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Does Perceived Crowding Cause Winter Backcountry Recreationists to Displace?

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Winter backcountry sports such as skiing and snowshoeing have experienced a tremendous increase in popularity in recent decades in the European Alps. Recreationists commonly encounter other recreationists on their route. Because enjoying solitude and being close to nature are important motivations for pursing winter backcountry activities, crowding on backcountry routes is highly likely to diminish recreational experiences, with potential consequences for nature and recreationists. This study explored perceptions of and responses to crowding among Swiss backcountry skiers and snowshoers, using an online survey that asked about their motivations for pursing their activity and gauged their perception of crowding using the "people at one time" approach. Each of the 830 participants rated 4 scenarios on a 9-point Likert scale ranging from "far too few people" to "far too many people" and answered follow-up questions about potential displacement choices in response to perceived crowding. Participants rarely perceived backcountry routes as having too few people but often perceived them as crowded. We found only minor differences in perceptions of crowding among participants pursuing different activities or those with different motivations. The most common reaction to perceived crowding was to avoid the route in the future, and the next most common was to adjust a route to avoid the crowd on the day in question. This indicates that crowding is likely to lead to short- and long-term spatial displacement of winter backcountry sport activities. This is likely to have a negative impact on wildlife—as well as on backcountry recreationists' safety, because they might inadvertently enter avalanche-prone areas.

Keywords: *Backcountry sports; outdoor recreation; skiing; snowshoeing; motivation; perceived crowding; social carrying capacity; wildlife; Switzerland.*

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Introduction

Nature-based winter backcountry sports have a long tradition in the European Alps; today, backcountry skiing and snowshoeing are 2 of the most popular activities (Lorch 1995; Geyer and Pohl 2007; Lamprecht et al 2014). Ingold (2005) estimated that 1 million people go on 10 million backcountry skiing trips in the European Alps every winter. Research from Switzerland shows enormous growth in winter backcountry recreation: between 1999 and 2013, the number of winter backcountry recreationists among Swiss residents 15–74 years old grew from approximately 70,000 to 250,000 (+250%; Lamprecht et al 2009, 2015), mainly because of an increase in snowshoers. During the same time, the number of backcountry trips increased from 1.5 million to 2.2 million (+45%; Lamprecht et al 2009, 2015), which is equivalent to about 12,000 individuals visiting the backcountry every day, assuming a 180-day winter season. This dramatic growth clearly reflects the recent increase in the popularity of outdoor activities, which has been attributed to increasing leisure time and growing interest in nature-oriented leisure activities (Ingold 2005; Lamprecht et al 2015).

Because the European Alps are an important natural habitat and ecological refuge (eg Ingold 2005; Milanesi et al 2017), this growing recreational use has become an increasing concern for wildlife protection and nature conservation (eg Ingold 2005; Arlettaz et al 2007; Braunisch et al 2011; Rupf et al 2011; Marion 2016). Some wildlife species find their last retreat in the Alps, which makes the area particularly valuable for conservation (Ingold 2005; Bätzing 2017). Because many wildlife species (eg capercaillie, black grouse, chamois, and ibex) are sensitive to disturbances, particularly in winter (Ingold 2005; Coppes et al 2017), conflicts between backcountry recreationists and wildlife are a critical issue (Ammer and

Pröbstl 1991; Ingold 2005; Thiel et al 2008; Pröbstl 2009; Neumann et al 2010; Rupf et al 2011; Robin et al 2017).

The massive growth in winter backcountry sport participation might also negatively affect the recreational experience (eg Heberlein and Shelby 1977; Manning 2011; Miller et al 2017; Schultz and Svajda 2017) and affect the recreationists' safety (McCammon 2004). Studies of winter backcountry recreationists have shown that they generally prefer trips with fewer human encounters and are motivated by the opportunity to enjoy solitude and connect with nature (eg Haegeli et al 2010; Sterl et al 2010; Haegeli et al 2012; Roult et al 2016; Schultz and Svajda 2017).

Reduced satisfaction might lead to short- or long-term displacement to backcountry areas that are less crowded or have so far not been used for recreation (Ingold 2005; Arnberger and Haider 2007; Manning 2011), which exacerbates the impact of recreation on wildlife. Because most avalanches resulting in harm to humans are triggered by the people caught in the avalanche (eg Jamieson et al 2010; Techel et al 2015), the presence of more people traveling in avalanche-prone terrain increases the chance of avalanche accidents. Furthermore, McCammon (2004) showed that the presence of others can increase the risk-taking behavior of recreationists, for example, by encouraging backcountry skiers to expose themselves to higher levels of avalanche hazard to ski untracked snow or increasing the risk-taking behavior of individuals or groups more confident in their avalanche risk management skills.

