

Research Article

“If we really disturbed them, they would leave”: Mountain sports participants and wildlife disturbance in the northern French Alps

Léna Gruas^{a,*}, Anne Loison^b, Moussa Ba^a, Clémence Perrin-Malterre^a

^a Université Savoie Mont Blanc, CNRS, EDYTEM, Chambéry, France

^b Université Savoie Mont Blanc, CNRS, LECA, Chambéry, France

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ABSTRACT

This article aims to participate in filling the gap of knowledge in mountain sports participants' perception of wildlife disturbance. In a context of growing popularity of these activities and, consequently, of increase of visitors in the Northern French Alps, we examines visitors of protected areas attitudes toward disturbance and wildlife tranquility areas. The quantitative survey focused on ski tourers and hikers ($N = 2050$), it shows that respondents who witnessed disturbance, such as flight response from wildlife, are much more likely to state that they might be a source of disturbance. Additionally, results show that attitudes and values towards wildlife and disturbance are more important than sociodemographic or activity related characteristics to explain perception of self-caused disturbance or avoidance of tranquility areas.

Management implications: Results illustrate the importance of providing protected areas managers with information on visitors as it can help targeting and raising awareness in ways that appeal directly to them, such as.

- By using photos and videos of distressed fleeing wildlife to appeal to emotion and to participate in shifting attitudes toward restricted areas and management measures;
- Targeting participants depending on their level and involvement in the activity;
- Reinforcement of mountain professionals training (mountain guides, ski instructors, mountain leaders etc.) with courses on the ecology and biodiversity of mountain ecosystems.

1. Introduction

Sport tourism and active leisure activities in natural areas are increasing in popularity all over the world (Gibson et al., 2018; Melo et al., 2020). However, increasing numbers of nature-based recreationists and tourists are an important source of pressure on natural environments, causing impacts on soil, water, vegetation and animals (Ballantyne & Pickering, 2013, 2015; Mounet et al., 2004; Rixen & Rolando, 2013, van der Duim & Caalders, 2002). Disturbance caused by nature-based activities represents a source of pressure for wildlife. Studies report impacts such as extra energy expenditure, modification of physiological and behavioural responses, or jeopardised feeding process (Arlettaz et al., 2015; Gutzwiller et al., 2017; Knight & Gutzwiller, 1995; Marchand et al., 2014; Patthey et al., 2008; Taylor & Knight, 2003). These studies appear in several reviews of literature that have been

published in order to globally assess the impact caused by recreation based on different indicators (Boyle & Samson, 1985; Larson et al., 2016; Sato et al., 2013; Steven et al., 2011) Between 50% and 88% of publications included in these reviews supported negative rather than positive or non-existent effects.

Despite its well-documented effects in ecological research few studies have examined the human perspective on wildlife disturbance. A literature review by Gruas et al. (2020) notes a lack of research on the topic, in comparison, a separate review on the effects of recreation on wildlife (Larson et al., 2016) examined nearly six times as many studies. Evaluating outdoor recreationists' perceptions of wildlife disturbance is crucial in order to mitigate its consequences.

* Corresponding author.

E-mail address: lena.gruas@gmail.com (L. Gruas).

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1.1. Outdoor recreationists' awareness of recreational impacts on wildlife

In the aforementioned literature review, [Gruas et al. \(2020\)](#) show that most of the 47 articles included in the review found that the majority of respondents were not aware that they might disturb wildlife. Among the factors that influence awareness, **experience in nature and knowledge of wildlife** was one of the most commonly looked at by researchers. Studies revealed for instance that witnessing negative impacts during the activity made people more likely to state that they could be a disturbance to wildlife ([Dearden et al., 2007](#); [Lucrezi et al., 2013](#); [Orsini & Newsome, 2005](#)). Experience in nature is strongly related to **experience in the activity** which also influenced perception. For instance, [Thapa et al. \(2005, p. 65\)](#) showed that “divers who had higher levels of specialization tended to have stronger marine-based environmental knowledge. In addition, specialization was a mediator in that those with higher levels of specialization also reported more pro-environmental behaviours”. However, other studies suggest that respondents with greater knowledge of wildlife and experience of their activity were less aware of the disturbance they can potentially cause. For instance, [Levêque et al. \(2015\)](#) found that the more frequently people engaged in a recreational activity in the forest, the less impact they thought they had on amphibians. They were therefore less supportive of management measures than inexperienced respondents. This was also shown by [Wu et al. \(2015\)](#) for backpackers: most respondents had little awareness of their environmental impacts and held negative attitudes toward restricted activities in the non-tourist district of protected areas. Another study ([Hillery et al., 2001](#)) points up that tourists are less sensitive than locals recreationists to the state of the environment in general, including the effect of nature-based recreational activities on wildlife. It also appears that awareness is not systematically associated with a change in behaviour, as illustrated by [Weiss et al. \(1998\)](#) survey on ski tourism. According to the review, few studies have considered **socio-demographic factors** to investigate their influence on awareness of wildlife disturbance. The few studies that took it into account show that gender does not seem to influence the level of awareness ([Haukeland et al., 2013](#); [Jorgensen & Bomberger Brown, 2016, 2016, 2016](#)). Age was also not significant in the same two studies, but [Le Corre et al. \(2013\)](#) found that the older the population, the less aware people were of bird disturbance. Geographical origins had no effect on perceptions of the state of the environment or of disturbance in two studies ([Jorgensen & Bomberger Brown, 2016](#); [Prayag & Brittnacher, 2014](#)). Three studies that explored the influence of education and occupation revealed that people with higher levels of education or in higher occupational categories were more aware of their impact on wildlife ([Grossberg et al., 2003](#); [Haukeland et al., 2013](#); [Le Corre et al., 2013](#)). Finally, although only two surveys have studied the weight of **environmental attitudes** ([Grossberg et al., 2003](#); [Haukeland et al., 2013](#)), both found that high environmental sensitivity implied a high level of awareness of wildlife disturbance and that it explained more variance than the sociodemographic variables. Regardless of the factors influencing perception, respondents generally believed that other recreationists were more impacting than themselves. Several studies demonstrated that recreationists and tourists tended to transfer the responsibility of disturbance on other user groups such as those practicing a different activity than theirs ([Johnson & Jackson, 2015](#); [Levêque et al., 2015](#); [Taylor & Knight, 2003](#)).

