Research Papers

Title

Application of the double-bounded dichotomous choice model to the estimation of crowding acceptability in natural recreation areas

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Abstract

Investigating visitors' crowding norms is necessary to establish the carrying capacity of natural recreation areas. For this purpose, several question formats have been used, but it is known that these have methodological issues. To reduce these methodological issues, we compared several different question formats to investigate respondents' perceptions of acceptable crowding limits, using montage photographs of different numbers of people at four sites in Shiretoko and Yakushima World Natural Heritage Site in Japan. We applied the double-bounded dichotomous choice model used in the contingent valuation method. Our use of conventional long- and short-format question models shows that acceptability decreases as the number of people increases, in single- and double-bounded models. This confirms the findings of past studies. Despite differences in the crowding norms as measured using different question formats, there was little difference in the number of people depicted in the photographs. The logit model of the double-bounded dichotomous choice model makes it possible to analyze the impact of differences in the number of people and other relevant factors, including the respondents' characteristics and attitudes. The number of respondents and the burden on respondents vary in each question format, and each provides different information to managers.

Management Implication

/ A double-bounded dichotomous choice model is shown to be a suitable method to analyze crowding norms at natural recreation sites.

/ This model is less burdensome for respondents and requires fewer samples than some other methods.

/ The choice model also permits one to analyze the influences of visitors' characteristics and other factors on crowding norms.

Keywords: Normative method; Visual approach; Crowding norm; Choice model

1. Introduction

1.1. Studies of crowding norms in natural recreation areas

Indicators and standards of quality are the critical elements underpinning carrying capacity setting in protected areas (Manning, 2011). Indicators of quality are defined using area objectives and the concerns of managers, stakeholders, and visitors. Standards of quality are defined by the norms that stakeholders and visitors consider acceptable. The norm in recreational research "address conditions that are the result of behavior and measure the degree to which selected conditions ought to exist" (Manning, 2011). Therefore, methods for investigating visitor perceptions of crowding are needed to assess the carrying capacity of natural recreation areas.

Methods for investigating crowding norms have been developed in various ways. It was mainstream practice in early studies to ask respondents directly to provide answers in the form of numerical values (Manning, 2011; Shelby, 1981). This approach generated a low survey response rate, with many respondents finding it difficult to answer the questions (Hall & Roggenbuck, 2002; Hall, Shelby, & Rolloff, 1996; Vaske, Donnelly, & Bingül, 2016). As a result, a different method was developed, in which respondents were presented with several options and asked to choose an acceptable one. The response rate for questions involving crowding norms in a popular and easily accessible outdoor area with many visitors is low (Roggenbuck, Williams, Bange, & Dean, 1991; Vaske et al., 2016). For this reason, many researchers have used a visual approach, which presents respondents with illustrations or photographs and asks them to identify the most acceptable level of crowding (Manning & Freimund, 2004; Manning, Valliere, Wang & Jacobi, 1999; Manning, 2011; Manning, Lime, Freimund, & Pitt, 1999). The illustrations or photographs enable respondents to perceive and recall the number of visitors clearly. This approach also has the advantage of being suitable

for high-density locations and virtual situations; therefore, it has been applied to a wide range of places and activities. It has been used to assess the number of visitors to an area; bikers on a trail (Arnberger & Haider, 2005; Arnberger, Aikoh, Eder, Shoji, & Mieno, 2010; Mieno, Shoji, Aikoh, Arnberger, & Eder, 2016), vehicles on a road (Anderson, Manning, Valliere, & Hallo, 2010), vessels in a protected ocean area (Needham, Szuster, & Bell, 2011), visitors at tourism sites (Manning, Wang, Valliere, Lawson & Newman, 2002), and visitors to a coastal wilderness site (Pierce & Manning, 2015). This method can be used to measure the acceptable impacts on natural resources by recreational activities, such as a piece of bare land (Kim & Shelby, 2005, 2006), in addition to measuring social conditions, such as the number of people and cars in an area.

Other studies have applied stated choice experiments to recreation research. The methodology was initially developed by Louviere and Hensher (1982) and Louviere and Woodworth (1983) and has been used primarily within the fields of transportation and marketing (e.g. Hensher 1994; Louviere 1994). This methodology allows individual preferences to be assessed by asking respondents to choose among various multi-attribute scenarios. In the literature of recreation research, the result shows the importance and their tradeoffs among natural resources, social, and managerial conditions, and visitors' experiences. Haider and Ewing (1990) made an early application of choice experiments to study leisure behaviors of visitors. They analyzed destination choices of Caribbean tourists. Stated choice experiments are now a widely used method, capable of evaluating the influence of factors including differences in recreational activities and settings and the number of people involved (Arnberger & Haider, 2005; Lawson & Manning, 2002; Newman, Manning, Dennis, & McKonly, 2005; Pettebone et al., 2011; van Riper, Manning, Monz, & Goonan, 2011). Louviere and Timmermans (1990) summarize the use and usefulness of the models in recreation research.

Most crowding-related studies have been conducted in North America (Manning, 2011; Vaske & Shelby, 2008). In Japan, which is the subject of this study, managers and researchers are interested in determining the carrying capacity of natural recreation sites, including crowding norms. The control of visitors and cars has become an issue at sites such as Yakushima, Shiretoko, and Mt. Fuji, which have been designated as World Heritage Sites in

87 recent years (Ishikawa et al., 2013). Since the 1990's, studies of crowding norms and other
88 relevant issues have been carried out, drawing on research examples in North America
89 (Aikoh, Cheng, & Asakawa, 2002; Mieno et al., 2016; Terasaki et al., 2011). The visual
90 approach has also made it possible to conduct international comparison studies of sites that
91 are distant from each other, such as a comparative of sites in Austria and Japan (Arnberger et
92 al., 2010). Similar comparisons have been made between destinations in North America and
93 Turkey (Sayan, Krymkowski, Manning, Valliere, & Rovelstad, 2013). This approach is
94 expected to make an important contribution to studies investigating the impact of cultural
95 factors on crowding norms (Evans, Lepore, & Allen, 2000) and the influence of
96 internationalization on tourism.
97 The present study aims to compare several different question formats to investigate
98 respondents' perceptions of acceptable crowding limits, using montage photographs. We have
99 applied the single-bounded and double-bounded methods used in contingent valuation
100 research to remove the known methodological issues associated with such approaches and
101 compared them with the conventional question formats.
102
103 1.2. Methodological issues in studies of crowding norms
104 Given the broad range of studies of crowding norms, several methodological issues have been
105 pointed out and the questionnaire format has evolved through the development of new
106 techniques (Manning, 2011). One issue involves the response format. At first, researchers
107 used an open-ended method, directly asking respondents to identify an acceptable number of
108 people (Shelby, 1981; Vaske & Donnelly, 2002). However, when use levels were high,
109 agreement on norms was low. In addition, some respondents felt strongly about the issue of
110 crowding, but could not answer the questions clearly (Hall et al., 1996). Consequently, a
111 semi-open method was adopted, which included options such as, "It matters to me, but I
112 cannot specify a number" (Hall et al., 1996). Although crowding norms were similar to those
113 obtained with open-ended questions, the standard deviation was different (Hall et al., 1996).
114 The closed-ended method has been used with respondents who are not fully aware of numeric
115 norms; it asks them to choose an acceptable item from a range of given possible responses.