To manage the potential consequences of the growing winter backcountry activities most effectively, it is critical to have an in-depth understanding of backcountry recreationists' perceptions of crowding and their potential displacement choices. While numerous studies exist on the perception of crowding in recreational activities (eg Vaske and Shelby 2008; Arnberger et al 2010; Kernen et al 2010; Manning 2011; Wyttenbach 2012; Schamel and Job 2013; Schultz and Svajda 2017), none of them have examined the resulting displacement choices in detail. The objective of this study is to address this knowledge gap by examining perceptions of crowding and reported displacement choices among Swiss backcountry skiers and snowshoers.

Background

Examination of the level or intensity of recreational use in an area is typically framed by the concept of carrying capacity (Wagar 1964; Manning 2002; Marion 2016). The term "social carrying capacity" (Shelby and Heberlein 1986; Manning et al 1999) describes the number of people or type of use beyond which effects to the visitor experience exceed acceptable levels (Kuss et al 1990). Once the social carrying capacity is exceeded, affected people will displace either spatially or temporally (Shelby et al 1988; Robertson and Regula 1994; Arnberger and Brandenburg 2002; Manning 2011). However, Luymes and Tamminga (1995) have shown that the presence of too few people can also lead to the choice to displace, which has led to the concept of a social minimum capacity.

Closely related to social carrying capacity is the concept of crowding, one of the most frequently studied aspects of outdoor recreation (Manning 1985; Shelby and Heberlein 1986; Graefe et al 1990; Lime 1996; Manning et al 1996; Stewart and Cole 2001; Fleishman et al 2004). Crowding is a psychological construct that is defined as a negative evaluation of the density of other visitors (Desor 1972; Altman 1975; Schmidt and Keating 1979). When people evaluate an area as crowded, they have implicitly compared their experience with their perception of a standard (Vaske and Shelby 2008) and made a value judgment that the density is too high. Recreationists' perceptions of crowding vary across recreational settings, seasons, available resources, and time (Shelby et al 1989).

People at one time (PAOT) is a visual approach that has been used in many studies to explore the relationship between perceived crowding and recreational satisfaction. Participants in these studies are shown a series of modified photos that show different numbers of people engaged in a specific activity. Participants then assess the perceived crowding on an ordinal scale that typically ranges from "acceptable" to "unacceptable" (Shelby and Shindler 1992; Manning et al 1996; Freimund et al 2002; Manning et al 2002). Ranges from "pleasant" to "unpleasant" (Vaske et al 1986), "satisfied" to "unsatisfied" (Shelby and Whittaker 1995), and "not at all crowded" to "extremely crowded" (Manning et al 1996) have also been used. The combined responses of the survey participants are then typically visualized in what is called a social norm curve (Manning et al 1999; Needham and Rollins 2005).

Methods

Survey design

To examine the effect of perceived crowding on winter backcountry recreationists, we conducted an online survey with a PAOT questionnaire (Figure 1) in the German-speaking part of Switzerland during the spring of 2010. We used 2 mountain scenes with an uphill track as the background and varied the number of individuals shown in the photos (0, 1, 2, 4, 8, 12, 16, or 20 recreationists in various positions). The design resulted in 16 scenarios per scene and therefore 32 photos total. Each survey participant evaluated 4 randomly assigned PAOT photos of the same scene. Because the presence of others could also be seen in a positive light (it might provide recreationists with a sense of safety), we used a bipolar scale (Manning 2007; Arnberger and Mann 2008) ranging from "far too few people" (*viel zu wenige Personen*; 1) to "far too many people" (*viel zu viele Personen*; 9). The number