The literature review insists on several limits to previously led surveys on nature recreationists perception of wildlife disturbance. The biggest one being that very few have taken into account or reported on the effect of multiple factors to explain perception of disturbance, making it impossible to explain the variation in the levels of awareness across studies. Authors thus concluded the review with a list of recommendations (see [Table 1](#) of [Gruas et al., 2020](#)) such as widening the focus to less studied activities, including more explaining variables, reporting on the effect of non-significant variables and encompassing the perception of management measure in the studies.

Table 1

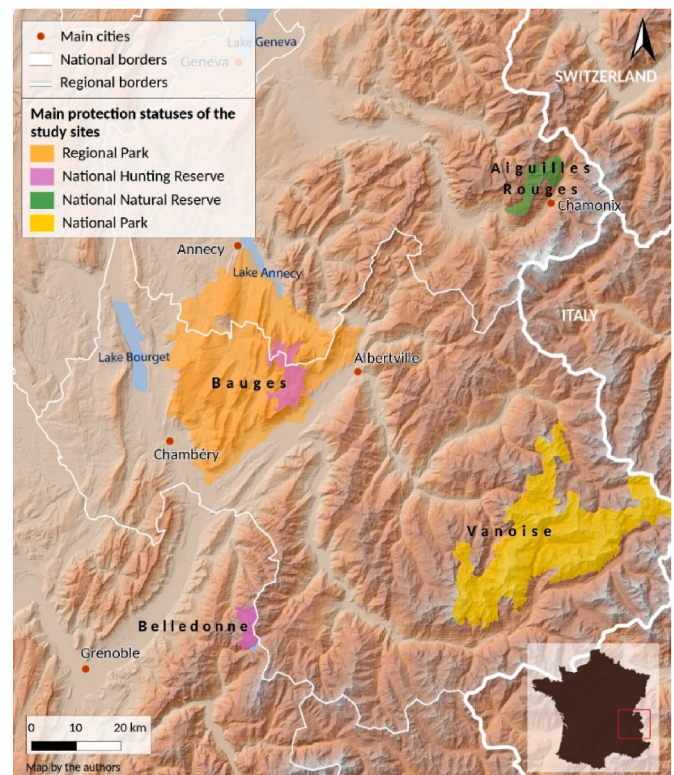
Repartition of respondents depending on activity they took part in and the massif they visited.

	Ski touring		Hiking		Total	
	N	%	N	%	N	%
Bauges	237	23%	205	20%	442	22%
Belledonne	292	29%	207	20%	499	24%
Aiguilles Rouges	254	25%	305	30%	559	27%
Vanoise	233	23%	317	31%	550	27%
Total	1016	100%	1034	100%	2050	100%

1.2. Research question and hypothesis

The research draws from this literature review in order to participate in filling the dearth of evidence regarding recreationists' awareness of wildlife disturbance in the northern French Alps. Indeed, information about visitors and their perception of wildlife, disturbance and tranquillity areas is needed by protected areas managers who are currently facing a large increase in visitors. They need to be able to make recreationists aware of the consequences of disturbance and of the necessity to comply to tranquillity areas. Information about visitors is useful as it allows to target them adequately with awareness raising measures.

The study focuses on two mountain sports: hiking and ski touring, and on four mountain massifs (Bauges, Belledonne, Aiguilles Rouges and Vanoise – see [Map 1](#)). We intend to gain a better understanding of which factors influence (1) The perception of self-caused wildlife disturbance: how do mountain sports participants perceive their own impact on wildlife? What makes them aware or unaware of their impact? (2) Compliance to tranquillity areas for wildlife aiming to reduce disturbance: who tends to avoid it and who does not? We intend to delve deeper into the role of sociodemographic variables and attitudes, two factors that have seemingly been over looked by previous studies, despite their important explaining capacities. We will also explore the role of activity and wildlife related factors (see [Fig. 1](#)).



Map 1. localisation of the fields of study (map by the authors).

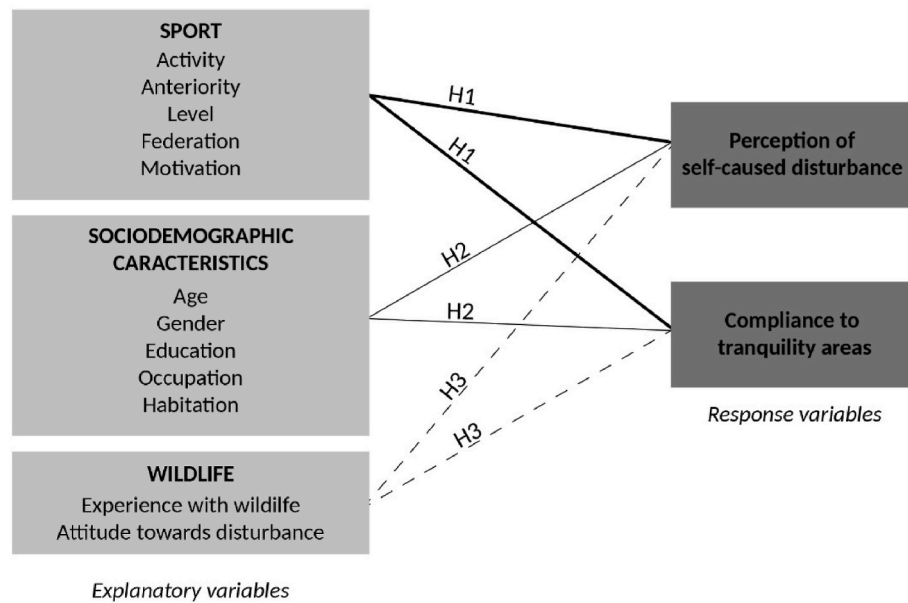


Fig. 1. Explanatory variables and response variables considered in the analysis.

Based on the literature review, we make the following hypotheses.