The response rate for crowding norm is higher for closed-ended methods, which allow respondents to choose an item, than for the semi-open method of asking them to write a number in the blank space. However, there is no difference in the crowding norms identified using these two methods (Hall & Roggenbuck, 2002; Vaske et al., 2016).

The introduction of the visual approach, which allows researchers to present a visual representation of the natural resource and the number of people through illustrations and photographs, has also led to variations in the question format. One approach is the short-format question method, in which respondents select the most acceptable picture from among a group of images of different numbers of people across a certain range. Since this method requires only one response, the burden on the respondent is small (Manning et al., 1999b). It produces an acceptable curve, depicted as a graph in which the number of people is represented on the x-axis and the ratio for considering a situation acceptable on the y-axis. A second method, the long-format question method, presents photographs one-by-one, asking respondents to rate the acceptability of each photograph on a Likert scale—a 9-point scale is most commonly used. This method is almost identical to full profile ratings-based conjoint analysis. However, long-format questions constitute a single attribute and the statistical analysis applied is also different. The full profile ratings-based conjoint analysis is generally applied to understand trade-offs among attributes, so profiles are multi-attribute. In this method, the burden on respondents is heavier, as they must respond to all of the pictures. Manning et al. (1999b) compared these formats and showed that the difference in norms was small; however, perceived crowing norms in short-format questions were lower than those in long-format question. Other studies have examined the acceptability of trail conditions with long- and short-format responses. These studies have found that the differences tend to be small, although some combinations show statistical differences (Kim & Shelby, 2005, 2006). When asked how difficult they found it to answer the questions, respondents said that long-format questions were more difficult to answer than short-format ones (Kim & Shelby, 2006). Study of norm crystallization, which is the level of agreement about social norms, have also shown differences between short- and long-format questions, although the differences are considered slight (Krymkowski, Manning, & Valliere, 2009).

Previous studies have pointed out the possibility of bias associated with the presentation of photographs (Manning, 2011). The two types of bias identified are starting point bias, in which images seen at the beginning have a disproportionate influence, and range bias, in which respondents are influenced by the range of the number of people that are shown (Manning, Lawson, Newman, Laven & Valliere, 2002; Manning and Freimund, 2004). The first image elicits "anchoring" in the field of psychology and economics; therefore, a respondent relies on the information offered (Mitchell & Carson, 1989). These biases are similar to those identified in environmental economics studies that use the contingent valuation method to ascertain willingness to pay. Manning et al. (2002a) have shown that evaluation values are slightly different when the order of photographs is reversed. A recent study by Gibson et al. (2014) has confirmed that crowding norms differ significantly when photographs are presented in a discontinuous order. The study has also confirmed the influence of different ranges of people in photographs. Studies on landscape preferences are similar to the studies on crowding norms, in that they use photographs as a stimulus. Researchers consider there may be an order effect, as well as start and end effects. Therefore, other methods are used, such as presenting the images at random or inserting dummy pictures that are not evaluated before and after the survey (Kaplan, Kaplan, & Brown, 1989; Strumse, 1996). The stated-choice model asks respondents to choose one picture from a set of several kinds of photographs by selecting the acceptable number of people and various other factors; therefore, this method is not affected by order bias (Gibson et al., 2014).

1.3. Applying the contingent valuation method to recreation research

The contingent valuation method and recreation studies on crowding norms use the same method of asking questions. There is little difference between stating the amount of money you are willing to pay and proposing an acceptable number of people. Similarly, choosing the right amount of money to pay or an acceptable number of people from a group of presented items are similar tasks (Shelby, 1981; Manning, Lawson & Frymier, 1999; Vaske et al., 2016). Current studies are examining the question of bias in the contingent valuation method

based on answer format and the potential for mitigating any bias. It is possible that this approach could be applied to research into crowding norms.

Elicitation formats that are less susceptible to bias have been developed in contingent valuation research (Bateman et al., 2002; Mitchell & Carson, 1989). Open-ended questions, bidding games, payment cards, and dichotomous choice are representative elicitation formats for contingent valuation.

Early studies often used the open-ended and bidding game format (Mitchell & Carson, 1989). The open-ended format asks respondents to choose their willingness-to-pay freely. However, respondents who are not used to pricing items find it difficult to answer the question. Therefore, no response and the nomination of extreme amounts such as "$0" occur frequently. Consequently, current studies do not often use this format. In the bidding game, respondents are presented with an amount and asked whether they are willing to pay the amount or not. Respondents who answer “yes” to the initial amount are presented a higher amount and asked whether they are willing to pay the higher amount. Respondents who answer “no” to the initial amount are presented with a lower amount and asked whether they are willing to pay it. Repeating the questions reveals the level of the willingness to pay. The bidding game format is easier to answer than open-ended questions; therefore, problems such as respondents giving no answer or nominating extreme amounts do not occur. However, the starting point bias might occur, in which the initial amount presented affects the answer. For example, a respondent’s answer is different when the initial amount presented is five USD from their answer when the first amount presented is 50 USD. This is because respondents perceive the initial amount as reasonable.

The payment card method, in which respondents are presented a list of several amounts and asked to choose the amount they prefer, is also relatively easy to answer. No response or responses nominating an extreme amount does not occur as frequently in the payment card format as in open-ended questions. Moreover, starting point bias does not occur, as in the bidding game format. However, range bias occurs, in which the range of amounts presented affects responses (Mitchell & Carson, 1989). For example, a respondent’s answers are different when choosing an amount between 0 and 30 USD from their answer when choosing

202 an amount between 0 and 1,000 USD. This is because respondents perceive the range of the
203 amounts presented as reasonable.
204 In the dichotomous-choice format, respondents are presented with a hypothetical
205 environmental change, the amount of money necessary to achieve the change, and asked
206 whether they are willing to pay the amount. The biases that occur in other formats, such as
207 starting point bias and range bias, do not occur in this format. In addition, dichotomous-
208 choice format avoids bias arising from the strategic behaviors of respondents under certain
209 conditions (Hoehn and Randall, 1987). Respondents find it easy to answer questions
210 presented in this format because judging whether to accept the cost of achieving the
211 environmental change is similar to the daily purchasing behavior of judging whether to buy
212 goods with a specific price. These advantages have resulted in dichotomous-choice becoming
213 the most widely used at present. The National Oceanic and Atmospheric Administration
214 (NOAA) guideline recommend using this format (Arrow et al., 1993).
215 The double-bounded format is statistically more efficient than the single-bounded format, and
216 the confidence interval of the estimated willingness-to-pay is narrower (Hanemann, Loomis,
217 & Kanninen, 1991). In the double-bounded format, respondents need to answer two
218 consecutive questions. If he or she accepts the initial amount at the first step, they are
219 presented with a higher amount in the second step. If respondents do not accept the initial
220 amount, they are presented with a lower amount in the second step. More information is
221 obtained in the double-bounded format than in the single-bounded format, which asks only
222 one question. It can estimate willingness-to-pay, even with a smaller number of respondents
223 than the single-bounded format.
224
225 1.4. Objective of the study
226 This study sought to identify the optimal method for estimating the carrying capacity at
227 natural recreation areas by comparing the three most commonly used methods for eliciting
228 people's crowding norms with the double-bounded dichotomous choice model. It compared
229 double-bounded dichotomous choice model for photo-based evaluations of crowding norms
230 with conventional question formats, such as short-format and long-format questions and the

single-bounded dichotomous choice model. We have applied the approaches used in contingent valuation method to resolve the methodological issues in the evaluation of crowding norms and discussed the differences among the three methods and their application in estimating the carrying capacity in protected areas.

