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From the Crowded Valleys to the Preserved Summits: Mountain Sports Participants' Attitudes Toward Protected Areas in the Sprawling Urban Areas of the Northern French Alps

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Managing the flow of visitors in protected areas of the northern French Alps has become a central issue due to inhabitants' growing interest in mountain sports. This article presents the findings of a survey of mountain sports participants involving 1883 respondents in 4 mountain massifs. We inquired about their knowledge of the recreation spot (protection statuses and wildlife) and their attitudes toward restricting access to minimize wildlife disturbance. Respondents had better knowledge of wildlife than of protection statuses. Although they supported measures that aim to reduce disturbance, they believed access to the mountains should not be restricted. Type of activity, mountain site, and proximity of residence to recreation spots all influenced knowledge and attitudes. These results should encourage managers to target visitors differently based on what they do and where they come from to ensure compliance with regulations and tranquility of wildlife.

Keywords: *nature sports; knowledge of protected areas; acceptance of protected areas; wildlife tranquility areas.*

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Introduction

The growing popularity of mountain sports

The growing interest in outdoor recreation and nature sports worldwide is undeniable (Newsome 2014; Balmford et al 2015; Melo et al 2020). Contact with nature is one of the main reasons for the practice (Melo and Gomes 2017; Perrin-Malterre et al 2019); in the context of urban living and growing disconnection with nature, nature sports is seen as a way to escape everyday life and to provide new sensations, emotions, and experience (Melo et al 2020). In France, a 2010 survey conducted by the Ministry of Health, Sports, and Youth reported that 25 million people took part in nature sports, with hiking and cycling being the most popular activities (Lefèvre and Thiery 2011).

Evaluating participants' relations to protected areas

Although outdoor recreation and contact with nature help to promote environmental awareness and ecofriendly behavior (Bjerke et al 2006; Kil et al 2014), participants are often not aware that their presence in nature has consequences for the environment, particularly for wildlife (Gruas et al 2020). However, the disturbance of wildlife caused by recreation has been well documented in ecological research, as summarized in several literature reviews (Steven et al 2011; Sato et al 2013; Larson et al 2016). More than half of these publications report an impact of recreation on wildlife or nature. In mountain environments, for instance, wildlife is particularly sensitive to disturbance during winter (Sato et al 2013; Larson et al 2016). As more people become involved in nature sports, the impacts are bound to intensify: not only will increasing numbers of recreationists visit natural areas, but the sensation of crowding will also cause them to expand their recreational area, thereby increasing impact on biodiversity (Rupf et al 2019). To cope with the increasing demand for nature and to minimize wildlife disturbance, managers of mountain protected areas are implementing awareness-raising campaigns and other practical measures, such as tranquility areas for wildlife. Public education requires managers to evaluate the knowledge and attitudes of users toward the protection statuses of their areas to carry out effective and appropriate educational strategies (Sterl et al 2008). Community understanding, support, and knowledge of measures are necessary for effective management, because these facilitate visitors' compliance and positive attitudes toward measures (Chuenpagdee et al 2013; Tonin and Lucaroni 2017). Place of residence and frequency of visits appear to be central in the development of knowledge and attitudes. Proximity to recreational places and/or frequent visits seem to positively influence knowledge of natural areas (wildlife, natural

history, restrictions, management issues, etc) (D'Antonio et al 2012; Levêque et al 2015; Cosquer et al 2019). However, results are not consistent in all surveys (eg knowledge of forests was influenced neither by the frequency of visits nor by the travel distance to the recreation spot, according to Heer et al 2003). In addition, the relationship between knowledge and acceptance of restrictive management measures is not straightforward and may depend on the geographical origin of recreationists. For instance, Cosquer et al (2019) demonstrated that nonlocals were more supportive than local residents regarding regulations because they did not have these constraints in their daily lives. Likewise, according to Gundersen et al (2015), area restrictions are controversial for local communities and leave managers with low legitimacy at the local level. Some local user groups can feel dispossessed of the rights to use what they perceive as their own land through a privatization process conducted by public authorities.

Research aims and questions

The aim of this research is thus to delve deeper into the link between the geographical proximity to a natural area and the knowledge and attitudes of recreationists toward the natural environment and restrictions of usage. We investigated several mountain massifs of different restrictive status and popularity. Our study was based in the Auvergne-Rhône-Alpes region in France, an administrative unit that covers the northern French Alps and is currently the second-most populated of the country. Between 2007 and 2017, the mean population growth was +0.7% per year, higher than the national mean (+0.5%) (Geymond and Lécroart 2019). The regional demographic growth leads to sprawl and densification of urban areas (Rigollet 2011). In 2020, 92% of the inhabitants of the Auvergne-Rhône-Alpes region lived in a functional urban area (Pollet and Roy 2020). Although demographic growth happens mostly in suburban areas (Desgouttes and Depil 2017), municipalities of low to very low density are also growing rapidly (Barrioz 2019; Geymond and Lécroart 2019). Motivated by leisure (Mao 2003; Martin 2013), amenity-led migration in mountain regions has been increasing since the 1990s, and new nature sports enthusiasts choose mountain regions as their main residence every year. In the northern French Alps, where the recreational potential is high (Schirpke et al 2018), population growth is thus bound to an intensification in mountain use. The presence of protected areas, such as national parks, is an important pull factor for tourists (Wall-Reinius and Fredman 2007), who contribute to the region's economy. The departments of Savoie and Haute-Savoie are the region's leading destinations in terms of wealth generated and jobs in the tourism industry (Agence Savoie Mont Blanc Tourisme 2022). Given that mountains are used by local residents, people from neighboring cities, and holidaymakers, there is an urgent need to assess how place of residence influences visitors' knowledge of and attitudes toward their destinations. Managers of protected areas need to assess the a priori knowledge of visitors, which could differ depending on where they come from and which activity they practice, to inform them about nature and wildlife protection measures.

We expected differences in knowledge and acceptance of restrictive measures to depend both on the visitors' place of residency and on mountain site characteristics, such as their distance from urban centers, their reputation, and their level of protection. We hypothesized that visitors to sites with the most emblematic and restrictive protection statuses would have better knowledge than visitors to other sites. In addition, we expected that winter recreationists practicing ski touring may be more aware of tranquility areas, as awareness campaigns are more common in this season. However, we expected that they would be less likely to agree to restrictions to their activity than summer recreationists practicing hiking. Being outside tracks and exploring fresh and untouched snow fields is an intrinsic part of the ski touring experience and pleasure, whereas walking is more easily done on marked tracks.

Based on a large survey performed in summer and winter at 4 mountain sites, we focused on the following questions:

1. What are the sociological and spatial profiles of the visitors of the northern French Alps' protected areas?
2. What are their levels of knowledge of protection statuses and wildlife?
3. To what extent does their place of residence influence their relationship with their site of practice, and is this relationship similar across mountain sites and among skiers and hikers?
4. How likely are recreationists to accept conservation measures meant to minimize wildlife disturbance, depending on their place of residency, their activity, and the mountain site they visited?

Study sites

The Alpine furrow that borders the mountain sites of the northern French Alps includes 2 functional urban areas of more than 700,000 inhabitants, Grenoble and Genève–Annemasse (extending over France and Switzerland), and 2 functional urban areas of 200,000–700,000 inhabitants, Chambéry and Annecy (Figure 1). The social structure of these urban areas includes a high proportion of inhabitants who belong to the most well-off classes, thus constituting a population that has the cultural and economic capital to be attracted to outdoor recreation (Pociello 1995).

