Seeing things differently: How are environmental conditions perceived and why does it matter?

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Abstract

Parks and protected areas that provide recreational opportunities for visitors are often faced with a set of unique management challenges. Primarily, this includes balancing the preservation of the ecosystem with recreational use, often involving the mitigation of visitor behaviors. As well, various groups that may interact with these areas often have conflicting priorities for or opinions on management actions. In order to promote sustainable visitor behaviors, increase support for management initiatives, and address some of these conflicting opinions, an understanding of how environmental conditions are perceived among user groups is needed. Therefore, this study sought to illuminate how two groups that differ in their levels of experience and knowledge with respect to a protected area with high levels of visitation perceive the state of its environment. A survey was administered to people identified as "experts" on the Niagara Glen Nature Reserve (Ontario, Canada) as well as to those identified as more casual "visitors" to the reserve. Perceptions of ecological conditions are compared to empirical measurements. For both visitors and experts, the overall perceptions of environmental conditions differed significantly from the ecological data, with visitors generally providing higher ratings of ecosystem conditions, whereas experts generally provided lower ones. Visitors and experts also differed significantly from one another in their perceptions—a meaningful finding for understanding intergroup conflicts as well as the basis for support for management initiatives. The findings highlight the importance of considering perceptions of environmental conditions between groups, and of understanding how perceptions relate to measured ecological data.

Keywords: perceptions; parks and protected areas; environmental conditions; visitors; experts; management

Introduction

Parks and protected areas that provide recreational or tourism spaces for humans are vital elements of healthy communities and are important for the well-being of society (Romagosa, Eagles, and Lemieux 2015). However, these recreational natural areas are often faced with a set of unique management challenges, especially in urban or highly populated settings. How people perceive the state of the natural environment

is an informative consideration in addressing some of these challenges.

One significant challenge associated with providing people experiences in nature is maintaining the integrity of sensitive ecosystems, often requiring the mitigation or management of visitor behaviors. Visitor actions such as picking and removing rare plants, off-trail hiking and vegetation trampling, unsanctioned activities (e.g., creating fire pits), and other degrading behaviors may result in a decrease in plant cover and diversity, vegetation mortality, soil compaction, changes to soil chemistry, introduction of foreign and invasive species, erosion, and other threats to ecological conditions (Littlemore and Barker 2001; Amrein, Rusterholz, and Baur 2005; Marion and Reid 2007; Kissling et al. 2009). Increasingly, it is recognized that visitor behaviors are influenced to some extent by perceptions (Pendleton, Martinà, and Webster 2001; Heer, Rusterholz, and Baur 2003; Steg and Vlek 2009; Forster et al. 2017), in that people are more likely to engage in activities that are detrimental to the environment if they perceive that it has the capacity to recover (Alessa, Bennett, and Kliskey 2003). Therefore, it has been suggested that managers of protected areas should first investigate how people perceive environmental conditions prior to developing communication strategies or educational efforts that are aimed at mitigating visitor impacts (Alessa, Bennett, and Kliskey 2003; Adams and Sandbrook 2013; Gelcich and O'Keeffe 2016).

Another common challenge, especially for protected areas with high use, is that several different types of stakeholders engage with these recreational natural spaces (Heer, Rusterholz, and Baur 2003). These may include, for example, protected area managers themselves, other stakeholders involved with management (e.g., Friends groups), casual hikers, naturalist clubs, other resource users (e.g., anglers, rock climbers), etc. The challenge therefore is achieving support for management initiatives across these groups, and developing effective communication targeted at each. Understanding how environmental conditions are perceived across groups is informative for achieving these goals (Yasué, Kaufman, and Vincent 2010; Gelcich and O'Keeffe 2016; Bennett et al. 2017). Heterogeneous groups engaging with a protected area, and variation in perceptions of environmental conditions among individuals, may explain conflicting opinions and differing priorities for management interventions (Heer, Rusterholz, and Baur 2003). An illustrative example includes the "use" versus "preserve" tension that often plays out between recreational visitors and naturalists. These perceptions should form the basis for the development of targeted communication efforts, which have been recommended to bridge the gap between different groups, resolve conflicts, and improve consensus among groups (Albert, Love, and Brewer 2013; Le Lay, Piégay, and Rivière-Honegger 2013). This study distinguishes "expert" perceptions from those of "non-experts." The term "expert" is operationalized here as individuals with experienced-based expertise or high familiarity of the site through participation in stewardship activities, membership in naturalist organizations, professional training, or frequent exposure (Adams and Sandbrook 2013). This definition encompasses stakeholders such as protected area managers, Friends groups, naturalist organizations, and other individuals participating in stewardship activities. Here, "non-expert" is operationalized as other recreational visitors to a natural area, and henceforward we will refer to this group as "visitors."

