

DISSERTATION

META-ANALYSIS AND COMPARATIVE ANALYSIS:  
ILLUSTRATIONS USING PERCEIVED CROWDING

Submitted by

Lori Beth Shelby

Department of Natural Resource Recreation and Tourism

In partial fulfillment of the requirements

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Colorado State University

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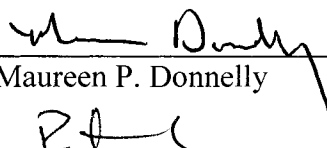
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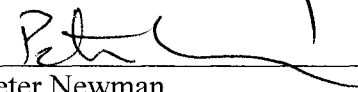
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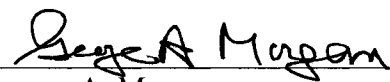
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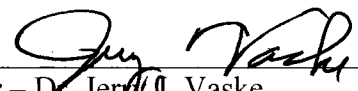
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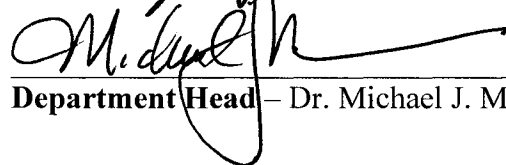
Committee on Graduate Work

  
\_\_\_\_\_  
Dr. Maureen P. Donnelly

  
\_\_\_\_\_  
Dr. Peter Newman

  
\_\_\_\_\_  
Dr. George A. Morgan

  
\_\_\_\_\_  
Adviser – Dr. Jerry J. Vaske

  
\_\_\_\_\_  
Department Head – Dr. Michael J. Manfredo

ABSTRACT OF DISSERTATION  
META-ANALYSIS AND COMPARATIVE ANALYSIS:  
ILLUSTRATIONS USING PERCEIVED CROWDING

*Meta-analysis* is a quantitative research synthesis that uses a specific quantitative measure (e.g., an effect size) to indicate the strength of relationship between variables for the studies making up the synthesis. *Comparative analysis* is another quantitative research synthesis technique where data (typically datasets) are aggregated over specific variables to reveal patterns in findings and identify factors that are not evident in a single study. Both analysis strategies (a) turn the focus away from one statistically significant result, (b) give credence to repeated results that are in the same direction across several studies, even if one or more are statistically insignificant, and (c) can assist researchers in making judgments about practical significance by encouraging examination of findings from multiple studies.

For the field of human dimensions of natural resources, quantitative research synthesis can be useful for analyzing outdoor crowding research. Since the mid-1970's, perceived crowding has been measured using a single item 9-point scale. This single item measure has been used in approximately 187 studies involving 627 evaluation contexts.

The dissertation contains three stand-alone papers. Chapter 2 provides an introduction to meta-analysis literature and discusses the challenges of applying meta-analysis to human dimensions research. Specifically, the various definitions of meta-analysis, the advantages and disadvantages, and the basic steps of meta-analysis are

introduced and discussed. Chapter 3 expands on the methodological literature associated with the analysis step in meta-analysis, and provides an empirical example using a subset of the perceived crowding data. Chapter 4 builds on an earlier comparative analysis of perceived crowding by: (a) describing perceived crowding studies from 1975 to 2005, (b) evaluating alternative approaches to summarizing the 9-point crowding scale, (c) assessing generalized factors that influence crowding, and (d) exploring previously proposed crowding standards.

Overall, this dissertation has attempted to describe meta-analysis and comparative analysis in the context of practical significance, and examine the potential of both quantitative synthesis strategies in the field of human dimensions of natural resources. Researchers are encouraged to further explore the use of meta-analysis and comparative analysis in other natural resource applications.

Lori Beth Shelby  
Natural Resource, Recreation, and Tourism Department  
Colorado State University  
Fort Collins, CO 80523  
Spring 2006

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## CHAPTER I. INTRODUCTION

The use of meta-analysis as a technique for quantitative research syntheses of multiple studies has become increasingly popular since the 1980s (Cooper & Hedges, 1994; Lipsey & Wilson, 1993). Agreement, however, has not occurred in any discipline on exactly what types of quantitative research syntheses should be labeled meta-analyses. This is partially due to the confusion and debate on what meta-analysis is or is not. There is not a single accepted definition.

*Meta-analysis* (in the social sciences) is frequently defined as a type of quantitative research synthesis that uses a specific quantitative measure (effect size) to indicate the strength of relationship between variables for the studies making up the synthesis (Gliner, Morgan, & Harmon, 2003; Lipsey & Wilson, 2001). *Comparative analysis* is another quantitative research synthesis technique, which has been defined as an analysis where data (typically datasets) are aggregated over specific variables to reveal patterns in findings and identify factors that are not evident in a single study (Vaske, in prep). These definitions for meta-analysis and comparative analysis overlap when a less specific definition of meta-analysis is used. Glass (1976), for example, defined meta-analysis as a “statistical analysis of a large collection of analysis results from individual studies for the purpose of integrating the findings” (p. 3). Meta-analyses are generally expected to utilize only those hypotheses and analysis results that have previously been considered on a single study level, and use effect sizes as the summarizing statistic across studies using specific meta-analytic procedures for analysis. Comparative analyses, on the other hand, have fewer

constraints allowing researchers more flexibility. The similarities and differences between comparative analysis and meta-analysis are explored in this dissertation.

Regardless of nomenclature, quantitative research syntheses of multiple studies can be a powerful tool for assisting researchers in making judgments about the practical significance of their research. Practical significance simply means a research finding that has practical implications; it can be used in practice.

Unfortunately, there are no statistical tests (even effect size) that directly measure practical significance. Practical significance involves a value judgment made by both the researcher and the consumer of research about the theoretical and applied implications of a study's findings (Thompson, 1999; Vaske, Gliner, & Morgan, 2002; Vogt, 1999).

Given the challenges associated with practical significance determination, knowledge gained from quantitative research synthesis may prove useful. Conducting a quantitative research synthesis requires a thorough search of the literature, which encourages researchers to consider the whole picture instead of relying on one or more published articles (Gliner et al., 2003; Rosenthal & DiMatteo, 2001). The focus is shifted away from one statistically significant result, and more credence is given to repeated results that are in the same direction across several studies, even if one or more are statistically insignificant (Rosenthal & DiMatteo, 2001). Meta-analysis and some comparative analyses create a summary statistic, effect size, which encourages considerations of practical significance. Quantitative synthesis of multiple studies, regardless of how it is conducted (e.g., comparative analysis or meta-analysis) is not a quick fix to the practical significance issue, but is one tool available to researchers.

For the field of human dimensions of natural resources, quantitative research synthesis is particularly useful for analyzing outdoor crowding research. Perceived

crowding is a psychological dimension that has been measured in a similar manner since the 1970s by the use of a single item 9-point scale developed by Heberlein and Vaske (1977). The measure asks individuals to indicate how crowded the area was either at the time of their visit or in various contexts (e.g., at the trailhead vs. on the trail).

Comparative analyses have been used to synthesize the results from multiple studies on perceived crowding (e.g., Shelby, Heberlein, Vaske, & Alfano, 1983; Shelby, Vaske, & Heberlein, 1989; Vaske & Donnelly, 2002). Meta-analytic techniques have not been applied to this literature. Given that both comparative analysis and meta-analysis can be valuable practical significance tools for researchers, the application of meta-analytic techniques to this literature may provide additional information.

Shelby et al. (1989) conducted a comparative analysis of perceived crowding that combined results from 15 years of research. The data included more than 17,000 respondents in 35 studies for 59 different settings or activities located in the United States and New Zealand. Their results suggested a relationship between perceived crowding and time, resource availability, accessibility and convenience, and management strategy. No relationship, however, was found between perceived crowding and region of the country where the study was conducted, type of activity examined, or survey methodology. Potential management standards were considered by developing five classifications for study areas ranging from high use-high impact to low use-low impact area. These classifications were used in conjunction with perceived crowding results for each area to create capacity judgments for management recommendations. For example, those locations or activities where >80% of the visitors feel crowded were judged to have overuse and visitor impact

problems. The management suggestion for these types of areas was to actively manage for high-density recreation or plan on sacrificing the area.

Seventeen years have passed since Shelby et al.'s (1989) study was conducted, resulting in a database now containing 30 years of research. Although the 1989 study provided the best knowledge that was available at the time, an updated analysis utilizing the entire database is appropriate. This dissertation serves two purposes: (a) to consider the roles of meta-analysis and comparative analysis as practical significance tools in the field of human dimensions of natural resources, and (b) to quantitatively integrate the available data on outdoor recreational crowding using meta-analysis and comparative analysis.

This dissertation consists of 5 chapters:

- Chapter 1 – Introduction,
- Chapter 2 – Description of meta-analysis, its methodology, and its practical significance role,
- Chapter 3 – A crowding meta-analysis as an example,
- Chapter 4 – Updated comparative analysis on perceived crowding, and
- Chapter 5 – Conclusions.

## CHAPTER II. TOWARD AN UNDERSTANDING OF META-ANALYSIS: A REVIEW OF THE METHODOLOGICAL LITERATURE

Determining if a research finding has practical significance is a challenge for researchers. Unfortunately, there are not statistical tests that directly measure practical significance. The researcher and practitioner must use personal judgment to weigh all of the available information and draw conclusions. Various methods have been suggested, however, to supplement null hypothesis significance testing (NHST) and to help researchers consider practical significance (see Table 2.1). Vaske, Gliner et al. (2002), for example, discussed the use of effect sizes, confidence intervals, and odds ratios for providing such information. Gliner, Vaske, and Morgan (2001) demonstrated the importance of effect size for determining practical significance, which avoids the problems commonly associated with NHST.

Meta-analysis is one of the available methods for providing evidence for or against practical significance. The methodology requires a thorough search of the literature including research reports and occasionally unpublished material. Researchers and research consumers are encouraged to ponder the whole picture instead of relying on one piece of the puzzle (e.g., one published article). The statistical procedures in a meta-analysis involve a summary statistic to quantitatively combine results from multiple research projects, which gives credence to repeated results. Traditionally, a summary effect size statistic is used. As with effect sizes determined from single research projects,

Table 2.1 Examples of practical significance measures

| Measures                                                 | Descriptions & references                                                                                                                                                                                                                           |
|----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Value judgment                                           | Practical significance is based on the personal and idiosyncratic values of each researcher and study context (Thompson, 1999).                                                                                                                     |
| Graphs & figures                                         | Graphs and figures can be used to provide information in a form that is easier to understand. See, for example, the Potential for Conflict Index (Manfredo, Vaske, & Teel, 2003; Vaske, Needham, Newman, Manfredo & Petchenik, in press).           |
| Binomial effect size display                             | Translates an effect size based on $r$ into a graphic of a 2 x 2 table showing the difference in outcome rates of two groups (Rosenthal & DiMatteo, 2001; Rosenthal, Rosnow, & Rubin, 2000).                                                        |
| Relative risk ratio                                      | The proportion of those in one group at risk for a certain outcome divided by the proportion of those in a second group at risk for the outcome (Morgan, 2003; Rosenthal et al., 2000).                                                             |
| Risk difference                                          | The proportion of those in one group at risk for a certain outcome subtracted from the proportion of those in a second group at risk for the outcome (Rosenthal et al., 2000).                                                                      |
| Odds ratio                                               | The ratio of one outcome to a second outcome in one group divided by the same ratio for a second group (Rosenthal et al. 2000; Vaske, Gliner et al., 2002).                                                                                         |
| Confidence interval                                      | A range of scores on the dependent variable that should include the population parameter at a certain level of risk (Smithson, 2003; Vaske, Gliner et al., 2002).                                                                                   |
| Effect size                                              | An index that shows the strength of relationship between variables (Gliner et al., 2001; Vaske, Gliner et al., 2002).                                                                                                                               |
| Replication                                              | Reproducing the findings of other studies (Thompson, 1994; 1999).                                                                                                                                                                                   |
| Meta-analysis, comparative analysis, & literature review | Synthesizing the results from multiple individual research projects on the same topic (Cooper & Hedges, 1994).                                                                                                                                      |
| Power                                                    | The probability that a statistical test will result in statistically significant results (Cohen, 1988; 1992).                                                                                                                                       |
| Bayesian inference                                       | The results from the current study are used to revise distributions created from previous studies and the researcher's subjective beliefs. The distributions are then used as the basis for statistical inferences (Pruzek, 1997; Rindskopf, 1997). |

those used to summarize multiple research projects allow for an estimate that is relatively easy to interpret and encourages researchers to consider the practical implication of their effect sizes based on additional factors such as their own value judgments (see Cohen, 1988; Vaske, Gliner et al., 2002, for interpreting effect sizes).

Although meta-analysis provides researchers with information when drawing practical significance conclusions, it has rarely been applied to the human dimensions of natural resources literature. This may be potentially attributable to the complex and intensely debated methodology associated with meta-analysis.

This article provides an introduction to the meta-analysis literature and discusses the challenges of applying meta-analysis to human dimensions (HD) research. Specifically, the various definitions of meta-analysis, the advantages and disadvantages of meta-analysis, and the basic steps of meta-analysis are introduced and discussed.

### What is Meta-analysis?

Gene Glass introduced the term meta-analysis during his presidential address at the annual convention of the American Education Research Association in 1976 (Glass, 2000). Although the term was new, the concept of statistically integrating studies already existed (e.g., Pearson, 1904; Tippet, 1931). Numerous influential books have since been published on meta-analytic methods, which have helped to develop the use of meta-analysis (Cooper & Hedges, 1994; Glass, McGaw, & Smith, 1981; Hedges & Olkin, 1985; Hunter & Schmidt, 1990; Rosenthal, 1984). Meta-analysis spread through the disciplines in the 1980s especially in psychology, education, and the medical sciences. More recently, examples of meta-analysis have appeared in the human dimensions

literature (e.g., Manfredo, Driver, & Tarrant, 1996; Pierskalla, Lee, Stein, Anderson, & Nickerson, 2004).

There is not a single well-accepted definition, or a single correct way to conduct a meta-analysis. Glass (1976) referred to meta-analysis as: “the statistical analysis of a large collection of analysis results from individual studies for the purpose of integrating the findings” (p. 3). This definition allows for a broad view of what meta-analysis is or is not. However, another common definition is given by Gliner et al. (2003): “Meta-analysis is a research synthesis that uses a quantitative measure, effect size, to indicate the strength of relationship between the treatments and dependent measures of studies making up that synthesis” (p. 1376). The differences in these definitions and in researchers’ use of meta-analysis techniques can be reflected in six issues: (a) the use of effect sizes in meta-analysis; (b) the unit of analysis in meta-analysis; (c) primary and secondary analysis vs. meta-analysis; (d) meta-analysis as a literature review; (e) meta-analysis vs. comparative analysis; and (f) a total methodology vs. a type of analysis.

#### *The Use of Effect Sizes in Meta-analysis*

Effect sizes, which measure the strength of the relationship between variables, are typically used as the summary statistic in a meta-analysis. An effect size is calculated for the variable relationship of interest for each study in the meta-analysis. The effect sizes are then summarized using a summary effect size statistic. For example, a meta-analysis of two continuous variables involves computing the correlation coefficient (e.g., Pearson’s  $r_{xy}$ ) for variable  $x$  and variable  $y$  for each study. Each  $r_{xy}$  is then weighted to reduce differences in sampling error due to the sample size of each study. Although further adjustments and transformations are generally made (e.g., to account for

measurement error or dichotomization of a continuous variable), a summary effect size statistic, such as a weighted mean effect size ( $ES_r$ ), is computed across all studies in the meta-analysis. Statistical analysis is then conducted on the summary effect size.

Although summary effect size statistics are common in the literature, the use of an effect size is not a requirement for a study to be considered a meta-analysis. This belief likely stems from a misinterpretation of Glass's use of meta-analysis as requiring effect sizes. Glass focused on the use of effect size in his writing, but cautioned (Glass, 2000) that effect size is not the only type of summary statistic that could be used. In fact, any of the quantitative methods useful in getting meaning from data are potentially useful in meta-analysis (Glass et al., 1981). Other authors have also focused on effect size, but have specifically mentioned that it was only an example of a common statistic that could be found for each study (e.g., Hunter & Schmidt, 1990; Rosenthal, 1984). Even though effect size has incorrectly been considered the only statistic for meta-analysis, it is the statistic used most frequently (e.g., Lipsey & Wilson, 2001). As a result, much of the methodology and techniques in meta-analysis are based on the numerous effect sizes available (e.g., Hunter & Schmidt's, 1990, correction formulas). Human dimensions researchers should use or not use effect sizes carefully based on the appropriate summarizing measures available for their study.

#### *The Unit of Analysis in Meta-analysis*

Some meta-analysis definitions are broad enough to incorporate a variety of units of analysis (i.e., experiments, studies, publications, evaluation contexts, or datasets). Scientists in some disciplines (e.g., psychology, medicine) consider the gold standard to be randomized controlled experiments (i.e., random assignment of participants to

treatment and comparison groups) (Gliner et al., 2003). Other investigators, however, also acknowledge that alternatives are acceptable as long as: (a) quantitative results have been generated, (b) the results are conceptually comparable, (c) the findings are statistically comparable (e.g., concepts are operationalized in the same manner or standardized), and (d) the results come from similar research designs (e.g., Cooper & Hedges, 1994; Glass et al, 1981; Lipsey & Wilson, 2001).

Much of the HD literature is derived from surveys (on-site, mailed, telephone) (Vaske, Shelby, & Manfredo, in press). Researchers working in this arena rarely have the opportunity for conducting randomized controlled experiments. The practical concern for HD researchers conducting meta-analyses is that the unit of analysis is reported plainly (e.g., study vs. evaluation context). Care should be taken to assure that possible commonalities related to unit of analysis are considered to account for possible bias (e.g., if the available datasets all come from one researcher or a group of researchers with similar theoretical and measurement tendencies).

#### *Primary and Secondary Analysis vs. Meta-analysis*

*Primary analysis* is the original analysis of data in a research study, while “*secondary analysis* is the re-analysis of data for the purpose of answering the original research question with better statistical techniques, or answering new questions with old data” (Glass, 1976; p. 3). Meta-analysis typically synthesizes existing information from published sources, such as journal articles and research reports (Glass et al, 1981; Hunter Schmidt, & Jackson, 1982). As a result, meta-analysis typically does not include primary or secondary analysis.

The use of primary or secondary analysis in meta-analysis has generated considerable controversy. Conflict arises because some studies referred to as meta-analyses do not synthesize the existing research and instead use multiple datasets or study information to reanalyze the data in new ways with new hypotheses. Generally, these latter studies are more appropriately considered secondary analysis studies. Secondary analysis, however, is a valuable tool for human dimensions research (see Kiecolt & Nathan, 1985 for further information). Human dimensions researchers should consider meta-analysis as a synthesis of existing research, not primary or secondary research. Most meta-analyses are based solely on numbers drawn directly from published articles.

#### *Meta-analysis as a Literature Review*

Meta-analysis can be considered to be a specialized type of integrative literature review article (see Cooper & Hedges, 1994, for an in-depth discussion on literature review types and alternative terminology). *Literature review articles* synthesize information, focus on findings, summarize the substance of the literature, and draw conclusions. *Integrative literature review articles* include only that subset of literature review articles that also attempt to create generalizations by synthesizing and integrating research, consider theory, endeavor to resolve conflicts in the literature, and try to identify issues for future research (see American Psychological Association, 2001; Cooper & Hedges, 1994). A meta-analysis should involve a literature review of the depth and quality that is required for an integrative review article.

#### *Meta-Analysis vs. Comparative Analysis*

*Comparative analysis articles* have become increasingly common in the human dimensions literature (e.g., Shelby et al., 1989; Vaske & Donnelly, 2002; Vaske,

Donnelly, Heberlein, & Shelby, 1982). By aggregating data over specific variables (e.g., crowding, norms, satisfaction) comparative analyses can reveal patterns in findings and identify factors that are not evident in a single study. Similarly to meta-analysis, they generally fulfill the requirements to be classified as an integrative literature review article, and additionally use quantitative means to aggregate the data (e.g., Donnelly, Vaske, Whittaker, & Shelby, 2000; Manfredo et al., 1996). The relationship of meta-analysis to comparative analysis depends on how meta-analysis is defined in relation to the various meta-analysis definitions. For example, if meta-analysis is defined strictly as using an effect size for each study, and then using a summary effect size statistic, not including primary or secondary analysis, and requiring a study as the unit of analysis, most comparative analyses would not be considered meta-analyses. Broader definitions of meta-analysis, however, would allow comparative analysis articles (e.g., Donnelly et al., 2000; Manfredo et al., 1996; Vaske & Donnelly, 2002) to be considered meta-analyses.

The HD literature has generally avoided referring to comparative analyses as meta-analyses. Although the definitional issues presented here allow for flexibility in the definition of meta-analysis, the fact that most disciplines use a strict definition should be considered. At a minimum, meta-analysis articles should incorporate meta-analysis methodology as an integral part of the study from its beginning.

#### *A Total Methodology vs. a Type of Analysis*

The term meta-analysis can refer to either the entire research process (i.e., problem conceptualization, coding, and statistical analysis), or simply the statistical analysis portion. This distinction is somewhat a matter of nomenclature, but is related to

*a priori* validity issues. Glass (1982) described meta-analysis as: “The application of research methods to the characteristics and findings of reports of research studies” (p. 93). Research methods included “such generalizations as are normally addressed in conceptualizing, designing and analyzing empirical research: problem selection, hypothesis formulation, definition and measurement of constructs and variables, sampling, data analysis” (Glass, 1982, p. 93). Although Glass’s addition of research methods to his previous meta-analysis definition was important, it did not include rigorous procedures for collecting and coding studies. Glass (2000) suggested that it is the differences between studies that are of interest; therefore there should not be any *a priori* exclusion of studies.

Cooper (1982) introduced a methodology for moving from primary research to meta-analysis, which included applying a rigorous methodology to the process of collecting and coding studies to alleviate validity concerns. Threats to validity related to the process of collecting and coding studies that might undermine the findings of a research synthesis. In the data collection stage, for example, studies might be qualitatively different from the target population of studies, or there might be consistent deficiencies in the research methods of the studies. Human dimensions researchers should clearly report their methodological choices (e.g., the Glassian approach with no consideration for *a priori* validity versus the Cooper methodology).

In summary, the issue of what exactly a meta-analysis is or is not has been a source of debate. Opinions related to the *true* definition of meta-analysis are primarily a matter of nomenclature, orthodoxy, and personal bias. What is important for meta-

analytic researchers is to clearly report how meta-analysis has been defined in order to alleviate any potential confusion by consumers of research.

### Basic Steps of Meta-analysis

The steps for conducting meta-analysis (e.g., Cooper, 1982; Lipsey & Wilson, 2001; Schafer, 1999) are analogous to the steps of primary research and include: (a) problem conceptualization and operationalization, (b) data collection and processing, (c) analysis, and (d) reporting.

#### *1. Problem Conceptualization and Operationalization*

The first step is to conceptualize the problem, operationalize the variables, and create the hypotheses. The goal of this step is to create a problem statement that includes a specification of the relevant research literature, the major category of independent variables, and the key dependent variables (Lipsey & Wilson, 2001). Theoretical and statistical issues must also be considered during this step (see Hall, Tickle-Degnen, Rosenthal, & Mosteller, 1994 for more information). Specifically, researchers should consider their level of confidence that the independent variable actually affects the dependent variable(s); that their findings can be generalized beyond a small subset of populations, settings, and procedures; and that their findings will advance the theoretical understanding of the literature.

Hedges (1994) reviews the statistical considerations that should be considered in this stage. For example, many methods for the analysis of effect sizes require large-samples (e.g., effect size indices based on studies using odds ratios require 50 or more per group). If the study sample sizes are very small, the researcher should carefully consider their quantitative options.

To choose the appropriate summary statistic, it is important to identify how the results are being reported in each study. Although it is commonplace to convert statistical findings (e.g.,  $d$  family to  $r$  family correlations), it is important that researchers identify a single effect size statistic that can represent the statistical findings as they have been reported for each study. If they cannot, the research findings should be sorted to differentiate those that require different effect size statistics and each group should be meta-analyzed separately. Due to the vast number of available effect sizes, researchers often have more than one available effect size that can be used to summarize the studies included in the synthesis. A decision must be made on which of the available statistics are most appropriate for the specific study (e.g.,  $r$  family,  $d$  family, pre-post contrasts). A similar decision needs to be made by researchers who choose procedures that do not use effect sizes to ensure that the meta-analysis can be conducted. Due to the complex calculations required for meta-analysis, many effect sizes are rarely utilized. The standardized mean difference, the correlation coefficient, or the odds-ratio is typically used because the applicable standard error formulation and other statistical procedures are readily available (Lipsey & Wilson, 2001).

Study eligibility criteria need to be considered. Lipsey and Wilson (2001) suggest that researchers prepare a detailed written specification of the criteria a study must meet to be included in the meta-analysis. Planning for the inclusion or exclusion criteria is perhaps the most important part of a meta-analysis, as it is directly related to internal/external validity, and generalizability (Gliner et al., 2003). Factors such as the variables used, samples, research methods, time frame, publication type, and cultural/language differences of studies should all be considered (see Cooper & Hedges,

1994 for details). These decisions are heavily dependent on a researcher's purposes, goals, and available resources.

## *2. Data Collection and Processing*

There are various sources available for learning about conducting a thorough literature search (e.g., Cooper & Hedges, 1994). Given that numerous articles will likely be identified, it is advised that a procedure be established for tracking article collection and organizing citation information. For example, a researcher may choose to create a bibliographic database.

Coding studies for meta-analysis is analogous to survey research. A questionnaire is prepared, and each article is *interviewed* by the coder based on the information provided by the article. As in survey research, it is important to prepare the questionnaire carefully, train the coders, and monitor the completeness, reliability, and validity of the data that are obtained. For example, closed-ended items should be used as much as possible because it is necessary to create a database of information (see Brown, Upchurch, & Acton, 2003; Cooper & Hedges, 1994; Stock, Benito, & Lasa, 1996, for more information on creating a codebook).

The choice of the specific summarizing statistic is central to the development of the codebook and depends on the nature of the research findings, the type of statistics reported for each study, and the hypotheses tested by the meta-analysis (Lipsey & Wilson, 2001). Care should be taken that the chosen effect size can be combined across studies with reasonable ease (see Grissom & Kim, 2005; Lipsey & Wilson, 2001; Rosenthal et al., 2000; Shadish & Haddock, 1994 for more information on effect sizes). Cooper and Hedges (1994) provide useful chapters on effect sizes in addition to other

summarizing statistics and methods. It is worth repeating here, however, that the standardized mean difference, the correlation coefficient, or the odds-ratio is typically used in meta-analysis because the applicable standard error formulation and other statistical procedures are readily available (Lipsey & Wilson, 2001).

After the creation of a codebook, coders need to be trained to ensure that they are familiar with the software, data file, and codebook. A single coder is not unusual in meta-analysis; however, if the researcher chooses to use multiple coders various suggestions on specific training methods are given in Lipsey and Wilson (2001). For multiple coders, reliability is determined based on the consistency between the coders (see Orwin, 1994; Yeaton & Wortman, 1993 for more information). For an individual coder, the consistency between one coding session to another is of interest (see Orwin, 1994).

Researchers frequently code studies directly into the computer (Lipsey & Wilson, 2001). In this case, the structure of the dataset and codebook become the survey instrument. This method has the advantage of efficiency, and allows for easy revisions of the codebook and dataset. Practically, the coding protocol is developed in two steps: one module codes information that applies to the entire study (e.g., sample size) and the other module codes effect size information for specific variables.

Important decisions in the data collection step are the type(s) of software that will be used and the structure of the meta-analytic files. For a typical meta-analysis, a single file can be used if the number of effect sizes is small. Multiple files are often used and then merged for analysis. In this circumstance, one data file contains the information about study descriptors (e.g., income), and the other data file contains information about

effect sizes. If numerous effect sizes are analyzed, a relational database may prove beneficial.

### *3. Analysis*

Analysis can be conducted on one variable across all studies (e.g., the mean or proportion can be the effect size statistic). When differences between groups are analyzed (e.g., the difference in mean level perceived crowding between frontcountry and backcountry users) the unstandardized mean difference is frequently used as the effect size measure. If the meta-analysis involves the association between two variables across all studies (e.g., using the correlation between perceived crowding and reported contacts), a Pearson's  $r_{xy}$  is typically used. Statistical methods for meta-analytically describing and combining studies, and then analyzing the effect sizes are discussed in depth in Cooper and Hedges (1994), Hedges and Olkin (1985), and Rosenthal (1984).

The amount and types of error and bias in studies for which a researcher decides to correct should be evaluated. There are many methods for correcting error and bias in meta-analysis findings (see Cooper & Hedges, 1994; Hunter & Schmidt, 1990). Although these differences among studies can be dealt with by statistical measures, all measures have their weaknesses. The important decision, which was made by researchers in Step 2, was what kinds of studies should be included when the studies differ from each other in multiple ways. The related question for this step is what kinds of aggregate measures are justified for the selected studies. In addition, researchers must ask what sources of bias and error may exist, and use the appropriate correction formulas. For example, if the sample sizes of the studies differ, there are various weighting methods available. In addition, weights for reliability and validity issues, transformation formulas and bias

corrections, outliers, and missing data can all be used (e.g., Beal, Corey, & Dunlap, 2002; Huffcutt & Arthur, 1995; Little & Rubin, 2002). The frequently used summary effect size statistics have commonly used adjustments (for more information see Hunter & Schmidt, 1990; Lipsey & Wilson, 2001; Rosenthal, 1984). For example, the standardized mean difference effect size is frequently corrected for small sample bias (Lipsey & Wilson, 2001).

Lipsey and Wilson (2001) provided a brief overview of the specific process involved in analysis of the effect size distribution, once effect sizes have been determined for each study: (a) insure that the effect sizes are independent (no more than one effect size for a construct from the each study), (b) compute the weighted mean using inverse variance weights (see Cooper & Hedges, 1994; Lipsey & Wilson, 2001 for formulas), (c) compute the confidence interval for the mean, and (d) test for homogeneity. Next, which model to use must be considered by the researcher (e.g., fixed vs. random effects)? The results may require that steps (b) and (d) be repeated using a different model.

The decision concerning which model to be used is not straightforward, and often subjective. Fixed effects and random effects models, in particular, are frequently used in meta-analysis, although mixed effects and hierarchical models are also used (see Cooper & Hedges, 1994; Hedges & Vevea, 1998; Hunter & Schmidt, 2000 for more details). Schulze (2004) provides a useful overview and statistical comparison of the various statistical approaches of meta-analysis, which use effect size as the summary statistic and the various models available.

A fixed effects model assumes that all of the studies in the meta-analysis are representative of the population of available studies and each study used a sample from

the same population of potential respondents. In other words, the researcher believes that the studies are similar. Tests of homogeneity, model specification, and goodness of fit are available to help the researcher determine if a fixed effects model is appropriate (see Cooper & Hedges, 1994, for more information). Alternatively, a random effects model can be chosen if the researcher believes that the studies are substantively different. Analyses based on the random effects model treat the studies as a sample from the population of studies. Thus, for the random effects model inferences are made from the sample studies to the population of studies of interest, whereas for the fixed effects model inferences to a population are not necessary because the entire population of interest is represented.

There are statistical methods available for testing statistical significance for commonly used effect size measures meta-analysis. For example, when comparing frontcountry and backcountry users on perceived crowding using the unstandardized mean difference an independent *t*-test may be used. ANOVA and chi-square are also frequently used to test for statistical significance in meta-analysis. For more information see Lipsey and Wilson (2001).

#### *4. Reporting*

The interpretation and reporting of results depends on the meta-analyst's personal judgments, understanding of the research, and purpose of their work. Specific methods for interpreting and using the results are integrally related to what specific measures were used. Specific advice for interpreting and evaluating meta-analysis results are provided in the literature (e.g., Cooper & Hedges, 1994; Hall & Rosenthal, 1995) Guidance for

writing up meta-analyses is also available (e.g., Cooper & Hedges, 1994; Rosenthal, 1995).

### Advantages of Meta-analysis

The advantages to meta-analysis can be grouped into two categories: (a) a means of considering the practical significance of a research finding, and (b) a rigorous methodology for quantitative research synthesis.

#### *Practical Significance*

Meta-analysis encourages researchers to consider the whole picture, gives credence to repeated results through the use of a summary statistic, and uses effect sizes that encourage researchers to consider practical significance. Meta-analysis can find effects or relationships that are obscured in other approaches (Lipsey & Wilson, 2001). Qualitative literature reviews, for example, do not allow researchers to consider statistical differences between studies. Meta-analysis also increases the variation in a sample, which can improve external validity (Gliner et al., 2003).

#### *Rigorous Methodology*

Meta-analysis procedures provide a rigorous methodology for quantitative research synthesis. Although there is not a correct way to conduct a meta-analysis, there is an expectation that a rigorous methodology be used that acknowledges the meta-analysis methodological literature. There are various sources that have provided the social sciences with rules and techniques for meta-analysis that encourage a rigorous approach (e.g., Glass et al, 1981; Hedges & Olkin, 1985; Hunter & Schmidt, 1990; Rosenthal, 1984). *The Handbook of Research Synthesis* (Cooper & Hedges, 1994) is a definitive source for the behavioral and medical sciences and incorporates ideas for

research synthesis with careful attention to rigor. The use of a rigorous approach encourages the researcher to become intimate with the data, create focused research hypotheses, and identify moderator variables (Rosenthal & DiMatteo, 2001). Researchers are thus afforded more tools for evaluating the meaning of the literature than other types of literature reviews.

#### Disadvantages of Meta-analysis

Most of the criticism of meta-analysis is related to the potential error and bias that can result from combining studies. Meta-analysis, however, also requires researchers to spend significantly more time learning the methodology than other types of literature reviews typically require.

##### *Effort and Expertise*

The effort and expertise required to conduct a meta-analysis can be problematic (Lipsey & Wilson, 2001). Nevertheless, researchers are producing literature that plainly introduces the concepts of meta-analysis. Lipsey and Wilson (2001), for example, published an understandable book specifically for the social sciences (see also Rosenthal & DiMatteo, 2001). Due to the scope and complexity of the literature, meta-analysis can become mechanical and overly structured (Lipsey & Wilson, 2001). Researchers must determine if the procedures are appropriate for their needs.

##### *Error and Bias*

Error and bias has been referred to as the *apples and oranges* problem. With the mix of studies used in a meta-analysis, differences between studies can be problematic (e.g., different sampling design, variable operationalization). It may not be appropriate to meta-analyze studies that use different sampling designs, variable operationalizations

and/or variable measurements. Chambers (2004) suggested that different techniques can be coded and tested to determine if the study methods yielded substantially dissimilar results. For example, coding rules should involve a careful operationalization of the variables of interest, and may include specific measurement methods that will be considered. In this manner, the researcher will limit the differences in the included studies.

The concern with mixing studies also includes the problems associated with mixing studies of different methodological quality (*garbage in - garbage out*). If studies with poor methodological quality are included it may bias the results of the meta-analysis. A judgment on the quality of each study by the researcher is often used to prevent this problem. A simple approach is rating the quality of the research study as *high* or *low* (Hedges, 1982). Other methods exist such as creating a rating according to the threat of a specific study impacting the validity of the meta-analysis (Campbell & Stanley, 1966; Cook & Campbell, 1979), and basing judgment on the characteristics of the study methods (Cooper, 1984). These types of methods are relatively easy to accomplish and can be done as part of setting the standards for study inclusion and exclusion in the early steps of meta-analysis.

Different researchers have supported different approaches to the inclusion or exclusion of different studies. Glass has consistently put forward the idea that *a priori* considerations of study quality and study differences is not necessary in meta-analysis (Glass, 1982; Glass et al, 1981), while others have suggested means for limiting the resulting bias (e.g., Cooper, 1982; Hunter & Schmidt, 1990). In response to the apples and oranges criticism, Glass (2000) stated, “of course it mixes apples and oranges; in the

study of fruit nothing else is sensible; comparing apples and oranges is the only endeavor worthy of true scientists; comparing apples to apples is trivial.” (p. 5). Glass (2000), however, did acknowledge that his critics might have a point. Ultimately, researchers must balance the apples and oranges problem and the garbage in/garbage out problem with their needs.

Another disadvantage of meta-analysis that receives frequent attention is the *file-drawer problem*, which involves the issue of publication bias. It is present when a meta-analysis attempts to review all significant and non-significant studies to provide a complete perspective. When the sample is intended to cover all of the studies, the tendency for studies with non-significant results to rarely be published becomes an important issue (Hedges, 1992). Methods have been developed to help detect and minimize publication bias (see Pham, Platt, McAuley, Klassen, & Moher, 2001, for an empirical comparison), such as the funnel plot (a scatterplot of sample size versus estimated effect size for a group of studies; Copas & Shi, 2000; Light & Pillemer, 1984); checking the file drawer of unpublished studies and estimating their numbers (Iyengar & Greenhouse, 1988; Rosenthal, 1979); trim-and-fill estimates to estimate the number of missing studies (Givens, Smith, & Tweedie, 1997; Duval & Tweedie, 2000); and weighted estimation methods (Murtaugh, 2002; Sutton, Song, Gilbody, & Abrams, 2000). Another way to approach the file drawer problem is to prevent it. For example, when specifying the standards for the inclusion of studies, limit the studies to those with adequate power and those that the researcher believes would pass high standards of peer-review for publication or funding (Kraemer, Gardner, Brooks, & Yesavage, 1998). Using this method, the researcher should remove publication bias because the sample is not

intended to cover all of the studies. It is unlikely that studies that would pass high standards of peer review and have adequate power would remain unpublished.

Using multiple findings from the same study is another possible source of bias in meta-analysis. If more than one report from the same study is used the corresponding effect sizes will not be independent of one another (Rosenthal & DiMatteo, 2001), or if more than one effect size in the same study is calculated, they may not be independent (Glass et al., 1981). The solution for this problem is straightforward; simply take steps when collecting and coding studies to insure that each study in the meta-analysis is independent. Alternatively, if independent samples are established multiple effect sizes for a study can be considered (Chambers, 2004). Statistical methods have also been presented to account for effect sizes that are not independent (e.g., Cheung & Chan, 2004; Gleser & Olkin, 1994; Mosteller & Tukey, 1968).

The complexity of conducting meta-analyses results in biases that are directly related to the researcher conducting the meta-analysis. For example, the criteria chosen for including or excluding studies, and the extent of the literature search conducted to find eligible studies (Rosenthal & DiMatteo, 2001). As a result, it is important for researchers to carefully document their procedures. Researchers must balance the advantages of meta-analysis against the disadvantages to conduct their studies in a manner that is most appropriate for the research being synthesized.

### Conclusions

In human dimensions literature the avenues for the use of meta-analysis remain unexplored. However, meta-analysis provides a rigorous methodology for quantitative research synthesis and can be a powerful tool for making determinations about practical

significance. Meta-analysis also has its disadvantages including the amount of effort and expertise required, and the error and biases that result from quantitatively mixing studies. These disadvantages can be generally be overcome by careful research, planning, and interpretation. Although meta-analysis can be a structured process as shown by the four basic steps of meta-analysis presented, each step allows for researchers to use their personal judgment. In this manner, researchers are given the opportunity to use their expertise on the subject matter (e.g., in determining the constraints on the studies to be included), which allows for practical significance to be considered not only as a result of the meta-analysis but also as an integral part of the process.

As with all of the practical significance measures (e.g., Table 2.1), meta-analysis is not the only way to consider practical significance. The multiple methods for determining practical significance only provide researchers with a toolbox. Currently, meta-analysis is an underutilized tool in the human dimensions literature for assisting researchers in determining practical significance.

### CHAPTER III. AN EXAMPLE OF THE ANALYSIS OF META-ANALYSIS

Gene Glass introduced the term meta-analysis during his presidential address at the annual convention of the American Education Research Association in 1976 (Glass, 2000). Although the term was new, the concept of statistically integrating studies already existed (e.g., Pearson, 1904; Tippet, 1931). Glass (1976) referred to meta-analysis as “the statistical analysis of a large collection of analysis results from individual studies for the purpose of integrating the findings” (p. 3). This definition allows for a broad view of what meta-analysis is or is not. Stricter definitions, however, are more common. Gliner et al. (2003, p. 1376), for example, indicated that “meta-analysis is a research synthesis that uses a quantitative measure, effect size, to indicate the strength of relationship between the treatments and dependent measures of studies making up that synthesis.”

For the purposes of this paper, meta-analysis is considered to involve an effect size that is calculated for each study and is used to analyze a large collection of analysis results from individual studies for the purpose of integrating the findings. Chapter 2 reviewed the differences between various definitions of meta-analysis in more depth, detailed the pros and cons of meta-analysis, and described the basic steps of meta-analysis. The analysis step in meta-analysis can be particularly confusing. This chapter reviews the methodological literature on the analysis step in meta-analysis, and illustrates the process with an example.

### *The Use of Effect Sizes for Analysis*

Although it is the most commonly used statistic, much of the methodology and techniques in meta-analysis are based on calculating an effect size for each variable relationship of interest for each study evaluated (e.g., Chen & Popovich, 2002; Cooper & Hedges, 1994; Grissom & Kim, 2005; Hedges & Olkin, 1985; Lipsey & Wilson, 2001; Rosenthal et al., 2000). For information on other methods of combining studies see Cooper and Hedges (1994), and Rosenthal (1984).

Table 3.1 shows some of the most frequently used effect size statistics that may be useful to human dimensions of wildlife meta-analysts (See also Lipsey & Wilson, 2001). These effect size statistics include  $r$  and  $d$  family correlations as typically reported in single study reports. When multiple studies compare means across particular subgroups, the standardized mean difference effect size is useful. Only a small number of effect size statistics have the standard error formulation and other statistical procedures worked out (Lipsey & Wilson, 2001), and therefore only a small number of effect size statistics are typically used in meta-analysis (i.e., the standardized mean difference, the correlation coefficient, and the odds-ratio).

An effect size statistic, the standard error of the effect size, and inverse variance of the standard error for each study need to be coded (see Lipsey & Wilson, 2001; Cooper & Hedges, 1994 for formulas specific to each effect size). Effect size values based on larger samples provide better estimates of the population value than those based on smaller samples (Lipsey & Wilson, 2001). Meta-analysts typically weight each effect size value for each study to account for the sample size differences. Although weights based on sample sizes are an option, Hedges (1982) and Hedges and Olkin (1985) have demonstrated that optimal weights are based on the standard

Table 3.1 Commonly used effect sizes for meta-analysis (Adapted from Lipsey &amp; Wilson, 2001)

| Effect Size Type             | Use                                                                                                                                                                                                                                                                                                         | Effect Size Statistic<br>(To be computed for each study)                                                                                                                                                                                                                                                     |
|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Proportion (Direct Method)   | Describe central tendency of a proportion across all studies.<br>Can compare proportions determined for different subgroups of studies.                                                                                                                                                                     | $ES_p = p = \frac{k}{n}$ <p> <math>p</math> = proportion of subjects in category of interest<br/> <math>k</math> = number of subjects in category of interest<br/> <math>n</math> = total number of subjects in sample </p>                                                                                  |
| Proportion (Logit Method)    | Describe central tendency of a proportion across all studies (when mean proportion across all studies is expected to be < 0.2 or > 0.8).<br>Can compare proportions determined for different subgroups of studies.                                                                                          | $ES_{pl} = \log_e \left[ \frac{p}{1-p} \right]$ <p> <math>p</math> = proportion of subjects in category of interest </p>                                                                                                                                                                                     |
| Arithmetic Mean              | Describe central tendency of mean across all studies.<br>Can compare means determined for different subgroups of studies.                                                                                                                                                                                   | $ES_m = \bar{X} = \frac{\sum x_i}{n}$ <p> <math>x_i</math> = individual score for subject <math>i</math> (<math>i = 1</math> to <math>n</math>)<br/> <math>n</math> = total number of subjects in sample </p>                                                                                                |
| Standardized Mean Gain       | Contrast two variables that differ only by time of measurement (each study involved a pre-post test).<br>All studies did not use the same measure but the measures can be standardized.                                                                                                                     | $ES_{ug} = \frac{\bar{X}_{t2} - \bar{X}_{t1}}{s_p} = \frac{\bar{G}}{s_g / \sqrt{2(1-r)}}$ <p> <math>s_p</math> = pooled standard deviation of time 1 &amp; time 2 scores<br/> <math>s_g</math> = standard deviation of gain scores<br/> <math>r</math> = correlation between time 1 &amp; time 2 scores </p> |
| Standardized Mean Difference | Contrast a variable across two or more groups of respondents (each study involved a group contrast using means).<br>All studies did not use same measure, but they can be standardized.                                                                                                                     | $ES_{sm} = \frac{\bar{X}_{G1} - \bar{X}_{G2}}{s_p}$ <p> <math>s_p</math> = pooled standard deviation of group 1 &amp; group 2 scores </p>                                                                                                                                                                    |
| Proportion Difference        | Contrast a variable across two or more groups of respondents (each study involved group contrast using proportions).                                                                                                                                                                                        | $ES_{pd} = p_{G1} - p_{G2}$ <p> <math>p_{G1}</math> = group 1 proportion<br/> <math>p_{G2}</math> = group 2 proportion </p>                                                                                                                                                                                  |
| Logged Odds-Ratio            | Contrast a dichotomous variable across two or more groups of respondents.                                                                                                                                                                                                                                   | $ES_{LOR} = \log_e \left( \frac{ad}{bc} \right)$                                                                                                                                                                                                                                                             |
| Pearson's Product-Moment $r$ | Covariation of two variables across all studies when each study compared two continuous variables. Point bi-serial correlation is used for a continuous and a dichotomous variable (can also use standardized mean difference). Phi is used for two dichotomous variables (can also use logged odds-ratio). | $ES_r = r_{xy}$                                                                                                                                                                                                                                                                                              |

error of the effect size. Because a larger standard error corresponds to less precise effect size values, the actual weights are computed as the inverse of the squared standard error value – the inverse variance weight (Lipsey & Wilson, 2001).

