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Crowding as a Descriptive Indicator and an Evaluative Standard: Results from 30 Years of Research

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This paper examined perceived crowding using 615 evaluation contexts obtained from 181 studies that used a 9-point scale. Four methods for summarizing the crowding scale were highly correlated ($r \geq .90$) across all evaluation contexts. Four independent variables (year study was conducted, region of United States, country, specific activity) affected perceived crowding for both the collapsed scale and the mean of the scale. One factor, specific location of the encounter, only affected perceived crowding for the percentages, not the mean. Consumptive versus nonconsumptive activities had no effect on perceived crowding. Using capacity judgment standards, 40% of the 615 evaluation contexts were in the suppressed crowding category, 16% were over capacity and 9% were greatly over capacity.

Keywords comparative analysis, crowding, crowding measurement, evaluative standards

Introduction

Virtually all recent planning frameworks recommend identifying and establishing quantitative impact indicators and standards (e.g., Visitor Impact Management [VIM], Graefe, Kuss, & Vaske, 1990; Visitor Experience and Resource Protection [VERP], National Park Service, 1997; Limits of Acceptable Change [LAC], Stankey et al., 1985). *Indicators* describe the biophysical, social, managerial, or other conditions that managers and visitors care about for a given experience. *Standards* restate management objectives in quantitative terms and specify the appropriate levels or acceptable limits for the impact indicators (i.e., how much impact is too much for a given indicator). Standards identify conditions that are desirable (e.g., no litter) as well as the conditions that managers do not want to exceed (e.g., encounters with other people). Perceived crowding combines descriptive information (i.e., the density or encounter level experienced by the individual) with evaluative information (i.e., the individual's negative evaluation of that density or encounter level). When people evaluate an area as crowded, they have implicitly compared the impact they experienced with their perception of a standard.

Crowding is one of the most frequently studied aspects of outdoor recreation (Fleishman, Feitelson, & Salomon, 2004; Graefe et al., 1990; Lime, 1996; Manning, 1985;

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Manning, Lime, Friemund, & Pitt, 1996; Shelby & Heberlein, 1986; Stewart & Cole, 2001). Given current population growth rates, crowding will likely continue to be an important research and management issue.

To better understand crowding, researchers have expanded their investigations from single activity/resource descriptive studies to comparative analyses of data aggregated across a variety of activities and resources (Shelby, Heberlein, Vaske, & Alfano, 1983; Shelby, Vaske, & Heberlein, 1989; Vaske & Donnelly, 2002). By contrasting identical measures of the same concept across a number of activities, resources, and visitor characteristics, aggregated data sets reveal patterns in the findings and identify factors that typically cannot be manipulated in a single study (e.g., the relationship of multiple activities and settings on crowding).

Shelby et al.'s (1989) comparative analysis indicated that crowding varied across recreational settings, time or season, resource availability, and accessibility. Their findings were based on 35 studies and 59 different settings and activities (i.e., evaluation contexts). Our article builds on the Shelby et al. article by examining 181 studies and 615 different settings and activities. The objectives were to:

(a) describe perceived crowding studies from 1975 to 2005,
(b) evaluate alternative approaches to summarizing the 9-point crowding scale,
(c) assess variables that influence crowding, and
(d) explore the crowding standards proposed by Shelby et al.

Measuring Perceived Crowding

Crowding is defined as a negative evaluation of density and involves a value judgment that the density or number of encounters with other visitors is too many (Altman, 1975; Desor, 1972; Schmidt & Keating, 1979; Stokols, 1972). The term *perceived crowding* is often used to emphasize the subjective or evaluative nature of the concept.

Perceived crowding is a psychological construct that exists in the minds of individuals and is usually measured by self-report techniques. Heberlein and Vaske (1977) developed a relatively simple measure of perceived crowding that asks people to indicate how crowded the area was at the time of their visit. Responses are given on a 9-point scale:

1	2	3	4	5	6	7	8	9
Not at all Crowded		Slightly Crowded			Moderately Crowded			Extremely Crowded

A response of 1 or 2 indicates *not at all crowded*, 3-4 indicates *slightly crowded*, 5-7 indicates *moderately crowded*, and 8-9 indicates *extremely crowded*. The single-item crowding measure is easy to fill out, interpret, and has been widely used in outdoor recreation research (Shelby et al., 1989). To date, the measure has been used in at least 181 different studies.