2. Method

2.1. Questionnaire research design

This study aims to investigate acceptable crowding norms, using photographs of different numbers of people at four study sites in Shiretoko and Yakushima World Natural Heritage Site in Japan, in combination with three different answer formats in February 2014. Seven photographs with varying numbers of "people at one time" (PAOT) depict the two sites in Shiretoko and two sites in Yakushima. Responses were obtained using a web questionnaire survey. They were registered respondents of a research company (Nikkei Research Inc.), living in the Tokyo metropolitan area; they are men and women aged 20–69. According to the age structure of populations in the area, 10,000 registered respondents were asked to participate in the survey via email. Respondents who accepted the request submitted their answers on the web page provided. The web page had been opened until the day when respondents reached more than 1,000 people. The total number of respondents was 1,192 in a week.

The respondents were divided into four groups (Table 1): 239 were asked to assess photo montages of site 1 & 2 in Shiretoko in long-format; 244 were asked to assess photo montages of site 3 & 4 in Yakushima in long-format; 249 respondents were asked to assess all four sites in short-format; and 460 were asked to make single- and double-bounded dichotomous choice (hereinafter referred to as "single-bounded" and "double-bounded") for all four sites. In long-format, we asked the respondents to evaluate seven photographs of two sites, using a seven-point scale, which ranged from "absolutely unacceptable" to "very acceptable." In short-format, we presented all seven pictures of each of the four sites and asked respondents to choose one photograph that showed an acceptable limit. In the single-bounded survey, we asked respondents to answer questions relating to each of the four sites. First, we presented

one of the seven photographs randomly and asked them their acceptability as "Yes," "No" or "I don't know." Then we asked respondents to answer second questions for the double-bounded survey. If they accepted the first photograph, we showed them a second photograph which the PAOT was one level higher, asking them their acceptability again. If they did not accept the first photograph, we showed them a second photograph which the PAOT was one level lower, asking them their acceptability again. We also asked respondents if they have visited Shiretoko or Yakushima World Natural Heritage sites in the past. Their crowding concern whether they thought about the issue of crowding when planning trips to any natural recreation areas were asked, using a five-point scale, which ranged from "unimportant" to "very important."

Table 1 Number of respondents of the web questionnaire survey for different question formats and study sites

Question format	Site	Number of respondents
Long-format	1, 2	239
	3, 4	244
Short-format	1, 2, 3, 4	249
Single- and Double-bounded	1, 2, 3, 4	460

Site 1: Kamui-Wakka entrance, 2: Kamui-Wakka waterfall, 3: Jomon-Sugi tramway trail, 4: Jomon-Sugi forest trail

2.2. Study sites and photographs

The study sites were selected from a group of places in Japan that attract a large number of visitors, in which some strategies for managing the number of people and vehicles have been implemented or considered. Study site 1 is the Kamui-Wakka entrance, and site 2 is the Kamui-Wakka waterfall at the Shiretoko World Natural Heritage site. Site 3 is the Jomon-Sugi tramway trail, and site 4 is the Jomon-Sugi forest trail at the Yakushima World Natural Heritage site.

In Shiretoko Kamui-Wakka, hot springs spurt into the river; visitors can enjoy wading in the shallow warm river and bathing in natural hot-water pools. It is a 300m round trip trail to the upper stream, which climbs up the top waterfall for about 5 meters and returns to the trailhead. Approximately 55,000 people visit the site between June and October each year. During the summer vacation, about 1,000 people visit in every day. The managers and local stakeholders must grapple with congestion in the river and around the waterfall and a shortage of parking. During the summer vacation, visitors must take a shuttle bus to the site, as access using private vehicles is prohibited.

"Jomon-Sugi (big old cedar)" is the popular hikers' destination in Yakushima island (Shibasaki, 2018). Hikers take shuttle buses to the trailhead and walk for about ten hours, to complete the whole trail. The first half follows a former logging tramway, and the second half is a steep climb through a subtropical broadleaf forest to "Jomon-Sugi." Approximately 60,000 people visit each year. About 800 people can visit in a single day during the holiday season in the beginning of May. There is so much congestion on the trail and observation deck in front of "Jomon-Sugi," not to mention a shortage of toilets, that the town council once discussed restricting the number of hikers.

For the Kamui-Wakka entrance, Kamui-Wakka waterfall, Jomon-Sugi tramway trail, and Jomon-Sugi forest trail, we have estimated the maximum density, based on past records, and determined the PAOT in each photograph. In photographs of the site 1: Kamui-Wakka entrance, the PAOT was 0, 5, 10, 16, 22, 29, and 36. In photographs of the site 2: Kamui-Wakka waterfall, the PAOT was 0, 3, 6, 10, 14, 19, and 24. The PAOT on the site 3: Jomon-Sugi tramway trail was 0, 2, 4, 6, 8, 11, and 14. Finally, the PAOT on the site 4: Jomon-Sugi forest trail was 0, 3, 6, 10, 14, 18, and 23. We took the background photographs on a clear day and placed hikers at each site, (Fig. 1) using Adobe Photoshop CS to create photo montages. The images on the website are in full color and displayed in 400 horizontal and 270 vertical pixels.

Site 1: Kamui-Wakka entrance

Photo 1 (0 PAOT)

Photo 7 (36 PAOT)

Site 2: Kamui-Wakka waterfall

Photo 1 (0 PAOT)

Photo 7 (24 PAOT)

Site 3: Jomon-Sugi tramway trail

Photo 1 (0 PAOT)

Photo 7 (14 PAOT)

Site 4: Jomon-Sugi forest trail

Photo 1 (0 PAOT)

Photo 7 (23 PAOT)