To study the influence of the place of residence on the knowledge of and attitudes toward protected areas, we focused on 4 mountain massifs located in the northern French Alps: Belledonne, Bauges, Aiguilles Rouges, and Vanoise.

- Belledonne and Bauges are medium-elevation massifs bordered by the urban centers of Chambéry, Annecy, or Grenoble, and most of their municipalities belong to the suburban centers of these functional urban areas (Figure 1). Due to their lower elevations and less emblematic protection statuses (both have a small hunting reserve, and Bauges is a natural regional park), these sites are not as popular as tourist destinations as other places in the Alps. Their touristic capacities reach 46 and 47 beds per square kilometer, respectively.

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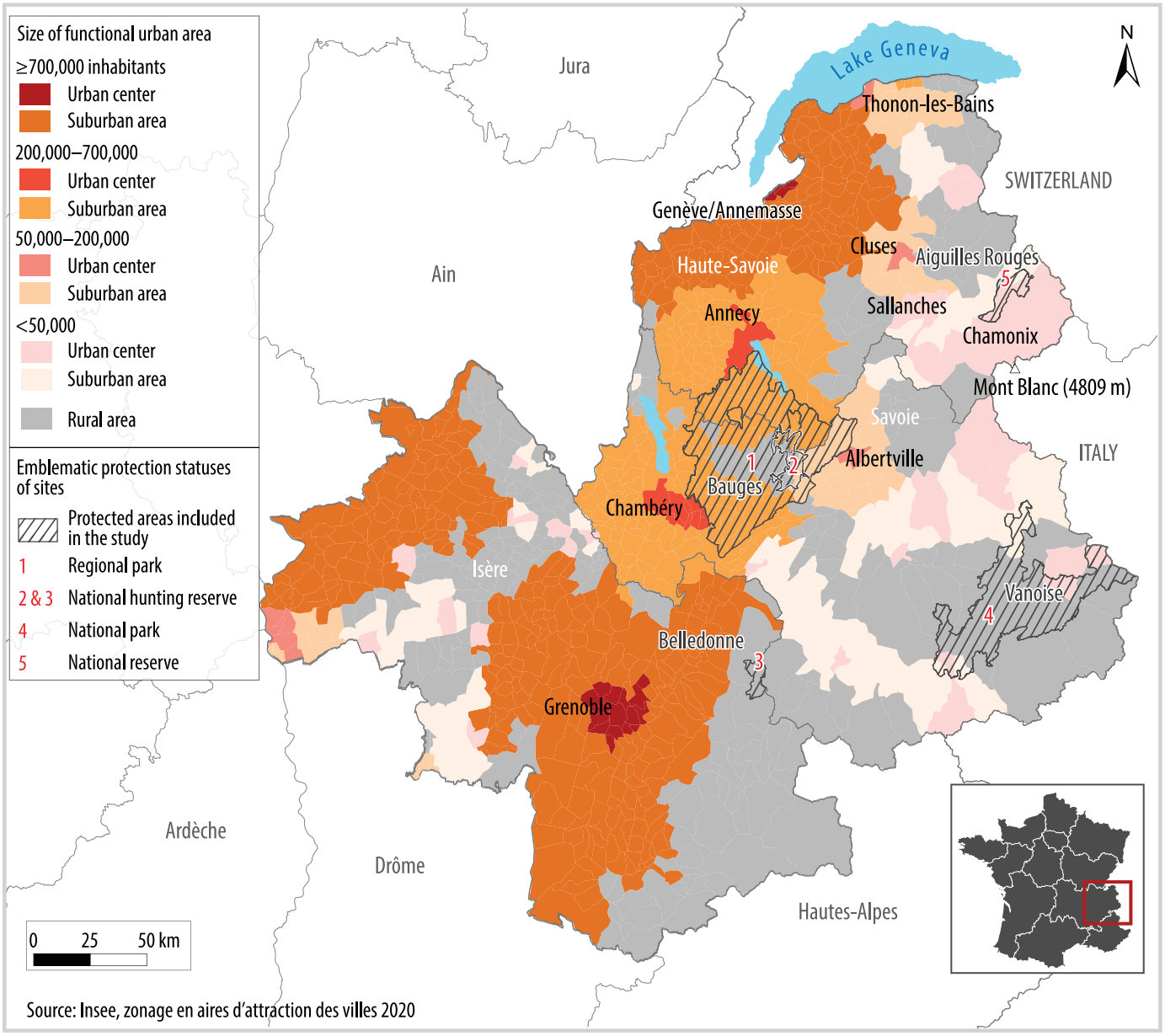
FIGURE 1 Location and size of functional urban areas in Isère, Savoie, and Haute-Savoie. (Map by Léna Gruas)



- Aiguilles Rouges and approximately half of Vanoise are uninhabited due to their relief and restrictive protection statuses that prevent construction within their perimeters (national nature reserve and national park, respectively). They are located farther from the largest functional urban areas of the region (Figure 1). Both sites receive high numbers of national and international visitors each year. Aiguilles Rouges benefits from its proximity to the city of Chamonix and to Mont Blanc. The touristic capacity is high, with 364 beds per square kilometer in the surrounding municipalities. Vanoise has some major touristic attributes: its high elevation (up to 3855 m) and its national park status attract many people, especially in summer for hiking. The range spreads over 2 valleys: Maurienne, which has a capacity of approximately 68 beds per square kilometer, and Tarentaise, with 200 beds per square kilometer.

Methods

Survey design

To examine participation in mountain sports in the northern Alps, we conducted a questionnaire survey at the 4 mountain sites presented above. For this article, we investigated the differences among sites and activities for 5 response variables: knowledge of wildlife (8 possible species), knowledge of protection statuses (8 possible statuses), knowledge of tranquility areas for wildlife (a single question with a yes or no answer), measures of acceptance of temporal or spatial limitation to recreation, and belief that access to natural areas should not be restricted, the latter 2 variables being assessed with a Likert scale, strongly inspired by that used by Sterl et al (2010), going from totally disagree to fully agree (Table 1). We also tested for the effect of where the recreationists came from, measured by how close they lived

TABLE 1 Response variables included in the survey.

Theme	Variable	Type of variable analyzed
Knowledge of wildlife	In your opinion, is it possible to encounter these animals in [site]? (8 species)	Proportion of right answers calculated over the 8 binary outcomes (correct or not correct) to each answer
Knowledge of status	In your opinion, which of these protection statuses apply to [site]? (8 protection statuses)	Proportion of right answers calculated over the 8 binary outcomes (correct or not correct) to each answer
Knowledge of tranquility area	Do you know that in some mountains there are access restrictions in order to minimize wildlife disturbances?	Binary outcome (yes versus no)
Acceptance of tranquility areas	Nature conservation necessitates temporal or spatial limitations of outdoor recreation.	Likert scale simplified as a binary outcome: agree (combining agree and totally agree) versus others (neutral, disagree, and totally disagree)
	The access to natural areas should not be restricted.	Likert scale simplified as a binary outcome: agree (combining agree and totally agree) versus others (neutral, disagree, and totally disagree)

to their recreation area (within the same site, in the nearby municipalities, or farther away).