Methods for Reporting Perceived Crowding Using the 9-point Crowding Scale

The crowding scale can be analyzed from various perspectives. When describing a wilderness experience where the goal is to provide an opportunity for low-density recreation, the scale has traditionally been collapsed into a dichotomous variable (not at all crowded vs. any degree of crowding). This provides a conceptually meaningful break point between those who labeled the situation as *not at all crowded* (scale points 1 and 2, a positive evaluation), and those who labeled the situation as *slightly*, *moderately*, or *extremely*

crowded (scale points 3 through 9, a negative evaluation). Research, however, suggests that individuals accept and can tolerate higher use levels in frontcountry settings (Graefe, Confer, Drogin, & Titre, 1994; Vaske & Donnelly, 1997; Vaske, Donnelly, & Lehto, 2002). In these situations, collapsing the scale into *not at all crowded* versus some degree of crowding may be too strict a definition for what constitutes crowding. Vaske and Donnelly (1997), for example, found a clear breakpoint for perceived crowding between *slightly* and *moderately* crowded. For frontcountry settings, these researchers recommended collapsing the scale into two categories: scale points 1 through 4 (*not at all* and *slightly crowded*) versus scale points 5 through 9 (*moderately* and *extremely crowded*).

A third approach to describing crowding calculates the mean value of the 9-point scale. The mean provides a single summary statistic that can highlight differences across resources and activities (Vaske, Donnelly, Doctor, & Petruzzi, 1994), and is not dependent on researcher-defined breakpoints. A fourth approach to describing crowding calculates the median of the scale. The median provides a single summary statistic that can be used to consider possible crowding standards. Given that alternative methods for reporting crowding could lead to different conclusions and management implications (Graefe et al., 1994; Vaske & Donnelly, 1997; Vaske et al., 2002), understanding the relationships among the summary procedures can facilitate the choice of the reporting method.

Crowding as a Descriptive Indicator

When aggregating studies, resources, visitor characteristics, and activities, it is useful to evaluate the influence of variables on perceived crowding that typically cannot be manipulated in a single study. Previous research suggests that study year, region, country, and activity are descriptive indicators of crowding (Shelby et al., 1989).

Year

Perceived crowding has changed over time (Shelby et al., 1989). Two studies conducted 10 years apart at Apostle Islands National Lakeshore, for example, showed that although use levels increased, perceived crowding decreased (Heberlein & Vaske, 1979; McKinnell & Heberlein, 1987). Eleven years of hunter density experiments at Sandhill Wildlife Demonstration Area in Wisconsin showed similar findings (Heberlein & Kuentzel, 2002). About 24% of the Sandhill deer hunters reported feeling crowded in 1982, and only 12% reported feeling crowded in 1988. In 1975, 52% of the Brule River canoers reported feeling crowded (Heberlein & Vaske, 1977). Ten years later, in 1985, only 37% of the canoers felt crowded (Heberlein & Proudman, 1986). Thus, *we hypothesize that perceived crowding will decrease over time (H_1).*

Region of United States and Country

Donnelly, Vaske, and Kuss (1981) highlighted differences between eastern and western wilderness areas in the United States. Eastern visitors encountered more people on the trail and were more tolerant of crowding than western visitors who saw fewer people on the trail, reported a solitary experience, and were more sensitive to crowding. These investigators also noted that the eastern wilderness areas were more accessible due to close proximity to major population areas. The 1989 comparative crowding analysis (Shelby et al., 1989) showed that areas close to major populations had higher crowding levels then less accessible areas.

Shelby et al.'s (1989) comparative crowding analysis, however, found crowding was not influenced by U.S. region (i.e., Northeastern, Midwestern, and Western). Shelby et al.

speculated that their results were likely due to small sample sizes in each region. Considering the East versus West argument, an increased sample size, and more representation from each region, *we hypothesize that perceived crowding will vary by region of the United States (H_2).*

The Shelby et al. (1989) article included two international studies and four international contexts, which was not a large enough number for an analysis of perceived crowding by country. The data set used for the study reported here included 31 international studies. *We hypothesize that perceived crowding will vary by country (H_3).*

Specific Location within a Resource

Crowding expectations may also differ at specific locations (e.g., campgrounds, attraction sites, at the trailhead) within a resource due to visitor expectations. Vaske et al. (2002) found differences in perceived crowding at man-made and natural attraction sites, trailheads, and during the trip (e.g., on the trail) in Rocky Mountain National Park. A similar pattern was found at the Columbia Icefield (Vaske & Donnelly, 2001) where crowding varied at human-made attraction sites versus on the trip (e.g., on the glacier). *We hypothesize that perceived crowding will vary at different locations within a resource (H_4).*

General Activities

Vaske, Donnelly, Heberlein, and Shelby (1982) theorized that participants in consumptive activities (i.e., hunters and anglers) differed from those in nonconsumptive activities (e.g., campers, hikers, boaters) in terms of the specificity of their recreation goals and their control in achieving those goals. Consumptive recreationists reported significantly lower satisfaction scores. Other analyses (Shelby et al., 1989), however, found no statistical differences between consumptive and nonconsumptive users in terms of crowding.