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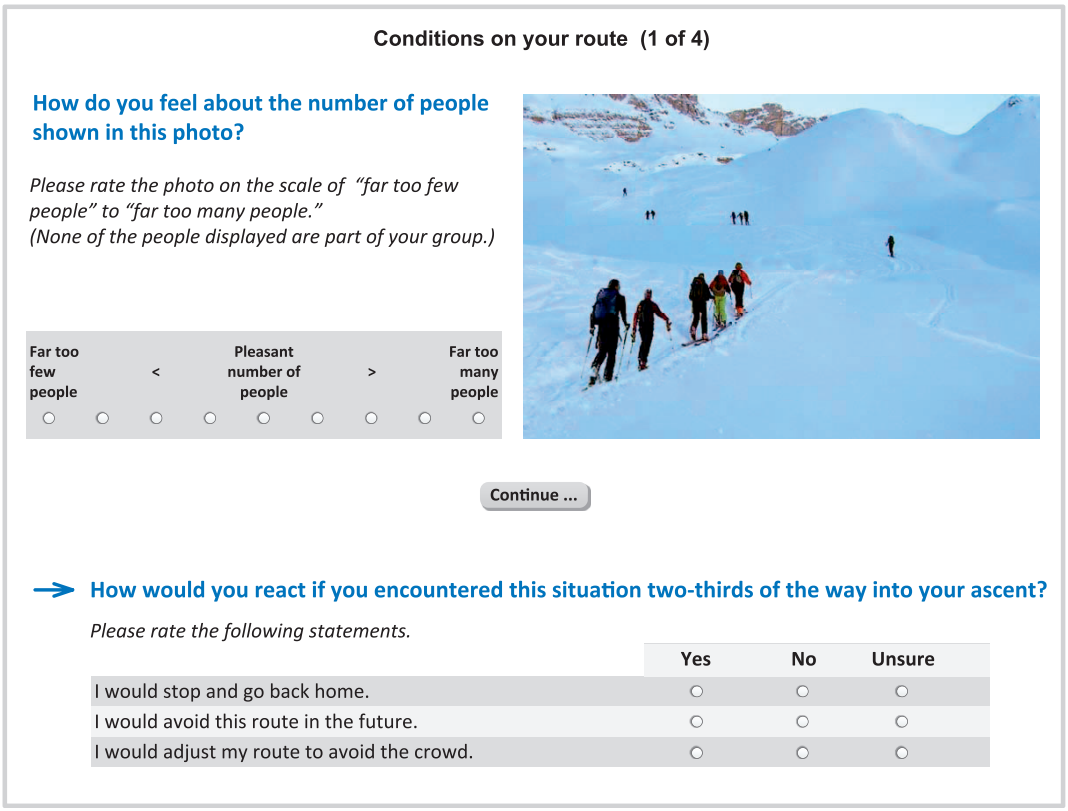
FIGURE 1 PAOT survey question showing 12 people (translated from German for this article).



indicating highest acceptance for the number of people present, or a "pleasant number of people" (*angenehme Anzahl Personen*) was 5.

To examine participants' displacement response to perceived crowding, we asked 3 follow-up questions about situations they perceived as having too few or too many people (options 1 to 3 and 7 to 9, respectively, on the scale), each framed as an option to which they could respond with "yes," "no," or "unsure":

- I would stop and go home.
- I would adjust my route to avoid the crowd.
- I would avoid this route in the future.

The first 2 options represent short-term responses, and the third represents a long-term response.

We collected basic sociodemographic information on survey participants. To assess their motivations for engaging in winter backcountry recreation, we asked the 13 Likert scale–type motivation questions developed by Zeidenitz et al (2007), based on Rheinberg (1993). This battery of questions has been used in several studies in Switzerland (eg Filli et al 2007; Campell et al 2010; Rupf 2014).

Survey deployment

The online survey was open for participation from 4 May to 21 June 2010. A convenience participant sample was produced by placing links to our survey on nature-oriented outdoor recreation websites (eg Swiss Alpine Club and Bächli Sport) and sending e-mails with links to students and employees of the Zurich University of Applied Sciences (ZHAW). To further increase our sample size, participants were encouraged to forward the link to interested friends and acquaintances. Of the 934 individuals who started the survey, at total of 830 (89%) completed it.

Statistical analysis

To identify motivation clusters among our participants, we first reduced the dimensions of the response patterns to the motivation questions by applying a principal component analysis with varimax rotation and Kaiser normalization. We then assigned participants to distinct motivation clusters using Ward's method and squared Euclidean distance.

To visualize the relationship between the number of people shown in the scenarios and the perceived crowdedness, we plotted social norm curves (Manning et al 1999) with boxplots for each PAOT category on the horizontal axis. We calculated the Kendall's tau-b coefficient (Sen 1968), a measure of rank correlation between 2 ordinal variables, to quantitatively examine this relationship.

TABLE 1 Principal component analysis of motivations deriving 4 main motivation dimensions and related loadings.[a)]

Motivation items	Motivation dimensions			
	Relaxation in nature	Getting away	Physical activity	Socializing/fun
Nature experience	**0.73**	0.02	0.14	0.07
Beautiful landscape	**0.71**	0.07	0.21	0.13
Recreation and relaxation	**0.69**	0.07	0.09	0.13
Wildlife observation	**0.40**	0.23	0.23	−0.28
Solitude	0.29	**0.63**	−0.28	−0.31
Saving money	−0.15	**0.63**	0.16	−0.03
Escaping everyday life	0.24	**0.60**	−0.02	0.19
Losing oneself in time and space	0.45	**0.56**	−0.10	0.17
Adventure, risk, or thrill	−0.26	**0.53**	0.09	0.46
Exercising	0.14	0.02	**0.86**	0.04
Being active	0.24	0.06	**0.78**	0.14
Social experience (family, friends)	0.23	−0.13	0.06	**0.71**
Having fun	0.13	0.22	0.11	**0.69**
Eigenvalue	3.10	1.57	1.36	1.12
Variance explained	23.8%	12.1%	10.5%	8.6%
Cumulative variance explained	23.8%	35.9%	46.4%	55.0%

[a)] Numbers in bold: most representative items for the dimension.