Selection of respondents

The survey took place between January 2018 and August 2019 to include 2 winter and 2 summer administration periods and to collect enough questionnaires at 17 spots across the 4 massifs. Questionnaires were filled out by participants after their outings. We met them directly on the recreational sites (usually in parking lots and occasionally in mountain huts). The acceptance rate was about 70%. We targeted people above 15 years of age who took part in either ski touring or snowshoeing in winter and in either hiking or trail running in summer. In total, 2786 people took part in the survey. Incomplete or incoherent questionnaires were discarded, resulting in a total of 2559 valid questionnaires. For the present analysis, we focused exclusively on inhabitants of France who were skiers or hikers and hence relied on 1883 respondents: 49% practiced ski touring and 51% were hikers.

Geographical analyses

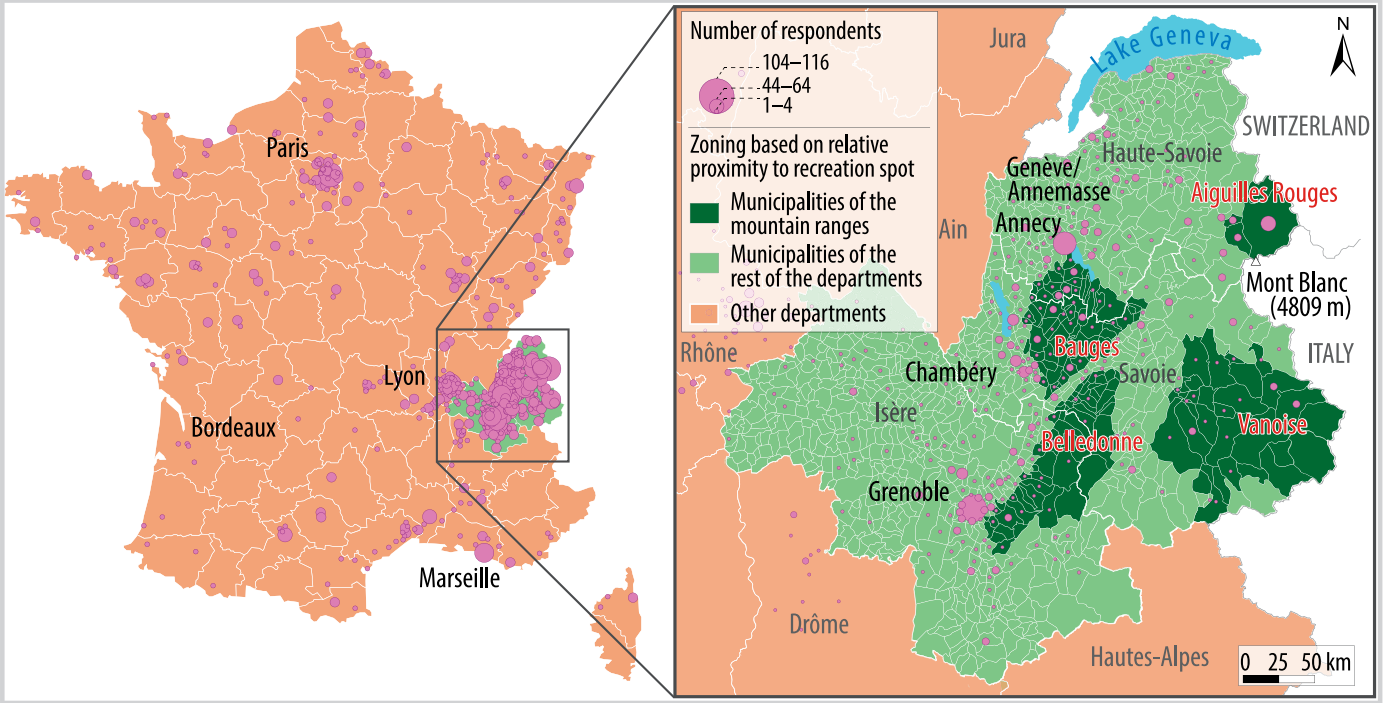
The geographical analysis was carried out using the French National Institute for Statistics and Economic Studies (INSEE) code of each participant. This numerical indexing code allows the place of habitation to be matched with different nomenclatures, such as the functional urban area, provided by the institute. Using the geographical coordinates of the respondents' INSEE code and of the site at which they were surveyed enabled us to calculate the distance traveled to get to the recreation area, as well as to categorize respondents according to how close their habitation is to the site they visited. Geographical treatments were conducted using QGis and R. Based on the municipality of habitation and the site where they were surveyed, we categorized respondents into zones of relative proximity to their recreation spot (detailed in Figure 2):

- Inhabitants of the mountain sites (locals, 11%). Municipalities were selected based on the sites' geological limits. For the uninhabited Aiguilles Rouges and the national park part of Vanoise, we included the municipalities on which the perimeter of the protection status is located. Respondents considered locals lived on average 12 km (SD = 7) from their recreation spot (distance as the crow flies). A total of 54% stated that the mountain range where they were interviewed was their favorite to visit.
- People who live elsewhere in the departments of the sites (Isère, Savoie, and Haute-Savoie) (nearby, 49%). The respondents from this category lived on average 43 km from the recreation site (SD = 27). A total of 30% said they were interviewed in their favorite range.
- Inhabitants of the rest of the country (farther, 40%). This group included people who lived outside the perimeter of the sites, and the mean distance to the site was 422 km (SD = 771). A total of 25% said they were interviewed in their favorite range.

Statistical analysis

We tested for the effects of activity, site, and proximity on the answers provided to each question. We first tested for the effects of activity and site. Then, given that answers differed by activity and site (see Results and Table S1, *Supplemental material*, https://doi.org/10.1659/MRD-JOURNAL-D-21-00001.1.S1), we performed the analyses of the geographical origin of respondents separately for skiers and hikers. Three of the response variables had binary outcomes (Table 1): knowledge of tranquility areas for wildlife, nature conservation necessitates temporal or spatial limitations of outdoor recreation, and access to natural areas should not be restricted. The 2 remaining response variables, knowledge of wildlife and knowledge of statuses, were combined binary outcomes (correct versus not correct) over a group of 8 questions (Table 1). We used logistic models given that all these response variables (binary outcome or combined multiple binary outcomes) have a binomial distribution (Zuur et al 2009; Crawley 2012). There were few missing values (between 0 and 3%), and we considered the missing values as "not correct" answers or "no opinion or disagree" answers. We tested for the effects of activity and site (and their 2-way interaction) on the whole dataset and of site and proximity (and their 2-way interaction) on the datasets per activity using chi-square tests. Observed values for the 5

FIGURE 2 Geographical origins of respondents in the departments of Savoie, Haute-Savoie, and Isère where the study sites are located, and representation of the zoning of proximity. Dark green, locals; pale green, nearby; brown, farther away. (Map by Léna Gruas)



response variables per activity, sites, and proximity are provided in Figures S1 to S4 (*Supplemental material*, https://doi.org/10.1659/MRD-JOURNAL-D-21-00001.1.S1). We used the R package glm for fitting of the logistic models (R Core Team 2019) and the R package visreg (Breheny and Burchett 2017) to estimate the predicted values and their confidence intervals for each modality of explanatory variables or a combination of modalities of explanatory variables.