- H1: We expect sports related factors to influence perception of self-caused disturbance and compliance to tranquillity areas
 - o H1a: Because awareness raising campaigns mostly focus on winter disturbance, winter participants will be more aware of disturbance and more likely to comply to tranquillity areas,
 - o H1b: Anteriority of practice and level in the activity should also play a role, with the most experienced participants being most knowledgeable,
- H2: We expect sociodemographic characteristics to influence perception of self-caused disturbance and compliance to tranquillity areas, especially:
 - o H2a: Respondents with the highest levels of education or in higher occupational categories could be more aware of wildlife disturbance,
 - o H2b: Unlike [Le Corre et al. \(2013\)](#), we expect older participants to be more aware and more careful of wildlife disturbance because they will most likely be more experienced,
- H3: We expect experience with wildlife and attitude towards it to influence perception of self-caused disturbance and compliance to tranquillity areas
 - o H3a: Previous experience with wildlife observation is likely to influence perception of disturbance,
 - o H3b: General attitudes towards the environmental impact of mountain sports will influence perception of disturbance and avoidance of tranquillity areas the most.

2. Methods

The study focused on four mountain massifs where protected areas managers had identified sensitive areas affected by growing numbers of visitors and increased pressure on wildlife. A quantitative survey was conducted to gather data from a representative sample of visitors of different profiles. This was supplemented with a qualitative method using semi-structured interviews. The interviewees were chosen so as to represent a range of levels of involvement in outdoor activities.

2.1. Study area

Bauges regional park and hunting reserve, Belledonne hunting

reserve, Aiguilles Rouges national natural reserve and Vanoise national park are all located in the northern French Alps (see [Map 1](#)). Although the historical implementation of the protection statuses varies (from as early as 1913 for the Bauges hunting reserve, to 1986 for Belledonne), they were all motivated on same grounds: the increase of tourism in the region, particularly alpine skiing with the development of ski resorts and the protection of local large ungulates (chamois, ibex and mouflon). Nowadays, all four sites attract mountain sports enthusiasts: locals from the nearby urban centers (mostly in Bauges and Belledonne), as well as national and international tourists (mostly in Aiguilles Rouges and Vanoise) ([Gruas, 2021](#)).

On the initiative of natural areas managers, studies have been led at the scale of each massif to quantify actual or potential levels of interactions between wildlife and recreational activities. All studies show that it is difficult for wildlife to limit interactions with recreational activities as areas used by summer and winter activities overlap with wildlife refuge areas ([Cuisson, 2018](#), p. 98; [Landreau, 2006](#), p. 78; [Lavorel et al., 2020](#)). In addition, in Bauges, [Duparc et al. \(2017\)](#) showed that actual interactions led to behavioural changes in ungulates. However, so far, nothing proves that these interactions and behaviour modification is harmful or will cause long-term impacts on wildlife ([Duparc et al., 2017](#)).

In the absence of scientific evidence of the impact of disturbance on animal populations, the precautionary principle prevails and has motivated the creation of tranquillity areas in those massifs. These areas are placed in strategic locations carefully selected by managers and represent refuge areas for wildlife. The zones can be regulatory, such as in the Hauts de Villaroger and Plan de Tuéda nature reserves (Vanoise), where ski touring is forbidden and offenders are liable to fines. On some sites, access can be restricted to a recommended route to minimise the risk of disturbance, but trespassers cannot be charged. This type of zone is present in the Bauges, Belledonne and Aiguilles Rouges, but also in many other Alpine massifs, in and out of ski resorts. Both types of zone, regulatory and non-regulatory, are indicated on the protected areas' websites or on maps provided by social networks specialised in mountain sports (such as [campcamp.com](#)). On the field, they can be (but are not systematically) indicated with signs at the start of or along the hiking route (see [Photo 1](#)) and, less often, delimited with ropes.



Photo 1. Sign indicating the entrance to the national hunting and wildlife reserve, in 2018 managers added a supplementary sign to indicate wildlife tranquility areas for black grouse (not regulatory). The sign reads “Let’s share the powder”, map legend designate yellow zones as “wintering areas to avoid” and the arrows indicates “not recommended downhill skiing itineraries”, the text gives information about black grouse ecology and explains that the zones were set up in concertation with ski touring clubs and federations (photo by the authors).

2.2. Quantitative survey

The method of data collection is mainly based on a questionnaire survey. The survey took place between January 2018 and August 2019 in order to include two winter and two summer administration periods and to collect questionnaires in 17 sites over the four massifs. Questionnaires were handed out and self-administered after the outings, we met participants directly on the recreational sites (on the car parks or in mountain huts in summer), acceptance rate was about 70%. Interviewers were instructed to reach out to all visitors above 15 years old 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 surveys. In this paper we only focus on ski tourers and hikers, thus relying on 2050 surveys. [Table 1](#) presents the repartition of respondents per activity and mountain massif.

The questionnaire was organised around four main themes. (1) Practice of the activity, aiming to assess the level, habits, motivations and experience with that sport. (2) Attitude towards and experience with wildlife. In this section we included a scale in order to measure the attitudes towards the impact of the activity on wildlife, the scale is directly borrowed from [Sterl et al. \(2010\)](#) who have used it to understand the attitude of ski tourers towards a management measure aiming to protect the capercaillie and black grouse in Austria. To confront attitude with reality, we also enquired about respondents’ encounters with wildlife and their perception of the disturbance they might have caused on this occasion, their knowledge of tranquility areas that are set up on the sites, and whether or not they tend to avoid them. (3)

Environmental attitudes and eco-friendly behaviours in daily life. (4) Sociodemographic characteristics (age, gender, education level, occupation etc.)

2.3. Quantitative analysis

2.3.1. Models specification and variables selection

We used binary logistic regression to come up with two separate models that allow to understand the position of respondents on two dependent variables: (1) perception of their own impact on wildlife (yes/no) (2) compliance to tranquility areas (always/not always).

The independent variables of both models were (1) sociodemographic variables (gender, age, education, profession), (2) type of visitor, (3) sports characteristics (activity, level, anteriority of practice, motivations), (4) experience with wildlife during an encounter, and (5) attitudes towards the impact of mountain sports on wildlife (see [Fig. 1](#)). We chose a significance level of $p < 0.05$ for the stepwise regression method and reference category was either the first one in the case of ordinal variables (for example “beginner” rather than “intermediary” or “expert” for the level of practice) or the one with most respondents.