We used Kruskal-Wallis tests (Kruskal and Wallis 1952) to examine differences in ordinal variables (eg perceived crowdedness and displacement responses) among groups. In the case of a significant Kruskal-Wallis test result, we followed up with pairwise Wilcoxon rank-sum tests with Bonferroni-corrected P values to explore the observed differences in more detail. We used Pearson's chi-square test for comparisons of categorical data. The entire statistical analysis was performed in R (R Core Team 2015), and we interpreted results with $P < 0.05$ to be statistically significant.

Results

Sociodemographic characteristics

Our survey sample ($n = 830$) consisted of 32% women and 68% men. The most common age group was 25–34 years (30%), followed by 35–44 years (23%); only 1% of participants were younger than 20 years. Most participants (85%) were from Switzerland; 10% were from Germany. More than half (59%) had a college or university degree.

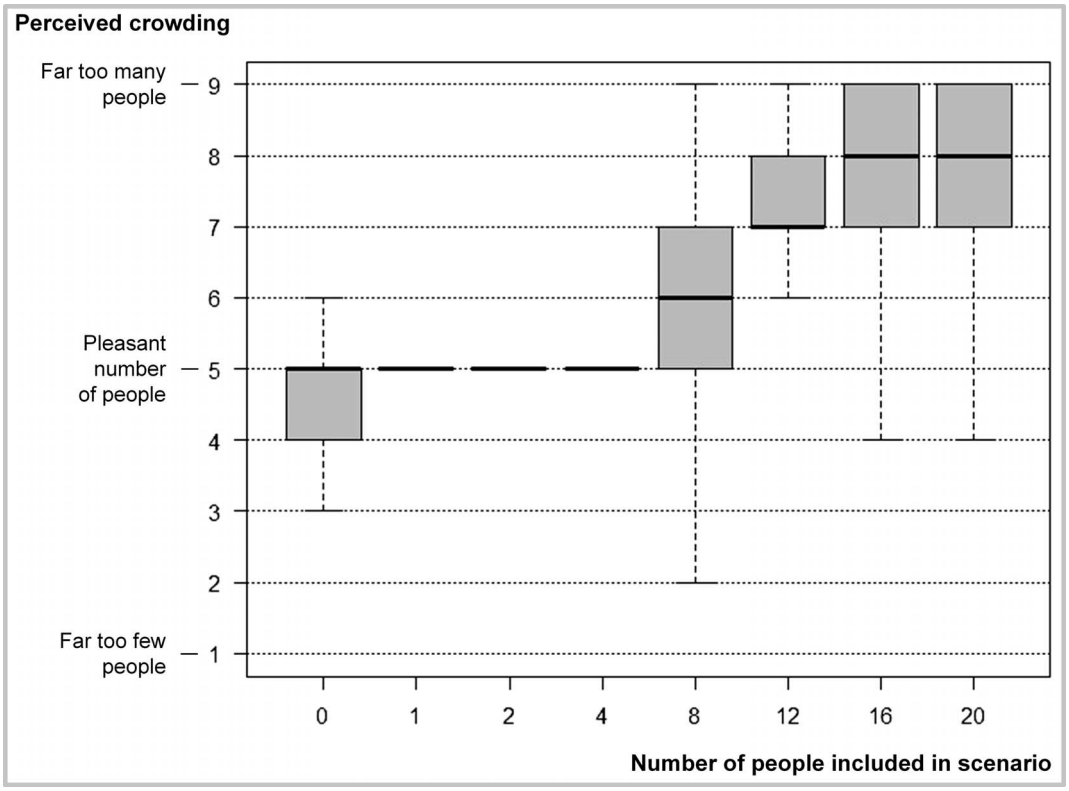
The survey sample consisted of 17% snowshoers and 83% skiers. Snowshoers had a significantly higher proportion of women (Pearson's chi-square test: $P < 0.01$) and were significantly older (Wilcoxon rank-sum test: $P = 0.03$) and less educated (Wilcoxon rank-sum test: $P = 0.02$).

