and Kelly 2018).

Results

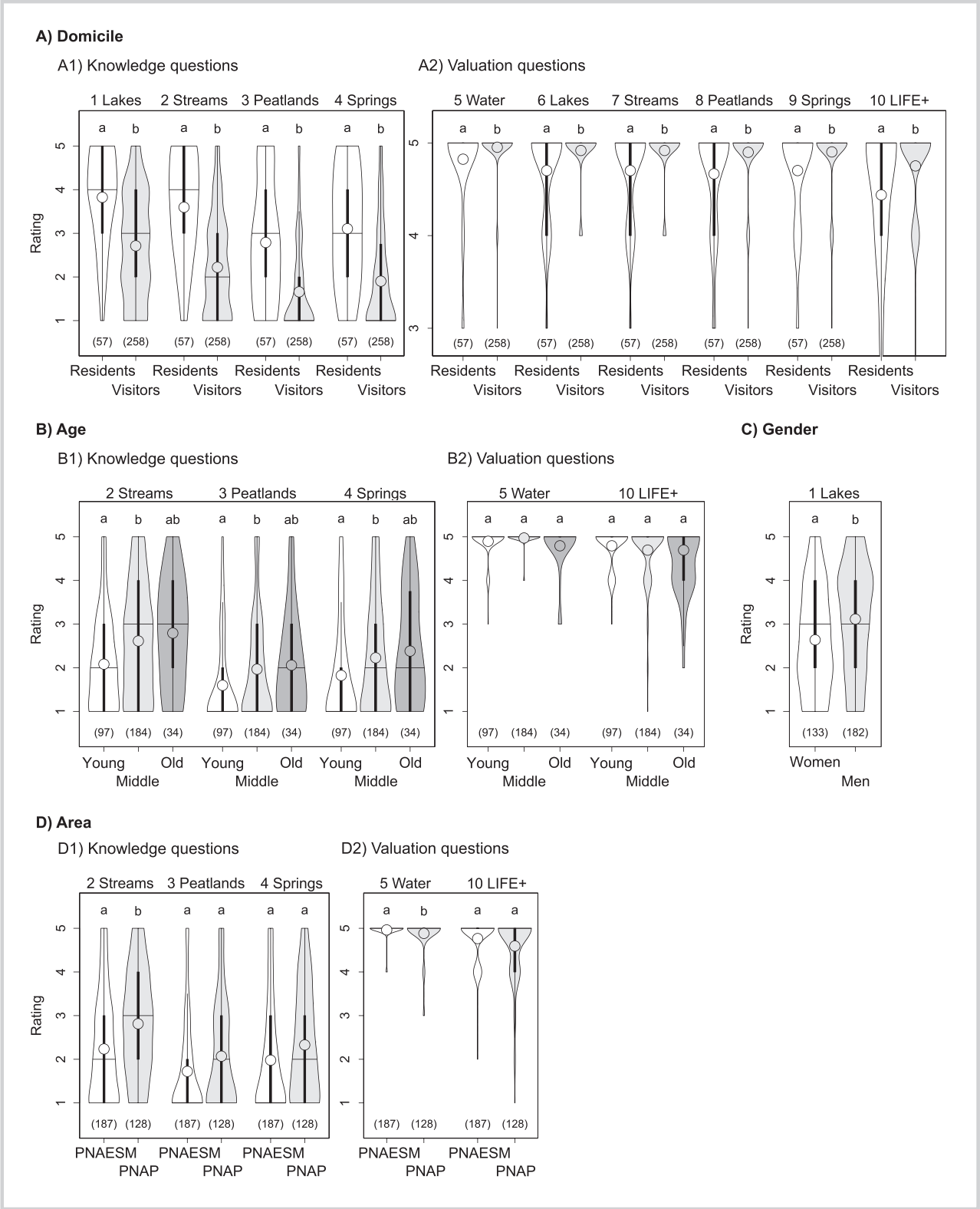
The survey was conducted in July and August 2016 among 319 users, with complete responses from a total of 315 questionnaires (57 of which were local residents and 258 of which were visitors). In PNAESM and its surroundings, 187 questionnaires were completed (31 residents and 156 visitors); the remaining 128 questionnaires were completed in PNAP and its surroundings (26 residents and 102 visitors).