Results

Sociodemographics

Our sample consisted of 63% men and 37% women. The gap between genders was especially wide in ski touring, whereas hiking almost reached parity (Table 2). Mean age was older for hikers than for ski touring individuals (Table 2). As expected, participants belonged to the most well-off social classes with high cultural and economic capitals: 47% graduated with a master's degree or higher, 47% work as managers or as higher professionals, and the annual median income per consumption unit is substantially over the national mean, with € 27,500 versus € 21,121 in France (€ 1 = US$ 1.21 on 1 December 2020).

Geographical distribution of respondents

Respondents from the area (departments of Isère, Savoie, and Haute-Savoie) traveled on average 66 km via the road network. Skiers traveled slightly less (60 km) than hikers (72 km). Unsurprisingly, given their proximity to a major functional urban area, visitors of Bauges and Belledonne traveled significantly less than visitors of Aiguilles Rouges and Vanoise (49 and 54 versus 70 and 109 km, respectively). Respondents from the rest of the country traveled on average 394 km to reach Bauges and Belledonne and 544 km over 6.15 hours to reach Aiguilles Rouges and Vanoise. As shown in Figure 3, the sites did not attract the same visitors, with more locals in Bauges and Aiguilles Rouges, more neighbors in Belledonne, and more visitors from farther away in Vanoise. The differences are accentuated in summer, especially for Vanoise National Park.

Recreationists' knowledge of site

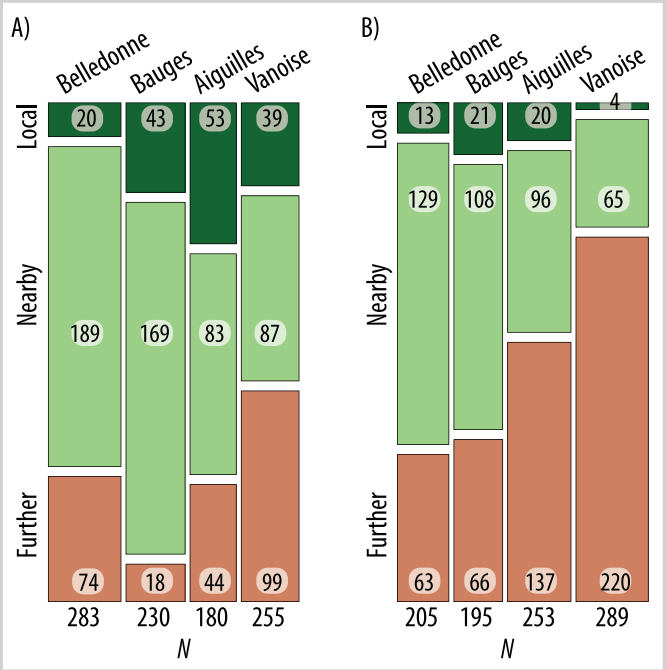
Knowledge of site statuses, of wildlife present, and of the existence of tranquility areas differed among skiers and hikers (see Table S1 for tests and Table S2 for predicted values, *Supplemental material*, https://doi.org/10.1659/MRD-JOURNAL-D-21-00001.1.S1): overall, the knowledge of skiers

TABLE 2 Sociodemographic characteristics of participants engaging in ski touring and hiking.

Sociodemographic characteristics	Ski touring (n = 925)	Hiking (n = 958)
Gender (% of men)	73	53
Mean age (y, median)	42 (40)	47 (48)
Degree		
% of high school diploma or lower	21	29
% of bachelor degree or higher	79	71
Occupation		
% of managers	53	42
% of retirees	7	16
Median income per CU (€)	28,000	27,000

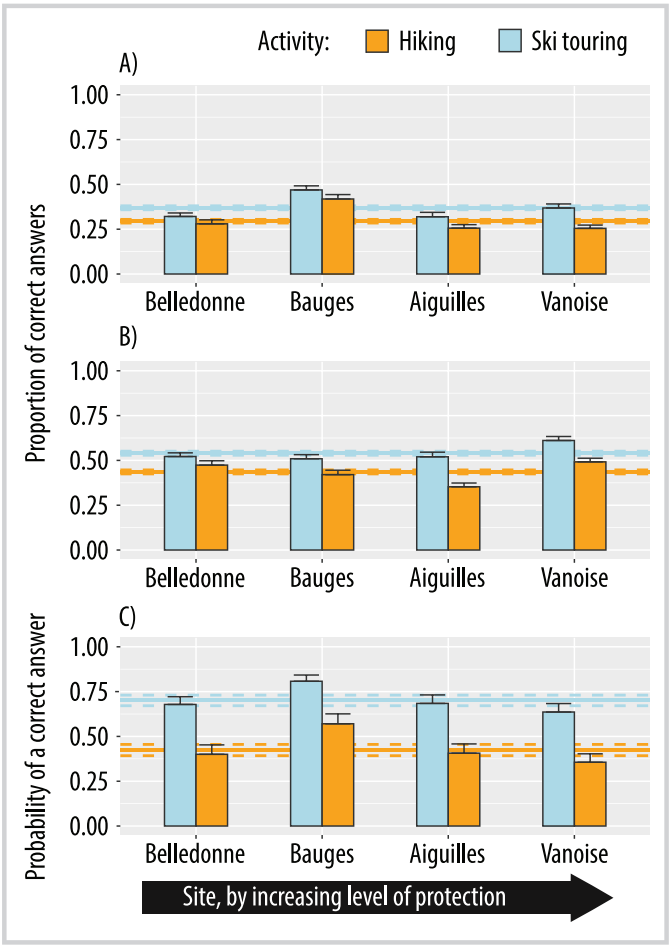
Note: CU, consumption unit.

FIGURE 3 Number of respondents by proximity class (local, nearby areas, and farther away in France), by site (Belledonne, Bauges, Aiguilles Rouges, and Vanoise), and by activity (ski touring and hiking). Bar widths correspond to the sample size per site (*N*). Numbers within bars indicate the number of respondents per site and proximity class.



was higher than the knowledge of hikers (of status, 37 versus 29%; of wildlife, 54 versus 44%; and of tranquility areas, 70 versus 42%, for skiers and hikers, respectively), with the largest differences for knowledge of tranquility areas (odds ratio: 1.67 for knowledge of tranquility areas versus 1.28 for knowledge of status and 1.27 for knowledge of wildlife in favor of skiers). The level of knowledge for the 3 variables also differed among sites, but this site effect was quite complex; the extent of the site effect differed by both activity and response variable (see detailed estimates per response variable, site, and activity in Table S2, *Supplemental material,* https://doi.org/10.1659/MRD-JOURNAL-D-21-00001.1.S1). For instance, the site effect on knowledge of status was mostly due to a higher proportion of correct answers in Bauges for both skiers and hikers (47 and 42%, respectively). In other ranges, the proportions were close to the overall average or below average (Figure 4) for both winter and summer (see values in Table S2, *Supplemental material,* https://doi.org/10.1659/MRD-JOURNAL-D-21-00001.1.S1). Similarly, knowledge of wildlife (Figure 4B and Table S2, *Supplemental material,* https://doi.org/10.1659/MRD-JOURNAL-D-21-00001.1.S1) revealed a contrast in the high proportion of correct answers in Vanoise for skiers (61%), close-to-average values for skiers of all other sites (52% in Belledonne and Aiguilles Rouges and 51% in Bauges massif), and low proportion of correct answers among hikers, particularly in Aiguilles Rouges (35%). These proportions were close to or slightly higher than average for hikers in Bauges (42%), Belledonne (47%), and Vanoise (49%). Finally, the site effect on knowledge of tranquility areas, for both skiers and hikers, contrasted Bauges (79% for skiers and 59% for hikers) to Vanoise (64% for skiers and 36% for hikers). Visitors to Belledonne (67% for skiers and 40% for hikers) and Aiguilles

FIGURE 4 Proportion of correct answers regarding protection statuses (A) and wildlife (B) and probability of a correct answer regarding tranquility areas (C), all by site and activity. Bars and error bars represent predicted values from the generalized models testing for the main effects and the 2-way interaction between site and activity. Horizontal lines correspond to mean values and their standard error for each activity (blue for skiing and orange for hiking) across sites.