The difference in findings between the satisfaction analysis and the crowding analysis can be partially explained by the measurement correspondence among the concepts. Social psychologists have repeatedly noted that for a relationship to be observed, the two concepts must be measured at the same level of specificity (Eagly & Chaiken, 1993). When there is a direct correspondence between the two measures (general to general or specific to specific), a relatively strong correlation will be observed. With no correspondence, the magnitude of the relationship declines. Whittaker, Vaske, and Manfredo (2006), found that value orientations (i.e., a general concept) had more influence on acceptability of general urban wildlife management than specific measures. In the satisfaction article by Vaske et al. (1982), both activity type (consumptive vs. nonconsumptive) and satisfaction (overall evaluation) were measured at a general level and a relationship was observed. In the comparative crowding analysis (Shelby et al., 1989), consumptive versus nonconsumptive was a general variable, while crowding was specific to the number encountered, and a relationship was not observed.

The lack of a relationship between consumptive versus nonconsumptive and perceived crowding also may be explained by the role encounters play in different activities. For example, some hunters view deer hunting as a solitary experience and thus prefer few encounters (Vaske, Donnelly, & Shelby, 1993). Others believe that the presence of additional hunters help move deer and thereby increase the likelihood of seeing and bagging game (Heberlein & Kuentzel, 2002). For this group, a large number of encounters may be preferable. The same logic applies to nonconsumptive recreation. Individuals who are motivated by solitude may find the presence of others disruptive. Alternatively, large numbers of people on a beach are often expected and may enhance the quality of the social experience.

Given this diversity of desired experiences within both consumptive and nonconsumptive activities and the lack of measurement correspondence between the concepts, the influence of consumptive versus nonconsumptive (a general concept) on crowding (a specific concept) may have no association as previously observed (Shelby et al., 1989). *We hypothesize that perceived crowding will not vary for consumptive versus nonconsumptive activities (H_5).*

Specific Activities

Alternatively, the range of activities included within the consumptive and nonconsumptive categories can be examined. For example, consumptive activities include angling and hunting. Nonconsumptive activities include camping, floating, rafting, kayaking, canoeing, boating, biking, and hiking. When different activity groups interact, conflict may arise. Studies have shown that paddling canoers are bothered by motorized boaters (Adelman, Heberlein, & Bonnicksen, 1982; Lime, 1975), and hikers are bothered by bikers (Carothers, Vaske, & Donnelly, 2001). It is likely that some activity groups will perceive more or less crowding than other activity groups depending on their needs and expectations for a particular activity. Thus, *we hypothesize that perceived crowding will vary among different activities (H_6).*

Crowding as an Evaluative Standard

Social carrying capacity is defined as the level or type of use beyond which impacts to the visitor experience exceed acceptable levels (Kuss, Graefe, & Vaske, 1990).When people evaluate an area as crowded, they have implicitly compared the condition they experienced (i.e., impacts) with their perception of what is acceptable (i.e., standards). If they conclude that the area is crowded, it would appear that the existing conditions exceeded their definitions of a standard, which is one criterion for an area being over capacity.

Shelby et al. (1989) identified five distinct categories of carrying capacity judgments based on the 9-point perceived crowding scale: suppressed crowding, low normal, high normal, over capacity, and greatly over capacity. The five categories were established based on the percentage of visitors reporting any level of crowding (scale points 3 through 9). These categories were adopted for purposes of this comparative analysis.

Methods

Since 1975, the single-item crowding measure has been used in 181 studies conducted across the United States, Canada, New Zealand, Ecuador, Sweden, and Thailand, resulting in crowding ratings for 615 different settings and activities. These activities included hunting of many types, fishing of many types, rafting, kayaking, canoeing, floating, boating, rock climbing, mountain climbing, backpacking, day hiking, biking, sailing, photography, and driving for pleasure. The areas studied showed considerable diversity with some showing extremely high density and use impact problems, others showing low densities and no problems, and still others actively using management strategies to control densities and use impacts. In total, 85,451 individuals had been asked the crowding question at the time of our analysis.