Sociodemographic profile of respondents

The mean age of respondents was 46.0 (±13.5 standard deviation [SD]) years and did not differ significantly between residents and visitors (Student's $t = 1.8179$, $P = 0.074$), although the mean age of residents (49.9 ± 18.6 years) was slightly higher than that of visitors (45.2 ± 12.0 years). Resident and visitor respondents were not equally distributed among age categories ($\chi^2 = 17.4$, $P < 0.001$): There were fewer young and middle-aged respondents among residents (26.3% and 47.4%, respectively) than visitors (31.8% and 60.9%, respectively), with more older residents than older visitors (26.3% and 7.4%, respectively). The gender distribution was 58% men and 42% women, and it did not significantly differ between residents and visitors ($\chi^2 = 3.23$, $P = 0.072$). The level of education (considered an indirect indicator of socioeconomic status) of the surveyed population differed remarkably between residents and visitors ($\chi^2 = 19.7$, $P < 0.001$): The percentage of visitors that had received higher education was double that of the

Downloaded From: https://bioone.org/journals/Mountain-Research-and-Development on 28 Mar 2024
Terms of Use: https://bioone.org/terms-of-use

FIGURE 2 Violin plots and post-hoc tests for the significant generalized linear model (GLM) main effects derived from the socioeconomic variables: (A) Domicile; (B) Age; (C) Gender; (D) Area. See Table 1 for question details. Different letters above the plots indicate significant differences in post-hoc pairwise comparison. Horizontal lines indicate medians; circles indicate means. Sample sizes are given in parentheses below the plots. Abbreviations of protected areas: PNAESM, Aigüestortes i Estany de Sant Maurici National Park; PNAP, Alt Pirineu Natural Park.



residents (62.0% and 31.6%, respectively), while the percentage of residents who had only completed primary education was about triple that of the visitors (15.8% and 5.4%, respectively). As for the origin of the surveyed visitors, most (82.4%) were from Catalonia, and approximately half of these were from the city of Barcelona. These were followed by visitors from the rest of Spain (16.1%), while the remaining 1.5% were foreigners (mostly from France).

Downloaded From: https://bioone.org/journals/Mountain-Research-and-Development on 28 Mar 2024
Terms of Use: https://bioone.org/terms-of-use

TABLE 3 Results of generalized linear models (GLM) developed for each survey question. The deviance (equivalent to variance for this type of analysis) contribution estimated by ANOVA tests is shown for each model term, and the percentage of total variance of significant terms is shown in parentheses (terms added sequentially, first to last). (Table extended on next page.)

Parameter	Question name				
	1 Knowledge of lakes	2 Knowledge of streams	3 Knowledge of peatland	4 Knowledge of tufa-forming springs	5 Importance of aquatic ecosystems
Null deviance	514.7	512.5	443.1	515.4	28.5
Degrees of freedom (null model)	314	314	314	314	314
Model deviance[a)]	424.5	367.8	341.8	410.3	23.5
Degrees of freedom (full model)	301	301	301	301	301
Explained deviance (% of total)	90.2 (17.5%)	144.6 (28.2%)	101.3 (22.9%)	105.2 (20.4%)	5.0 (17.5%)
Deviance contribution[b)]					
Domicile	57.7 (64.0)***	88.3 (61.1)***	59.7 (58.9)***	67.5 (64.2)***	0.8 (15.6)**
Age	6.4 ^{NS}	18.7 (13.0)***	9.5 (9.4)*	10.9 (10.4)*	0.8 (15.7)**
Gender	11.6 (12.8)**	4.6 ^{NS}	2.6 ^{NS}	4.1 ^{NS}	0.3 ^{NS}
Education	0.9 ^{NS}	1.3 ^{NS}	0.1 ^{NS}	1.6 ^{NS}	0.1 ^{NS}
Area	0.3 ^{NS}	19.0 (13.2)***	6.3 (6.2)*	5.6 (5.3)*	0.4 (8.3)*
Domicile×Age	11.5 (12.8)*	4.9 ^{NS}	9.9 (9.7)*	10.6 (10.1)*	1.4 (27.2)***
Domicile×Gender	0.0 ^{NS}	0.0 ^{NS}	0.1 ^{NS}	1.0 ^{NS}	0.5 (10.6)**
Domicile×Education	1.4 ^{NS}	6.4 ^{NS}	6.4 ^{NS}	2.3 ^{NS}	0.3 ^{NS}
Domicile×Area	0.5 ^{NS}	1.3 ^{NS}	6.6 (6.6)*	1.5 ^{NS}	0.4 (8.1)*