Evidently, managers value an understanding of how people perceive environmental conditions and how this may vary among the groups that interact with the natural area. Adding further value to these considerations, perceptions of environmental conditions can be considered in relation to ecological data. The support of management initiatives has been suggested to be related to the congruence of perceptions with ecological data, in that more congruence may result in increased support of conservation (Patel et al. 1999; Yasué, Kaufman, and Vincent 2010). Furthermore, the communication of management efforts risks being irrelevant if it does not align with how people perceive the environment (Yasué, Kaufman, and Vincent 2010). Therefore, identifying inconsistencies between how the environment is perceived and what is measured by management offers insights for education campaigns or communication efforts (Patel et al. 1999; Pendleton, Martinà, and Webster 2001). Finally, comparing the perceptions of different groups in relation to ecological data may be insightful, as perceptions of individuals with more expertise may be more congruent with ecological data (Patel et al. 1999; Cook et al. 2010; McDonald et al. 2016).

Previous research has addressed intergroup differences in values, aesthetic preferences, and opinions (Patel et al. 1999; Burger 2002; Lester et al. 2017); however, studies that quantify perceptions of environmental conditions across different groups of people are relatively uncommon. In a marine context, Forster et al. (2017) compared perceptions of ecosystem (coral reef) health across various sectors in the Caribbean and found both commonalities and differences in perceptions among groups. In a terrestrial parks setting, Martin, McCool, and Lucas (1989) found that managers and visitors differed in their perceptions of environmental impact, and of what aspects they perceived to be impacted. Heer, Rusterholz, and Baur (2003) compared user groups within recreational forests and also found that the groups differed in their perceptions of conditions, as well as in the degree and subject of impact. Furthermore, group differences in perceptions have rarely been quantitatively compared to ecological data. Patel et al. (1999) compared visitors' values and qualitative descriptions of forest health to scientific perspectives, and found that perceptions of visitors who value nature generally aligned with scientific perspectives. Conversely, Pendleton, Martinà, and Webster (2001) found that residents' perceptions of ocean health did not align with ecological data.

In a recreational protected area setting, rarely have perceptions been compared across user groups and to ecological data. That is the purpose of this study. Two specific research questions are associated with the respective components of the purpose:

1. How do perceptions of environmental conditions differ among user groups that interact with the nature reserve—specifically, between experts and visitors?
2. How do the experts' and visitors' perceptions of environmental conditions relate to ecological data?

Materials and methods

Study site. The study took place at the Niagara Glen Nature Reserve (NGNR; UTM zone 17N, 658068 mE, 4777297 mN), in Ontario, Canada. The NGNR is maintained and managed by the Niagara Parks Commission. The site is an ecologically sensitive Carolinian forest with a variety of rare plant species (Varga and Kor 1993). At the same time, due to the proximity to Niagara Falls, Ontario (within 7 km), the 2.19-ha reserve is visited by approximately 130,000 people per year (C. Burant, personal communication, May 2018). This, in combination with a mandate of environmental protection, creates a situation where managers must navigate the tension between visitor use and ecological integrity—an illustrative example of the challenges faced by many recreational protected areas. Several user groups interact with the NGNR, including rock climbing groups, naturalist organizations, picnickers, hikers, anglers, and other recreational users. In the past, there have been conflicting opinions and tensions regarding the extent of visitor use versus preservation among these user groups.

Perceptions of environmental conditions. A questionnaire was administered to two groups to collect information on perceptions of environmental conditions. The research protocol was approved by the Research Ethics Board of Brock University on June 25, 2018. Data were collected from July 1, 2018 to September 30, 2018.