Data for this article were obtained from secondary analyses of articles, dissertations, theses, and published and unpublished reports. Detailed information on the data is available on-line (see http://welcome.warnercnr.colostate.edu/NRRT/people/jerryj.htm) and includes: (a) descriptions of studies conducted in the United States, (b) descriptions of international studies, (c) rankings of perceived crowding for different evaluation contexts, and

(d) references for data used in the comparative analysis. Some evaluation contexts referred to specific locations where recreationists evaluated crowding. For example, visitors were asked to evaluate crowding at campsites, while climbing, and at the summit on Mt. Shasta. Evaluation contexts also represented time (e.g., year of study, weekend vs. weekday, opening day vs. rest of hunting season), or users evaluating other types of recreationists (e.g., kayakers evaluations of encounters with motorboaters). The 615 evaluation contexts constituted the basic unit of analysis in this article.

Variables Measured

Dependent variables. Perceived crowding was summarized using four different methods: (a) percentages for the collapsed crowding scale (i.e., *slightly*, *moderately*, or *extremely crowded*; scale points 3 through 9); (b) percentages for those who labeled the situation as *moderately* or *extremely crowded* (scale points 5 through 9); (c) means, and (d) medians of the crowding scale.

Independent variables. The independent variables included: (a) study year, (b) region of United States, (c) country, (d) specific location within a resource, (e) general activities, (f) specific activities, and (g) carrying capacity judgments.

Year was analyzed using two different variables. The *five year view* grouped the year the study was conducted into five year increments: 1975 to 1979, 1980 to 1984, 1985 to 1989, 1990 to 1994, 1995 to 1999, and 2000 to 2005. The *decade view* grouped study year into 10 year increments: 1975 to 1984, 1985 to 1994, 1995 to 2005.

Region of U.S. was coded as Pacific (Alaska, California, Hawaii, Oregon, Washington), Midwest (Michigan, Minnesota, Wisconsin), South (West Virginia, Tennessee), Rocky Mountain (Arizona, Colorado, Nevada, Utah), Mid-Atlantic (Delaware, Maryland, New York, Pennsylvania), New England (Maine, Massachusetts, New Hampshire, Vermont), and South Atlantic (North Carolina, South Carolina).

The *country* variable represented the countries in the dataset: United States, Canada, and New Zealand. Although the single-item 9-point scale was also used in Ecuador, Sweden, and Thailand, not enough studies warranted their inclusion in analyses by *country*.

The *specific location within a resource* variable was coded start/end of trip, during trip, natural attraction, man-made attraction, or campground. The *general activities* variable referred to consumptive and nonconsumptive. The *specific activities* included hunting, angling, camping, floating, rafting, kayaking, canoeing, boating, biking, and hiking.

Carrying capacity judgments were based on the five categories proposed by Shelby et al. (1989): 0–35% *suppressed crowding*, 36–50% *low normal*, 51–65% *high normal*, 66–80% *more than capacity*, and 81–100% *much more than capacity*. Similar to Shelby et al., results are reported as the percent of respondents feeling any level of crowding (i.e., scale points 3 through 9). The percent of evaluation contexts in each of the five categories was computed for *region of U.S.*, *country*, *specific location within a resource*, *general activities*, and *specific activities*.

Bivariate relationships between the independent variables and dependent variable were examined using Analysis of Variance. Eta (η) was reported as the effect size measure.

Results

Across all evaluation contexts, the four methods of reporting crowding were highly correlated ($r \geq .90$; see Table 1). For example, the correlation between the scale mean and the percent feeling any level of crowding (scale points 3 through 9) was $r = .95$. Given these correlations, we opted to use only two of the four analysis methods: percent reporting any

TABLE 1 Correlations among Alternative Methods for Reporting Perceived Crowding

Measure of crowding	Scale points 3–9	Scale points 5–9	Scale mean	Scale median
Scale points 3–9 (%)	—			
Scale points 5–9 (%)	.90	—		
Scale mean	.95	.97	—	
Scale median	.90	.94	.95	—

Note. All coefficients are significant at $p < .01$.

crowding (i.e., 3–9) and scale mean. These statistics reflect the two most common reporting methods in studies using the 9-point perceived crowding scale.