Knowledge and valuation of aquatic mountain ecosystems

All 5 variables (main terms) included in the GLMs were statistically significant except the factor Education (Table 3). In general, the subjective valuation of aquatic mountain ecosystems scored highly compared to the subjective knowledge of these ecosystems (Figure 2). The Domicile factor was significant in all 10 models, and it showed the greatest contribution to deviance in 9 of them (Table 3). However, residents and visitors differed in their responses to each survey question and to knowledge versus valuation questions. While residents reported greater knowledge of aquatic mountain ecosystems, visitors valued these ecosystems more (Figure 2A). Visitors also supported the conservation actions of the LIFE+ LimnoPirineus project more than did residents (Figure 2A). The variable Age was significant in 5 models (Table 3). Young users scored their knowledge of aquatic mountain ecosystems lower than middle-aged and older users (Figure 2B). Post-hoc tests for Age categories were not conclusive for the significant terms obtained in the valuation questions (Figure 2B). The factor Gender was significant only for question 1, Knowledge of lakes (Table 3), in which women scored their knowledge lower than men (Figure 2C). The term Area was significant in 5 models (Table 3) and showed that PNAESM users reported lower knowledge of aquatic mountain ecosystems than PNAP users (Figure 2D). In contrast, PNAESM users placed a higher importance on aquatic mountain ecosystems in general (Figure 2D). Post-hoc tests for Area categories were not conclusive for the model of question 10, Valuation of LIFE+ LimnoPirineus (Figure 2D).

All 4 interaction terms included in the GLMs showed several significant 2-way interactions between the factor Domicile and the others terms, with the exception of the interaction of Domicile×Education. The interaction Domicile×Age was significant for 3 knowledge and 3 valuation questions (Table 3). This highlighted 2 specificities within the general trend of greater reported knowledge of residents but higher valuation by visitors: Young residents reported lower knowledge than all visitor categories, and young/middle-aged residents and visitors gave similar valuations of the ecosystems (Figure 3A). Older residents valued the ecosystems less than all other resident and visitor categories (Figure 3B). The interaction term Domicile×Gender was significant for 4 valuation questions (Table 3) and highlighted interesting differences within resident users. Male residents generally placed lower importance on aquatic ecosystems than female residents, and than visitors regardless of gender. Female residents valued specific aquatic ecosystems less than all other categories (Figure 4). The interaction term Domicile×Area was significant for 1 knowledge and 1 valuation question (Table 3) and highlighted 2 specificities within the general trend of higher reported knowledge of residents but higher valuation of visitors: Visitors to PNAESM rated their knowledge of peatlands lower than visitors to PNAP (Figure 5A). Residents of PNAP valued aquatic ecosystems less than

Downloaded From: https://bioone.org/journals/Mountain-Research-and-Development on 28 Mar 2024
Terms of Use: https://bioone.org/terms-of-use

TABLE 3 Extended. (First part of Table 3 on previous page.)

Parameter	Question name				
	6 Valuation of lakes	7 Valuation of streams	8 Valuation of peatlands	9 Valuation of tufa-forming springs	10 Valuation of LIFE+ LimnoPirineus
Null deviance	37.4	50.6	50.6	44.4	116.7
Degrees of freedom (null model)	314	314	314	314	214
Model deviance[a)]	33.3	45.8	45.8	40.8	105.3
Degrees of freedom (full model)	301	301	301	301	301
Explained deviance (% of total)	4.1 (11.1%)	4.6 (12.4%)	4.7 (9.3%)	3.6 (8.1%)	11.5 (9.8%)
Deviance contribution[b)]					
Domicile	2.2 (53.1)***	2.2 (47.4)***	2.5 (53.4)***	1.9 (52.5)***	4.6 (39.9)***
Age	0.5 ^{NS}	0.5 ^{NS}	0.1 ^{NS}	0.1 ^{NS}	2.3 (19.9)*
Gender	0.1 ^{NS}	0.1 ^{NS}	0.0 ^{NS}	0.0 ^{NS}	0.1 ^{NS}
Education	0.1 ^{NS}	0.1 ^{NS}	0.1 ^{NS}	0.0 ^{NS}	0.5 ^{NS}
Area	0.1 ^{NS}	0.1 ^{NS}	0.5 ^{NS}	0.3 ^{NS}	1.5 (13.2)*
Domicile×Age	0.7 (16.4)*	1.1 (23.4)**	0.9 ^{NS}	0.4 ^{NS}	1.9 ^{NS}
Domicile×Gender	0.6 (13.5)*	0.5 (11.5)*	0.3 ^{NS}	0.7 (19.1)*	0.0 ^{NS}
Domicile×Education	0.0 ^{NS}	0.0 ^{NS}	0.2 ^{NS}	0.2 ^{NS}	0.6 ^{NS}
Domicile×Area	0.0 ^{NS}	0.0 ^{NS}	0.0 ^{NS}	0.0 ^{NS}	0.0 ^{NS}

[a)] Sometimes referred to as "residual" deviance.
[b)] Asterisks indicate the level of statistical significance associated with each term: *$P \leq 0.05$; **$P \leq 0.01$; ***$P \leq 0.001$; NS, not significant ($P > 0.05$). See Methods and Results sections for further details.

residents of PNAESM and visitors of both protected areas (Figure 5B).