There are numerous methods available for adjusting effect sizes to improve the meta-analysis results and correct for bias, outliers, artifacts, or error (see Cooper & Hedges, 1994; Glass et al., 1981; Hedges & Olkin, 1985; Hunter & Schmidt, 1990; Lipsey & Wilson, 2001; Rosenthal, 1984). Some effect sizes are used so frequently in meta-analysis that specific adjustments are considered the standard. For example, when Pearson's  $r_{xy}$  is used as the effect size, a Fisher's  $Z_r$  transformation is usually used to approximate a normal distribution (Rosenthal, 1984). Hunter and Schmidt (1990) coined the term “artifact” to describe study imperfections that can impact meta-analysis (artifactual or manmade errors). They identified and provided adjustments for several artifacts that alter the size of the study correlation in comparison to the actual correlation (e.g., sampling error, measurement error, and deviation from perfect construct validity). These approaches do not follow Glass's (2000) assertion that a priori considerations should not be made, but do provide tools for addressing criticisms of meta-analysis discussed in chapter 2 (e.g., the apples and oranges criticism, and the garbage in –garbage out criticism).

#### *Steps for Analysis*

Once the necessary information is coded, and the necessary adjustments to the effect size statistics have been made, the effect sizes can be analyzed. There are two basic analysis steps in the analysis step of a meta-analysis: (a) combine the studies and analyze the distribution of the effect sizes, and (b) compare studies by analyzing the relationship between effect sizes and other descriptive variables of interest to better understand the variability of the effect sizes across studies. Figure 1 outlines the

methods typically used in meta-analysis analyses. There are four basic steps in describing the distribution of effect sizes: (a) create independent effect sizes for each study, (b) compute the weighted mean of effect sizes using inverse variance weights, (c) determine the confidence interval for the mean, and (d) analyze for homogeneity.

The homogeneity of the effect size distribution provides an indicator of whether the independent effect sizes for each study are from the same population (see Hedges & Olkin, 1985; Rosenthal, 1984; Snedecor, 1946, for methods). A common method is based on the chi-square distribution and uses the test statistic  $Q$  (the sum of squares of the effect size around the weighted mean effect size) (Hedges & Olkin, 1985). A homogeneous distribution of effect sizes means that the dispersion of effect sizes around their mean is less than or equal to the expected sampling error. The variability in effect sizes is hypothesized to equal sampling error alone. A significant result indicates a heterogeneous distribution. Average effect sizes that come from heterogeneous distributions should be treated with caution.

The test of homogeneity facilitates the choice of fixed, random, or mixed models. If the distribution of effect sizes is homogeneous, a fixed effects model may be appropriate. If the distribution is not homogeneous, the variance in the fixed effects model may be explainable; a random effects model may be used, or a mixed effects model may be implemented. As with other null hypothesis significance tests, the homogeneity test should not be considered exclusively. A homogeneous result may still have variables producing excess variability in effect sizes that need to be considered (Hall & Rosenthal, 1995). In meta-analyses where the sample size is large, variation in the values is worth studying since small differences may lead to large values of the test statistic (Hedges & Olkin, 1985). The research question of interest should lead the decision-making instead of a single result from a null hypothesis

significance test (Hedges & Vevea, 1998). In some cases, for example, a fixed effects analysis may be appropriate even when there is significant heterogeneity (e.g., when the research question is about a particular set of studies that have already been conducted).

#### *Fixed, Random, and Mixed Effects Models*

When the mean effect size distribution is homogeneous a fixed effects model may be appropriate (Figure 1). For a fixed effects model, an observed effect size is assumed to be an accurate estimate for the population with only random subject-level sampling error in that study/evaluation context (Lipsey & Wilson, 2001). The mean effect size calculation used above should produce a reasonably accurate estimate of the effect size for all studies/contexts. When the mean effect size is heterogeneous or there is an inferential reason to conduct further analysis, three available options: (a), a random effects model, (b) a fixed effects model which attempts to explain the variability in effect sizes, and (c) a mixed effects model (Figure 1).

1. A *random effects model* assumes that the variability beyond subject-level sampling error is random and cannot be identified (Lipsey & Wilson, 2001). In this case, an inverse variance weight is used to account for random variability at both the study/context level and the level of individual respondents for each study. There are two common methods for obtaining a random variability estimate: (a) the method of moments and (b) the method of maximum likelihood (see Raudenbush, 1994; Shadish & Haddock, 1994 for computational details). The meta-analyst should repeat the analysis steps shown in Figure 1 using the new inverse variance weight.

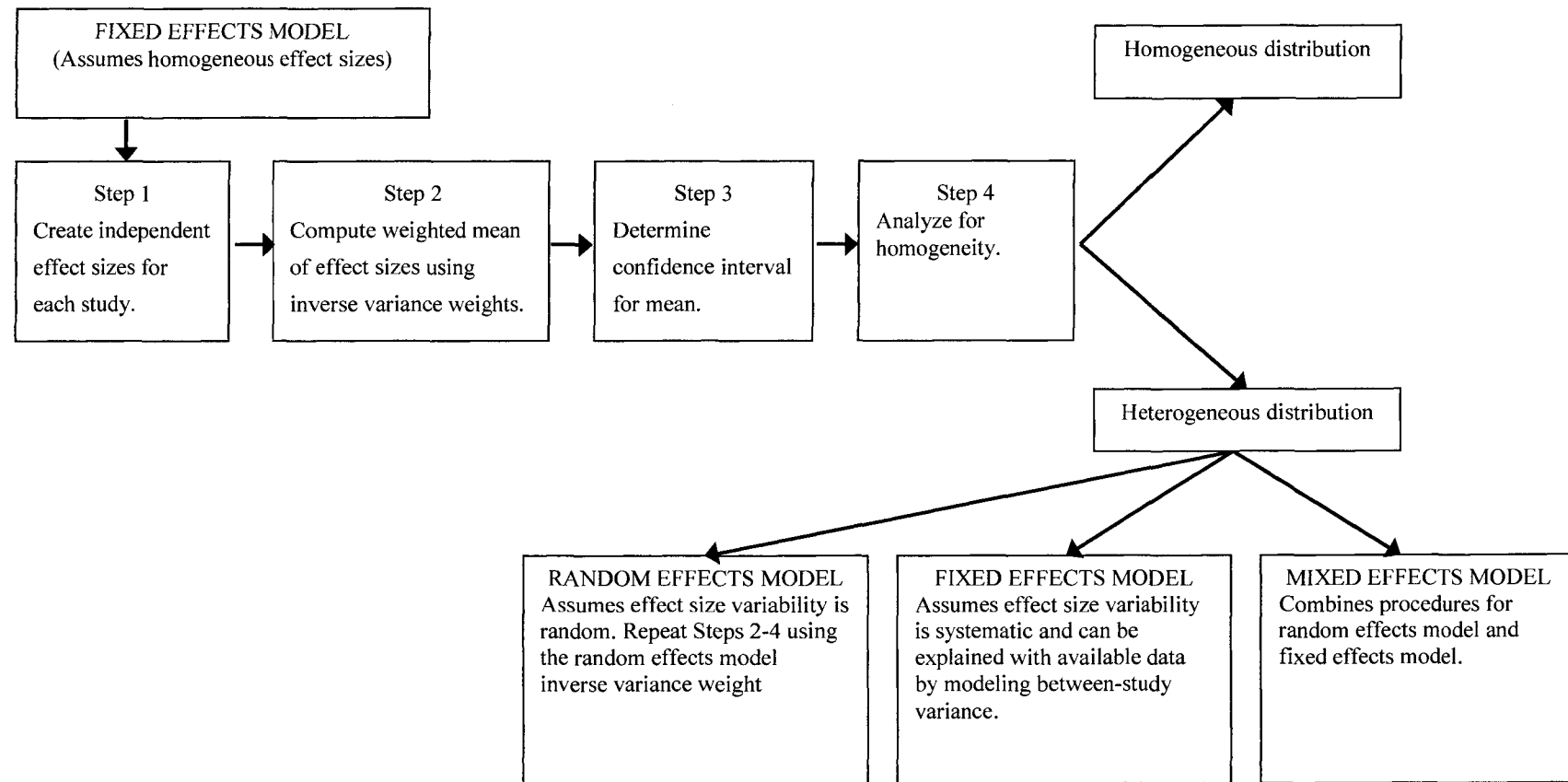


Figure 3.1 Analysis steps for meta-analysis

2. Continue to assume a *fixed effects model*, but add the assumption that the variability beyond subject-level sampling error can be explained by other variables that were coded for the meta-analysis. These variables would systematically differentiate studies with larger or smaller effect sizes (Lipsey & Wilson, 2001). Two methods for modeling the variability between studies for fixed effects models are evident in the literature: (a) a meta-analytic approach to ANOVA, and (b) a meta-analytic approach to regression. Hunter and Schmidt (2000) demonstrated that fixed effects meta-analysis models typically have a substantial Type I bias (wrongly rejecting a true null hypothesis), which leads to incorrect conclusions, whereas random effect models do not.

If you have a heterogeneous group, the group can be broken into *a priori* subgroups with large samples to create more homogeneous subgroups (e.g., trout anglers in wilderness and salmon anglers in non-wilderness areas). An analysis similar to ANOVA in primary research can be used to compare between these subgroups (see Hedges, 1982; Hedges, 1994; Hedges & Olkin, 1985 for computational details). The homogeneity of effect size between groups and within groups is tested that allows for tests of the effects of groupings in addition to an indication that the final groups have internally homogeneous effect sizes.

When meta-analysts are interested in explaining the variance between studies that have continuous independent variables, an analogue to multiple regression is often used (see Hedges, 1982; Hedges, 1994; Hedges & Olkin, 1985 for computational details). The predictor variables represent study characteristics such as the population studied (e.g., demographics, type of activity participated in, location of activity) or methodological characteristics (e.g., variable operationalization, on-site vs. mailed surveys, methodological quality). The effect sizes are regressed on the

predictor variables to determine the relationship between study characteristics and effect sizes.

Cooper and Hedges (1994), Hedges (1982), Hedges and Olkin (1985), and Rosenthal (1984) detail approaches for explaining between study variability. Hedges and Olkin (1985), for example, provide information on effect size clustering methods to use when *a priori* decisions about study characteristics and/or groupings of studies are not appropriate.

3. If an effect size distribution is still heterogeneous after the modeling variables explaining effect size variance, a *mixed-effects model* may be appropriate. A mixed effects model attempts to explain the variability by study characteristic variables and assumes random variability beyond subject-level sampling error (Lipsey & Wilson, 2001). For this model, the random effects variance component is calculated based on the residual variability from modeling study characteristics instead of the total variability (see Cooper & Hedges, 1994; Kalaian & Raudenbush, 1996; Overton, 1998).

A recent technique for modeling between study variability is multi-level modeling based on hierarchical linear models (see Goldstein, 1995; Raudenbush & Bryk, 1985; Noorgate & Onghena, 2003 for details). This method models variation and covariation both between and within studies (Becker & Schram, 1994), and typically involves a random effects or mixed effects model. Noorgate and Onghena (2003) showed that a maximum likelihood multilevel approach is generally superior to fixed effects approaches, but not substantially different from random-effects approaches. The use of the more traditional models, however, is still common practice. Most meta-analysts cannot use hierarchical analysis due to current software limitations (Becker & Schram, 1994).

As with all statistical analysis, caution should be used in interpreting and drawing causal influences in meta-analysis. The use of study characteristic variables for analyzing the differences between effect sizes for a group of studies is useful; however, it is not a replacement for analyzing the differences in study characteristics in primary research in an experimental situation. Analyzing these relationships meta-analytically may provide insight that a single study could not (Hall & Rosenthal, 1995).

### An Empirical Illustration

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 dimension 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. The question asks people to indicate how crowded the area was at the time of their visit. Responses are given on the scale below:

|                       |   |                     |   |                       |   |                      |   |   |
|-----------------------|---|---------------------|---|-----------------------|---|----------------------|---|---|
| 1                     | 2 | 3                   | 4 | 5                     | 6 | 7                    | 8 | 9 |
| Not at all<br>Crowded |   | Slightly<br>Crowded |   | Moderately<br>Crowded |   | Extremely<br>Crowded |   |   |

The single-item crowding measure is easy to fill out, interpret and compare across studies, and has been widely used in outdoor recreation research (Shelby et al., 1989). To date, the measure has been used in at least 170 different studies, including approximately 600 evaluation contexts. Approximately 80,500 individuals have

responded to the 9-point perceived crowding scale. Although comparative analyses of the crowding scale have been conducted (e.g., Shelby et al., 1983; Shelby et al., 1989; Vaske & Donnelly, 2002), an analysis following the procedures in the meta-analysis literature has not been applied to the 9-point crowding scale.

A proportion was used as the effect size to explore a one variable relationship – the central tendency of individuals feeling crowded across evaluation contexts. In most meta-analyses, an effect size is typically used to analyze a two variable relationship in each study. For example, Pearson's  $r_{xy}$ , Cohen's  $d$ , or the difference between two proportions is calculated for each study of interest. The meta-analysis of a one-variable relationship involves evaluating the pattern of observations across the variable (e.g., through a central tendency) (Lipsey & Wilson, 2001). Such effect sizes in meta-analysis are rare, but allow for an examination of the 9-point crowding variable using meta-analytic methods, and offer a simple illustration of the analysis step of meta-analysis. Lipsey and Wilson (2001) provide formulas for using a single variable proportion as an effect size.

Meta-analysis typically uses a study as the unit of analysis; however, an evaluation context is often considered appropriate for the 9-point crowding scale (e.g., Donnelly et al, 2000; Shelby et al., 1989; Vaske & Donnelly, 2002). Evaluation contexts may refer to (a) specific locations where the recreationist evaluates crowding, (b) time (year of study, weekend, weekday, opening day, or rest of the season), or (c) users evaluating other types of recreationists. See Tables 3.2 (hunting) and 3.3 (fishing) for a listing of the evaluation contexts used in this study. Details for all evaluation contexts are presented in Appendix A, Table A1.

Table 3.2. Summary of hunting contexts included in meta-analysis on perceived crowding

| Citation                                    | Study site                               | Evaluation context                | <i>n</i> | <i>ES<sub>p</sub></i> | <i>SE<sub>p</sub></i> | <i>w<sub>p</sub></i> |
|---------------------------------------------|------------------------------------------|-----------------------------------|----------|-----------------------|-----------------------|----------------------|
| Heberlein, Baumgartner, & Trent (1980)      | Bong Wildlife Management Unit (1979)     | Pheasant Hunters – Rest of Season | 169      | .48                   | .04                   | 677.08               |
|                                             |                                          | Pheasant Hunters – Opening Day    | 755      | .89                   | .01                   | 7711.95              |
| Heberlein (1981)                            | Bong Wildlife Management Unit (1981)     | Pheasant Hunters Rest of Season   | 325      | .68                   | .03                   | 1493.57              |
|                                             |                                          | Pheasant Hunter – Opening Day     | 418      | .75                   | .02                   | 2229.33              |
| Kuentzel (2005)                             | Cape Cod                                 | Hunters - Field sample            | 97       | .01                   | .01                   | 9797.98              |
| Vaske, Shelby, Graefe, & Heberlein (1986)   | Fishing Bay                              | Goose Hunters                     | 230      | .61                   | .03                   | 966.79               |
| Kuentzel & Heberlein (1998)                 | Grand River Marsh                        | Firing Line                       | 448      | .79                   | .02                   | 2700.42              |
|                                             |                                          | Managed Hunt                      | 935      | .17                   | .01                   | 6626.51              |
| Shelby & Heberlein (1986)                   | Horicon Grand River Marsh                | Goose Hunters – Firing Line       | 445      | .86                   | .02                   | 3696.01              |
|                                             | Horicon Grand River                      | Goose Hunters – Managed Hunt      | 913      | .17                   | .01                   | 6470.59              |
| Vaske, Donnelly, Wittmann, & Laidlaw (1995) | Mt Evans                                 | Deer Hunter                       | 389      | .72                   | .02                   | 1929.56              |
| Heberlein et al (1980)                      | Public Hunting Area                      | Pheasant Hunters                  | 194      | .85                   | .03                   | 1521.57              |
| Heberlein & Kuentzel (2002)                 | Sandhill Wildlife Management Unit (1979) | Deer Hunters - Does Day 1         | 148      | .20                   | .03                   | 925.00               |
|                                             |                                          | Deer Hunters - Does Day 2         | 137      | .35                   | .04                   | 602.20               |
|                                             | Sandhill Wildlife Management Unit (1980) | Deer Hunters - Does Day 2 SE      | 82       | .49                   | .06                   | 328.13               |
|                                             |                                          | Deer Hunters - Does Day 1 NW      | 77       | .53                   | .06                   | 309.11               |
|                                             | Sandhill Wildlife Management Unit (1982) | Deer Hunters - Does SE            | 41       | .22                   | .06                   | 238.93               |
|                                             |                                          | Deer Hunters - Trophy bucks SE    | 85       | .52                   | .05                   | 340.54               |

Table 3.2. Summary of hunting contexts included in meta-analysis on perceived crowding (*continued*)

| Citation                         | Study site                               | Evaluation context                   | <i>n</i> | <i>ES<sub>p</sub></i> | <i>SE<sub>p</sub></i> | <i>w<sub>p</sub></i> |
|----------------------------------|------------------------------------------|--------------------------------------|----------|-----------------------|-----------------------|----------------------|
| Heberlein & Kuentzel (2002)      | Sandhill Wildlife Management Unit (1982) | Deer Hunters - Does NW               | 84       | .74                   | .05                   | 436.59               |
|                                  | Sandhill Wildlife Management Unit (1983) | Deer Hunters - Trophy bucks NW       | 81       | .62                   | .05                   | 343.80               |
|                                  | Sandhill Wildlife Management Unit (1984) | Deer Hunters - Does SE               | 52       | .35                   | .07                   | 228.57               |
|                                  |                                          | Deer Hunters - Does NW               | 44       | .39                   | .07                   | 184.95               |
|                                  |                                          | Deer Hunters - Does NE               | 48       | .52                   | .07                   | 192.31               |
|                                  | Sandhill Wildlife Management Unit (1987) | Deer Hunters - Trophy bucks Day 2 SW | 49       | .49                   | .07                   | 196.08               |
|                                  |                                          | Deer Hunters - Trophy bucks Day 2 SE | 73       | .58                   | .06                   | 299.67               |
|                                  |                                          | Deer Hunters - Trophy bucks Day 2 NW | 69       | .68                   | .06                   | 317.10               |
|                                  |                                          | Deer Hunters - Trophy bucks Day 2 NE | 65       | .68                   | .06                   | 298.71               |
|                                  | Sandhill Wildlife Management Unit (1988) | Deer Hunters - Trophy bucks Day 2 NW | 81       | .59                   | .05                   | 334.85               |
|                                  |                                          | Deer Hunters - Trophy bucks Day 1 SE | 75       | .67                   | .05                   | 339.21               |
|                                  | Sandhill Wildlife Management Unit (1989) | Deer Hunters - Trophy bucks Day 2 SE | 91       | .50                   | .05                   | 364.00               |
|                                  |                                          | Deer Hunters - Trophy bucks Day 1 NW | 82       | .67                   | .05                   | 370.87               |
| Vaske, Graefe, & Caldwell (1984) | Tuckahoe State Park                      | Goose Hunters                        | 62       | .27                   | .06                   | 314.56               |

Table 3.3. Summary of fishing contexts included in meta-analysis on perceived crowding

| Citation                          | Study site                                      | Evaluation context               | <i>n</i> | <i>ES<sub>p</sub></i> | <i>SE<sub>p</sub></i> | <i>w<sub>p</sub></i> |
|-----------------------------------|-------------------------------------------------|----------------------------------|----------|-----------------------|-----------------------|----------------------|
| Heberlein & Vaske (1977)          | Brule River (1975)                              | Anglers                          | 170      | .5200                 | .0383                 | 681.09               |
| Vaske (1993)                      | Cache la Poudre River                           | Anglers evaluation of kayakers   | 83       | .2900                 | .0498                 | 403.11               |
|                                   |                                                 | Angler evaluation of rafterss    | 86       | .3400                 | .0511                 | 383.24               |
|                                   |                                                 | Anglers                          | 87       | .4000                 | .0525                 | 362.50               |
| Donnelly & Vaske (1998)           | Colorado Reservoirs – Crystall Reservoir        | Anglers                          | 76       | .1800                 | .0441                 | 514.91               |
|                                   | Colorado Reservoirs – South Catamount Reservoir | Anglers                          | 139      | .3500                 | .0405                 | 610.99               |
|                                   | Colorado Reservoirs – North Catamount Reservoir | Anglers                          | 161      | .3900                 | .0384                 | 676.75               |
| Alaska Div. of Parks & Rec (1993) | Kenai River – Middle Bank                       | Salmon Anglers – Low Use Days    | 130      | .6300                 | .0423                 | 557.70               |
|                                   | Kenai River – Lower Bank                        | Salmon Anglers – Low Use Days    | 350      | .6900                 | .0247                 | 1636.28              |
|                                   | Kenai River                                     | Driftboat Anglers – Low Use Days | 65       | .7400                 | .0544                 | 337.84               |
|                                   | Kenai River – Upper Bank                        | Salmon Anglers – Low Use Days    | 201      | .8500                 | .0252                 | 1576.47              |
|                                   |                                                 | Salmon Anglers – High Use Days   | 41       | 1.0000                | .0000                 |                      |
| Shelby & Stein (1984)             | Klamath River                                   | Salmon Anglers                   | 50       | .7000                 | .0648                 | 238.10               |
| Shelby (1983)                     | Rakaia River - Upstream                         | Salmon Anglers                   | 67       | .4500                 | .0608                 | 270.71               |
|                                   | Rakaia River – At River Mouth                   | Salmon Anglers                   | 68       | .7400                 | .0532                 | 353.43               |
| Shelby (1983)                     | Waimakariri River                               | Salmon Anglers                   | 138      | .7500                 | .0369                 | 736.00               |
| Alaska Div. of Parks & Rec (1991) | Willow Creek                                    | Salmon Anglers                   | 96       | .7900                 | .0416                 | 578.66               |

### Accounting for Outliers, Artifacts, Bias and Error

Accounting for bias, error, artifacts, and outliers need to be based on the appropriateness for a given meta-analysis, and the availability of methods for the selected summary statistic. The illustration used here was based on a simple meta-analysis using a proportion for a single variable. For the proportion, few correction formulas are available, and none were appropriate for this study. The removal of outliers was not appropriate since the proportions were expected to vary widely across contexts. Bias and error corrections were addressed by careful inclusion and exclusion of studies. In this study, five exclusion criteria were used to address bias and error.

First, based on the comparative analysis (Chapter 4), there was a statistically significant difference between on-site and mailed surveys for the 9-point crowding scale. Only the more frequently used on-site surveys were included in the meta-analysis here. Second, to address variance in sampling design and operationalization, only studies using the 9-point crowding scale were included.

Third, methodological quality is a concern with meta-analysis and can be addressed by coding a judgment of quality with each study (Hedges, 1982). In this dissertation, evaluation contexts with extremely small sample sizes ( $< 40$ ) were excluded from analysis.

Fourth, all perceived crowding studies were reviewed, regardless of their publication status. An expansive search of unpublished recreation studies that used the 9-point crowding scale was conducted by searching dissertations/theses, government reports, published articles, and contacting individual researchers who had reported crowding results. Unlike some fields (e.g., psychology) where numerous investigators may examine a given concept, human dimensions of natural resources is a relatively small discipline, few individuals conduct HD crowding research, and the population

of these researchers could be identified. The data from all known studies were included.

Fifth, if more than one report from the same study is used the corresponding effect sizes will not be independent of one another (Rosenthal & DiMatteo, 2001), or if more than one effect size in the same study is calculated, they may not be independent (Glass et al., 1981). To address this concern care was taken that multiple reports on the same study were not included to insure that results from each study were only coded once. There was no duplication of the same respondents for the same crowding question for the same study that was coded more than once. Although more than one effect size may be calculated for the same study, only one effect size per context was calculated. These effect sizes were considered to be independent.

The decision to adopt these five correction factors was based upon a defensible logic. In other meta-analyses, the use of bias and correction factors is less obvious. In these cases a sensitive analysis should be conducted. When the decisions made in a meta-analysis are not as easy to defend as the one's used in this example (such as only using published journal articles and attempting to make conclusions to all studies), a sensitivity analysis can determine whether choosing other reasonable alternatives will impact the conclusions (see Copas & Shi, 2000; Greenhouse & Iyengar, 1994; Duval & Tweedie, 2000 for more details on methods). For example, stem-and leaf plots or box plots may be used to examine the differences between alternatives. Funnel plots are frequently used to check for publication bias between published studies included in the meta-analysis and a sample of unpublished studies not included in the meta-analysis (see Pham et al., 2001; Sterne & Harbord, 2004). For the perceived crowding example, this was not necessary since the small

community of individuals conducting crowding studies allowed for the inclusion of unpublished studies.

#### Creating an Effect Size for each Evaluation Context

The proportion of respondents feeling crowded (responded 3-9 on the 9 pt. crowding scale) was coded as the effect size measure for each evaluation context. A standard error for each proportion, and an inverse variance weight were coded. All evaluation contexts (e.g., paddling canoers evaluations of encounters with individuals engaged in motorized activities) were meta-analyzed ( $n = 319$ ). See Appendix A Table A1 for a listing of all evaluation contexts. In addition, two subgroups were analyzed to illustrate the use of meta-analysis: (a) crowding evaluations made by hunters ( $n = 32$ ; Table 3.2), and (b) crowding evaluations made by anglers ( $n = 17$ ; Table 3.3). The formulas used in these analyses follow.

##### *Effect Size Formula*

$$ES_p = p = k / n \quad (1)$$

where  $p$  is proportion of individuals feeling crowded,  $k$  is the number of individuals feeling crowded, and  $n$  is the sample size for the context.

##### *Standard Error Formula*

$$SE_p = \sqrt{\frac{p(1-p)}{n}} \quad (2)$$

##### *Inverse Variance Weight Formula*

$$w_p = \frac{1}{SE_p^2} = \frac{n}{p(1-p)} \quad (3)$$

#### Computing the Weighted Mean of the Effect Sizes

The weighted mean effect size for any effect size was computed by the formula:

$$\overline{ES} = \frac{\sum (w_i ES_i)}{\sum w_i} \quad (4)$$

where  $w$  is the inverse variance weight,  $ES$  is the arithmetic mean for each context, and  $i$  represents each independent context.

Results for the entire group and the hunters and anglers subgroups are in Table 3.4. For all evaluation contexts, the average mean  $ES$  (the average proportion across all studies) was 0.37. In other words, 37% of respondents, on average, felt at least somewhat crowded across all 319 evaluation contexts. For the angler contexts, 60% of respondents, on average, felt crowded across the 17 evaluation contexts. For the hunter contexts, 46% of respondents felt crowded across the 32 evaluation contexts.

Table 3.4. Summary statistics for the all contexts, and the hunter and angler subgroups

| Groups          | $n$ | Mean $ES$ | 95% CI      |             | $Q$       |
|-----------------|-----|-----------|-------------|-------------|-----------|
|                 |     |           | Lower limit | Upper limit |           |
| All contexts    | 319 | 0.37      | 0.36        | 0.37        | 77,049.08 |
| Angler subgroup | 17  | 0.60      | 0.58        | 0.62        | 414.12    |
| Hunter subgroup | 32  | 0.46      | 0.45        | 0.47        | 6,257.50  |

\* $p < .05$

These findings highlight the importance of segmenting the population into more homogeneous groups. For example, compared to the overall mean  $ES$  (37%), anglers reported substantially higher levels of crowding (60%). Given the statistically significant  $Q$  for all three analyses, further segmentation is suggested (see discussion below). Such analyses were not performed given the limited sample sizes for these subgroups.

### Determining the Confidence Interval for the Proportion

The confidence interval was determined by calculating the standard error of the mean using the square root of the sum of the inverse variance weights (Hedges & Olkin, 1985).

$$\overline{ES} \pm z_{(1-\alpha)}(SE_{\overline{ES}}); SE_{\overline{ES}} = \sqrt{\frac{1}{\sum w_i}} \quad (5)$$

where  $z_{(1-\alpha)}$  is the critical value for the  $z$  distribution (1.96 for  $\alpha = .05$ ). If the confidence interval does not include zero, the mean effect size is statistically significant at  $p \leq \alpha$ .

For all three groups, the mean effect size is statistically different from zero (Table 3.4). Even when considering the lower and upper limits of the 95% confidence intervals (Table 3.4), the angler subgroup showed a noticeably higher mean effect size than the hunter subgroup, and the mean effect size for all contexts. None of the confidence intervals for the groups overlapped suggesting that the differences between subgroups has practical significance.

### Analyzing for Homogeneity

The homogeneity of the effect size distribution was analyzed using the  $Q$  statistic:  $Q = \sum w_i (ES_i - \overline{ES})^2$ . The null hypothesis that the variability of the effect sizes is what would be expected from sampling error alone was rejected for all three groups (i.e., the effect sizes were not homogeneous, Table 3.4). Given a sufficient sample size, the next logical step in meta-analysis would consider random and mixed effects models. For this example, the variation was likely due to factors that could not be analyzed due to small sample sizes. For example, a more homogeneous group may be obtained by analyzing different types of hunters separately (e.g., large game and waterfowl hunters). For anglers, a more homogeneous group may be obtained by

analyzing type of location separately (e.g., rivers and lakes). This issue is complicated by the lack of consistently measured and reported study characteristic variables.

#### Future Research Applications

The average mean effect size can be used for comparing the results of individual studies and contexts. Judging by the difference in mean effect sizes for the contexts involving evaluations by anglers and hunters it may be appropriate for managers to use average mean effect sizes for specific activities or locations that can be conducted as the sample sizes for each category increase over time. Researchers are encouraged to continue using the 9-point crowding scale.

Although our example was purposely simplistic to facilitate understanding, the potential for meta-analysis application in the field of human dimensions of wildlife is noteworthy. It is particularly useful to examine variable relationships across a group of independent studies, for example, the correlation between perceived crowding and density estimates or satisfaction and success at bagging game.

## CHAPTER IV. CROWDING AS A DESCRIPTIVE INDICATOR AND AN EVALUATIVE STANDARD: RESULTS FROM 30 YEARS OF RESEARCH

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

In an effort to understand crowding, investigators have expanded their investigations from single resource descriptive studies to comparative analyses of data aggregated across a wide variety of activities and resources (Shelby et al., 1983; Shelby et al., 1989; Vaske & Donnelly, 2002). By contrasting identical measures of the same concept across a number of activities, resources, and visitor characteristics, aggregated data sets can 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).

The Shelby et al. (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. The present study builds on the Shelby et al article by examining a database of 170 studies and 601 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 generalized factors that influence crowding, and (d) explore the crowding standards proposed by Shelby et al. (1989).

### 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. The question asks people to indicate how crowded the area was at the time of their visit.

Responses are given on the scale below:

|            |   |          |   |   |            |   |           |   |
|------------|---|----------|---|---|------------|---|-----------|---|
| 1          | 2 | 3        | 4 | 5 | 6          | 7 | 8         | 9 |
| Not at all |   | Slightly |   |   | Moderately |   | Extremely |   |
| Crowded    |   | Crowded  |   |   | Crowded    |   | 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 compare across studies, and has been widely used in outdoor recreation research (Shelby et al., 1989). To date, the measure has been used in at least 170 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 crowded versus 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). Recent 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 recommend 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 crowding scale. The mean provides a single summary statistic that can be used to highlight differences across different 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 crowding scale. The median provides a single summary statistic that can be used to consider possible crowding standards. Given that these alternative methods for reporting crowding could lead to different conclusions and management implications (Graefe, et al., 1994; Vaske & Donnelly, 1997; Vaske, Donnelly et al., 2002), understanding the relationships among the summary procedures can facilitate the choice of reporting method.

### Crowding as a Descriptive Indicator

When aggregating studies, resources, visitor characteristics, and activities, it is reasonable to consider generalized variables as possible factors that typically cannot be manipulated in a single study. Previous research suggests that year, survey mode, region, country, resource, and activity may be considered as descriptive indicators of crowding (Shelby et al., 1989).

#### *Year*

Perceived crowding has changed over time. Two studies conducted 10 years apart at the Apostle Islands National Lakeshore, for example, showed that although use levels increased, perceived crowding decreased (McKinnell & Heberlein, 1987). In Shelby et al. (1989) several specific studies show similar findings. Sandhill deer hunters reported 24% feeling crowded in 1982, while only 12% reported feeling crowded in 1988. In 1975, 52% of the Brule river canoers reported feeling crowded; ten years later in 1985 only 37% of the canoers felt crowded. Thus, *we hypothesize that levels of perceived crowding will change over time (H<sub>1</sub>)*.

#### *Survey Mode*

Manfredo (1984) compared the effects of on-site and off-site (mail) measures and found significant differences between the two methodologies. It appears that different concepts are being measured during the two data collection periods. For perceptions of crowding, Tarrant (1999) found more crowding in mail-back surveys than on-site surveys for Nantahala River users. Shelby and Heberlein (1986) recommended that on-site measures should be used when researchers want to understand on-site conditions and how well these conditions meet a users needs. Off-site measures are useful for studies of general reasons for recreation participation. Shelby, et al. (1989) found no significant differences in crowding

among the on-site and off-site measures. *We hypothesize that crowding will not be different for follow-up vs. onsite surveys (H<sub>2</sub>).*

#### *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 wilderness 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 that were in close proximity to major populations had higher crowding levels than less convenient and less accessible areas.

The 1989 comparative crowding analysis, however, found crowding was not influenced by U.S. region (i.e., Northeastern, Midwestern, and Western). Shelby et al. (1989) speculated that the results were likely due to a small sample size that was unrepresentative of each region. Considering the east versus west argument, an increased sample size, and more representation from each region, *we hypothesize that regions of the United States will have different crowding levels (H<sub>3</sub>).*

The 1989 article included two international studies and four international contexts, which was not a large enough number for a separate analysis. The data set used for the study reported here included 20 international studies (79 international contexts). Considering that crowding may be influenced by specific areas within the United States, *we hypothesize that different countries will have different crowding levels (H<sub>4</sub>).*

### *General Resource*

Different types of general resources may offer different types of experiences. For example, on a winding river or trail system, vegetation and geographic considerations might mask the presence of people using the resource. Individuals in these types of resources may see relatively few other visitors and thus not feel crowded (Vaske & Donnelly, 2000). *We hypothesize that different types of general resources will have different crowding levels (H<sub>5</sub>).*

### *Specific Location Within a Resource*

Crowding expectations may be different at specific locations (e.g., campgrounds, attraction sites, at the trailhead) within a resource due to visitor expectations. Vaske, Donnelly et al. (2002), for example, found differences in perceived crowding at manmade and natural attraction sites, at 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 manmade attraction sites versus on the trip (e.g., on the glacier). *We hypothesize that different types of locations within a resource will have different crowding levels (H<sub>6</sub>).*

### *General Activities*

Vaske et al. (1982) theorized that participants in consumptive activities (e.g., hunters and anglers) differ from those in nonconsumptive activities 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 in terms of 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. When there is no correspondence, the magnitude of the relationship declines. Whittaker, Vaske, and Manfreda (in press), found that a general measure had more influence on acceptability of urban wildlife management than specific measures. In a satisfaction analysis (Vaske et al., 1982), both activity type (consumptive versus 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), type of use (activity type) was measured at a general level, while crowding was specific to the number encountered, and a relationship was not observed.

The lack of a relationship between type of use (consumptive versus nonconsumptive) and perceived crowding may also 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, thereby increasing the likelihood of seeing game. 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 use or consumptive vs. nonconsumptive (a general

concept) on crowding (a specific concept) may have no association as previously observed (Shelby et al., 1989). *We hypothesize that there will be no difference in the level of perceived crowding for consumptive and non-consumptive activities (H<sub>7</sub>).*

#### *Specific Activities*

Alternatively, one can examine the range of activities included within the consumptive and nonconsumptive categories. For example, consumptive activities may include anglers and hunters. Nonconsumptive activities include campers, floaters, rafters, kayakers, canoers, boaters, bikers, and hikers. When different activity groups interact, conflict may arise. Studies, for example, have shown that paddling canoers are bothered by motorized boaters (e.g., Adelman, Heberlein, & Bonnicksen, 1982; Lime, 1975), and hikers are bothered by bikers (e.g., 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 there will be a difference in the level of perceived crowding for different activities (H<sub>8</sub>).*

#### *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*. When people evaluate an area as crowded, they have at least implicitly compared the condition they experienced (impacts) with their perception of what is acceptable (standards). If they conclude that the area is crowded, it would appear that the existing conditions exceeded their definitions of a standard (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 percent of visitors reporting any level of crowding (scale points 3 through 9). These categories have been adopted for purposes of this comparative analysis.

### Methods

Since 1975, the single-item crowding measure has been used in 170 studies conducted across the United States, Canada, New Zealand, Ecuador, Sweden, and in Taiwan resulting in crowding ratings for 601 different settings and activities (evaluation contexts). These activities include 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 show considerable diversity, with some showing extremely high density and use impact problems, others showing low densities and no problems, and still others actively utilizing management strategies to control densities and use impacts. In total, over 80,479 individuals have been asked the crowding question to date.

The data for this paper were obtained from secondary analysis of articles, dissertations, theses, and published and unpublished reports (see Tables B1 through B7 in Appendix B for more information). Some evaluation contexts refer to specific locations where recreationists evaluated crowding. For example, visitors were asked to evaluate crowding at campsites, while climbing (on the trail), and at the summit at Mt. Shasta. Evaluation contexts can also represent time (year of study, weekend, weekday, opening day, or rest of the season), managed recreation, or users evaluating other types of recreationists. The 601 evaluation contexts in this analysis constitute the basic unit of analysis.

### *Variables Measured*

*Dependent variable.* Perceived crowding was summarized using four different methods: (a) Collapsing the crowding scale by 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); (b) collapsing the crowding scale by those who labeled the situation as *not at all crowded* or *slightly crowded* (scale points 1 through 4), and those who labeled the situation as *moderately* or *extremely crowded* (scale 5 through 9, a negative evaluation); (c) calculating the mean of the crowding scale; and (d) calculating the median of the crowding scale.

*Independent variables.* To determine the characteristics affecting crowding, each evaluation context was coded in terms of generalized variables: (a) year, (b) survey mode, (c) region of United States, (d) country, (e) general resource, (f) specific location within a resource, (g) activities, and (h) crowding standard.

Year was analyzed using two different variables. The *5 year view* variable was coded as a categorical variable in which the years were grouped into 6 categories based on 5 year increments: 1975 to 1979, 1980 to 1984, 1985 to 1989, 1990 to 1994, 1995 to 1999, and 2000 to 2005 (6 years). The *decade view* variable was coded as a categorical variable in which the years were grouped into three categories based on 10 year increments: 1974 to 1984, 1985 to 1994, 1995 to 2005 (11 years).

The *survey mode* variable was coded as a dichotomous variable: on-site survey versus mail survey.

*Regions of U.S.* was coded as Pacific (i.e., 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 was coded into categories to represent the countries included in the dataset: United States, Canada, New Zealand, Ecuador, Sweden, and Thailand.

General resources were coded into three different categorical variables: (a) *lake or river*; (b) *non wild and scenic river or wild and scenic river* coded as exclusive categories; and (c) *national monument, national park, or national forest*.

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 was coded consumptive and nonconsumptive. The *specific activities* variable was coded as hunters, anglers, campers, floaters, rafters, kayakers, canoers, boaters, bikers, or hikers.

Bivariate relationships between each of the independent variables and the dependent variable were presented using Analysis of Variance tests. Posthoc tests were not reported for these analyses due to the large number of variables being analyzed. Eta was reported as the effect size measure. Eta measures the strength of the relationship between all of the independent variables in the analysis and the dependent variable.

The *carrying capacity judgments* variable was based on five distinct categories developed and 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”. The five categories were operationalized as in Shelby et al. (1989) by coding the crowding standard variable based on the percent of respondents feeling any level of crowding – scale points 3

through 9. The percent of evaluation contexts that fell into each of the five categories was computed for *region of U.S.*, *country*, *lake or river*, *river or wild and scenic river*, *national monument*, *national park*, or *national forest*, *specific location within a resource*, *general activities*, and *specific activities*.

### Results

Across all evaluation contexts, the four methods of reporting crowding are highly correlated ( $r \geq .90$  for all bivariate relationships, Table 4.1). For example, the correlation of scale points 3-9 and scale points 5-9 was  $r = .90$ . Given the high correlations we opted to use only two of the four methods for analysis of the dependent and independent variables: scale points 3-9 and scale mean. These methods were chosen because scale points 3-9 is the most frequently reported method, and the scale mean is the second most frequently reported method in studies using the 9-point perceived crowding scale.

Table 4.1 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  $p < .001$

### Year

Crowding varied by the year (Table 4.2). In the 5 year view, there were statistical differences for the crowding scale points 3-9 ( $F = 7.43$ ,  $df = 599$ ,  $p < .001$ ;  $\eta = .24$ ) and the crowding scale mean ( $F = 8.95$ ,  $df = 555$ ,  $p < .001$ ;  $\eta = .27$ ). For the decade view, there were also statistical differences for the crowding scale points 3-9 ( $F = 14.60$ ,  $df = 599$ ,  $p < .001$ ;  $\eta = .22$ ) and the crowding scale mean ( $F = 17.20$ ,  $df$

= 555,  $p < .001$ ;  $\eta = .24$ ). Hypothesis 1 is supported by both the crowding scale points 3-9 and the scale mean when considered in the 5 year view and the decade view.

Table 4.2 Crowding scale averages by 5-year view and decade view

| Variable                 | # of studies | # of contexts | Crowding scale points 3-9 |       |         |        | Crowding scale mean |      |         |        |
|--------------------------|--------------|---------------|---------------------------|-------|---------|--------|---------------------|------|---------|--------|
|                          |              |               | Average (%)               | SD    | F value | $\eta$ | Average mean        | SD   | F value | $\eta$ |
| 5 year view <sup>1</sup> |              |               |                           |       | 7.43**  | .24    |                     |      | 8.95**  | .27    |
| 1975 - 1979              | 11           | 15            | 51.00                     | 20.00 |         |        | 3.35                | 1.31 |         |        |
| 1980 - 1984              | 26           | 63            | 40.97                     | 20.42 |         |        | 2.78                | 0.99 |         |        |
| 1985 - 1989              | 30           | 71            | 50.24                     | 29.42 |         |        | 3.12                | 1.43 |         |        |
| 1990 - 1994              | 24           | 95            | 54.26                     | 24.95 |         |        | 3.61                | 1.41 |         |        |
| 1995 - 1999              | 33           | 128           | 43.91                     | 24.25 |         |        | 2.81                | 1.16 |         |        |
| 2000 - 2005              | 45           | 228           | 38.27                     | 22.98 |         |        | 2.70                | 0.96 |         |        |
| Decade view              |              |               |                           |       | 14.60** | .22    |                     |      | 17.20** | .24    |
| 1975-1984                | 37           | 78            | 42.90                     | 20.60 |         |        | 2.89                | 1.08 |         |        |
| 1985-1994                | 54           | 166           | 52.54                     | 26.94 |         |        | 3.41                | 1.44 |         |        |
| 1995-2005                | 78           | 356           | 40.29                     | 23.57 |         |        | 2.74                | 1.04 |         |        |

<sup>1</sup> All categories include five years with the exception of 2000-2005.; \*\*  $p < .001$

### *Survey Mode*

The data did not support Hypothesis 2, which predicted that survey mode would not influence crowding (Table 4.3). There were statistical differences for the crowding scale points 3-9 ( $F = 6.67$ ,  $df = 562$ ,  $p = .010$ ;  $\eta = .11$ ) and the scale mean ( $F = 10.58$ ,  $df = 519$ ,  $p = .001$ ;  $\eta = .14$ ).