Motivation

The motivation variables were suitable for a principal component analysis based on the Kaiser-Meyer-Olkin measure of sampling adequacy (0.694) and the Bartlett test (chi-square [78] = 7855.2; $P < 0.001$). While principal component analysis of responses to our 13 motivation questions revealed 5 dimensions with eigenvalues higher than 1, we chose 4 dimensions (Table 1) because the fifth dimension did not exhibit distinct factor loadings. Based on factor loading, we labeled the 4 motivation dimensions "relaxation in nature," "getting away," "physical activity," and "socializing/fun." These 4 motivation dimensions describe 55% of the overall variance in the motivations for pursuing backcountry skiing or snowshoeing.

Our cluster analysis (Ward's method and squared Euclidean distance) revealed that our participants can be best described with a 4-cluster solution. Each of these clusters is primarily associated with one of the main motivation dimensions: 29% of our sample were assigned to the nature lovers cluster, 26% were included in the escapists cluster, 25% were in the cluster of health-

FIGURE 2 Boxplot illustrating the social norm curve for the complete dataset ($n = 3320$), with the number of people as the categorical variable on the horizontal axis (thick black lines represent the median).



conscious people, and 20% were in the social people cluster.

We observed significant differences in the prevalence of motivations between backcountry skiers and backcountry snowshoers (Pearson's chi-square test: $P < 0.01$). The proportions of participants in the escapists and health-conscious people clusters were significantly higher among snowshoers (35% vs 24% and 34% vs 24%), while the proportions of participants in the nature lovers and social people clusters were significantly higher among backcountry skiers (31% vs 17% and 21% vs 13%).

Perceived crowding

The total number of assessed crowding situations included in our analysis was 3320. Each of the 32 photos was evaluated between 191 and 222 times. Participants most often perceived the scenarios as having a "pleasant number of people" (crowding value = 5) (46%); 43% of the scenarios were perceived to have too many people (crowding value > 5), and only 11% were perceived to have too few people (crowding value < 5). No significant differences in perceived crowding were observed between the 2 background scenes (Wilcoxon rank-sum test: $P = 0.17$).

We found a strong positive correlation between the number of people present in the scenarios and the perceived crowdedness (Figure 2; Kendall's tau-b: $\tau_b = 0.591$; $P < 0.001$). All scenarios including 12 or more people were perceived as crowded by more than half of the participants.

Pairwise Wilcoxon rank-sum tests revealed significant differences in crowding perceptions between most adjacent PAOT scenarios (Table 2). The only pairs of adjacent scenarios that were not perceived to differ were those with 0 and 1 person and those with 1 and 2 people. The responses to the scenarios with 16 and 20 people differed only marginally.

When only 1 or 2 people were shown in the photos, the position of the people in the scenarios did not affect the perceived crowdedness. However, significant differences based on position were found for photos with 4 or 8 people. In both cases, photos where all people were in the background were assessed more favorably than those with people in the foreground and background (Wilcoxon rank-sum test with Bonferroni correction: $P = 0.05$ and $P < 0.01$).

We did not find a difference in perceived crowding between backcountry skiers and backcountry snowshoers when comparing the complete dataset (Wilcoxon rank-sum test: $P = 0.60$). However, snowshoers perceived scenarios with 2 people as having too few people more often than backcountry skiers did (Wilcoxon rank-sum test: $P < 0.01$).

TABLE 2 Wilcoxon rank-sum test comparisons between adjacent PAOT categories (as shown in survey scenarios) and perceived crowding.

Number of people shown	Perceived crowding[a]					Wilcoxon rank-sum test (*P* value)
	Min	Q1	Med	Q3	Max	
0	1	4	5	5	9	
						0.14
1	1	5	5	5	8	
						0.07
2	1	5	5	5	8	
						<0.01
4	2	5	5	5	9	
						<0.01
8	1	5	6	7	9	
						<0.01
12	2	7	7	8	9	
						<0.01
16	1	7	8	9	9	
						0.04
20	2	7	8	9	9	

[a] Min, lowest rating; Q1, first quartile; Med, median; Q3, third quartile; Max, highest rating of crowding perception.

More distinct differences emerged among the motivation clusters (Figure 3). Overall, nature lovers perceived the most crowding, while escapists perceived the least crowding; health-conscious people and social people fell between these 2 groups. The difference between nature lovers and escapists was significant, whereas the difference between health-conscious people and escapists was only marginally significant (Wilcoxon rank-sum test with Bonferroni correction: $P = 0.03$ and 0.05, respectively). An examination of the scenario-specific differences revealed significant differences among the motivation clusters for scenarios with 8 people (Kruskal-Wallis test: $P < 0.01$). In these scenarios, health-conscious people perceived the situations as most crowded, followed by nature lovers, escapists, and social people (significant Wilcoxon rank-sum tests with Bonferroni correction between health-conscious people and social people [$P < 0.01$], nature lovers and social people [$P = 0.02$], and health-conscious people and escapists [$P < 0.01$]).