Discussion

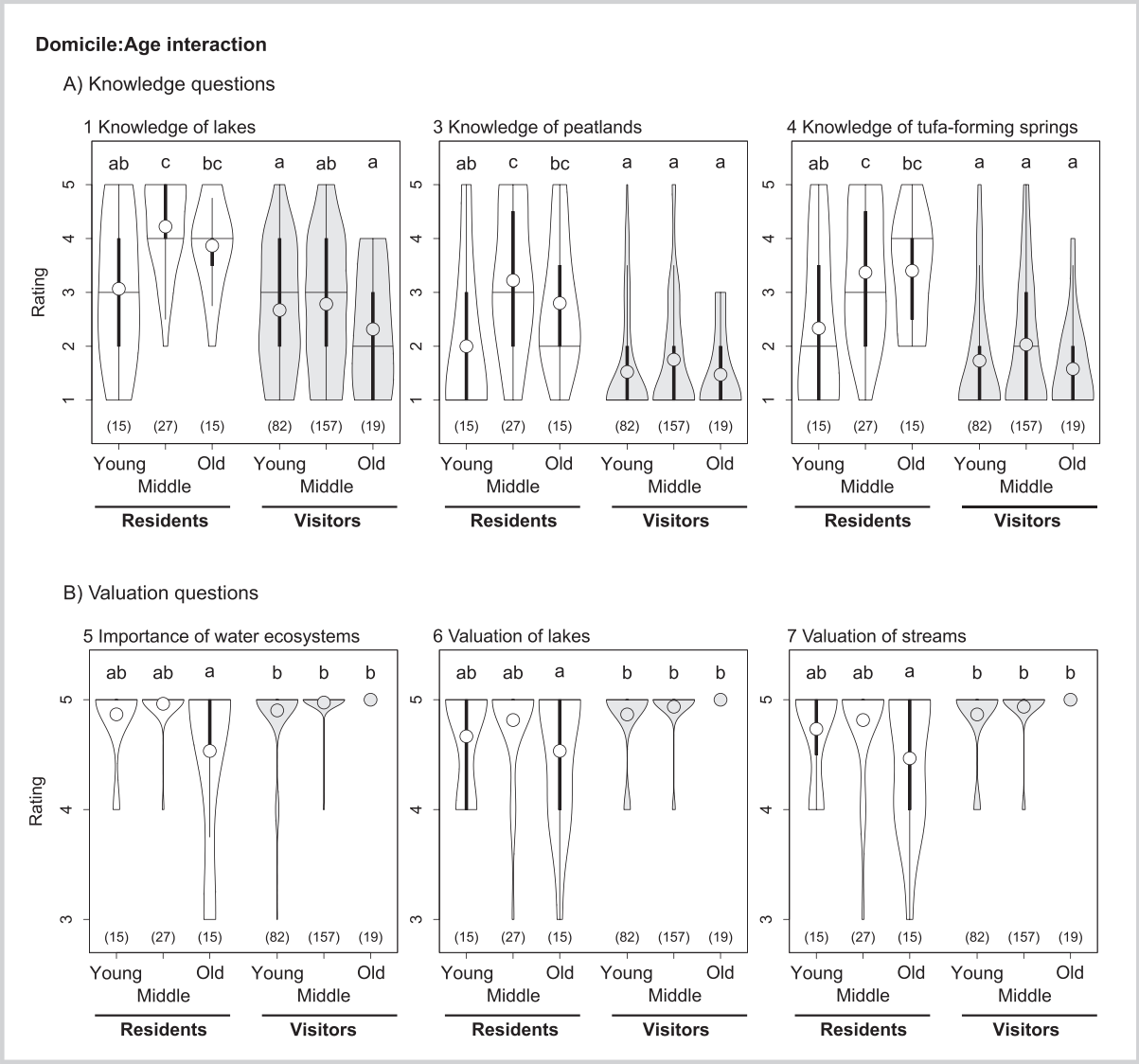
The study provided interesting data on the profile of visitors to and local residents of the 2 protected areas (PNAESM and PNAP) in relation to their knowledge and perceptions associated with the aquatic mountain ecosystems there. Furthermore, the study identified the different degrees of social knowledge about the 4 types of aquatic mountain ecosystems analyzed. Lakes were the best known, followed by rivers and streams, with natural springs and peatlands being significantly less familiar. All groups of respondents rated their knowledge of peatlands the lowest. Residents reported better knowledge than visitors of all 4 types of aquatic ecosystems, in both parks. This variation in knowledge contrasts, however, with the high overall rating that was given by all respondents, with almost no differences, to the 4 types of aquatic mountain ecosystems, indicating that they are very important from an ecological, landscape, and recreational point of view. This is closely related to the very high value given by all respondents to the LIFE+ project's conservation actions in these ecosystems.