Year

Crowding varied by the year the study was conducted (Table 2). In the five year view, statistical differences were found in the average percent feeling crowding ($F = 8.86$,

TABLE 2 Crowding Scale Averages by 5-Year View, Decade View, Country, and U.S. Region

			Crowding scale points 3–9				Crowding scale mean			
Variable	# of studies	# of contexts	Average (%)	*SD*	*F* value	η	Average mean	*SD*	*F* value	η
5 year view[1]					8.86**	.26			10.13**	.29
1975–1979	11	15	51.0	20.0			3.4	1.3		
1980–1984	26	63	41.0	20.4			2.8	1.0		
1985–1989	30	71	50.2	29.4			3.1	1.4		
1990–1994	35	109	55.4	24.2			3.6	1.4		
1995–1999	33	128	43.9	24.2			2.8	1.2		
2000–2005	45	228	38.3	23.0			2.7	1.0		
Decade view[2]					17.69**	.23			19.75**	.26
1975–1984	37	78	42.9	20.6			2.9	1.1		
1985–1994	65	180	53.3	26.4			3.4	1.4		
1995–2005	78	356	40.3	23.6			2.7	1.0		
Region of U.S.					11.64**	.35			16.69**	.42
Pacific	60	231	49.2	24.3			3.2	1.1		
Midwest	33	98	38.0	23.2			2.7	1.1		
South	2	2	49.5	26.2			3.2	1.0		
Rocky Mountain	24	103	39.2	22.3			2.6	1.0		
Mid-Atlantic	12	31	43.4	28.3			3.1	1.4		
New England	12	32	31.2	20.0			2.4	0.7		
South Atlantic	4	21	75.7	14.4			4.8	1.1		
Country[3]					6.30*	.14			3.97*	.12
United States	150	522	44.9	24.8			3.0	1.2		
Canada	10	53	36.8	26.1			2.7	1.2		
New Zealand	17	25	57.9	18.8			3.6	0.9		

[1]All categories include five years with the exception of 2000-2005.
[2]All categories include ten years with the exception of 1995-2005.
[3]Ecuador, Sweden, and Thailand were deleted from this analysis due to low sample size (4 studies in total).
*$p < .05$ **$p < .001$.

$df = 613$, $p < .001$; $\eta = .26$) and the crowding scale mean ($F = 10.13$, $df = 569$, $p < .001$; $\eta = .29$). For the decade view, statistical differences also were evident in the percent feeling crowded ($F = 17.69$, $df = 613$, $p < .001$; $\eta = .23$) and the crowding scale mean ($F = 19.75$, $df = 569$, $p < .001$; $\eta = .26$). Hypothesis 1 was supported by both the crowding percents and the crowding scale mean when considered in the five year view and the decade view. Consistent with previous research (Heberlein & Kuentzel, 2002; Heberlein & Proudman, 1986; McKinnell & Heberlein, 1987), perceived crowding has declined over time.

Region of the United States

Hypothesis 2 predicted that crowding would vary in different regions of the United States. Our data supported the hypothesis (Table 2). The South Atlantic region had the highest level of crowding with a mean of 76% ($SD = 14\%$), compared to the New England region with the lowest crowding ($M = 31\%$, $SD = 20\%$). The difference between all regions of the United States for the percentages (Pacific, Midwest, South, Rocky Mountain, Mid-Atlantic, New England, and South Atlantic) was statistically significant ($F = 11.64$, $df = 417$, $p < .001$; $\eta = .35$). The crowding scale mean also resulted in statistical differences ($F = 16.69$, $df = 482$, $p < .001$; $\eta = .42$).

Country

Crowding was influenced by country (Table 2). There were significant differences for the crowding percent variable ($F = 6.30$, $df = 599$, $p = .002$; $\eta = .14$) and the scale mean ($F = 3.97$, $df = 554$, $p = .019$; $\eta = .12$). Hypothesis 3 was supported for both the percentages and the scale mean. Forty-five percent of respondents who completed the question in the United States felt some degree of crowding, compared to 37% of those in Canada and 58% in New Zealand.

Specific Location within a Resource

Crowding varied by specific location within a resource for the crowding percent variable ($F = 3.72$, $df = 600$, $p = .005$; $\eta = .16$), but not for the crowding mean ($F = 1.90$, $df = 555$, $p = .109$; $\eta = .12$; see Table 3). Hypothesis 4 was only supported when analyzed by percentages. More than half of the respondents felt crowded at natural (56%) and man-made (51%) attractions. Nearly as many (49%) perceived some level of crowding at campgrounds. On average, reported crowding was lowest (34%) at the starting and ending locations of the trip.

General Activities

As predicted, crowding was not influenced by consumptive versus nonconsumptive activities for the crowding percent variable or the scale mean (Table 3). Nonconsumptive recreationists averaged 45% feeling any level of crowding ($SD = 25\%$) compared to 41% for individuals engaged in consumptive activities ($SD = 25\%$). This difference was not significant ($F = 3.22$, $df = 607$, $p = .073$; $\eta = .07$). For the mean of the crowding scale, nonconsumptive recreationists had an average of 3.0 ($SD = 1.2$) and consumptive individuals averaged 2.9 with $SD = 1.2$ ($F = 0.59$, $df = 562$, $p = .442$; $\eta = .03$). The percentage feeling any level of crowding and the mean of the crowding scale supported Hypothesis 5.