Response to crowding

The analysis of follow-up questions revealed interesting information about how different types of recreationists respond to severe crowding (perceived crowding rated as ≥ 7). Overall, the option "I would avoid this route in the future" was chosen most frequently, followed by "I would adjust my route to avoid the crowd." (Figure 4). The option "I would stop and go home" was rarely chosen. For all options, the percentage of "yes" responses, as well as "yes" and "unsure" responses combined, grew with increasing crowding severity. However, the growth for "I would avoid this route in the future" and "I would adjust my route to avoid the crowd" exhibited the biggest jump between perceived crowding levels 8 and 9. The increase for "I would stop and go home" was considerably smaller. The responses to situations that were considered to have too few people (perception values ≤ 3) were similar. However, we did not pursue the analysis in this direction because of the small number of such responses.

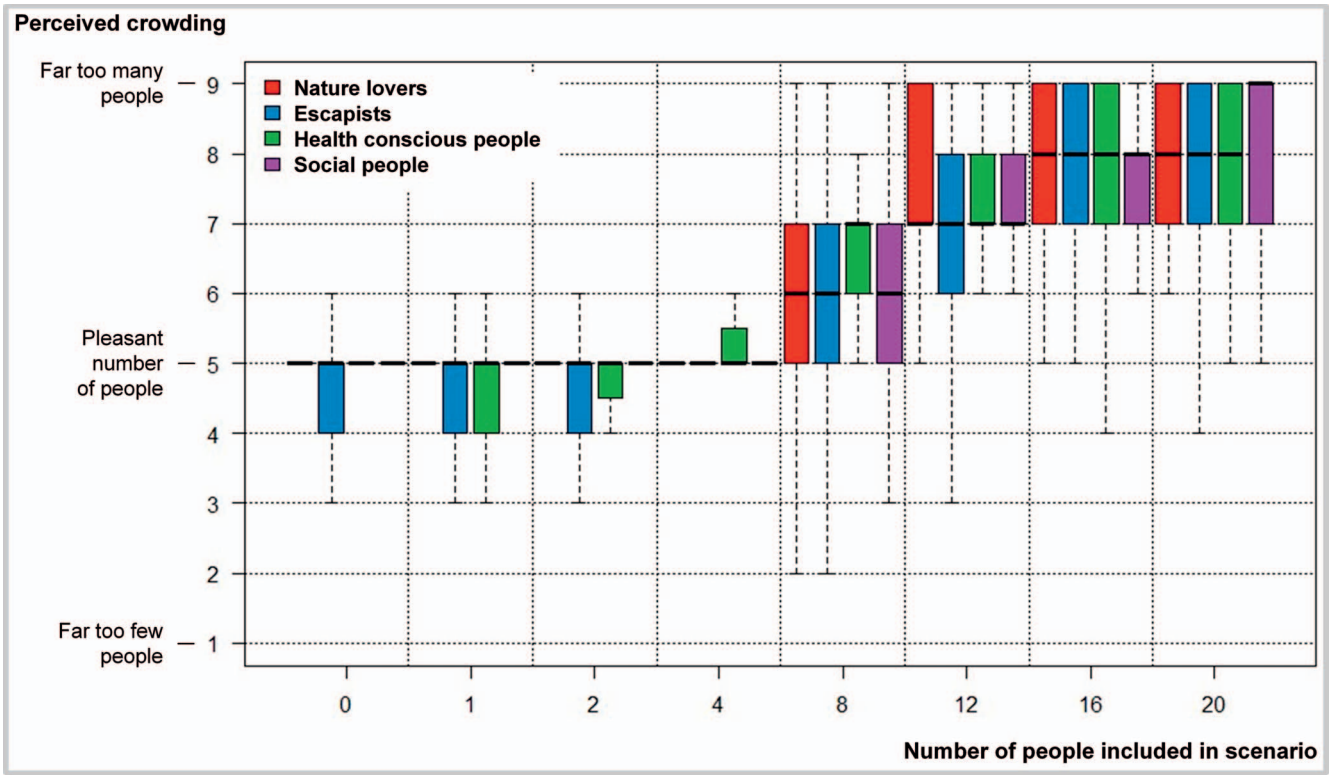
At perceived crowding level 9, the percentage of participants who would abandon the trip was significantly larger among skiers than among snowshoers (Wilcoxon rank-sum test: $P < 0.01$). No significant differences were observed for this question at lower perceived crowding levels. No significant differences were observed in the responses to "I would adjust my route to avoid the crowd." We observed the biggest differences in the responses to "I would avoid this route in the future." Snowshoers had significantly higher percentages of "yes" responses to this option than backcountry skiers at perceived crowding levels 7 and 8 (Wilcoxon rank-sum test: $P < 0.01$ for both), but there was no difference at level 9.