Going into more detail, we identified some interesting differences. For example, residents reported better knowledge than visitors on aquatic mountain ecosystems, but, in contrast, they also valued these ecosystems less. These results seem paradoxical and unexpected, as, according to Flotemersch et al (2019), different studies have shown that stakeholder proximity to an aquatic ecosystem, as well as the frequency of visit(s), positively influences the values placed on that resource. A possible interpretation of our results is that residents are more familiar with these ecosystems than visitors, since they have visited the mountain environment many times, probably more times than most of the visitors. Accordingly, residents know these ecosystems much better than visitors. At the same time, visitors are fascinated and attracted by the water and mountain landscape and its ecosystems more than residents, as evidenced by their willingness to specifically travel to those areas.

Looking at the age and gender components, young users in general reported lower knowledge of aquatic mountain ecosystems than middle-aged and older users. Specifically, young residents reported the lowest knowledge, and older residents valued the ecosystems least. Further, women reported less knowledge of mountain lakes than men. While male residents gave the lowest importance to aquatic ecosystems in general, women residents valued specific aquatic ecosystems least. One reason for these differences could be the different social and cultural backgrounds of these groups (Flotemersch et al 2019). For example, young people are more concerned about the environment than older generations and accordingly place more value on

Downloaded From: https://bioone.org/journals/Mountain-Research-and-Development on 28 Mar 2024
Terms of Use: https://bioone.org/terms-of-use

FIGURE 3 Violin plots and post-hoc tests for the significant 2-way interaction effects of Domicile×Age. See Table 1 for question details. Different letters above the plots indicate significant differences in post-hoc pairwise comparison. Horizontal lines indicate medians; circles indicate means. Sample sizes are given in parentheses below the plots.



natural ecosystems, although they do not know the different types of aquatic ecosystems as well as more experienced older people.

Several differences were detected between the 2 parks. Users of PNAESM reported lower knowledge but valued aquatic mountain ecosystems more highly than users of PNAP. Specifically, residents of PNAP valued aquatic ecosystems the least. Although these findings require a deeper and more detailed study, one hypothesis is that PNAP's aquatic ecosystems are valued less than their counterparts in the national park because of the lower level of protection accorded to them (some people might think that a lower level of protection means a lower value of ecosystems).

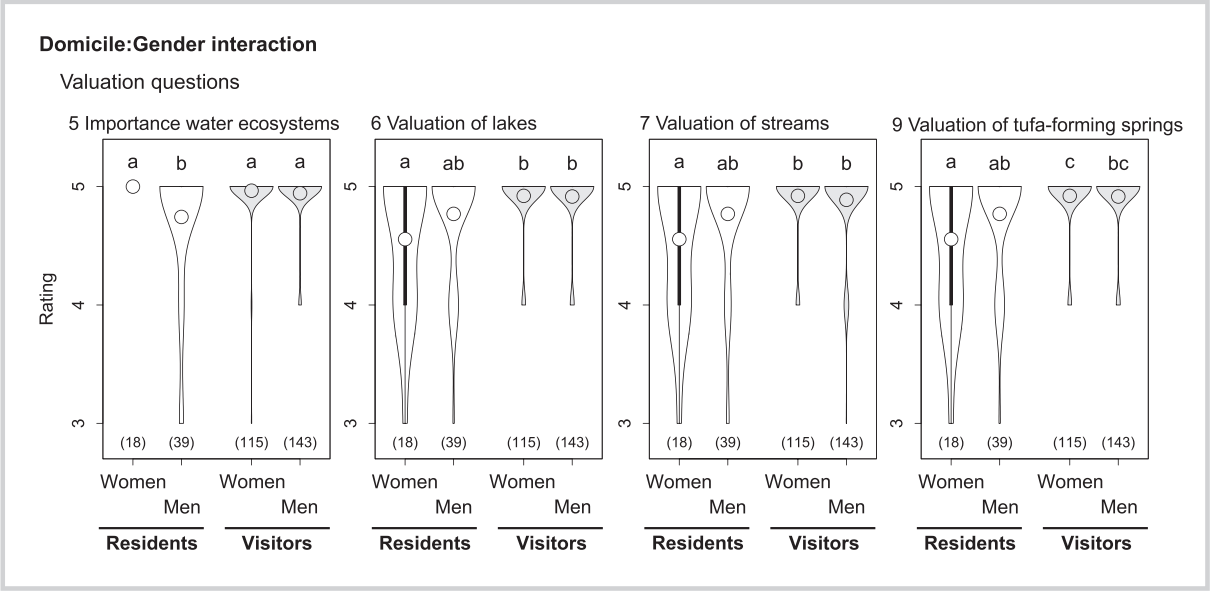
The surveys also showed strong support for the conservation actions that are currently being carried out by the LIFE+ LimnoPirineus project in the study area, although the older residents generally valued them less than visitors. This could be explained by the fact that older generations—especially in rural settings—tend to be less proactive toward environmental and nature conservation projects (Arcury and Christianson 1993). However, this hypothesis should be investigated in future studies.