As explained above, individuals who interact with NGNR can be categorized into "experts" and "visitors." As operationalized in this study, experts included members of local naturalist organizations or Friends groups who frequently engage with the NGNR, NGNR staff with professional training, and individuals who have previously engaged in stewardship activities at the NGNR. This group of experts were initially recruited through a key informant who was able to identify relevant individuals and groups who engage with the NGNR, consistent with how "expert" was defined. Participants were subsequently recruited through snowball sampling. Individuals identified for the expert group were invited to participate and, upon agreeing, were asked to hike the trails. Participants were not made aware of the subject or content of the study. However, it is recognized that they may have been more aware of their surroundings than normal given that they knew they were participating in a study. Upon completion of their hike, participants completed the survey on Qualtrics offline software on tablets. Participants were required to complete the survey independently.

The visitor group consisted of individuals who were using the site for hiking or other recreational activities and who did not meet the inclusion criteria for being an expert. The hiking trails at the NGNR conclude

at a large vertical staircase that acts as the entry and exit point. Therefore, visitors were recruited on site as they completed the trails and exited the staircase. These hikers were approached by the researchers and were read an invitation script to participate in research. A souvenir drink bottle was offered as a token of appreciation to those who agreed to participate. Due to interest in the token of appreciation, interest in participation and response rate was very high, and random sampling proved to be inappropriate. Therefore, convenience sampling was used. Pseudo-random sampling was implemented, whereby the sampling dates and times were randomly selected. Similar to those in the expert group, participants completed the survey on electronic tablets. Participants were required to complete the survey independently.

The questionnaire consisted of three sections. The first section collected demographic information, including participants' field of study/training and sector of employment so that such factors could be taken into consideration, particularly for the visitor group. The second section pertained to how respondents perceived environmental conditions. Perceptions of environmental conditions were categorized into three subsections: perceived conditions of the composition, structure, and function of the ecosystem (Wurtzebach and Schultz 2016). The use of this design is unique and valuable, as it is common for environmental conditions to be compared either generally (i.e., overall condition of the site), or for very specific attributes (e.g., fish population). In contrast, this study collected data on the perceived condition of indicators, which could then be used to infer conditions of the composition, structure, and function of the ecosystem, in addition to its overall condition. These categories and the formation of the questionnaire were based on the ecological data that were collected to ensure consistency in analysis. An important note is that the questionnaire was designed to collect data that were consistent with the ecological data across higher-level dimensions (e.g., composition, structure, and function). While most questions directly correlated with the ecological data, some were modified due to the fact that some ecological indicators are not perceivable to the naked eye (Table 1). Questions were designed to prompt recollection of the senses (e.g., "recall what you saw, heard, or smelled," etc.) for each element of the ecosystem, such as animal and plant diversity, plant cover, and soil quality. For some questions, such as those rating biodiversity, a layperson definition was provided. For other questions, such as rating the presence of invasive species, participants were presented with photographs taken on site to assist with visual recall. Participants rated the set of indicators on a scale from "poor" to "very good," which were given a numerical value from 1 to 4. This limited scale was used to facilitate the comparison of perceptions data with the ecological data, which were also rated on a scale from 1 to 4. Finally, the third section of the questionnaire collected supporting information on the participant's experience at the nature reserve. This included questions collecting ordinal data on respondents' frequency of visits to the NGNR, and how much time they spend in nature generally, as these variables may influence perceptions of environmental condition. For the experts, this section also included the nature of their engagement with the NGNR. Finally, the third section included an open-ended question for respondents to provide any additional comments on the NGNR.

Ecological data. Perceptions of environmental conditions were compared to ecological data collected as part of a related study from July 1, 2018 to September 30, 2018. The ecological data were collected for ten sampling plots across the NGNR by a team of researchers, following protocols outlined by the reserve. Data were collected on a suite of indicators measuring the composition, structure, and function of the ecosystem (Table 1), which included vegetation diversity, invasive species cover, soil compaction, etc. Following an adapted version of The Nature Conservancy's methodology for ecological integrity assessments, measurements were rated on a scale from 1 ("poor") to 4 ("very good") and were rated in relation to acceptable ranges based on management objectives of the NGNR (see Supplementary Data). This conversion of continuous data collected in the field to categorical data enabled the comparison of the ecological data to those on perceptions.