310

311 Fig.1 Examples of presented study photographs in the web questionnaire with varying
312 numbers of people at one time for four study sites. Photo 1 have no people, photo7 have the
313 most people.
314
315 2.3. Analyzing single- and double-bounded dichotomous choice model
316 The response data obtained through the single-bounded and double-bounded dichotomous
317 choice format is analyzed by using the logit model derived from the random utility model
318 (Hanemann, 1984; Hanemann et al. 1991).
319 In the model, the following is assumed for the utility function of the respondent k:
320
321 $$U_k^i = V_k^i + \varepsilon_k^i$$
322
323 where i takes Y when the respondent k answers yes to the bid, while takes N when the
324 respondent k answers no to the bid. Here, V_k^i and ε_k^i represent the deterministic and
325 stochastic terms of the utility, respectively. It is assumed that the respondent k considers the
326 environmental change and the associated payment and chooses the alternative with the higher
327 utility. Since the probability P_k^Y that the respondent k will answer yes is equal to a
328 probability for which the utility from the alternative Y, U_k^Y is larger than the utility from the
329 alternatives n, U_k^N, described as below:
330
331 $$P_k^Y = \Pr(U_k^Y > U_k^N) = \Pr(V_k^Y + \varepsilon_k^Y > V_k^N + \varepsilon_k^N)$$
332
333 Assuming that the error term ε_k^i follows a type I extreme value distribution (Gumbel
334 distribution), the probability P_k^Y is described by the following binary logit model:
335 $$P_k^Y = \frac{1}{1 + e^{-\Delta V}}$$
336
337
338

where ΔV represents the utility difference function and the following log-linear function is assumed: $\Delta V = \alpha + \beta \ln T_k$. In the utility difference function, T_k represents the bid offered to the respondent k, while the α and the β indicate the utility obtained from the improvement of the environment and the utility obtained from the payment, respectively. By extending the utility difference function as follows, it is possible to analyze the influence of other factors such as the knowledge on the subjects, the degree of interest in the issue and the socio-demographic variables of the respondents such as gender, age and income on the answers of the respondents: $\Delta V = \alpha + \beta \ln T_k + \boldsymbol{\gamma}\mathbf{z_k}$, where, $\mathbf{z_k}$ is a vector of other factors that may affect the answer of the respondent k, and $\boldsymbol{\gamma}$ is a vector of parameters of those factors.

The parameters are estimated by the maximum likelihood method. The log likelihood function can be written as follows:

$$\ln L = \sum_k \left(\delta_k^Y \ln P_k^Y + \delta_k^N \ln P_k^N \right)$$

where δ_k^Y and δ_k^N are the dummy variable such that $\delta_k^Y = 1$ when the respondent k answers yes to the bid and $\delta_k^Y = 0$ otherwise, while $\delta_k^N = 1$ when the respondent k answers no to the bid and $\delta_k^N = 0$ otherwise.

So far, we explained the single-bounded dichotomous choice. The response data obtained through the double-bounded dichotomous choice format is analyzed by using an extended version of the above model.

The probability P^{NN} that the respondent k answers no to both the first bid (T_k) and the second lower bid (T_k^L) is as follows (Hanemann et al. 1991):

$$P^{NN}(T_k, T_k^L) = Pr\{T_k > WTP \text{ and } T_k^L > WTP\} = G(T_k^L; \theta)$$

where G is a distribution function and θ is the parameter vector. Likewise, P^{NY} which is the probability that the respondent k answers no to the first bid and answers yes to the second lower bid, P^{YN} which is the likelihood that the respondent *k* answers yes to the first bid and answers no to the second higher bid (T_k^U) and P^{YY} which is the likelihood that the respondent k answers yes to both the first and the second higher bid are as follows, respectively;

$$P^{NY}(T_k, T_k^L) = Pr\{T_k \geq WTP \geq T_k^L\} = G(T_k;\theta) - G(T_k^L;\theta)$$

$$P^{YN}(T_k, T_k^U) = Pr\{T_k \leq WTP \leq T_k^U\} = G(T_k^U;\theta) - G(T_k;\theta)$$

$$P^{YY}(T_k, T_k^U) = Pr\{T_k \leq WTP \text{ and } T_k^U \leq WTP\} = 1 - G(T_k^U;\theta)$$

The parameters are estimated by the maximum likelihood method. The log likelihood function can be written as follows:

$$lnL(\theta) = \sum_k \{d_k^{YY} lnP^{YY}(T_k, T_k^U) + d_k^{YN} lnP^{YN}(T_k, T_k^U) + d_k^{NY} lnP^{NY}(T_k, T_k^L) + d_k^{NN} lnP^{NN}(T_k, T_k^L)\}$$

where d_k^{YY} is a dummy variable such that $d_k^{YY} = 1$ when the respondent answers yes to both of the two bids and $d_k^{YY} = 0$ otherwise. Similarly, d_k^{YN}, d_k^{NY} and d_k^{NN} are the dummy variables corresponding to each response pattern.

We assume a log-linear function for $G(T)$ and the constant term α and the parameter of logarithmic value of the bid β for θ as follows:

$$G(T) = \frac{1}{1 + \exp\{-(\alpha + \beta lnT)\}}$$

where T is the bid for the respondents.

The median and mean WTP can be calculated by using the estimated parameters, α and β (Hanemann 1984). The median WTP is the amount that the probability that the respondent will answer yes to the bid is 0.5 and can be calculated as follows:

$$\text{Median WTP} = \exp\left(-\frac{\alpha}{\beta}\right)$$

Whereas the mean WTP is obtained by integrating the probability that the respondent will answer yes with respect to the bid. However, since it is not realistic to integrate to the extremely high amount, the maximum bid is often used as the integration upper limit. In that case, the mean WTP is calculated as follows:

$$Mean\ WTP(trancation\ at\ T_{max}) = \int_0^{T_{\max}} \frac{1}{1+\exp^{-\Delta V}} dT$$

where T_{max} is the maximum bid.

Similar to single-bounded format, it is possible to analyze the influence of other factors (e.g. household income).

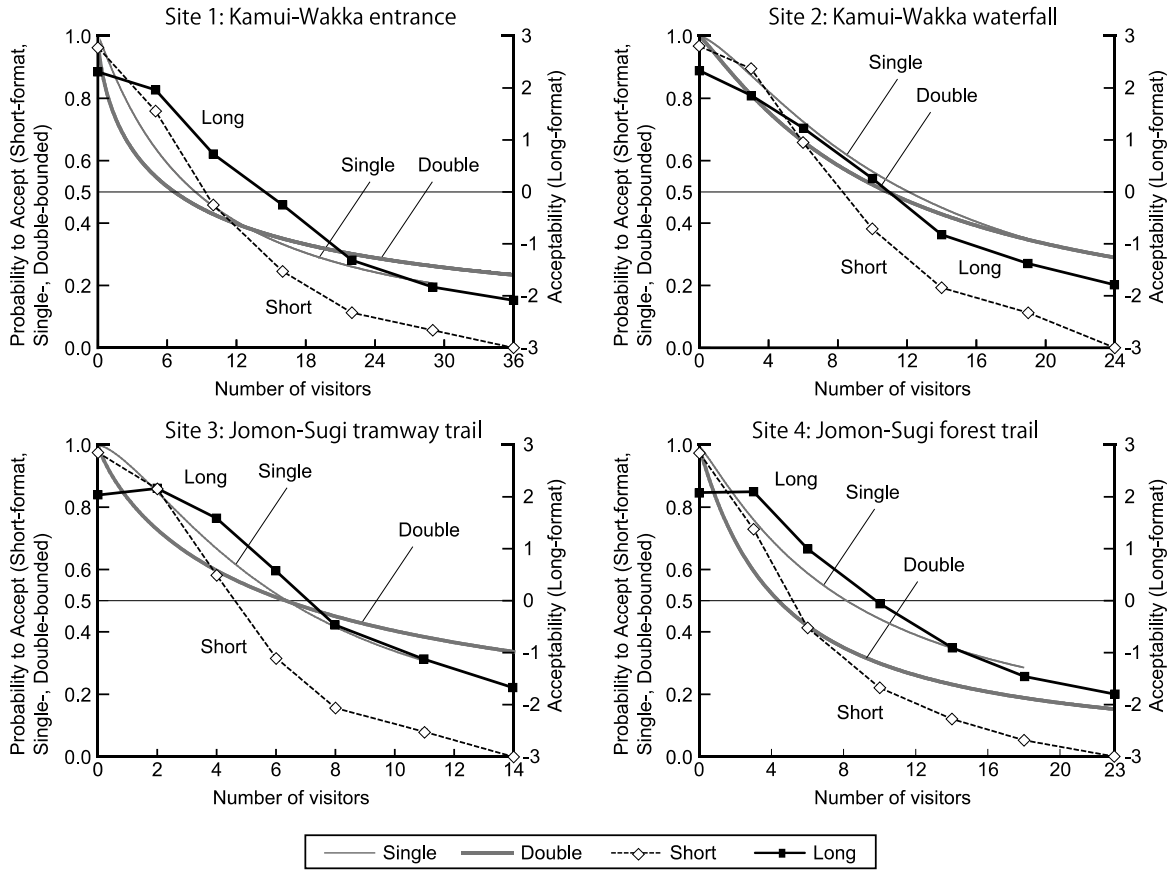
The analyses for this study were carried out using SPSSver.22 and NLOGIT3.0.