Rouges (72% for skiers and 38% for hikers) had a probability of knowing about tranquility areas similar to the overall average (70% for skiers and 42% for hikers; Figure 4). In any case, the site differences did not support the hypothesis that the strength of the protection status (from hardly any in Belledonne to the strongest in Vanoise, a national park) explained the level of knowledge regarding status, wildlife, or tranquility areas, with the exception of knowledge of wildlife among skiers in Vanoise, which was clearly above that of skiers in other sites. The complex site and activity effects (see tests in Table S1, *Supplemental material,* https://doi.org/10.1659/MRD-JOURNAL-D-21-00001.1.S1) justified analyses of the effect of proximity on the 3 knowledge response variables for skiing and hiking separately.

All models testing whether the geographical origin of respondents influenced their knowledge (of status, wildlife, and tranquility areas; Table 3) strongly supported that the closer the recreationists lived to their area of practice, the better their knowledge for all 3 response variables. This held true for both skiers and hikers (Figure 5). The contrasts were particularly noticeable between locals and people coming from the farthest away in France (Figure 5). However, the extent of the differences among locals, recreationists from

TABLE 3 Results from testing the general linear models for the effects of 2 explanatory variables, site and proximity, and their 2-way interaction on the 5 response variables.

Activity	Response variable	Site	Proximity	Site proximity
Ski	Knowledge of status	**$\chi^2 = 115.08$, df = 3, $P < 0.01$**	**$\chi^2 = 33.26$, df = 2, $P < 0.01$**	**$\chi^2 = 25.66$, df = 6, $P < 0.01$**
	Knowledge of wildlife	**$\chi^2 = 49.39$, df = 3, $P < 0.01$**	**$\chi^2 = 107.76$ df = 2, $P < 0.01$**	**$\chi^2 = 32.74$, df = 6, $P < 0.01$**
	Knowledge of tranquility area	**$\chi^2 = 14.20$, df = 3, $P < 0.01$**	**$\chi^2 = 17.74$, df = 2, $P < 0.01$**	$\chi^2 = 5.06$, df = 6, $P = 0.54$
	Agreement with the statement that limitations are required	**$\chi^2 = 11.70$, df = 3, $P < 0.01$**	**$\chi^2 = 21.90$, df = 2, $P < 0.01$**	$\chi^2 = 5.19$, df = 6, $P = 0.52$
	Agreement with the statement that access should not be restricted	$\chi^2 = 7.19$, df = 3, $P = 0.07$	$\chi^2 = 0.22$, df = 2, $P = 0.90$	$\chi^2 = 7.28$, df = 6, $P = 0.30$
Hiking	Knowledge of status	**$\chi^2 = 142.97$, df = 3, $P < 0.01$**	**$\chi^2 = 20.24$ df = 2, $P < 0.01$**	$\chi^2 = 8.08$, df = 6, $P = 0.23$
	Knowledge of wildlife	**$\chi^2 = 98.18$, df = 3, $P < 0.01$**	**$\chi^2 = 15.70$, df = 2, $P < 0.01$**	$\chi^2 = 7.95$, df = 6, $P = 0.24$
	Knowledge of tranquility area	**$\chi^2 = 30.49$, df = 3, $P < 0.01$**	**$\chi^2 = 12.70$, df = 2, $P < 0.01$**	$\chi^2 = 6.39$ df = 6, $P = 0.38$
	Agreement with the statement that limitations are required	**$\chi^2 = 16.02$, df = 3, $P < 0.01$**	**$\chi^2 = 7.09$, df = 2, $P = 0.03$**	$\chi^2 = 7.54$, df = 6, $P = 0.27$
	Agreement with the statement that access should not be restricted	**$\chi^2 = 20.46$, df = 3, $P < 0.01$**	**$\chi^2 = 7.84$, df = 2, $P = 0.02$**	$\chi^2 = 10.58$, df = 6, $P = 0.10$

Note: χ^2 values, degrees of freedom (df), and P values are provided. Main effects and interactions with $P < 0.05$ are shown in bold.

nearby areas, and recreationists from farther away in France varied depending on the response variable considered and between activities.

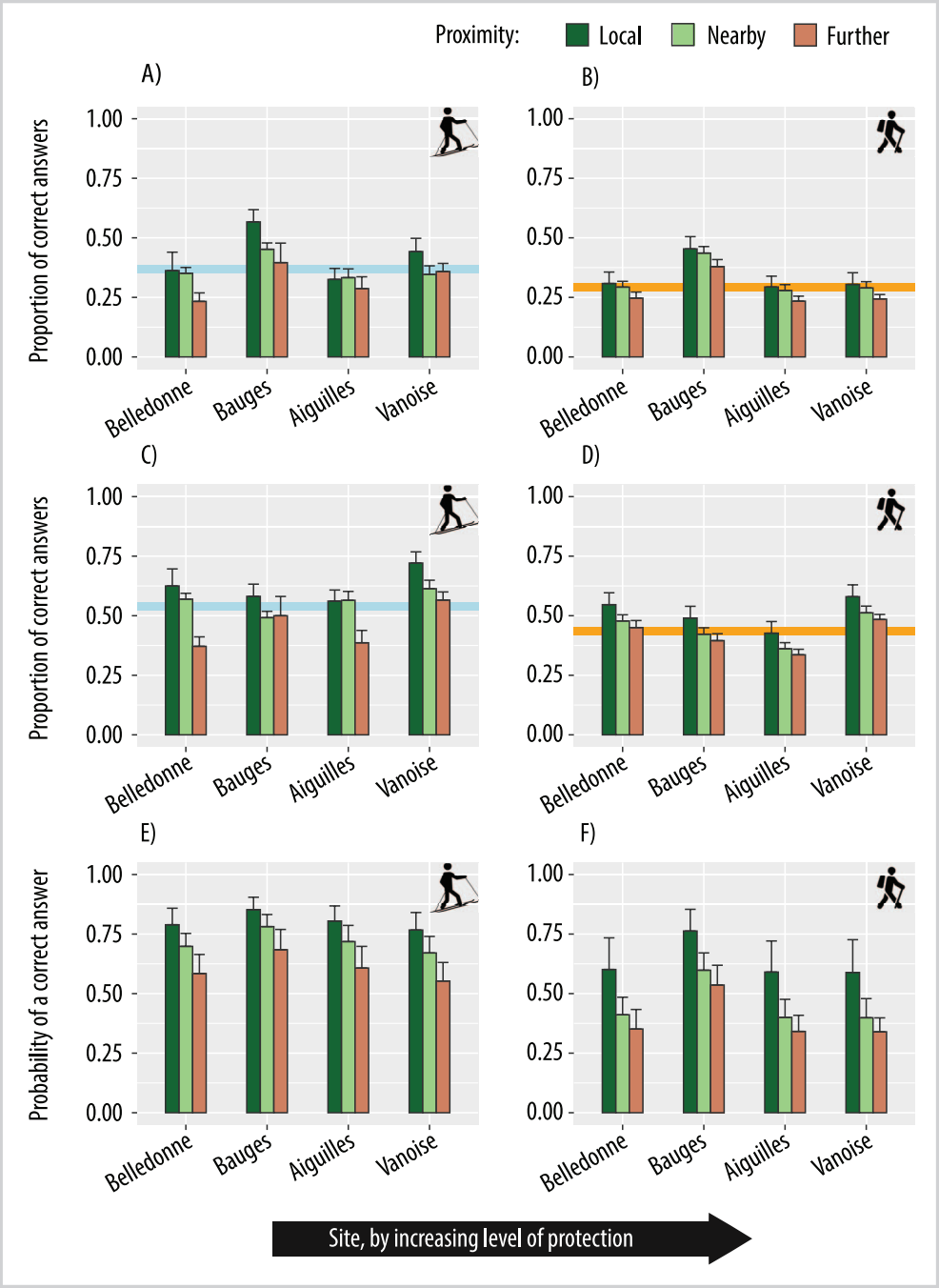
For hikers, the proximity effect was similar for all sites for the 3 response variables (no significant interaction between site and proximity; Table 3). Accordingly, the proportion of correct answers on status was 0.95 and 0.80 times lower for people from nearby and from farther away in France, respectively, than the proportion of correct answers from locals. For knowledge of wildlife, the proportion of correct answers was likewise 0.85 times lower for people from nearby areas and 0.79 times lower for people from farther away in France than the proportion of correct answers from locals (Figure 5D). The effect of proximity was even stronger for the probability of hikers knowing about the tranquility areas, as the probabilities were 0.68 times lower for people from nearby areas and 0.58 times lower for people from farther away in France than for locals (Figure 5F).