Table 4.3 Crowding scale averages by survey mode

| Variable    | # of studies | # of contexts | Crowding scale points 3-9 |       |         |        | Crowding scale mean |      |         |        |
|-------------|--------------|---------------|---------------------------|-------|---------|--------|---------------------|------|---------|--------|
|             |              |               | Average (%)               | SD    | F value | $\eta$ | Average mean        | SD   | F value | $\eta$ |
| Survey mode |              |               |                           |       | 6.67*   | .11    |                     |      | 10.58** | .14    |
| Mailed      | 45           | 113           | 48.95                     | 25.50 |         |        | 3.25                | 1.36 |         |        |
| On-site     | 117          | 450           | 42.16                     | 24.85 |         |        | 2.83                | 1.16 |         |        |

$p < .05$  \*\*  $p \leq .001$

### *Region of the United States.*

Hypothesis 3 predicted that different regions would influence crowding. Our data supported the hypothesis (Table 4.4). The South Atlantic region had the highest level of crowding with a mean of 76% (SD = 14.43), compared to the New England region with the lowest level of crowding with a mean of 31% (SD = 19.96). The difference between all regions of the United States (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 mean also resulted in statistical differences ( $F = 16.69$ ,  $df = 482$ ,  $p < .001$ ;  $\eta = .42$ ).

### *Country*

Crowding was influenced by country (Table 4.4). There were significant differences for the crowding scale points 3-9 ( $F = 2.52$ ,  $df = 600$ ,  $p = .029$ ;  $\eta = .14$ ) and the scale mean ( $F = 3.85$ ,  $df = 555$ ,  $p = .002$ ;  $\eta = .18$ ). Hypothesis 4 was supported for both the crowding scale points 3-9 and the scale mean.

Table 4.4 Crowding scale averages by country and U.S. region

| Variable        | # of studies | # of contexts | Crowding scale 3-9 |       |         |        | Crowding scale mean |      |         |        |
|-----------------|--------------|---------------|--------------------|-------|---------|--------|---------------------|------|---------|--------|
|                 |              |               | Average (%)        | SD    | F value | $\eta$ | Average mean        | SD   | F value | $\eta$ |
| Region of U. S. |              |               |                    |       | 11.64** | .35    |                     |      | 16.69** | .42    |
| Pacific         | 60           | 231           | 49.18              | 24.29 |         |        | 3.20                | 1.13 |         |        |
| Midwest         | 33           | 98            | 38.00              | 23.19 |         |        | 2.66                | 1.08 |         |        |
| South           | 2            | 2             | 49.50              | 26.16 |         |        | 3.15                | 1.03 |         |        |
| Rocky Mountain  | 24           | 103           | 39.21              | 22.26 |         |        | 2.56                | 1.00 |         |        |
| Mid-Atlantic    | 12           | 31            | 43.35              | 29.29 |         |        | 3.11                | 1.42 |         |        |
| New England     | 12           | 32            | 31.19              | 19.96 |         |        | 2.41                | 0.71 |         |        |
| South Atlantic  | 4            | 21            | 75.67              | 14.43 |         |        | 4.81                | 1.13 |         |        |
| Country         |              |               |                    |       | 2.52*   | .14    |                     |      | 3.85*   | .18    |
| United States   | 150          | 522           | 44.85              | 24.79 |         |        | 2.99                | 1.19 |         |        |
| Canada          | 10           | 53            | 36.81              | 26.08 |         |        | 2.68                | 1.21 |         |        |
| New Zealand     | 6            | 11            | 51.82              | 19.51 |         |        | 3.10                | --   |         |        |
| Ecuador         | 1            | 5             | 39.40              | 4.51  |         |        | 1.54                | 0.09 |         |        |
| Sweden          | 2            | 9             | 30.56              | 11.58 |         |        | 2.21                | 0.45 |         |        |
| Thailand        | 1            | 1             | 90.00              | --    |         |        | 5.70                | --   |         |        |

$p < .05$  \*\*  $p < .001$

### General Resource

Crowding varied by the general type of resource (Table 4.5). There were not significant differences between lakes and rivers for scale points 3-9 ( $F = 2.89$ ,  $df = 145$ ,  $p = .091$ ;  $\eta = .14$ ), but the differences for the crowding scale mean were statistically significant ( $F = 4.58$ ,  $df = 128$ ,  $p = .034$ ;  $\eta = .19$ ). Hypothesis 5 was supported for the crowding scale mean for lakes and rivers. For rivers and wild and scenic rivers, specifically, there were differences for both the crowding scale points 3-9 ( $F = 16.02$ ,  $df = 119$ ,  $p < .001$ ;  $\eta = .35$ ), and the scale mean ( $F = 15.03$ ,  $df = 102$ ,  $p < .001$ ;  $\eta = .36$ ). Hypothesis 5 was supported by both the crowding scale points 3-9 and the crowding scale mean. National monuments, national parks, and national forests did not show statistically significant differences for the crowding scale points

3-9 ( $F = 0.14$ ,  $df = 195$ ,  $p = .873$ ;  $\eta = .04$ ), or the crowding scale mean ( $F = 1.96$ ,  $df = 190$ ,  $p = .144$ ;  $\eta = .14$ ). Hypothesis 5 was not supported by the crowding scale points 3-9 or the crowding scale mean.

Table 4.5 Crowding scale averages by general resource

| General resource variable            | # of studies | # of contexts | Crowding scale points 3-9 |       |         |        | Crowding scale mean |      |         |        |
|--------------------------------------|--------------|---------------|---------------------------|-------|---------|--------|---------------------|------|---------|--------|
|                                      |              |               | Average (%)               | SD    | F value | $\eta$ | Average mean        | SD   | F value | $\eta$ |
| Lake and river                       |              |               |                           |       | 2.89    | .14    |                     |      | 4.58*   | .19    |
| Lake                                 | 13           | 41            | 55.98                     | 19.11 |         |        | 3.53                | 0.94 |         |        |
| River                                | 41           | 105           | 62.71                     | 22.40 |         |        | 4.01                | 1.31 |         |        |
| Rivers <sup>1</sup>                  |              |               |                           |       | 16.02** | .35    |                     |      | 15.03** | .36    |
| River                                | 30           | 74            | 64.28                     | 21.69 |         |        | 4.13                | 1.30 |         |        |
| Wild & scenic river                  | 13           | 46            | 46.02                     | 28.03 |         |        | 3.07                | 1.44 |         |        |
| Public land designation <sup>1</sup> |              |               |                           |       | 0.14    | .04    |                     |      | 1.96    | .14    |
| National monument                    | 6            | 21            | 48.38                     | 17.45 |         |        | 3.03                | 0.82 |         |        |
| National park                        | 26           | 95            | 49.75                     | 21.45 |         |        | 3.05                | 0.87 |         |        |
| National forest                      | 21           | 80            | 51.18                     | 29.39 |         |        | 3.40                | 1.56 |         |        |

<sup>1</sup> Includes U.S. crowding studies only.

\*  $p < .05$  \*\*  $p < .001$

### *Specific Location Within a Resource*

Crowding varied by specific location within a resource for the crowding scale collapsed at 3 through 9, but not for the crowding mean (Table 4.6). There were statistically significant differences for the crowding scale points 3-9 ( $F = 3.72$ ,  $df = 600$ ,  $p = .005$ ;  $\eta = .16$ ), but not for the scale mean ( $F = 1.90$ ,  $df = 555$ ,  $p = .109$ ;  $\eta = .12$ ). Hypothesis 6 was supported by only by the crowding scale points 3-9.

Table 4.6 Crowding scale averages by specific location within a resource

| Variable                       | # of contexts | Crowding scale points 3-9 |       |         |        | Crowding scale mean |      |         |        |
|--------------------------------|---------------|---------------------------|-------|---------|--------|---------------------|------|---------|--------|
|                                |               | Average (%)               | SD    | F value | $\eta$ | Average mean        | SD   | F value | $\eta$ |
| Specific location <sup>1</sup> |               |                           |       | 3.72*   | .16    |                     |      | 1.90    | .12    |
| Start/end of trip              | 45            | 34.71                     | 25.97 |         |        | 2.60                | 1.29 |         |        |
| During trip                    | 479           | 43.74                     | 24.71 |         |        | 2.92                | 1.21 |         |        |
| Natural attraction             | 16            | 56.06                     | 22.43 |         |        | 3.31                | 0.93 |         |        |
| Man-made attraction            | 45            | 51.24                     | 23.61 |         |        | 3.17                | 1.08 |         |        |
| Campground                     | 16            | 48.75                     | 19.02 |         |        | 3.18                | 0.96 |         |        |

<sup>1</sup> Categories are exclusive for contexts. One study is likely to have specific contexts in different locations.

\*  $p < .05$

### *General Activities*

Crowding was not influenced by general types of use for crowding scale points 3-9 or the mean of the scale (Table 4.7). Using crowding scale points 3-9, nonconsumptive types of use average 45% feeling crowded (SD = 25%) compared to 40% for consumptive evaluation contexts (SD = 25%). This difference was not significant ( $F = 1.63$ ,  $df = 593$ ,  $p = .083$ ;  $\eta = .07$ ). For the mean of the crowding scale, nonconsumptive types of use had an average mean of 2.94 (SD = 1.18) and consumptive types of use averaged a mean of 2.86 with a standard deviation of 1.24. The mean of the crowding scale showed a nonsignificant difference ( $F = 1.63$ ,  $df = 548$ ,  $p = .507$ ;  $\eta = .03$ ). Both crowding scale points 3-9 and the mean of the crowding scale supported Hypothesis 7.

### *Specific Activities*

Crowding was influenced by the specific type of activity (Table 4.7). For example, crowding scale points 3-9 averaged to 35% for hunters (SD = 24%). For anglers, crowding scale points 3-9 averaged to 58% (SD = 23%). The difference between all activities (hunters, anglers, campers, floaters, rafters, kayakers, canoers,

boaters, bikers, and hikers) was significant ( $F = 9.28$ ,  $df = 298$ ,  $p < .001$ ;  $\eta = .47$ ).

The mean of the crowding scale also showed a significant difference ( $F = 10.33$ ,  $df = 280$ ,  $p < .001$ ;  $\eta = .51$ ). Both crowding scale points 3-9 and the mean of the crowding scale supported Hypothesis 8.

Table 4.7 Crowding scale averages by general and specific activities

| Variable          | # of studies | # of contexts | Crowding scale points 3-9 |       |         |        | Crowding scale mean |      |         |        |
|-------------------|--------------|---------------|---------------------------|-------|---------|--------|---------------------|------|---------|--------|
|                   |              |               | Average (%)               | SD    | F value | $\eta$ | Average mean        | SD   | F value | $\eta$ |
| General Activity  |              |               |                           |       | 3.02    | .07    |                     |      | 0.44    | .03    |
| Consumptive       | 39           | 123           | 40.41                     | 25.29 |         |        | 2.86                | 1.24 |         |        |
| Nonconsumptive    | 131          | 471           | 44.75                     | 24.53 |         |        | 2.94                | 1.18 |         |        |
| Specific Activity |              |               |                           |       | 9.28**  | .47    |                     |      | 10.33** | .51    |
| Hunters           | 28           | 95            | 35.25                     | 22.67 |         |        | 2.62                | 1.07 |         |        |
| Anglers           | 11           | 28            | 57.89                     | 22.97 |         |        | 3.91                | 1.41 |         |        |
| Campers           | 1            | 7             | 58.86                     | 10.99 |         |        | 3.57                | 0.56 |         |        |
| Floaters          | 2            | 9             | 17.00                     | 23.54 |         |        | 1.51                | 0.74 |         |        |
| Rafters           | 6            | 25            | 35.04                     | 31.48 |         |        | 2.47                | 1.57 |         |        |
| Kayakers          | 3            | 22            | 42.91                     | 28.06 |         |        | 3.04                | 1.46 |         |        |
| Canoers           | 4            | 9             | 74.22                     | 19.65 |         |        | 4.98                | 1.58 |         |        |
| Boaters           | 24           | 66            | 58.88                     | 22.58 |         |        | 3.70                | 1.14 |         |        |
| Bikers            | 2            | 10            | 39.70                     | 26.86 |         |        | 2.28                | 1.57 |         |        |
| Hikers            | 13           | 30            | 36.30                     | 16.37 |         |        | 2.34                | 0.90 |         |        |

\*\* $p < .001$

### *Crowding Standards*

Table 4.8 describes the capacity judgments suggested by Shelby et al. (1989). For all 601 evaluation contexts 41% showed suppressed crowding, 18% low normal crowding, 17% high normal crowding, 16% over capacity, and 8% greatly over capacity.

Table 4.8 Carrying capacity judgments based on levels of perceived crowding

| Percent feeling crowded | Capacity judgment     | Comment                                                                                                                                                                                                      | Total # of contexts (n = 601) | Percent of contexts |
|-------------------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|---------------------|
| 0-35%                   | Suppressed crowding   | Crowding is likely limited by management, situational factors, or natural factors may offer unique low-density experiences.                                                                                  | 244                           | 40.6%               |
| 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.                                                    | 109                           | 18.1%               |
| 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. | 103                           | 17.1%               |
| 66-80%                  | Over capacity         | 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.       | 95                            | 15.8%               |
| 81-100%                 | Greatly over capacity | It is generally necessary to manage for high-density recreation. A crowding problem has typically been identified.                                                                                           | 50                            | 8.3%                |

In the United States 40% of the 522 evaluation contexts showed suppressed crowding (Table 4.9), whereas 15% were over capacity and 9% were greatly over capacity. For Canada, 49% showed suppressed crowding, 17% were over capacity, and 2% were greatly over capacity. The South Atlantic region of the United States showed the greatest percent of contexts at greatly over capacity (52%), whereas the New England and South regions had 0% of contexts at greatly over capacity.

Table 4.9 Carrying capacity judgments by country and U.S. region

| Variable        | Total # of contexts | Carrying capacity judgments - % of contexts |                     |                      |                        |                                 |
|-----------------|---------------------|---------------------------------------------|---------------------|----------------------|------------------------|---------------------------------|
|                 |                     | Suppressed crowding (0-35%)                 | Low normal (36-50%) | High normal (51-60%) | Over capacity (66-80%) | Greatly over capacity (81-100%) |
| Region of U. S. |                     |                                             |                     |                      |                        |                                 |
| Pacific         | 231                 | 32.9                                        | 17.7                | 19.0                 | 19.0                   | 11.3                            |
| Midwest         | 98                  | 48.0                                        | 22.4                | 14.3                 | 10.2                   | 5.1                             |
| South           | 2                   | 50.0                                        | 0                   | 0                    | 50.0                   | 0                               |
| Rocky Mountain  | 103                 | 51.5                                        | 16.5                | 14.6                 | 14.6                   | 2.9                             |
| Mid-Atlantic    | 31                  | 45.2                                        | 3.2                 | 25.8                 | 19.4                   | 6.5                             |
| New England     | 32                  | 59.4                                        | 21.9                | 15.6                 | 3.1                    | 0                               |
| South Atlantic  | 21                  | 0                                           | 4.8                 | 19.0                 | 23.8                   | 52.4                            |
| Country         |                     |                                             |                     |                      |                        |                                 |
| United States   | 522                 | 40.2%                                       | 17.2%               | 17.4%                | 16.1%                  | 9.0%                            |
| Canada          | 53                  | 49.1                                        | 17.0                | 15.1                 | 17.0                   | 1.9                             |
| Ecuador         | 5                   | 0                                           | 100                 | 0                    | 0                      | 0                               |
| Thailand        | 1                   | 0                                           | 0                   | 0                    | 0                      | 100                             |
| New Zealand     | 11                  | 18.2                                        | 27.3                | 27.3                 | 18.2                   | 9.1                             |
| Sweden          | 9                   | 66.7                                        | 22.2                | 11.1                 | 0                      | 0                               |

Table 4.10 shows capacity judgments by general resource; 12% of the contexts at lakes were greatly over capacity, and 28% of the rivers were greatly over capacity. When rivers were considered separately from wild and scenic rivers 44% showed suppressed crowding, while 14% of rivers showed suppressed crowding. For public land designations, national forests had the greatest percent of contexts at greatly over capacity (24%), whereas for national monument and national parks greatly over capacity = 5%.

Table 4.10 Carrying capacity judgments by general resource

| General resource variable            | Total # of contexts | Carrying capacity judgments - % of contexts |                     |                      |                        |                                 |
|--------------------------------------|---------------------|---------------------------------------------|---------------------|----------------------|------------------------|---------------------------------|
|                                      |                     | Suppressed crowding (0-35%)                 | Low normal (36-50%) | High normal (51-60%) | Over capacity (66-80%) | Greatly over capacity (81-100%) |
| Lake and river                       |                     |                                             |                     |                      |                        |                                 |
| Lake                                 | 41                  | 17.1%                                       | 26.8%               | 24.4%                | 19.5%                  | 12.2%                           |
| River                                | 105                 | 16.2                                        | 12.4                | 21.9                 | 21.9                   | 27.6                            |
| Rivers <sup>1</sup>                  |                     |                                             |                     |                      |                        |                                 |
| River                                | 74                  | 13.5                                        | 10.8                | 20.3                 | 27.0                   | 28.4                            |
| Wild & scenic river                  | 46                  | 43.5                                        | 15.2                | 17.4                 | 6.5                    | 17.4                            |
| Public land designation <sup>1</sup> |                     |                                             |                     |                      |                        |                                 |
| National monument                    | 21                  | 28.6                                        | 19.0                | 33.3                 | 14.3                   | 4.8                             |
| National park                        | 95                  | 28.4                                        | 18.9                | 23.2                 | 24.2                   | 5.3                             |
| National forest                      | 80                  | 38.8                                        | 10.0                | 11.3                 | 16.3                   | 23.8                            |

<sup>1</sup> Includes U.S. crowding studies only.

Natural and manmade attractions resulted in 38% and 31%, respectively, of contexts being over capacity, whereas for start/end of trip and during trip less than 15% of contexts were overcapacity (Table 4.11). Less than 10% of all specific locations within a resource were greatly over capacity.

Table 4.11 Carrying capacity judgments by specific location within a resource

| Variable                       | Total # of contexts | Carrying capacity judgments - % of contexts |                     |                      |                        |                                 |
|--------------------------------|---------------------|---------------------------------------------|---------------------|----------------------|------------------------|---------------------------------|
|                                |                     | Suppressed crowding (0-35%)                 | Low normal (36-50%) | High normal (51-60%) | Over capacity (66-80%) | Greatly over capacity (81-100%) |
| Specific location <sup>1</sup> |                     |                                             |                     |                      |                        |                                 |
| Start/End of trip              | 5                   | 55.6%                                       | 11.1%               | 17.8%                | 11.1%                  | 4.4%                            |
| During trip                    | 479                 | 41.5                                        | 19.4                | 16.3                 | 13.6                   | 9.2                             |
| Natural attraction             | 16                  | 18.8                                        | 6.3                 | 31.3                 | 37.5                   | 6.3                             |
| Man-made attraction            | 45                  | 28.9                                        | 11.1                | 22.2                 | 31.1                   | 6.7                             |
| Campground                     | 6                   | 25.0                                        | 31.3                | 12.5                 | 31.3                   | 0                               |

<sup>1</sup> Categories are exclusive for contexts. One study is likely to have specific contexts in different locations.

Table 4.12 reports carrying capacity judgments by general activity and specific activity. For example, canoers showed the greatest percent of contexts at greatly over capacity (56%), whereas campers, floaters, and hikers had 0% of contexts greatly over capacity. Hunters, floaters, rafters, kayakers, bikers, and hikers had 50% or more of contexts showing suppressed crowding.

Table 4.12 Carrying capacity judgments by general and specific activities

| Variable          | Total # of contexts | Carrying capacity judgments - % of contexts |                     |                      |                        |                                 |
|-------------------|---------------------|---------------------------------------------|---------------------|----------------------|------------------------|---------------------------------|
|                   |                     | Suppressed crowding (0-35%)                 | Low normal (36-50%) | High normal (51-60%) | Over capacity (66-80%) | Greatly over capacity (81-100%) |
| General activity  |                     |                                             |                     |                      |                        |                                 |
| Consumptive       | 123                 | 48.8%                                       | 17.9%               | 11.4%                | 15.4%                  | 6.5%                            |
| Nonconsumptive    | 471                 | 38.9                                        | 18.5                | 18.5                 | 15.5                   | 8.7                             |
| Specific activity |                     |                                             |                     |                      |                        |                                 |
| Hunters           | 95                  | 55.8                                        | 18.9                | 10.5                 | 10.5                   | 4.2                             |
| Anglers           | 28                  | 25.0                                        | 14.3                | 14.3                 | 32.1                   | 14.3                            |
| Campers           | 7                   | 0                                           | 28.6                | 28.6                 | 42.9                   | 0                               |
| Floaters          | 9                   | 66.7                                        | 22.2                | 11.1                 | 0                      | 0                               |
| Rafters           | 25                  | 60.0                                        | 0                   | 8.0                  | 24.0                   | 8.0                             |
| Kayakers          | 22                  | 50.0                                        | 13.6                | 9.1                  | 9.1                    | 18.2                            |
| Canoers           | 9                   | 0                                           | 11.1                | 22.2                 | 11/1                   | 55.6                            |
| Boaters           | 66                  | 15.2                                        | 24.2                | 19.7                 | 21.2                   | 19.7                            |
| Bikers            | 10                  | 60.0                                        | 10.0                | 0                    | 20.0                   | 10.0                            |
| Hikers            | 30                  | 50.0                                        | 26.7                | 16.7                 | 6.7                    | 0                               |

## Discussion

The single-item 9-point scale has been useful for academic and applied research, and has been used by researchers, in multiple countries, and for different activities and types of resources. It works well in on-site studies, in which only a limited number of questions can be asked, and can also be used on mailed surveys sent to participants after their visit. However, the type of methodology appears to

have an effect on reported level of crowding so investigators should be aware of this difference. This finding is inconsistent with the findings of Shelby et al. (1989), but may have been influenced by sample size for our analysis. More research on on-site vs. mailed surveys for crowding would facilitate understanding the cause of the differences, and their extent.

The single- item crowding measure is easy to interpret and compare across studies or contexts. On the basis of available data and published results, we were able to make the comparisons described above. The simplicity of the item leads investigators to report the data in ways that can be compared easily. Because of the utility of this measure, we encourage continued use of the 9-point scale; it takes little space and is easy for respondents to fill out. Investigators should resist the temptation to modify the response scale; in a number of studies it was changed to seven, five, or four points, and as a result the findings could not be compared here.

The 9-point single item crowding measure has been used in 170 different studies involving 601 evaluation contexts. This frequency of application permits comparisons within and between recreation activities and settings that is typically not possible with most psychological constructs examined in recreation research. The previous analysis of the measure (Shelby et al., 1989) described recreationists' perceptions of crowding in different evaluation contexts and suggested a strategy for using the crowding variable when establishing management standards. The current analysis attempted to extend this descriptive exploration of the data and address issues raised by the earlier summary.

This study explored four alternatives to reporting crowding: (a) collapsing the scale on scale points 3 through 9, the traditional approach, (b) collapsing the scale on points 5 through 9, (c) mean of the 9-point crowding scale, and (d) median of the 9-point crowding scale. Given that the four different methods for reporting

perceived crowding were highly correlated, researchers and managers should use whichever method is most appropriate for their needs.

Collapsing the scale at points 3 through 9 is conceptually intuitive (not at all crowded versus some degree of crowding) and has been the traditional format for summarizing the variable (Heberlein & Vaske, 1977; Shelby & Heberlein, 1986; Shelby et al., 1989). The disadvantage is that because the crowding scale is collapsed at scale points 3 to 9, this method cannot distinguish between groups that are reporting slight levels of crowding versus groups reporting higher levels of crowding. Collapsing the scale at points 5 through 9 is more sensitive to this type of problem and does have some empirical support for using this breakpoint (e.g., Vaske & Donnelly, 1997). The disadvantage with this method is that it cannot distinguish between groups that feel only slightly crowded versus no levels of crowding. The mean and medians of the crowding scale avoids the issue of selecting a breakpoint by computing the average of the distribution. Since all four measures are easy to compute and interpret, all four should probably be presented when summarizing the scale. Alternatively, a percent breakdown of the scale should be presented to allow comparative analysis researchers to later compute these measures.

The choice of one measure over another should be based on the management objectives. When managing for low density resources (e.g., wilderness) where a few encounters may disrupt the experience, reporting the collapsed points 3 through 9 is more sensitive to crowding and may be the most appropriate. For higher density settings, either or both collapsing points 5 through 9 or 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 method.

The comparative data showed that six factors affected the level of perceived crowding: survey mode, year, region of United States, country, general resource (river and wild and scenic river), and specific activity for both collapsing the scale at 3-9, and the mean of the crowding 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.

Two factors affected the level of perceived crowding only for one method: specific location for the collapsed scale at 3-9 and general resource (lake and river) for the mean of the crowding scale. Although it is possible that the different methods of reporting the scale affect these two factors, a larger sample size for contexts at types of locations and resources may also be useful.

Two of the aggregate variables examined here had no effect on perceived crowding. Interestingly, public land designations (national monument, national park, and national forest) showed no difference. It is logical that for these types of locations where individuals can typically seek out a desired experience within the expanse of the resource, perceived crowding would be similar. Also as hypothesized consumptive vs. nonconsumptive had no effect on perceived crowding. It is noteworthy that this finding was consistent with the findings of the Shelby et al. (1989) comparative analysis. However, previous research (Vaske et al., 1982) showed 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.

Adapting the crowding measure to carrying capacity assessments as presented by Shelby et al. (1989) is particularly helpful in advising managers about

potential carrying capacity problems (Table 4.8). By themselves, crowding data from a single study are not particularly useful; with no other studies with which to compare the present one, it is difficult to determine how crowded is too crowded (Shelby & Heberlein, 1986). The broader perspective offered by multiple studies or contexts makes this measure useful for comparing areas and making rough determinations about carrying capacity issues. It is important to note that the authors of the Shelby et al. (1989) study had intimate knowledge of the individual studies included in the comparative analysis. Seventeen years later, the number of crowding studies and the number of researchers has greatly increased, which prevents quantitative syntheses where the knowledge of the studies is as thorough. As a result, the original categories shown in Table 4.8 are the best method that is currently available to assess carrying capacity judgments based on levels of perceived crowding. More research is necessary to determine how well these carrying capacity judgments predict carrying capacity problems.

The crowding measure alone is not a perfect substitute for the information about use levels, impacts, and evaluative standards that a more complete carrying capacity study can provide. Nevertheless, the single crowding item is simple, fast, and inexpensive, which thereby allows researchers to easily gain insight about a potential study site. For the Shelby et al. (1989) analysis the investigators were personally familiar with the 35 studies and 59 contexts, which led them to trust the judgments expressed in Table 4.8. With 170 studies and 601 contexts, this type of familiarity is no longer possible. In our judgment, until future research shows that the standards need to be changed, the standards proposed by Shelby et al. (1989) are appropriate to apply for the purposes of the data presented here. Tables 4.9 through 4.12 expanded on the research presented by Shelby et al. (1989), to demonstrate a broad perspective of carrying capacity judgments for region, country, general

resource, specific location within a resource, general activity, and specific activity. These results can be compared to site/study specific information.

In conclusion, comparisons of aggregate data from 170 studies shows that a 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 levels but does not vary with consumptive or nonconsumptive recreation activities or general resource (national park, national forest, and national monument). It provides useful comparative data that allow managers to understand better the carrying capacity challenges that face them and give investigators an idea about what kinds of studies would be most useful. We urge other investigators to use this scale in other studies and to report results in a comparable form so that the database can be expanded.

## CHAPTER V. CONCLUSION

This dissertation extended the application of quantitative literature reviews to human dimensions of natural resources by: (a) exploring the similarities and differences between comparative analysis and meta-analysis as practical significance tools, and (b) illustrating the potential for meta-analysis in outdoor crowding research. The two preceding chapters extended perceived crowding literature by (a) reporting preliminary meta-analytic findings and (b) updating the Shelby et al. (1989) comparative analysis.

By reviewing the controversial issue of: “What is meta-analysis?” identifying the strengths and weaknesses of meta-analysis, and explaining the basic steps of meta-analysis, chapter 2 provided human dimensions researchers with a straightforward introduction to meta-analysis as it is applicable to the field. Meta-analysis provides a rigorous methodology for quantitative research synthesis and has the potential for making practical significance determinations. The disadvantages associated with the error and biases that result from quantitatively mixing studies in a meta-analysis can be challenging. Careful research, planning, and interpretation can assist the researcher in overcoming these weaknesses. Meta-analysis may appear to be an overly structured process but each step allows for researchers to use their personal judgment and expertise. As a result, researchers can consider practical significance not only as a result of the meta-analysis but also as an integral part of the process. It is important to note that traditional meta-analysis methods are common in the education, medical, and psychological literature. Conducting a quantitative synthesis and calling it a meta-analysis when not following the strict rules associated with commonly used and traditional meta-analysis methodology (e.g., a summary effect size statistic) can decrease

the credibility of the work, especially when the methodology followed is not clearly explained and defended.

Comparative analysis is a less formal type of quantitative research synthesis than traditional meta-analysis that allows more flexibility for researchers. As discussed in Chapter 2 broader meta-analysis definitions include most comparative analyses. Both methods can benefit from each other. Meta-analysis research offers bias and correction formulas, and rules for exclusion of studies leading to bias, whereas comparative analysis offers flexibility in statistical methods and unit of analysis. Comparative analysis, however, assumes that researchers have access to the original datasets, whereas meta-analysis allows research to move forward based only on published findings.

The analysis step in formal meta-analysis can be particularly challenging. Chapter 3 provided a further review of the methodological findings in addition to using the 9-point crowding variable as an illustration. For the illustration, all evaluation contexts ( $n = 319$ ), the hunter subgroup ( $n = 32$ ), and the angler subgroup ( $n = 17$ ) resulted in a statistically significant  $Q$ . In other words, for all evaluation contexts and the two subgroups there may still be variables producing excess variability in the effect sizes that need to be considered in future research. Unfortunately, the sample sizes for the two subgroups are too low to continue this analysis at this time.

Approximately 30 years has passed since Heberlein and Vaske (1977) developed the 9-point single-item crowding measure. To date, the question has been asked to over 80,479 individuals. The Shelby et al (1989) comparative analysis indicated that crowding varied across time (peak periods), resource availability, accessibility and convenience, and management strategy. Their findings were based on 35 studies and 59 different settings and activities. A database of 187 studies and 627 different settings and activities

was developed for this dissertation, which represents an extensive search for all unpublished and published crowding studies. Across all evaluation contexts where the 9-point crowding scale was implemented ( $n = 601$ ), the expanded dataset led to six factors that affect the level of perceived crowding: survey mode, year, region of U.S., country, general resource (river and wild and scenic river), and specific activities (Chapter 4).

Two variables were measured in the Shelby et al (1989) comparative analysis that did not show significant results: survey mode and region of the United States. These variables were also included in the chapter 4 comparative analysis; however, this time they both showed significant results. The result for region of the United States is consistent with the speculation from Shelby et al (1989) that a small sample size may have been the issue. For the differences between survey modes, the increase in sample size likely allowed for the difference between on-site and mailed surveys to be found.

Chapter 4 also explored four alternatives to reporting the crowding scale: (a) collapsing the scale on scale points 3 through 9, the traditional approach, (b) collapsing the scale on points 5 through 9, (c) mean of the 9-point crowding scale, and (d) median of the 9-point crowding scale. The four different methods for reporting perceived crowding were highly correlated. As a result, researchers and managers should use whichever method is most appropriate for their needs. Since all four measures are easy to compute and interpret, all four should probably be presented when summarizing the scale to allow for future comparative and meta-analysis research.

Overall, this dissertation (a) put quantitative research techniques in the context of practical significance, (b) described meta-analysis and comparative analysis as quantitative research techniques, (c) explored the similarities and differences between comparative analysis and meta-analysis, (d) examined the potential for meta-analysis in

the field of human dimensions of natural resources, (e) reported preliminary meta-analytic findings for the 9-point crowding variable, and (f) updated the Shelby et al. (1989) comparative analysis. Researchers are encouraged to (a) further explore the use of meta-analysis and comparative analysis in the human dimensions of natural resources field, and (b) continue the use of the 9-point crowding scale to allow for further explorations by quantitative synthesis techniques.

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## APPENDIX A. ADDITIONAL META-ANALYSIS TABLE

Table A1. Summary of all contexts included in meta-analysis on perceived crowding

| Citation                                         | Study site                                       | Evaluation context                                  |                                              | n   | $ES_p$ | $SE_p$ | $w_p$   |
|--------------------------------------------------|--------------------------------------------------|-----------------------------------------------------|----------------------------------------------|-----|--------|--------|---------|
|                                                  |                                                  | Evaluation by                                       | Evaluation for                               |     |        |        |         |
| Manning, Valliere, & Jacobi (1997)               | Acadia Carriage Roads - 1995                     | Visitors (bikers, hikers, horse riders)             | Other users                                  | 514 | .32    | .02    | 2362.13 |
| Manning (2004a)                                  | Acadia National Park - 2004                      | Wildwood Stables horseback riders & carriage riders | Other riders                                 | 107 | .14    | .03    | 888.70  |
|                                                  |                                                  | Sieur de Monts visitors                             | Other visitors                               | 116 | .30    | .04    | 552.38  |
|                                                  |                                                  | Bass Harbor Head Light Visitors                     | Other visitors                               | 134 | .32    | .04    | 615.81  |
|                                                  |                                                  | Sand Beach visitors                                 | Other visitors                               | 121 | .40    | .04    | 504.17  |
|                                                  |                                                  | Ocean Drive - Fabbri Picnic area visitors           | Other visitors (road experience)             | 118 | .41    | .05    | 487.80  |
|                                                  |                                                  | Hiking trails combined                              | Other hikers                                 | 249 | .43    | .03    | 1015.91 |
|                                                  |                                                  | Jordan Pond House Visitors                          | Other visitors                               | 109 | .54    | .05    | 438.81  |
|                                                  |                                                  | Echo Lake Beach Visitors                            | Other visitors                               | 110 | .56    | .05    | 446.43  |
|                                                  |                                                  | Precipice trail hikers                              | Other hikers                                 | 110 | .61    | .05    | 462.38  |
|                                                  |                                                  | Cadillac Mountain Visitors                          | Other visitors                               | 126 | .63    | .04    | 540.54  |
|                                                  |                                                  | Ocean Drive - Otter Cliffs visitors                 | Other visitors (road experience)             | 122 | .63    | .04    | 523.38  |
|                                                  |                                                  | Thunder Hole visitors                               | Other visitors                               | 150 | .74    | .04    | 779.63  |
| Manning (2001a)                                  | Acadia National Park - Isle au Haut - 2001       | Visitors                                            | Other visitors - on park lands               | 228 | .13    | .02    | 2015.92 |
| Manning (2002a)                                  | Acadia National Park - Isle au Haut - 2002       | Visitors                                            | Other visitors - on the trails               | 341 | .17    | .02    | 2416.73 |
|                                                  |                                                  | Visitors                                            | Other visitors - overall on Isle au Haut     | 341 | .23    | .02    | 1925.47 |
| Bacon, Manning, Lawson, Valiere, & Lauer (2003)  | Acadia National Park - Schoodic Peninsula - 2000 | Visitors                                            | Other visitors - at the Schoodic Peninsula   | 583 | .36    | .02    | 2530.38 |
| Manning, Wang, Valliere, Lawson, & Newman (2002) | Alcatraz Island - 1998                           | Visitors                                            | Other visitors - walking roads and trails    | 865 | .43    | .02    | 3529.17 |
|                                                  |                                                  | Visitors                                            | Other visitors - in the theater/exhibit area | 865 | .56    | .02    | 3510.55 |
|                                                  |                                                  | Visitors                                            | Other visitors - bookstores & giftshops      | 865 | .57    | .02    | 3529.17 |

Table A1. Summary of all contexts included in meta-analysis on perceived crowding (*continued*)

| Citation                                     | Study site                                | Evaluation context                  |                                              | n    | $ES_p$ | $SE_p$ | $w_p$    |
|----------------------------------------------|-------------------------------------------|-------------------------------------|----------------------------------------------|------|--------|--------|----------|
|                                              |                                           | Evaluation by                       | Evaluation for                               |      |        |        |          |
| Manning et al. (2002)                        | Alcatraz Island - 1998                    | Visitors                            | Other visitors - on the ferry                | 865  | .63    | .02    | 3710.85  |
|                                              |                                           | Visitors                            | Other visitors - Overall                     | 865  | .68    | .02    | 3975.18  |
|                                              |                                           | Visitors                            | Other visitors - in the prison cell house    | 865  | .76    | .01    | 4742.32  |
| Manning (2005)                               | Alcatraz Island - 2005                    | Visitors                            | Other visitors - walking on roads & trails   | 288  | .64    | .03    | 1250.00  |
|                                              |                                           | Visitors                            | Other visitors - bookstore & giftshop        | 288  | .78    | .02    | 1678.32  |
|                                              |                                           | Visitors                            | Other visitors - in the theater/exhibit area | 288  | .83    | .02    | 2041.11  |
|                                              |                                           | Visitors                            | Other visitors - on the ferry                | 288  | .84    | .02    | 2142.86  |
|                                              |                                           | Visitors                            | Other visitors - Overall                     | 288  | .85    | .02    | 2258.82  |
|                                              |                                           | Visitors                            | Other visitors - in the prison cell house    | 288  | .92    | .02    | 3913.04  |
|                                              |                                           | Visitors                            | Other visitors - in the prison cell house    | 288  | .92    | .02    | 3913.04  |
| Whittaker (1989a)                            | Alexander Creek                           | All users                           | Entire River                                 | 45   | .78    | .06    | 262.24   |
| Heberlein & Alfano (1983)                    | Apostle Islands National Lakeshore (1981) | Boaters                             | All Users                                    | 323  | .59    | .03    | 1335.26  |
| Newman, Manning, Bacon Graefe, & Kyle (2003) | Appalachian National Scenic Trail         | Non-Thru hiker                      | Other hikers                                 | 1290 | .47    | .02    | 5178.64  |
| Fix (1996)                                   | Arches National Park - Moab               | Thru hiker                          | Other hikers                                 | 233  | .55    | .03    | 941.41   |
|                                              |                                           | Mountain Bikers at Campground       | Other visitors                               | 194  | .73    | .03    | 984.27   |
|                                              |                                           | Mountain Bikers on Slick Rock Trail | Other visitors                               | 298  | .85    | .02    | 2337.25  |
| Vaske & Donnelly (2002)                      | Athabasca-Sunwapta Rivers                 | White water rafters                 | Evaluations of Kayakers at the Put-In        | 188  | .01    | .01    | 18989.90 |
|                                              |                                           | White water rafters                 | Evaluations of Kayakers on the River         | 188  | .01    | .01    | 18989.90 |
|                                              |                                           | White water rafters                 | Evaluations of Kayakers at the Take-Out      | 188  | .01    | .01    | 18989.90 |

Table A1. Summary of all contexts included in meta-analysis on perceived crowding (*continued*)

| Citation                                 | Study site                           | Evaluation context       |                                         | n   | $ES_p$ | $SE_p$ | $w_p$    |
|------------------------------------------|--------------------------------------|--------------------------|-----------------------------------------|-----|--------|--------|----------|
|                                          |                                      | Evaluation by            | Evaluation for                          |     |        |        |          |
| Vaske & Donnelly (2002)                  | Athabasca-Sunwapta Rivers            | Float trip visitors      | Evaluations of Kayakers on the River    | 181 | .01    | .01    | 18282.83 |
|                                          |                                      | Float trip visitors      | Evaluations of Rafters on the River     | 181 | .02    | .01    | 9234.69  |
|                                          |                                      | Float trip visitors      | Evaluations of Rafters at the Put-In    | 181 | .02    | .01    | 9234.69  |
|                                          |                                      | Float trip visitors      | Evaluations of Rafters at the Take-Out  | 181 | .02    | .01    | 9234.69  |
|                                          |                                      | Float trip visitors      | Evaluations of Kayakers at the Take-Out | 181 | .02    | .01    | 9234.69  |
|                                          |                                      | Float trip visitors      | Evaluations of Kayakers at the Put-In   | 181 | .02    | .01    | 9234.69  |
|                                          |                                      | White water rafters      | Evaluations of Rafters at the Take-Out  | 188 | .04    | .01    | 4895.83  |
|                                          |                                      | White water rafters      | Evaluations of Rafter on the River      | 188 | .07    | .02    | 2887.86  |
|                                          |                                      | White water rafters      | Evaluations of Rafters at the Put-In    | 188 | .09    | .02    | 2295.48  |
| Vaske & Donnelly (1993a)                 | Banff National Park                  | Tourists                 | Other Tourist                           | 501 | .40    | .02    | 2087.50  |
| Graefe (1989)                            | Berlin Lake                          | Boaters                  | Start of Trip                           | 706 | .55    | .02    | 2852.53  |
|                                          |                                      | Boaters                  | End of Trip                             | 704 | .69    | .02    | 3291.26  |
|                                          |                                      | Boaters                  | On Lake                                 | 727 | .90    | .01    | 8077.78  |
|                                          |                                      | Boaters                  | Rest of Season                          | 727 | .90    | .01    | 8077.78  |
| Heberlein et al. (1980)                  | Bong Wildlife Management Unit (1979) | Pheasant Hunters         | Rest of Season                          | 169 | .48    | .04    | 677.08   |
| Heberlein (1981)                         | Bong Wildlife Management Unit (1981) | Pheasant Hunters         | Opening Day                             | 755 | .89    | .01    | 7711.95  |
|                                          |                                      | Pheasant Hunters         | Rest of Season                          | 325 | .68    | .03    | 1493.57  |
|                                          |                                      | Pheasant Hunter          | Opening Day                             | 418 | .75    | .02    | 2229.33  |
| Budruk, Manning, Valliere, & Wang (2002) | Boston Harbor Islands                | Little Brewster Visitors | Other visitors to Little Brewster       | 60  | .12    | .04    | 568.18   |

Table A1. Summary of all contexts included in meta-analysis on perceived crowding (*continued*)

| Citation                    | Study site                      | Evaluation context   |                                              | n    | $ES_p$ | $SE_p$ | $w_p$    |
|-----------------------------|---------------------------------|----------------------|----------------------------------------------|------|--------|--------|----------|
|                             |                                 | Evaluation by        | Evaluation for                               |      |        |        |          |
| Budruk et al.(2002)         | Boston Harbor Islands           | World's End Visitors | Other visitors to World's End                | 99   | .23    | .04    | 559.01   |
|                             |                                 | Hingham Visitors     | Other visitors to Hingham                    | 90   | .26    | .05    | 467.78   |
|                             |                                 | Long Wharf Visitors  | Other visitors to Long Wharf                 | 402  | .34    | .02    | 1791.44  |
| Whittaker (1997)            | Brooks River                    | September visitors   | Other visitors                               | 80   | .94    | .03    | 1418.44  |
| Heberlein & Vaske (1977)    | Brule River (1975)              | Tubers               |                                              | 483  | .43    | .02    | 1970.62  |
|                             |                                 | Anglers              |                                              | 170  | .52    | .04    | 681.09   |
|                             |                                 | Canoers              | Higher Use                                   | 2239 | .52    | .01    | 8970.35  |
| Heberlein & Proudman (1986) | Brule River (1985)              | Canoers              | Lower Use                                    | 1010 | .37    | .02    | 4332.90  |
| Adelman et al. (1982)       | BWCA                            | Canoers              | Moose Lake                                   | 196  | .73    | .03    | 994.42   |
| Vaske (1993)                | Cache la Poudre River - Anglers | Anglers              | Evaluations of Kayakers                      | 83   | .29    | .05    | 403.11   |
|                             |                                 | Anglers              | Evaluations of Rafters                       | 86   | .34    | .05    | 383.24   |
|                             |                                 | Anglers              | Evaluations of Other Anglers                 | 87   | .40    | .05    | 362.50   |
| Vaske & Donnelly (199b)     | Cache la Poudre River - Boaters | Rafters              | Evaluations of Kayakers at the Take-Out      | 704  | .04    | .01    | 18333.33 |
|                             |                                 | Rafters              | Evaluations of Kayakers at the Put-In        | 713  | .06    | .01    | 12641.84 |
|                             |                                 | Rafters              | Evaluations of Kayakers on the River         | 711  | .07    | .01    | 10921.66 |
|                             |                                 | Kayakers             | Evaluations of Other Kayakers at the Put-In  | 258  | .07    | .02    | 3963.13  |
|                             |                                 | Kayakers             | Evaluation of Other Kayakers at the Take-Out | 256  | .09    | .02    | 3125.76  |
|                             |                                 | Rafters              | Evaluations of Other Rafters on the River    | 752  | .13    | .01    | 6648.98  |
|                             |                                 |                      |                                              |      |        |        |          |