TABLE 3 Crowding Scale Averages by Specific Location within a Resource, General Activity, and Specific Activity

		Crowding scale points 3-9				Crowding scale mean			
Variable	# of contexts[1]	Average (%)	*SD*	*F* value	η	Average mean	*SD*	*F* value	η
Specific location				3.72*	.16			1.90	.12
Start/end of trip	45	34.7	26.0			2.6	1.3		
During trip	479	43.7	24.7			2.9	1.2		
Natural attraction	16	56.1	22.4			3.3	0.9		
Man-made attraction	45	51.2	23.6			3.2	1.1		
Campground	16	48.8	19.0			3.2	1.0		
General activity				3.22	.07			0.59	.03
Consumptive	125	40.8	25.4			2.9	1.2		
Nonconsumptive	483	45.2	24.5			3.0	1.2		
Specific activity				8.67**	.45			8.87**	.47
Hunters	95	35.3	22.7			2.6	1.1		
Anglers	30	58.2	23.0			3.9	1.4		
Campers	7	58.9	11.0			3.6	0.6		
Floaters	9	17.0	23.5			1.5	0.7		
Rafters	25	35.0	31.5			2.5	1.6		
Kayakers	23	43.6	27.6			3.0	1.4		
Canoers	10	71.0	21.1			4.7	1.7		
Boaters	66	58.9	22.6			3.7	1.1		
Hikers	45	45.4	21.0			2.9	1.1		
Bikers	8	45.4	27.1			2.7	1.5		

[1]One study is likely to have specific contexts in one or more locations or activities.
*$p < .05$; **$p < .001$.

Specific Activities

Crowding varied by specific type of activity (Table 3). For example, the percentages for the collapsed crowding scale averaged 35% for hunters ($SD = 24\%$) and 58% for anglers ($SD = 23\%$). The difference between all activities (hunting, angling, camping, floating, rafting, kayaking, canoeing, boating, biking, and hiking) was significant ($F = 8.67$, $df = 317$, $p < .001$; $\eta = .45$). Canoers were most likely to report some of level of crowding (71%). On average, floaters were the least crowded (17%). The mean of the crowding scale also showed a significant difference ($F = 8.87$, $df = 299$, $p < .001$; $\eta = .47$). The percentages for crowding and the mean of the crowding scale supported Hypothesis 6.

Crowding Standards

Table 4 describes the capacity judgments suggested by Shelby et al. (1989). For all 615 evaluation contexts, 40% showed suppressed crowding, 18% low normal crowding, 17% high normal crowding, 16% over capacity, and 9% greatly over capacity.

In the United States, 40% of the 522 evaluation contexts showed suppressed crowding (Table 5), whereas 16% were overcapacity and 9% were greatly overcapacity. For Canada, 49% showed suppressed crowding, 17% were overcapacity, and 2% were greatly

TABLE 4 Carrying Capacity Judgments Based on Levels of Perceived Crowding

Percent feeling crowded	Capacity judgment	Comment	Total # of contexts ($n = 615$)	Percent of contexts
0–35%	Suppressed crowding	Crowding is likely limited by management, situational factors, or natural factors may offer unique low-density experiences.	245	40%
36–50%	Low normal	Access, displacement, or crowding problems are not likely to exist at this time. Similar to the above category, may offer unique low-density experiences.	111	18%
51–65%	High normal	These locations or activities probably have not exceeded carrying capacity but may be tending in that direction. Should be studied if increased use is expected, allowing management to anticipate problems.	107	17%
66–80%	Overcapacity	These locations or activities are generally known to have overuse problems, and they are likely to be operating at more than their capacity. Studies and management necessary to preserve experiences.	99	16%
81–100%	Greatly overcapacity	It is generally necessary to manage for high-density recreation. A crowding problem has typically been identified.	53	9%

overcapacity. The South Atlantic region of the United States showed the greatest percentage of contexts at greatly overcapacity (52%), whereas the New England and South regions had 0% of contexts at greatly overcapacity.

Natural and man-made attractions resulted in 38% and 31%, respectively, of contexts being overcapacity. For start/end of trip and during trip less than 15% of contexts were overcapacity. Less than 10% of all specific locations within a resource were greatly overcapacity, (Table 6).

Table 6 also reports carrying capacity judgments by general and specific activities. Canoers, for example, showed the greatest percentage of contexts at greatly overcapacity (50%), whereas campers and floaters had 0% of contexts greatly overcapacity. Hunters, floaters, rafters, and bikers had 50% or more of contexts showing suppressed crowding.