Data treatment. Participant ratings of environmental conditions were treated in the same way as the ecological data, in that the ratings for indicators and measures were aggregated to create a rating for the corresponding ecosystem component (structure, function, and composition), which were then aggregated to create an overall rating. In this case,

TABLE 1. Ecosystem components and corresponding ecological indicators and questionnaire elements.

Component *Attribute*	Ecological indicator (number of measures)	Questionnaire element (excluding recollection prompts)
Structure		
Vegetation	Canopy cover, tree structure (2)	"Based on your observed walk, how would you rate the condition of the forest canopy?" "How would you rate the condition of trees in the [NGNR]?"
Ground cover	Bare soil / ground cover	"How would you rate the quality of the soil?" "How would you rate the condition of the forest floor?"
Composition		
Biodiversity	Vegetation plots, Tree survey	"How would you rate the variety of vegetation?" "How would you rate the diversity (or variety) of animals in the [NGNR]?"
Invasive species	Invasive species % cover (2)	"How would you rate the condition of the Glen based on the presence of these invasive species?" (2)
Function		
Ecosystem function	Soil composition (2)	"Based on your reflections, how would you rate the quality of soil habitats?"
Stressors	Vegetation trampling	"How would you rate the Glen in terms of 'naturalness' on a scale of 1 to 4? (Naturalness meaning untouched/unmodified by humans)" "Based on observations of human actions (destructive, passive, or beneficial), how would you rate the human impact on the Glen?"

weightings were not applied due to the challenge of comparing ecological and social data; however, it is recognized that there may be flaws associated with such a design (Andreasen et al. 2001). This data treatment resulted in an ecological "score" for composition, structure, function, and overall condition, as well as a set of "scores" for each respondent.

To analyze the data, nonparametric statistical tests were used due to the categorical rating given to the ecological data as well as a deviation from normal distribution for the visitors' perceptions of ecological condition. To compare perceptions of each group to the ecological data, the median of the visitor sample and of the expert sample were statistically compared to the ecological value using Wilcoxon Signed Rank tests. Wilcoxon Signed Rank tests compare a sample median to a "hypothetical" or known value, which in this case is the ecological rating. Perceptions of the experts were compared to the perceptions of the visitors using a Mann Whitney U test.

Results

Survey results. One hundred thirty-four surveys were completed, consisting of 24 from experts and 110 from visitors. The difference in group size is acknowledged, as well as the small sample size for the expert group. The sample size of this group was lower due to the

limited number of individuals who would meet the requirements of being considered an expert, as defined in this study. See Table 2 for demographic information on the two groups. Chi square tests revealed the groups did not significantly differ across most demographic fields including gender, age, and time spent in nature. However, they did significantly differ for home town, with visitors representing a wider geographical range. The high percentage of visitors from the United States can be explained by the proximity (under 10 km) of the NGNR to two international border crossings. A quarter of visitors held a master's degree or higher, however, only one respondent had a higher degree in a field related to the environment or ecology.

Kruskal-Wallis tests were performed to determine if there was a significant main effect of specific demographic characteristics on perceptions of environmental conditions for the two groups. Specifically, education level, home town, and time spent in nature were hypothesized to be related to how people perceive the environment (Petrosillo et al. 2007; Curado et al. 2014; Tarannum, Kansal, and Sharma 2018). Due to the multiple comparisons, tests were conducted using Bonferroni adjusted levels of .0125 (.05/4). None of the Kruskal-Wallis tests were significant at adjusted alpha levels.

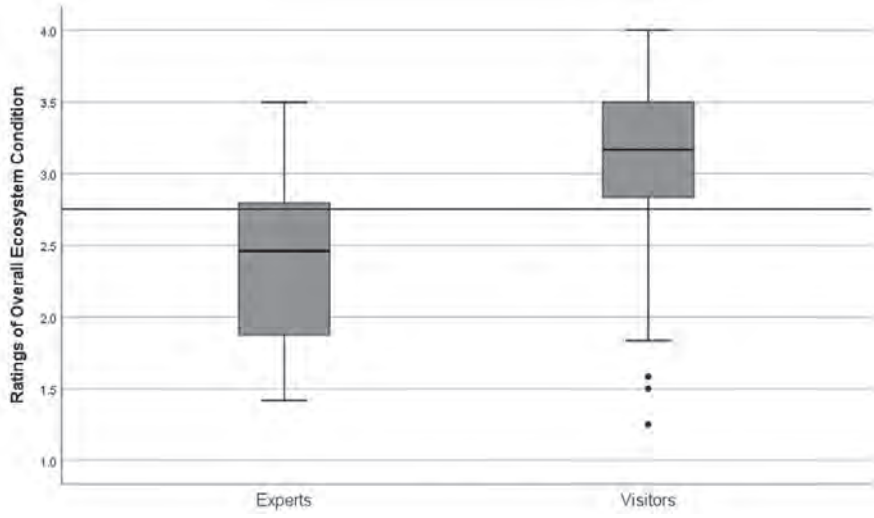
TABLE 2. Demographic information for groups surveyed.