While we did not find differences among the motivation clusters in the responses to "I would stop and go home" and "I would avoid this route in the future," significant differences emerged in the responses to "I would adjust my route to avoid the crowd" at perceived crowding level 7 (Kruskal-Wallis test: $P < 0.01$). Social people and nature lovers had a higher percentage of participants considering adjusting their route to avoid the crowd. No significant differences were observed at higher levels of perceived crowding. In addition, we found no significant differences among the responses of the motivation clusters to "I would avoid this route in the future."

Discussion and conclusion

This study is the first to assess crowding perceptions and associated responses among backcountry skiers and snowshoers in Switzerland. Consistent with previous studies on crowding (eg Vaske and Shelby 2008; Arnberger et al 2010; Kernen et al 2010, Manning 2011; Wyttenbach 2012; Schultz and Svajda 2017), our results show that winter backcountry recreationists are sensitive to increasing numbers of other recreationists. For both skiers and snowshoers, 8 emerged as the maximum acceptable number of people in their view. Our results also show that winter backcountry recreationists hardly

FIGURE 3 Boxplot showing social norm curves for the 4 motivation clusters, with the number of people as the categorical variable on the horizontal axis (thick black lines represent the median).



ever perceive the number of people they encounter on a trip as too few, which is consistent with previous studies that highlight solitude as a key motivation for participating in these activities (eg Haegeli et al 2010; Sterl et al 2010; Haegeli et al 2012; Roult et al 2016; Schultz and Svajda 2017). This search for solitude and remote, pristine places has led to the relatively new phenomenon of backcountry skiing in the Arctic, a costly but memorable experience (Berbeka 2018).

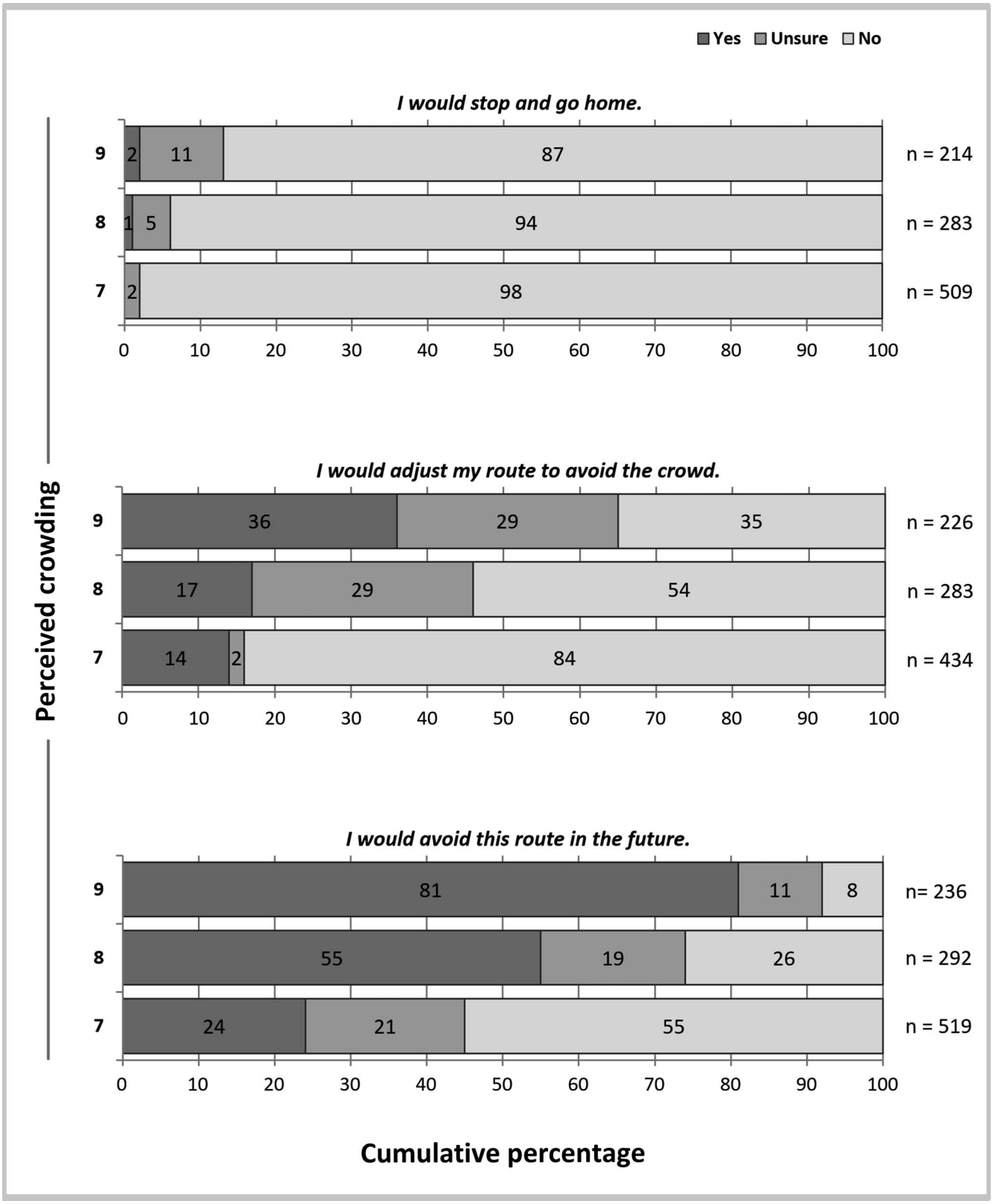
In addition to the number of people, their position within the landscape played a critical role. Scenarios in which other recreationists were positioned in the background only were assessed more favorably than scenarios with people in the foreground or in both foreground and background. This indicates that winter recreationists are more comfortable with people when they are farther away. Arnberger (2003) made the same observations in an urban park setting.