Discussion

The 9-point crowding measure has been used in 181 different studies involving 615 evaluation contexts. This frequency of application permits comparisons within and between

TABLE 5 Carrying Capacity Judgments by Country and U.S. Region

		Carrying capacity judgments – % of contexts				
Variable	Total # of contexts	Suppressed crowding (0–35%)	Low normal (36–50%)	High normal (51–65%)	Over capacity (66–80%)	Greatly over capacity (81–100%)
Region of U. S.						
Pacific	231	33%	18%	19%	19%	11%
Midwest	98	48	22	15	10	5
South	2	50	0	0	50	0
Rocky Mountain	103	51	17	14	15	3
Mid-Atlantic	31	45	3	25	19	7
New England	32	59	22	16	3	0
South Atlantic	21	0	5	19	24	52
Country						
United States	522	40	18	17	16	9
Canada	53	49	17	15	17	2
New Zealand	25	12	20	28	24	16

TABLE 6 Carrying Capacity Judgments by Specific Location within a Resource, General Activity, and Specific Activity

		Carrying capacity judgments – % of contexts				
Variable	Total # of contexts	Suppressed crowding (0–35%)	Low normal (36–50%)	High normal (51–65%)	Over capacity (66–80%)	Greatly over capacity (81–100%)
Specific location						
Start/End of trip	45	56%	11%	18%	11%	4%
During trip	479	42	19	16	14	9
Natural attraction	16	19	6	31	38	6
Man-made attraction	45	29	11	22	31	7
Campground	16	25	31	13	31	0
General activity						
Consumptive	125	49	18	11	15	7
Nonconsumptive	483	38	18	19	16	9
Specific activity						
Hunters	95	56	19	10	11	4
Anglers	30	24	16	13	30	17
Campers	7	0	29	28	43	0
Floaters	9	67	22	11	0	0
Rafters	25	60	0	8	24	8
Kayakers	23	48	13	13	9	17
Canoers	10	0	10	30	10	50
Boaters	66	15	24	20	21	20
Hikers	45	38	21	18	16	7
Bikers	8	50	12	0	25	13

recreation activities and settings that is typically not possible with most psychological constructs examined in recreation research. Our comparative data showed that four factors affected the level of perceived crowding: year study was conducted, region of United States, country, and specific activity for both the average percentages (collapsed scale at 3-9) and the mean of the scale. These aggregate data supported the relationships among use levels, encounters, and crowding that are well established in single studies with individual data and extend what is known by documenting aggregate factors that affect crowding.

Research Implications

This study explored four alternatives to reporting crowding: (a) percentages for scale points 3 through 9 (slightly to extremely crowded), (b) percentages for scale points 5 through 9 (moderately to extremely crowded), (c) means, and (d) medians. Collapsing the scale at points 3 through 9 is conceptually intuitive (*not at all crowded* vs. some degree of crowding) and has been the traditional format for summarizing the variable (Heberlein & Vaske, 1977; Shelby & Heberlein, 1986; Shelby et al., 1989). Given that the correlations between the four methods of reporting crowding exceeded $r = .90$, researchers and managers should use whichever method is most appropriate for understanding the data.

A researcher's choice of one summary statistic over another should be based on management objectives. When managing for low density resources (e.g., wilderness) where a few encounters may disrupt the experience, reporting percentages for the collapsed points 3 through 9 may be the most appropriate. For higher density settings, either collapsing points 5 through 9 or calculating the mean of the crowding scale may provide the best indicator of crowding impacts. When considering appropriate management standards, reporting the median may be appropriate in addition to another reporting method.

Although the number of evaluation contexts summarized in this article was 10 times greater than what was available for the Shelby et al. (1989) article ($n = 615$ vs. 59, respectively), knowledge gaps still remain. For example, panel data from Apostle Islands National Lakeshore (Heberlein & Vaske, 1979; McKinnell & Heberlein, 1987) showed that perceived crowding declined between 1975 and 1985 despite increasing use levels. Our comparative analyses showed a similar trend with 51% who felt crowded in studies conducted between 1975 and 1979, while 38% felt crowded in studies conducted between 2000 and 2005. The findings from our analyses might be attributable to the specific locations where the studies were conducted (e.g., differences in density levels, regional differences) or the activities respondents participated in during different years. Testing for these potential interaction effects (e.g., year $*$ location $*$ density $*$ region $*$ activity), however, must remain a topic for further study. The current data set does not contain a sufficient number of cases per cell to analyze the possible combinations of predictor variables.