Table A1. Summary of all contexts included in meta-analysis on perceived crowding (*continued*)

| Citation                                   | Study site                                         | Evaluation context          |                                              | n   | $ES_p$ | $SE_p$ | $w_p$   |
|--------------------------------------------|----------------------------------------------------|-----------------------------|----------------------------------------------|-----|--------|--------|---------|
|                                            |                                                    | Evaluation by               | Evaluation for                               |     |        |        |         |
| Vaske & Donnelly (1993b)                   | Cache la Poudre River - Boaters                    | Rafters                     | Evaluations of Other Rafters at the Take-Out | 732 | .13    | .01    | 6472.15 |
|                                            |                                                    | Kayakers                    | Evaluations of Other Kayakers on the River   | 258 | .14    | .02    | 2142.86 |
|                                            |                                                    | Kayakers                    | Evaluations of Rafters at the Take-Out       | 253 | .21    | .03    | 1525.02 |
|                                            |                                                    | Rafters                     | Evaluations of Other Rafters at the Put-In   | 259 | .22    | .03    | 1509.32 |
|                                            |                                                    | Kayakers                    | Evaluations of Rafters at the Put-In         | 257 | .32    | .03    | 1181.07 |
|                                            |                                                    | Kayakers                    | Evaluations of Rafters on the River          | 259 | .38    | .03    | 1099.32 |
| Kuentzel (2005)                            | Cape Cod                                           | Hunters - Field sample      | Other hunters                                | 97  | .01    | .01    | 9797.98 |
| Donnelly & Vaske (1998)                    | Colorado Reservoirs                                | Anglers                     | Crystall Reservoir                           | 76  | .18    | .04    | 514.91  |
|                                            |                                                    | Anglers                     | South Catamount Reservoir                    | 139 | .35    | .04    | 610.99  |
|                                            |                                                    | Anglers                     | North Catamount Reservoir                    | 161 | .39    | .04    | 676.75  |
| Hall & Shelby (2000)                       | Colorado River - Grand Canyon National Park (1998) | Commercial Motor Boaters    | All Boaters                                  | 453 | .42    | .03    | 1859.61 |
|                                            |                                                    | Commercial Oar Boaters      | All Boaters                                  | 439 | .54    | .03    | 1767.31 |
|                                            |                                                    | Private Boaters             | All Boaters                                  | 124 | .85    | .03    | 972.55  |
| Vaske, Donnelly, Doctor, & Petruzzi (1994) | Columbia Icefield (1993)                           | Tourist- Snocoach Tour      | Snocoach Road                                | 501 | .30    | .02    | 2385.71 |
|                                            |                                                    | Tourist- Toe of the Glacier | Glacier                                      | 409 | .40    | .02    | 1704.17 |
|                                            |                                                    | Tourist-Snocoach Tour       | Glacier                                      | 501 | .48    | .02    | 2007.21 |

Table A1. Summary of all contexts included in meta-analysis on perceived crowding (*continued*)

| Citation                                        | Study site                   | Evaluation context          |                                 | n    | $ES_p$ | $SE_p$ | $w_p$   |
|-------------------------------------------------|------------------------------|-----------------------------|---------------------------------|------|--------|--------|---------|
|                                                 |                              | Evaluation by               | Evaluation for                  |      |        |        |         |
| Vaske et al (1994)                              | Columbia Icefield (1993)     | Tourist- Toe of the Glacier | Snocoach Road                   | 409  | .48    | .02    | 1638.62 |
|                                                 |                              | Tourist-Snocoach Tour       | Number of Snocoaches at Glacier | 501  | .48    | .02    | 2007.21 |
|                                                 |                              | Tourist- Toe of the Glacier | Visitor Facilities              | 409  | .68    | .02    | 1879.60 |
|                                                 |                              | Tourists – Snocoach Tour    | Other Visitors                  | 501  | .79    | .01    | 3019.89 |
| Vaske & Donnelly (1997)                         | Columbia Icefield (1996)     | Tourist- Toe of the Glacier | Glacier                         | 1382 | .31    | .01    | 6460.96 |
|                                                 |                              | Tourists – Snocoach Tour    | At the Snocoach Transfer Area   | 511  | .51    | .02    | 2044.82 |
|                                                 |                              | Tourist- Toe of the Glacier | Hall                            | 1382 | .55    | .01    | 5583.84 |
|                                                 |                              | Tourist- Snocoach Tour      | Glacier                         | 511  | .55    | .02    | 2064.65 |
|                                                 |                              | Tourist- Snocoach Tour      | Hall                            | 511  | .65    | .02    | 2246.15 |
|                                                 |                              | Tourist- Snocoach Tour      | Visitor Facilities              | 511  | .67    | .02    | 2311.17 |
|                                                 |                              | Tourists – Snocoach Tour    | Visitor Facilities              | 511  | .74    | .02    | 2655.93 |
| Vaske & Donnelly (1998)                         | Columbia Icefield (1997)     | Tourists – Snocoach Tour    | In the Glacier Gallery          | 1379 | .73    | .01    | 6996.45 |
|                                                 |                              | Tourists – Snocoach Tour    | Icefield Visitor Center         | 1337 | .83    | .01    | 9475.55 |
| Vaske & Donnelly (2001)                         | Columbia Icefield (2000)     | Tourists – Snocoach Tour    | While Walking on the Glacier    | 429  | .52    | .02    | 1718.75 |
|                                                 |                              | Tourists – Snocoach Tour    | At the Snocoach Transfer Area   | 432  | .58    | .02    | 1773.40 |
|                                                 |                              | Tourists – Snocoach Tour    | Icefield Exhibit Hall           | 390  | .74    | .02    | 2027.03 |
|                                                 |                              | Tourists – Snocoach Tour    | Icefield Visitor Center         | 425  | .80    | .02    | 2656.25 |
| Graefe (1993)                                   | Delaware Coastal Beaches     | Beach Users                 | On the Beach                    | 562  | .80    | .02    | 3512.50 |
| Falk, Graefe, Drogin, Confer, & Chandler (1992) | Delaware Inland Bay          | Boaters                     | On the Bay                      | 635  | .76    | .02    | 3481.36 |
| Whittaker (1989b)                               | Deshka River                 | All Users                   | Entire River                    | 258  | .51    | .03    | 1032.41 |
| Vaske et al. (1982)                             | Dolly Sods Wilderness        | Hikers in Wilderness        | Lower Use Period                | 149  | .31    | .04    | 696.59  |
| Whittaker (1996a)                               | Eagle River                  | Rafters                     | Other Rafters                   | 80   | .20    | .04    | 500.00  |
| Shelby, Goodwin, Brunson, & Anderson (n.d.)     | Enchantments National Forest | Backpackers in Wilderness   | Other Backpackers               | 345  | .56    | .03    | 1400.16 |
| Vaske, Fedler, & Graefe (1986)                  | Fishing Bay                  | Goose Hunters               | Firing Line                     | 230  | .61    | .03    | 966.79  |

Table A1. Summary of all contexts included in meta-analysis on perceived crowding (*continued*)

| Citation                                   | Study site                       | Evaluation context                                          |                                                       | n    | $ES_p$ | $SE_p$ | $w_p$   |
|--------------------------------------------|----------------------------------|-------------------------------------------------------------|-------------------------------------------------------|------|--------|--------|---------|
|                                            |                                  | Evaluation by                                               | Evaluation for                                        |      |        |        |         |
| Andereck & Becker (1993)                   | Fort Sumter National Monument    | Tourists                                                    | At the Fort                                           | 1637 | .44    | .01    | 6643.67 |
| Cottrell & Ritter (2005)                   | Fulufjallet National Park - 2005 | Tourists                                                    | On the Boat                                           | 1668 | .51    | .01    | 6674.67 |
|                                            |                                  | Hikers - Walking on Trail around Njupeskar Falls Area       | Evaluations of Other Hikers                           | 86   | .18    | .04    | 582.66  |
|                                            |                                  | Hikers - Overnight Cabins                                   | Evaluations of Other Hikers                           | 46   | .24    | .07    | 252.19  |
|                                            |                                  | Hikers - At Visitor's Center                                | Evaluations of Other Hikers                           | 86   | .28    | .05    | 426.59  |
|                                            |                                  | Hikers - Walking on Trail to and from Njupeskar Falls       | Evaluations of Other Hikers                           | 97   | .41    | .05    | 400.99  |
|                                            |                                  | Hikers - At Parking Lot                                     | Evaluations of Other Hikers                           | 102  | .53    | .05    | 409.47  |
| Kuentzel & Heberlein (1998)                | Grand River Marsh - Firing Line  | Firing Line                                                 | Other Goose Hunters                                   | 448  | .79    | .02    | 2700.42 |
| Kuentzel & Heberlein (1998)                | Grand River Marsh - Managed Hunt | Managed Hunt                                                | Other Goose Hunters                                   | 935  | .17    | .01    | 6626.51 |
| Donnelly (1980)                            | Great Gulf Wilderness            | Backpackers in Wilderness                                   | Lower Use Period                                      | 721  | .24    | .02    | 3952.85 |
| Knopf, Andereck, Virden, & Fletcher (2002) | Gunnison Gorge Natl Conserv Area | Gunnison Gorge Wilderness/Inner Canyon (river - wilderness) | Evaluations of all users                              | 129  | .47    | .04    | 517.86  |
| Manning (2003b)                            | Haleakala National Park - 2003   | Visitors at Red Hill Overlook                               | Other visitors - at visitor's center/observation area | 103  | .07    | .03    | 1582.18 |
|                                            |                                  | Visitors at Red Hill Overlook                               | Other visitors - overall                              | 103  | .09    | .03    | 1257.63 |
|                                            |                                  | Visitors at Visitor Center                                  | Other visitors - overall                              | 101  | .65    | .05    | 443.96  |
|                                            |                                  | Visitors at Visitor Center                                  | Other visitors - at visitor's center/observation area | 101  | .69    | .05    | 472.18  |
|                                            |                                  |                                                             |                                                       |      |        |        |         |
| Manning (2004b)                            | Haleakala National Park - 2004   | Visitors at Visitor Center                                  | Other visitors - at visitor's center/observation area | 147  | .30    | .04    | 700.00  |

Table A1. Summary of all contexts included in meta-analysis on perceived crowding (*continued*)

| Citation                               | Study site                                    | Evaluation context                       |                                                       | n   | $ES_p$ | $SE_p$ | $w_p$   |
|----------------------------------------|-----------------------------------------------|------------------------------------------|-------------------------------------------------------|-----|--------|--------|---------|
|                                        |                                               | Evaluation by                            | Evaluation for                                        |     |        |        |         |
| Manning (2004b)                        | Haleakala National Park - 2004                | Visitors at Visitor Center               | Other visitors - overall                              | 147 | .33    | .04    | 664.86  |
|                                        |                                               | Visitors at Red Hill Overlook            | Other visitors - at visitor's center/observation area | 141 | .35    | .04    | 619.78  |
|                                        |                                               | Visitors at Red Hill Overlook            | Other visitors - overall                              | 141 | .41    | .04    | 582.89  |
| Manning (2003b)                        | Haleakala National Park - Bicycle Tour Survey | Bicycle tourists                         | Other visitors - on the park roads                    | 201 | .32    | .03    | 923.71  |
|                                        |                                               | Bicycle tourists                         | Other visitors - overall                              | 201 | .41    | .03    | 830.92  |
|                                        |                                               | Bicycle tourists                         | Other visitors - at the mountain summit               | 201 | .70    | .03    | 957.14  |
| Manning (2003b)                        | Haleakala National Park - Exit Survey         | Visitors - as exiting park               | Other visitors                                        | 300 | .28    | .03    | 1488.10 |
| Manning (2002b)                        | Hawaii Volcanoes National Park                | Visitors at Thurston Lava Tube           | Other visitors - at Thurston Lava Tube                | 244 | .21    | .03    | 1470.77 |
|                                        |                                               | Visitors at Thurston Lava Tube           | Other visitors - overall                              | 244 | .31    | .03    | 1140.72 |
|                                        |                                               | Visitors at End of Chain of Craters Road | Other visitors - overall                              | 89  | .36    | .05    | 386.28  |
|                                        |                                               | Visitors at Visitor Center               | Other visitors - overall                              | 136 | .37    | .04    | 583.44  |
|                                        |                                               | Visitors at Visitor Center               | Other visitors - at Visitor Center                    | 136 | .42    | .04    | 558.29  |
|                                        |                                               | Visitors at End of Chain of Craters Road | Other visitors - at end of chain of craters road      | 89  | .48    | .05    | 356.57  |
| Shelby & Heberlein (1986)              | Horicon Grand River Marsh - Firing Line       | Goose Hunters                            | Firing Line                                           | 445 | .86    | .02    | 3696.01 |
|                                        | Horicon Grand River Marsh - Managed Hunt      | Goose Hunters                            | Managed Hunt                                          | 913 | .17    | .01    | 6470.59 |
| Vaske, Donnelly, Doctor, et al. (1994) | Jasper National Park                          | Tourist                                  | Other Tourist                                         | 470 | .35    | .02    | 2065.93 |

Table A1. Summary of all contexts included in meta-analysis on perceived crowding (*continued*)

| Citation                          | Study site                 | Evaluation context       |                                                | n   | $ES_p$ | $SE_p$ | $w_p$   |
|-----------------------------------|----------------------------|--------------------------|------------------------------------------------|-----|--------|--------|---------|
|                                   |                            | Evaluation by            | Evaluation for                                 |     |        |        |         |
| Carothers et al. (2001)           | Jefferson County           | Hikers                   | Other Hikers                                   | 210 | .09    | .02    | 2564.10 |
|                                   |                            | Bikers                   | Hikers                                         | 163 | .12    | .03    | 1543.56 |
|                                   |                            | Dual-Sport               | Hikers                                         | 400 | .12    | .02    | 3787.88 |
|                                   |                            | Bikers                   | Other Bikers                                   | 163 | .19    | .03    | 1059.13 |
|                                   |                            | Dual-Sport               | Bikers                                         | 400 | .22    | .02    | 2331.00 |
|                                   |                            | Hikers                   | Bikers                                         | 210 | .30    | .03    | 1000.00 |
| Trench & Wallace (1994)           | Joshua Tree National Park  | Rock Climbers            | Other Rock Climbers at Last Site               | 675 | .53    | .02    | 2709.76 |
| Sutton, Devlin, & Simmons (1993)  | Kapati Island              | First Time Visitors      | Other Visitors                                 | 226 | .29    | .03    | 1097.62 |
| Manning (2001b)                   | Kenai Fjords National Park | Repeat Visitors          | Other Visitors                                 | 41  | .46    | .08    | 165.06  |
|                                   |                            | Visitors to Exit Glacier | Other visitors along trail to Exit Glacier     | 359 | .23    | .02    | 2027.10 |
| Alaska Div. of Parks & Rec (1993) | Kenai River                | Salmon Anglers           | Middle Bank Anglers - Low Use Days             | 130 | .63    | .04    | 557.70  |
|                                   |                            | Salmon Anglers           | Lower Bank Anglers - Low Use Days              | 350 | .69    | .02    | 1636.28 |
|                                   |                            | Power Boaters            | Lower River Powerboat Anglers - Low Use Days   | 298 | .72    | .03    | 1478.17 |
|                                   |                            | Driftboat Anglers        | Upper River Driftboat Anglers - Low Use Days   | 65  | .74    | .05    | 337.84  |
|                                   |                            | Power Boaters            | Middle River Powerboat Anglers - High Use Days | 73  | .78    | .05    | 425.41  |
|                                   |                            | Salmon Anglers           | Upper Bank Anglers - Low Use Days              | 201 | .85    | .03    | 1576.47 |

Table A1. Summary of all contexts included in meta-analysis on perceived crowding (*continued*)

| Citation                             | Study site                      | Evaluation context   |                                   | n   | $ES_p$ | $SE_p$ | $w_p$   |
|--------------------------------------|---------------------------------|----------------------|-----------------------------------|-----|--------|--------|---------|
|                                      |                                 | Evaluation by        | Evaluation for                    |     |        |        |         |
| Alaska Div. of Parks & Rec (1993)    | Kenai River                     | Power Boaters        | Lower River Powerboat             | 131 | .92    | .02    | 1779.89 |
| Shelby & Stein (1984)                | Klamath River - Fall Anglers    | Salmon Anglers       | Anglers - High Use Days           | 50  | .70    | .07    | 238.10  |
|                                      | Klamath River - Summer Floaters | Floaters             | Summer Season Floaters            | 105 | .38    | .05    | 445.67  |
| Tolpelko (2005)                      | Koh Chang Marine National Park  | Snorkellers          | Other Snorkellers                 | 705 | .90    | .01    | 7833.33 |
| Whittaker (1989c)                    | Lake Creek                      | All Users            | Entire River                      | 64  | .78    | .05    | 372.96  |
| Institute of Environ. Studies (1986) | Lake Delavan - Recreationists   | Recreationists       | One Day Visit                     | 309 | .53    | .03    | 1240.47 |
| Graefe (1994a)                       | Lake Mead                       | Boaters              | Start of Trip                     | 718 | .32    | .02    | 3299.63 |
|                                      |                                 | Boaters              | On Lake                           | 718 | .33    | .02    | 3247.40 |
|                                      |                                 | Boaters              | Shoreline                         | 681 | .37    | .02    | 2921.49 |
|                                      |                                 | Boaters              | End of Trip                       | 466 | .37    | .02    | 1999.14 |
| Graefe (1994b)                       | Lake Mohave                     | Boaters              | Start of Trip                     | 400 | .45    | .02    | 1616.16 |
|                                      |                                 | Boaters              | End of Trip                       | 194 | .48    | .04    | 777.24  |
|                                      |                                 | Boaters              | Shoreline                         | 330 | .50    | .03    | 1320.00 |
|                                      |                                 | Boaters              | On Lake                           | 391 | .50    | .03    | 1564.00 |
| Graefe et al. (2005)                 | Lake Shasta - On-site           | Boaters              | On the lake                       | 469 | .45    | .02    | 1894.95 |
|                                      |                                 | Boaters              | At the put-in                     | 534 | .56    | .02    | 2167.21 |
|                                      |                                 | Boaters              | At stopping points or attractions | 520 | .63    | .02    | 2230.80 |
|                                      |                                 | Boaters              | At the take-out                   | 527 | .69    | .02    | 2463.77 |
| Carroll (2001)                       | Lake Sonoma                     | Recreational Boaters | All Users                         | 83  | .62    | .05    | 352.29  |
| Graefe et al. (2005)                 | Lake Trinity - On-site          | Boaters              | On the lake                       | 210 | .29    | .03    | 1019.91 |
|                                      |                                 | Boaters              | At the put-in                     | 228 | .38    | .03    | 967.74  |
|                                      |                                 | Boaters              | At stopping points or attractions | 193 | .47    | .04    | 774.79  |
|                                      |                                 | Boaters              | At the take-out                   | 229 | .52    | .03    | 917.47  |

Table A1. Summary of all contexts included in meta-analysis on perceived crowding (*continued*)

| Citation                                | Study site               | Evaluation context            |                                       | n   | $ES_p$ | $SE_p$ | $w_p$   |
|-----------------------------------------|--------------------------|-------------------------------|---------------------------------------|-----|--------|--------|---------|
|                                         |                          | Evaluation by                 | Evaluation for                        |     |        |        |         |
| Whittaker (1989d)                       | Little Susitna River     | All Users                     | Entire River                          | 203 | .79    | .03    | 1223.63 |
| Manning (2001c)                         | Mesa Verde National Park | Visitors at Sun Point         | Other visitors - at Sun Point         | 215 | .11    | .02    | 2196.12 |
|                                         |                          | Overlook                      | Overlook                              |     |        |        |         |
|                                         |                          | Visitors at Step House        | Other visitors - at Step House        | 153 | .13    | .03    | 1352.79 |
|                                         |                          | Visitors at Sun Point         | Other visitors - overall              | 215 | .48    | .03    | 861.38  |
|                                         |                          | Overlook                      |                                       |     |        |        |         |
|                                         |                          | Visitors at Cliff Palace      | Other visitors - overall              | 294 | .60    | .03    | 1225.00 |
|                                         |                          | Visitors at Step House        | Other visitors - overall              | 153 | .63    | .04    | 656.37  |
|                                         |                          | Visitors at Spruce Tree House | Other visitors - overall              | 301 | .64    | .03    | 1306.42 |
|                                         |                          | Visitors at Museum            | Other visitors - at Museum            | 345 | .66    | .03    | 1537.43 |
|                                         |                          | Visitors at Museum            | Other visitors - overall              | 345 | .67    | .03    | 1560.38 |
|                                         |                          | Visitors at Spruce Tree House | Other visitors - at Spruce Tree House | 301 | .67    | .03    | 1361.37 |
|                                         |                          | Visitors at Cliff Palace      | Other visitors - at Cliff Palace      | 294 | .76    | .03    | 1611.84 |
|                                         |                          |                               |                                       |     |        |        |         |
| Vaske, Donnelly, Wittmann et al. (1995) | Mt Evans                 | Tourists                      | Other Tourist                         | 402 | .61    | .03    | 1689.79 |
|                                         |                          | Tourists                      | Regional Survey                       | 200 | .70    | .03    | 952.38  |
|                                         |                          | Deer Hunter                   | Other Deer Hunters                    | 389 | .72    | .02    | 1929.56 |
| Vaske, Donnelly, & Puttkammer (1994)    | Mt Shasta                | Mountain Climbers             | At the Campground                     | 310 | .42    | .03    | 1272.58 |
|                                         |                          | Mountain Climbers             | At the Summit                         | 310 | .52    | .03    | 1241.99 |
|                                         |                          | Mountain Climbers             | During Climb                          | 310 | .68    | .03    | 1424.63 |
| Tarrant, Cordell, & Kibler (1997)       | Nantahala River - Mailed | Kayakers                      | At the Put-in – On-site Evaluations   | 184 | .60    | .04    | 766.67  |
|                                         |                          | Canoers                       | At the Put-In – On-site Evaluations   | 103 | .64    | .05    | 447.05  |
|                                         |                          | Rafters                       | At the Put-In – On-site Evaluations   | 337 | .66    | .03    | 1501.78 |

Table A1. Summary of all contexts included in meta-analysis on perceived crowding (*continued*)

| Citation                           | Study site                                 | Evaluation context                              |                                                | n    | $ES_p$ | $SE_p$ | $w_p$    |
|------------------------------------|--------------------------------------------|-------------------------------------------------|------------------------------------------------|------|--------|--------|----------|
|                                    |                                            | Evaluation by                                   | Evaluation for                                 |      |        |        |          |
| Tarrant et al. (1997)              | Nantahala River - Mailed                   | Rafters                                         | Approach to Final Rapids – On-site Evaluations | 337  | .70    | .03    | 1604.76  |
|                                    |                                            | Kayakers                                        | Approach to Final Rapids – On-site Evaluations | 184  | .73    | .03    | 933.54   |
|                                    |                                            | Rafters                                         | On the River – On-site Evaluations             | 337  | .80    | .02    | 2106.25  |
| Tarrant et al. (1997)              | Nantahala River - On-site                  | Kayakers                                        | On the River – On-site Evaluations             | 184  | .82    | .03    | 1246.61  |
|                                    |                                            | Canoers                                         | On the River – On-site Evaluations             | 104  | .83    | .04    | 737.07   |
|                                    |                                            | Canoers                                         | Approach to Final Rapids – On-site Evaluations | 104  | .84    | .04    | 773.81   |
| Higham (1994)                      | New Zealand's Conservation Estate - Higham | Tourists                                        | Other Tourists at South Island Walking Tracks  | 336  | .82    | .02    | 2276.42  |
| Randall (2000)                     | Pacific Rim National Park                  | Ocean kayakers                                  | On water with other boats                      | 375  | .39    | .03    | 1576.29  |
| Andereck et al. (2002)             | Phoenix North Public Lands                 | Ocean kayakers                                  | At campsite                                    | 375  | .80    | .02    | 2343.75  |
|                                    |                                            | Urban proximate BLM land north of Phoenix metro | Evaluations of all users                       | 234  | .39    | .03    | 983.61   |
| Graefe (1994c)                     | Presque Isle                               | Boaters                                         | Start of Trip                                  | 473  | .35    | .02    | 2079.12  |
|                                    |                                            | Boaters                                         | End of Trip                                    | 472  | .51    | .02    | 1888.76  |
|                                    |                                            | Boaters                                         | On Lake                                        | 462  | .64    | .02    | 2005.21  |
|                                    |                                            | Boaters                                         | At Channel                                     | 364  | .78    | .02    | 2121.21  |
| Heberlein et al (1980)             | Public Hunting Area                        | Pheasant Hunters                                | Opening Day                                    | 194  | .85    | .03    | 1521.57  |
| Shelby (1983)                      | Rakaia River                               | Salmon Anglers                                  | Upstream                                       | 67   | .45    | .06    | 270.71   |
|                                    |                                            | Salmon Anglers                                  | At River Mouth                                 | 68   | .74    | .05    | 353.43   |
| Graefe, Todd, Moore, & Lenz (1988) | Raystown Lake                              | Boaters                                         | Start of Trip                                  | 1145 | .63    | .01    | 4912.05  |
|                                    |                                            | Boaters                                         | End of Trip                                    | 1114 | .66    | .01    | 4964.35  |
|                                    |                                            | Boaters                                         | Stopping Places                                | 795  | .75    | .02    | 4240.00  |
|                                    |                                            | Boaters                                         | On Lake                                        | 1149 | .91    | .01    | 14029.30 |
| Vaske et al. (2002)                | Rocky Mountain National Park               | Hikers                                          | Longs Peak Hikers at the Trailhead             | 414  | .37    | .02    | 1776.06  |

Table A1. Summary of all contexts included in meta-analysis on perceived crowding (*continued*)

| Citation                    | Study site                               | Evaluation context                           |                                       | n   | $ES_p$ | $SE_p$ | $w_p$    |
|-----------------------------|------------------------------------------|----------------------------------------------|---------------------------------------|-----|--------|--------|----------|
|                             |                                          | Evaluation by                                | Evaluation for                        |     |        |        |          |
| Vaske et al. (2002)         | Rocky Mountain National Park             | Tourists                                     | Bear Lake – Glacier Basin Shuttle Lot | 226 | .55    | .03    | 913.13   |
|                             |                                          | Tourists                                     | Trail around Bear Lake                | 381 | .65    | .02    | 1674.73  |
|                             |                                          | Tourists                                     | Bear Lake – Area by Kiosk             | 544 | .66    | .02    | 2424.24  |
|                             |                                          | Tourists                                     | Trails near Bear Lake                 | 467 | .68    | .02    | 2146.14  |
|                             |                                          | Hikers                                       | Longs Peak Hikers on the Trail        | 419 | .69    | .02    | 1958.86  |
|                             |                                          | Hikers                                       | Longs Peak Hikers at the Summit       | 217 | .69    | .03    | 1014.49  |
|                             |                                          | Tourists                                     | Visitors at the Alpine Visitor Center | 606 | .74    | .02    | 3149.69  |
| Manning (2002c)             | Sagamore Hill National Historic Site     | Visitors                                     | Other visitors - The grounds          | 409 | .04    | .01    | 10651.04 |
|                             |                                          | Visitors                                     | Other visitors - Picnic area          | 409 | .04    | .01    | 10651.04 |
|                             |                                          | Visitors                                     | Other visitors - Visitor center       | 409 | .10    | .01    | 4544.44  |
|                             |                                          | Visitors                                     | Other visitors - Roosevelt home       | 409 | .35    | .02    | 1797.80  |
| Heberlein & Kuentzel (2002) | Sandhill Wildlife Management Unit - 1979 | Deer Hunters - Doe hunt (anterless) Day 1    | Other Deer Hunters                    | 148 | .20    | .03    | 925.00   |
|                             |                                          | Deer Hunters - Doe hunt (anterless) Day 2    | Other Deer Hunters                    | 137 | .35    | .04    | 602.20   |
| Heberlein & Kuentzel (2002) | Sandhill Wildlife Management Unit - 1980 | Deer Hunters - Doe hunt (anterless) Day 2 SE | Other Deer Hunters                    | 82  | .49    | .06    | 328.13   |
|                             |                                          | Deer Hunters - Doe hunt (anterless) Day 1 NW | Other Deer Hunters                    | 77  | .53    | .06    | 309.11   |
| Heberlein & Kuentzel (2002) | Sandhill Wildlife Management Unit - 1982 | Deer Hunters - Doe hunt (anterless) SE       | Other Deer Hunters                    | 41  | .22    | .06    | 238.93   |

Table A1. Summary of all contexts included in meta-analysis on perceived crowding (*continued*)

| Citation                    | Study site                               | Evaluation context                               |                                | n   | $ES_p$ | $SE_p$ | $w_p$    |
|-----------------------------|------------------------------------------|--------------------------------------------------|--------------------------------|-----|--------|--------|----------|
|                             |                                          | Evaluation by                                    | Evaluation for                 |     |        |        |          |
| Heberlein & Kuentzel (2002) | Sandhill Wildlife Management Unit - 1982 | Deer Hunters - Trophy buck hunt (Either sex) SE  | Other Deer Hunters             | 85  | .52    | .05    | 340.54   |
|                             |                                          | Deer Hunters - Doe hunt (anterless) NW           | Other Deer Hunters             | 84  | .74    | .05    | 436.59   |
| Heberlein & Kuentzel (2002) | Sandhill Wildlife Management Unit - 1983 | Deer Hunters - Trophy buck hunt (Either sex) NW  | Other Deer Hunters             | 81  | .62    | .05    | 343.80   |
| Heberlein & Kuentzel (2002) | Sandhill Wildlife Management Unit - 1984 | Deer Hunters - Doe hunt (anterless) SE           | Other Deer Hunters             | 52  | .35    | .07    | 228.57   |
|                             |                                          | Deer Hunters - Doe hunt (anterless) NW           | Other Deer Hunters             | 44  | .39    | .07    | 184.95   |
|                             |                                          | Deer Hunters - Doe hunt (anterless) NE           | Other Deer Hunters             | 48  | .52    | .07    | 192.31   |
|                             |                                          | Deer Hunters - Trophy buck hunt (Mixed) Day 2 SW | Other Deer Hunters             | 49  | .49    | .07    | 196.08   |
| Heberlein & Kuentzel (2002) | Sandhill Wildlife Management Unit - 1987 | Deer Hunters - Trophy buck hunt (Mixed) Day 2 SE | Other Deer Hunters             | 73  | .58    | .06    | 299.67   |
|                             |                                          | Deer Hunters - Trophy buck hunt (Mixed) Day 2 NW | Other Deer Hunters             | 69  | .68    | .06    | 317.10   |
|                             |                                          | Deer Hunters - Trophy buck hunt (Mixed) Day 2 NE | Other Deer Hunters             | 65  | .68    | .06    | 298.71   |
|                             |                                          | Deer Hunters - Trophy buck hunt (Mixed) Day 2 NW | Other Deer Hunters             | 81  | .59    | .05    | 334.85   |
| Heberlein & Kuentzel (2002) | Sandhill Wildlife Management Unit - 1988 | Deer Hunters - Trophy buck hunt (Mixed) Day 1 SE | Other Deer Hunters             | 75  | .67    | .05    | 339.21   |
|                             |                                          | Deer Hunters - Trophy buck hunt (Mixed) Day 2 SE | Other Deer Hunters             | 91  | .50    | .05    | 364.00   |
| Heberlein & Kuentzel (2002) | Sandhill Wildlife Management Unit - 1989 | Deer Hunters - Trophy buck hunt (Mixed) Day 1 NW | Other Deer Hunters             | 82  | .67    | .05    | 370.87   |
|                             |                                          | Visitors                                         | Other visitors - On trails     | 367 | .02    | .01    | 18724.49 |
| Manning (2001d)             | Saratoga National Historic Site          | Visitors                                         | Other visitors - On park roads | 367 | .03    | .01    | 12611.68 |

Table A1. Summary of all contexts included in meta-analysis on perceived crowding (*continued*)

| Citation                                   | Study site                                              | Evaluation context       |                                            | n   | $ES_p$ | $SE_p$ | $w_p$   |
|--------------------------------------------|---------------------------------------------------------|--------------------------|--------------------------------------------|-----|--------|--------|---------|
|                                            |                                                         | Evaluation by            | Evaluation for                             |     |        |        |         |
| Manning (2001d)                            | Saratoga National Historic Site                         | Visitors                 | Other visitors - At historic sites         | 367 | .04    | .01    | 9557.29 |
|                                            |                                                         | Visitors                 | Other visitors - at interpretive programs  | 367 | .06    | .01    | 6507.09 |
|                                            |                                                         | Visitors                 | Other visitors - At visitor facilities     | 367 | .13    | .02    | 3244.92 |
| Botkin (1985)                              | Seneca Rocks - Monongahela National Forest              | Rock Climbers            | Other Climbers                             | 416 | .68    | .02    | 1911.76 |
| Kuentzel (1995)                            | Shelburne Museum                                        | Day Visitors             | Other Visitors                             | 894 | .25    | .01    | 4768.00 |
| Randall (1977)                             | Stockings Park - Sleeping Bear Dunes National Lakeshore | Driving Tourists         | Other Tourist                              | 481 | .41    | .02    | 1988.42 |
| Whittaker (1989e)                          | Talachulitna River                                      | All Users                | Entire River                               | 104 | .64    | .05    | 451.39  |
| Whittaker (1989f)                          | Talkeetna River                                         | All Users                | Entire River                               | 54  | .81    | .05    | 350.88  |
| Vaske et al. (1984)                        | Tuckahoe State Park                                     | Goose Hunters            | Low Density Dispersed Hunt                 | 62  | .27    | .06    | 314.56  |
| Titre & Schuster (2002)                    | Upper Colorado River                                    | Boaters                  | Other Boaters                              | 201 | .57    | .03    | 820.07  |
| Graefe, Gitelson, Fedler, & Zeigler (1989) | Upper Youghiogheny River                                | Rafters                  | River Users                                | 617 | .35    | .02    | 2712.09 |
| Vaske (2003a)                              | Upper Youghiogheny River                                | Kayakers                 | River Users                                | 319 | .51    | .03    | 1276.51 |
|                                            | Vail & Wolf Creek Pass - Vail Pass - White River NF     | Vail Pass - motorized    | snowmobilers - trail                       | 106 | .13    | .03    | 937.22  |
|                                            |                                                         | Vail Pass - motorized    | skiers/snowshoers/snowboarders - trail     | 105 | .18    | .04    | 711.38  |
|                                            |                                                         | Vail Pass - nonmotorized | skiers/snowshoers/snowboarders - trail     | 97  | .28    | .05    | 481.15  |
|                                            |                                                         | Vail Pass - nonmotorized | skiers/snowshoers/snowboarders - trailhead | 98  | .29    | .05    | 475.96  |
|                                            |                                                         | Vail Pass - motorized    | snowmobilers - trailhead                   | 107 | .30    | .04    | 509.52  |

Table A1. Summary of all contexts included in meta-analysis on perceived crowding (*continued*)

| Citation      | Study site                                                        | Evaluation context             |                                            | n   | $ES_p$ | $SE_p$ | $w_p$   |
|---------------|-------------------------------------------------------------------|--------------------------------|--------------------------------------------|-----|--------|--------|---------|
|               |                                                                   | Evaluation by                  | Evaluation for                             |     |        |        |         |
| Vaske (2003a) | Vail & Wolf Creek Pass - Vail Pass - White River NF               | Vail Pass - motorized          | skiers/snowshoers/snowboarders - trailhead | 106 | .31    | .04    | 495.56  |
|               |                                                                   | Vail Pass - nonmotorized       | snowmobilers - trailhead                   | 95  | .57    | .05    | 387.60  |
|               |                                                                   | Vail Pass - nonmotorized       | snowmobilers - trail                       | 95  | .57    | .05    | 387.60  |
| Vaske (2003b) | Vail & Wolf Creek Pass - Wolf Creek Pass - San Juan/Rio Grande NF | Wolf Creek Pass - motorized    | skiers/snowshoers/snowboarders - trailhead | 76  | .08    | .03    | 1032.61 |
|               |                                                                   | Wolf Creek Pass - motorized    | snowmobilers - trail                       | 77  | .09    | .03    | 940.17  |
|               |                                                                   | Wolf Creek Pass - nonmotorized | skiers/snowshoers/snowboarders - trail     | 148 | .12    | .03    | 1401.52 |
|               |                                                                   | Wolf Creek Pass - motorized    | skiers/snowshoers/snowboarders - trail     | 74  | .12    | .04    | 700.76  |
|               |                                                                   | Wolf Creek Pass - motorized    | snowmobilers - trailhead                   | 77  | .13    | .04    | 680.81  |
|               |                                                                   | Wolf Creek Pass - nonmotorized | skiers/snowshoers/snowboarders - trailhead | 151 | .27    | .04    | 766.11  |
|               |                                                                   | Wolf Creek Pass - nonmotorized | snowmobilers - trail                       | 145 | .29    | .04    | 704.23  |
|               |                                                                   | Wolf Creek Pass - nonmotorized | snowmobilers - trailhead                   | 148 | .35    | .04    | 650.55  |
|               |                                                                   | Wolf Creek Pass - nonmotorized | snowmobilers - trailhead                   | 148 | .35    | .04    | 650.55  |
| Shelby(1983)  | Waimakariri River                                                 | Salmon Anglers                 | Other Salmon Anglers                       | 138 | .75    | .04    | 736.00  |

Table A1. Summary of all contexts included in meta-analysis on perceived crowding (*continued*)

| Citation                                     | Study site                    | Evaluation context                             |                                                      | n   | $ES_p$ | $SE_p$ | $w_p$   |
|----------------------------------------------|-------------------------------|------------------------------------------------|------------------------------------------------------|-----|--------|--------|---------|
|                                              |                               | Evaluation by                                  | Evaluation for                                       |     |        |        |         |
| Needham, Rollins, & Vaske (2005)             | Whistler Mountain             | Summer Visitors - Flute Summit / Musical Bumps | Other Summer Visitors - Flute Summit / Musical Bumps | 59  | .37    | .06    | 253.11  |
|                                              |                               | Summer Visitors - Mid-Mountain / Bike Park     | Other Summer Visitors - Mid-Mountain / Bike Park     | 126 | .43    | .04    | 514.08  |
|                                              |                               | Summer Visitors - Top of Gondola / Roundhouse  | Other Summer Visitors - Top of Gondola / Roundhouse  | 187 | .56    | .04    | 758.93  |
|                                              |                               | Summer Visitors - Russet Lake                  | Other Summer Visitors - Russet Lake                  | 57  | .56    | .07    | 231.33  |
|                                              |                               | Summer Visitors - Harmony Lakes                | Other Summer Visitors - Harmony Lakes                | 119 | .71    | .04    | 577.95  |
| Graefe, Vaske, Kuss, Pawelko, & Miles (1984) | White Mountain Natl Forrest   | Backpackers in Wilderness                      | Presidential Range                                   | 385 | .39    | .02    | 1618.33 |
| Shelby & Wing (1993)                         | White Salmon River            | Boaters                                        | Other Boaters                                        | 857 | .16    | .01    | 6376.49 |
| Alaska Division of Parks & Rec (1991)        | Willow Creek                  | Salmon Anglers                                 | Other Salmon Anglers                                 | 96  | .79    | .04    | 578.66  |
| Blackwood (1977)                             | Wolf River                    | Floaters                                       | Low Water                                            | 304 | .61    | .03    | 1277.85 |
| Manning (1998)                               | Yosemite National Park - 1998 | Visitors to Yosemite Falls                     | Other visitors - on the trail to Yosemite Falls      | 399 | .61    | .02    | 1677.18 |
|                                              |                               | Visitors to Yosemite Falls                     | Other visitors - at the base of Yosemite Falls       | 399 | .61    | .02    | 1677.18 |
|                                              |                               | Visitors to Yosemite Falls                     | Other visitors - Overall in Yosemite Valley          | 399 | .65    | .02    | 1753.85 |
|                                              |                               | Visitors to Vernal Falls                       | Other visitors - at Vernal Falls                     | 411 | .80    | .02    | 2568.75 |
|                                              |                               | Visitors to Vernal Falls                       | Other visitors - Overall in Yosemite Valley          | 411 | .80    | .02    | 2568.75 |
| Manning (1999)                               | Yosemite National Park - 1999 | Visitors to Mirror Lake                        | Other visitors - along this trail to Mirror Lake     | 318 | .28    | .03    | 1577.38 |
|                                              |                               | Visitors to Mirror Lake                        | Other visitors - Overall in Yosemite                 | 318 | .66    | .03    | 1417.11 |

Table A1. Summary of all contexts included in meta-analysis on perceived crowding (*continued*)

| Citation        | Study site                    | Evaluation context            |                                                  | n   | $ES_p$ | $SE_p$ | $w_p$   |
|-----------------|-------------------------------|-------------------------------|--------------------------------------------------|-----|--------|--------|---------|
|                 |                               | Evaluation by                 | Evaluation for                                   |     |        |        |         |
| Manning (1999)  | Yosemite National Park - 1999 | Visitors to Glacier Point     | Other visitors - at Glacier Point                | 323 | .69    | .03    | 1510.05 |
|                 |                               | Visitors to Glacier Point     | Other visitors - Overall in Yosemite             | 323 | .71    | .03    | 1568.72 |
|                 |                               | Visitors to Bridalveil Falls  | Other visitors - along this trail                | 301 | .76    | .02    | 1650.22 |
|                 |                               | Visitors to Bridalveil Falls  | Other visitors - at the base of Bridalveil Falls | 301 | .81    | .02    | 1955.82 |
|                 |                               | Visitors to Bridalveil Falls  | Other visitors - Overall in Yosemite             | 301 | .84    | .02    | 2239.58 |
| Newman (2002)   | Yosemite National Park - 2001 | Wilderness Remote Users       | Other users - along trails                       | 96  | .10    | .03    | 1066.67 |
|                 |                               | Wilderness Transition Users   | Other users - along trails                       | 251 | .23    | .03    | 1417.28 |
|                 |                               | Wilderness Remote Users       | Other users - along trails                       | 94  | .36    | .05    | 407.99  |
|                 |                               | Wilderness Transition Users   | Other users - along trails                       | 246 | .41    | .03    | 1016.95 |
|                 |                               | Frontcountry Users            | Other users - at campsites                       | 289 | .42    | .03    | 1186.37 |
| Manning (2003e) | Zion National Park - On-site  | Frontcountry Users            | Other users - along trails                       | 289 | .51    | .03    | 1156.46 |
|                 |                               | Weeping Rock Trail Users      | Other users - along this trail                   | 138 | .21    | .03    | 831.83  |
|                 |                               | Grotto Trail Day Users        | Other users - on the trail                       | 159 | .62    | .05    | 674.87  |
|                 |                               | Virgin River Narrow Day Users | Other users - in this area                       | 202 | .69    | .03    | 944.37  |

## APPENDIX B. ADDITIONAL COMPARATIVE ANALYSIS TABLES

Table B1. Description of studies conducted in the United States

| State  | Study site                 | Date | Population studied       | Citation                            | Study sample size | Response rate (%) | Survey mode |
|--------|----------------------------|------|--------------------------|-------------------------------------|-------------------|-------------------|-------------|
| Alaska | Alexander Creek            | 1989 | All users                | Whittaker (1989a)                   | 45                | 80                | On-site     |
|        | Brooks River               | 1993 | July visitors            | Whittaker (1997)                    | 80                |                   | On-site     |
|        | Deshka River               | 1989 | All Users                | Whittaker (1989b)                   | 258               | 73                | On-site     |
|        | Eagle River                | 1996 | Rafters                  | Whittaker (1996a)                   | 80                | 90                | On-site     |
|        | Goodnews River             | 1996 | All Users                | Whittaker (1996b)                   | 82                | 87                | Mailed      |
|        |                            | 2001 | All Users                | Whittaker (2001b)                   | 231               |                   | Mailed      |
|        | Gulkana River              | 1999 | All Users                | Whittaker, Vaske, & Williams (2000) | 305               | 58                | Mailed      |
|        | Kanektok River             | 1996 | All Users                | Whittaker (1996c)                   | 105               | 79                | Mailed      |
|        |                            | 2001 | All Users                | Whittaker (2001b)                   | 151               |                   | Mailed      |
|        | Kenai Fjords National Park | 2001 | Visitors to Exit Glacier | Manning (2001b)                     | 359               | 77                | On-site     |
|        |                            |      |                          |                                     |                   |                   |             |
|        | Kenai River                | 1993 | Salmon Anglers           | Alaska Div. of Parks & Rec (1993)   | 1,530             | 95                | On-site     |
|        |                            |      | Recreationists           |                                     |                   |                   |             |
|        |                            |      | Driftboat Anglers        |                                     |                   |                   |             |
|        |                            |      | Power Boaters            |                                     |                   |                   |             |
|        | Lake Creek                 | 1989 | All Users                | Whittaker (1989c)                   | 64                | 80                | On-site     |
|        | Little Susitna River       | 1989 | All Users                | Whittaker (1989d)                   | 203               | 89                | On-site     |