For skiers, the results were more complex, because the decrease in the level of knowledge of status and wildlife for people residing farther from their site of practice was different among sites (significant 2-way interaction between site and proximity; Table 3; Figure 5A, C). People from farther away in France had a proportion of correct answers about statuses that was 0.64 (Belledonne), 0.70 (Bauges), 0.81 (Vanoise), and 0.88 (Aiguilles Rouges) times lower than for locals (Figure 5A; see all values given in Table S3, *Supplemental material,* https://doi.org/10.1659/MRD-JOURNAL-D-21-00001.1.S1). For knowledge about wildlife, the proportion of correct answers was also the lowest for the people residing farther away in France: 0.59 (Belledonne), 0.69 (Aiguilles Rouges), 0.78 (Vanoise), and 0.86 (Bauges) times lower than the proportion for locals (Figure 5B; see detailed values given in Table S3, *Supplemental material,* https://doi.org/10.1659/MRD-JOURNAL-D-21-00001.1.S1). When it comes to knowing about the tranquility areas, however, the effect of proximity was the same for skiers in all sites. Skiers had a probability of answering correctly that was 0.89 times lower when they were from a nearby area and 0.75 times lower when they were from farther away in France than that of local skiers in all sites (Figure 5E). The site of Belledonne, which we classified as a suburban site with few protection statuses, was, as expected, the site where people who were not living close to their area of practice had the least knowledge about their site of practice in both summer and winter.

Attitudes toward management measures

Support for conservation measures aiming to protect wildlife differed among activities and among sites (see tests in Table S1, *Supplemental material,* https://doi.org/10.1659/MRD-JOURNAL-D-21-00001.1.S1). Across all sites, a large majority of respondents agreed that limitations are required, but agreement was slightly less among skiers (76%) than among hikers (86%). The agreement was highest among hikers in Vanoise (91%) and Bauges (89%) and lowest among skiers in Vanoise (64%). The among-site differences in agreement to limitations did not correspond to the conservation status: for instance, although the agreement was highest in Vanoise National Park in summer, hikers from Aiguilles Rouges, which has the second-highest degree of protection, did not agree more than hikers in Belledonne, where there is no restrictive status.

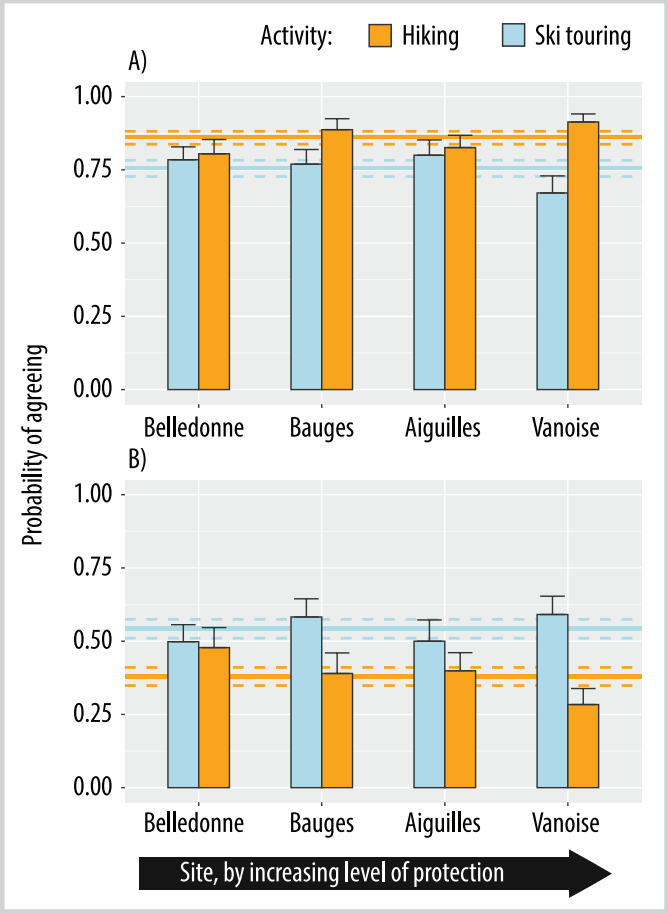
FIGURE 5 Proportion of correct answers regarding protection statuses (A and B) and wildlife (C and D) and probability of a correct answer regarding tranquility areas (E and F) by site (*x*-axis), proximity (bar color), and activity (pictogram). The values and error bars represent the predicted values and 95% error bars from the generalized linear models (see Table 3 for test results), with 2-way interaction when significant (A and C) and with only the main effects of site and proximity when the 2-way interaction was not significant (B and D–F). Horizontal lines are the mean values across site and proximity for ski touring and hiking (blue for ski touring and orange for hiking).



The percentage of respondents who thought that access should not be restricted was higher among skiers (54%) than among hikers (38%) (see test results in Table S1 and expected values in Table S2, *Supplemental material,* https://doi.org/10.1659/MRD-JOURNAL-D-21-00001.1.S1). The differences among sites were only significant for hikers, whereas most skiers were against restrictions, whatever their site of practice. In line with the results on the first question on the tranquility areas (Figure 6B), the lowest percentage of people thinking that access should not be restricted was for hikers in Vanoise National Park (28%). The opinion among hikers appeared to be consistent with the level of protection in the different sites, because the agreement for a lack of restriction was highest in Belledonne (48%, the site currently with no restriction), intermediate in Les Bauges and Aiguilles Rouges (39 and 40%, respectively, sites with intermediary levels of restriction), and as already pointed out, lowest in Vanoise (28%).