	Experts	Visitors	X^2 (p)
	N = 24	N = 110	
Gender			
Male	62.5%	46.4%	
Female	37.5%	52.7%	
			1.94 (.163)
Age			
18–34	45.9%	40.8%	
35–49	29.2%	25.5%	
50–64	20.9%	29.1%	
65+	4.2%	4.5%	
			.711 (.876)
Home town			
Niagara Region	50.0%	29.1%	
Greater Toronto Area	45.8%	16.4%	
Other Ontario Region	4.2%	20.0%	
Other Canadian Province	0%	4.55%	
USA	0%	25.5%	
International	0%	4.55%	
			20.3 (.000)
Urban/Rural			
Urban	33.3%	28.2%	
Suburban	54.2%	57.3%	
Rural	12.5%	14.5%	
			.271 (.873)
Education Level			
Less than college	16.7%	26.4%	
College Diploma	29.2%	13.6%	
Bachelor's Degree	45.8%	35.5%	
Master's Degree or higher	8.3%	24.6%	6.61 (.086)
Time Spent in Nature	4.3%	2.7%	
Not very often (e.g., once a year)	30.4%	35.5%	
Moderate (e.g., several times a year)	39.1%	37.3%	
Often (e.g., few times a month)	26.1%	24.5%	
Very often (e.g., weekly)			.340 (.952)

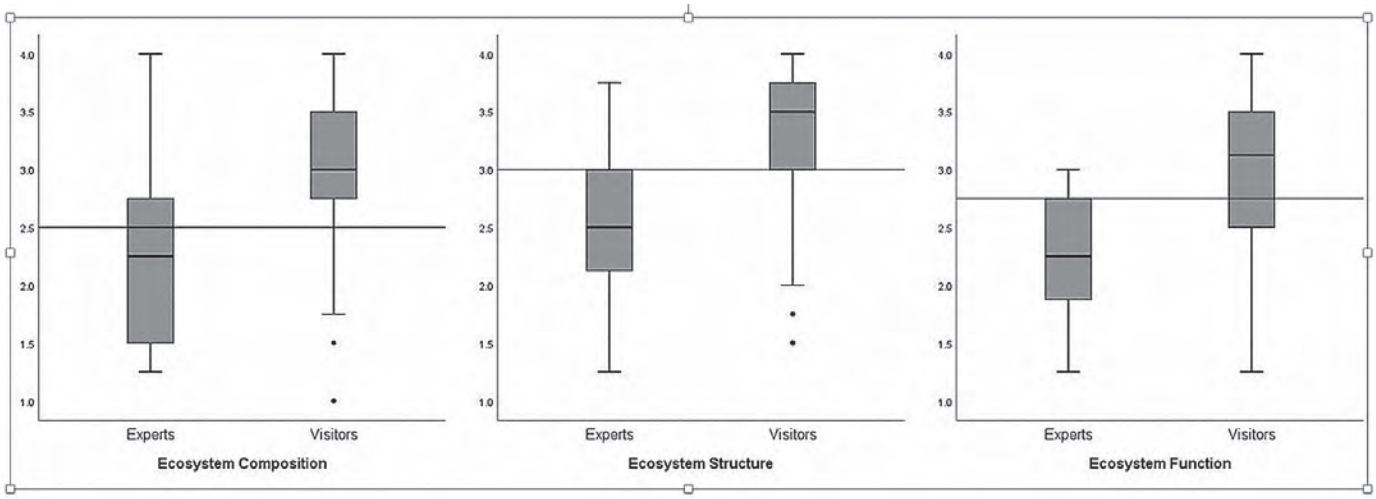
Comparing visitors to experts. A Mann-Whitney U test indicated that there was a significant difference in the overall perceived ratings of the experts (*Mdn* = 2.46) and the visitor group (*Mdn* = 3.17), $U = 436.5$, $p < .000$, $r = .444$, such that perceived ratings were higher for the visitors than the experts. Figure 1 and Figure 2 demonstrate the degree to which groups differed in their perceptions of environmental conditions relative to the ecological rating (represented by the reference line) as well as the direction of the difference. Figure 1 presents the distributions of group perceptions of overall environmental conditions in relation to the ecological rating. Figure 2 displays group perceptions on more specific components of environmental conditions (i.e., composition, structure, and function) in relation to the ecological rating. More specifically, the visitors and experts differ from the ecological value by similar amounts, however, they differ in opposite directions.