Table B1. Description of studies conducted in the United States (*continued*)

| State   | Study site                                   | Date | Population studied       | Citation                           | Study sample size | Response rate (%) | Survey mode |
|---------|----------------------------------------------|------|--------------------------|------------------------------------|-------------------|-------------------|-------------|
| Arizona | McNeil River                                 | 1998 | Standby Permittees       | Bright (1999)                      | 415               | 57                | Mailed      |
|         |                                              |      | Successful Permittees    |                                    |                   |                   |             |
|         | Mt McKinley - Denali National Park           | 1977 | Mountain Climbers        | Shelby & Yuskavitch (1977)         | 33                | 66                | On-site     |
|         |                                              | 1978 | Hikers                   | Womble (1981)                      | 2,829             | 79                | Mailed      |
|         | Nanticote River                              | 1996 | Boaters                  |                                    | 100               |                   |             |
|         | Talachulitna River                           | 1989 | All Users                | Whittaker (1989e)                  | 104               | 71                | On-site     |
|         | Talkeetna River                              | 1989 | All Users                | Whittaker (1989f)                  | 54                | 77                | On-site     |
|         | Togiak River                                 | 1996 | All Users                | Whittaker (1996d)                  | 39                | 58                | Mailed      |
|         |                                              | 2001 | All Users                | Whittaker (2001c)                  | 50                |                   | Mailed      |
|         | Willow Creek                                 | 1991 | Salmon Anglers           | Alaska Div. of Parks & Rec. (1991) | 96                | 85                | On-site     |
|         | Colorado River - Glen Canyon Nat'l Rec. Area | 1984 | Anglers                  | HBRS (1985)                        | 211               | 83                | On-site     |
|         | Colorado River - Grand Canyon Nat'l Park     | 1998 | Commercial Oar Boaters   | Hall & Shelby (2000)               | 1,021             | 83                | On-site     |
|         |                                              |      | Commercial Motor Boaters |                                    |                   |                   |             |
|         |                                              |      | Private Boaters          |                                    |                   |                   |             |
|         | Grand Canyon National Park                   | 1985 | Rafters                  | HBRS (1986)                        | 538               | 91                | On-site     |
|         | Phoenix North Public Lands                   | 2002 | Visitors                 | Andereck et al. (2002)             | 234               | 35                | On-site     |

Table B1. Description of studies conducted in the United States (*continued*)

| State      | Study site                   | Date | Population studied   | Citation                      | Study sample size | Response rate (%) | Survey mode |
|------------|------------------------------|------|----------------------|-------------------------------|-------------------|-------------------|-------------|
| California | Alcatraz Island              | 1998 | Visitors             | Manning et al. (2002)         | 865               | 80                | On-site     |
|            |                              | 2005 | Visitors             | Manning (2005)                | 288               | 81                | On-site     |
|            | Joshua Tree National Park    | 1994 | Rock Climbers        | Trench & Wallace (1994)       | 675               | 95                | On-site     |
|            | Klamath River                | 1984 | Salmon Anglers       | Shelby & Stein (1984)         | 50                | 43                | On-site     |
|            |                              | 1984 | Floaters             | Shelby & Stein (1984)         | 105               | 90                | On-site     |
|            | Lake Shasta                  | 2002 | Boaters              | Graefe et al. (2005)          | 546               |                   | On-site     |
|            |                              | 2002 | Houseboats           | Graefe et al. (2005)          | 769               | 62                | Mailed      |
|            |                              |      | Rental boats         |                               |                   |                   |             |
|            |                              |      | Marina-based boats   |                               |                   |                   |             |
|            | Lake Sonoma                  | 2000 | Recreational Boaters | Carroll (2001)                | 157               | 89                | On-site     |
|            |                              |      | Fishing - Boaters    |                               |                   |                   |             |
|            | Lake Trinity                 | 2002 | Boaters              | Graefe et al. (2005)          | 239               |                   | On-site     |
|            |                              | 2002 | Rental boats         | Graefe et al. (2005)          | 383               | 62                | Mailed      |
|            |                              |      | Marina-based boats   |                               |                   |                   |             |
|            |                              |      | Houseboats           |                               |                   |                   |             |
|            | Mt Shasta                    | 1994 | Mountain Climbers    | Vaske, Donnelly et al. (1994) | 310               | 50                | On-site     |
|            | Muir Beach                   | 2003 | Visitors             | Manning (2003c)               | 404               | 61                |             |
|            | Muir Woods National Monument | 2003 | Visitors             | Manning (2003d)               | 404               | 55                |             |
|            |                              | 2004 | Visitors             | Manning (2004d)               | 173               | 60                |             |

Table B1. Description of studies conducted in the United States (*continued*)

| State    | Study site                         | Date | Population studied          | Citation                               | Study sample size | Response rate (%) | Survey mode |
|----------|------------------------------------|------|-----------------------------|----------------------------------------|-------------------|-------------------|-------------|
|          | Yosemite National Park             | 1998 | Visitors                    | Manning (1998)                         | 810               |                   | On-site     |
|          |                                    | 1999 | Visitors                    | Manning (1999)                         | 942               |                   | On-site     |
|          |                                    | 2001 | Frontcountry Users          | Newman (2002)                          | 712               | 78                | On-site     |
|          |                                    |      | Wilderness Remote Users     |                                        |                   |                   |             |
|          |                                    |      | Wilderness Transition Users |                                        |                   |                   |             |
| Colorado | Cache la Poudre River              | 1993 | Anglers                     | Vaske (1993)                           | 89                | 95                | On-site     |
|          |                                    | 1993 | Kayakers                    | Vaske & Donnelly (1993b)               | 1,065             | 97                | On-site     |
|          |                                    |      | Rafters                     |                                        |                   |                   |             |
|          | Colorado Reservoirs                | 1998 | Anglers                     | Donnelly & Vaske (1998)                | 312               | 94                | On-site     |
|          | Gunnison Gorge Nat'l Conserv. Area | 2002 | Wilderness Users            | Knopf et al. (2002)                    | 196               | 48                | On-site     |
|          |                                    |      | OHV area Users              |                                        |                   |                   |             |
|          |                                    |      | Non-wilderness Users        |                                        |                   |                   |             |
|          | Jefferson County                   | 1996 | Hikers                      | Carothers et al. (2001)                | 775               | 95                | On-site     |
|          |                                    |      | Bikers                      |                                        |                   |                   |             |
|          |                                    |      | Dual-Sport                  |                                        |                   |                   |             |
|          | Mesa Verde National Park           | 2001 | Visitors                    | Manning (2001c)                        | 1,308             |                   | On-site     |
|          | Mt Evans                           | 1994 | Deer Hunter                 | Vaske, Donnelly, Wittman et al. (1995) | 986               | 96                | On-site     |
|          |                                    |      | Tourists                    |                                        |                   |                   |             |

Table B1. Description of studies conducted in the United States (*continued*)

| State    | Study site                                            | Date | Population studied                    | Citation                      | Study sample size | Response rate (%) | Survey mode |
|----------|-------------------------------------------------------|------|---------------------------------------|-------------------------------|-------------------|-------------------|-------------|
|          | Rocky Mountain National Park                          | 2001 | Tourists<br>Hikers                    | Vaske, Donnelly et al. (2002) | 1,643             | 95                | On-site     |
|          | Upper Colorado River                                  | 2000 | Boaters                               | Titre & Schuster (2002)       | 201               |                   | On-site     |
|          | Vail Pass -<br>White River National Forest            | 2003 | Nonmotorized Users<br>Motorized Users | Vaske (2003a)                 | 224               | 96                | On-site     |
|          | Wolf Creek Pass –<br>San Juan/Rio Grande Nat'l Forest | 2003 | Nonmotorized Users<br>Motorized Users | Vaske (2003b)                 | 243               | 96                | On-site     |
| Delaware | Delaware Coastal Beaches                              | 1993 | Beach Users                           | Graefe (1993)                 | 562               |                   | On-site     |
|          | Delaware Inland Bay                                   | 1991 | Boaters                               | Falk et al. (1992)            | 635               |                   | On-site     |
| Hawaii   | Haleakala National Park                               | 2003 | Visitors                              | Manning (2003b)               | 204               | 63                | On-site     |
|          |                                                       | 2003 | Bicycle tourists                      | Manning (2003b)               | 201               |                   | On-site     |
|          |                                                       | 2003 | Visitors - as exiting park            | Manning (2003b)               | 300               | 63                | On-site     |
|          |                                                       | 2004 | Visitors                              | Manning (2004b)               | 288               |                   | On-site     |
|          | Hawaii Volcanoes National Park                        | 2002 | Visitors                              | Manning (2002b)               | 469               | 58                | On-site     |
| Maine    | Acadia Carriage Roads                                 | 1995 | Carriage Road users                   | Manning et al. (1997)         | 514               | 70                | On-site     |
|          |                                                       | 1996 | Carriage Road users                   | Manning et al. (1997)         | 377               | 70                | Mailed      |

Table B1. Description of studies conducted in the United States (*continued*)

| State         | Study site                                           | Date | Population studied | Citation                       | Study sample size | Response rate (%) | Survey mode |
|---------------|------------------------------------------------------|------|--------------------|--------------------------------|-------------------|-------------------|-------------|
| Maryland      | Acadia National Park - Isle au Haut                  | 2001 | Visitors           | Manning (2001a)                | 228               | 91                | On-site     |
|               |                                                      | 2002 | Visitors           | Manning (2002c)                | 341               | 87                | On-site     |
|               |                                                      | 2003 | Residents          | Manning (2003c)                | 79                | 64                | Mailed      |
|               | Acadia National Park - Schoodic Peninsula            | 2000 | Visitors           | Bacon et al. (2003)            | 583               | 79                | On-site     |
|               | Acadia National Park                                 | 2004 | Visitors           | Manning (2004a)                | 1,572             | 75                | On-site     |
|               | Fishing Bay                                          | 1986 | Goose Hunters      | Vaske, Fedler, & Graefe (1986) | 230               | 95                | On-site     |
|               | Gun Powder River                                     | 1984 | Trout Anglers      | McGurrin (1984)                | 162               | 97                | On-site     |
|               | Savage River                                         | 1980 | Trout Anglers      | Vaske & Donnelly (1980)        | 203               | 89                | Mailed      |
|               | State Wide - Maryland                                | 1977 | Turkey Hunters     | Donnelly & Vaske (1981)        | 452               | 93                | Mailed      |
|               |                                                      | 1984 | Deer Hunters       | Vaske et al. (1984)            | 998               | 72                | Mailed      |
| Massachusetts | Tuckahoe State Park                                  | 1984 | Goose Hunters      | Vaske et al. (1984)            | 62                | 98                | On-site     |
|               | Upper Youghiogeny River                              | 1989 | Kayakers           | Graefe, Gitelson et al. (1989) | 936               |                   | On-site     |
|               |                                                      |      | Rafters            |                                |                   |                   |             |
| Massachusetts | Boston Harbor Islands                                | 2000 | Visitors           | Budruk et al. (2002)           | 694               | 85                | On-site     |
|               | Cape Cod                                             | 2004 | Hunters            | Kuentzel (2005)                | 408               | 94                | On-site     |
| Michigan      | Stockings Park - Sleeping Bear Dunes Nat'l Lakeshore | 1977 | Driving Tourists   | Randall (1977)                 | 481               | 87                | On-site     |
| Minnesota     | BWCA                                                 | 1982 | Canoers            | Adelman et al. (1982)          | 196               | 65                | On-site     |

Table B1. Description of studies conducted in the United States (*continued*)

| State          | Study site                           | Date | Population studied        | Citation               | Study sample size | Response rate (%) | Survey mode |
|----------------|--------------------------------------|------|---------------------------|------------------------|-------------------|-------------------|-------------|
| Nevada         | Lake Mead                            | 1994 | Boaters                   | Graefe (1994a)         | 821               |                   | On-site     |
|                | Lake Mohave                          | 1994 | Boaters                   | Graefe (1994b)         | 430               |                   | On-site     |
| New Hampshire  | Great Gulf Wilderness                | 1980 | Backpackers in Wilderness | Donnelly (1980)        | 721               | 96                | On-site     |
|                | White Mountain National Forest       | 1984 | Backpackers in Wilderness | Graefe et al. (1984)   | 385               | 97                | On-site     |
| New York       | Sagamore Hill National Historic Site | 2002 | Visitors                  | Manning (2002c)        | 409               | 98                | On-site     |
|                | Saratoga National Historic Site      | 2001 | Visitors                  | Manning (2001d)        | 367               | 68                | On-site     |
| North Carolina | Cape Hatteras National Seashore      | 2002 | Visitors                  | Vogelsong (2003)       | 1,015             | 62                | Mailed      |
|                | Nantahala River                      | 1994 | Canoers                   | Tarrant et al. (1997)  | 666               | 52                | Mailed      |
|                |                                      |      | Kayakers                  |                        |                   |                   |             |
|                |                                      |      | Rafters                   |                        |                   |                   |             |
|                |                                      | 1994 | Canoers                   | Tarrant et al. (1997)  | 1,470             | 97                | On-site     |
|                |                                      |      | Rafters                   |                        |                   |                   |             |
|                |                                      |      | Kayakers                  |                        |                   |                   |             |
|                |                                      |      |                           |                        |                   |                   |             |
| Oregon         | Clackamas River                      | 1988 | Boaters                   | Shelby et al. (1990)   | 309               | 84                | Mailed      |
|                |                                      | 1995 | Boaters                   | Shelby et al. (1989)   |                   |                   |             |
|                | Deschutes River                      | 1987 | Boaters                   | Shelby et al. (1987)   | 479               | 83                | Mailed      |
|                | Eagle Cap Wilderness                 | 1980 | Hikers in Wilderness      | Petersen (1980)        | 118               | 84                | Mailed      |
|                | Illinois River                       | 1981 | Rafters                   | Shelby & Colvin (1981) | 263               | 92                | Mailed      |

Table B1. Description of studies conducted in the United States (*continued*)

| State          | Study site                                  | Date | Population studied            | Citation                                | Study sample size | Response rate (%) | Survey mode |
|----------------|---------------------------------------------|------|-------------------------------|-----------------------------------------|-------------------|-------------------|-------------|
| Oregon         | Jefferson County Reservoirs                 | 1997 | Campers<br>Day-use Area Users | Dedrick, Hall, Shelby, & Everett (1998) |                   |                   |             |
|                | McKenzie River                              | 1991 | Boaters                       | Rolloff, Hall, & Shelby (1995)          |                   |                   |             |
|                |                                             | 1996 | Boaters                       | Hall & Shelby (1996)                    | 303               | 46                | Mailed      |
|                | Mt. Jefferson Wilderness                    | 1991 | Hikers                        | Dawson & Watson (2000)                  | 594               | 81                | Mailed      |
|                | Mt Jefferson Wilderness                     | 1980 | Backpackers in<br>Wilderness  | Petersen (1980)                         | 261               | 73                | Mailed      |
|                | Mt. Washington Wilderness                   | 1991 | Hikers                        | Dawson & Watson (2000)                  | 241               | 81                | Mailed      |
|                | Oregon Beaches                              | 2001 | Beachgoers                    | Shelby & Tokarczyk (2002)               |                   |                   | On-site     |
|                | Oregon Caves National Monument              | 1995 | Monument Visitors             | Rolloff, Johnson, & Shelby (1996)       | 616               | 63                | Mailed      |
|                | Rogue River                                 | 1979 | Rafters                       | Shelby & Colvin (1979)                  | 268               | 78                | Mailed      |
|                | Snake River (Hell's Canyon Nat'l Rec. Area) | 1980 | Rafters                       | Shelby & Danley (1980)                  | 295               | 83                | Mailed      |
|                | Three Sisters Wilderness                    | 1991 | Hikers                        | Dawson & Watson (2000)                  | 636               | 81                | Mailed      |
|                | Berlin Lake                                 | 1989 | Boaters                       | Graefe (1989)                           | 866               |                   | On-site     |
|                | Presque Isle                                | 1994 | Boaters                       | Graefe (1994c)                          | 479               |                   | On-site     |
|                | Raystown Lake                               | 1987 | Boaters                       | Graefe et al. (1988)                    | 1,170             | 90                | On-site     |
| South Carolina | Fort Sumter National Monument               | 1987 | Tourists                      | Andereck & Becker (1993)                | 1,687             | 96                | On-site     |

Table B1. Description of studies conducted in the United States (*continued*)

| State         | Study site                                    | Date | Population studied    | Citation                                 | Study sample size | Response rate (%) | Survey mode |
|---------------|-----------------------------------------------|------|-----------------------|------------------------------------------|-------------------|-------------------|-------------|
| Utah          | Antelope Island State Park                    | 1999 | Frontcountry Visitors | Brunson & Christensen (2000)             | 504               | 59                | Mailed      |
|               |                                               |      | Hikers                |                                          |                   |                   |             |
|               |                                               |      | Horseback Riders      |                                          |                   |                   |             |
|               |                                               |      | Mountain Bikers       |                                          |                   |                   |             |
|               | Arches National Park                          | 1996 | Mountain Bikers       | Fix (1996)                               | 310               | 90                | On-site     |
|               |                                               | 1997 | Visitors              | Wang, Manning, Lawson, & Valliere (2001) | 791               | 70                |             |
|               | Grand Staircase - Escalante National Monument | 1999 | Backcountry Visitors  | Palmer, Lael, & Brunson (May, 2000)      | 550               | 90                | Mailed      |
|               |                                               | 1999 | Hunters               | Palmer, Lael, & Brunson (July, 2000)     | 163               | 67                | Mailed      |
| Vermont       | Zion National Park                            | 2003 | Hikers                | Manning (2003e)                          | 333               | 53                | Mailed      |
|               |                                               | 2003 | Users                 | Manning (2003e)                          | 310               | 82                | On-site     |
|               | Shelburne Museum                              | 1995 | Day Visitors          | Kuentzel (1995)                          | 894               | 79                | On-site     |
|               |                                               |      | Backpackers in        |                                          |                   |                   |             |
| Washington    | Enchantments National Forest                  | 1988 | Wilderness            | Shelby et al. (n.d.)                     | 345               | 85                | On-site     |
|               | White Salmon River                            | 1991 | Boaters               | Shelby & Wing (1993)                     | 857               |                   | On-site     |
| West Virginia | Dolly Sods Wilderness                         | 1982 | Hikers in Wilderness  | Vaske et al. (1982)                      | 149               | 96                | On-site     |
|               | Seneca Rocks - Monongahohela Nat'l Forest     | 1985 | Rock Climbers         | Botkin (1985)                            | 416               | 98                | On-site     |

Table B1. Description of studies conducted in the United States (*continued*)

| State     | Study site                         | Date | Population studied  | Citation                             | Study sample size | Response rate (%) | Survey mode |
|-----------|------------------------------------|------|---------------------|--------------------------------------|-------------------|-------------------|-------------|
| Wisconsin | Apostle Islands National Lakeshore | 1981 | Boaters             | Heberlein & Alfano (1983)            | 323               | 57                | On-site     |
|           |                                    | 1985 | Sail Boaters        | Kuentzel & Heberlein (2003)          | 377               | 79                | Mailed      |
|           |                                    | 1997 | Sail Boaters        | Kuentzel & Heberlein (2003)          | 492               | 69                | Mailed      |
|           | Bong Wildlife Management Unit      |      | Sea Kayakers        |                                      |                   |                   |             |
|           |                                    | 1979 | Pheasant Hunters    | Heberlein et al. (1980)              | 924               | 80                | On-site     |
|           |                                    | 1981 | Pheasant Hunter     | Heberlein (1981)                     | 743               | 44                | On-site     |
|           | Brule River                        | 1975 | Anglers             | Heberlein & Vaske (1977)             | 2,965             | 95                | On-site     |
|           |                                    |      | Tubers              |                                      |                   |                   |             |
|           |                                    |      | Canoers             |                                      |                   |                   |             |
|           | Door County                        | 1985 | Canoers             | Heberlein & Proudman (1986)          | 1,010             | 95                | On-site     |
|           |                                    | 1986 | Boaters             | Heberlein, McKinnell, & Erwin (1986) | 229               | 80                | Mailed      |
|           | Grand River Marsh                  | 1978 | Firing Line Hunters | Kuentzel & Heberlein (1998)          | 448               | 75                | On-site     |
|           |                                    |      | Managed Hunt        |                                      |                   |                   |             |
|           | Horicon Grand River Marsh          | 1978 | Hunters             | Kuentzel & Heberlein (1998)          | 935               | 100               | On-site     |
|           |                                    | 1986 | Goose Hunters       | Shelby & Heberlein (1986)            | 445               | 75                | On-site     |
|           |                                    | 1986 | Goose Hunters       | Shelby & Heberlein (1986)            | 913               | 100               | On-site     |
|           | Lake Delavan                       | 1986 | Recreationists      | Insitute of Environ. Studies (1986)  | 309               |                   | On-site     |
|           |                                    | 1986 | Riparian Landowners | Insitute of Environ. Studies (1986)  | 362               | 75                | Mailed      |
|           | Public Hunting Area                | 1980 | Pheasant Hunters    | Heberlein et al. (1980)              | 194               | 93                | On-site     |

Table B1. Description of studies conducted in the United States (*continued*)

| State           | Study site                        | Date | Population studied | Citation                     | Study sample size | Response rate (%) | Survey mode |
|-----------------|-----------------------------------|------|--------------------|------------------------------|-------------------|-------------------|-------------|
|                 | Sandhill Wildlife Management Unit | 1979 | Deer Hunters       | Heberlein & Kuentzel (2002)  | 285               |                   | On-site     |
|                 |                                   | 1980 | Deer Hunters       | Heberlein & Kuentzel (2002)  | 349               |                   | On-site     |
|                 |                                   | 1981 | Deer Hunters       | Heberlein & Kuentzel (2002)  | 212               |                   | On-site     |
|                 |                                   | 1982 | Deer Hunters       | Heberlein & Kuentzel (2002)  | 325               |                   | On-site     |
|                 |                                   | 1983 | Deer Hunters       | Heberlein & Kuentzel (2002)  | 142               |                   | On-site     |
|                 |                                   | 1984 | Deer Hunters       | Heberlein & Kuentzel (2002)  | 308               |                   | On-site     |
|                 |                                   | 1985 | Deer Hunters       | Heberlein & Kuentzel (2002)  | 122               |                   | On-site     |
|                 |                                   | 1986 | Deer Hunters       | Heberlein & Kuentzel (2002)  | 119               |                   | On-site     |
|                 |                                   | 1987 | Deer Hunters       | Heberlein & Kuentzel (2002)  | 372               |                   | On-site     |
|                 |                                   | 1987 | Deer Hunters       | Heberlein & Kuentzel (2002)  | 372               |                   | On-site     |
|                 |                                   | 1988 | Deer Hunters       | Heberlein & Kuentzel (2002)  | 249               |                   | On-site     |
|                 |                                   | 1989 | Deer Hunters       | Heberlein & Kuentzel (2002)  | 261               |                   | On-site     |
|                 |                                   |      | Wildlife           |                              |                   |                   |             |
|                 | State Wide - Wisconsin            | 1986 | Photographers      | Petchenik & Heberlein (1986) | 62                | 72                | Mailed      |
|                 |                                   | 1977 | Deer Hunters       | Heberlein & Laybourne (1978) | 235               | 83                | Mailed      |
|                 |                                   | 1982 | Deer Hunters       |                              | 235               |                   | Mailed      |
|                 |                                   | 1982 | Goose Hunters      | Kuentzel & Heberlein (1992)  | 254               | 50                | Mailed      |
|                 | Wolf River                        | 1977 | Floaters           | Blackwood (1977)             | 304               | 98                | On-site     |
| Multiple States | Appalachian National Scenic Trail | 1999 | Hikers             | Newman et al. (2003)         | 1,532             | 66                | On-site     |

Table B2. Description of international studies

| Country                   | Study site                                      | Date | Population studied  | Citation                                   | Study sample size | Response rate (%) | Survey mode |
|---------------------------|-------------------------------------------------|------|---------------------|--------------------------------------------|-------------------|-------------------|-------------|
| Canada (Alberta)          | Athabasca-Sunwapta Rivers                       | 1999 | White water rafters | Vaske & Donnelly (2002)                    | 369               | 95                | On-site     |
|                           |                                                 |      | Float trip visitors |                                            |                   |                   |             |
|                           | Banff National Park                             | 1993 | Tourists            | Vaske & Donnelly (1993a)                   | 501               |                   | On-site     |
|                           | Columbia Icefield                               | 1993 | Tourists            | Vaske et al. (1994)                        | 910               | 97                | On-site     |
|                           |                                                 | 1996 | Tourists            | Vaske & Donnelly (1997)                    | 1,893             | 96                | On-site     |
|                           |                                                 | 1997 | Tourists            | Vaske & Donnelly (1998)                    | 1,422             | 96                | On-site     |
| Canada (British Columbia) | Gwaii Haanas Nat'l Park Reserve & Heritage Site | 2000 | Tourists            | Vaske & Donnelly (2001)                    | 438               | 97                | On-site     |
|                           |                                                 | 1995 | Motor Boaters       | Vaske, Donnelly, Freimund, & Miller (1995) | 205               | 66                | Mailed      |
|                           |                                                 |      | Kayakers            |                                            |                   |                   |             |
|                           | Jasper National Park                            | 1993 | Tourist             | Vaske, Donnelly, Doctor et al. (1994)      | 470               | 97                | On-site     |
|                           | Pacific Rim National Park                       | 2001 | Ocean kayakers      | Randall (2003)                             | 375               | 87                | On-site     |
|                           | Whistler Mountain                               | 2000 | Visitors            | Needham et al. (2004)                      | 548               | 84                | On-site     |
| Ecuador                   | Cuyabeno Wildlife Reserve                       | 1995 | Ecotourists         | Wallace & Lincango (1996)                  | 131               | 99                | Mailed      |
| New Zealand               | Kapiti Island                                   | 1991 | Visitors            | Sutton et al. (1993)                       | 461               | 64                | On-site     |
|                           | New Zealand's Conservation Estate               |      | Tourists            | Higham (1994)                              | 336               |                   | On-site     |
|                           |                                                 | 1992 | Tourists            | O'Neill (1994)                             |                   | 60                | On-site     |
|                           | New Zealand Backcountry                         | 1996 | Backcountry Users   | Kearsley & Coughlan (1999)                 | 970               | 47                | Mailed      |
|                           | Rakaia River                                    | 1983 | Salmon Anglers      | Shelby (1983)                              | 119               | 40                | On-site     |
|                           | Waimakariri River                               | 1985 | Salmon Anglers      | Shelby(1983)                               | 138               | 30                | On-site     |

Table B2. Description of international studies (*continued*)

| Country  | Study site                     | Date | Population studied | Citation                  | Study sample size | Response rate (%) | Survey mode |
|----------|--------------------------------|------|--------------------|---------------------------|-------------------|-------------------|-------------|
| Sweden   | Fulufjallet National Park      | 2001 | Hikers             | Fredman & Hörnsten (2004) | 1,498             | 77                | Mailed      |
|          |                                | 2005 | Hikers             | Cottrell & Ritter (2005)  | 107               |                   | On-site     |
| Thailand | Koh Chang Marine National Park | 2005 | Snorkellers        | Tolpelko (2005)           | 705               |                   | On-site     |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts

| Study site                                   | Date | Evaluation context                              |                                               |                  | Method for describing crowding |                  |            |              |
|----------------------------------------------|------|-------------------------------------------------|-----------------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                              |      | Evaluation by:                                  | Evaluation for:                               | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Deschutes River                              | 1987 | Boaters                                         | Weekends Section 1                            | Oregon           | 100                            | 85               | 6.00       | 6.00         |
| Kenai River                                  | 1993 | Salmon Anglers                                  | Upper Bank Anglers - High Use Days            | Alaska           | 100                            | 91               | 6.90       | 7.00         |
| Deschutes River                              | 1987 | Boaters                                         | Weekends Section 4                            | Oregon           | 97                             | 75               | 5.60       | 6.00         |
| Deschutes River                              | 1987 | Boaters                                         | Weekend Section 2                             | Oregon           | 95                             | 81               | 6.30       | 6.00         |
| Nantahala River                              | 1994 | Canoers                                         | On the River - Mail Survey                    | North Carolina   | 95                             | 89               | 7.00       | 7.00         |
| Deschutes River                              | 1987 | Boaters                                         | Weekday Section 2                             | Oregon           | 94                             | 67               | 5.50       | 6.00         |
| Colorado River - Glen Canyon Nat'l Rec. Area | 1984 | Anglers                                         | Thanksgiving Week                             | Arizona          | 94                             |                  |            |              |
| Alcatraz Island                              | 2005 | Visitors                                        | Other visitors - in the prison cell house     | California       | 92                             | 48               | 4.65       | 4.00         |
| Kenai River                                  | 1993 | Power Boaters                                   | Lower River Powerboat Anglers - High Use Days | Alaska           | 92                             | 76               | 6.05       | 6.00         |
| Lake Shasta                                  | 2002 | Houseboats                                      | All boaters                                   | California       | 92                             | 68               | 5.35       | 6.00         |
| Brooks River                                 | 1993 | July visitors                                   | Other visitors                                | Alaska           | 91                             | 65               | 3.04       | 3.00         |
| Raystown Lake                                | 1987 | Boaters                                         | On Lake                                       | Pennsylvania     | 91                             | 71               | 5.70       | 6.00         |
| Sandhill Wildlife Management Unit            | 1986 | Deer Hunters - Trophy buck hunt (Either sex) SE | Other Deer Hunters                            | Wisconsin        | 91                             | 6                | 2.15       | 2.00         |
| Berlin Lake                                  | 1989 | Boaters                                         | On Lake                                       | Pennsylvania     | 90                             | 66               | 5.40       | 6.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                                  | Date | Evaluation context                  |                                        |                  | Method for describing crowding |                  |            |              |
|---------------------------------------------|------|-------------------------------------|----------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                             |      | Evaluation by:                      | Evaluation for:                        | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Koh Chang Marine National Park              | 2005 | Snorkellers                         | Other Snorkellers                      | Thailand         | 90                             | 68               | 5.70       | 6.00         |
| Nantahala River                             | 1994 | Canoers                             | Approach to Final Rapids - Mail Survey | North Carolina   | 90                             | 84               | 6.46       | 7.00         |
| Nantahala River                             | 1994 | Canoers                             | At the Put-In - Mail Survey            | North Carolina   | 90                             | 72               | 6.02       | 6.00         |
| Bong Wildlife Management Unit               | 1979 | Pheasant Hunters                    | Opening Day                            | Wisconsin        | 89                             | 74               | 6.20       | 6.00         |
| Nantahala River                             | 1994 | Kayakers                            | On the River - Mail Survey             | North Carolina   | 89                             | 79               | 5.97       | 6.00         |
| Nantahala River                             | 1994 | Kayakers                            | Approach to Final Rapids - Mail Survey | North Carolina   | 89                             | 73               | 5.61       | 6.00         |
| Deschutes River                             | 1987 | Boaters                             | Weekdays Section 4                     | Oregon           | 88                             | 66               | 5.40       | 6.00         |
| Deschutes River                             | 1987 | Boaters                             | Weekdays Section 1                     | Oregon           | 88                             | 60               | 5.10       | 6.00         |
| Lake Delavan                                | 1986 | Riparian Landowners                 | Weekends                               | Wisconsin        | 87                             | 60               | 5.14       | 6.00         |
| Oregon Caves National Monument              | 1995 | Monument Visitors                   | Other Monument Visitors                | Oregon           | 87                             | 25               | 4.20       | 4.00         |
| Horicon Grand River Marsh                   | 1986 | Goose Hunters                       | Firing Line                            | Wisconsin        | 86                             | 66               | 5.11       | 5.00         |
| Alcatraz Island                             | 2005 | Visitors                            | Other visitors - Overall               | California       | 85                             | 47               | 4.29       | 4.00         |
| Arches National Park                        | 1996 | Mountain Bikers on Slick Rock Trail | Other visitors                         | Utah             | 85                             | 46               | 4.56       | 4.00         |
| Colorado River - Grand Canyon National Park | 1998 | Private Boaters                     | All Boaters                            | Arizona          | 85                             | 39               | 4.60       | 5.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                  | Date | Evaluation context                   |                                                |                  | Method for describing crowding |                  |            |              |
|-----------------------------|------|--------------------------------------|------------------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                             |      | Evaluation by:                       | Evaluation for:                                | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Kenai River                 | 1993 | Salmon Anglers                       | Upper Bank Anglers - Low Use Days              | Alaska           | 85                             | 72               | 5.59       | 6.00         |
| Kenai River                 | 1993 | Driftboat Anglers                    | Upper River Driftboat Anglers - High Use Days  | Alaska           | 85                             | 42               | 4.16       | 3.00         |
| Lake Shasta                 | 2002 | Marina-based boats                   | All boaters                                    | California       | 85                             | 56               | 4.63       | 5.00         |
| McKenzie River              | 1996 | Boaters - Lower River                | Other Boaters                                  | Oregon           | 85                             | 48               | 4.90       | 5.00         |
| Public Hunting Area         | 1980 | Pheasant Hunters                     | Opening Day                                    | Wisconsin        | 85                             |                  |            |              |
| Alcatraz Island             | 2005 | Visitors                             | Other visitors - on the ferry                  | California       | 84                             | 59               | 4.99       | 5.00         |
| Gulkana River               | 1999 | All Users                            | Richardson Highway Bridge Area                 | Alaska           | 84                             | 59               | 5.44       | 6.00         |
| Nantahala River             | 1994 | Rafters                              | On the River - Mail Survey                     | North Carolina   | 84                             | 70               | 5.54       | 6.00         |
| Nantahala River             | 1994 | Canoers                              | Approach to Final Rapids - On-site Evaluations | North Carolina   | 84                             | 63               | 5.22       | 5.00         |
| Yosemite National Park      | 1999 | Visitors to Bridalveil Falls         | Other visitors - Overall in Yosemite           | California       | 84                             | 48               | 4.57       | 4.00         |
| Jefferson County Reservoirs | 1997 | Upper Deschutes Day - Use Area Users | Other users                                    | Oregon           | 84                             |                  | 5.10       |              |
| Alcatraz Island             | 2005 | Visitors                             | Other visitors - in the theater/exhibit area   | California       | 83                             | 44               | 4.32       | 4.00         |
| Columbia Icefield           | 1997 | Tourists - Snocoach Tour             | Icefield Visitor Center                        | Canada (Alberta) | 83                             | 64               | 5.35       | 6.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                        | Date | Evaluation context           |                                                  |                  | Method for describing crowding |                  |            |              |
|-----------------------------------|------|------------------------------|--------------------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                   |      | Evaluation by:               | Evaluation for:                                  | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Nantahala River                   | 1994 | Canoers                      | On the River - On-site Evaluations               | North Carolina   | 83                             | 65               | 5.25       | 5.00         |
| Kenai River                       | 1993 | Salmon Anglers               | Lower Bank Anglers - High Use Days               | Alaska           | 82                             | 44               | 4.40       | 4.00         |
| Nantahala River                   | 1994 | Kayakers                     | At the Put-In - Mail Survey                      | North Carolina   | 82                             | 60               | 5.10       | 5.00         |
| Nantahala River                   | 1994 | Kayakers                     | On the River - On-site Evaluations               | North Carolina   | 82                             | 62               | 4.86       | 5.00         |
| New Zealand's Conservation Estate |      | Tourists                     | Other Tourists at South Island Walking Tracks    | New Zealand      | 82                             | 38               |            |              |
| Nantahala River                   | 1994 | Rafters                      | Approach to Final Rapids - Mail Survey           | North Carolina   | 81                             | 54               | 4.99       | 5.00         |
| Talkeetna River                   | 1989 | All Users                    | Entire River                                     | Alaska           | 81                             |                  |            |              |
| Goodnews River                    | 2001 | All Users                    | Other users outside of wilderness                | Alaska           | 81                             | 52               | 4.80       | 5.00         |
| Yosemite National Park            | 1999 | Visitors to Bridalveil Falls | Other visitors - at the base of Bridalveil Falls | California       | 81                             | 56               | 5.14       | 5.00         |
| Columbia Icefield                 | 2000 | Tourists - Snocoach Tour     | Icefield Visitor Center                          | Canada (Alberta) | 80                             | 51               | 4.79       | 5.00         |
| Delaware Coastal Beaches          | 1993 | Beach Users                  | On the Beach                                     | Delaware         | 80                             | 54               | 4.70       | 5.00         |
| Lake Trinity                      | 2002 | Houseboats                   | All boaters                                      | California       | 80                             | 33               | 4.35       | 4.00         |
| Nantahala River                   | 1994 | Rafters                      | On the River - On-site Evaluations               | North Carolina   | 80                             | 48               | 4.47       | 4.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                | Date | Evaluation context       |                                                |                           | Method for describing crowding |                  |            |              |
|---------------------------|------|--------------------------|------------------------------------------------|---------------------------|--------------------------------|------------------|------------|--------------|
|                           |      | Evaluation by:           | Evaluation for:                                | State or country          | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Nantahala River           | 1994 | Rafters                  | At the Put-In - Mail Survey                    | North Carolina            | 80                             | 57               | 5.18       | 5.00         |
| Pacific Rim National Park | 2001 | Ocean kayakers           | At campsite                                    | Canada (British Columbia) | 80                             | 55               | 4.95       | 4.00         |
| Yosemite National Park    | 1998 | Visitors to Vernal Falls | Other visitors - at Vernal Falls               | California                | 80                             | 36               | 4.11       | 4.00         |
| Yosemite National Park    | 1998 | Visitors to Vernal Falls | Other visitors - Overall in Yosemite Valley    | California                | 80                             | 41               | 4.28       | 4.00         |
| Columbia Icefield         | 1993 | Tourists - Snocoach Tour | Other Visitors                                 | Canada (Alberta)          | 79                             | 55               | 4.88       | 5.00         |
| Grand River Marsh         | 1978 | Firing Line              | Other Goose Hunters                            | Wisconsin                 | 79                             | 66               | 5.81       | 6.00         |
| Little Susitna River      | 1989 | All Users                | Entire River                                   | Alaska                    | 79                             |                  |            |              |
| Willow Creek              | 1991 | Salmon Anglers           | Other Salmon Anglers                           | Alaska                    | 79                             | 73               | 6.21       | 7.00         |
| Alcatraz Island           | 2005 | Visitors                 | Other visitors - bookstore & giftshop          | California                | 78                             | 42               | 4.19       | 4.00         |
| Alexander Creek           | 1989 | All users                | Entire River                                   | Alaska                    | 78                             |                  |            |              |
| Kenai River               | 1993 | Power Boaters            | Middle River Powerboat Anglers - High Use Days | Alaska                    | 78                             | 39               | 4.28       | 4.00         |
| Lake Creek                | 1989 | All Users                | Entire River                                   | Alaska                    | 78                             |                  |            |              |
| Presque Isle              | 1994 | Boaters                  | At Channel                                     | Pennsylvania              | 78                             | 51               | 4.76       | 5.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                    | Date | Evaluation context                 |                                                        |                  | Method for describing crowding |                  |            |              |
|-------------------------------|------|------------------------------------|--------------------------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                               |      | Evaluation by:                     | Evaluation for:                                        | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Kenai River                   | 1993 | Driftboat Anglers                  | Lower River Driftboat Anglers - High Use Days          | Alaska           | 77                             | 77               | 5.28       | 6.00         |
| Jefferson County Reservoirs   | 1997 | Cove Marina Users                  | Other users                                            | Oregon           | 77                             |                  | 4.30       |              |
| Alcatraz Island               | 1998 | Visitors                           | Other visitors - in the prison cell house              | California       | 76                             | 41               | 4.15       | 4.00         |
| Delaware Inland Bay           | 1991 | Boaters                            | On the Bay                                             | Delaware         | 76                             | 55               | 4.70       | 4.00         |
| Gun Powder River              | 1984 | Trout Anglers                      | Opening Day                                            | Maryland         | 76                             | 60               | 5.70       | 7.00         |
| Mesa Verde National Park      | 2001 | Visitors at Cliff Palace           | Other visitors - at Cliff Palace                       | Colorado         | 76                             | 33               | 3.81       | 4.00         |
| Yosemite National Park        | 1999 | Visitors to Bridalveil Falls       | Other visitors - along this trail                      | California       | 76                             | 43               | 4.35       | 4.00         |
| Zion National Park            | 2003 | Virgin River Narrows hikers        | Other hikers - between Orderville Canyon & paved trail | Utah             | 76                             | 53               | 4.89       | 5.00         |
| Bong Wildlife Management Unit | 1981 | Pheasant Hunter                    | Opening Day                                            | Wisconsin        | 75                             | 45               | 4.40       | 4.00         |
| Muir Woods National Monument  | 2003 | Visitors                           | Other visitors - in the parking area                   | California       | 75                             | 56               | 5.16       | 6.00         |
| Raystown Lake                 | 1987 | Boaters                            | Stopping Places                                        | Pennsylvania     | 75                             | 50               | 4.60       | 4.00         |
| Waimakariri River             | 1985 | Salmon Anglers                     | Other Salmon Anglers                                   | New Zealand      | 75                             | 53               |            |              |
| Jefferson County Reservoirs   | 1997 | Lower Deschutes Day-Use Area Users | Other users                                            | Oregon           | 75                             |                  | 4.30       |              |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                        | Date | Evaluation context                      |                                                |                  | Method for describing crowding |                  |            |              |
|-----------------------------------|------|-----------------------------------------|------------------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                   |      | Evaluation by:                          | Evaluation for:                                | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Acadia National Park              | 2004 | Thunder Hole visitors                   | Other visitors                                 | Maine            | 74                             | 42               | 4.20       | 4.00         |
| Columbia Icefield                 | 1996 | Tourists - Snocoach Tour                | Visitor Facilities                             | Canada (Alberta) | 74                             | 57               | 5.01       | 6.00         |
| Columbia Icefield                 | 2000 | Tourists - Snocoach Tour                | Icefield Exhibit Hall                          | Canada (Alberta) | 74                             | 43               | 4.19       | 4.00         |
| Kenai River                       | 1993 | Driftboat Anglers                       | Upper River Driftboat Anglers - Low Use Days   | Alaska           | 74                             | 47               | 4.40       | 4.00         |
| Rakaia River                      | 1983 | Salmon Anglers                          | At River Mouth                                 | New Zealand      | 74                             | 43               |            |              |
| Rocky Mountain National Park      | 2001 | Tourists                                | Visitors at the Alpine Visitor Center          | Colorado         | 74                             | 40               | 4.06       | 4.00         |
| Sandhill Wildlife Management Unit | 1982 | Deer Hunters - Doe hunt (antlerless) NW | Other Deer Hunters                             | Wisconsin        | 74                             | 55               | 4.62       | 5.00         |
| Arches National Park              | 1996 | Mountain Bikers at Campground           | Other visitors                                 | Utah             | 73                             | 40               | 4.22       | 4.00         |
| BWCA                              | 1982 | Canoers                                 | Moose Lake                                     | Minnesota        | 73                             |                  |            |              |
| Columbia Icefield                 | 1997 | Tourists - Snocoach Tour                | In the Glacier Gallery                         | Canada (Alberta) | 73                             | 41               | 4.15       | 4.00         |
| Nantahala River                   | 1994 | Kayakers                                | Approach to Final Rapids - On-site Evaluations | North Carolina   | 73                             | 49               | 4.50       | 4.00         |
| Grand Canyon National Park        | 1985 | Rafters                                 | 1985 Summer                                    | Arizona          | 72                             |                  |            |              |
| Kenai River                       | 1993 | Power Boaters                           | Lower River Powerboat Anglers - Low Use Days   | Alaska           | 72                             | 44               | 4.31       | 4.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                         | Date | Evaluation context              |                                         |                           | Method for describing crowding |                  |            |              |
|------------------------------------|------|---------------------------------|-----------------------------------------|---------------------------|--------------------------------|------------------|------------|--------------|
|                                    |      | Evaluation by:                  | Evaluation for:                         | State or country          | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Mt Evans                           | 1994 | Deer Hunter                     | Other Deer Hunters                      | Colorado                  | 72                             | 43               | 4.36       | 4.00         |
| Muir Woods National Monument       | 2003 | Visitors                        | Other visitors - in the gift shop       | California                | 72                             | 39               | 4.12       | 4.00         |
| Togiak River                       | 2001 | All Users                       | Other users outside of wilderness       | Alaska                    | 72                             | 40               | 3.95       | 4.00         |
| Lake Shasta                        | 2002 | Rental boats                    | All boaters                             | California                | 71                             | 43               | 4.08       | 4.00         |
| Lake Trinity                       | 2002 | Marina-based boats              | All boaters                             | California                | 71                             | 39               | 3.82       | 4.00         |
| Whistler Mountain                  | 2000 | Summer Visitors - Harmony Lakes | Other Summery Visitors - Harmony Lakes  | Canada (British Columbia) | 71                             | 47               | 4.13       | 4.00         |
| Yosemite National Park             | 1999 | Visitors to Glacier Point       | Other visitors - Overall in Yosemite    | California                | 71                             | 33               | 3.83       | 3.00         |
| Clackamas River                    | 1988 | Boaters                         | All users                               | Oregon                    | 70                             | 31               | 3.66       | 3.00         |
| Haleakala National Park            | 2003 | Bicycle tourists                | Other visitors - at the mountain summit | Hawaii                    | 70                             | 36               | 3.92       | 3.00         |
| Klamath River                      | 1984 | Salmon Anglers                  | Fall Season Salmon Anglers              | California                | 70                             | 44               | 4.16       | 4.00         |
| McKenzie River                     | 1996 | Boaters - Middle River          | Other Boaters                           | Oregon                    | 70                             | 25               | 3.80       | 3.00         |
| Mt Evans                           | 1994 | Tourists                        | Regional Survey                         | Colorado                  | 70                             | 31               | 4.02       | 4.00         |
| Mt McKinley - Denali National Park | 1977 | Mountain Climbers               | Other Climbers                          | Alaska                    | 70                             |                  |            |              |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                   | Date | Evaluation context                    |                                                       |                  | Method for describing crowding |                  |            |              |
|------------------------------|------|---------------------------------------|-------------------------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                              |      | Evaluation by:                        | Evaluation for:                                       | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Nantahala River              | 1994 | Rafters                               | Approach to Final Rapids - On-site Evaluations        | North Carolina   | 70                             | 39               | 3.87       | 3.00         |
| State Wide- Maryland         | 1984 | Deer Hunter - Muzzle Loader           | No Specific Resource                                  | Maryland         | 70                             | 40               | 4.05       | 4.00         |
| Jefferson County Reservoirs  | 1997 | Crooked River Day-Use Area Users      | Other users                                           | Oregon           | 70                             |                  | 4.30       |              |
| Oregon Beaches               | 2001 | Oregon Beachgoers - Short Sands Beach | Other beachgoers                                      | Oregon           | 70                             | 41               | 3.96       | 4.00         |
| Berlin Lake                  | 1989 | Boaters                               | End of Trip                                           | Pennsylvania     | 69                             | 47               | 4.50       | 4.00         |
| Door County                  | 1986 | Boaters                               | Other Boaters                                         | Wisconsin        | 69                             | 38               | 3.92       | 4.00         |
| Haleakala National Park      | 2003 | Visitors at Visitor Center            | Other visitors - at visitor's center/observation area | Hawaii           | 69                             | 33               | 3.79       | 4.00         |
| Kenai River                  | 1993 | Salmon Anglers                        | Lower Bank Anglers - Low Use Days                     | Alaska           | 69                             | 47               | 4.24       | 4.00         |
| Lake Shasta                  | 2002 | Boaters                               | At the take-out                                       | California       | 69                             | 41               | 3.92       | 4.00         |
| Rocky Mountain National Park | 2001 | Hikers                                | Longs Peak Hikers on the Trail                        | Colorado         | 69                             | 39               | 4.02       | 4.00         |
| Rocky Mountain National Park | 2001 | Hikers                                | Longs Peak Hikers at the Summit                       | Colorado         | 69                             | 43               | 4.20       | 4.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                                   | Date | Evaluation context                               |                                   |                  | Method for describing crowding |                  |            |              |
|----------------------------------------------|------|--------------------------------------------------|-----------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                              |      | Evaluation by:                                   | Evaluation for:                   | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Yosemite National Park                       | 1999 | Visitors to Glacier Point                        | Other visitors - at Glacier Point | California       | 69                             | 29               | 3.66       | 3.00         |
| Zion National Park                           | 2003 | Virgin River Narrow Day Users                    | Other users - in this area        | Utah             | 69                             | 32               | 3.75       | 3.00         |
| Alcatraz Island                              | 1998 | Visitors                                         | Other visitors - Overall          | California       | 68                             | 28               | 3.52       | 3.00         |
| Bong Wildlife Management Unit                | 1981 | Pheasant Hunters                                 | Rest of Season                    | Wisconsin        | 68                             | 44               | 4.40       | 4.00         |
| Columbia Icefield                            | 1993 | Tourist- Toe of the Glacier                      | Visitor Facilities                | Canada (Alberta) | 68                             | 49               | 4.50       | 4.00         |
| Mt Shasta                                    | 1994 | Mountain Climbers                                | During Climb                      | California       | 68                             | 43               | 4.10       | 4.00         |
| Rocky Mountain National Park                 | 2001 | Tourists                                         | Trails near Bear Lake             | Colorado         | 68                             | 32               | 3.77       | 3.00         |
| Rogue River                                  | 1979 | Rafters                                          | Other Rafters                     | Oregon           | 68                             | 30               | 3.60       | 3.00         |
| Sandhill Wildlife Management Unit            | 1987 | Deer Hunters - Trophy buck hunt (Mixed) Day 2 NW | Other Deer Hunters                | Wisconsin        | 68                             | 26               | 3.87       | 3.00         |
| Sandhill Wildlife Management Unit            | 1987 | Deer Hunters - Trophy buck hunt (Mixed) Day 2 NE | Other Deer Hunters                | Wisconsin        | 68                             | 40               | 4.00       | 4.00         |
| Seneca Rocks - Monongahohela National Forest | 1985 | Rock Climbers                                    | Other Climbers                    | West Virginia    | 68                             | 37               | 3.88       | 3.00         |
| Columbia Icefield                            | 1996 | Tourist- Snocoach Tour                           | Visitor Facilities                | Canada (Alberta) | 67                             | 40               | 4.02       | 4.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                        | Date | Evaluation context                               |                                                |                  | Method for describing crowding |                  |            |              |
|-----------------------------------|------|--------------------------------------------------|------------------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                   |      | Evaluation by:                                   | Evaluation for:                                | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Kenai River                       | 1993 | Driftboat Anglers                                | Middle River Driftboat Anglers - High Use Days | Alaska           | 67                             | 67               | 4.19       | 5.00         |
| Mesa Verde National Park          | 2001 | Visitors at Museum                               | Other visitors - overall                       | Colorado         | 67                             | 29               | 3.60       | 3.00         |
| Mesa Verde National Park          | 2001 | Visitors at Spruce Tree House                    | Other visitors - at Spruce Tree House          | Colorado         | 67                             | 26               | 3.54       | 3.00         |
| Sandhill Wildlife Management Unit | 1988 | Deer Hunters - Trophy buck hunt (Mixed) Day 1 SE | Other Deer Hunters                             | Wisconsin        | 67                             | 37               | 3.93       | 4.00         |
| Sandhill Wildlife Management Unit | 1989 | Deer Hunters - Trophy buck hunt (Mixed) Day 1 NW | Other Deer Hunters                             | Wisconsin        | 67                             | 39               | 3.83       | 4.00         |
| Kanektok River                    | 2001 | All Users                                        | Other users outside of wilderness              | Alaska           | 67                             | 36               | 3.82       | 3.00         |
| Jefferson County Reservoirs       | 1997 | Crooked River Campground Users                   | Other campers                                  | Oregon           | 67                             |                  | 3.90       |              |
| Jefferson County Reservoirs       | 1997 | Pelton Park Campground Users                     | Other campers                                  | Oregon           | 67                             |                  | 4.00       |              |
| Mesa Verde National Park          | 2001 | Visitors at Museum                               | Other visitors - at Museum                     | Colorado         | 66                             | 32               | 3.71       | 3.00         |
| Muir Woods National Monument      | 2003 | Visitors                                         | Other visitors - in the cafe                   | California       | 66                             | 34               | 3.81       | 3.00         |
| Nantahala River                   | 1994 | Rafters                                          | At the Put-In - On-site Evaluations            | North Carolina   | 66                             | 41               | 4.08       | 3.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                       | Date | Evaluation context                            |                                             |                  | Method for describing crowding |                  |            |              |
|----------------------------------|------|-----------------------------------------------|---------------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                  |      | Evaluation by:                                | Evaluation for:                             | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Raystown Lake                    | 1987 | Boaters                                       | End of Trip                                 | Pennsylvania     | 66                             | 44               | 4.20       | 4.00         |
| Rocky Mountain National Park     | 2001 | Tourists                                      | Bear Lake - Area by Kiosk                   | Colorado         | 66                             | 33               | 3.77       | 3.00         |
| Yosemite National Park           | 1999 | Visitors to Mirror Lake                       | Other visitors - Overall in Yosemite        | California       | 66                             | 25               | 3.43       | 3.00         |
| Jefferson County Reservoirs      | 1997 | Perry South Campground Users                  | Other campers                               | Oregon           | 66                             |                  | 3.80       |              |
| Oregon Beaches                   | 2001 | Oregon Beachgoers - Indiana and Ecola Beaches | Other beachgoers                            | Oregon           | 66                             | 35               | 3.63       | 3.00         |
| Arches National Park             | 1997 | Devil's Garden Hikers                         | Other hikers at Devil's Garden              | Utah             | 65                             | 22               | 3.42       | 3.00         |
| Columbia Icefield                | 1996 | Tourist- Snocoach Tour                        | Hall                                        | Canada (Alberta) | 65                             | 36               | 3.76       | 3.00         |
| Gulkana River                    | 1999 | All Users                                     | Canyon Rapids Area                          | Alaska           | 65                             | 32               | 3.64       | 3.00         |
| Gulkana River                    | 1999 | All Users                                     | Sourdough Launch Area                       | Alaska           | 65                             | 37               | 4.01       | 3.00         |
| Haleakala National Park          | 2003 | Visitors at Visitor Center                    | Other visitors - overall                    | Hawaii           | 65                             | 26               | 3.44       | 3.00         |
| Israel Nature Reserve - Ein-Gedi | 1995 | Hikers                                        | Other Hikers                                | Israel           | 65                             | 42               | 2.22       | 2.00         |
| Rocky Mountain National Park     | 2001 | Tourists                                      | Trail around Bear Lake                      | Colorado         | 65                             | 31               | 3.74       | 3.00         |
| Yosemite National Park           | 1998 | Visitors to Yosemite Falls                    | Other visitors - Overall in Yosemite Valley | California       | 65                             | 25               | 3.52       | 3.00         |
| Alcatraz Island                  | 2005 | Visitors                                      | Other visitors - walking on roads & trails  | California       | 64                             | 24               | 3.32       | 3.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                  | Date | Evaluation context                     |                                        |                  | Method for describing crowding |                  |            |              |
|-----------------------------|------|----------------------------------------|----------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                             |      | Evaluation by:                         | Evaluation for:                        | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Mesa Verde National Park    | 2001 | Visitors at Spruce Tree House          | Other visitors - overall               | Colorado         | 64                             | 23               | 3.30       | 3.00         |
| Nantahala River             | 1994 | Canoers                                | At the Put-In -<br>On-site Evaluations | North Carolina   | 64                             | 42               | 4.06       | 4.00         |
| Presque Isle                | 1994 | Boaters                                | On Lake                                | Pennsylvania     | 64                             | 33               | 3.69       | 3.00         |
| Talachulitna River          | 1989 | All Users                              | Entire River                           | Alaska           | 64                             |                  |            |              |
| Jefferson County Reservoirs | 1997 | Deschutes River Campground Users       | Other campers                          | Oregon           | 64                             |                  | 3.90       |              |
| Acadia National Park        | 2004 | Cadillac Mountain visitors             | Other visitors                         | Maine            | 63                             | 28               | 3.54       | 3.00         |
| Acadia National Park        | 2004 | Ocean Drive -<br>Otter Cliffs visitors | Other visitors<br>(road experience)    | Maine            | 63                             | 26               | 3.44       | 3.00         |
| Alcatraz Island             | 1998 | Visitors                               | Other visitors - on the ferry          | California       | 63                             | 30               | 3.57       | 3.00         |
| Gulkana River               | 1999 | All Users                              | Lower Main Stem                        | Alaska           | 63                             | 36               | 3.83       | 4.00         |
| Kenai River                 | 1993 | Salmon Anglers                         | Middle Bank Anglers -<br>High Use Days | Alaska           | 63                             | 27               | 3.42       | 3.00         |
| Kenai River                 | 1993 | Salmon Anglers                         | Middle Bank Anglers -<br>Low Use Days  | Alaska           | 63                             | 39               | 3.92       | 4.00         |
| Lake Shasta                 | 2002 | Boaters                                | At stopping points or<br>attractions   | California       | 63                             | 43               | 4.16       | 4.00         |
| Mesa Verde National Park    | 2001 | Visitors at Step House                 | Other visitors - overall               | Colorado         | 63                             | 14               | 3.04       | 3.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                        | Date | Evaluation context                              |                                                 |                  | Method for describing crowding |                  |            |              |
|-----------------------------------|------|-------------------------------------------------|-------------------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                   |      | Evaluation by:                                  | Evaluation for:                                 | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Raystown Lake                     | 1987 | Boaters                                         | Start of Trip                                   | Pennsylvania     | 63                             | 36               | 3.80       | 3.00         |
| Jefferson County Reservoirs       | 1997 | Chinook Island Users                            | Other users                                     | Oregon           | 63                             |                  | 3.50       |              |
| Lake Sonoma                       | 2000 | Recreational Boaters                            | All Users                                       | California       | 62                             | 31               | 3.52       | 3.00         |
| Sandhill Wildlife Management Unit | 1983 | Deer Hunters - Trophy buck hunt (Either sex) NW | Other Deer Hunters                              | Wisconsin        | 62                             | 37               | 4.04       | 3.00         |
| Zion National Park                | 2003 | Grotto Trail Day Users                          | Other users - on the trail                      | Utah             | 62                             | 28               | 3.38       | 3.00         |
| Jefferson County Reservoirs       | 1997 | Indian Park Campground Users                    | Other campers                                   | Oregon           | 62                             |                  | 3.90       |              |
| Acadia National Park              | 2004 | Precipice trail hikers                          | Other hikers                                    | Maine            | 61                             | 26               | 3.40       | 3.00         |
| Fishing Bay                       | 1986 | Goose Hunters                                   | Firing Line                                     | Maryland         | 61                             | 31               | 3.70       | 4.00         |
| Mt Evans                          | 1994 | Tourists                                        | Other Tourist                                   | Colorado         | 61                             | 35               | 3.67       | 3.00         |
| Muir Woods National Monument      | 2003 | Visitors                                        | Other visitors - in the visitor center          | California       | 61                             | 29               | 3.41       | 3.00         |
| Sandhill Wildlife Management Unit | 1982 | Deer Hunters - Doe hunt (anterless) NE          | Other Deer Hunters                              | Wisconsin        | 61                             | 36               | 3.64       | 4.00         |
| Wolf River                        | 1977 | Floaters                                        | Low Water                                       | Wisconsin        | 61                             |                  |            |              |
| Yosemite National Park            | 1998 | Visitors to Yosemite Falls                      | Other visitors - on the trail to Yosemite Falls | California       | 61                             | 23               | 3.38       | 3.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                         | Date | Evaluation context                               |                                                |                  | Method for describing crowding |                  |            |              |
|------------------------------------|------|--------------------------------------------------|------------------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                    |      | Evaluation by:                                   | Evaluation for:                                | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Yosemite National Park             | 1998 | Visitors to Yosemite Falls                       | Other visitors - at the base of Yosemite Falls | California       | 61                             | 23               | 3.42       | 3.00         |
| Gulkana River                      | 1999 | All Users                                        | Sourdough Segment                              | Alaska           | 60                             | 31               | 3.61       | 3.00         |
| Mesa Verde National Park           | 2001 | Visitors at Cliff Palace                         | Other visitors - overall                       | Colorado         | 60                             | 27               | 3.40       | 3.00         |
| Nantahala River                    | 1994 | Kayakers                                         | At the Put-in - On-site Evaluations            | North Carolina   | 60                             | 33               | 3.67       | 3.00         |
| State Wide- Maryland               | 1984 | Deer Hunter- Bow Hunters                         | No Specific Resource                           | Maryland         | 60                             | 30               | 3.68       | 3.00         |
| Kanektok River                     | 1996 | All Users                                        | Other users                                    | Alaska           | 60                             | 32               | 3.78       | 3.00         |
| Apostle Islands National Lakeshore | 1981 | Boaters                                          | All Users                                      | Wisconsin        | 59                             |                  |            |              |
| Sandhill Wildlife Management Unit  | 1988 | Deer Hunters - Trophy buck hunt (Mixed) Day 2 NW | Other Deer Hunters                             | Wisconsin        | 59                             | 22               | 3.30       | 3.00         |
| Arches National Park               | 1997 | Delicate Arch Visitors                           | Other visitors at Delicate Arch                | Utah             | 58                             | 19               | 3.12       | 3.00         |
| Columbia Icefield                  | 2000 | Tourists - Snocoach Tour                         | At the Snocoach Transfer Area                  | Canada (Alberta) | 58                             | 23               | 3.22       | 3.00         |
| Kenai River                        | 1993 | Recreationists                                   | Middle River Non-anglers                       | Alaska           | 58                             | 24               | 3.22       | 3.00         |
| Sandhill Wildlife Management Unit  | 1987 | Deer Hunters - Trophy buck hunt (Mixed) Day 2 SE | Other Deer Hunters                             | Wisconsin        | 58                             | 34               | 3.86       | 3.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                              | Date | Evaluation context              |                                              |                  | Method for describing crowding |                  |            |              |
|-----------------------------------------|------|---------------------------------|----------------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                         |      | Evaluation by:                  | Evaluation for:                              | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Jefferson County Reservoirs             | 1997 | Three Rivers Day-Use Area Users | Other users                                  | Oregon           | 58                             |                  | 3.50       |              |
| Alcatraz Island                         | 1998 | Visitors                        | Other visitors - bookstores & giftshops      | California       | 57                             | 26               | 3.46       | 3.00         |
| Muir Woods National Monument            | 2004 | Visitors                        | Other visitors - in the parking area         | California       | 57                             | 29               | 3.51       | 3.00         |
| Upper Colorado River                    | 2000 | Boaters                         | Other Boaters                                | Colorado         | 57                             | 34               | 3.48       | 3.00         |
| Vail Pass - White River National Forest | 2003 | Nonmotorized Users              | snowmobilers - trailhead                     | Colorado         | 57                             | 40               | 3.88       | 3.00         |
| Vail Pass - White River National Forest | 2003 | Nonmotorized Users              | snowmobilers - trail                         | Colorado         | 57                             | 37               | 3.75       | 3.00         |
| Acadia National Park                    | 2004 | Echo Lake Beach visitors        | Other visitors                               | Maine            | 56                             | 33               | 3.54       | 3.00         |
| Alcatraz Island                         | 1998 | Visitors                        | Other visitors - in the theater/exhibit area | California       | 56                             | 25               | 3.33       | 3.00         |
| Apostle Islands National Lakeshore      | 1997 | Sail Boaters                    | All Users                                    | Wisconsin        | 56                             | 13               | 3.10       | 3.00         |
| Arches National Park                    | 1997 | Windows Visitors                | Other visitors at Windows                    | Utah             | 56                             | 24               | 3.22       | 3.00         |
| Enchantments National Forest            | 1988 | Backpackers in Wilderness       | Other Backpackers                            | Washington       | 56                             | 24               | 3.24       | 3.00         |
| Lake Shasta                             | 2002 | Boaters                         | At the put-in                                | California       | 56                             | 34               | 3.59       | 3.00         |
| New Zealand's Conservation Estate       | 1992 | Tourists                        | Other Tourists at Milford Sound              | New Zealand      | 56                             | 54               |            |              |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                                  | Date | Evaluation context                            |                                                     |                           | Method for describing crowding |                  |            |              |
|---------------------------------------------|------|-----------------------------------------------|-----------------------------------------------------|---------------------------|--------------------------------|------------------|------------|--------------|
|                                             |      | Evaluation by:                                | Evaluation for:                                     | State or country          | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Whistler Mountain                           | 2000 | Summer Visitors - Top of Gondola / Roundhouse | Other Summer Visitors - Top of Gondola / Roundhouse | Canada (British Columbia) | 56                             | 33               | 3.32       | 3.00         |
| Whistler Mountain                           | 2000 | Summer Visitors - Russet Lake                 | Other Summer Visitors - Russet Lake                 | Canada (British Columbia) | 56                             | 30               | 3.35       | 3.00         |
| Appalachian National Scenic Trail           | 1999 | Thru hiker                                    | Other hikers                                        | Multiple States           | 55                             | 29               | 3.40       | 3.00         |
| Berlin Lake                                 | 1989 | Boaters                                       | Start of Trip                                       | Pennsylvania              | 55                             | 30               | 3.40       | 3.00         |
| Columbia Icefield                           | 1996 | Tourist- Toe of the Glacier                   | Hall                                                | Canada (Alberta)          | 55                             | 33               | 3.43       | 3.00         |
| Columbia Icefield                           | 1996 | Tourist- Snocoach Tour                        | Glacier                                             | Canada (Alberta)          | 55                             | 25               | 3.25       | 3.00         |
| Rocky Mountain National Park                | 2001 | Tourists                                      | Bear Lake - Glacier Basin Shuttle Lot               | Colorado                  | 55                             | 30               | 3.37       | 3.00         |
| Sandhill Wildlife Management Unit           | 1986 | Wildlife Photography                          | Other Tourist                                       | Wisconsin                 | 55                             |                  |            |              |
| Acadia National Park                        | 2004 | Jordan Pond House visitors                    | Other visitors                                      | Maine                     | 54                             | 26               | 3.28       | 3.00         |
| Colorado River - Grand Canyon National Park | 1998 | Commercial Oar Boaters                        | All Boaters                                         | Arizona                   | 54                             | 13               | 3.15       | 3.00         |
| Gulkana River                               | 1999 | All Users                                     | Upstream CoNational Forestfluence Segment           | Alaska                    | 54                             | 24               | 3.26       | 3.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                                   | Date | Evaluation context                            |                                               |                  | Method for describing crowding |                  |            |              |
|----------------------------------------------|------|-----------------------------------------------|-----------------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                              |      | Evaluation by:                                | Evaluation for:                               | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Kenai River                                  | 1993 | Driftboat Anglers                             | Middle River Driftboat Anglers - Low Use Days | Alaska           | 54                             | 9                | 2.70       | 3.00         |
| Lake Trinity                                 | 2002 | Rental boats                                  | All boaters                                   | California       | 54                             | 23               | 3.14       | 3.00         |
| New Zealand Backcountry                      | 1996 | Backcountry Users                             | Other Backcountry Users                       | New Zealand      | 54                             | 23               | 3.10       |              |
| State Wide- Maryland                         | 1984 | Deer Hunter - Rifle Hunters                   | No Specific Resource                          | Maryland         | 54                             | 32               | 3.59       | 3.00         |
| Fulufjallet National Park                    | 2005 | Hikers - At Parking Lot                       | Evaluations of Other Hikers                   | Sweden           | 53                             | 25               | 3.05       | 3.00         |
| Grand Canyon National Park                   | 1985 | Rafters                                       | 1985 Winter                                   | Arizona          | 53                             |                  |            |              |
| Joshua Tree National Park                    | 1994 | Rock Climbers                                 | Other Rock Climbers at Last Site              | California       | 53                             | 31               | 3.54       | 3.00         |
| Lake Delavan                                 | 1986 | Recreationists                                | One Day Visit                                 | Wisconsin        | 53                             | 30               | 3.12       | 3.00         |
| Mt Jefferson Wilderness                      | 1980 | Backpackers in Wilderness                     | Other Backpackers                             | Oregon           | 53                             |                  |            |              |
| Muir Woods National Monument                 | 2003 | Visitors                                      | Other visitors - along the trails             | California       | 53                             | 19               | 2.97       | 3.00         |
| Muir Woods National Monument                 | 2004 | Visitors                                      | Other visitors - overall                      | California       | 53                             | 15               | 2.92       | 3.00         |
| Sandhill Wildlife Management Unit            | 1980 | Deer Hunters - Doe hunt (antlerless) Day 1 NW | Other Deer Hunters                            | Wisconsin        | 53                             | 21               | 3.25       | 3.00         |
| Snake River (Hell's Canyon Nati'l Rec. Area) | 1980 | Rafters                                       | In Hell's Canyon                              | Oregon           | 53                             |                  |            |              |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                        | Date | Evaluation context                                 |                                             |                  | Method for describing crowding |                  |            |              |
|-----------------------------------|------|----------------------------------------------------|---------------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                   |      | Evaluation by:                                     | Evaluation for:                             | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Brule River                       | 1975 | Anglers                                            |                                             | Wisconsin        | 52                             | 35               | 3.72       | 3.00         |
| Brule River                       | 1975 | Canoers                                            | Higher Use                                  | Wisconsin        | 52                             | 26               | 3.35       | 2.00         |
| Cape Hatteras National Seashore   | 2002 | Visitors                                           | Other visitors                              | North Carolina   | 52                             | 16               | 2.80       | 3.00         |
| Columbia Icefield                 | 2000 | Tourists - Snocoach Tour                           | While Walking on the Glacier                | Canada (Alberta) | 52                             | 23               | 3.16       | 3.00         |
| Lake Trinity                      | 2002 | Boaters                                            | At the take-out                             | California       | 52                             | 24               | 2.96       | 3.00         |
| Mt Shasta                         | 1994 | Mountain Climbers                                  | At the Summit                               | California       | 52                             | 28               | 3.27       | 3.00         |
| Muir Woods National Monument      | 2003 | Visitors                                           | Other visitors - along the road to the park | California       | 52                             | 28               | 3.44       | 3.00         |
| Muir Woods National Monument      | 2004 | Visitors                                           | Other visitors - in the gift shop           | California       | 52                             | 15               | 2.86       | 3.00         |
| Sandhill Wildlife Management Unit | 1982 | Deer Hunters - Trophy buck hunt (Either sex) SE    | Other Deer Hunters                          | Wisconsin        | 52                             | 42               | 4.00       | 3.00         |
| Sandhill Wildlife Management Unit | 1984 | Deer Hunters - Doe hunt (anterless) NE             | Other Deer Hunters                          | Wisconsin        | 52                             | 29               | 3.29       | 3.00         |
| Oregon Beaches                    | 2001 | Oregon Beachgoers - Cape Kiwanda to Nestucca River | Other beachgoers                            | Oregon           | 52                             | 29               | 3.39       | 3.00         |
| Columbia Icefield                 | 1996 | Tourists - Snocoach Tour                           | At the Snocoach Transfer Area               | Canada (Alberta) | 51                             | 19               | 2.97       | 3.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                        | Date | Evaluation context                                    |                                               |                  | Method for describing crowding |                  |            |              |
|-----------------------------------|------|-------------------------------------------------------|-----------------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                   |      | Evaluation by:                                        | Evaluation for:                               | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Deshka River                      | 1989 | All Users                                             | Entire River                                  | Alaska           | 51                             |                  |            |              |
| Fort Sumter National Monument     | 1987 | Tourists                                              | On the Boat                                   | South Carolina   | 51                             | 31               | 3.32       | 3.00         |
| Gulkana River                     | 1999 | All Users                                             | Upper Main Stem                               | Alaska           | 51                             | 16               | 2.97       | 3.00         |
| New Zealand's Conservation Estate | 1992 | Tourists                                              | Other Tourists at Greenstone & Caples Valleys | New Zealand      | 51                             | 46               |            |              |
| Presque Isle                      | 1994 | Boaters                                               | End of Trip                                   | Pennsylvania     | 51                             | 27               | 3.22       | 3.00         |
| Upper Youghiogheny River          | 1989 | Kayakers                                              | River Users                                   | Maryland         | 51                             | 23               | 3.00       | 2.00         |
| Yosemite National Park            | 2001 | Frontcountry Users                                    | Other users - along trails                    | California       | 51                             | 26               | 3.40       | 3.00         |
| Oregon Beaches                    | 2001 | Oregon Beachgoers - Necanicum River to Tillamook Head | Other beachgoers                              | Oregon           | 51                             | 24               | 3.10       | 3.00         |
| Kenai River                       | 1993 | Recreationists                                        | Upper River Non-anglers                       | Alaska           | 50                             | 27               | 3.39       | 3.00         |
| Lake Mohave                       | 1994 | Boaters                                               | Shoreline                                     | Nevada           | 50                             | 30               | 3.31       | 3.00         |
| Lake Mohave                       | 1994 | Boaters                                               | On Lake                                       | Nevada           | 50                             | 25               | 3.10       | 2.00         |
| McKenzie River                    | 1991 | Boaters - Lower River                                 | Other Boaters                                 | Oregon           | 50                             | 19               |            |              |
| Sandhill Wildlife Management Unit | 1989 | Deer Hunters - Trophy buck hunt (Mixed) Day 2 SE      | Other Deer Hunters                            | Wisconsin        | 50                             | 34               | 3.55       | 2.00         |
| Eagle Cap Wilderness              | 1980 | Hikers in Wilderness                                  | Other Hikers                                  | Oregon           | 49                             |                  |            |              |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                        | Date | Evaluation context                                |                                                  |                  | Method for describing crowding |                  |            |              |
|-----------------------------------|------|---------------------------------------------------|--------------------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                   |      | Evaluation by:                                    | Evaluation for:                                  | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Sandhill Wildlife Management Unit | 1980 | Deer Hunters - Doe hunt (anterless) Day 2 SE      | Other Deer Hunters                               | Wisconsin        | 49                             | 21               | 4.90       | 2.00         |
| Sandhill Wildlife Management Unit | 1987 | Deer Hunters - Trophy buck hunt (Mixed) Day 2 SW  | Other Deer Hunters                               | Wisconsin        | 49                             | 26               | 3.16       | 2.00         |
| Bong Wildlife Management Unit     | 1979 | Pheasant Hunters                                  | Rest of Season                                   | Wisconsin        | 48                             | 24               | 3.00       | 2.00         |
| Columbia Icefield                 | 1993 | Tourist-Snocoach Tour                             | Glacier                                          | Canada (Alberta) | 48                             | 20               | 2.97       | 2.00         |
| Columbia Icefield                 | 1993 | Tourist - Toe of the Glacier                      | Snocoach Road                                    | Canada (Alberta) | 48                             | 19               | 2.81       | 2.00         |
| Columbia Icefield                 | 1993 | Tourist - Snocoach Tour                           | Number of Snocoaches at Glacier                  | Canada (Alberta) | 48                             | 18               | 2.83       | 2.00         |
| Hawaii Volcanoes National Park    | 2002 | Visitors at End of Chain of Craters Road          | Other visitors - at end of chain of craters road | Hawaii           | 48                             | 21               | 2.85       | 2.00         |
| Lake Mohave                       | 1994 | Boaters                                           | End of Trip                                      | Nevada           | 48                             | 29               | 3.34       | 2.00         |
| Mesa Verde National Park          | 2001 | Visitors at Sun Point Overlook                    | Other visitors - overall                         | Colorado         | 48                             | 12               | 2.69       | 2.00         |
| Sandhill Wildlife Management Unit | 1980 | Deer Hunters - Doe hunt (anterless) Day 1 SW      | Other Deer Hunters                               | Wisconsin        | 48                             | 19               | 2.81       | 2.00         |
| Oregon Beaches                    | 2001 | Oregon Beachgoers - Chapman Point to Humbug Point | Other beachgoers                                 | Oregon           | 48                             | 23               | 3.00       | 2.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                        | Date | Evaluation context                                          |                                               |                  | Method for describing crowding |                  |            |              |
|-----------------------------------|------|-------------------------------------------------------------|-----------------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                   |      | Evaluation by:                                              | Evaluation for:                               | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Appalachian National Scenic Trail | 1999 | Non-Thru hiker                                              | Other hikers                                  | Multiple States  | 47                             | 23               | 3.00       | 2.00         |
| Cuyabeno Wildlife Reserve         | 1995 | Ecotourists                                                 | Evaluations of Other Tourist in the Villages  | Ecuador          | 47                             | 20               | 1.69       | 1.00         |
| Gunnison Gorge Natl Conserv Area  | 2002 | Gunnison Gorge Wilderness/Inner Canyon (river - wilderness) | Evaluations of all users                      | Colorado         | 47                             | 23               | 3.00       | 2.00         |
| Israel Nature Reserve - Banias    | 1995 | Hikers                                                      | Other Hikers                                  | Israel           | 47                             | 19               | 1.71       | 1.00         |
| Lake Sonoma                       | 2000 | Fishing - Boaters                                           | All Users                                     | California       | 47                             | 30               | 3.13       | 2.00         |
| Lake Trinity                      | 2002 | Boaters                                                     | At stopping points or attractions             | California       | 47                             | 28               | 3.16       | 2.00         |
| Kapati Island                     | 1991 | Repeat Visitors                                             | Other Visitors                                | New Zealand      | 46                             | 19               |            |              |
| Kenai River                       | 1993 | Power Boaters                                               | Middle River Powerboat Anglers - Low Use Days | Alaska           | 46                             | 20               | 3.21       | 2.00         |
| State Wide- Wisconsin             | 1977 | Deer Hunters                                                | No Specific Resource                          | Wisconsin        | 46                             | 25               | 3.13       | 2.00         |
| Acadia Carriage Roads             | 1996 | Carriage Road users                                         | Other users                                   | Maine            | 45                             | 23               | 3.05       | 2.00         |
| Gulkana River                     | 1999 | All Users                                                   | Paxson Launch Area                            | Alaska           | 45                             | 19               | 2.97       | 2.00         |
| Lake Mohave                       | 1994 | Boaters                                                     | Start of Trip                                 | Nevada           | 45                             | 28               | 3.17       | 2.00         |
| Lake Shasta                       | 2002 | Boaters                                                     | On the lake                                   | California       | 45                             | 25               | 2.96       | 2.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                                  | Date | Evaluation context                              |                                                  |                           | Method for describing crowding |                  |            |              |
|---------------------------------------------|------|-------------------------------------------------|--------------------------------------------------|---------------------------|--------------------------------|------------------|------------|--------------|
|                                             |      | Evaluation by:                                  | Evaluation for:                                  | State or country          | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Rakaia River                                | 1983 | Salmon Anglers                                  | Upstream                                         | New Zealand               | 45                             | 24               |            |              |
| Fort Sumter National Monument               | 1987 | Tourists                                        | At the Fort                                      | South Carolina            | 44                             | 25               | 2.94       | 2.00         |
| Sandhill Wildlife Management Unit           | 1981 | Deer Hunters - Trophy buck hunt (Either sex) NE | Other Deer Hunters                               | Wisconsin                 | 44                             | 19               | 3.15       | 2.00         |
| State Wide- Maryland                        | 1977 | Turkey Hunters                                  | No Specific Resource                             | Maryland                  | 44                             | 20               | 2.94       | 2.00         |
| Goodnews River                              | 1996 | All Users                                       | Other users                                      | Alaska                    | 44                             | 22               | 2.98       | 2.00         |
| Jefferson County Reservoirs                 | 1997 | Monty Campground Users                          | Other campers                                    | Oregon                    | 44                             |                  | 2.80       |              |
| Acadia National Park                        | 2004 | Hiking trails combined                          | Other hikers                                     | Maine                     | 43                             | 10               | 2.53       | 2.00         |
| Alcatraz Island                             | 1998 | Visitors                                        | Other visitors - walking roads and trails        | California                | 43                             | 13               | 2.68       | 2.00         |
| Brule River                                 | 1975 | Tubers                                          |                                                  | Wisconsin                 | 43                             | 13               | 2.87       | 2.00         |
| McKenzie River                              | 1996 | Boaters - Upper River                           | Other Boaters                                    | Oregon                    | 43                             | 14               | 2.90       | 2.00         |
| Whistler Mountain                           | 2000 | Summer Visitors - Mid-Mountain / Bike Park      | Other Summer Visitors - Mid-Mountain / Bike Park | Canada (British Columbia) | 43                             | 20               | 2.77       | 2.00         |
| Colorado River - Grand Canyon National Park | 1998 | Commercial Motor Boaters                        | All Boaters                                      | Arizona                   | 42                             | 10               | 2.66       | 2.00         |
| Gulkana River                               | 1999 | All Users                                       | Lower West Fork                                  | Alaska                    | 42                             | 18               | 2.88       | 2.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                        | Date | Evaluation context                                   |                                    |                  | Method for describing crowding |                  |            |              |
|-----------------------------------|------|------------------------------------------------------|------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                   |      | Evaluation by:                                       | Evaluation for:                    | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Gunnison Gorge Natl Conserv Area  | 2002 | Smith Fork to Austin - Gunnison River non-wilderness | Evaluations of all users           | Colorado         | 42                             | 6                | 2.50       | 2.00         |
| Hawaii Volcanoes National Park    | 2002 | Visitors at Visitor Center                           | Other visitors - at Visitor Center | Hawaii           | 42                             | 16               | 2.69       | 2.00         |
| Mt Shasta                         | 1994 | Mountain Climbers                                    | At the Campground                  | California       | 42                             | 24               | 2.99       | 2.00         |
| Muir Woods National Monument      | 2004 | Visitors                                             | Other visitors - along the trails  | California       | 42                             | 15               | 2.74       | 2.00         |
| Muir Woods National Monument      | 2004 | Visitors                                             | Other visitors - in the cafe       | California       | 42                             | 14               | 2.74       | 2.00         |
| Nanticote River                   | 1996 | Boaters                                              | Boating Conditions on the River    | Alaska           | 42                             | 14               | 2.39       | 2.00         |
| Sandhill Wildlife Management Unit | 1984 | Deer Hunters - Trophy buck hunt (Either sex) SW      | Other Deer Hunters                 | Wisconsin        | 42                             | 17               | 2.79       | 2.00         |
| Yosemite National Park            | 2001 | Frontcountry Users                                   | Other users - at campsites         | California       | 42                             | 24               | 3.10       | 2.00         |
| Jefferson County Reservoirs       | 1997 | Lake Simtustus RV Park Users                         | Other campers                      | Oregon           | 42                             |                  | 2.70       |              |
| Oregon Beaches                    | 2001 | Oregon Beachgoers - Harris Beach                     | Other beachgoers                   | Oregon           | 42                             | 16               | 2.59       | 2.00         |
| Acadia National Park              | 2004 | Ocean Drive - Fabbri Picnic area visitors            | Other visitors (road experience)   | Maine            | 41                             | 10               | 2.57       | 2.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                                           | Date | Evaluation context                                    |                                        |                  | Method for describing crowding |                  |            |              |
|------------------------------------------------------|------|-------------------------------------------------------|----------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                                      |      | Evaluation by:                                        | Evaluation for:                        | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Fulufjallet National Park                            | 2005 | Hikers - Walking on Trail to and from Njupeskar Falls | Evaluations of Other Hikers            | Sweden           | 41                             | 17               | 2.56       | 2.00         |
| Haleakala National Park                              | 2004 | Visitors at Red Hill Overlook                         | Other visitors - overall               | Hawaii           | 41                             | 21               | 2.85       | 2.00         |
| Haleakala National Park                              | 2003 | Bicycle tourists                                      | Other visitors - overall               | Hawaii           | 41                             | 11               | 2.79       | 3.00         |
| Muir Woods National Monument                         | 2004 | Visitors                                              | Other visitors - in the visitor center | California       | 41                             | 10               | 2.55       | 2.00         |
| Sandhill Wildlife Management Unit                    | 1984 | Deer Hunters - Trophy buck hunt (Either sex) NE       | Other Deer Hunters                     | Wisconsin        | 41                             | 10               | 2.45       | 2.00         |
| State Wide- Wisconsin                                | 1982 | Deer Hunters                                          | Other Deer Hunters                     | Wisconsin        | 41                             | 17               | 2.75       | 2.00         |
| Stockings Park - Sleeping Bear Dunes Nat'l Lakeshore | 1977 | Driving Tourists                                      | Other Tourist                          | Michigan         | 41                             | 15               | 2.84       | 2.00         |
| Yosemite National Park                               | 2001 | Wilderness Transition Users                           | Other users - along trails             | California       | 41                             | 21               | 2.80       | 2.00         |
| Oregon Beaches                                       | 2001 | Oregon Beachgoers - Sutton Creek to Siuslaw River     | Other beachgoers                       | Oregon           | 41                             | 18               | 2.84       | 2.00         |
| Acadia National Park                                 | 2004 | Sand Beach visitors                                   | Other visitors                         | Maine            | 40                             | 13               | 2.64       | 2.00         |
| Banff National Park                                  | 1993 | Tourists                                              | Other Tourist                          | Canada (Alberta) | 40                             | 16               | 2.72       | 2.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                        | Date | Evaluation context                                |                                         |                  | Method for describing crowding |                  |            |              |