3 Results

3.1 The acceptability curve of three types of question formats

The acceptability curve of the crowding norms in each question format (long-format, short-format, single-bounded, and double-bounded) are shown below (Fig. 2). For the long-format, it shows the average acceptability value of each PAOT in the presented pictures. Their acceptability declined gradually, as the number of people increased from 0 PAOT. The short-format method shows the cumulative ratio of respondents who chose the most acceptable photographs. As it was the case with the long-format method, the ratio of acceptability declined gradually, as the number of people increased from 0 PAOT. For the single-bounded

418 approach, a curve was presumed by analyzing the ratio of respondents who judged the PAOT
419 of each randomly presented photograph to be acceptable. As for the results of the four study
420 sites, as the number of people increased from 0 PAOT, the ratio of acceptability tended to
421 decrease. For the double-bounded approach, the curve was estimated using a logit model
422 analysis, based on the acceptability of the first PAOT randomly presented and the response to
423 a second photograph. In all formats, as the number of people increased from 0 PAOT, the
424 ratio of acceptability tended to decrease.
425 When comparing question formats, the curve was gentlest in the long-format; the double-
426 bounded method had the steepest slope until the tolerance ratio hit 0.5. As the number of
427 people increased, the slope of the single-bounded and double-bounded graphs became
428 moderate, while the slope of the short-format became steep. Although no respondent found
429 the largest PAOT in the short-format acceptable, the logit model estimated a ratio of 0.2 for
430 the single-bounded and double-bounded approaches.
431 A comparison of study sites found that the site 1 had a higher PAOT and gentler slope than
432 the site 2 or site 4. The site 3 had the steepest slope. The number of people grew less
433 acceptable from 0 PAOT onwards. For the site 4, the acceptability of 2 PAOT was higher for
434 0 PAOT only in the long-format version.
435



436

437 Fig.2 The acceptability curves of crowding norms in each question format at four study sites

438

439 3.2 A comparison of the crowding norm among three types of question format

440 Table 2 shows the crowding norms for each question format. For the long-format, the
441 crowding norm is the number of people at the acceptability thresholds where the acceptability
442 curve intersects scale 0 of acceptability. For the short-format, it is the average value of the
443 number of people in selected photographs. For the single- and double-bounded approaches,
444 the median value intersecting 0.5 is shown using each logit-model estimate. Although
445 Manning et al. (2002a) have pointed out that it is difficult to statistically compare the
446 acceptability curve of the long-format, short-format, and dichotomous choice approaches, we
447 estimated 95% confidence interval of single- and double-bounded model's median value by
448 the Monte Carlo method based on Krinsky and Robb (1986).

449 The long-format crowding norms are larger than the short-format crowding norms in all sites.
450 Although the double-bounded crowding norms are smaller than the single-bounded norms,
451 the confidence intervals of them are overlapped. The crowding norms of long-format for the

site 1 and 4 are larger than any of the other question format and the confidence intervals of single- and double-bounded. In site 2 and 3, the crowding norms of short-format are smaller than any of the other question format and the confidence intervals.

Table 2 Crowding norms among different types of question format for the four study sites

Question format	Crowding norms			
	Site 1: Kamui-Wakka entrance	Site 2: Kamui-Wakka waterfall	Site 3: Jomon-Sugi tramway trail	Site 4: Jomon-Sugi forest trail
Long-format [a]	14.5	10.9	7.0	9.8
Short-format [b]	8.6	7.5	4.1	5.0
Single-bounded [c]	8.4	12.1	6.4	6.0
Confidence interval	(6.3 – 10.3)	(10.3 – 14.6)	(5.5 – 7.5)	(5.1 – 8.0)
Double-bounded [c]	6.7	10.9	6.3	4.4
Confidence interval	(4.8 – 8.9)	(9.2 – 13.0)	(5.1 – 6.9)	(3.5 – 5.4)

[a] Number of people at which the acceptability curve intersects scale 0 of acceptability.

[b] Average number of people in the selected photographs.

[c] The median value intersecting 0.5 using each logit-model.

3.3 Coefficient estimates for the single- and double-bounded models

In both the single- and double-bounded models, the study site results were significant and converged. The coefficient estimates are shown below, in Table 3. In both models for four study sites, estimated coefficients of logit models were statistically significant. The t-statistics of the double-bounded models were larger than that of single-bounded models. The larger the t value, the smaller the variance of the estimated value (Hanemann et al., 1991).

Table 3 Coefficient estimates of the single- and double-bounded models for the four study sites

	Single-bounded	Double-bounded

Study sites	Constant		Number of visitors		Constant		Number of visitors	
Site 1: Kamui-Wakka entrance								
Coefficient estimate	2.32		-1.09		1.33		-0.70	
t-statistic	5.04	***	-6.12	***	10.15	***	-16.25	***
Site 2: Kamui-Wakka waterfall								
Coefficient estimate	3.45		-1.38		2.70		-1.13	
t-statistic	7.52	***	-7.17	***	17.35	***	-19.77	***
Site 3: Jomon-Sugi tramway trail								
Coefficient estimate	2.76		-1.49		1.58		-0.86	
t-statistic	7.60	***	-7.45	***	13.64	***	-18.96	***
Site 4: Jomon-Sugi forest trail								
Coefficient estimate	2.97		-1.66		1.55		-1.04	
t-statistic	7.15	***	-8.59	***	11.56	***	-20.19	***

***: $p<0.001$

In addition to the PAOT in the photographs, the double-bounded models incorporated relevant factors relating to past visits to both World Natural Heritage sites; the respondents' concerns about crowding were estimated (Table 4). The logit models of both the site 1 and 2 at the Kamui-Wakka were significantly affected by visitors' past experiences and crowding concerns. Positive coefficients of past experience indicated that respondents who had visited the sites previously were tolerant of the PAOT in photographs. Negative coefficients of crowding concern indicated that respondents who dislike crowding are sensitive to PAOT in photographs. The model of the site 3 showed statistical significant influence only in relation to crowding concern. The model of the site 4 showed no influence of either past experience or

crowding concern. As an example, the curve of site 1 is shown in Fig. 3. The acceptability curve of respondents who had visited at Shiretoko, and were not concerned with crowding was gentler; the curve of respondents who had not visited there, and were concerned with crowding was steeper. The logit model could concretely illustrate the influence of relevant factors.