Conclusions

This study has shown the high importance that residents of and visitors to high-mountain protected areas place on aquatic ecosystems. It has also highlighted the differences between residents and visitors and between generations. Although no similar studies have evaluated visitors' and residents' perceptions of aquatic mountain ecosystems, so no comparisons can be made, we believe that this is an important case study of the Catalan Pyrenees. Similar studies in other high-mountain areas would be interesting, in order to see whether the differences we documented among social groups are evident in other regions. We believe that the approach and methods used in this study are transferable to

Downloaded From: https://bioone.org/journals/Mountain-Research-and-Development on 28 Mar 2024
Terms of Use: https://bioone.org/terms-of-use

FIGURE 4 Violin plots and post-hoc tests for the significant 2-way interaction effects of Domicile×Gender. See Table 1 for question details. Different letters above the plots indicate significant differences in post-hoc pairwise comparison. Horizontal lines indicate medians; circles indicate means. Sample sizes are given in parentheses below the plots.

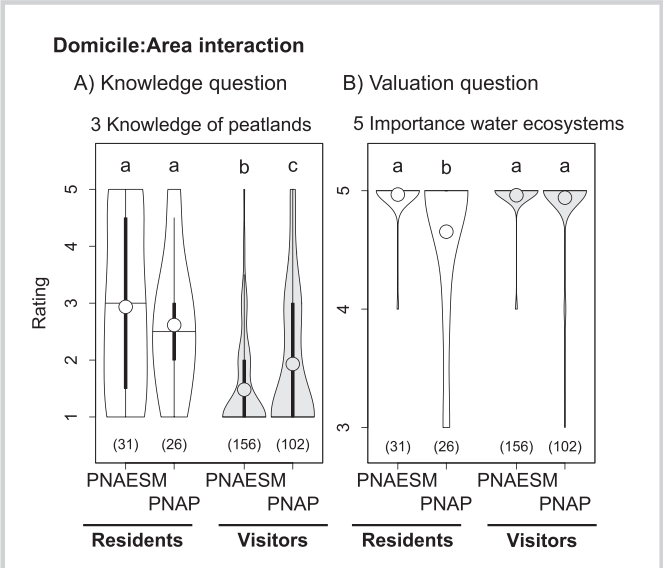


other mountain regions of the world. Our findings are in line with other social perception studies on aquatic ecosystems in other geographical contexts, such as those mentioned in the introduction to this paper (Faggi et al 2013; Walker-Springett et al 2016). All theses studies illustrate how highly aquatic ecosystems are valued in society, above other ecosystems and landscapes, both natural and humanized.

In short, this study has highlighted the need to document and disseminate the characteristics, values, status, and problems of aquatic mountain ecosystems. It has provided more social knowledge of an essentially ecological theme, answering calls from the scientific community on the increasing need to incorporate the social sciences into the analysis and management of ecosystems in general (Mascia et al 2003) and aquatic ecosystems in particular (Walker-Springett et al 2016; Flotemersch et al. 2019). This is especially important in light of current challenges, particularly the need to maintain ecosystem services (Millennium Ecosystem Assessment 2005; Borja et al 2012).

This study contributes to filling a gap in the literature on users' knowledge and valuation of aquatic mountain ecosystems in protected areas. In addition, it provides background that can be used to design nature management and conservation actions that will be acceptable in mountain protected areas. Future studies should also analyze residents' and visitors' perceptions of aquatic mountain ecosystems in depth in order to devise better-informed management strategies for those ecosystems.

FIGURE 5 Violin plots and post-hoc tests for the significant 2-way interaction effects of Domicile×Area. See Table 1 for question details. Different letters above the plots indicate significant differences in post-hoc pairwise comparison. Horizontal lines indicate medians; circles indicate means. Sample sizes are given in parentheses below the plots. Abbreviations of protected areas: PNAESM, Aigüestortes i Estany de Sant Maurici National Park; PNAP, Alt Pirineu Natural Park.



ACKNOWLEDGMENTS

The authors thank the many local and visitor users of the protected areas studied who gave us invaluable information about their perceptions on aquatic mountain ecosystems. Also, we would like to acknowledge the facilities provided by management teams, employees, and nature wardens of the Aigüestortes i Estany de Sant Maurici National Park and the Alt Pirineu Natural Park. Joan Pons is thanked for assisting with surveys. Katie O'Brien and David O'Brien assisted in editing the manuscript and made useful suggestions. Financial support was provided by the European Union LIFE+ LimnoPirineus project (LIFE13 NAT/ES/001210) and the Spanish government projects FUNBIO (RTI2018-096217-B-I00) and BIOOCULT (2413/2017).