2.3.2. Variable transformation and treatment of data

The dependent variable “Disturbance of wildlife” (first model) was recoded in a binary variable: “a lot” and “probably” became “yes”, and “not really”, “not at all” and “I don’t know” became “no”. The analysis only applied to people who had already met wildlife while practising a mountain sport ($n = 1748$). The dependent variable “avoidance of tranquility areas” (second model) was also recoded in a binary variable (“never”, “rarely” and “often” became “not always”, and the modality “always” remained the same). This analysis only applied to people who knew about tranquility areas ($n = 1180$).

Missing values were replaced by the mean value for continuous variables. For qualitative variables, respondents with missing values were discarded from the analysis.

We used the statistical programme Spad to analyse the data.

2.4. Qualitative material

To complete the quantitative data, we used 29 semi-directive interviews carried with skitourers (see [Supplementary Table 1](#)). Interviewees were selected so as to represent the diversity of profiles of participants: different motivations, modalities of practice and levels of experience. The interview guide was organised in two sections: practice of the sports activity and perception of the natural environment. The interviews were entirely transcribed and a thematic analysis ([Braun & Clarke, 2021](#)) was performed on the corpus.

The use of a mixed method approach had the strong advantage to allowed for the collection of a large and diverse sample while also enabling a more in-depth examination of issues related to wildlife disturbance. The qualitative interviews provided valuable insights and unexpected perspectives on the avoidance of tranquility areas.

3. Results

3.1. Explanatory variables

3.1.1. Background data on sociodemographic and sports characteristics

Our sample consisted of 63% of men and 37% of women. The repartition differed with 74% of men in ski touring and 54% in hiking (see [Fig. 2](#) and [Supplementary Table 2](#)) for distinction between ski tourers and hikers). Mean age was 44 years old but it varied depending on the activities. Participants belonged to the most well-off social classes: 47% graduated from a master’s degree or higher and 47% have high-skilled occupations, mostly in the private sector (41%). 7% of respondents worked as mountain professionals (mountain guides, ski instructors, etc.) Most visitors were day-trippers (79% in winter, 50% in

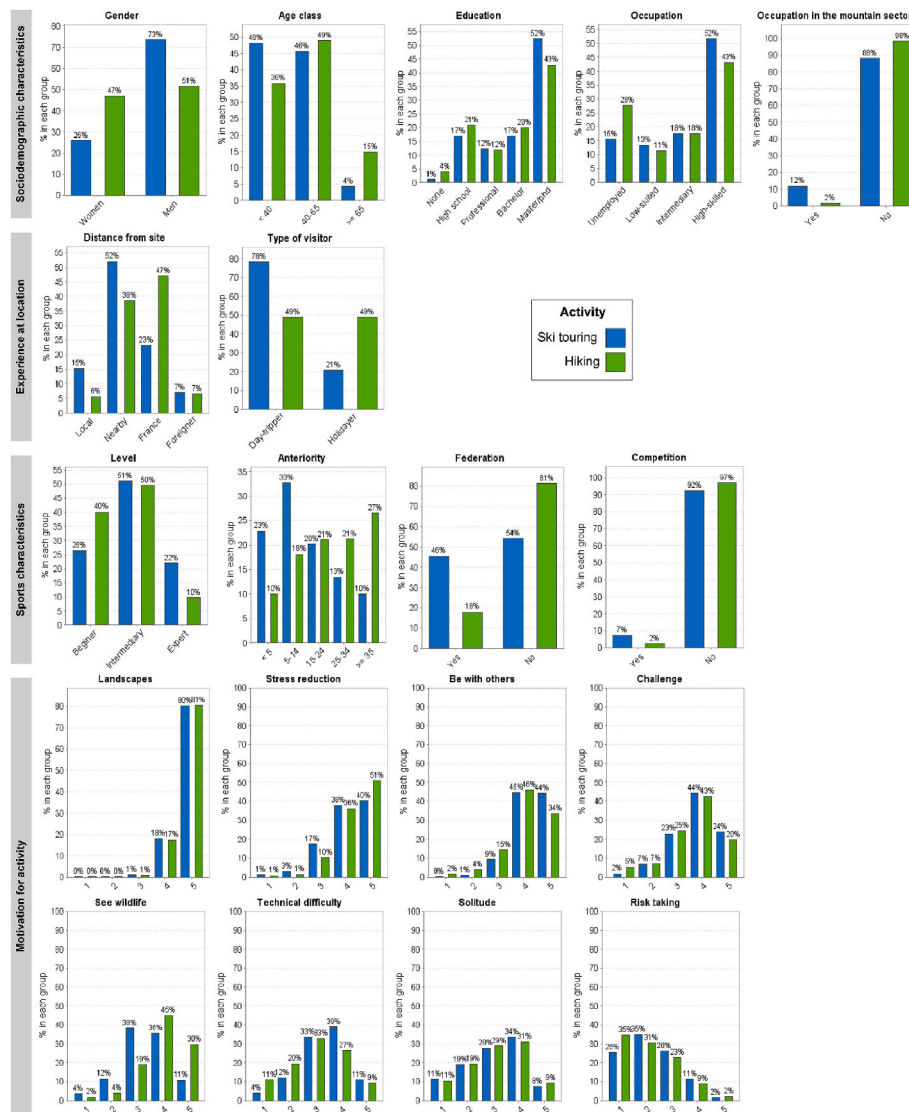


Fig. 2. Socio-demographics, experience at location and sports characteristics (n = 2050).

summer). Geographical origins varied, with 10% of locals (who travel on average 10 km to reach the site of practice), 44% of nearby inhabitants (32 km), 38% of people travelling from the rest of France (515 km) and 7% of foreigners (mostly Switzerland, Belgium and Great Britain).

The sample is composed of 49.6% ski tourers and 50.4% hikers. Participants estimated that their level was mostly intermediary (51%) and only 16% considered themselves experts. Mean anteriority of practice was 19 years (24 years for hikers and 15 for ski tourers). 32% of respondents belonged to a mountain sports federation (mainly ski tourers – 60%). The top three motivations were “landscapes observation”, “stress reduction” and “conviviality, spending time with others”.