Comparing perceptions to ecological data. The ecological ratings used in the statistical analysis are presented as the reference lines in Figures 1 and 2. These ecological ratings will also be referred to as the "hypothetical median" in the non-parametric tests below. To statistically compare the visitor perceptions to the ecological ratings, one-sample Wilcoxon signed rank tests were performed. It was found that park visitors' perceptions of overall environmental conditions differed significantly from the ecological rating. Park visitors tend to have overall higher ratings of ecosystem conditions (*Mdn* = 3.17) than the ecologically obtained value of 2.75, $Z = 6.53$, $p < .000$. Table 3 displays similar one-sample Wilcoxon signed rank tests for components of environmental conditions.

A one-sample Wilcoxon signed rank test showed overall lower ratings of the state of the environment



(right)
FIGURE 1. Boxplot showing median perceptions of overall ecosystem conditions in relation to the overall ecological rating (represented by the solid reference line).



(below)
FIGURE 2. Boxplots showing median perceptions for ecosystem composition, structure, and function in relation to the ecological rating. Reference lines represent the ecological rating.

TABLE 3. One-sample Wilcoxon signed rank tests comparing visitor perceptions of components of ecological conditions to ecologically obtained values (hypothetical median).

Component	Ratings		N	Standardized test statistic	*p value*
	Hypothetical median	Observed sample median			
Composition	2.50	3.00	110	7.16	.000*
Structure	3.00	3.50	110	5.32	.000*
Function	2.75	3.12	110	4.14	.000*

* Significant at alpha of .05

TABLE 4. One-sample Wilcoxon signed rank tests comparing expert perceptions of components of ecological conditions to ecologically obtained values (hypothetical median).

Component	Ratings		N	Standardized test statistic	*p value*
	Hypothetical median	Observed sample median			
Composition	2.50	2.25	24	−1.27	.204
Structure	3.00	2.50	24	−2.59	.010*
Function	2.75	2.25	24	−3.42	.001*

* Significant at alpha of .05

from experts (*Mdn* = 2.46) than the ecologically measured value (2.75), $Z = -2.65$, $p = .008$. See Table 4 for comparisons of expert perceptions with ecological data on different components of the ecosystem.

Discussion

Investigating visitor perceptions of environmental conditions. Visitor perceptions of environmental conditions differed significantly from the ecological data. Generally, visitors rated the environment as being in a better condition than the ecologically collected rating. These results agree with similar studies that found that community or public perceptions tended to be at odds with ecological data (Pendleton, Martinà, and Webster 2001; Yasué, Kaufman, and Vincent 2010). Perceptions of environmental health are formed based on previous experiences with nature and an individual's "baseline" of what constitutes environmental health (Albert, Love, and Brewer 2013). However, contrary to findings by Petrosillo et al. (2007) and Curado et al. (2014), who found that past experiences/demographic attributes, and education level, respectively, influenced how people perceived environmental quality, the findings of this study showed no relationship between time spent in nature or education level on how visitors rated the state of the environment.