REFERENCES

Adler D, Kelly ST. 2018. *vioplot: Violin Plot. R package version 0.3.2*. https://github.com/TomKellyGenetics/vioplot; accessed on 15 February 2020.

Arcury TA, Christianson EH. 1993. Rural–urban differences in environmental knowledge and actions. *Journal of Environmental Education* 25(1):19–25.

Arias A. 2015. Understanding and managing compliance in the nature conservation context. *Journal of Environmental Management* 153:134–143.

Atauri JA, Bravo MA, Ruiz A. 2000. Visitors' landscape preferences as a tool for management of recreational use in natural areas: A case study in Sierra de Guadarrama (Madrid, Spain). *Landscape Research* 25(1):49–62.

Downloaded From: https://bioone.org/journals/Mountain-Research-and-Development on 28 Mar 2024
Terms of Use: https://bioone.org/terms-of-use

Barber JS, Biddlecom AE, Axinn WG. 2003. Neighborhood social change and perceptions of environmental degradation. *Population and Environment* 25(2):77–108.
Borja C, Camacho A, Florín M. 2012. Lagos y humedales en la evaluación de los ecosistemas del milenio en España. *Ambienta* 98:82–90.
Bowler DE, Buyung-Ali LM, Knight TM, Pullin AS. 2010. A systematic review of evidence for the added benefits to health exposure to natural environments. *BMC Public Health* 10:456.
Burgess DJ, Mayer-Smith JM. 2011. Listening to children: Perceptions of nature. *Journal of Natural History Education and Experience* 5:27–43.
Cole DN, Knight RL. 1990. Impacts of recreation on biodiversity in wilderness. *In:* Rasmussen A, editor. *Wilderness Areas: Their Impacts. Proceedings of a Symposium*. Logan, UT: Utah State University, pp 33–40.
Cole DN, Landres PB. 1996. Threats to wilderness ecosystems: Impacts and research needs. *Ecological Applications* 6(1):168–184.
Colley K, Craig T. 2019. Natural places: Perceptions of wildness and attachment to local greenspace. *Journal of Environmental Psychology* 61:71–78.
Dustin D, Zajchowski C, Gatti E, Bricker K, Brownlee MTJ, Schwab K. 2018. Greening health: The role of parks, recreation, and tourism in health promotion. *Journal of Parks and Recreation Administration* 36:113–123.
Faggi A, Breuste J, Madanes N, Gropper C, Perelman P. 2013. Water as an appreciated feature in the landscape: A comparison of residents' and visitors' preferences in Buenos Aires. *Journal of Cleaner Production* 60:182–187.
Farías El. 2011. *Estudi sobre l'afluència i la caracterització dels visitants al Parc Natural de l'Alt Pirineu*. Barcelona, Spain: Generalitat de Catalunya–Departament d'Agricultura, Ramaderia, Pesca, Alimentació i Medi Natural.
Farías El, Grau HR, Camps A. 2005. Trail preferences and visitor characteristics in Aigüestortes i Estany de Sant Maurici National Park, Spain. *Mountain Research and Development* 25(1):51–59.
Flotemersch JE, Shattuck S, Aho K, Cox CE, Cairns MR. 2019. Factors influencing social demands of aquatic ecosystems. *Ecology and Society* 24(4):9.
Gleeson EH, von Dach SW, Flint CG, Greenwood GB, Price MF, Balsiger J, Nolin A, Vanacker V. 2016. Mountains of our future Earth: Defining priorities for mountain research—A synthesis from the 2015 Perth III Conference. *Mountain Research and Development* 36(4):537–548.
Hartig T, Mitchell R, de Vries S, Frumkin H. 2014. Nature and health. *Annual Review of Public Health* 35:207–228.
Hastie TJ, Pregibon D. 1992. Generalized linear models. *In:* Chambers JM, Hastie TJ, editors. *Statistical Models in S*. Pacific Grove, CA: Wadsworth & Brooks/Cole, pp 195–247.
Kaplan S. 1995. The restorative benefits of nature: Toward an integrative framework. *Journal of Environmental Psychology* 15:169–182.
Kernan M, Ventura M, Brancelj A, Clarke G, Raddum G, Stuchlík E, Catalan J. 2009. Regionalisation of remote European mountain lake ecosystems according to their biota: Environmental versus geographical patterns. *Freshwater Biology* 54(12):2470–2493.
Khew JYT, Yokiohari M, Tanaka T. 2014. Public perceptions of nature and landscape preference in Singapore. *Human Ecology* 42:979–988.
Lenth R. 2019. *emmeans: Estimated Marginal Means, aka Least-Squares Means. R package version 1.4.2*. https://CRAN.R-project.org/package=emmeans; accessed on 15 February 2020.