3.1.2. Attitudes towards wildlife disturbance caused by mountain sports

Although a large majority of respondents agreed that mountain sports can disturb wildlife, and few thought that wildlife was used to disturbance, most of them still believed that ski touring had no negative effects on nature and wildlife if recreationists did not turn up in crowds (see Table 3). Even though most people agreed with the statement that “Temporal or spatial limitations of mountain sports are necessary for nature conservation” (82% totally agreed or agreed), respondents seemed more willing to accept restrictions of access in habitats of rare or endangered species. Furthermore, the majority agreed to the statement that mountain sports should be possible without any limitations. The

activity did not influence participants’ views on disturbance and tranquillity areas. The interviews reinforce the results that most respondents are aware that mountain sports impact the environment, including disturbance of wildlife. Like several others, this skier admits in an interview: *“I know that even though we love nature, we do a lot of damage, especially to trees. Skiing in the forest is great, but we cut off the tops of all the little fir trees, with the ski blades. So we prevent them from growing. I know that we sometimes disturb animals too.”*

Like Sterl et al. (2010) did on that same scale, a factor analysis was applied to determine the underlying dimensions of the respondents’ attitudes towards environmental impacts of their activity. The PCA was performed on skiers and hikers taken together and it resulted in two factors explaining 54% of the total variance (Table 3, and Supplementary Fig. 1). Items that indicate agreement with the fact that mountain recreation can impact wildlife and should be restricted to protect animals contributed most to factor 1. The first factor thus indicates respondents level of awareness of the impacts and will be referred to in the rest of the article as “impact awareness”. On the contrary, items that contributed the most to factor 2 were related to the idea that mountain sports had no or little impact on wildlife and should not be restricted, indicating to what extent respondents rejected restrictions. This factor will thus be referred to as “restriction rejection”.

Table 3

Attitudes towards environmental impacts of mountain sports (1 = totally disagree, 5 = totally agree) and results of factor analysis using varimax rotation for the extraction of orthogonal factors. Items were assigned to dimensions on the basis of a factor loading ≥ 0.40 .

Items	Attitudes			PCA	
	Mean	Ski touring	Hiking	Factor 1 "impact awareness"	Factor 2 "restriction rejection"
In habitats of rare or endangered species access restrictions are acceptable	Mean 5 4 3 2 1	4,32 49% 39% 9% 3%	4,45 60% 30% 7% 2%	0,814	-0,014
Visitors have no negative impact on nature and wildlife as long as they do not turn up in crowd	Mean 5 4 3 2 1	3,45 12% 45% 21% 19% 3%	3,37 10% 45% 21% 21% 3%	0,127	0821
The access to natural areas should not be restricted	Mean 5 4 3 2 1	3,45 20% 32% 25% 19% 4%	3,09 12% 26% 27% 30% 5%	-0,354	0447
Wildlife is used to recreationists and hardly reacts to that disturbance	Mean 5 4 3 2 1	2,42 1% 14% 25% 45% 15%	2,38 3% 12% 22% 47% 16%	-0,229	0672
Visitors might disturb wildlife	Mean 5 4 3 2 1	4,06 27% 58% 12% 3% 1%	4,01 26% 56% 15% 3% 2%	0,435	-0,457
Nature recreation necessitates temporal or spatial limitations of outdoor recreation	Mean 5 4 3 2 1	4 31% 44% 18% 5% 1%	4,28 46% 41% 11% 2% 1%	0,794	-0,175
Variance Eigenvalue				36% 2181	17,70% 1,06

3.1.3. Actual experience with wildlife and wildlife disturbance management measures

When it comes to actual experience with wildlife, it appears that 92% of respondents had already seen animals while practicing mountain sports (Fig. 3 and Supplementary Table 3). Most of them state that the specie they were able to observe (mostly chamois or bouquetin, more rarely mouflon) did not seem to react to their presence, either because they did not move or because they were too far to tell, as related by this interviewee: "Sometimes I have passed by herds of chamois. It didn't even traumatise them. One of them moved a little, and that was it; almost nothing". Considering both hikers and skiers, only 26% think that they disturbed wildlife ("a lot" or "probably") which contrast with the fact that 82% of visitors agreed or totally agreed with the idea that mountain sports might disturb wildlife (Table 3). This indicates a very significant difference between the disturbance that one knows can occur and the disturbance that one thinks they have caused.

57% of respondents knew about the concept of tranquility areas for wildlife (regulatory and non-regulatory, see 2.1), however the proportion of skiers aware of the existence of such zones was significantly higher: 71% vs. 44% ($\chi^2 = 154,612$, $df = 1$, $p = 0,000$). This can be explained by the larger diffusion of awareness raising campaign in winter, when wildlife is considered more vulnerable. Out of the people who knew about tranquility areas, 42% stated that they always avoided

them, proportions were similar among skiers and hikers.

3.2. Factors influencing perception of disturbance and compliance to tranquility areas

Variables included in the first model accounted for 34% variation in perception of disturbance (Nagelkerke $R^2 = 0,338$), results of the Hosmer-Lemeshow test indicated a good fit of the data to the logistic regression method (Hosmer-Lemeshow $\chi^2 = 6315$; $df = 8$; $p = 0,612$). For the second model, variables accounted for 13% of variation in compliance to tranquility areas (Nagelkerke $R^2 = 0,128$) and data also fitted the method (Hosmer-Lemeshow $\chi^2 = 2927$; $df = 8$; $p = 0,939$).

3.2.1. Perception of disturbance

The regression analysis identified four variables influencing the perception of disturbance (Table 5). The significant variables included both factors of attitudes towards environmental impacts of mountain recreation: "impact awareness" and "restriction rejection" (see 2.3), level in the activity and reaction of the animal on the occasion of the encounter. It appears that, the more aware respondents were of theoretical disturbance, the more likely they were to be aware of their own disturbance (odds ratio = 1,23, $p = 0,002$). On the opposite, visitors who rejected access restrictions tended to state that they personally did not disturb wildlife (odds ratio = 0,55, $p = 0,000$). The most experienced respondents were more aware of their own disturbance: intermediary (odds ratio = 1,50, p value = 0,008) and expert (odds ratio = 1,9, p value = 0,001) level respondents were more likely to state that they had disturb wildlife than beginners. However, there was no significant difference between intermediary and expert level participants.