The tendency of community members to overestimate the condition of the ecosystem relative to ecological data may be due to several potential factors. For example, Yasué, Kaufman, and Vincent (2010) suggest wishful thinking as a potential explanation, and Pendleton, Martinà, and Webster (2001) suggest that people might not identify any concerns or threatening issues. Similarly, a possible explanation of overestimation of forest condition could be due to the assumption and preconception that protected areas are places of high naturalness and "pure" or "untouched" nature (Shultis and Way 2006). This conceptualization that protected areas are sites of desirable "naturalness" is supported by participant comments. Some examples

emerging from the open-ended survey question include: "natural setting," "very natural setting," "keep maintaining its naturalness," "I think [the NGNR] was the most nature-diverse hike I've gone on," and "Overall appeared to be maintained in a quite natural way. Human impact was minimal, limited pretty well to the trails and adjacent areas." Public conceptions of protected areas as intact natural areas and static ecosystems often do not align with assessments of ecological integrity by management (Shultis and Way 2006).

Interestingly, visitors' perceptions were least congruent when it came to ecosystem composition, where the average visitor rating was much higher than the measured ecological rating. Visitor perceptions may be influenced by an oversimplified visual memory when recalling their surroundings during the hike (Cook et al. 2010). For example, perhaps visitors interpreted the sight of lush, green plant cover as being a sign of good ecosystem condition, whereas such ground cover could have low species diversity or perhaps a high percentage of invasive species. Visitors could be oversimplifying that "green is good." This is supported by a study by Patel et al. (1999), who reported that visitors relied on visual components, and specifically the prevalence of "greenness," in their assessment of the state of the forest. The authors also found that visitors to a Carolinian forest in an Ontario protected area did not demonstrate a strong understanding of native and exotic species, and therefore might not be able to identify invasive plants. This could be especially relevant for non-local or international visitors.

The potential negative consequences of overestimation of environmental conditions are apparent when considering the influence of perceptions on visitor behavior in natural areas (Pendleton, Martinà, and Webster 2001; Alessa, Bennett, and Kliskey 2003). For example, perceptions of excellent environmental conditions or a failure to perceive ecological threats may influence engagement in detrimental behaviors (Alessa, Bennett, and Kliskey 2003). As well, public perceptions of environmental conditions that run counter to management objectives could lead to conflicts and lack of support for management, particularly in relation to restrictions on user activity (Shultis and Way 2006). Therefore, it is apparent that the ability for environmental managers to shape or influence how people perceive the state of the environment would be beneficial in order to influence visitor behaviors and garner increased support for management interventions that may restrict user activities.

The current findings also make clear the value in identifying discrepancies between visitor perceptions and ecological data to allow for opportunities to better align the two. Such comparisons can offer valuable insights in identifying areas to focus education efforts (Patel et al. 1999; Pendleton, Martinà, and Webster 2001; Shultis and Way 2006). However, it is noted that the quantitative comparisons carried out in this study may be more appropriate and useful in certain management contexts, for example, in justifying visitor restrictions. In the case of the NGNR, while there are opportunities to educate non-expert visitors on all aspects of ecological conditions, priorities should focus on aspects more likely to influence behavior. For example, educational tours might consider identifying examples of vegetation trampling to encourage hiking along marked trails. However, identifying such negative aspects of environmental conditions could also decrease visitor enjoyment. Fortunately, there are other opportunities to both influence perceptions and increase enjoyment. In the case of the NGNR, species diversity could be an important element. Identifying rare plant species, perhaps through a guided tour, could increase enjoyment of visitors and inform them of the consequences of removing the rare species.

Expert perceptions. Expert perceptions also differed significantly from the ecological data in that they generally had lower ratings of ecosystem conditions than the data. However, notably, experts' perceptions of ecosystem composition did not statistically differ from the ecological data. Similar findings have been reported by others (e.g., Cook et al. 2010). This could be due to the fact that composition variables such as species diversity or presence of invasive species are of higher familiarity to the experts. While visitors' perceptions may be related to an oversimplified visual memory ("green is good") as described above, the experts appear to be more aware of invasive species in their surroundings.