Except for skiers' opinions about restricted access, the proximity of the site of practice influenced the opinions of

FIGURE 6 Proportion of respondents agreeing with the statements that tranquility areas are required (A) and access should not be restricted (B) depending on the activity (color) and site (*x*-axis). The values and error bars represent the predicted values and 95% error bars from the generalized linear models (see Table 3 for test results). Horizontal lines correspond to mean values and their standard error for each activity (blue for skiing and orange for hiking) across sites.



respondents on both questions (see tests in Table 3 and detailed values for all categories in Table S3, *Supplemental material*, https://doi.org/10.1659/MRD-JOURNAL-D-21-00001.1.S1). Between 54% (Vanoise) and 71% (Aiguilles Rouges) of local skiers and between 68% (Belledonne) and 82% (Vanoise) of hikers agreed with restricting access. These percentages were higher by 8 to 16% for hikers or skiers from farther away (Figure 7). Local hikers also thought that access should not be restricted to a greater extent (16 to 18% more) than hikers from farther away. Agreement that access should not be restricted is below 50% for all categories, except for locals of the 3 sites with the lowest protection statuses (Belledonne, Bauges, and Aiguilles Rouges, with agreement of 60, 51, and 54%, respectively). Slightly more than half of the skiers (54%), independent of where they came from and independent of their site of practice, believed that access should not be restricted.

Discussion

Types of recreationists in the northern French Alps

Our study shows that in the northeast of the Auvergne-Rhône-Alpes region—the second-most populated region in France and a location considered to have high recreational potential—92% of mountain sports participants lived in a functional urban area. This is exactly the same proportion as across the entire region (Pollet and Roy 2020). Inhabitants of rural areas, who are in closer contact with nature in their place of residence, are thus not more likely than others to take part in mountain sports. This suggests that nature sports participants' recruitment does not operate spatially but rather socially. Our results are consistent with the idea that mountain sports participants belong to the most affluent social classes. This agrees with previous observations made of those visiting natural areas and especially of those participating in adventure sports (Hardiman and Burgin 2010).

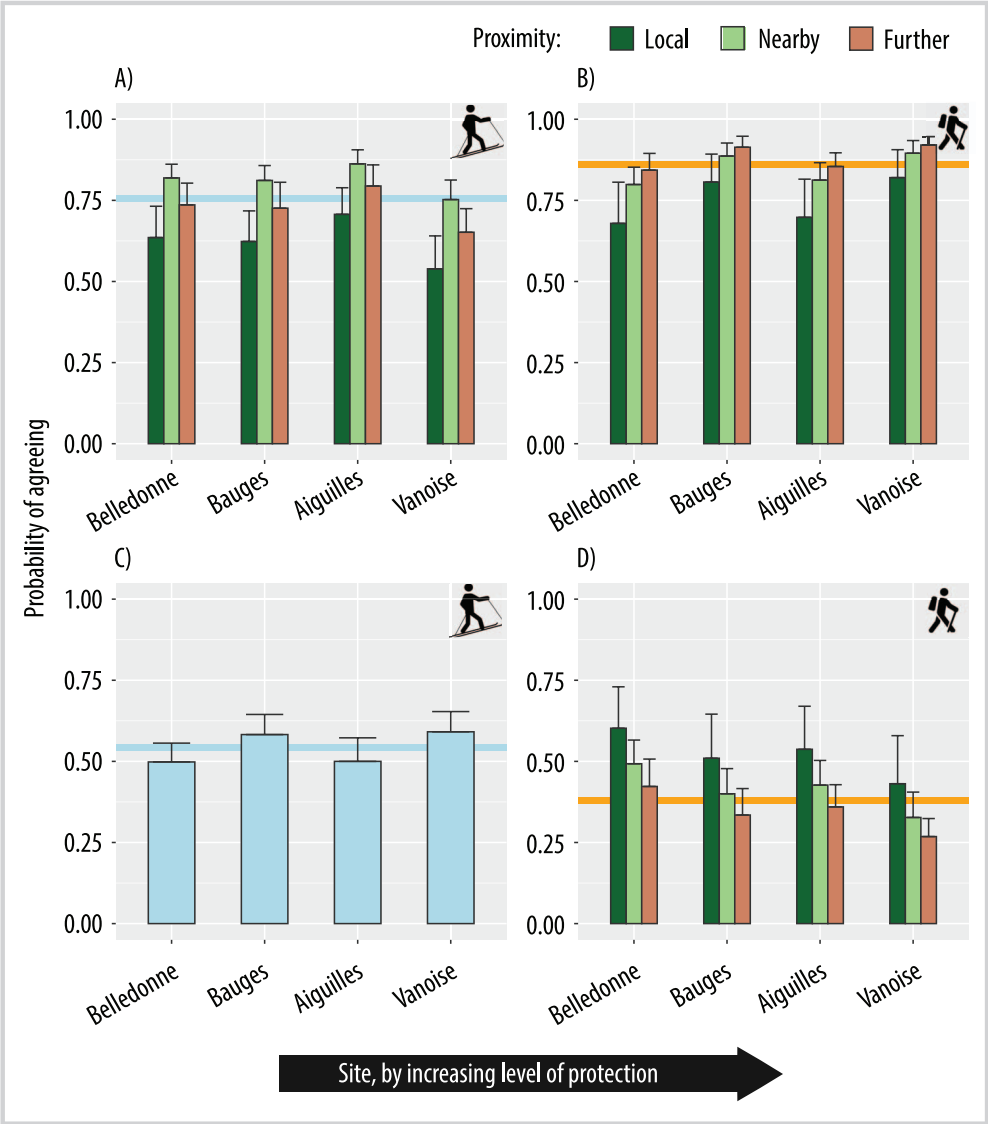
Visitors' knowledge of protection statuses and wildlife

Knowledge varied significantly depending on the mountain ranges; however, the results contradict our hypothesis that knowledge increases with the strength of restriction levels of protection statuses. Vanoise was the first national park created in France for the conservation of ibex; managers still use the emblematic images of ungulate species to promote the national park, which explains the better knowledge of wildlife at this study site. In Aiguilles Rouges and Bauges, where knowledge of wildlife was lower, respondents were probably misled, because in these 2 ranges, 2 of the 3 emblematic ungulates of the Alps are not present (there are no mouflon in the Aiguilles Rouges, and ibex are not found in Bauges). Knowledge of tranquility areas for wildlife varied a lot too. In Bauges and Aiguilles Rouges, better knowledge is most likely due to the presence of several tranquility areas for wildlife at the locations where the survey was carried out.

Activity influenced knowledge of protection statuses and wildlife a lot. In winter, ski touring is riskier and requires knowledge specific to snow and avalanches. Technical skills are also necessary (Volken et al 2007). Furthermore, because there is no clear, marked-out path, skills in orienteering are important to get around in the mountain and to reach summits. The learning process is longer than it is for hiking and requires more frequent contact with the mountain environment. This explains better technical skills and the better knowledge of mountain environments of ski tourers than of hikers. This supports the findings of Cosquer et al (2019), who showed that better-informed recreational users were those involved in activities requiring formal training. In the northern alpine context, better knowledge of tranquility areas for wildlife is also partly explained by those areas being mostly set up to minimize winter disturbance; thus, more communication about them is made in winter.