The variable that seemed to weight the most on perception of disturbance was the behaviour of the animal during an encounter (Wald statistic = 284,13). The more alert the behaviour, the more the animal was considered to be disturbed: if it had a vigilant behavioural response - such as interrupt feeding process and/or looked around but did not move (odds ratio = 4,79, p value = 0,000), or if it ran away or moved (odds ratio = 22,29, p value = 0,000), recreationists were more likely think they had disturbed it then if it remained static or was too far away to judge. This observation is corroborated with interviews, a participant for instance states: "I tell myself that if I don't see them, I'm not disturbing them". In some case participants seem to have an anthropomorphic perception of disturbance as the interpretation of the animal's reaction echoes the interpretation that one would have of a human behavior: "For me, an animal is disturbed from the moment it goes away and people follow it", "If we really disturbed them, I think they would leave", "They know very well that we can't join them so ... So, we don't disturb them that much".

3.2.2. Avoidance of tranquility areas

The model was composed of the same variables as the first one, with the addition of the perception of disturbance. The regression analysis identified 4 variables influencing systematic compliance to tranquility areas (Table 6). "Impact awareness" and "Restrictions rejection" (factor 1 and 2) were again good predictors of behaviour towards tranquility areas, with people scoring high on factor 1 being more likely to always avoid the zones (odds ratio = 1,45; $p = 0,000$), and people scoring high on factor 2 less likely (odds ratio = 0,72; $p = 0,000$). The only activity related significant variable was the motive "risk taking", the more respondents were attracted by it, the less likely they were to avoid the areas (odds ratio = 0,77; $p = 0,000$). Age was also a good predictor of avoidance with people aged 40-65 being more likely to avoid tranquility areas (odds ratio = 1939; $p = 0,000$) than younger respondents.

In depth discussion with the interviewees allowed to better understand the reasons why they don't always avoid protected areas for wildlife. Arguments fall into three main themes.

3.2.2.1. No evidence of wildlife in the area. Some argue against the

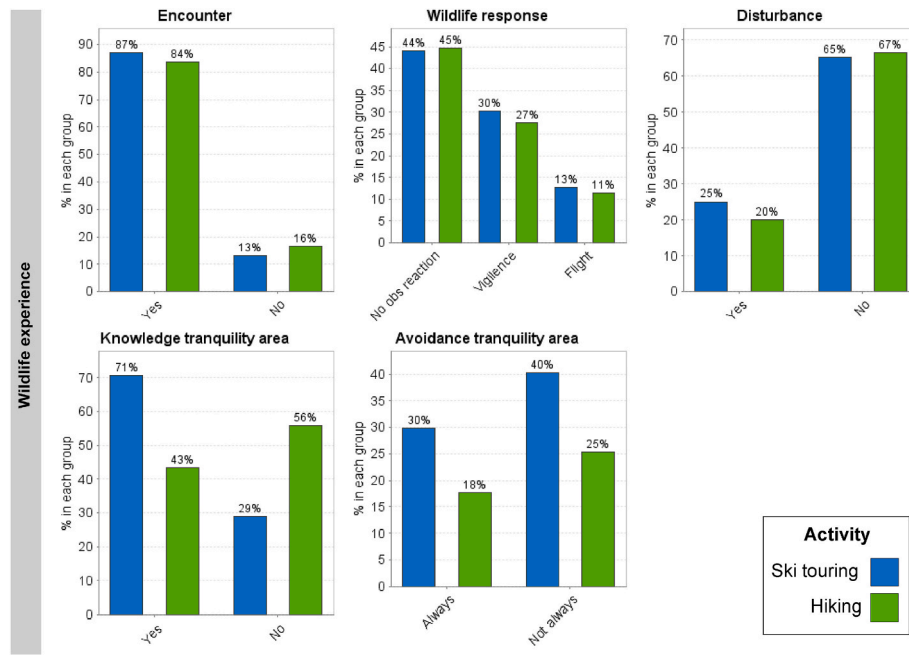


Fig. 3. Actual experience with wildlife and tranquillity areas for wildlife (n = 2050).

Table 5

Results of the binary logistic regression using stepwise regression (dependent variable: 1 = I disturbed wildlife; 0 = I did not disturb wildlife), Nagelkerke $R^2 = 0,338$; Hosmer–Lemeshow $\chi^2 = 6315$; $df = 8$; $p = 0,612$.

Variable	Regression coefficient	Standard error	Wald statistic	P-value	Odds ratio	OR confidence interval 95%	
						Inferior	Superior
Level (ref = Beginner)			12,009	0,000			
Level (Intermediary)	0,403	0151	7084	0,008	1497	1112	2014
Level (Expert)	0,642	0195	10,805	0,001	1899	1296	2784
Wildlife response (ref = No observable reaction)			284,127	0,000			
Wildlife response (Vigilance)	1566	0,148	111,304	0,000	4789	3580	6407
Wildlife response (Flight)	3104	0,186	277,759	0,000	22,287	15,471	32,105
Impact awareness (Factor 1)	0,208	0068	9309	0,002	1231	1077	1408
Restriction rejection (Factor 2)	-0,600	0067	79,687	0,000	0549	0,481	0626
Constant (intercept)	-2709	0,162	279,126	0,000			

Table 6

Results of the binary logistic regression using stepwise regression (dependent variable: 1 = I always avoid tranquillity areas; 0 = I don't always avoid tranquillity areas); the Wald-statistic tests whether a variable is significant.

Variable	Regression coefficient	Standard error	Wald statistic	P-value	Odds ratio	OR confidence interval 95%	
						Inferior	Superior
Risk taking	-0,265	0061	19,138	0,000	0767	0,681	0864
Impact awareness (Factor 1)	0,373	0066	31,611	0,000	1452	1275	1654
Restriction rejection (Factor 2)	-0,326	0063	27,199	0,000	0722	0,639	0816
Age_class (ref= < 40)			27,851	0,000			
Age_class (40–65)	0,662	0134	24,595	0,000	1939	1492	2519
Age_class (>= 65)	-0,013	0229	0,003	0956	0,987	0631	1546
Constant (intercept)	-0,090	0173	0,272	0602			

merits of zones and the restrictions by using the perceived absence of wildlife in these areas: “We know that there is a zone there [location in the Bauges massif], but in the end, we never see chamois. So, we wonder about its utility”. Two other skiers state: “It’s funny because this area is protected and we never see anything there”, “Honestly, I thought that even though it was a protected area I didn’t disturb much because I didn’t see any animals.” The last quote conveys the idea that the skier interprets not seeing wildlife as an absence of it, but also, as we noted earlier, the absence of an encounter with animals as an absence of disturbance.