LimnoPirineus. 2015. Project: Presentation. *In: LimnoPirineus: Conservation of Aquatic Habitats and Species in High Mountains of the Pyrenees*. http://www.lifelimnopirineus.eu/en/project; accessed on 15 February 2020.
Mascia MB, Brosius JP, Dobson TA, Forbes BC, Horowitz L, McKean MA, Turner NJ. 2003. Conservation and the social sciences. *Conservation Biology* 17(3):649–650.
Millennium Ecosystem Assessment. 2005. *Ecosystems and Human Well-Being: Wetlands and Water*. Washington, DC: World Resources Institute.
Miró A, O'Brien D, Tomàs J, Buchaca T, Sabás I, Osorio V, Lucati F, Pou-Rovira Q, Ventura M. 2020. Rapid amphibian community recovery following removal of non-native fish from high mountain lakes. *Biological Conservation* 251:108783.
Moyle BD, Weiler B. 2017. Revisiting the importance of visitation: Public perceptions of park benefits. *Tourism and Hospitality Research* 17(1):91–105.
Newsome D, Moore SA, Dowling RD. 2002. *Natural Area Tourism. Ecology, Impacts and Management*. Bristol, United Kingdom: Channel View Publications.
Price MF, editor. 2004. *Conservation and Sustainable Development in Mountain Areas*. Gland, Switzerland and Cambridge, United Kingdom: IUCN [The World Conservation Union].
Primack RB. 2014. *Essentials of Conservation Biology*. 6th edition (1st edition 1993). Sunderland, MA: Sinauer Associates.
R Core Team. 2018. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing. http://www.R-project.org/; accessed on 15 February 2020.
Relph E. 1976. *Place and Placelessness*. London, United Kingdom: Pion.
Romagosa F. 2008. Impactos de la frecuentación turística en el Parque Natural de los Aiguamolls de l'Empordà. *Investigaciones Geográficas* 46:107–125.
Romagosa F, Eagles PFJ, Lemieux CJ. 2015. From the inside out to the outside in: Exploring the role of parks and protected areas as providers of human health and well-being. *Journal of Outdoor Recreation and Tourism* 10:70–77.
Schmitz MF, De Aranzabal I, Pineda FD. 2007. Spatial analysis of visitor preferences in the outdoor recreational niche of Mediterranean cultural landscapes. *Environmental Conservation* 34(4):300–312.
Searle SR, Speed FM, Milliken GA. 1980. Population marginal means in the linear model: An alternative to least squares means. *The American Statistician* 34(4):216–221.
Taff BD, Benfield J, Miller ZD, D'Antonio A, Schwartz F. 2019. The role of tourism impacts on cultural ecosystem services. *Environments* 6(4):43.
Veal AJ. 1997. *Research Methods for Leisure and Tourism. A Practical Guide*. London, United Kingdom: Financial Times Management.
Ventura M, Tiberti R, Buchaca T, Buñay D, Sabás I, Miró A. 2017. Why should we preserve fishless high mountain lakes? *In:* Catalan J, Ninot JM, Aniz MM, editors. *High Mountain Conservation in a Changing World*. Cham, Switzerland: Springer, pp 181–205.
Walker-Springett K, Jefferson R, Böck K, Breckwoldt A, Comby E, Cottet M, Hübner G, Le Lay YF, Shaw S, Wyles K. 2016. Ways forward for aquatic conservation: Applications of environmental psychology to support management objectives. *Journal of Environmental Management* 166:525–536.
Wiejaczka L, Piróg D, Tamang L, Prokop P. 2018. Local residents' perceptions of a dam and reservoir project in the Teesta Basin, Darjeeling Himalayas, India. *Mountain Research and Development* 38(3):203–210.
Worboys GL, Lockwood M, Kothari A, Feary S, Pulsford I. 2015. *Protected Area Governance and Management*. Canberra, Australia: ANU Press.
Zins A. 2006. Centrality of recreation activities. *In:* Weiermair K, Pechlaner H, Bieger T, editors. *Time Shift, Leisure and Tourism, Impacts of Time Allocation on Successful Products and Services*. Berlin, Germany: ESV, pp 203–221.

Supplemental material

APPENDIX S1 Extended description of question 10, Valuation of LIFE+ LimnoPirineus.

Found at DOI: https://doi.org/10.1659/MRD-JOURNAL-D-19-00040.1.S1.

Downloaded From: https://bioone.org/journals/Mountain-Research-and-Development on 28 Mar 2024
Terms of Use: https://bioone.org/terms-of-use