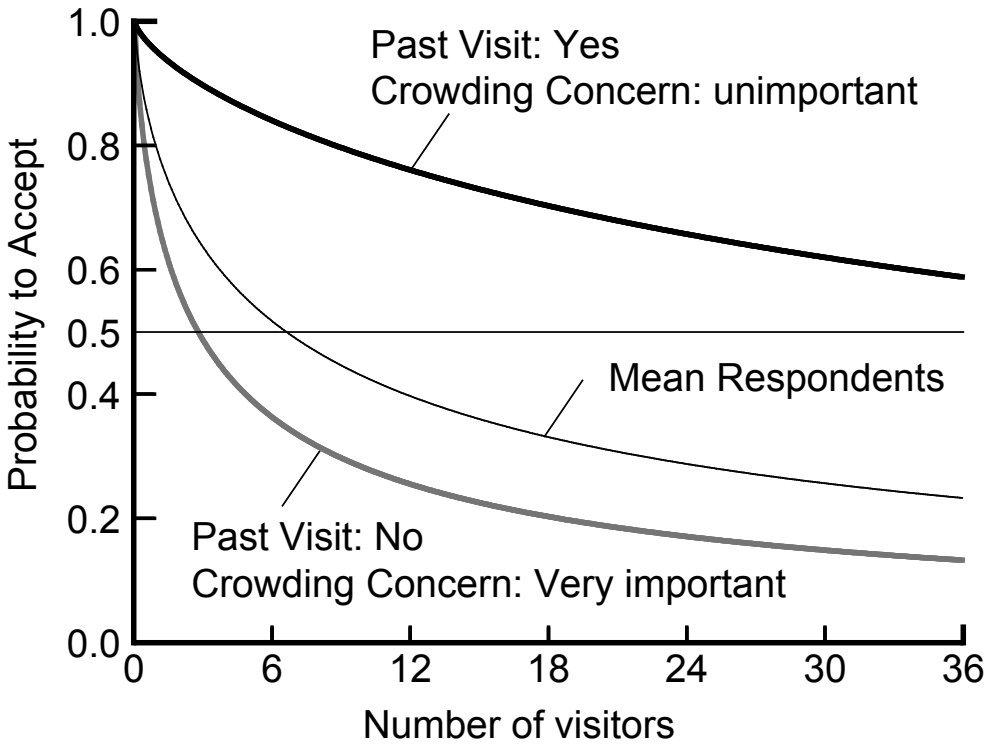
Table 4 Coefficient estimates of double-bounded models for crowding norms, past visit and crowding concerns of respondents

	coefficient	t-value	
Site 1: Kamui-Wakka entrance			
Constant	2.67	4.71	***
Number of visitors	-0.73	-16.55	***
Past visit	0.69	2.89	**
Crowding concern	-0.38	-2.76	***
Site 2: Kamui-Wakka waterfall			
Constant	3.73	6.33	***
Number of visitors	-1.16	-20.21	***
Past visit	0.56	2.38	**
Crowding concern	-0.29	-2.00	**
Site 3: Jomon-Sugi tramway trail			
Constant	3.34	5.63	***
Number of visitors	-0.87	-18.57	***
Past visit	0.35	0.79	
Crowding concern	-0.45	-3.12	**
Site 4: Jomon-Sugi forest trail			

Constant	2.46	3.98	***
Number of visitors	-1.05	-19.75	***
Past visit	0.37	0.79	
Crowding concern	-0.23	-1.56	

***: $p < 0.001$, **: $p < 0.01$

489



490

491 Fig.3 The acceptability curve for crowding norms with / without past visit at Shiretoko and
492 crowding concerns of respondents at site 1

493

494 4. Discussion

495 In this study, respondents' acceptance of the level of crowding decreased as the number of
496 people in the photograph increased. This result confirms previous findings on congestion
497 norms and supports the robustness of methods based on an acceptability curve (Manning,
498 2011). When acceptability curves were compared across the various question formats, it was
499 clear that the short-format curve was steeper than the long-format curve. As past studies have
500 shown, the short-format norm tends to be slightly less than the long-format norm (Kim

501 &Shelby, 2005; Manning et al., 1999b; Manning et al., 2002a). The curve of the logit model
502 shifted downward, and the slope of the double-bounded curve was steeper than the single-
503 bounded curve. We found a similar tendency in studies based on the contingent valuation
504 method. Estimates of willingness to pay have been shown to be lower in the double-bounded
505 model than in the single-bounded model (Hanemann et al., 1991).
506 The present study confirmed the findings of past studies regarding crowding norm values
507 across different question formats. Single- and double-bounded approaches varied slightly,
508 depending on the study site involved. In the case of the Jomon-Sugi trails (site 3 and 4), the
509 single-bounded approach produced a value between short and long format, as previous studies
510 have shown. On the other hand, in some of the Kamui-Wakka examples (site 1 and 2),
511 double-bounded estimates produced a smaller value than the short-format, and single-
512 bounded estimates produced a value larger than the long-format. However, the confidence
513 interval of the single- and double-bounded approaches are overlapped, and the value of the
514 crowding norm was within one level of PAOT across the question formats. The present study
515 demonstrated the robustness of the visual crowding norm approach, as was the case in
516 previous studies (Manning et al., 1999b; Manning et al., 2002b; Manning, 2011), and showed
517 that the double-bounded approach produced results comparable to conventional methods.
518 In addition to exploring the conventional question formats, the contingent valuation method
519 was used to estimate crowding norms, using the double-bounded dichotomous choice model.
520 The norms were comparatively stable, and the results confirmed existing studies (Hanemann
521 et al., 1991). Further, this study clarified various influences by adding past visiting
522 experiences and the attitudes of respondents to the logit model. In addition, social and
523 managerial attributes may also be affected. The logit model is known to be useful for
524 examining the magnitude of particular influences. The long-format model can obtain the
525 significant amount of information, for example, involving the crystallization of norms, but
526 respondents frequently find the burden of answering long-format questions too heavy. In the
527 short-format model, the respondents' burden is light, and the answers do not seem difficult,
528 but the value of the norm is slightly reduced. In addition, results can be influenced by
529 presentation order and ranges of people in the photographs. The single-bounded and double-