3.2.2.2. *Safety first.* The safety can be the source of a joke for some: “If they keep making tranquillity areas wildlife they shouldn’t be surprised if skiers end up in dangerous, avalanche prone zones to avoid animals being disturbed!” It is also used in a more serious way: “The snow conditions dictate the danger, the crowd, the exposure. So, if I see that the quality of the snow changes, a cornice is ready to break, the sun heating up more than expected, fog setting in, I might change my itinerary. If I have to go into a tranquillity area to do so, I will”. While it is true that skiers must adapt their itinerary and prioritise their safety in dangerous conditions, the safety argument sometimes seems to be used to absolve themselves of a certain

responsibility, to justify the desire to enjoy immaculate powder snow.

3.2.2.3. Fun and performance. Picking fun and performance over wildlife tranquillity regularly comes out in the interviews, it appears as a kind of “guilty pleasure” for ski tourers: “*Sometimes, skiers tend to want to enjoy themselves above all. It’s hard to say no to a beautiful field of powder sparkling in the sun, if the snow is good and even if it is a protected area; I think I will go*”. “*The combe was really tempting and it was fantastic to ski. I went down there knowing that it was forbidden. And we didn’t even disturb any ungulates.*” It seems that the search for performance, pleasure and sensations influences what participants allowed themselves to do or not.

4. Discussion

In this study we investigated the factors influencing perception of wildlife disturbance and avoidance of tranquillity areas. The study deals with visitors of four mountain massifs of the northern French Alps, taking parts in winter and summer mountain sports. Our survey and analysis was conveyed drawing from the results and recommendations from a systematic quantitative literature review focusing of the perception of disturbance caused by recreation (Gruas et al., 2020).

4.1. Sports related factors

Sports related factors were represented in both models. However, the activity did not influence the perception of disturbance which goes against the observation made by several other authors (Maguire et al., 2013; Stalmaster & Kaiser, 1998; Taylor & Knight, 2003; Vaske et al., 1992) and invalidate hypothesis H1a. Perception of disturbance was however influenced by level in the activity, which validates hypothesis H2b, with beginners being less likely to state they have disturbed wildlife. This may be related to the degree and familiarity with wildlife gained with experience and therefore a better understanding of behavioural responses, but also simply because when accessing less isolated and more frequented areas the chances of encountering animals and disturbing them are lower and disturbance is thus less easily observed.

When it comes to compliance to tranquillity areas, it seems that the choice of whether or not to comply to it results from an internal compromise between the search for performance and sensations and one’s personal ethics. This process seems especially significant among skiers whose practice is more committed, as shown by the “risk taking” motive that comes out in the regression model.

Although the variable “professional of the mountain sector” was included in both models, it was never significant. This observation raises the important question of the training of mountain professionals, who act as authorities on outings with their clients. Although knowledge of fauna and flora is an integral part of the training of mountain leaders until recently it did not include wildlife disturbance, or only at the discretion of the trainers, depending on their sensitivity to the issue. The same applies to the training of high mountain guides provided by the national ski and alpinism school (ENSA). The French national training centre is gradually integrating awareness-raising module to winter disturbance. However, these actions are very recent and still limited. In our survey, mountain professionals were not more aware than others of their impact on wildlife (or at least they were not more likely to admit having an impact), which is partly consistent with the results of Weiss et al. (1998) who noticed that locals who get income from ski tourism were less likely than other user groups to state that skiing affected wildlife.

4.2. Sociodemographic variables

Contrary to observation made in several studies (Grossberg et al., 2003; Haukeland et al., 2013; Le Corre et al., 2013) perception of self-caused disturbance was never influenced by sociodemographic

variables as neither age, gender, location of habitation, education or profession were significant in the regression. Indeed, unlike previous results (Grossberg et al., 2003; Haukeland et al., 2013; Le Corre et al., 2013), respondents with higher educational and professional capitals were not more likely to think they had disturbed wildlife nor to avoid tranquillity areas thus invalidating hypothesis H2a. This could be explained by a very socially homogenous sample. Indeed 47% of the sample graduated from a master degree or higher, which is only the case of 10% of the French population (INSEE, 2022), and 47% have a manager occupation vs. 9% of the population (INSEE, 2022).

Compliance to tranquillity areas however can be predicted by the age variable with respondents aged 40–65 being more likely to avoid the areas than respondents under 40 years old. This can be explained by a higher commitment of young participants (more attracted to the risk taking motive for instance) being thus less prone to avoiding tranquillity areas. These results validate hypothesis H2b.

4.3. Gap between disturbance in general and self-caused is mostly explain by wildlife response behaviour

Another striking result of the study is the assessment that although the majority of respondents is aware that their activity might disturb wildlife, most of them also tend not to personally think that they have disturbed it. Few studies have explored the difference of perception between general and self-caused disturbance. In the studies published by Sterl et al. (2008), Orsini and Newsome (2005) and Wu et al. (2015), respondents are consistent as they deny both the general impact of the activity and their personal impact. The phenomenon of denying one’s own responsibility, on the other hand, is observed by Van Winkle and MacKay (2008) and by Le Corre et al. (2013). In the latter study, the results are particularly close to those of this survey, with 66% of respondents believing that protected areas visitors can have negative effects on birds, but only 17% believing that their presence has a negative effect. These observations therefore indicate a form of cognitive dissonance (Festinger, 1957). When realising inconsistency between their beliefs (my activity disturbs) and behaviour (I practise this activity), recreationists modify the perception of their own impact, and even argue to justify the harmlessness of their presence. The theory of cognitive dissonance is regularly used to explain inconsistencies between values and environmentally responsible behaviour (Thøgersen, 2004). In the context of recreational activities, Wu, Lin, & Liu (2020), focused on the intentional aspect, showing a strong cognitive dissonance among visitors who leave their waste behind in a national park. Juvan and Dolnicar (2014) showed that even people who are actively engaged in environmental protection in their daily lives nevertheless engage in behaviours that have negative environmental consequences, even unintentionally, during their holidays.