We found only limited differences in perceived crowdedness between backcountry snowshoers and backcountry skiers, but more significant differences emerged among the motivation clusters. Nature lovers were overall most sensitive to crowding, and escapists were least bothered by it, which seems consistent with their motivations for engaging in their activity. Health-conscious people were the second most bothered by crowding and assessed the scenario with 8 other recreationists as the worst; this might be because it is more difficult to pursue physical exercise on crowded trails.

While information on perceived crowdedness can provide useful insight, understanding recreationists' responses to crowding is more critical for developing meaningful management strategies. Few survey participants said they would abandon their backcountry trip and go home if they encountered a situation they considered crowded. Instead, the most common response was to avoid the route in the future. In our survey sample, snowshoers were more sensitive to crowding; they chose this response option significantly more frequently at lower levels of perceived crowding than backcountry skiers.

Future avoidance of a route results in long-term displacement of winter recreationists into less crowded areas, which can increase pressure on areas where wildlife has so far been only minimally disturbed. To ensure the continued protection of sensitive alpine wildlife species, it is important to strengthen existing wildlife protection zones with strict prohibitions on entry and to expand them in certain regions. Approaches to this will differ because the legal basis for wildlife protection zones varies in different countries. However, establishing such zones is not sufficient; it is critical to enforce compliance with fines and to develop guidelines that can be used to educate recreationists on appropriate behavior in wildlife-sensitive areas (Job et al 2014). One example of

FIGURE 4 Reactions to perceived crowding conditions (numbers 7–9 represent the strongest "too many people" responses).



such an effort is the *Respektiere deine Grenzen* (Respect to Protect) campaign in Switzerland (Immoos and Hunziker 2015).

A considerably smaller, but still substantial, portion of survey participants said they would adjust their route on site to avoid the crowd. Social people and nature lovers more frequently choose this option at lower levels of perceived crowdedness. Because backcountry skiing and snowshoeing are often practiced in or adjacent to core wildlife habitat, this short-term displacement could increase the impacts on wildlife. It could also result in larger numbers of avalanche accidents. Well-established backcountry routes generally represent rather conservative terrain choices that minimize exposure to avalanche hazard, and deviating from these could increase that hazard.

The preferences expressed by our survey participants produced realistic results, in line with personal statements reported by Perrin-Malterre and Chanteloup (2018). Various studies have shown that perceived crowding decreased even though levels of recreational use increased during the same period (Heberlein and Vaske 1979; McKinnell and Heberlein 1987; Heberlein and Kuentzel 2002; Manning 2011). In this respect, our study represents a snapshot in time and should be repeated in the future.

Recreationists' stated behavior and their actual behavior on backcountry trips might be different. The latter could differ even more in other mountain regions than in the Swiss Alps. Observational studies examining the effect of crowding directly in the field are required to provide more detailed insight for the development of effective management approaches. However, the dispersed character of backcountry recreation might make it difficult to collect data from a sufficiently large sample over a range of conditions (Schamel and Job 2017). Furthermore, most of our sample was taken from the German-speaking part of Switzerland, and it might not be possible to extrapolate our results outside of this area.

Despite these limitations, the displacement choices reported by participants in our study indicate that continued growth in winter backcountry activities has the potential to become an increasingly serious problem for sensitive wildlife species. Ensuring that these species continue to thrive in an increasingly busy environment will require a targeted approach that is developed collaboratively by all stakeholders.

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