530 bounded methods can mitigate the influence of starting point bias in contingent valuation
531 methods. A single-bounded dichotomous choice requires a certain number of respondents
532 (Mitchell & Carson, 1989), as is the case with the short-format. On the other hand, the
533 double-bounded method is considered effective for a finite sample (Hanemann et al., 1991). It
534 is likely to be useful for studies of crowding norms.
535 Although the differences in question format are slight, the burden on the respondent, the
536 necessary sample size, and the information obtained are different in each format. In this study,
537 we obtained data from a web questionnaire. As a result, there were sufficient responses, and
538 the respondents were given sufficient time to answer. Study sites with few visitors might not
539 get sufficient responses. Further, if the visitor's stay is short, there may not be enough time to
540 answer the questionnaire. All these methods can be used appropriately, depending on the
541 purpose of the survey and the situation of the study site.
542 The order of the crowding norms for the four sites varied from place to place. In the case of
543 the Jomon-Sugi tramway trail (site 3), acceptability declined abruptly as the number of people
544 increased. In Jomon-Sugi (site3 and 4), people are walking in regular rows in the
545 photographs, but in Kamui-Wakka (site 1 and 2), some of the people are standing apart in the
546 river. The background of each picture and the arrangement of people were different. There is
547 also a possibility that the difference in the ranges pointed out by existing research may have
548 been influenced (Gibson et al., 2014). Differences of behavior and placement of people in the
549 photographs of the four sites may have affected the responses (Aikoh et al., 2002; Arnberger
550 & Haider, 2005; Arnberger et al., 2010; Manning and Freimund, 2004).
551 More case studies are needed to compare the validity of the question format, across various
552 activities, settings, and indicators. To date, only a few studies have set out to compare these
553 question formats (Hall et al., 1996; Krymkowski et al., 2009; Manning et al., 1999b; Manning
554 et al., 2002a). Although all four acceptability curves are drawn based on different methods,
555 the comparison method of curves can be a future research topic. In addition, the influence
556 exerted by the range of photographs that are shown to respondents means that any future
557 studies will need to prepare and consider a wider range of photographs, as Gibson et al.,

(2014) have done. The results of a web survey should be compared with those of on-site surveys.

5. Conclusion

We compared perceived crowding at four areas in natural heritage sites in Japan, using long- and short-format questions, single-bounded, and double-bounded methods. As in previous studies, acceptability tended to decrease as the number of people in the photographs increased. Although the values of the crowding norms represented by the four methods are different, as previous studies have shown, these differences are not large. It would be possible to develop a significant and stable model using the single-bounded or double-bounded method. The double-bounded model is more efficient than the single-bounded model but tends to produce a small norm. Using the logit model, it is possible to analyze influence, by taking factors such as respondents' attributes and attitudes into account.

The contingent valuation method of analysis, both single-bounded and double-bounded, was shown to be useful in analyzing perceived crowding. In addition, each method entails different sample sizes, the burden on respondents, and results; all of them have value.

In addition to long-format and short-format questions, the double-bounded method can be applied to determine the crowding norms of natural recreation sites. It is possible to analyze the influence of visitors' characteristics and other factors through this method, using a logit model. In each question format, the number of respondents and the burden on them vary, but they provide different information to managers. If there are few visitors and their stay is short, the double-bounded dichotomous choice model may be more useful. Managers will be able to choose the question format according to the situation at the study site and the purpose of the research, and management's interests.

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591 Reference

592 Aikoh, T., Cheng, C., & Asakawa, S. (2002). Applying a photographic approach to estimate
593 visitors' perceptions of crowding to determine acceptable limits of encounters in natural
594 parks. *Journal of the Japanese Institute of Landscape Architecture*, 65(5), 669–672.
595 doi:10.5632/jila.65.669 in Japanese with English summary
596 Anderson, L. E., Manning, R. E., Valliere, W. A., & Hallo, J. C. (2010). Normative standards
597 for wildlife viewing in parks and protected areas. *Human Dimensions of Wildlife*, *15*(1), 1-15.
598 Arnberger, A., Aikoh, T., Eder, R., Shoji, Y., & Mieno, T. (2010). How many people should be
599 in the urban forest? A comparison of trail preferences of Vienna and Sapporo forest visitor
600 segments. *Urban forestry & urban greening*, *9*(3), 215-225.
601 Arnberger, A., & Haider, W. (2005). Social effects on crowding preferences of urban forest
602 visitors. *Urban Forestry & Urban Greening*, *3*(3), 125-136.
603 Arrow, K., Solow, R., Portney, P., Leamer, E.E., Radner, R., Schuman, H., 1993. Report of
604 NOAA Panel on contingent valuation. Federal Register, 58(10), (January 15), 4601-4614.
605 Bullock, S. D., & Lawson, S. R. (2008). Managing the "commons" on Cadillac Mountain: a
606 stated choice analysis of Acadia National Park visitors' preferences. *Leisure Sciences*, *30*(1),
607 71-86.
608 Bateman, I., Carson, R. T., Day, B., Hanemann, M., Hanley, Nick., Hett, T. Jones-Lee, M.,
609 Loomes, G., Mourato, S., Ozdemiroglu, E., Pearce, D. W., Sugden, R. and Swanson, J. (2002).
610 *Economic valuation with stated preference techniques: A manual*. Edward Elgar, Cheltenham,
611 UK.
612 Evans, G. W., Lepore, S. J., & Allen, K. M. (2000). Cross-cultural differences in tolerance for
613 crowding: fact or fiction?. *Journal of personality and social psychology*, *79*(2), 204.
614 Gibson, A. W., Newman, P., Lawson, S., Fristrup, K., Benfield, J. A., Bell, P. A., & Nurse, G.
615 A. (2014). Photograph presentation order and range effects in visual-based outdoor recreation
616 research. *Leisure Sciences*, *36*(2), 183-205.
617 Haider, W., & Ewing, G. O. (1990). A model of tourist choices of hypothetical Caribbean
618 destinations. *Leisure Sciences*, *12*(1), 33-47.
619 Hall, T. E., & Roggenbuck, J. W. (2002). Response format effects in questions about norms:

620 Implications for the reliability and validity of the normative approach. *Leisure Sciences*, *24*(3-
621 4), 325-337.
622 Hall, T., Shelby, B., & Rolloff, D. (1996). Effect of varied question format on boaters'
623 norms. *Leisure Sciences*, *18*(2), 193-204.
624 Hanemann, W. M., 1984. Welfare evaluations in contingent valuation experiments with
625 discrete responses. American journal of agricultural economics, 66(3), 332-341.
626 Hanemann, M., Loomis, J., & Kanninen, B. (1991). Statistical efficiency of double-bounded
627 dichotomous choice contingent valuation. *American journal of agricultural economics*, *73*(4),
628 1255-1263.
629 Hensher DA (1994) Stated preference analysis of travel choices: the state of practice.
630 Transportation 21:107–133
631 Ishikawa, K., Hachiya, N., Aikoh, T., Shoji, Y., Nishinari, K., & Satake, A. (2013). A decision
632 support model for traffic congestion in protected areas: A case study of Shiretoko National
633 Park. *Tourism Management Perspectives*, *8*, 18-27.
634 Kaplan, R., Kaplan, S., & Brown, T. (1989). Environmental preference: a comparison of four
635 domains of predictors. *Environment and behavior*, *21*(5), 509-530.
636 Kim, S. O., & Shelby, B. (2005). Developing standards for trail conditions using image capture
637 technology. *Leisure Sciences*, *27*(3), 279-295.
638 Kim, S. O., & Shelby, B. (2006). Comparing onsite and offsite methods for measuring norms
639 for trail impacts. *Environmental management*, *37*(4), 567-578.
640 Krinsky I. & Robb, A. L. (1986) On approximating the statistical properties of elasticities.
641 Review of Economics and Statistics 68:715–719
642 Krymkowski, D. H., Manning, R. E., & Valliere, W. A. (2009). Norm crystallization:
643 Measurement and comparative analysis. *Leisure Sciences*, *31*(5), 403-416.
644 Lawson, S. R., & Manning, R. E. (2002). Tradeoffs among social, resource, and management
645 attributes of the Denali wilderness experience: a contextual approach to normative
646 research. *Leisure Sciences*, *24*(3-4), 297-312.
647 Louviere JJ, Hensher DA (1982) On the design and analysis of simulated choice or allocation
648 experiments in travel choice modeling. Transp Res Record 890:11–17