As exemplified by the results of the first regression model, the cognitive dissonance diminishes when the disturbance is undeniable, for instance when respondents witness a flight reaction from an animal and thus state that they have indeed disturbed it. This validates hypothesis H3a and demonstrate how difficult it is for most recreationists to picture what they do not see with their own eyes. Qualitative results hint that some visitors seem to consider that their experience gives them a layman’s knowledge of animal behaviour, for instance when they use terms such as: “*it’s obvious*”, “*they don’t seem disturbed*”. They interpret wildlife reactions with an anthropomorphic view: thus those who do not flee are not considered to be disturbed. These situations are in line with the observations of Stalmaster and Kaiser (1998) and Taylor and Knight (2003), who show through questionnaires and wildlife observation that recreationists consider it acceptable to get closer to wildlife than wildlife actually allows (flight distance is greater than visitors imagine).

4.4. General attitudes influence more than anything else

Both self-caused perception of disturbance and compliance to

tranquillity areas were mainly explained by attitudes towards the environmental impact of mountain sport. Indeed, respondents who agreed with the fact that mountain recreation can impact wildlife and should be restricted were much more likely to state that they had disturbed wildlife and that they usually complied to tranquillity areas. On the contrary respondents who believed mountain sports had no or little impact on wildlife and should not be restricted, were more likely to state that they had not disturbed wildlife and that they do not always avoid tranquillity areas; hypothesis H3b is thus confirmed. Despite a previously noted cognitive dissonance between one's personal impact and the impact of other participants, this result translates consistency between general and specific attitudes towards disturbance and between general attitudes and behaviour.

The concepts of "attitude towards behaviour" or "behavioural intentions" from the theory of planned behaviour (Ajzen, 1991) explain best this consistency. The assessment of a specific behaviour and one's intention to perform it immediately precedes actual behaviours and is thus more likely to influence it. As pointed out by Immoos and Hunziker (2015), this suggest that on-sites measures aiming to reduce wildlife disturbance have little effect on behaviour compared to preexisting values and attitudes of visitors.

However, the French context is a bit specific. Indeed, nature sports participants tend to believe that they should benefit from a total freedom to move around in the natural environment. This idea is inherent to the development of nature sports in France, which are considered to be free, unrestricted and carried out in an undeveloped environment (Corneloup & Bourdeau, 2004). It emerged from the interviews that the common sense of the participants should take precedence over the prohibition. Access restrictions are seen as an obstacle to personal freedom, especially during leisure time (Zeidenitz et al., 2007). Krieger, Deldrève, & Lewis (2017) describe this phenomenon as "the urge to tear down barriers" (p.35). Even if users of a natural areas declare that they understand the environmental interest of protection, they do not wish to see the environment denatured by it. The authors explain that "environmental measures reaffirm the power of the domestic, made apparent by barriers and prohibitions, in a world where users cultivate the experience of the 'wild' and the distance from social constraints" (p. 35).

4.5. Limitations of the study

This study is subject to some limitations. The first limitation lies in the quantitative methods and the biases it induces when measuring behaviours as compliance with restrictive areas is only declarative. Second, the analysis show that both models have a low explaining power which suggest that other variables that were not included in analysis play an important part in explaining perception of disturbance and avoidance of tranquillity areas.

5. Conclusion and implications for management

This article presented the findings of a large scale quantitative survey regarding mountain sports and wildlife disturbance. The study found that witnessing or experiencing undeniable disturbance (i.e a behavioural response such as flight) is what makes respondents aware that they can cause disturbance to wildlife (not only other participants). These results seem to be bolstering findings on the matter. We also show that attitudes and values towards wildlife and disturbance are more important than activity related characteristics to explain perception of self-caused disturbance or avoidance of tranquillity areas. Those results shed a new light on the study of wildlife disturbance as values, attitudes and orientations had rarely been taken into consideration in previous studies (Gruas et al., 2020). Future research on wildlife disturbance could explore various methods to gain a deeper understanding of the issue, such as observing people's behaviour towards signs, tranquillity areas, and during wildlife encounters. This could include analyzing how much time visitors spend reading signs, how likely they are to avoid

marked tranquillity areas, and how they respond to wildlife encounters. Additionally, conducting short, directive interviews based on the observed behaviours could provide valuable insights.

These results have direct implication for managers of protected areas as they provide useful and rare insight on mountain sports participants. This information can be used to target and raise awareness in ways that appeal directly to them. Since evidence of disturbance and attitudes towards it are most likely to influence perception or compliance to management measures, we suggest using photos and videos of distressed fleeing wildlife to not only show the reality and immediate consequences of disturbance, but also to appeal to emotion and participate in shifting attitudes toward restricted areas and management measures. Such visual supports could be broadcasted in ski resorts and tourist centers, as well as on websites that are often visited to prepare the itineraries (avalanche forecast, route planning website, hikers/skiers groups and communities on social media). We also suggest targeting participants depending on their level and involvement in the activity. By posting guards on easier routes to talk with families and beginners about disturbance: its consequences for wildlife and the importance of complying to management measures. Higher level participants (i.e people stating they enjoyed "risk-taking"), could be targeted during various events (mountain film festivals, ski mountaineering competitions). In addition, training of mountain professionals (mountain guides, ski instructors, mountain leaders etc.) absolutely needs to be reinforced with courses on the ecology and biodiversity of mountain ecosystems. This would allow to target high-level participants and to encourage them to pass on knowledge about disturbance and the importance of respecting management measures to future clients.

CRedit authorship contribution statement

Léna Gruas: Project administration, Investigation, Conceptualization, Formal analysis, Methodology, Visualization, Writing – original draft. **Anne Loison:** Supervision, Methodology, Writing – review & editing. **Moussa Ba:** Methodology, Validation, Writing – review & editing. **Clémence Perrin-Malterre:** Funding acquisition, Supervision, Methodology, Writing – review & editing.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jort.2023.100610>.

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