Similarly, the regional differences uncovered by the analyses in this article were consistent with speculations offered by Donnelly et al. (1981) but not empirically supported by Shelby et al. (1989). The Shelby et al. comparative analysis hypothesized that the lack of a statistical relationship was due to the small sample sizes within each of the regions. Although the overall sample in our comparative analysis was larger ($n = 615$), when the evaluation contexts were categorized by region, sample size issues persisted (e.g., the sample size for the southern region = 2). An explanation for why regional differences in crowding existed remains a topic for further study.

One independent variable, specific location of the encounter (e.g., at the trailhead, on the trail), only affected perceived crowding for the percentages, not the mean. A larger sample size for contexts may be helpful in detecting consistent differences between the reporting methods. As hypothesized, no differences were found between consumptive and

nonconsumptive activities in terms of perceived crowding. This finding was consistent with the Shelby et al. (1989) comparative crowding analysis. Other research (Vaske et al., 1982), however, has shown that hunters and anglers were less satisfied than those engaged in nonconsumptive activities even if they were successful in bagging game. These differences in the more general satisfaction variable apparently do not extend to the more specific crowding phenomenon.

Shelby et al. (1989) were personally familiar with all 35 studies and 59 contexts, which led them to trust the evaluative standards expressed in Table 4. Eighteen years later with 181 studies and 615 contexts, this level of familiarity was no longer possible. Given the larger sample, researchers should consider other alternatives such as meta-analysis for comparing multiple data sets (Lipsey & Wilson, 2001; Shelby & Vaske, 2008). Shelby and Vaske (2007), for example, combined comparative analyses with meta-analyses to evaluate perceived crowding among hunters and anglers. Similar to this article, the comparative analysis arrayed the evaluation contexts from 100% to 0% crowded. A formal meta-analysis was used to calculate the means, confidence intervals, and tests for homogeneity of variance for the hunters and anglers. Consistent with prior research summaries (Shelby & Heberlein, 1986; Shelby et al., 1989; Vaske et al., 1982), hunters and anglers were not homogeneous groups. Meta-analysis statistics (e.g., Q) provided a gauge for determining the degree of homogeneity.

Combining comparative and meta-analytic techniques enhances theoretical and empirical advancement, and facilitates understanding practical applications of a concept. With relatively few exceptions (Hunt, Floyd, & Ditton, 2007; Shelby & Vaske, 2007), the use of formal meta-analysis techniques in the human dimensions literature remains largely unexplored. In our judgment, however, until future meta-analyses or other unknown techniques show that the standards need to be changed, the standards proposed by Shelby et al. (1989) remain a viable method for assessing carrying capacity judgments based on levels of perceived crowding.

Because of its utility, we encourage continued use of the single-item crowding question. As we have stressed elsewhere (Shelby et al., 1989; Shelby & Vaske, 2007) it is important to type the response scale exactly as shown in this article. Changing the alignment of the descriptive labels under the numbered response categories potentially changes the scale's meaning and yields noncomparable results. In 13 studies identified in our literature search, the scale was changed to seven (4 studies), five (6 studies), or four (3 studies) points. As a result the findings could not be compared here.

Management Implications

Unlike some indicators of quality recreation experiences such as overall satisfaction that typically show little variation (Shelby & Heberlein, 1986), perceived crowding varied by changing use conditions and management actions. Our findings are useful for advising natural resource managers about potential carrying capacity problems and highlighting the value of multiple data sets. With no other studies for comparison against a single finding, determining how crowded is too crowded is difficult. The broader perspective offered by multiple studies or evaluation contexts makes the crowding measure useful for comparing areas and making rough carrying capacity determinations. A complete listing of the perceived crowding scores (i.e., percentages, means, medians) from all 615 evaluation contexts can be found at: http://welcome.warnercnr.colostate.edu/NRRT/people/jerryj.htm. The crowding measure alone is not a perfect substitute for information about use levels, impacts, and evaluative standards that a more complete carrying capacity study can provide. Nevertheless, the measure is simple, fast, and inexpensive, which thereby allows researchers and managers to easily gain insight about a potential study site.

In conclusion, the 9-point perceived crowding scale has been used as a descriptive impact indicator and an evaluative standard. Comparisons of aggregate data from 181 studies showed that the single-item measure of perceived crowding continues to be useful in a variety of situations. It varies with a number of factors that influence use. It provides useful comparative data that allow managers to understand better the carrying capacity challenges that face them and gives investigators an idea about what kinds of studies would be most useful. We urge investigators to use this scale in other studies and to report results in a comparable form so that the database can be expanded.

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