Aside from ecosystem composition, expert perceptions did not align with the ecological data. Experts tended to underestimate environmental conditions compared to the ecological data. Experts' perceptions may be

influenced by a reliance on negative indicators such as invasive plant species (Wood and Lavery 2000; Cook et al. 2010). An important note on study design is that experts were asked to recall condition, and might be recalling the areas in worst condition. In contrast to the visitor comments, expert comments emerging from the open-ended survey question were frequently pessimistic and focused on either human impact or invasive species. Some comments include: "a lot of buckthorn along the trail"; "distressed at proliferation of unsanctioned trails, disappearance of plants through picking and bouldering"; and several comments on broken glass such as, "noticed a fair amount of litter such as empty bottles, broken glass." The positive comments (of which there were two) included: "Nice to see research done about the Glen. Hopefully it will be a bit more protected" and "I like the new signage."

Lastly, it is important to note that the differences between expert perceptions and ecological data could be due to shortcomings of data collection. For example, rapid assessments have been critiqued for only providing a snapshot across time and space, whereas many of the experts have developed their perceptions over a longer period of time (Wood and Lavery 2000; Albert, Love, and Brewer 2013). These nuances should be further explored. The current study relied on recollection of conditions rather than opportunities to engage experts in physical data collection; however, the current findings can inform such future work.

Comparing group perceptions. The experts and visitors differed significantly in their perceptions of ecosystem conditions, a finding that offers important implications for park management and environmental management more broadly. These findings are similar to those of others who found differences between groups in their perceptions or preferences (e.g., Le Lay, Piégay, and Rivière-Honegger 2013). Perceptions of the experts and visitors deviated from the ecological measurement to a similar degree, but in opposite directions, with experts tending to have lower, and visitors higher, ratings.

These findings could have implications in terms of gauging how different groups might respond to management initiatives as well as their opinions of management priorities: important information for developing public support (Albert, Love, and Brewer 2013). Comparing group perceptions can also inform managers about potential areas of disagreement and the factors driving them (Forster et al. 2017). For example, in the case of the NGNR, the divergent estimations of environmental conditions of experts and visitors illustrate the "use versus preserve" tension. Those who perceive the NGNR as being in excellent condition may be less likely to agree with actions taken to reduce use. This was evident in several comments from visitors opposing fees and from some experts expressing concern about human impact.

Finally, it is important to recognize that the observed differences in the groups could be due to a flaw in the study design. Due to the purposive sampling and recruitment of the expert group, the experts were aware that they were participating in a research project and as a result may have been more aware of their surroundings and that there was potential concern about the reserve. Best efforts were made to ensure that the experts were not aware of the purpose of the study or the content of the questionnaire. However, it is recognized that their general awareness of being participants in a research project may have had an influence on their answers.

Conclusions

Perceptions of environmental conditions can be particularly important to understanding the human components of natural areas—an especially relevant consideration in recreational protected areas or natural areas with direct human interaction (Bennett 2016; Gelcich and O'Keeffe 2016; Bennett et al. 2017). Knowledge of visitor perceptions of environmental conditions can have ecological and social benefits, given that individual behaviors in natural environments and support for management initiatives are influenced to some extent by how individuals perceive the environment. In addition to researching differences in values, aesthetic preferences, and attitudes between groups, how groups perceive environmental conditions should also be a focus for scholarship and practice (Albert, Love, and Brewer 2013).

This research examined how environmental conditions are perceived among groups and how these perceptions relate to ecological data. Two distinct groups—experts and visitors—were surveyed on their perceptions of environmental conditions, which were then compared to ecological data. Overall, experts and visitors differed in their perceptions of environmental conditions, with

experts producing lower ratings of conditions and visitors generally overestimating conditions relative to the ecological data.

These findings highlight the importance of monitoring perceptions of different groups, especially in relation to ecological data. Knowledge of visitor perceptions can enable managers to better understand how people may interact with their environment, provide insights on public support for management initiatives, inform education efforts, and inform the larger picture of the social context of the site. Knowledge of intergroup differences in perceptions, particularly in relation to ecological data, are important for developing consensus to improve support for conservation and address some of the tensions existing between groups.

This research contributes evidence that groups perceive the state of the environment differently. Future research should further investigate the drivers of these perceptions of the environment. For example, what are the specific reasons why experts underestimate ecosystem conditions? How do these perceptions relate to values and knowledge? Lastly, it is apparent that the ability for environmental managers to shape or influence how people perceive the state of the environment would be beneficial to influence behaviors or increase support. Research is needed that explores this void.

Supplementary data

Supplementary data for this article can be found online at https://doi.org/10.6084/m9.figshare.11373969.

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