|-----------------------------------|------|---------------------------------------------------|-----------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                   |      | Evaluation by:                                    | Evaluation for:                         | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Cache la Poudre River             | 1993 | Anglers                                           | Evaluations of Other Anglers            | Colorado         | 40                             | 15               | 2.46       | 2.00         |
| Columbia Icefield                 | 1993 | Tourist- Toe of the Glacier                       | Glacier                                 | Canada (Alberta) | 40                             | 14               | 2.48       | 2.00         |
| Cuyabeno Wildlife Reserve         | 1995 | Ecotourists                                       | Evaluations of others in camp           | Ecuador          | 40                             | 12               | 1.52       | 1.00         |
| Fulufjallet National Park         | 2001 | Hikers - Trail BB                                 | Evaluations of Other Hikers on Trail BB | Sweden           | 40                             | 14               | 2.66       | 2.00         |
| Muir Beach                        | 2003 | Visitors                                          | Other visitors - in the parking area    | California       | 40                             | 14               | 2.52       | 2.00         |
| Sandhill Wildlife Management Unit | 1984 | Deer Hunters - Trophy buck hunt (Either sex) SE   | Other Deer Hunters                      | Wisconsin        | 40                             | 23               | 3.00       | 2.00         |
| Sandhill Wildlife Management Unit | 1985 | Deer Hunters - Trophy buck hunt (Either sex) SW   | Other Deer Hunters                      | Wisconsin        | 40                             | 20               | 2.76       | 2.00         |
| Oregon Beaches                    | 2001 | Oregon Beachgoers - Hug Point to Arch Cape        | Other beachgoers                        | Oregon           | 40                             | 12               | 2.70       | 2.00         |
| Oregon Beaches                    | 2001 | Oregon Beachgoers - Netarts River to Cape Lookout | Other beachgoers                        | Oregon           | 40                             | 13               | 2.48       | 2.00         |
| Antelope Island State Park        | 1999 | Frontcountry visitors                             | Weekends                                | Utah             | 39                             | 19               | 2.70       | 2.00         |
| Colorado Reservoirs               | 1998 | Anglers                                           | North Catamount Reservoir               | Colorado         | 39                             | 13               | 2.60       | 1.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                         | Date | Evaluation context                              |                                              |                           | Method for describing crowding |                  |            |              |
|------------------------------------|------|-------------------------------------------------|----------------------------------------------|---------------------------|--------------------------------|------------------|------------|--------------|
|                                    |      | Evaluation by:                                  | Evaluation for:                              | State or country          | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Gunnison Gorge Nat'l Conserv. Area | 2002 | Flat Top and Peach Valley - OHV areas           | Evaluations of all users                     | Colorado                  | 39                             | 16               | 2.70       | 2.00         |
| Kenai River                        | 1993 | Driftboat Anglers                               | Lower River Driftboat Anglers - Low Use Days | Alaska                    | 39                             | 10               | 2.57       | 2.00         |
| New Zealand's Conservation Estate  | 1992 | Tourists                                        | Other Tourists at Mount Cook                 | New Zealand               | 39                             | 36               |            |              |
| Pacific Rim National Park          | 2001 | Ocean kayakers                                  | On water with other boats                    | Canada (British Columbia) | 39                             | 17               | 2.74       | 2.00         |
| Phoenix North Public Lands         | 2002 | Urban proximate BLM land north of Phoenix metro | Evaluations of all users                     | Arizona                   | 39                             | 15               | 2.70       | 2.00         |
| Sandhill Wildlife Management Unit  | 1981 | Deer Hunters - Trophy buck hunt (Either sex) NW | Other Deer Hunters                           | Wisconsin                 | 39                             | 21               | 3.03       | 2.00         |
| Sandhill Wildlife Management Unit  | 1984 | Deer Hunters - Doe hunt (antlerless) NW         | Other Deer Hunters                           | Wisconsin                 | 39                             | 14               | 2.68       | 2.00         |
| White Mountain Natl Forrest        | 1984 | Backpackers in Wilderness                       | Presidential Range                           | New Hampshire             | 39                             | 11               | 2.60       | 2.00         |
| Apostle Islands National Lakeshore | 1985 | Sail Boaters                                    | All Users                                    | Wisconsin                 | 38                             | 8                | 2.38       | 2.00         |
| Apostle Islands National Lakeshore | 1997 | Sea Kayakers                                    | All Users                                    | Wisconsin                 | 38                             | 9                | 2.56       | 2.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                                         | Date | Evaluation context                                      |                                             |                           | Method for describing crowding |                  |            |              |
|----------------------------------------------------|------|---------------------------------------------------------|---------------------------------------------|---------------------------|--------------------------------|------------------|------------|--------------|
|                                                    |      | Evaluation by:                                          | Evaluation for:                             | State or country          | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Cache la Poudre River                              | 1993 | Kayakers                                                | Evaluations of Rafters on the River         | Colorado                  | 38                             | 18               | 2.68       | 2.00         |
| Gwaii Haanas National Park Reserve & Heritage Site | 1995 | Motor Boaters                                           | Evaluations of Kayakers at Camping Sites    | Canada (British Columbia) | 38                             | 31               | 3.26       | 1.00         |
| Klamath River                                      | 1984 | Floaters                                                | Summer Season Floaters                      | California                | 38                             | 16               | 2.52       | 2.00         |
| Lake Trinity                                       | 2002 | Boaters                                                 | At the put-in                               | California                | 38                             | 25               | 2.88       | 2.00         |
| Sandhill Wildlife Management Unit                  | 1987 | Deer Hunters - Trophy buck hunt (Mixed) Day 1 NW        | Other Deer Hunters                          | Wisconsin                 | 38                             | 3                | 2.21       | 2.00         |
| Oregon Beaches                                     | 2001 | Oregon Beachgoers - Neahkanie Mountain to Nehalem River | Other beachgoers                            | Oregon                    | 38                             | 10               | 2.49       | 2.00         |
| Brule River                                        | 1985 | Canoers                                                 | Lower Use                                   | Wisconsin                 | 37                             | 11               | 2.44       | 2.00         |
| Cuyabeno Wildlife Reserve                          | 1995 | Ecotourists                                             | Evaluations of Tourists on Daily Excursions | Ecuador                   | 37                             | 16               | 1.55       | 1.00         |
| Cuyabeno Wildlife Reserve                          | 1995 | Ecotourists                                             | Evaluations of tourists in lodge            | Ecuador                   | 37                             | 13               | 1.50       | 1.00         |
| Hawaii Volcanoes National Park                     | 2002 | Visitors at Visitor Center                              | Other visitors - overall                    | Hawaii                    | 37                             | 14               | 2.57       | 2.00         |
| Lake Mead                                          | 1994 | Boaters                                                 | Shoreline                                   | Nevada                    | 37                             | 21               | 2.67       | 2.00         |
| Lake Mead                                          | 1994 | Boaters                                                 | End of Trip                                 | Nevada                    | 37                             | 20               | 2.67       | 2.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                                | Date | Evaluation context                              |                                                      |                           | Method for describing crowding |                  |            |              |
|-------------------------------------------|------|-------------------------------------------------|------------------------------------------------------|---------------------------|--------------------------------|------------------|------------|--------------|
|                                           |      | Evaluation by:                                  | Evaluation for:                                      | State or country          | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Rocky Mountain National Park              | 2001 | Hikers                                          | Longs Peak Hikers at the Trailhead                   | Colorado                  | 37                             | 19               | 2.66       | 2.00         |
| Sandhill Wildlife Management Unit         | 1984 | Deer Hunters - Doe hunt (antlerless) SW         | Other Deer Hunters                                   | Wisconsin                 | 37                             | 8                | 2.50       | 2.00         |
| Whistler Mountain                         | 2000 | Summer Visitors - Flute Summit / Musical Bumps  | Other Summer Visitors - Flute Summit / Musical Bumps | Canada (British Columbia) | 37                             | 14               | 2.44       | 2.00         |
| Oregon Beaches                            | 2001 | Oregon Beachgoers - North Sand Lake Spit        | Other beachgoers                                     | Oregon                    | 37                             | 6                | 2.25       | 2.00         |
| Acadia National Park - Isle au Haut       | 2003 | Residents                                       | Other visitors - along the trails                    | Maine                     | 36                             | 9                | 2.50       | 2.00         |
| Acadia National Park - Schoodic Peninsula | 2000 | Visitors                                        | Other visitors - at the Schoodic Peninsula           | Maine                     | 36                             | 13               | 2.39       | 2.00         |
| Cuyabeno Wildlife Reserve                 | 1995 | Ecotourists                                     | Evaluations of others in tour group                  | Ecuador                   | 36                             | 10               | 1.46       | 1.00         |
| Hawaii Volcanoes National Park            | 2002 | Visitors at End of Chain of Craters Road        | Other visitors - overall                             | Hawaii                    | 36                             | 11               | 2.51       | 2.00         |
| Sandhill Wildlife Management Unit         | 1985 | Deer Hunters - Trophy buck hunt (Either sex) NE | Other Deer Hunters                                   | Wisconsin                 | 36                             | 4                | 2.00       | 2.00         |
| Yosemite National Park                    | 2001 | Wilderness Remote Users                         | Other users - along trails                           | California                | 36                             | 24               | 2.70       | 2.00         |
| Mt. Jefferson Wilderness                  | 1991 | Wilderness Users (Hikers)                       | Other Wilderness Users                               | Oregon                    | 36                             | 16               | 2.57       | 2.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                                      | Date | Evaluation context                                 |                                                       |                           | Method for describing crowding |                  |            |              |
|-------------------------------------------------|------|----------------------------------------------------|-------------------------------------------------------|---------------------------|--------------------------------|------------------|------------|--------------|
|                                                 |      | Evaluation by:                                     | Evaluation for:                                       | State or country          | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Oregon Beaches                                  | 2001 | Oregon Beachgoers - Point Maxwell to Netarts River | Other beachgoers                                      | Oregon                    | 36                             | 14               | 2.51       | 2.00         |
| Clackamas River                                 | 1995 | Boaters                                            | All users                                             | Oregon                    | 35                             | 8                |            |              |
| Colorado Reservoirs                             | 1998 | Anglers                                            | South Catamount Reservoir                             | Colorado                  | 35                             | 16               | 2.66       | 1.00         |
| Gwaii Haanas Nat'l Park Reserve & Heritage Site | 1995 | Motor Boaters                                      | Evaluations of Kayakers at Cultural Sites             | Canada (British Columbia) | 35                             | 16               | 2.51       | 1.00         |
| Gwaii Haanas Nat'l Park Reserve & Heritage Site | 1995 | Kayakers                                           | Evaluations of Kayakers at Camping Sites              | Canada (British Columbia) | 35                             | 10               | 2.31       | 2.00         |
| Haleakala National Park                         | 2004 | Visitors at Red Hill Overlook                      | Other visitors - at visitor's center/observation area | Hawaii                    | 35                             | 18               | 2.66       | 2.00         |
| Jasper National Park                            | 1993 | Tourist                                            | Other Tourist                                         | Canada (British Columbia) | 35                             | 10               | 2.43       | 2.00         |
| Presque Isle                                    | 1994 | Boaters                                            | Start of Trip                                         | Pennsylvania              | 35                             | 16               | 2.45       | 2.00         |
| Sagamore Hill National Historic Site            | 2002 | Visitors                                           | Other visitors - Roosevelt home                       | New York                  | 35                             | 11               | 2.36       | 2.00         |
| Sandhill Wildlife Management Unit               | 1979 | Deer Hunters - Doe hunt (anterless) Day 2          | Other Deer Hunters                                    | Wisconsin                 | 35                             | 14               | 2.44       | 1.00         |
| Sandhill Wildlife Management Unit               | 1984 | Deer Hunters - Doe hunt (anterless) SE             | Other Deer Hunters                                    | Wisconsin                 | 35                             | 15               | 2.46       | 2.00         |
| Upper Youghiogheny River                        | 1989 | Rafters                                            | River Users                                           | Maryland                  | 35                             | 14               | 2.40       | 2.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                                         | Date | Evaluation context                              |                                          |                  | Method for describing crowding |                  |            |              |
|----------------------------------------------------|------|-------------------------------------------------|------------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                                    |      | Evaluation by:                                  | Evaluation for:                          | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Wolf Creek Pass - San Juan/Rio Grande Nat'l Forest | 2003 | Nonmotorized Users                              | snowmobilers - trailhead                 | Colorado         | 35                             | 14               | 2.36       | 1.00         |
| Acadia National Park - Isle au Haut                | 2003 | Residents                                       | Other visitors - overall on Isle au Haut | Maine            | 34                             | 14               | 2.56       | 2.00         |
| Boston Harbor Islands                              | 2000 | Long Wharf Visitors                             | Other visitors to Long Wharf             | Massachusetts    | 34                             | 12               | 2.31       | 2.00         |
| Cache la Poudre River                              | 1993 | Anglers                                         | Evaluations of Rafters                   | Colorado         | 34                             | 17               | 2.31       | 1.00         |
| Oregon Beaches                                     | 2001 | Oregon Beachgoers - Roads End to Siletz River   | Other beachgoers                         | Oregon           | 34                             | 12               | 2.35       | 2.00         |
| Oregon Beaches                                     | 2001 | Oregon Beachgoers - Siletz River to Boiler Bay  | Other beachgoers                         | Oregon           | 34                             | 13               | 2.41       | 2.00         |
| Gulkana River                                      | 1999 | All Users                                       | Middle Fork                              | Alaska           | 33                             | 6                | 2.44       | 2.00         |
| Haleakala National Park                            | 2004 | Visitors at Visitor Center                      | Other visitors - overall                 | Hawaii           | 33                             | 11               | 2.56       | 2.00         |
| Kenai River                                        | 1993 | Recreationists                                  | Lower River Non-anglers                  | Alaska           | 33                             | 17               | 2.26       | 1.00         |
| Lake Delavan                                       | 1986 | Riparian Landowners                             | Weekdays                                 | Wisconsin        | 33                             | 10               | 2.48       | 2.00         |
| Lake Mead                                          | 1994 | Boaters                                         | On Lake                                  | Nevada           | 33                             | 13               | 2.32       | 2.00         |
| Sandhill Wildlife Management Unit                  | 1982 | Deer Hunters - Trophy buck hunt (Either sex) SW | Other Deer Hunters                       | Wisconsin        | 33                             | 13               | 2.67       | 2.00         |
| Togiak River                                       | 1996 | All Users                                       | Other users                              | Alaska           | 33                             | 15               | 2.56       | 2.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                                    | Date | Evaluation context                                    |                                                                         |                  | Method for describing crowding |                  |            |              |
|-----------------------------------------------|------|-------------------------------------------------------|-------------------------------------------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                               |      | Evaluation by:                                        | Evaluation for:                                                         | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Zion National Park                            | 2003 | Virgin River Narrows hikers                           | Other hikers - between head of Virgin River Narrows & Orderville Canyon | Utah             | 33                             | 16               | 2.57       | 2.00         |
| Oregon Beaches                                | 2001 | Oregon Beachgoers - Columbia River to Necanicum River | Other beachgoers                                                        | Oregon           | 33                             | 18               | 2.52       | 2.00         |
| Oregon Beaches                                | 2001 | Oregon Beachgoers - Lily Lake area to Sutton Creek    | Other beachgoers                                                        | Oregon           | 33                             |                  |            |              |
| Acadia Carriage Roads                         | 1995 | Carriage Road users                                   | Other users                                                             | Maine            | 32                             | 8                | 2.28       | 2.00         |
| Acadia National Park                          | 2004 | Bass Harbor Head Light visitors                       | Other visitors                                                          | Maine            | 32                             | 6                | 2.36       | 2.00         |
| Cache la Poudre River                         | 1993 | Kayakers                                              | Evaluations of Rafters at the Put-In                                    | Colorado         | 32                             | 16               | 2.51       | 1.00         |
| Colorado River - Glen Canyon Nat'l Rec. Area  | 1984 | Anglers                                               | Midweek                                                                 | Arizona          | 32                             |                  |            |              |
| Grand Staircase - Escalante National Monument | 1999 | Hunters                                               | Post-Designation Experience Visitors                                    | Utah             | 32                             | 5                | 2.20       | 2.00         |
| Haleakala National Park                       | 2003 | Bicycle tourists                                      | Other visitors - on the park roads                                      | Hawaii           | 32                             | 6                | 2.32       | 2.00         |
| Lake Mead                                     | 1994 | Boaters                                               | Start of Trip                                                           | Nevada           | 32                             | 12               | 2.41       | 1.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                              | Date | Evaluation context                                |                                             |                  | Method for describing crowding |                  |            |              |
|-----------------------------------------|------|---------------------------------------------------|---------------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                         |      | Evaluation by:                                    | Evaluation for:                             | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Sandhill Wildlife Management Unit       | 1983 | Deer Hunters - Trophy buck hunt (Either sex) SE   | Other Deer Hunters                          | Wisconsin        | 32                             | 9                | 2.09       | 1.00         |
| Three Sisters Wilderness                | 1991 | Wilderness Users (Hikers)                         | Other Wilderness Users                      | Oregon           | 32                             | 16               | 2.48       | 2.00         |
| Antelope Island State Park              | 1999 | Mountain Bikers                                   | Evaluations of other Backcountry Visitors   | Utah             | 31                             | 11               | 2.26       | 2.00         |
| Columbia Icefield                       | 1996 | Tourist - Toe of the Glacier                      | Glacier                                     | Canada (Alberta) | 31                             | 16               | 2.30       | 1.00         |
| Dolly Sods Wilderness                   | 1982 | Hikers in Wilderness                              | Lower Use Period                            | West Virginia    | 31                             | 15               | 2.42       | 1.82         |
| Hawaii Volcanoes National Park          | 2002 | Visitors at Thurston Lava Tube                    | Other visitors - overall                    | Hawaii           | 31                             | 8                | 2.24       | 2.00         |
| Sandhill Wildlife Management Unit       | 1987 | Deer Hunters - Trophy buck hunt (Mixed) Day 1 SW  | Other Deer Hunters                          | Wisconsin        | 31                             | 6                | 2.06       | 2.00         |
| Vail Pass - White River National Forest | 2003 | Motorized Users                                   | skiers/snowshoers /snowboarders - trailhead | Colorado         | 31                             | 13               | 2.31       | 1.00         |
| Oregon Beaches                          | 2001 | Oregon Beachgoers - Humbug Point to Hug Point     | Other beachgoers                            | Oregon           | 31                             | 19               | 2.90       | 2.00         |
| Oregon Beaches                          | 2001 | Oregon Beachgoers - Yaquina Head to Yaquina River | Other beachgoers                            | Oregon           | 31                             | 10               | 2.19       | 2.00         |
| Acadia National Park                    | 2004 | Sieur de Monts visitors                           | Other visitors                              | Maine            | 30                             | 5                | 2.15       | 2.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                                    | Date | Evaluation context                                 |                                                       |                  | Method for describing crowding |                  |            |              |
|-----------------------------------------------|------|----------------------------------------------------|-------------------------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                               |      | Evaluation by:                                     | Evaluation for:                                       | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Antelope Island State Park                    | 1999 | Horseback Riders                                   | Evaluations of Other Backcountry Visitors             | Utah             | 30                             | 10               | 2.15       | 1.50         |
| Columbia Icefield                             | 1993 | Tourist - Snocoach Tour                            | Snocoach Road                                         | Canada (Alberta) | 30                             | 8                | 2.32       | 2.00         |
| Grand Staircase - Escalante National Monument | 1999 | Backcountry Visitors                               | Pre-Designation Experience Visitors                   | Utah             | 30                             | 12               | 2.30       | 2.00         |
| Grand Staircase - Escalante National Monument | 1999 | Backcountry Visitors                               | Post-Designation Experience Visitors                  | Utah             | 30                             | 8                | 2.17       | 2.00         |
| Haleakala National Park                       | 2004 | Visitors at Visitor Center                         | Other visitors - at visitor's center/observation area | Hawaii           | 30                             | 12               | 2.52       | 2.00         |
| Jefferson County                              | 1996 | Hikers                                             | Bikers                                                | Colorado         | 30                             | 12               | 1.39       | 0.00         |
| McNeil River                                  | 1998 | Standby Permittees                                 | All users                                             | Alaska           | 30                             | 12               | 2.26       | 2.00         |
| Sandhill Wildlife Management Unit             | 1986 | Deer Hunters - Trophy buck hunt (Either sex) SW    | Other Deer Hunters                                    | Wisconsin        | 30                             | 4                | 2.19       | 2.00         |
| Kanektok River                                | 2001 | All Users                                          | Other users in wilderness                             | Alaska           | 30                             | 10               | 2.26       | 2.00         |
| Vail Pass - White River National Forest       | 2003 | Motorized Users                                    | snowmobilers - trailhead                              | Colorado         | 30                             | 8                | 2.05       | 1.00         |
| Oregon Beaches                                | 2001 | Oregon Beachgoers - Cape Sebastian to Pistol River | Other beachgoers                                      | Oregon           | 30                             | 9                | 2.04       | 1.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                        | Date | Evaluation context                                |                         |                  | Method for describing crowding |                  |            |              |
|-----------------------------------|------|---------------------------------------------------|-------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                   |      | Evaluation by:                                    | Evaluation for:         | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Oregon Beaches                    | 2001 | Oregon Beachgoers - Threemile Cr. to Umpqua River | Other beachgoers        | Oregon           | 30                             |                  |            |              |
| Cache la Poudre River             | 1993 | Anglers                                           | Evaluations of Kayakers | Colorado         | 29                             | 16               | 2.24       | 1.00         |
| Kapati Island                     | 1991 | First Time Visitors                               | Other Visitors          | New Zealand      | 29                             | 6                |            |              |
| Lake Trinity                      | 2002 | Boaters                                           | On the lake             | California       | 29                             | 15               | 2.29       | 1.00         |
| McNeil River                      | 1998 | Successful Permittees                             | All users               | Alaska           | 29                             | 9                | 2.26       | 2.00         |
| Sandhill Wildlife Management Unit | 1980 | Deer Hunters - Doe hunt (anterless) Day 1 NE      | Other Deer Hunters      | Wisconsin        | 29                             | 23               | 2.51       | 2.00         |
| Sandhill Wildlife Management Unit | 1981 | Deer Hunters - Trophy buck hunt (Either sex) SW   | Other Deer Hunters      | Wisconsin        | 29                             | 8                | 2.25       | 2.00         |
| Sandhill Wildlife Management Unit | 1984 | Deer Hunters - Trophy buck hunt (Either sex) NW   | Other Deer Hunters      | Wisconsin        | 29                             | 6                | 2.23       | 2.00         |
| Sandhill Wildlife Management Unit | 1985 | Deer Hunters - Trophy buck hunt (Either sex) SE   | Other Deer Hunters      | Wisconsin        | 29                             | 12               | 2.21       | 2.00         |
| Sandhill Wildlife Management Unit | 1986 | Deer Hunters - Trophy buck hunt (Either sex) NW   | Other Deer Hunters      | Wisconsin        | 29                             | 19               | 2.35       | 1.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                                         | Date | Evaluation context                              |                                                  |                           | Method for describing crowding |                  |            |              |
|----------------------------------------------------|------|-------------------------------------------------|--------------------------------------------------|---------------------------|--------------------------------|------------------|------------|--------------|
|                                                    |      | Evaluation by:                                  | Evaluation for:                                  | State or country          | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Sandhill Wildlife Management Unit                  | 1986 | Deer Hunters - Trophy buck hunt (Either sex) NE | Other Deer Hunters                               | Wisconsin                 | 29                             | 4                | 2.21       | 2.00         |
| Vail Pass - White River National Forest            | 2003 | Nonmotorized Users                              | skiers/snowshoers /snowboarders - trailhead      | Colorado                  | 29                             | 7                | 2.09       | 1.00         |
| Wolf Creek Pass - San Juan/Rio Grande Nat'l Forest | 2003 | Nonmotorized Users                              | snowmobilers - trail                             | Colorado                  | 29                             | 15               | 2.37       | 1.00         |
| Fulufjallet National Park                          | 2005 | Hikers - At Visitor's Center                    | Evaluations of Other Hikers                      | Sweden                    | 28                             | 5                | 1.98       | 1.00         |
| Haleakala National Park                            | 2003 | Visitors - as exiting park                      | Other visitors                                   | Hawaii                    | 28                             | 8                | 2.10       | 2.00         |
| Muir Woods National Monument                       | 2004 | Visitors                                        | Other visitors - along the road to the park      | California                | 28                             | 11               | 2.36       | 2.00         |
| Vail Pass - White River National Forest            | 2003 | Nonmotorized Users                              | skiers/snowshoers /snowboarders - trail          | Colorado                  | 28                             | 6                | 1.98       | 1.00         |
| Yosemite National Park                             | 1999 | Visitors to Mirror Lake                         | Other visitors - along this trail to Mirror Lake | California                | 28                             | 7                | 2.23       | 2.00         |
| Gwaii Haanas Nat'l Park Reserve & Heritage Site    | 1995 | Kayakers                                        | Evaluations of Kayakers at Cultural Sites        | Canada (British Columbia) | 27                             | 6                | 2.06       | 1.00         |
| Muir Beach                                         | 2003 | Visitors                                        | Other visitors - along the road to the park      | California                | 27                             | 9                | 2.09       | 1.00         |
| Muir Beach                                         | 2003 | Visitors                                        | Other visitors - overall                         | California                | 27                             | 7                | 1.99       | 1.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                                         | Date | Evaluation context                                    |                                             |                           | Method for describing crowding |                  |            |              |
|----------------------------------------------------|------|-------------------------------------------------------|---------------------------------------------|---------------------------|--------------------------------|------------------|------------|--------------|
|                                                    |      | Evaluation by:                                        | Evaluation for:                             | State or country          | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| State Wide - Wisconsin                             | 1982 | Goose Hunters                                         | Other Goose Hunters                         | Wisconsin                 | 27                             | 13               | 2.32       | 2.00         |
| Tuckahoe State Park                                | 1984 | Goose Hunters                                         | Low Density Dispersed Hunt                  | Maryland                  | 27                             | 6                | 2.00       | 2.00         |
| Wolf Creek Pass - San Juan/Rio Grande Nat'l Forest | 2003 | Nonmotorized Users                                    | skiers/snowshoers /snowboarders - trailhead | Colorado                  | 27                             | 6                | 1.91       | 1.00         |
| Oregon Beaches                                     | 2001 | Oregon Beachgoers - Devils Punchbowl to Schooner Poin | Other beachgoers                            | Oregon                    | 27                             | 7                | 2.04       | 1.00         |
| Oregon Beaches                                     | 2001 | Oregon Beachgoers - Siuslaw River to Siltcoos River   | Other beachgoers                            | Oregon                    | 27                             | 12               | 2.26       | 1.00         |
| Boston Harbor Islands                              | 2000 | Hingham Visitors                                      | Other visitors to Hingham                   | Massachusetts             | 26                             | 9                | 2.09       | 1.00         |
| Fulufjallet National Park                          | 2001 | Hikers - Trail AA                                     | Evaluations of Other Hikers on Trail AA     | Sweden                    | 26                             | 8                | 2.08       | 1.50         |
| Grand Staircase - Escalante National Monument      | 1999 | Hunters                                               | Paunsaugunt Limited-Entry Hunt              | Utah                      | 26                             | 5                | 2.03       | 2.00         |
| Illinois River                                     | 1981 | Rafters                                               | Other Rafters                               | Oregon                    | 26                             | 7                |            |              |
| Fulufjallet National Park                          | 2001 | Hikers - Trail BA                                     | Evaluations of Other Hikers on Trail BA     | Sweden                    | 25                             | 13               | 2.15       | 1.50         |
| Gwaii Haanas Nat'l Park Reserve & Heritage Site    | 1995 | Kayakers                                              | Evaluations of Motorboats on the Water      | Canada (British Columbia) | 25                             | 10               | 2.09       | 1.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                                      | Date | Evaluation context                                 |                                             |                           | Method for describing crowding |                  |            |              |
|-------------------------------------------------|------|----------------------------------------------------|---------------------------------------------|---------------------------|--------------------------------|------------------|------------|--------------|
|                                                 |      | Evaluation by:                                     | Evaluation for:                             | State or country          | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Sandhill Wildlife Management Unit               | 1981 | Deer Hunters - Doe hunt (antlerless) NW            | Other Deer Hunters                          | Wisconsin                 | 25                             | 11               | 2.32       | 2.00         |
| Savage River                                    | 1980 | Trout Anglers                                      | Lower Use Period                            | Maryland                  | 25                             |                  |            |              |
| Shelburne Museum                                | 1995 | Day Visitors                                       | Other Visitors                              | Vermont                   | 25                             | 9                | 2.00       | 1.00         |
| Oregon Beaches                                  | 2001 | Oregon Beachgoers - Harbor Beach                   | Other beachgoers                            | Oregon                    | 25                             | 4                | 1.99       | 2.00         |
| Fulufjallet National Park                       | 2005 | Hikers - Overnight Cabins                          | Evaluations of Other Hikers                 | Sweden                    | 24                             | 7                | 1.89       | 1.00         |
| Great Gulf Wilderness                           | 1980 | Backpackers in Wilderness                          | Lower Use Period                            | New Hampshire             | 24                             | 7                | 1.99       | 1.44         |
| Gwaii Haanas Nat'l Park Reserve & Heritage Site | 1995 | Kayakers                                           | Evaluations of Motorboats at Cultural Sites | Canada (British Columbia) | 24                             | 16               | 2.40       | 1.00         |
| Muir Beach                                      | 2003 | Visitors                                           | Other visitors - at the beach               | California                | 24                             | 7                | 1.96       | 1.00         |
| Oregon Beaches                                  | 2001 | Oregon Beachgoers - Nehalem River to Tillamook Bay | Other beachgoers                            | Oregon                    | 24                             | 3                | 1.91       | 1.00         |
| Oregon Beaches                                  | 2001 | Oregon Beachgoers - Rocky Knoll to Heceta Head     | Other beachgoers                            | Oregon                    | 24                             | 8                | 1.95       | 1.00         |
| Acadia National Park - Isle au Haut             | 2002 | Visitors                                           | Other visitors - overall on Isle au Haut    | Maine                     | 23                             | 5                | 1.92       | 1.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                        | Date | Evaluation context                               |                                            |                  | Method for describing crowding |                  |            |              |
|-----------------------------------|------|--------------------------------------------------|--------------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                   |      | Evaluation by:                                   | Evaluation for:                            | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Boston Harbor Islands             | 2000 | World's End Visitors                             | Other visitors to World's End              | Massachusetts    | 23                             | 3                | 2.02       | 2.00         |
| Gun Powder River                  | 1984 | Trout Anglers                                    | Late Season                                | Maryland         | 23                             |                  |            |              |
| Kenai Fjords National Park        | 2001 | Visitors to Exit Glacier                         | Other visitors along trail to Exit Glacier | Alaska           | 23                             | 12               | 1.83       | 1.00         |
| Sandhill Wildlife Management Unit | 1981 | Deer Hunters - Doe hunt (antlerless) SE          | Other Deer Hunters                         | Wisconsin        | 23                             | 19               | 2.46       | 1.00         |
| Sandhill Wildlife Management Unit | 1988 | Deer Hunters - Trophy buck hunt (Mixed) Day 1 NE | Other Deer Hunters                         | Wisconsin        | 23                             | 0                | 1.54       | 1.00         |
| Yosemite National Park            | 2001 | Wilderness Transition Users                      | Other users - along trails                 | California       | 23                             | 9                | 1.90       | 1.00         |
| Oregon Beaches                    | 2001 | Oregon Beachgoers - Tenmile Creek to Coos Bay    | Other beachgoers                           | Oregon           | 23                             | 3                | 1.82       | 1.00         |
| Oregon Beaches                    | 2001 | Oregon Beachgoers - Whaleshead Beach             | Other beachgoers                           | Oregon           | 23                             | 8                | 1.90       | 1.00         |
| Mt McKinley - Denali Nat'l Park   | 1978 | Hikers                                           | Other Hikers                               | Alaska           | 22                             | 4                | 1.40       | 1.00         |
| Antelope Island State Park        | 1999 | Frontcountry visitors                            | Weekdays                                   | Utah             | 22                             | 10               | 2.03       | 1.50         |
| Cache la Poudre River             | 1993 | Rafters                                          | Evaluations of Other Rafters at the Put-In | Colorado         | 22                             | 6                | 1.85       | 1.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                                      | Date  | Evaluation context                               |                                            |                           | Method for describing crowding |                  |            |              |
|-------------------------------------------------|-------|--------------------------------------------------|--------------------------------------------|---------------------------|--------------------------------|------------------|------------|--------------|
|                                                 |       | Evaluation by:                                   | Evaluation for:                            | State or country          | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Grand Staircase - Escalante National Monument   | 1999  | Hunters                                          | Pre-Designation Experience Visitors        | Utah                      | 22                             | 6                | 1.97       | 1.00         |
| Gulkana River                                   | 1999  | All Users                                        | Upper West Fork                            | Alaska                    | 22                             | 0                | 1.78       | 1.00         |
| Gwaii Haanas Nat'l Park Reserve & Heritage Site | 1995  | Motor Boaters                                    | Evaluations of Motorboats at Camping Sites | Canada (British Columbia) | 22                             | 20               | 2.85       | 1.00         |
| Jefferson County                                | 1996  | Dual-Sport                                       | Bikers                                     | Colorado                  | 22                             | 4                | 0.84       | 0.00         |
| Sandhill Wildlife Management Unit               | 1,982 | Deer Hunters - Doe hunt (anterless) SE           | Other Deer Hunters                         | Wisconsin                 | 22                             | 2                | 1.83       | 2.00         |
| Cache la Poudre River                           | 1993  | Kayakers                                         | Evaluations of Rafters at the Take-Out     | Colorado                  | 21                             | 12               | 2.13       | 1.00         |
| Hawaii Volcanoes National Park                  | 2002  | Visitors at Thurston Lava Tube                   | Other visitors - at Thurston Lava Tube     | Hawaii                    | 21                             | 7                | 1.94       | 1.00         |
| Sandhill Wildlife Management Unit               | 1982  | Deer Hunters - Trophy buck hunt (Either sex) NW  | Other Deer Hunters                         | Wisconsin                 | 21                             | 5                | 1.89       | 1.00         |
| Sandhill Wildlife Management Unit               | 1983  | Deer Hunters - Trophy buck hunt (Either sex) NE  | Other Deer Hunters                         | Wisconsin                 | 21                             | 0                | 1.74       | 1.00         |
| Sandhill Wildlife Management Unit               | 1987  | Deer Hunters - Trophy buck hunt (Mixed) Day 1 SE | Other Deer Hunters                         | Wisconsin                 | 21                             | 5                | 2.00       | 2.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                        | Date | Evaluation context                                  |                                           |                  | Method for describing crowding |                  |            |              |
|-----------------------------------|------|-----------------------------------------------------|-------------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                   |      | Evaluation by:                                      | Evaluation for:                           | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Zion National Park                | 2003 | Weeping Rock Trail Users                            | Other users - along this trail            | Utah             | 21                             | 5                | 1.93       | 2.00         |
| Oregon Beaches                    | 2001 | Oregon Beachgoers - Sand Lake to Cape Kiwanda       | Other beachgoers                          | Oregon           | 21                             | 7                | 1.86       | 1.00         |
| Oregon Beaches                    | 2001 | Oregon Beachgoers - Elk River to Port Orford Head   | Other beachgoers                          | Oregon           | 21                             | 10               | 1.97       | 1.00         |
| Oregon Beaches                    | 2001 | Oregon Beachgoers - Devils Backbone to Nesika Beach | Other beachgoers                          | Oregon           | 21                             | 0                | 1.83       | 1.00         |
| Oregon Beaches                    | 2001 | Oregon Beachgoers - Bayocean Spit                   | Other beachgoers                          | Oregon           | 21                             |                  |            |              |
| Antelope Island State Park        | 1999 | Hikers                                              | Evaluations of other Backcountry Visitors | Utah             | 20                             | 6                | 1.90       | 2.00         |
| Eagle River                       | 1996 | Rafters                                             | Other Rafters                             | Alaska           | 20                             | 6                | 1.83       | 1.00         |
| Fulufjallet National Park         | 2001 | Hikers - Trail AB                                   | Evaluations of Other Hikers on Trail AB   | Sweden           | 20                             | 7                | 1.92       | 1.00         |
| Sandhill Wildlife Management Unit | 1979 | Deer Hunters - Doe hunt (anterless) Day 1           | Other Deer Hunters                        | Wisconsin        | 20                             | 6                | 1.84       | 1.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                                      | Date | Evaluation context                               |                                            |                           | Method for describing crowding |                  |            |              |
|-------------------------------------------------|------|--------------------------------------------------|--------------------------------------------|---------------------------|--------------------------------|------------------|------------|--------------|
|                                                 |      | Evaluation by:                                   | Evaluation for:                            | State or country          | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Sandhill Wildlife Management Unit               | 1980 | Deer Hunters - Doe hunt (antlerless) Day 2 NE    | Other Deer Hunters                         | Wisconsin                 | 20                             | 5                | 1.75       | 1.00         |
| Sandhill Wildlife Management Unit               | 1982 | Deer Hunters - Trophy buck hunt (Either sex) NE  | Other Deer Hunters                         | Wisconsin                 | 20                             | 7                | 1.87       | 1.00         |
| Sandhill Wildlife Management Unit               | 1985 | Deer Hunters - Trophy buck hunt (Either sex) NW  | Other Deer Hunters                         | Wisconsin                 | 20                             | 12               | 2.23       | 2.00         |
| Sandhill Wildlife Management Unit               | 1988 | Deer Hunters - Trophy buck hunt (Mixed) Day 2 NE | Other Deer Hunters                         | Wisconsin                 | 20                             | 0                | 1.47       | 1.00         |
| Zion National Park                              | 2003 | Backcountry Canyon hikers                        | Other hikers - in this canyon              | Utah                      | 20                             | 7                | 1.88       | 1.00         |
| Mt. Washington Wilderness                       | 1991 | Wilderness Users (Hikers)                        | Other Wilderness Users                     | Oregon                    | 20                             | 8                | 1.98       | 2.00         |
| Jefferson County Reservoirs                     | 1997 | Round Butte Overlook Park Users                  | Other users                                | Oregon                    | 20                             |                  | 2.10       |              |
| Gwaii Haanas Nat'l Park Reserve & Heritage Site | 1995 | Kayakers                                         | Evaluations of Motorboats at Camping Sites | Canada (British Columbia) | 19                             | 9                | 1.98       | 1.00         |
| Jefferson County                                | 1996 | Bikers                                           | Other Bikers                               | Colorado                  | 19                             | 2                | 0.76       | 0.00         |
| New Zealand's Conservation Estate               | 1992 | Tourists                                         | Other Tourists at Taiaroa Head             | New Zealand               | 19                             | 19               |            |              |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                                      | Date | Evaluation context                                    |                                             |                           | Method for describing crowding |                  |            |              |
|-------------------------------------------------|------|-------------------------------------------------------|---------------------------------------------|---------------------------|--------------------------------|------------------|------------|--------------|
|                                                 |      | Evaluation by:                                        | Evaluation for:                             | State or country          | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Sandhill Wildlife Management Unit               | 1980 | Deer Hunters - Doe hunt (anterless) Day 1 SE          | Other Deer Hunters                          | Wisconsin                 | 19                             | 11               | 2.14       | 2.00         |
| Oregon Beaches                                  | 2001 | Oregon Beachgoers - Bay Ocean Spit                    | Other beachgoers                            | Oregon                    | 19                             | 6                | 1.83       | 1.00         |
| Colorado Reservoirs                             | 1998 | Anglers                                               | Crystall Reservoir                          | Colorado                  | 18                             | 5                | 1.89       | 1.00         |
| Fulufjallet National Park                       | 2005 | Hikers - Walking on Trail around Njupeskar Falls Area | Evaluations of Other Hikers                 | Sweden                    | 18                             | 2                | 1.62       | 1.00         |
| Gwaii Haanas Nat'l Park Reserve & Heritage Site | 1995 | Motor Boaters                                         | Evaluations of Motorboats at Cultural Sites | Canada (British Columbia) | 18                             | 8                | 2.10       | 1.00         |
| Sandhill Wildlife Management Unit               | 1982 | Deer Hunters - Doe hunt (anterless) SW                | Other Deer Hunters                          | Wisconsin                 | 18                             | 4                | 1.96       | 1.00         |
| Sandhill Wildlife Management Unit               | 1983 | Deer Hunters - Trophy buck hunt (Either sex) SW       | Other Deer Hunters                          | Wisconsin                 | 18                             | 6                | 1.65       | 1.00         |
| Vail Pass - White River National Forest         | 2003 | Motorized Users                                       | skiers/snowshoers /snowboarders - trail     | Colorado                  | 18                             | 7                | 1.90       | 1.00         |
| Acadia National Park - Isle au Haut             | 2002 | Visitors                                              | Other visitors - on the trails              | Maine                     | 17                             | 4                | 1.74       | 1.00         |
| Grand River Marsh                               | 1978 | Managed Hunt                                          | Other Goose Hunters                         | Wisconsin                 | 17                             | 6                | 1.84       | 1.00         |
| Horicon Grand River Marsh                       | 1986 | Goose Hunters                                         | Managed Hunt                                | Wisconsin                 | 17                             | 6                | 2.23       | 2.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                        | Date | Evaluation context                                |                                             |                  | Method for describing crowding |                  |            |              |
|-----------------------------------|------|---------------------------------------------------|---------------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                   |      | Evaluation by:                                    | Evaluation for:                             | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Zion National Park                | 2003 | Backcountry hikers                                | Other hikers - along the backcountry trails | Utah             | 17                             | 4                | 1.74       | 1.00         |
| Muir Beach                        | 2003 | Visitors                                          | Other visitors - along the trails           | California       | 16                             | 4                | 1.70       | 1.00         |
| White Salmon River                | 1991 | Boaters                                           | Other Boaters                               | Washington       | 16                             | 3                | 1.66       | 1.00         |
| Oregon Beaches                    | 2001 | Oregon Beachgoers - Alsea River to Star Creek     | Other beachgoers                            | Oregon           | 16                             | 2                | 1.68       | 1.00         |
| Oregon Beaches                    | 2001 | Oregon Beachgoers - Umpqua River to Tenmile Creek | Other beachgoers                            | Oregon           | 16                             | 10               | 1.77       | 1.00         |
| Oregon Beaches                    | 2001 | Oregon Beachgoers - Bastendorff Beach             | Other beachgoers                            | Oregon           | 16                             | 5                | 1.72       | 1.00         |
| Oregon Beaches                    | 2001 | Oregon Beachgoers - Cape Blanco to Elk River      | Other beachgoers                            | Oregon           | 16                             | 3                | 1.55       | 1.00         |
| Oregon Beaches                    | 2001 | Oregon Beachgoers - Rogue River to Cape Sebastian | Other beachgoers                            | Oregon           | 16                             | 3                | 1.65       | 1.00         |
| Sandhill Wildlife Management Unit | 1981 | Deer Hunters - Trophy buck hunt (Either sex) SE   | Other Deer Hunters                          | Wisconsin        | 15                             | 0                | 1.64       | 1.00         |
| Goodnews River                    | 2001 | All Users                                         | Other users in wilderness                   | Alaska           | 15                             | 7                | 2.20       | 2.00         |
| Togiak River                      | 2001 | All Users                                         | Other users in wilderness                   | Alaska           | 15                             | 8                | 1.95       | 2.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                                      | Date | Evaluation context                                      |                                            |                           | Method for describing crowding |                  |            |              |
|-------------------------------------------------|------|---------------------------------------------------------|--------------------------------------------|---------------------------|--------------------------------|------------------|------------|--------------|
|                                                 |      | Evaluation by:                                          | Evaluation for:                            | State or country          | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Oregon Beaches                                  | 2001 | Oregon Beachgoers - Nestucca River to Cascade Head      | Other beachgoers                           | Oregon                    | 15                             | 4                | 1.69       | 1.00         |
| Oregon Beaches                                  | 2001 | Oregon Beachgoers - Battle Rock to Humbug Mountain      | Other beachgoers                           | Oregon                    | 15                             | 0                | 1.56       | 1.00         |
| Oregon Beaches                                  | 2001 | Oregon Beachgoers - Winchuck and Crissie Fields Beaches | Other beachgoers                           | Oregon                    | 15                             |                  |            |              |
| Acadia National Park                            | 2004 | Wildwood Stables horseback riders & carriage riders     | Other riders                               | Maine                     | 14                             | 2                | 1.65       | 1.00         |
| Cache la Poudre River                           | 1993 | Kayakers                                                | Evaluations of Other Kayakers on the River | Colorado                  | 14                             | 5                | 1.64       | 1.00         |
| Gwaii Haanas Nat'l Park Reserve & Heritage Site | 1995 | Motor Boaters                                           | Evaluations of Motorboats on the Water     | Canada (British Columbia) | 14                             | 10               | 1.92       | 1.00         |
| Gwaii Haanas Nat'l Park Reserve & Heritage Site | 1995 | Motor Boaters                                           | Evaluations of Kayakers on the Water       | Canada (British Columbia) | 14                             | 8                | 1.86       | 1.00         |
| Sandhill Wildlife Management Unit               | 1980 | Deer Hunters - Doe hunt (antlerless) Day 2 NW           | Other Deer Hunters                         | Wisconsin                 | 14                             | 8                | 1.73       | 1.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                          | Date | Evaluation context                               |                                              |                  | Method for describing crowding |                  |            |              |
|-------------------------------------|------|--------------------------------------------------|----------------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                     |      | Evaluation by:                                   | Evaluation for:                              | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Sandhill Wildlife Management Unit   | 1988 | Deer Hunters - Trophy buck hunt (Mixed) Day 1 NW | Other Deer Hunters                           | Wisconsin        | 14                             | 5                | 1.76       | 1.00         |
| Oregon Beaches                      | 2001 | Oregon Beachgoers - South Beach                  | Other beachgoers                             | Oregon           | 14                             | 4                | 1.66       | 1.00         |
| Oregon Beaches                      | 2001 | Oregon Beachgoers - Pistol River to Crook Pt.    | Other beachgoers                             | Oregon           | 14                             |                  |            |              |
| Acadia National Park - Isle au Haut | 2001 | Visitors                                         | Other visitors - on park lands               | Maine            | 13                             | 4                | 1.76       | 1.00         |
| Cache la Poudre River               | 1993 | Rafters                                          | Evaluations of Other Rafters on the River    | Colorado         | 13                             | 3                | 1.61       | 1.00         |
| Cache la Poudre River               | 1993 | Rafters                                          | Evaluations of Other Rafters at the Take-Out | Colorado         | 13                             | 3                | 1.61       | 1.00         |
| Mesa Verde National Park            | 2001 | Visitors at Step House                           | Other visitors - at Step House               | Colorado         | 13                             | 5                | 1.77       | 1.00         |
| Sandhill Wildlife Management Unit   | 1981 | Deer Hunters - Doe hunt (antlerless) NE          | Other Deer Hunters                           | Wisconsin        | 13                             | 0                | 1.75       | 2.00         |
| Sandhill Wildlife Management Unit   | 1988 | Deer Hunters - Trophy buck hunt (Mixed) Day 2 SW | Other Deer Hunters                           | Wisconsin        | 13                             | 0                | 1.67       | 2.00         |
| Saratoga National Historic Site     | 2001 | Visitors                                         | Other visitors - At visitor facilities       | New York         | 13                             | 1                | 1.56       | 1.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                                         | Date | Evaluation context                           |                                         |                  | Method for describing crowding |                  |            |              |
|----------------------------------------------------|------|----------------------------------------------|-----------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                                    |      | Evaluation by:                               | Evaluation for:                         | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Vail Pass - White River National Forest            | 2003 | Motorized Users                              | snowmobilers - trail                    | Colorado         | 13                             | 2                | 1.55       | 1.00         |
| Wolf Creek Pass - San Juan/Rio Grande Nat'l Forest | 2003 | Motorized Users                              | snowmobilers - trailhead                | Colorado         | 13                             | 4                | 1.53       | 1.00         |
| Boston Harbor Islands                              | 2000 | Little Brewster Visitors                     | Other visitors to Little Brewster       | Massachusetts    | 12                             | 3                | 1.59       | 1.00         |
| Jefferson County                                   | 1996 | Bikers                                       | Hikers                                  | Colorado         | 12                             | 1                | 0.53       | 0.00         |
| Jefferson County                                   | 1996 | Dual-Sport                                   | Hikers                                  | Colorado         | 12                             | 0                | 0.57       | 0.00         |
| Sandhill Wildlife Management Unit                  | 1981 | Deer Hunters - Doe hunt (anterless) SW       | Other Deer Hunters                      | Wisconsin        | 12                             | 0                | 1.59       | 1.00         |
| Wolf Creek Pass - San Juan/Rio Grande Nat'l Forest | 2003 | Nonmotorized Users                           | skiers/snowshoers /snowboarders - trail | Colorado         | 12                             | 4                | 1.57       | 1.00         |
| Wolf Creek Pass - San Juan/Rio Grande Nat'l Forest | 2003 | Motorized Users                              | skiers/snowshoers /snowboarders - trail | Colorado         | 12                             | 3                | 1.47       | 1.00         |
| Oregon Beaches                                     | 2001 | Oregon Beachgoers - Face Rock to New River   | Other beachgoers                        | Oregon           | 12                             | 3                | 1.51       | 1.00         |
| Oregon Beaches                                     | 2001 | Oregon Beachgoers - Otter Pt. to Rogue River | Other beachgoers                        | Oregon           | 12                             |                  |            |              |
| Mesa Verde National Park                           | 2001 | Visitors at Sun Point Overlook               | Other visitors - at Sun Point Overlook  | Colorado         | 11                             | 0                | 1.64       | 1.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                                      | Date | Evaluation context                                   |                                              |                           | Method for describing crowding |                  |            |              |
|-------------------------------------------------|------|------------------------------------------------------|----------------------------------------------|---------------------------|--------------------------------|------------------|------------|--------------|
|                                                 |      | Evaluation by:                                       | Evaluation for:                              | State or country          | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Oregon Beaches                                  | 2001 | Oregon Beachgoers - Fivemile Point to Coquille River | Other beachgoers                             | Oregon                    | 11                             | 0                | 1.51       | 1.00         |
| Gwaii Haanas Nat'l Park Reserve & Heritage Site | 1995 | Kayakers                                             | Evaluations of Kayakers on the Water         | Canada (British Columbia) | 10                             | 2                | 1.52       | 1.00         |
| Sagamore Hill National Historic Site            | 2002 | Visitors                                             | Other visitors - Visitor center              | New York                  | 10                             | 2                | 1.53       | 1.00         |
| Yosemite National Park                          | 2001 | Wilderness Remote Users                              | Other users - along trails                   | California                | 10                             | 4                | 1.60       | 1.00         |
| Oregon Beaches                                  | 2001 | Oregon Beachgoers - Collins Creek to Alsea River     | Other beachgoers                             | Oregon                    | 10                             | 5                | 1.55       | 1.00         |
| Athabasca-Sunwapta Rivers                       | 1999 | White water rafters                                  | Evaluations of Rafters at the Put-In         | Canada (Alberta)          | 9                              | 1                | 1.35       | 1.00         |
| Cache la Poudre River                           | 1993 | Kayakers                                             | Evaluation of Other Kayakers at the Take-Out | Colorado                  | 9                              | 0                | 1.32       | 1.00         |
| Haleakala National Park                         | 2003 | Visitors at Red Hill Overlook                        | Other visitors - overall                     | Hawaii                    | 9                              | 3                | 1.52       | 1.00         |
| Jefferson County                                | 1996 | Hikers                                               | Other Hikers                                 | Colorado                  | 9                              | 3                | 0.50       | 0.00         |
| Sandhill Wildlife Management Unit               | 1980 | Deer Hunters - Doe hunt (antlerless) Day 2 SW        | Other Deer Hunters                           | Wisconsin                 | 9                              | 4                | 1.52       | 1.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                                         | Date | Evaluation context                                     |                                                       |                  | Method for describing crowding |                  |            |              |
|----------------------------------------------------|------|--------------------------------------------------------|-------------------------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                                    |      | Evaluation by:                                         | Evaluation for:                                       | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Wolf Creek Pass - San Juan/Rio Grande Nat'l Forest | 2003 | Motorized Users                                        | snowmobilers - trail                                  | Colorado         | 9                              | 4                | 1.49       | 1.00         |
| Oregon Beaches                                     | 2001 | Oregon Beachgoers - Takenitch Creek to Threemile Creek | Other beachgoers                                      | Oregon           | 9                              | 5                | 1.68       | 1.00         |
| Oregon Beaches                                     | 2001 | Oregon Beachgoers - Siltcoos River to Takenitch Cr.    | Other beachgoers                                      | Oregon           | 9                              |                  |            |              |
| Wolf Creek Pass - San Juan/Rio Grande Nat'l Forest | 2003 | Motorized Users                                        | skiers/snowshoers /snowboarders - trailhead           | Colorado         | 8                              | 1                | 1.34       | 1.00         |
| Oregon Beaches                                     | 2001 | Oregon Beachgoers - Sixes River mouth                  | Other beachgoers                                      | Oregon           | 8                              |                  |            |              |
| Athabasca-Sunwapta Rivers                          | 1999 | White water rafters                                    | Evaluations of Rafter on the River                    | Canada (Alberta) | 7                              | 1                | 1.33       | 1.00         |
| Cache la Poudre River                              | 1993 | Rafters                                                | Evaluations of Kayakers on the River                  | Colorado         | 7                              | 2                | 1.34       | 1.00         |
| Cache la Poudre River                              | 1993 | Kayakers                                               | Evaluations of Other Kayakers at the Put-In           | Colorado         | 7                              | 1                | 1.32       | 1.00         |
| Haleakala National Park                            | 2003 | Visitors at Red Hill Overlook                          | Other visitors - at visitor's center/observation area | Hawaii           | 7                              | 4                | 1.48       | 1.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                           | Date | Evaluation context                                |                                           |                  | Method for describing crowding |                  |            |              |
|--------------------------------------|------|---------------------------------------------------|-------------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                      |      | Evaluation by:                                    | Evaluation for:                           | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Oregon Beaches                       | 2001 | Oregon Beachgoers - Agate Beach to Fivemile Point | Other beachgoers                          | Oregon           | 7                              | 0                | 1.20       | 1.00         |
| Cache la Poudre River                | 1993 | Rafters                                           | Evaluations of Kayakers at the Put-In     | Colorado         | 6                              | 1                | 1.27       | 1.00         |
| Saratoga National Historic Site      | 2001 | Visitors                                          | Other visitors - at interpretive programs | New York         | 6                              | 2                | 1.44       | 1.00         |
| Athabasca-Sunwapta Rivers            | 1999 | White water rafters                               | Evaluations of Rafters at the Take-Out    | Canada (Alberta) | 4                              | 1                | 1.26       | 1.00         |
| Boston Harbor Islands                | 2000 | Deer Island Visitors                              | Other visitors to Deer Island             | Massachusetts    | 4                              | 4                | 1.33       | 1.00         |
| Cache la Poudre River                | 1993 | Rafters                                           | Evaluations of Kayakers at the Take-Out   | Colorado         | 4                              | 1                | 1.24       | 1.00         |
| Sagamore Hill National Historic Site | 2002 | Visitors                                          | Other visitors - The grounds              | New York         | 4                              | 1                | 1.34       | 1.00         |
| Sagamore Hill National Historic Site | 2002 | Visitors                                          | Other visitors - Picnic area              | New York         | 4                              | 0                | 1.31       | 1.00         |
| Sandhill Wildlife Management Unit    | 1987 | Deer Hunters - Trophy buck hunt (Mixed) Day 1 NE  | Other Deer Hunters                        | Wisconsin        | 4                              | 0                | 1.40       | 1.00         |
| Saratoga National Historic Site      | 2001 | Visitors                                          | Other visitors - At historic sites        | New York         | 4                              | 1                | 1.32       | 1.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                      | Date | Evaluation context                            |                                         |                  | Method for describing crowding |                  |            |              |
|---------------------------------|------|-----------------------------------------------|-----------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                 |      | Evaluation by:                                | Evaluation for:                         | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Cape Cod                        | 2005 | Hunters - License holders in Barnshaft County | Other hunters                           | Massachusetts    | 3                              | 15               | 2.58       | 2.00         |
| Saratoga National Historic Site | 2001 | Visitors                                      | Other visitors - On park roads          | New York         | 3                              | 0                | 1.28       | 1.00         |
| Athabasca-Sunwapta Rivers       | 1999 | Float trip visitors                           | Evaluations of Rafters on the River     | Canada (Alberta) | 2                              | 1                | 1.12       | 1.00         |
| Athabasca-Sunwapta Rivers       | 1999 | Float trip visitors                           | Evaluations of Rafters at the Put-In    | Canada (Alberta) | 2                              | 1                | 1.17       | 1.00         |
| Athabasca-Sunwapta Rivers       | 1999 | Float trip visitors                           | Evaluations of Rafters at the Take-Out  | Canada (Alberta) | 2                              | 2                | 1.19       | 1.00         |
| Athabasca-Sunwapta Rivers       | 1999 | Float trip visitors                           | Evaluations of Kayakers at the Take-Out | Canada (Alberta) | 2                              | 1                | 1.08       | 1.00         |
| Athabasca-Sunwapta Rivers       | 1999 | Float trip visitors                           | Evaluations of Kayakers at the Put-In   | Canada (Alberta) | 2                              | 1                | 1.09       | 1.00         |
| Saratoga National Historic Site | 2001 | Visitors                                      | Other visitors - On trails              | New York         | 2                              | 0                | 1.26       | 1.00         |
| Athabasca-Sunwapta Rivers       | 1999 | White water rafters                           | Evaluations of Kayakers at the Put-In   | Canada (Alberta) | 1                              | 0                | 1.04       | 1.00         |
| Athabasca-Sunwapta Rivers       | 1999 | White water rafters                           | Evaluations of Kayakers on the River    | Canada (Alberta) | 1                              | 0                | 1.05       | 1.00         |
| Athabasca-Sunwapta Rivers       | 1999 | White water rafters                           | Evaluations of Kayakers at the Take-Out | Canada (Alberta) | 1                              | 0                | 1.04       | 1.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                        | Date | Evaluation context                               |                                      |                  | Method for describing crowding |                  |            |              |
|-----------------------------------|------|--------------------------------------------------|--------------------------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                   |      | Evaluation by:                                   | Evaluation for:                      | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Athabasca-Sunwapta Rivers         | 1999 | Float trip visitors                              | Evaluations of Kayakers on the River | Canada (Alberta) | 1                              | 0                | 1.06       | 1.00         |
| Cape Cod                          | 2004 | Hunters - Field sample                           | Other hunters                        | Massachusetts    | 1                              | 9                | 2.13       | 2.00         |
| Boston Harbor Islands             | 2000 | Thompson Island Visitors                         | Other visitors to Thompson Island    | Massachusetts    | 0                              | 0                | 1.00       | 1.00         |
| Cape Cod                          | 2005 | Hunters - Volunteer sample                       | Other hunters                        | Massachusetts    | 0                              | 8                | 2.08       | 2.00         |
| Sandhill Wildlife Management Unit | 1988 | Deer Hunters - Trophy buck hunt (Mixed) Day 1 SW | Other Deer Hunters                   | Wisconsin        | 0                              | 0                | 1.33       | 1.00         |
| Sandhill Wildlife Management Unit | 1988 | Deer Hunters - Trophy buck hunt (Mixed) Day 2 SE | Other Deer Hunters                   | Wisconsin        | 0                              | 0                | 1.50       | 1.00         |
| Sandhill Wildlife Management Unit | 1989 | Deer Hunters - Trophy buck hunt (Mixed) Day 1 NE | Other Deer Hunters                   | Wisconsin        | 0                              | 0                | 1.13       | 1.00         |
| Sandhill Wildlife Management Unit | 1989 | Deer Hunters - Trophy buck hunt (Mixed) Day 1 SW | Other Deer Hunters                   | Wisconsin        | 0                              | 0                | 1.15       | 1.00         |
| Sandhill Wildlife Management Unit | 1989 | Deer Hunters - Trophy buck hunt (Mixed) Day 1 SE | Other Deer Hunters                   | Wisconsin        | 0                              | 0                | 1.17       | 1.00         |