Proximity to recreational areas also explained the better level of knowledge. This is consistent with previous studies showing that repeated visits to an area improve knowledge (Levêque et al 2015; Larm et al 2018). Local inhabitants, who probably visit the range more regularly, are thus bound to reach higher knowledge levels than other participants. No matter the site, knowledge decreased with distance. Regardless of the emblematic status or touristic attractivity of the sites, locals were always more knowledgeable than visitors from farther away. However, acceptance of restrictions followed a different direction.

FIGURE 7 Proportion of respondents agreeing with the statements that tranquility areas are required (A and B) and access should not be restricted (C and D), by site (*x*-axis), proximity (bar color), and activity (pictogram). The values and error bars represent the predicted values and 95% error bars from the generalized linear models (see Table 3 for test results). Horizontal lines are the mean values across site and proximity for ski touring and hiking (blue for ski touring and orange for hiking). (C) The histograms are not colored by proximity because neither proximity nor site had a significant effect on the response variable (the mean value across sites, shown by the horizontal bar, is within the confidence interval of each site's mean value).



Acceptance of restrictions

Out of the entire sample, most people affirmed that access to natural areas should not be restricted. Limitation of access is seen as a hindrance of individual freedom, especially during recreational time (Zeidenitz et al 2007). These participants believe visitors should be made aware of their responsibilities, as exemplified by Evrard et al (2011: 144): "refusal of interdiction is also refusal of constraints or, at least, a demand for loosening of restrictions to the benefice of individual responsibilities and preference for incentive over obligation."

However, the defiance toward access limitation tends to decrease with distance. The effect of the proximity variable shows that despite higher knowledge of wildlife and protection statuses, locals generally had more negative attitudes toward restrictions. This finding corroborates the not-in-my-backyard (NIMBY) effect, which has been reported in connection with the setup of nature preserves (Byrka et al 2016). That is, people who live close to nature reserves and are most exposed to its related restrictions are significantly less likely to accept the restrictions compared with people who live more remotely from the nearest preserve and are thus less exposed to restrictions. As shown in studies on social acceptance of protected areas (Gall and Rodwel 2016; Laslaz 2020), it appears necessary to promote effective and ongoing stakeholder engagement.

In contrast, nonlocals have a higher level of acceptance of management measures, but their knowledge of protection statuses and of tranquility areas for wildlife is lower. The focus for managing these visitors should be on improving their knowledge about these areas to promote compliance with management measures. Information on the localization of areas should be associated with information on the reason they were implemented: minimizing wildlife disturbance.

Better knowledge of the impacts of nature sports on the environment tends to improve participants' acceptance of management measures (Manning et al 2012; Cornelisse and Duane 2013). Precise behavioral information is also welcome, because as shown by Ballantyne et al (2009: 663), "tourists are particularly interested in practical information about what they could do to help protect the wildlife, rather than general information about conservation issues."

The effect of the activity variable on the acceptance of restrictions was also noticeable, especially in Vanoise, where hikers were the most favorable to it, whereas skiers were the least. In addition, in winter, the proximity effect was not the same as in summer with, for instance, nearby residents most favoring restrictions in all 4 sites. This indicates that visitors, their motivations, and their attitudes differ widely from season to season, and it reinforces the activity effect by showing that practice-specific characteristics can influence acceptance of restrictions. Salz and Loomis (2005) found, for example, that highly specialized anglers might be opposed to restricted fishing areas because they potentially threaten access to specific fishing locations. Sterl et al (2010) found that the pursuit of sporting challenges may be linked to a negative attitude toward conservation measures. According to them, people who participate in the outdoor sports are less interested in nature and may disagree with management measures to protect it. In mountain sports, the desire to preserve one's right of access to the practice environment would be even stronger in sensation-seeking sports requiring a higher level of specialization than in activities more oriented toward contemplation, such as hiking.

Although this factor was not taken into consideration in this article, other studies show that environmental attitudes play an important part in acceptance of restrictions (Schenk et al 2007; Byrka et al 2016; Gruas 2021). According to Byrka et al (2016), it can even cancel the NIMBY effect by offsetting the extra costs for residents living in the vicinity of the nature preserves.

Limitations of the study

This study is subject to some limitations. First, although we tried to make the sample as diverse as possible (different types of mountain ranges; selection of numerous sites giving access to hikes of different levels; administration of the survey on weekdays, weekends, and during and outside holidays; etc), we do not know how representative it is, because the parent population is not known. A second limitation lies in the phrasing of the knowledge questions. As such, it provides information on whether respondents knew about the names of the statuses or the species and about their presence on the ranges. Yet this does not inform us whether respondents knew (1) what the statuses imply (restrictions) and (2) wildlife habits, behavior, or sensitivity to disturbance, which would have been useful information. Moreover, a self-administered questionnaire cannot guarantee the respondents' level of understanding of the questions and of the responses submitted.

Limitations represent opportunities for future research. Thematically, we thus suggest implementing supplementary explanatory variables such as environmental attitudes. Methodologically, including qualitative data collection such as semistructured interviews or focus groups would bring additional analytical sense.

Conclusion

This article presents the findings of a survey of mountain sports participants in 4 protected areas of the northern French Alps. It confirms the general tendency for the most affluent social classes to be attracted to mountain sports. The spatial approach we chose brings insight on variables that can explain knowledge of a mountain range and attitudes toward its regulation. It shows that the living environment (urban, suburban, or rural) barely played a part in the construction of knowledge and acceptance of protected areas. Proximity and type of activity, in contrast, were key factors. In addition, levels of knowledge of protection statuses and wildlife varied a lot depending on the mountain range.

These results will allow managers of protected areas to target visitors differently:

1. Insights on differences between activities should encourage targeting participants differently between winter and summer. Social media dedicated to each activity can be used for communication and exchange with participants. Managers can also take part in events specific to the activities (ski touring races, movie screenings, festivals, etc). On site, signs should be located at different entry points of the protected areas (parking lots might be higher in summer than in winter depending on snow conditions).
2. Managers should work with locals to help them acquire more positive attitudes toward conservation. This can be achieved through local events or communication through municipal newsletters. Cooperative management and inclusion of stakeholders and local visitors in the development of measures to reduce disturbance could make them more likely to accept and comply with measures. Simultaneously, managers should try to improve knowledge of occasional visitors via visitor centers, pedagogical signs, ski resort guides and other mountain professionals, mountain stores, or even tourist accommodations.
3. Results indicate that communication is probably carried out differently depending on the ranges. Managers of different protected areas should continue to work together to develop a more standardized communication policy to raise visitors' awareness efficiently in all ranges.

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Supplemental material

TABLE S1 Results for the general linear models.
TABLE S2 Values of the 5 response variables for each activity when the variable proximity is ignored.
TABLE S3 Predicted values of the 5 response variables for each activity by proximity and site.

FIGURE S1 Observed proportions (and standard errors) for the 3 questions about knowledge by massif and depending on proximity, for skiers.

FIGURE S2 Observed proportions (and standard errors) for the 3 questions about knowledge by massif and depending on proximity, for hikers.

FIGURE S3 Probability to agree (and standard errors) for the 2 questions about opinions for skiers.

FIGURE S4 Probability to agree (and standard errors) for the 2 questions about opinions for hikers.

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