649 Louviere JJ, Woodworth G (1983) Design and analysis of simulated consumer choice or
650 allocation experiments: An approach based on aggregate data. J Marketing Res 20:350–367
651 Louviere, J., & Timmermans, H. (1990). Stated preference and choice models applied to
652 recreation research: a review. *Leisure Sciences*, *12*(1), 9-32.
653 Louviere JJ (1994) Conjoint analysis, in: Bagozzi RP (ed) Advanced method of marketing
654 research. Blackwell, Malden MA
655 Manning, R. E. (2011). Studies in outdoor recreation: Search and research for satisfaction.
656 Corvallis, OR: Oregon State University Press., 468pp.
657 Manning, R. E., & Freimund, W. A. (2004). Use of visual research methods to measure
658 standards of quality for parks and outdoor recreation. *Journal of leisure research*, *36*(4), 557.
659 Manning, R., Lawson, S., & Frymier, L. (1999a). Navigating the confluence of two streams of
660 social research: Contingent valuation and normative standards. Human Ecology Review, 35-48.
661 Manning, R., Lawson, S., Newman, P., Laven, D., & Valliere, W. (2002a). Methodological
662 issues in measuring crowding-related norms in outdoor recreation. *Leisure Sciences*, *24*(3-4),
663 339-348.
664 Manning, R. E., Lime, D. W., Freimund, W. A., & Pitt, D. G. (1996). Crowding norms at
665 frontcountry sites: A visual approach to setting standards of quality. *Leisure sciences*, *18*(1), 39-
666 59.
667 Manning, R. E., Valliere, W. A., Wang, B. & Jacobi, C. (1999b). Crowding norms: Alternative
668 measurement approaches. *Leisure Sciences*, *21*(2), 97-115.
669 Manning, R., Wang, B., Valliere, W., Lawson, S., & Newman, P. (2002b). Research to estimate
670 and manage carrying capacity of a tourist attraction: a study of Alcatraz Island. *Journal of*
671 *Sustainable Tourism*, *10*(5), 388-404.
672 McFarland, S. G. (1981). Effects of question order on survey responses. *Public Opinion*
673 *Quarterly*, *45*(2), 208-215.
674 Mitchell, R. C., & Carson, R. T., 1989. *Using surveys to value public goods: the contingent*
675 *valuation method*. Resources for the Future, Washington, D.C..
676 Mieno, T., Shoji, Y., Aikoh, T., Arnberger, A., & Eder, R. (2016). Heterogeneous preferences
677 for social trail use in the urban forest: A latent class model. *Urban Forestry & Urban*

678 *Greening*, *19*, 20-28.
679 Moore, D. W. (2002). Measuring new types of question-order effects: Additive and
680 subtractive. *The Public Opinion Quarterly*, *66*(1), 80-91.
681 Needham, M. D., Szuster, B. W., & Bell, C. M. (2011). Encounter norms, social carrying
682 capacity indicators, and standards of quality at a marine protected area. *Ocean & coastal*
683 *management*, *54*(8), 633-641.
684 Newman, P., Manning, R., Dennis, D., & McKonly, W. (2005). Informing Carrying Capacity
685 Decision Making in Yosemite National Park, USA Using Stated Choice Modeling. *Journal of*
686 *Park & Recreation Administration*, *23*(1).
687 Pettebone, D., Newman, P., Lawson, S. R., Hunt, L., Monz, C., & Zwiefka, J. (2011).
688 Estimating visitors' travel mode choices along the bear lake road in Rocky Mountain National
689 Park. *Journal of Transport Geography*, *19*(6), 1210-1221.
690 Pierce, W. V., & Manning, R. E. (2015). Day and overnight visitors to the Olympic
691 Wilderness. *Journal of Outdoor Recreation and Tourism*, *12*, 14-24.
692 Roggenbuck, J. W., Williams, D. R., Bange, S. P., & Dean, D. J. (1991). River float trip
693 encounter norms: Questioning the use of the social norms concept. *Journal of Leisure*
694 *Research*, *23*(2), 133-153.
695 Sayan, S., Krymkowski, D. H., Manning, R. E., Valliere, W. A., & Rovelstad, E. L. (2013).
696 Cultural influence on crowding norms in outdoor recreation: a comparative analysis of
697 visitors to national parks in Turkey and the United States. *Environmental management*, *52*(2),
698 493-502.
699 Schwarz, N., Hippler, H. J., Deutsch, B., & Strack, F. (1985). Response scales: Effects of
700 category range on reported behavior and comparative judgments. *Public Opinion*
701 *Quarterly*, *49*(3), 388-395.
702 Shelby, B. (1981). Encounter norms in backcountry settings. *Journal of Leisure*
703 *Research*, *13*(2), 129-138.
704 Shibasaki S. (2018) Yakushima Island: Landscape History, World Heritage Designation, and
705 Conservation Status for Local Society. In: Chakraborty A., Mokudai K., Cooper M.,

706 Watanabe M., Chakraborty S. (eds) Natural Heritage of Japan. Geoheritage, Geoparks and
707 Geotourism (Conservation and Management Series). Springer, Cham
708 Strumse, E. (1996). Demographic differences in the visual preferences for agrarian landscapes
709 in western Norway. *Journal of Environmental Psychology*, *16*(1), 17-31.
710 Terasaki, T., Aikoh, T., Take, M., Nakajima, Y. and M. Toyama (2011) A Study on Canoe
711 Tourists' Crowding Perception, Limits of Acceptance and Social Carrying Capacity in Gesashi
712 River, Okinawa. *Journal of Forest Economics*, *57*(3), 12-21. in Japanese with English summary
713 van Riper, C. J., Manning, R. E., Monz, C. A., & Goonan, K. A. (2011). Tradeoffs among
714 resource, social, and managerial conditions on mountain summits of the Northern
715 Forest. *Leisure Sciences*, *33*(3), 228-249.
716 Vaske, J. J., & Donnelly, M. P. (2002). Generalizing the encounter--norm--crowding
717 relationship. *Leisure Sciences*, *24*(3-4), 255-269.
718 Vaske, J. J., Donnelly, M. P., & Bingül, M. B. (2016). Response Format Effects in Encounter
719 Norm Questions. *Leisure Sciences*, *38*(3), 284-294.
720 Vaske, J. J., & Shelby, L. B. (2008). Crowding as a descriptive indicator and an evaluative
721 standard: Results from 30 years of research. *Leisure Sciences*, *30*(2), 111-126.