Table B3. Ranking of perceived crowding for different resources and evaluation contexts (*continued*)

| Study site                        | Date | Evaluation context                               |                    |                  | Method for describing crowding |                  |            |              |
|-----------------------------------|------|--------------------------------------------------|--------------------|------------------|--------------------------------|------------------|------------|--------------|
|                                   |      | Evaluation by:                                   | Evaluation for:    | State or country | Scale points 3-9               | Scale points 5-9 | Scale mean | Scale median |
| Sandhill Wildlife Management Unit | 1989 | Deer Hunters - Trophy buck hunt (Mixed) Day 2 NW | Other Deer Hunters | Wisconsin        | 0                              | 0                | 1.29       | 1.00         |
| Sandhill Wildlife Management Unit | 1989 | Deer Hunters - Trophy buck hunt (Mixed) Day 2 NE | Other Deer Hunters | Wisconsin        | 0                              | 0                | 1.08       | 1.00         |
| Sandhill Wildlife Management Unit | 1989 | Deer Hunters - Trophy buck hunt (Mixed) Day 2 SW | Other Deer Hunters | Wisconsin        | 0                              | 0                | 1.21       | 1.00         |
| Oregon Beaches                    | 2001 | Oregon Beachgoers - Arch Cape to Cape Falcon     | Other beachgoers   | Oregon           | 0                              |                  |            |              |
| Oregon Beaches                    | 2001 | Oregon Beachgoers - Sacchi Beach                 | Other beachgoers   | Oregon           | 0                              |                  |            |              |
| Oregon Beaches                    | 2001 | Oregon Beachgoers - New River to Blacklock Pt.   | Other beachgoers   | Oregon           | 0                              |                  |            |              |

Table B4. Crowding scale averages by state and study description

| State  | Study site                         | Date | Population studied                 | # of contexts | Crowding scale points 3-9 |           | Crowding scale mean |           |
|--------|------------------------------------|------|------------------------------------|---------------|---------------------------|-----------|---------------------|-----------|
|        |                                    |      |                                    |               | Average (%)               | <i>SD</i> | Average mean        | <i>SD</i> |
| Alaska | Alexander Creek                    | 1989 | All users                          | 1             | 78.00                     |           |                     |           |
|        | Brooks River                       | 1993 | September visitors                 | 1             | 94.00                     |           | 4.35                |           |
|        | Deshka River                       | 1989 | All users                          | 1             | 51.00                     |           |                     |           |
|        | Eagle River                        | 1996 | Rafters                            | 1             | 20.00                     |           | 1.83                |           |
|        | Goodnews River                     | 1996 | All users                          | 1             | 44.00                     |           | 2.98                |           |
|        |                                    | 2001 | All users                          | 2             | 48.00                     | 46.67     | 3.50                | 1.84      |
|        | Gulkana River                      | 1999 | All users                          | 11            | 53.09                     | 17.17     | 3.35                | 0.95      |
|        | Kanektok River                     | 1996 | All users                          | 1             | 60.00                     |           | 3.78                |           |
|        |                                    | 2001 | All users                          | 2             | 48.50                     | 26.16     | 3.04                | 1.10      |
|        | Kenai Fjords National Park         | 2001 | Visitors to Exit Glacier           | 1             | 23.00                     |           | 1.83                |           |
|        | Kenai River                        | 1993 | Anglers, boaters, & recreationists | 19            | 67.74                     | 17.99     | 4.13                | 1.20      |
|        | Lake Creek                         | 1989 | All users                          | 1             | 78.00                     |           |                     |           |
|        | Little Susitna River               | 1989 | All users                          | 1             | 79.00                     |           |                     |           |
|        | McNeil River                       | 1998 | Standby & successful permittees    | 2             | 29.50                     | 0.71      | 2.26                | 0.00      |
|        | Mt McKinley - Denali National Park | 1977 | Mountain climbers                  | 1             | 70.00                     |           |                     |           |
|        | Nanticote River                    | 1996 | Boaters                            | 1             | 42.00                     |           | 2.39                |           |
|        | Talachulitna River                 | 1989 | All users                          | 1             | 64.00                     |           |                     |           |
|        | Talkeetna River                    | 1989 | All users                          | 1             | 81.00                     |           |                     |           |

Table B4. Crowding scale averages by state and study description (*continued*)

| State      | Study site                                   | Date | Population studied                             | # of contexts | Crowding scale points 3-9 |       | Crowding scale mean |      |
|------------|----------------------------------------------|------|------------------------------------------------|---------------|---------------------------|-------|---------------------|------|
|            |                                              |      |                                                |               | Average (%)               | SD    | Average mean        | SD   |
| Arizona    | Togiak River                                 | 1996 | All users                                      | 1             | 33.00                     |       | 2.56                |      |
|            |                                              | 2001 | All users                                      | 2             | 43.50                     | 40.31 | 2.95                | 1.41 |
|            | Willow Creek                                 | 1991 | Salmon anglers                                 | 1             | 79.00                     |       | 6.21                |      |
|            | Colorado River - Glen Canyon Nat'l Rec. Area | 1984 | Anglers                                        | 2             | 63.00                     | 43.84 |                     |      |
|            | Colorado River - Grand Canyon Nat'l Park     | 1998 | Boaters                                        | 2             | 48.00                     | 8.49  | 2.91                | 0.35 |
| California | Grand Canyon National Park                   | 1985 | Rafters                                        | 2             | 62.50                     | 13.44 |                     |      |
|            | Phoenix North Public Lands                   | 2002 | Visitors                                       | 1             | 39.00                     |       | 2.70                |      |
|            | Alcatraz Island                              | 1998 | Visitors                                       | 6             | 60.50                     | 11.33 | 3.45                | 0.47 |
|            | Alcatraz Island                              | 2005 | Visitors                                       | 6             | 81.00                     | 9.47  | 4.29                | 0.56 |
|            | Joshua Tree National Park                    | 1994 | Rock climbers                                  | 1             | 53.00                     |       | 3.54                |      |
|            | Klamath River                                | 1984 | Salmon anglers                                 | 1             | 70.00                     |       | 4.16                |      |
|            |                                              | 1984 | Floaters                                       | 1             | 38.00                     |       | 2.52                |      |
|            | Lake Shasta                                  | 2002 | Boaters                                        | 4             | 58.25                     | 10.31 | 3.66                | 0.52 |
|            | Lake Shasta                                  | 2002 | Houseboats, rental boats, & marina-based boats | 3             | 82.67                     | 10.69 | 4.69                | 0.64 |
|            | Lake Sonoma                                  | 2000 | Recreational boaters                           | 2             | 54.50                     | 10.61 | 3.33                | 0.28 |
|            | Lake Trinity                                 | 2002 | Boaters                                        | 4             | 41.50                     | 10.15 | 2.82                | 0.37 |

Table B4. Crowding scale averages by state and study description (*continued*)

| State    | Study site                              | Date | Population studied                                       | # of contexts | Crowding scale points 3-9 |       | Crowding scale mean |      |
|----------|-----------------------------------------|------|----------------------------------------------------------|---------------|---------------------------|-------|---------------------|------|
|          |                                         |      |                                                          |               | Average (%)               | SD    | Average mean        | SD   |
| Colorado |                                         |      | Houseboats, rental boats, & marina-based boats           | 3             | 68.33                     | 13.20 | 3.77                | 0.61 |
|          | Lake Trinity                            | 2002 |                                                          |               |                           |       |                     |      |
|          | Mt Shasta                               | 1994 | Mountain climbers                                        | 3             | 54.00                     | 13.11 | 3.45                | 0.58 |
|          | Muir Beach                              | 2003 | Visitors                                                 | 5             | 26.80                     | 8.64  | 2.05                | 0.30 |
|          | Muir Woods National Monument - 2003     | 2003 | Visitors                                                 | 6             | 63.17                     | 9.58  | 3.82                | 0.76 |
|          | Muir Woods National Monument - 2004     | 2004 | Visitors                                                 | 7             | 45.00                     | 9.83  | 2.81                | 0.36 |
|          | Yosemite National Park - 1998           | 1998 | Visitors                                                 | 5             | 69.40                     | 9.81  | 3.74                | 0.42 |
|          | Yosemite National Park - 1999           | 1999 | Visitors                                                 | 7             | 67.86                     | 18.72 | 3.89                | 0.94 |
|          | Yosemite National Park - 2001           | 2001 | Frontcountry & wilderness users                          | 6             | 33.83                     | 14.85 | 2.58                | 0.70 |
|          | Cache la Poudre Rive                    | 1993 | Anglers                                                  | 3             | 34.33                     | 5.51  | 2.34                | 0.11 |
|          | Cache la Poudre River                   | 1993 | Kayakers & rafters                                       | 12            | 15.50                     | 10.77 | 1.71                | 0.49 |
|          | Colorado Reservoirs                     | 1998 | Anglers                                                  | 3             | 30.67                     | 11.15 | 2.38                | 0.43 |
|          |                                         |      | Wilderness users, OHV area users, & non-wilderness users |               |                           |       |                     |      |
|          | Gunnison Gorge Natl Conserv Area        | 2002 |                                                          | 3             | 42.67                     | 4.04  | 2.73                | 0.25 |
|          | Jefferson County                        | 1996 | Hikers, bikers, & dual-sport                             | 6             | 17.33                     | 7.89  | 0.77                | 0.33 |
|          | Mesa Verde National Park                | 2001 | Visitors                                                 | 10            | 53.50                     | 22.96 | 3.05                | 0.78 |
|          | Mt Evans                                | 1994 | Deer hunters & tourists                                  | 3             | 67.67                     | 5.86  | 4.02                | 0.35 |
|          | Rocky Mountain National Park            | 2001 | Tourists & hikers                                        | 8             | 62.88                     | 11.78 | 3.70                | 0.49 |
|          | Upper Colorado River                    | 2000 | Boaters                                                  | 1             | 57.00                     |       | 3.48                |      |
|          | Vail Pass - White River National Forest | 2003 | Nonmotorized & motorized users                           | 8             | 32.88                     | 16.17 | 2.44                | 0.88 |

Table B4. Crowding scale averages by state and study description (*continued*)

| State    | Study site                                         | Date | Population studied             | # of contexts | Crowding scale points 3-9 |       | Crowding scale mean |      |
|----------|----------------------------------------------------|------|--------------------------------|---------------|---------------------------|-------|---------------------|------|
|          |                                                    |      |                                |               | Average (%)               | SD    | Average mean        | SD   |
| Delaware | Wolf Creek Pass - San Juan/Rio Grande Nat'l Forest | 2003 | Nonmotorized & motorized users | 8             | 18.13                     | 10.48 | 1.76                | 0.41 |
|          | Delaware Coastal Beaches                           | 1993 | Beach users                    | 1             | 80.00                     |       | 4.70                |      |
|          | Delaware Inland Bay                                | 1991 | Boaters                        | 1             | 76.00                     |       | 4.70                |      |
| Hawaii   | Haleakala National Park                            | 2003 | Visitors                       | 4             | 37.50                     | 34.11 | 2.56                | 1.23 |
|          |                                                    | 2003 | Bicycle tourists               | 3             | 47.67                     | 19.86 | 3.01                | 0.82 |
|          |                                                    | 2003 | Visitors - as exiting park     | 1             | 28.00                     |       | 2.10                |      |
|          |                                                    | 2004 | Visitors                       | 4             | 34.75                     | 4.65  | 2.65                | 0.15 |
| Maine    | Hawaii Volcanoes National Park                     | 2002 | Visitors                       | 6             | 35.83                     | 9.28  | 2.47                | 0.33 |
|          | Acadia Carriage Roads                              | 1995 | Carriage road users            | 1             | 32.00                     |       | 2.28                |      |
|          | Acadia Carriage Roads                              | 1996 | Carriage road users            | 1             | 45.00                     |       | 3.05                |      |
|          | Acadia National Park - Isle au Haut                | 2001 | Visitors                       | 1             | 13.00                     |       | 1.76                |      |
|          | Acadia National Park - Isle au Haut                | 2002 | Visitors                       | 2             | 20.00                     | 4.24  | 1.83                | 0.13 |
|          | Acadia National Park - Isle au Haut                | 2003 | Residents                      | 2             | 35.00                     | 1.41  | 2.53                | 0.04 |
|          | Acadia National Park - Schoodic Peninsula          | 2000 | Visitors                       | 1             | 36.00                     |       | 2.39                |      |
| Maryland | Acadia National Park                               | 2004 | Visitors                       | 12            | 47.58                     | 17.23 | 2.94                | 0.73 |
|          | Fishing Bay                                        | 1986 | Goose hunters                  | 1             | 61.00                     |       | 3.70                |      |
|          | Gun Powder River                                   | 1984 | Trout anglers                  | 2             | 49.50                     | 37.48 | 5.70                |      |
|          | Savage River                                       | 1980 | Trout anglers                  | 1             | 25.00                     |       |                     |      |
|          | State Wide- Maryland - 1977                        | 1977 | Turkey hunters                 | 1             | 44.00                     |       | 2.94                |      |

Table B4. Crowding scale averages by state and study description (*continued*)

| State          | Study site                                           | Date | Population studied           | # of contexts | Crowding scale points 3-9 |       | Crowding scale mean |      |
|----------------|------------------------------------------------------|------|------------------------------|---------------|---------------------------|-------|---------------------|------|
|                |                                                      |      |                              |               | Average (%)               | SD    | Average mean        | SD   |
| Massachusetts  | State Wide- Maryland - 1984                          | 1984 | Deer hunters                 | 3             | 61.33                     | 8.08  | 3.77                | 0.24 |
|                | Tuckahoe State Park                                  | 1984 | Goose hunters                | 1             | 27.00                     |       | 2.00                |      |
|                | Upper Youghiogheny River                             | 1989 | Kayakers & rafters           | 2             | 43.00                     | 11.31 | 2.70                | 0.42 |
|                | Boston Harbor Islands                                | 2000 | Visitors                     | 6             | 16.50                     | 13.32 | 1.72                | 0.50 |
|                | Cape Cod                                             | 2004 | Hunters                      | 3             | 1.33                      | 1.53  | 2.26                | 0.28 |
| Michigan       | Stockings Park - Sleeping Bear Dunes Nat'l Lakeshore | 1977 | Driving Tourists             | 1             | 41.00                     |       | 2.84                |      |
| Minnesota      | BWCA                                                 | 1982 | Canoers                      | 1             | 73.00                     |       |                     |      |
| Nevada         | Lake Mead                                            | 1994 | Boaters                      | 4             | 34.75                     | 2.63  | 2.52                | 0.18 |
|                | Lake Mohave                                          | 1994 | Boaters                      | 4             | 48.25                     | 2.36  | 3.23                | 0.11 |
| New Hampshire  | Great Gulf Wilderness                                | 1980 | Backpackers in Wilderness    | 1             | 24.00                     |       | 1.99                |      |
|                | White Mountain Nat'l Forrest                         | 1984 | Backpackers in Wilderness    | 1             | 39.00                     |       | 2.60                |      |
| New York       | Sagamore Hill National Historic Site                 | 2002 | Visitors                     | 4             | 13.25                     | 14.77 | 1.64                | 0.49 |
|                | Saratoga National Historic Site                      | 2001 | Visitors                     | 5             | 5.60                      | 4.39  | 1.37                | 0.13 |
| North Carolina | Cape Hatteras National Seashore                      | 2002 | Visitors                     | 1             | 52.00                     |       | 2.80                |      |
|                | Nantahala River                                      | 1994 | Canoers, kayakers, & rafters | 13            | 79.38                     | 11.56 | 5.10                | 1.08 |
|                | Nantahala River                                      | 1994 | Canoers, kayakers, & rafters | 5             | 82.00                     | 1.58  | 5.10                | 0.17 |
| Oregon         | Clackamas River                                      | 1988 | Boaters                      | 1             | 70.00                     |       | 3.66                |      |
|                | Clackamas River                                      | 1995 | Boaters                      | 1             | 35.00                     |       |                     |      |

Table B4. Crowding scale averages by state and study description (*continued*)

| State          | Study site                                           | Date | Population studied           | # of contexts | Crowding scale points 3-9 |       | Crowding scale mean |      |
|----------------|------------------------------------------------------|------|------------------------------|---------------|---------------------------|-------|---------------------|------|
|                |                                                      |      |                              |               | Average (%)               | SD    | Average mean        | SD   |
|                | Deschutes River                                      | 1987 | Boaters                      | 8             | 93.67                     | 4.84  | 5.65                | 0.43 |
|                | Eagle Cap Wilderness                                 | 1980 | Hikers in Wilderness         | 1             | 49.00                     |       |                     |      |
|                | Illinois River                                       | 1981 | Rafters                      | 1             | 26.00                     |       |                     |      |
|                | Jefferson County Reservoirs                          | 1997 | Campers & day-use area users | 14            | 61.36                     | 16.43 | 3.72                | 0.77 |
|                | McKenzie River                                       | 1991 | Boaters                      | 1             | 50.00                     |       |                     |      |
|                | McKenzie River                                       | 1996 | Boaters                      | 3             | 66.00                     | 21.28 | 3.87                | 1.00 |
|                | Mt. Jefferson Wilderness                             | 1991 | Hikers                       | 1             | 36.00                     |       | 2.57                |      |
|                |                                                      | 1980 | Backpackers in wilderness    | 1             | 53.00                     |       |                     |      |
|                | Mt. Washington Wilderness                            | 1991 | Hikers                       | 1             | 20.00                     |       | 1.98                |      |
|                | Oregon Beaches                                       | 2001 | Beachgoers                   | 53            | 24.98                     | 15.38 | 2.18                | 0.62 |
|                | Oregon Caves National Monument                       | 1995 | Monument visitors            | 1             | 87.00                     |       | 4.20                |      |
|                | Rogue River                                          | 1979 | Rafters                      | 1             | 68.00                     |       | 3.60                |      |
|                | Snake River (Hell's Canyon National Recreation Area) | 1980 | Rafters                      | 1             | 53.00                     |       |                     |      |
|                | Three Sisters Wilderness                             | 1991 | Hikers                       | 1             | 32.00                     |       | 2.48                |      |
| Pennsylvania   | Berlin Lake                                          | 1989 | Boaters                      | 3             | 71.33                     | 17.62 | 4.43                | 1.00 |
|                | Presque Isle                                         | 1994 | Boaters                      | 4             | 57.00                     | 18.35 | 3.53                | 0.97 |
|                | Raystown Lake                                        | 1987 | Boaters                      | 4             | 73.75                     | 12.58 | 4.58                | 0.82 |
| South Carolina | Fort Sumter National Monument                        | 1987 | Tourists                     | 2             | 47.50                     | 4.95  | 3.13                | 0.27 |

Table B4. Crowding scale averages by state and study description (*continued*)

|               |                                              |                                                       |                    |               | Crowding scale points 3-9 |       | Crowding scale mean |      |      |
|---------------|----------------------------------------------|-------------------------------------------------------|--------------------|---------------|---------------------------|-------|---------------------|------|------|
| State         | Study site                                   | Date                                                  | Population studied | # of contexts | Average (%)               | SD    | Average mean        | SD   |      |
| Utah          | Antelope Island State Park                   | Visitors, hikers, horseback riders, & mountain bikers |                    |               | 5                         | 28.40 | 7.64                | 2.21 | 0.31 |
|               |                                              | 1996 Mountain bikers                                  |                    |               | 2                         | 79.00 | 8.49                | 4.39 | 0.24 |
|               |                                              | 1997 Visitors                                         |                    |               | 3                         | 59.67 | 4.73                | 3.25 | 0.15 |
|               | Grand Staircase - Escalante Nat'l Monument   | 1999 Backcountry visitors                             |                    |               | 2                         | 30.00 | 0.00                | 2.24 | 0.09 |
|               |                                              | 1999 Hunters                                          |                    |               | 3                         | 26.67 | 5.03                | 2.07 | 0.12 |
|               | Zion National Park                           | 2003 Hikers                                           |                    |               | 4                         | 36.50 | 27.23               | 2.77 | 1.46 |
|               |                                              | 2003 Users                                            |                    |               | 3                         | 50.67 | 25.93               | 3.02 | 0.96 |
| Vermont       | Shelburne Museum                             | 1995 Day visitors                                     |                    |               | 1                         | 25.00 |                     | 2.00 |      |
| Washington    | Enchantments National Forest                 | 1988 Backpackers in wilderness                        |                    |               | 1                         | 56.00 |                     | 3.24 |      |
|               | White Salmon River                           | 1991 Boaters                                          |                    |               | 1                         | 16.00 |                     | 1.66 |      |
| West Virginia | Dolly Sods Wilderness                        | 1982 Hikers in wilderness                             |                    |               | 1                         | 31.00 |                     | 2.42 |      |
|               | Seneca Rocks - Monongahohela National Forest | 1985 Rock climbers                                    |                    |               | 1                         | 68.00 |                     | 3.88 |      |
| Wisconsin     | Apostle Islands National Lakeshore           | 1981 Boaters                                          |                    |               | 1                         | 59.00 |                     |      |      |
|               |                                              | 1985 Sail boaters                                     |                    |               | 1                         | 38.00 |                     | 2.38 |      |
|               |                                              | 1997 Sail boaters & sea kayakers                      |                    |               | 2                         | 47.00 | 12.73               | 2.83 | 0.38 |
|               | Bong Wildlife Management Unit                | 1979 Pheasant hunters                                 |                    |               | 2                         | 68.50 | 28.99               | 4.60 | 2.26 |
|               |                                              | 1981 Pheasant hunters                                 |                    |               | 2                         | 71.50 | 4.95                | 4.40 | 0.00 |

Table B4. Crowding scale averages by state and study description (*continued*)

| State | Study site                        | Date | Population studied         | # of contexts | Crowding scale points 3-9 |       | Crowding scale mean |      |
|-------|-----------------------------------|------|----------------------------|---------------|---------------------------|-------|---------------------|------|
|       |                                   |      |                            |               | Average (%)               | SD    | Average mean        | SD   |
|       | Brule River                       | 1975 | Anglers, tubers, & canoers | 3             | 49.00                     | 5.20  | 3.31                | 0.43 |
|       |                                   | 1985 | Canoers                    | 1             | 37.00                     |       | 2.44                |      |
|       | Door County                       | 1986 | Boaters                    | 1             | 69.00                     |       | 3.92                |      |
|       | Grand River Marsh                 | 1978 | Firing line hunters        | 1             | 79.00                     |       | 5.81                |      |
|       |                                   | 1978 | Managed hunt hunters       | 1             | 17.00                     |       | 1.84                |      |
|       | Horicon Grand River Marsh         | 1986 | Goose hunters              | 1             | 86.00                     |       | 5.11                |      |
|       |                                   | 1986 | Goose hunters              | 1             | 17.00                     |       | 2.23                |      |
|       | Lake Delavan                      | 1986 | Recreationists             | 1             | 53.00                     |       | 3.12                |      |
|       | Lake Delavan                      | 1986 | Riparian landowners        | 2             | 60.00                     | 38.18 | 3.81                | 1.88 |
|       | Public Hunting Area               | 1980 | Pheasant hunters           | 1             | 85.00                     |       |                     |      |
|       | Sandhill Wildlife Management Unit | 1979 | Deer hunters               | 2             | 27.50                     | 10.61 | 2.14                | 0.42 |
|       |                                   | 1980 | Deer hunters               | 8             | 30.13                     | 17.46 | 2.58                | 1.11 |
|       |                                   | 1981 | Deer hunters               | 8             | 25.00                     | 11.89 | 2.27                | 0.60 |
|       |                                   | 1982 | Deer hunters               | 8             | 37.63                     | 21.76 | 2.81                | 1.12 |
|       |                                   | 1983 | Deer hunters               | 4             | 33.25                     | 20.09 | 2.38                | 1.12 |
|       |                                   | 1984 | Deer hunters               | 8             | 39.38                     | 6.57  | 2.68                | 0.34 |
|       |                                   | 1985 | Deer hunters               | 4             | 31.25                     | 8.77  | 2.30                | 0.32 |
|       |                                   | 1986 | Deer hunters               | 4             | 44.75                     | 30.84 | 2.23                | 0.09 |
|       |                                   | 1987 | Deer hunters               | 8             | 42.13                     | 22.92 | 2.82                | 1.02 |

Table B4. Crowding scale averages by state and study description (*continued*)

| State           | Study site                        | Date | Population studied     | # of contexts | Crowding scale points 3-9 |       | Crowding scale mean |      |
|-----------------|-----------------------------------|------|------------------------|---------------|---------------------------|-------|---------------------|------|
|                 |                                   |      |                        |               | Average (%)               | SD    | Average mean        | SD   |
|                 |                                   | 1988 | Deer hunters           | 8             | 24.50                     | 25.25 | 2.06                | 0.98 |
|                 |                                   | 1989 | Deer hunters           | 8             | 14.63                     | 27.46 | 1.80                | 1.17 |
|                 |                                   | 1986 | Wildlife photographers | 1             | 55.00                     |       |                     |      |
|                 | State Wide- Wisconsin- 1977       | 1977 | Deer hunters           | 1             | 46.00                     |       | 3.13                |      |
|                 | State Wide- Wisconsin- 1982 deer  | 1982 | Deer hunters           | 1             | 41.00                     |       | 2.75                |      |
|                 | State Wide- Wisconsin- 1982 goose | 1982 | Goose hunters          | 1             | 27.00                     |       | 2.32                |      |
|                 | Wolf River                        | 1977 | Floaters               | 1             | 61.00                     |       |                     |      |
| Multiple States | Appalachian National Scenic Trail | 1999 | Hikers                 | 2             | 51.00                     | 5.66  | 3.20                | 0.28 |

Table B5. Crowding scale averages by country and study description

| State                     | Study Site                                      | Date | Population studied                        | # of contexts | Crowding scale points 3-9 |       | Crowding scale mean |      |
|---------------------------|-------------------------------------------------|------|-------------------------------------------|---------------|---------------------------|-------|---------------------|------|
|                           |                                                 |      |                                           |               | Average (%)               | SD    | Average mean        | SD   |
| Canada (Alberta)          | Athabasca-Sunwapta Rivers                       | 1999 | White water rafters & float trip visitors | 12            | 2.83                      | 2.59  | 1.15                | 0.11 |
|                           | Banff National Park                             | 1993 | Tourists                                  | 1             | 40.00                     |       | 2.72                |      |
|                           | Columbia Icefield                               | 1993 | Tourists                                  | 7             | 51.57                     | 16.63 | 3.26                | 1.01 |
|                           | Columbia Icefield                               | 1996 | Tourists                                  | 7             | 56.86                     | 13.98 | 3.53                | 0.86 |
|                           | Columbia Icefield                               | 1997 | Tourists                                  | 2             | 78.00                     | 7.07  | 4.75                | 0.85 |
|                           | Columbia Icefield                               | 2000 | Tourists                                  | 4             | 66.00                     | 13.17 | 3.84                | 0.79 |
| Canada (British Columbia) | Gwaii Haanas Nat'l Park Reserve & Heritage Site | 1995 | Motor boaters & kayakers                  | 12            | 23.42                     | 9.07  | 2.24                | 0.47 |
|                           | Jasper National Park                            | 1993 | Tourists                                  | 1             | 35.00                     |       | 2.43                |      |
|                           | Pacific Rim National Park                       | 2001 | Ocean kayakers                            | 2             | 59.50                     | 28.99 | 3.85                | 1.56 |
|                           | Whistler Mountain                               | 2000 | Visitors                                  | 5             | 52.60                     | 13.20 | 3.20                | 0.65 |
| Ecuador                   | Cuyabeno Wildlife Reserve                       | 1995 | Ecotourists                               | 5             | 39.40                     | 4.51  | 1.54                | 0.09 |
| New Zealand               | Kapiti Island                                   | 1991 | Visitors                                  | 2             | 37.50                     | 12.02 |                     |      |
|                           | New Zealand's Conservation Estate               | 1992 | Tourists                                  | 4             | 41.25                     | 16.46 |                     |      |
|                           |                                                 |      | Tourists                                  | 1             | 82.00                     |       |                     |      |
|                           | New Zealand Backcountry                         | 1996 | Backcountry Users                         | 1             | 54.00                     |       | 3.10                |      |
|                           | Rakaia River                                    | 1983 | Salmon Anglers                            | 2             | 59.50                     | 20.51 |                     |      |
| Sweden                    | Waimakariri River                               | 1985 | Salmon Anglers                            | 1             | 75.00                     |       |                     |      |
|                           | Fulufjället National Park                       | 2001 | Hikers                                    | 9             | 30.56                     | 11.58 | 2.21                | 0.45 |
|                           | Fulufjället National Park                       | 2005 | Hikers                                    | 9             | 30.56                     | 11.58 | 2.21                | 0.45 |
| Thailand                  | Koh Chang Marine National Park                  | 2005 | Snorkellers                               | 1             | 90.00                     |       | 5.70                |      |

Table B6. Carrying capacity by state

| State           | Overall<br><i>n</i> | # of<br>studies | # of<br>contexts | Carrying capacity judgments - % of contexts |                           |                            |                              |                                          |
|-----------------|---------------------|-----------------|------------------|---------------------------------------------|---------------------------|----------------------------|------------------------------|------------------------------------------|
|                 |                     |                 |                  | Suppressed<br>crowding<br>(0-35%)           | Low<br>normal<br>(35-50%) | High<br>normal<br>(50-60%) | Over<br>capacity<br>(65-80%) | Greatly<br>over<br>capacity<br>(80-100%) |
| Alaska          | 5620                | 20              | 53               | 20.8                                        | 13.2                      | 24.5                       | 24.5                         | 17.0                                     |
| Arizona         | 2004                | 4               | 8                | 12.5                                        | 25.0                      | 25.0                       | 12.5                         | 25.0                                     |
| California      | 9078                | 17              | 70               | 12.9                                        | 20.0                      | 40.0                       | 25.7                         | 11.4                                     |
| Colorado        | 7509                | 11              | 65               | 56.9                                        | 12.3                      | 13.8                       | 16.9                         | 0                                        |
| Delaware        | 1197                | 2               | 2                | 0                                           | 0                         | 0                          | 100                          | 0                                        |
| Hawaii          | 1462                | 5               | 18               | 50.0                                        | 33.3                      | 5.6                        | 11.1                         | 0                                        |
| Maine           | 3694                | 7               | 20               | 40.0                                        | 30.0                      | 25.0                       | 5.0                          | 0                                        |
| Maryland        | 3043                | 7               | 11               | 36.4                                        | 9.1                       | 36.4                       | 18.2                         | 0                                        |
| Massachusetts   | 1102                | 2               | 9                | 100.0                                       | 0                         | 0                          | 0                            | 0                                        |
| Michigan        | 481                 | 1               | 1                | 0                                           | 100.0                     | 0                          | 0                            | 0                                        |
| Minnesota       | 196                 | 1               | 1                | 0                                           | 0                         | 0                          | 100                          | 0                                        |
| Nevada          | 1251                | 2               | 8                | 25.0                                        | 75.0                      | 0                          | 0                            | 0                                        |
| New Hampshire   | 1106                | 2               | 2                | 50.0                                        | 50.0                      | 0                          | 0                            | 0                                        |
| New York        | 776                 | 2               | 9                | 100.0                                       | 0                         | 0                          | 0                            | 0                                        |
| North Carolina  | 3151                | 3               | 19               | 0                                           | 0                         | 15.8                       | 26.3                         | 57.9                                     |
| Oregon          | 7325                | 16              | 88               | 52.3                                        | 15.9                      | 9.1                        | 12.5                         | 10.2                                     |
| Pennsylvania    | 2515                | 3               | 11               | 9.1                                         | 0                         | 36.4                       | 36.4                         | 18.2                                     |
| South Carolina  | 1687                | 1               | 2                | 0                                           | 50.0                      | 50.0                       | 0                            | 0                                        |
| Utah            | 2961                | 7               | 22               | 59.1                                        | 4.5                       | 18.2                       | 13.6                         | 4.5                                      |
| Vermont         | 894                 | 1               | 1                | 100.0                                       | 0                         | 0                          | 0                            | 0                                        |
| Washington      | 1202                | 2               | 2                | 50.0                                        | 0                         | 50.0                       | 0                            | 0                                        |
| West Virginia   | 565                 | 2               | 2                | 50.0                                        | 0                         | 0                          | 50                           | 0                                        |
| Wisconsin       | 14503               | 31              | 96               | 49.0                                        | 21.9                      | 14.6                       | 9.4                          | 5.2                                      |
| Multiple States | 1532                | 1               | 2                | 0                                           | 50                        | 50.0                       | 0                            | 0                                        |

Table B7. Carrying capacity by country

| Country       | Overall<br><i>n</i> | # of<br>studies | # of<br>contexts | Carrying capacity judgments - % of contexts |                           |                            |                              |                                       |
|---------------|---------------------|-----------------|------------------|---------------------------------------------|---------------------------|----------------------------|------------------------------|---------------------------------------|
|               |                     |                 |                  | Suppressed<br>crowding<br>(0-35%)           | Low<br>normal<br>(35-50%) | High<br>normal<br>(50-60%) | Over<br>capacity<br>(65-80%) | Greatly over<br>capacity<br>(80-100%) |
| United States | 73657               | 148             | 520              | 40.4                                        | 17.3                      | 17.5                       | 15.8                         | 9.0                                   |
| Canada        | 7131                | 10              | 53               | 49.1                                        | 17.0                      | 15.1                       | 17.0                         | 1.9                                   |
| Ecuador       | 1197                | 2               | 2                | 0                                           | 0                         | 0                          | 100                          | 0                                     |
| New Zealand   | 2024                | 6               | 11               | 18.2                                        | 27.3                      | 27.3                       | 18.2                         | 9.1                                   |
| Sweden        | 1605                | 2               | 9                | 66.7                                        | 22.2                      | 11.1                       | 0                            | 0                                     |
| Thailand      | 705                 | 1               | 1                | 40.4                                        | 17.3                      | 17.5                       | 15.8                         | 9.0                                   |